



August 24, 2016

Elise Hsieh, Executive Director
 Exxon Valdez Oil Spill Trustee Council
 4210 University Drive
 Anchorage, AK 99508-4626

Dear Elise:

Final FY 2017-2021 Proposal Submittal for Long-term Monitoring

17120114-D. Continuous Plankton Recorder Monitoring of Plankton populations on the Alaskan Shelf

Gulf Watch Alaska, the long-term monitoring program of the Exxon Valdez Oil Spill Trustee Council (EVOSTC), has finalized our program and project proposals for fiscal years 2017-2021 funding based on comments received from EVOSTC’s Science Panel on May 19, 2016. Below is the final budget summary and response to Science Panel comments for the Continuous Plankton Recorders project.

EVOSTC Funding Requested (including 9% GA)

FY17	FY18	FY19	FY20	FY21	TOTAL
\$76,500	\$78,800	\$81,200	\$78,200	\$86,100	\$400,800

Non-EVOSTC Funding Available

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

Science Panel comment: *The Panel notes this is a continuing time series of zooplankton information useful to a variety of other projects. The proposer (Batten) has a solid record of producing timely results, including a consistent dataset.*

PI Response:

- Thank you for the comment. The proposal was not revised.

Sincerely,

Mandy Lindeberg
Gulf Watch Alaska Program Lead designate

Attachment: Gulf Watch Alaska: Environmental Drivers Component Project Proposal:
17120114-D—Continuous Plankton Recorder monitoring of plankton
populations on the Alaskan Shelf

**EVOSTC FY17-FY21 INVITATION FOR PROPOSALS
PROGRAM PROJECT PROPOSAL SUMMARY PAGE**

Project Title

Gulf Watch Alaska: Environmental Drivers Component Project:

17120114-D—Continuous Plankton Recorder monitoring of plankton populations on the Alaskan Shelf

Primary Investigator(s) and Affiliation(s)

Sonia Batten, Sir Alister Hardy Foundation for Ocean Science

Robin Brown, North Pacific Marine Science Organisation

Date Proposal Submitted

24 August 2016

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 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. Recent results show that interannual variability in plankton dynamics is high and plankton responded clearly and rapidly to the recent warm conditions, with changes evident in abundance, composition and timing.

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

FY17	FY18	FY19	FY20	FY21	TOTAL
\$76.5	\$78.8	\$81.2	\$78.2	\$86.1	\$400.8

Non-EVOSTC Funding Available

FY17	FY18	FY19	FY20	FY21	TOTAL
\$183.7	\$183.9	\$186.3	\$188.3	\$190.3	\$932.5

1. Executive Summary

The Continuous Plankton Recorder (CPR) transect samples the Alaskan shelf across the slope into the open Gulf of Alaska (GOA), providing a record of taxonomically resolved, seasonal, near-surface zooplankton and large phytoplankton abundance over a wide spatial scale (Figure 1). Many important species, including herring, salmon, birds and marine mammals forage in these regions of the shelf and GOA 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. CPR sampling began in 2000 so there is now an adequate time series available to assess the impacts of climate variability. 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 2014-2015 has also caused widespread impacts on Alaskan marine ecosystems which are still being noted and assessed.

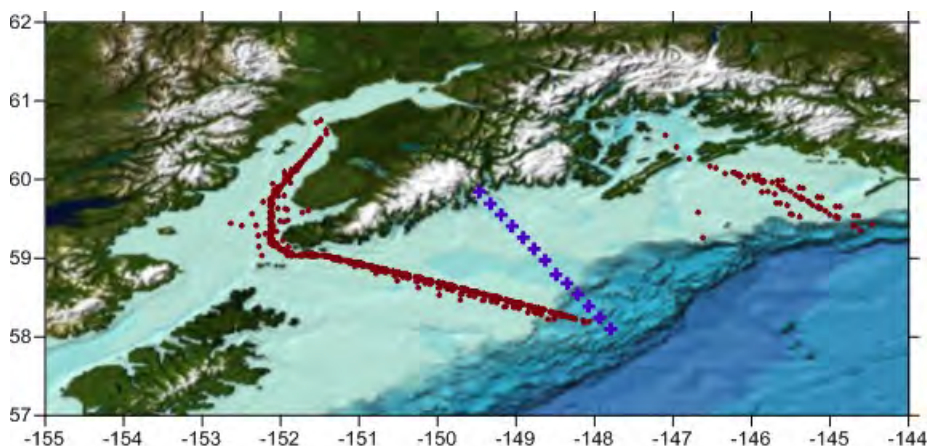


Figure 1. Location of historic CPR samples on the shelf (red dots) from 2000 to 2015 and the Seward Line stations (blue +). Since 2004 the transect has sampled into Cook Inlet and has a very consistent location.

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. During the most recent period of funding the transition from cool conditions to unusually warm conditions occurred and changes in the plankton were quite dramatic. There was a change in the diatom community to species more favored by low nutrients, and cell counts were low. The zooplankton community was dominated by small species very early in the year in 2015, to levels not seen before in the time series (Figure 2) and the presence of jellyfish appears to be increasing. Strong relationships between plankton indices from the CPR and first year Prince William Sound (PWS) herring growth have recently been documented as a product of collaboration between the

Gulf Watch Alaska (GWA) and Herring Research and Monitoring programs (Batten et al. 2016). It is likely that the conditions in 2015 will not have been favorable for young herring.

