Exxon Valdez **Oil Spill Trustee Council**

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

Annual Project Reporting Form

Project Number: 25120114-L

Project Title: Seward Line

Principal Investigator(s): Prof. Russell Hopcroft, University of Alaska Fairbanks, Dr. Seth Danielson, University of Alaska Fairbanks

Reporting Period: February 1, 2025 – January 31, 2026

Submission Date: March 16, 2026

Project Website: https://gulfwatchalaska.org/, https://nga.lternet.edu/

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

☒ **Project progress is on schedule.**

☐ **Project progress is delayed.**

☐ **Budget reallocation request.**

☐ **Personal changes.**

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1. Summary of Work Performed:

The Seward Line was sampled in early May and mid-September of 2026. Processing of samples continues year-round, and descriptive aspects evolve as more data becomes available.

During May, the surface temperature was 6-6.5°C, with the average temperature of the upper 100 m along the Seward Line nearly 0.5°C above the long-term mean (Fig. 1). During September, the average upper 100 m temperature was slightly over 1.0°C above the long-term mean and represented the warmest fall in time-series. This was somewhat unexpected because both the Pacific Decadal Oscillation (PDO) and El Niño Southern Oscillation (ENSO) indices were negative throughout the year. Surprisingly, there has been little public awareness of this protracted heatwave.

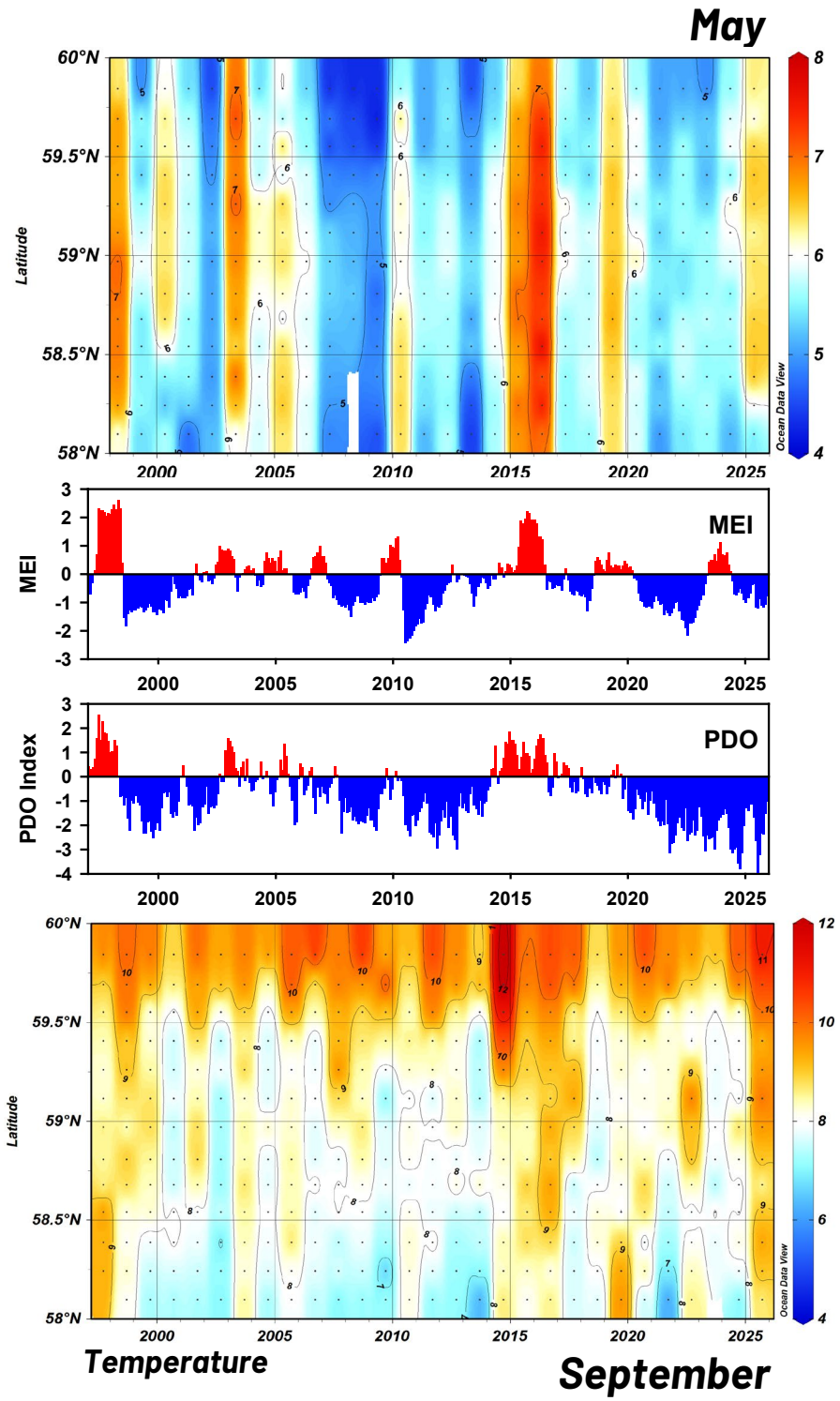

Figure 1. Average temperature of the upper 100 m along the Seward Line during May (upper) and September (lower)oceanographic cruises. The monthly Multivariate El Niño/Southern Oscillation Index (MEI) and Pacific Decadal Oscillation (PDO) are aligned to the same time scale. Warm years match the MEI phase, and to a lesser extent the PDO, but these associations weakened after the 2014-2016 heatwave.

During spring 2026, there was relatively modest chlorophyll in the surface layer with highest concentrations observed on the outer shelf (Fig. 2) and the community dominated by small cells (Figs. 3, 4) that do not favor the transfer of primary production to zooplankton. During spring, *Neocalanus* biomass appeared to be below normal (Fig. 5), with development somewhat delayed. This developmental pattern was somewhat anomalous based on water temperatures, but consistent with observations of low chlorophyl that would suggest potential food limitation. About a third of the variability in large copepods during spring is positively associated with the PDO. In contrast, biomass of the euphausiid community is negatively correlated with the PDO. Neither group is well correlated to the multivariate El Niño/Southern Oscillation Index (MEI) or temperature.

The fall cruise saw lower chlorophyll, with limited suggestion of a fall bloom being underway (Fig. 6, 7). The abundance of small copepods was low (Figs. 5, 8), and there was limited contribution from warm-water taxa that have been a significant component of the fall community when ocean conditions are warm. The abundance of warm water copepods species is positively correlated to the PDO (r^2~0.5), not to temperature per se. The positive phase of PDO results in increased advective transport in coastal waters, bringing these California species northward to the Seward Line rather than arising from local production. This explains the low abundance of warm-water copepods in 2025 when temperatures should have been favorable to them. In contrast, euphausiids appeared to do well in spring and qualitative observations suggest they were above average during fall.