Continued sampling of the CPR transect over the next 5 years will test the hypothesis that plankton

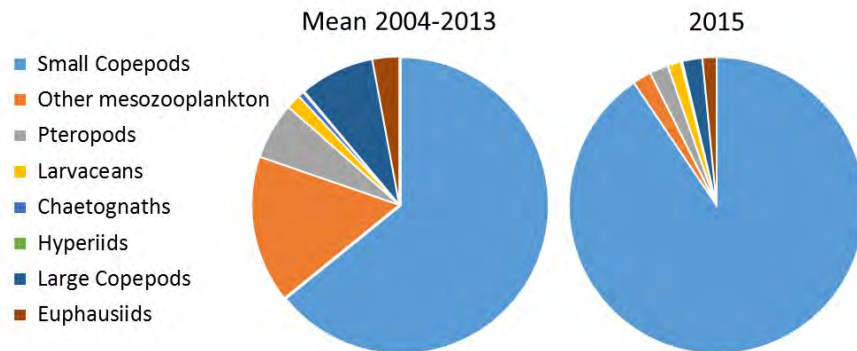


Figure 2. Zooplankton community composition in spring 2015 compared to the mean for 2004-2013, as a %. Before 2014 small copepods comprised 25-75%, but reached 82 and 91 % in 2014 and 2015, respectively.

communities have changed in response to several years of warming, and will additionally determine whether any returns to cool conditions also see a return to more typical sub-arctic plankton communities. The CPR will sample the same transect approximately monthly, 6 times per year, between about April and September providing sufficient temporal resolution to detect seasonal shifts as well as community composition changes. The transect links two of the other plankton sampling regions within the Environmental Drivers group, that of the Seward Line (Figure 1) and in Kachemak Bay, to provide a larger-scale context for these more intensive regional projects. With similar sampling frequency to the PWS oceanographic and zooplankton sampling, 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. The project has a proven track record with a high sampling success rate, all past deliverables have been fully met and there is a strong record of primary publications resulting from the program (see the list of publications in Batten’s resume below).

2. Relevance to the Invitation for Proposals

This project specifically addresses the *Exxon Valdez* Oil Spill Trustee Council’s (EVOSTC’s) goal to determine “how factors other than oil may inhibit full recovery or adversely impact recovering resources” since the results will demonstrate how ocean climate variability, mediated through physical processes, causes variability in lower trophic levels. Plankton support the recovering resources either directly as a food source, as in the case of juvenile herring, or indirectly with intermediate trophic levels, but an assessment of plankton variability is essential to understanding fluctuations in resources of concern. This study contributes to the project of interest “An assessment of the transport of nutrients between the GOA and PWS and the effects on biological production over time”. The addition of a further 5 years of data will extend the dataset to almost 20 years, a duration where relationships with longer lived higher trophic levels can start to be determined. CPR data are already provided as an annual summery to the National Oceanographic and Atmospheric Administration Ecosystems Considerations Report, a synthesis report used by fisheries managers, and this contribution will be continued. See <http://access.afsc.noaa.gov/reem/ecoweb/index.cfm> for previous reports.

3. Project Personnel

Dr. Sonia Batten

Scientific PI
Sir Alister Hardy Foundation for Ocean Science (SAHFOS)
C/o 4737 Vista View Crescent
Nanaimo, British Columbia, V9V 1N8, Canada
(250) 756-7747 (office)
soba@sahfos.ac.uk

Robin Brown

Administrative Lead
Executive Director
North Pacific Marine Science Organisation
P.O. Box 6000
9860 West Saanich Rd.
Sidney, British Columbia, V8L 4B2, Canada
(250) 363-6364 (office)
(250) 363-6827
Robin.Brown@pices.int
(CPR Funding Consortium administrator)

Please see 2 page CVs at end of this document

4. Project Design

A. OBJECTIVES

Objectives are unchanged from the previously funded project. The fundamental goal of this program is to provide consistent large spatial scale data on plankton populations of the Alaskan Shelf to extend the existing time series and integrate the data with other regional sampling. More specifically, we will provide monthly (spring to fall – typically April to September) sampling of zooplankton and large phytoplankton along the transect from the oceanic GOA to Cook Inlet, analyzing every 4th oceanic and every shelf sample to provide taxonomically resolved abundances.

B. PROCEDURAL AND SCIENTIFIC METHODS

We do not propose to make any changes to the sampling regime that has been operating so successfully. The cargo vessel Matson (formerly Horizon) Kodiak will tow a CPR northbound towards Cook Inlet approximately once per month between about April and September each year to provide 6 samplings per year. The samples will be unloaded and the gear serviced each time by Alaskan technicians who have been trained by SAHFOS. SAHFOS is the world authority on CPR sampling. Sample processing will be carried out at the Canadian Department of Fisheries and Oceans (DFO) laboratory in Sidney, BC and at the SAHFOS laboratory in the UK, as before. Briefly, the CPR is deployed from the stern of the volunteer vessel once it has cleared port and is underway (or when the Captain deems it is safe to do so) and is towed behind the vessel on a fixed length cable so that it samples the surface mixed layer at a depth of about 7m. Water enters the front of the CPR, passes along a tunnel and through a silk filtering mesh (with a mesh size of 270µm) which retains the plankton and allows the water to exit at the back of the machine. The movement of the CPR through the water turns an external propeller which, via a drive shaft and gear-box, moves the

filtering mesh across the tunnel. As the filtering mesh leaves the tunnel it is covered by a second band of mesh so that the plankton are sandwiched between these two layers, which then wind on into a storage chamber containing preservative. The CPR is normally deployed in Juan de Fuca Strait and recovered in Cook Inlet at around 60°N or at the Captain's discretion. The ship's officers record launch and recovery times and positions and all course changes. At the end of the tow the machine is returned to the laboratory and using the information from the ship's log the transect is reconstructed and the mesh is marked into separate samples, each representing 18.5 km of tow and about 3m³ of seawater filtered.

The first step is the assessment of phytoplankton colour (the greenness of the sample) which is a representation of the total phytoplankton biomass and includes the organisms that are too fragile to survive the sampling process intact but which leave an impression on the mesh (see Raitso et al. 2013 for more information on this index). The assessment is made against a standard colour chart, into one of 4 colour categories. The mesh is then cut into separate samples which are randomly distributed amongst a team of analysts for taxonomic assessment. Hard-shelled phytoplankton are semi-quantitatively determined under a microscope by viewing 20 fields of view and recording the presence of all the different taxa in each field. Small zooplankton are identified and counted from a subsample (1/49 of the sample) whilst all zooplankton larger than about 2 mm are counted with no subsampling, unless numbers are very large. Identification is carried out to the highest practicable taxonomic level and is a compromise between speed of analysis and scientific interest. Since copepods make up the majority of the zooplankton most copepods are identified to species level whilst other groups are generally identified to a lower level. Although CPR sampling is continuous, the midpoint of the sample is used to label it with latitude, longitude, time and date. Quality Control of analysis also follows SAHFOS standard protocols; briefly, results from adjacent samples are compared and inconsistencies checked, and if necessary corrected, before the sample data are finalised and released. All of the samples are archived after analysis so that they can be re-examined at any time, or used for additional analyses (molecular studies and stable isotope analyses are now possible, for example).

Summary indices such as 'mesozooplankton biomass' and 'total diatom abundance' are routinely calculated from the abundance data. Temperature loggers have been fitted to the CPRs since 2011 and we are endeavoring to maintain in situ temperature data collection on this transect.

C. DATA ANALYSIS AND STATISTICAL METHODS

The sampling frequency and spacing is suitable to characterize seasonal, interannual and spatial variability in the plankton at the mesoscale. Large scale patchiness (on the order of 10s to 100s of kms) needs to be considered as a factor that may contribute to observed variability in the plankton data. The greatest resolution possible from CPR data is 18.5 km, however, to maximise coverage with the resources available we process samples spaced 74 km in the open ocean (every fourth sample being processed) but all samples on the shelf. An individual sample will pass through small patches of plankton and so provide an 'average' of the small-scale patchiness. We have established the decorrelation length-scales for common taxa from data collected early in the survey (2000) and determined that samples that are spaced well apart, such as every 74 km, are likely to be representative and not likely to be within or outside of a patch.

Our methodology has remained unchanged since the survey's inception so comparisons with previously collected CPR data are straightforward. Comparisons with other plankton sampling are more problematic as each sampling system has a bias of some sort caused by, for example, mesh size, depth of sampling, taxonomic resolution. However, by using indices such as anomalies and pooling taxa to create functional

groups useful comparisons can be made. The Environmental Drivers group has made some progress in this regard and as the individual time series lengthen such comparisons will be more robust and informative.

D. STUDY AREA

The project will sample waters on a transect leaving from the Straits of Juan de Fuca outside of Puget Sound (48.45°N, 125°W, Captain's discretion) across the GOA to Cook Inlet and Anchorage. Sampling will end at about 60°N, 151.9°W (at Captain's discretion). See Figure 1 above for a map of the northern end of the transect. It intersects with the outermost Seward line stations and also samples outside of Kachemak Bay in Cook Inlet, thereby linking with two other Environmental Drivers sampling locations. Ship tracks vary minimally from month to month.

5. Coordination and Collaboration

WITHIN THE PROGRAM

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 Kachemak Bay 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 PWS 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. 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 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 GWA PIs summarising the meroplankton to examine the long-term variability in larvae, and we expect such collaboration to continue.

WITH OTHER EVOSTC-FUNDED PROGRAMS AND PROJECTS

We have actively collaborated with the Herring Research and Monitoring program in the most recent funding period, and a publication has been produced (Batten et al. 2016). These time series will be updated during this project, and as they lengthen we expect further insights, especially in light of the unusually warm conditions currently being experienced.

WITH TRUSTEE OR MANAGEMENT AGENCIES

There are no planned or required collaborations with other management agencies at this time.

WITH NATIVE AND LOCAL COMMUNITIES

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 some local involvement.

6. Schedule

PROGRAM MILESTONES

Objective 1. Sample collection on the transect from Cook Inlet to Puget Sound will begin in spring 2017 and continue approximately monthly through to August/September 2017 (6 transects will be sampled). This schedule will be repeated each year to 2021. All shelf samples will be processed and every 4th oceanic sample.

Objective 2. A subset of samples (25%) will be processed within 3 months of collection at the Institute of Ocean Sciences (DFO, Canada) and results from this processing (e.g., estimated mesozooplankton biomass and comparisons with data from previous years) will be available in progress reports and on the project website as soon as practicable. Full, quality controlled data from 2017 will be available by July 2018, and in a similar fashion in subsequent years (e.g. July 2019 for data collected within 2018). Data will be publicly available through the GWA data portal:

<http://portal.aos.org/gulf-of-alaska.php#metadata/87f56b09-2c7d-4373-944e-94de748b6d4b/project/files>

and also directly from S. Batten on request.

MEASURABLE PROGRAM TASKS

Measurable project tasks are presented by fiscal year and quarter graphically in Table 1 and descriptively below.

Table 1. Project tasks and activities by fiscal year and quarter, beginning February 1, 2017.

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

FY 2017 (Year 6)

FY 17, 1st quarter (February 1, 2017 - April 30, 2017)
February: Shipping of serviced CPR from UK to Matson Kodiak
Mar/April: First transect sampled

FY 17, 2nd quarter (May 1, 2017 - July 31, 2017)
May-July: Three transects sampled
June: First results from 2017 sampling, ongoing hereafter
July: Finalised data from previous year completed

FY 17, 3rd quarter (August 1, 2017 - October 31, 2017)
Aug-Sept: Two transects sampled, CPR shipped back to UK for winter overhaul
August: Submit progress report

FY 17, 4th quarter (November 1, 2017 - January 31, 2018)
November: Attend PI meeting

December: Processing and initial analysis of samples collected in summer/fall 2017 will be completed
January: Attend Alaska Marine Science Symposium and PI meeting.
Prepare annual report

FY 2018 (Year 7)

FY 18, 1st quarter (Feb 1, 2018 - April 30, 2018)
February: Shipping of serviced CPR from UK to Matson Kodiak
Mar/April: First transect sampled

FY 18, 2nd quarter (May 1, 2018 - July 31, 2018)
May-July: Three transects sampled
June: First results from 2018 sampling, ongoing hereafter
July: Finalised data from previous year completed

FY 18, 3rd quarter (August 1, 2018 - October 31, 2018)
Aug-Sept: Two transects sampled, CPR shipped back to UK for winter overhaul
August: Submit progress report

FY 18, 4th quarter (November 1, 2018 -January 31, 2019)
November: Attend PI meeting
December: Processing and initial analysis of samples collected in summer/fall 2018 will be completed
January: Attend Alaska Marine Science Symposium and PI meeting
Prepare annual report

FY 2019 (Year 8)

FY 19, 1st quarter (Feb 1, 2019 - April 30, 2019)
February: Shipping of serviced CPR from UK to Matson Kodiak
Mar/April: First transect sampled

FY 19, 2nd quarter (May 1, 2019 - July 31, 2019)
May-July: Three transects sampled
June: First results from 2019 sampling, ongoing hereafter
July: Finalised data from previous year completed

FY 19, 3rd quarter (August 1, 2019 - October 31, 2019)
Aug-Sept: Two transects sampled, CPR shipped back to UK for winter overhaul
August: Submit progress report

FY 19, 4th quarter (November 1, 2019 -January 31, 2020)
November: Attend PI meeting
December: Processing and initial analysis of samples collected in summer/fall 2019 will be completed
January: Attend Alaska Marine Science Symposium and PI meeting
Prepare annual report

FY 2020 (Year 9)

FY 20, 1st quarter (Feb 1, 2020 - April 30, 2020)
February: Shipping of serviced CPR from UK to Matson Kodiak
Mar/April: First transect sampled

FY 20, 2nd quarter (May 1, 2020 - July 31, 2020)
May-July: Three transects sampled
June: First results from 2020 sampling, ongoing hereafter
July: Finalised data from previous year completed

FY 20, 3rd quarter (August 1, 2020 - October 31, 2020)
Aug-Sept: Two transects sampled, CPR shipped back to UK for winter overhaul
August: Submit progress report

FY 20, 4th quarter (November 1, 2020 -January 31, 2021)
November: Attend PI meeting
December: Processing and initial analysis of samples collected in summer/fall 2020 will be completed
January: Attend Alaska Marine Science Symposium and PI meeting
Prepare annual report

FY 2021 (Year 10)

FY 21, 1st quarter (Feb 1, 2020 - April 30, 2021)
February: Shipping of serviced CPR from UK to Matson Kodiak
Mar/April: First transect sampled

FY 21, 2nd quarter (May 1, 2021 - July 31, 2021)
May-July: Three transects sampled
June: First results from 2021 sampling, ongoing hereafter
July: Finalised data from previous year completed

FY 21, 3rd quarter (August 1, 2021 - October 31, 2021)
Aug-Sept: Two transects sampled, CPR shipped back to UK for winter overhaul
August: Submit progress report

FY 21, 4th quarter (November 1, 2021 -January 31, 2022)
November: Attend PI meeting
December: Processing and initial analysis of samples collected in summer/fall 2021 will be completed
January: Attend Alaska Marine Science Symposium and PI meeting
Prepare annual report

7. Budget

BUDGET FORMS (ATTACHED)

Completed budget forms are attached.

SOURCES OF ADDITIONAL FUNDING

The North Pacific CPR survey is supported by a Consortium managed by PICES, of which the EVOSTC is a member. There are two CPR transects in the survey, one of which is not in the *Exxon Valdez* oil 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 Figure 1. Other members of the Consortium which contribute to this transects costs are:

The North Pacific Research Board (NPRB) contributes funding at a similar annual level to that requested here, through the NPRBs Long Term Monitoring Program. We are currently in Year 2 of a 20-year commitment.

The DFO contributes \$50k annually as well as in-kind support by providing laboratory facilities at the DFO lab in Sidney, BC.

The CPR parent organization, SAHFOS, is also providing salary support for some of the UK-based personnel, and in-kind support through sample archiving and curation.

Owing to the differing financial year cycles of each organisation, contributing funds per EVOSTC fiscal year from each source have been estimated as best we can.

LITERATURE CITED

- Batten, S.D., Moffitt, S., Pegau, W.S., and Campbell, R. 2016. Plankton indices explain interannual variability in Prince William Sound herring first year growth. *Fish. Oceanogr.* 25:420-432.
- Batten, S.D., Clarke, R.A., Flinkman, J., Hays, G.C., John, E.H., John, A.W.G., Jonas, T.J., Lindley, J.A., Stevens, D.P., Walne, A.W. 2003. CPR sampling – The technical background, materials and methods, consistency and comparability. *Progress in Oceanography* 58:193-215.
- Francis, R. C. and Hare, S.R. 1994. Decadal-scale regime shifts in the large marine ecosystems of the Northeast Pacific: a case for historical science. *Fish. Oceanogr.* 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: 10.1029/2004JC002710.
- Okkonen, S.R., Weingartner, T.J., Danielson, S.L., and Musgrave, D.L. (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.
- Raitsos, D.E., Walne, A., Lavender, S.J., Licandro, P., Reid, P.C., and Edwards, M. 2013. A 60-year ocean colour data set from the Continuous Plankton Recorder. *Journal of Plankton Research*, 35(1):158–164
- Royer, T.C. 1979. On the effect of precipitation and runoff on coastal circulation in the Gulf of Alaska. *J. Phys. Oceanogr.* 9:555–563.
- Stabeno, P.J., Bond, N.A., Hermann, A.J., Kachel, N.B., Mordy, C.W. and Overland, J.E. 2004. Meteorology and oceanography of the Northern Gulf of Alaska, *Continental Shelf Research* 24:859-897.

- Weingartner, T.J., Danielson, S.L. and Royer, T.C. 2005. Freshwater variability and predictability in the Alaska Coastal Current, Deep Sea Research Part II: Topical Studies in Oceanography, Volume 52, Pages 169-191.
- Weingartner, T. J., K. O. Coyle, B. Finney, R. Hopcroft, T. Whitley, 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, S. Strom. 2002. The Northeast Pacific GLOBEC Program: Coastal Gulf of Alaska. Oceanography 15:48-63

Resume: Sonia Dawn Batten Ph.D.

Sir Alister Hardy Foundation for Ocean
Science (SAHFOS)
C/o 4737 Vista View Crescent
Nanaimo, British Columbia, V9V 1N8, Canada

Tel: 1-250-756-7747
FAX: 1-250-729-2622
Email: soba@sahfos.ac.uk

Qualifications

1990–1994. PhD. Marine Biology. ‘Correlative studies of the ecophysiology and community structure of benthic macrofauna’ Southampton University, UK.

1987–1990. BSc. Honours Degree in Oceanography with Biology, 2(i). Southampton Uni., UK

Career History

2000 to present. Part-time Research Fellow. SAHFOS.

2003 and 2004. Temporary Instructor, Malaspina University College, Fisheries and Aquaculture program.

1996–2000. Assistant Director. SAHFOS, UK

1994–1996. Postdoctoral Research Fellow. SAHFOS, UK

Current Activities

During the past 23 years I have been working with the Continuous Plankton Recorder Survey through the Sir Alister Hardy Foundation for Ocean Science. Since 2000 I have been based in western Canada, co-ordinating the north Pacific CPR survey which in 2008 became the N. Pacific CPR Consortium under PICES. My main research focus has been the mesozooplankton; their distribution, ecology and role in the upper pelagic ecosystem. Since Sept 2015 I have also been the Chair of the Global Alliance of CPR Surveys.

Five Recent Publications

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

Batten, S.D., and Gower, J.F.R. (2014). Did the iron fertilization near Haida Gwaii in 2012 affect the pelagic lower trophic level ecosystem? *J. Plankton Res.*, 39, 925-932.

Rooper, C.N., J.L. Boldt, S.D. Batten & C. Gburski. (2012). Growth and production of Pacific ocean perch (*Sebastes alutus*) in nursery habitats of the Gulf of Alaska. *Fisheries Oceanography* 21, 415-429.

Batten, S.D and Walne, A.W. (2011) Variability in northwards extension of warm water copepods in the NE Pacific. *Journal of Plankton Research* 33, 1643-1653.

Batten, S.D., and Mackas, D.L. (2009) Shortened duration of the annual *Neocalanus plumchrus* biomass peak in the Northeast Pacific. *Marine Ecology Progress Series*. 393, 189-198.

Relevant Other Publications

Chiba, S., Batten, S., Sasaoka, K., Sasai, Y., and Sugisaki, H. (2012). Influence of the Pacific Decadal Oscillation on phytoplankton phenology and community structure in the western North Pacific. *Geophysical Research Letters* 39, L15603, doi:10.1029/2012GL052912

Batten, S.D and Burkill, P.H. (2010) The Continuous Plankton Recorder: towards a global perspective. *Journal of Plankton Research* 2010 32: 1619-1621

Mackas, D.L., Batten, S.D., and Trudel, M., (2007) Effects on zooplankton of a warming ocean: recent evidence from the Northeast Pacific. *Progress in Oceanography*, 75, 223-252

Batten, S.D. and Freeland, H.J. (2007). Plankton populations at the bifurcation of the North Pacific Current. *Fisheries Oceanography*, 16, 536-646.

Batten, S.D and Crawford, W.R. (2005). The influence of coastal origin eddies on oceanic plankton distributions in the eastern Gulf of Alaska. *Deep Sea Research II*, 52, 991-1009.

Collaborators during the last 4 years (excludes Gulf watch PIs not published with)

Boldt, Jennifer, DFO Canada

Campbell, Robert, PWSSC

Chiba, Sanae JAMSTEC, Japan

Gower, John, DFO Canada

Moffit, Steve, ADF&G

Pegau, Scott, PWSSC

Rooper, Christopher, NOAA

Sugisaki, Hiroya, FRA, Japan

Walne, Anthony, SAHFOS

Yoshiki, Tomoko, JAMSTEC, Japan

Curriculum Vitae
Robin M. Brown

Personal Information

Full Name: Robin Middleton Brown
Date of Birth: July 18, 1954
Work Address: North Pacific Marine Science Organization (PICES)
P.O. Box 6000
9860 West Saanich Rd.
Sidney, British Columbia
V8L 4B2
ph: (250) 363-6364
fax: (250) 363-6827
email: Robin.Brown@pices.int

1976 Graduated from the University of British Columbia with a Bachelor of Science (Marine Biology) degree.

Employment:

February, 2015 – present	Executive Secretary, North Pacific Marine Science Organization (PICES)
August, 1999 to February, 2015	Division/Research Manager - Ocean Sciences Division at the Institute of Ocean Sciences Department of Fisheries and Oceans – Science Branch).
February, 1992 to August, 1999	Oceanographic Data Manager at the Institute of Ocean Sciences (Department of Fisheries and Oceans).
June, 1985 to January, 1991	Multidisciplinary Oceanographer with the Ocean Ecology Group at the Institute of Ocean Sciences (Department of Fisheries and Oceans).
May 1979-June 1985	Oceanographer with Seakem Oceanography Ltd., Sidney, B.C. (now AXYS Environmental Consulting Ltd.)
1976-1979:	Research Assistant - University of British Columbia

Awards and Recognition:

2012 - Deputy Minister's Commendation for efforts in support of the Cohen Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River.
2010 - Assistant Deputy Minister's Distinction Award for contributions to / coordination of the visit of the Emperor and Empress of Japan to the Institute of Ocean Sciences.
2009 - DFO Prix d'Excellence for contributions to the team that worked to have Bowie Seamount designated as a Marine Protected Area
1993 - Deputy Minister's Commendation for contributions to the Fisheries Management Information Study Team

International Experience:

North Pacific Marine Science Organization (PICES):

- Canadian delegate to the Governing Council (appointed in 2013)
- Member of the Finance and Administration Committee (appointed in 2012)
- Chair of the Advisory Panel on Status, Outlooks, Forecasts and Engagement (AP-SOFE) from 2009-2012. Continuing appointment as a member of this Advisory Panel since 2012.
- Chair of the Technical Committee on Data Exchange (TCODE) from 1995 – 2001. Continuing appointment as a member of this Committee since 2001.
- Chair of the Study Group on Ecosystem Status Reporting (2006-2007)
- Member of Science Board (1995-2001; 2009; 2012)
- Attended every PICES Annual Meeting since 1995 (PICES IV) and several other intersessional meetings and special PICES symposia
- Chairman of Local Organizing Committee for PICES-2007 in Victoria, B.C.

North Pacific Anadromous Fish Commission (NPAFC)

- Appointed as Lead Commissioner for Canada in 2013
- Lead Canadian representative on the Finance and Administration Committee.
- Elected as Vice- Chairman in May 2014

Coordinator – Visit of the Emperor and Empress of Japan to the Institute of Ocean Sciences (2007):

Canadian Representative – APEC Marine Resource Conservation Task Team (1995-1997)

Advisor – International GLOBEC Program – data management policy and practices (1994-1996)

Teamwork and Interagency Coordination:

Member of the Science Team providing analysis and advice to Fisheries and Oceans Canada for the Cohen Commission of Inquiry.

Co-chair of the Science and Monitoring Committee of the Federal-Provincial Japan Tsunami Debris Coordinating Committee (2012 – present).

Selected Publications and Reports

- Smith, J.N., **R.M. Brown**, W.J. Williams, M. Robert, R. Nelson and S.B. Moran. 2014. Arrival of the Fukushima radioactivity plume in North American continental waters. PNAS February 3, 2015 vol. 112 no. 5 pp. 1310-1315
- Chen, J., M.W. Cooke, J. Mercier, B. Ahier, M. Trudel, G. Workman, M. Wyeth and **R. Brown**. 2014. A report on radioactivity measurements of fish samples from the west coast of Canada. Radiat. Prot. Dosimetry .doi:10.1093/rpd/ncu150
- Lucas, B.G., Verrin, S., and **Brown, R.** (Editors). 2007. Ecosystem overview: Pacific North Coast Integrated Management Area (PNCIMA). Can. Tech. Rep. Fish. Aquat. Sci. 2667: xii + 105 p

Collaborators:

N/A

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	\$0.0	\$3.65	\$13.7	
Equipment	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	
Indirect Costs (40%)	\$ 20	\$ 21	\$ 21	\$ 20	\$ 23	\$105.1	
SUBTOTAL	\$70.2	\$72.3	\$74.5	\$71.7	\$79.0	\$367.7	
General Administration (9% of subtotal)	\$6.3	\$6.5	\$6.7	\$6.5	\$7.1	\$33.1	N/A
PROJECT TOTAL	\$76.5	\$78.8	\$81.2	\$78.2	\$86.1	\$400.8	
Other Resources (Cost Share Funds)	\$183.7	\$183.9	\$186.3	\$188.3	\$190.3	\$801.6	

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

FY17-21

Project Title: CPR sampling of the GoA
Primary Investigator: Sonia Batten

**NON-TRUSTEE AGENCY
SUMMARY PAGE**

Personnel Costs:		Months Budgeted	Monthly Costs	Overtime	Personnel Sum
Name	Project Title				
S Batten	Long term monitoring of zooplankton	1.2	8.4		10.1
Doug Moore	populations on the Alaskan Shelf and Gulf	1.4	6.2		8.7
Technicians - workshop	of Alaska using Continuous Plankton recorders	0.3	6.1		1.8
Technicians - analysts		2.0	5.7		11.4
D Stevens		0.3	6.4		2.1
D. Wilson		0.2	8.4		1.7
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
Subtotal			41.3	0.0	
Personnel Total					\$35.8

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
Description					0.0
					0.0
Portion of PI's travel to PI meetings					1.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
Travel Total					\$1.1

FY17

**Project Title: CPR sampling of the GoA
Primary Investigator: Sonia Batten**

**FORM 3B
PERSONNEL & TRAVEL
DETAIL**

Contractual Costs: Description	Contract Sum
Portion of local CPR servicing in Anchorage	2.8
Portion of CPR leasing	3.8
Portion of computing services	0.2
Portion of website maintenance by PICES	0.5
Portion of tow payment to ship	0.8
Shipping of gear	1.5
Shipping of samples	0.4
If a component of the project will be performed under contract, the 4A and 4B forms are required.	
Contractual Total	\$10.0

Commodities Costs: Description	Commodities Sum
lab consumables	0.9
Filtering mesh	1.9
Tow wires	0.5
Commodities Total	\$3.2

FY17

**Project Title: CPR sampling of the GoA
Primary Investigator: Sonia Batten**

**FORM 3B
CONTRACTUAL &
COMMODITIES DETAIL**

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
New Equipment Total			\$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
existing CPRs will be used. Lease costs charged above cover replacement/repair	1	SAHFOS
external bodies	1	SAHFOS
internal mechanisms	3	SAHFOS
Temperature recorder	1	SAHFOS
Existing microscopes will also be used, (including one purchased in FY03)	7	SAHFOS

FY17

**Project Title: CPR sampling of the GoA
Primary Investigator: Sonia Batten**

**FORM 3B
EQUIPMENT DETAIL**

Personnel Costs:		Months Budgeted	Monthly Costs	Overtime	Personnel Sum
Name	Project Title				
S Batten	Long term monitoring of zooplankton	1.2	8.7		10.4
Doug Moore	populations on the Alaskan Shelf and Gulf	1.4	6.4		9.0
Technicians - workshop	of Alaska using Continuous Plankton recorders	0.3	6.2		1.9
Technicians - analysts		2.0	5.9		11.8
D Stevens		0.3	6.6		2.1
D. Wilson		0.2	8.7		1.7
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
Subtotal			42.5	0.0	
Personnel Total					\$36.9

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
Description					
					0.0
					0.0
Portion of PI's travel to PI meetings					1.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
Travel Total					\$1.1

FY18

**Project Title: CPR sampling of the GoA
Primary Investigator: Sonia Batten**

**FORM 3B
PERSONNEL & TRAVEL
DETAIL**

New Equipment Purchases:	Number of Units	Unit Price	Equipment Sum
Description			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
New Equipment Total			\$0.0

Existing Equipment Usage:	Number of Units	Inventory Agency
Description		
existing CPRs will be used. Lease costs charged above cover replacement/repair	1	
external bodies	1	
internal mechanisms	3	
Temperature recorder	1	
Existing microscopes will also be used, (including one purchased in FY03)	7	

FY18

**Project Title: CPR sampling of the GoA
Primary Investigator: Sonia Batten**

**FORM 3B
EQUIPMENT DETAIL**

Personnel Costs:		Months Budgeted	Monthly Costs	Overtime	Personnel Sum
Name	Project Title				
S Batten	Long term monitoring of zooplankton	1.2	8.9		10.7
Doug Moore	populations on the Alaskan Shelf and Gulf	1.4	6.6		9.3
Technicians - workshop	of Alaska using Continuous Plankton recorders	0.3	6.4		1.9
Technicians - analysts		2.0	6.1		12.1
D Stevens		0.3	6.8		2.2
D. Wilson		0.2	8.9		1.8
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
Subtotal			43.8	0.0	
Personnel Total					\$38.0

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
Description					0.0
					0.0
Portion of PI's travel to PI meetings					1.2
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
Travel Total					\$1.2

FY19

**Project Title: CPR sampling of the GoA
Primary Investigator: Sonia Batten**

**FORM 3B
PERSONNEL & TRAVEL
DETAIL**

Contractual Costs:		Contract
Description		Sum
Portion of local CPR servicing in Anchorage		3.0
Portion of CPR leasing		4.0
Portion of computing services		0.2
Portion of website maintenance by PICES		0.5
Portion of tow payment to ship		0.8
Shipping of gear		1.6
Shipping of samples		0.4
If a component of the project will be performed under contract, the 4A and 4B forms are required.	Contractual Total	\$10.6

Commodities Costs:		Commodities
Description		Sum
lab consumables		0.9
filtering mesh		2.0
Tow wires		0.5
	Commodities Total	\$3.4

FY19

Project Title: CPR sampling of the GoA
Primary Investigator: Sonia Batten

FORM 3B
CONTRACTUAL &
COMMODITIES DETAIL

New Equipment Purchases:		Number of Units	Unit Price	Equipment Sum
Description				
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
New Equipment Total				\$0.0

Existing Equipment Usage:		Number of Units	Inventory Agency
Description			
existing CPRs will be used. Lease costs charged above cover replacement/repair		1	
external bodies		1	
internal mechanisms		3	
Temperature recorder		1	
Existing microscopes will also be used, (including one purchased in FY03)		7	

FY19

**Project Title: CPR sampling of the GoA
Primary Investigator: Sonia Batten**

**FORM 3B
EQUIPMENT DETAIL**

Personnel Costs:		Months Budgeted	Monthly Costs	Overtime	Personnel Sum
Name	Project Title				
S Batten	Long term monitoring of zooplankton	1.2	9.2		11.0
Doug Moore	populations on the Alaskan Shelf and Gulf	1.4	6.8		9.5
Technicians - workshop	of Alaska using Continuous Plankton recorders	0.3	6.6		2.0
Technicians - analysts		2.0	6.2		12.5
D Stevens		0.3	7.0		2.3
D. Wilson		0.2	9.2		1.8
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
Subtotal			45.1	0.0	
Personnel Total					\$39.1

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
Description					0.0
					0.0
Portion of PI's travel to PI meetings					1.2
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
Travel Total					\$1.2

FY20

**Project Title: CPR sampling of the GoA
Primary Investigator: Sonia Batten**

**FORM 3B
PERSONNEL & TRAVEL
DETAIL**

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
New Equipment Total			\$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
existing CPRs will be used. Lease costs charged above cover replacement/repair	1	
external bodies	1	
internal mechanisms	3	
Temperature recorder	1	
Existing microscopes will also be used, (including one purchased in FY03)	7	

FY20

**Project Title: CPR sampling of the GoA
Primary Investigator: Sonia Batten**

**FORM 3B
EQUIPMENT DETAIL**

Personnel Costs:		Months Budgeted	Monthly Costs	Overtime	Personnel Sum
Name	Project Title				
S Batten	Long term monitoring of zooplankton	1.2	9.5		11.3
Doug Moore	populations on the Alaskan Shelf and Gulf	1.4	7.0		9.8
Technicians - workshop	of Alaska using Continuous Plankton recorders	0.3	6.8		2.0
Technicians - analysts		2.0	6.4		12.9
D Stevens		0.3	7.2		2.3
D. Wilson		0.2	9.5		1.9
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
Subtotal			46.4	0.0	
Personnel Total					\$40.3

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
Description					0.0
					0.0
Portion of PI's travel to PI meetings					1.3
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
Travel Total					\$1.3

FY21

**Project Title: CPR sampling of the GoA
Primary Investigator: Sonia Batten**

**FORM 3B
PERSONNEL & TRAVEL
DETAIL**

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
New Equipment Total			\$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
existing CPRs will be used. Lease costs charged above cover replacement/repair	1	
external bodies	1	
internal mechanisms	3	
Temperature recorder	1	
Existing microscopes will also be used, (including one purchased in FY03)	7	

FY21

**Project Title: CPR sampling of the GoA
Primary Investigator: Sonia Batten**

**FORM 3B
EQUIPMENT DETAIL**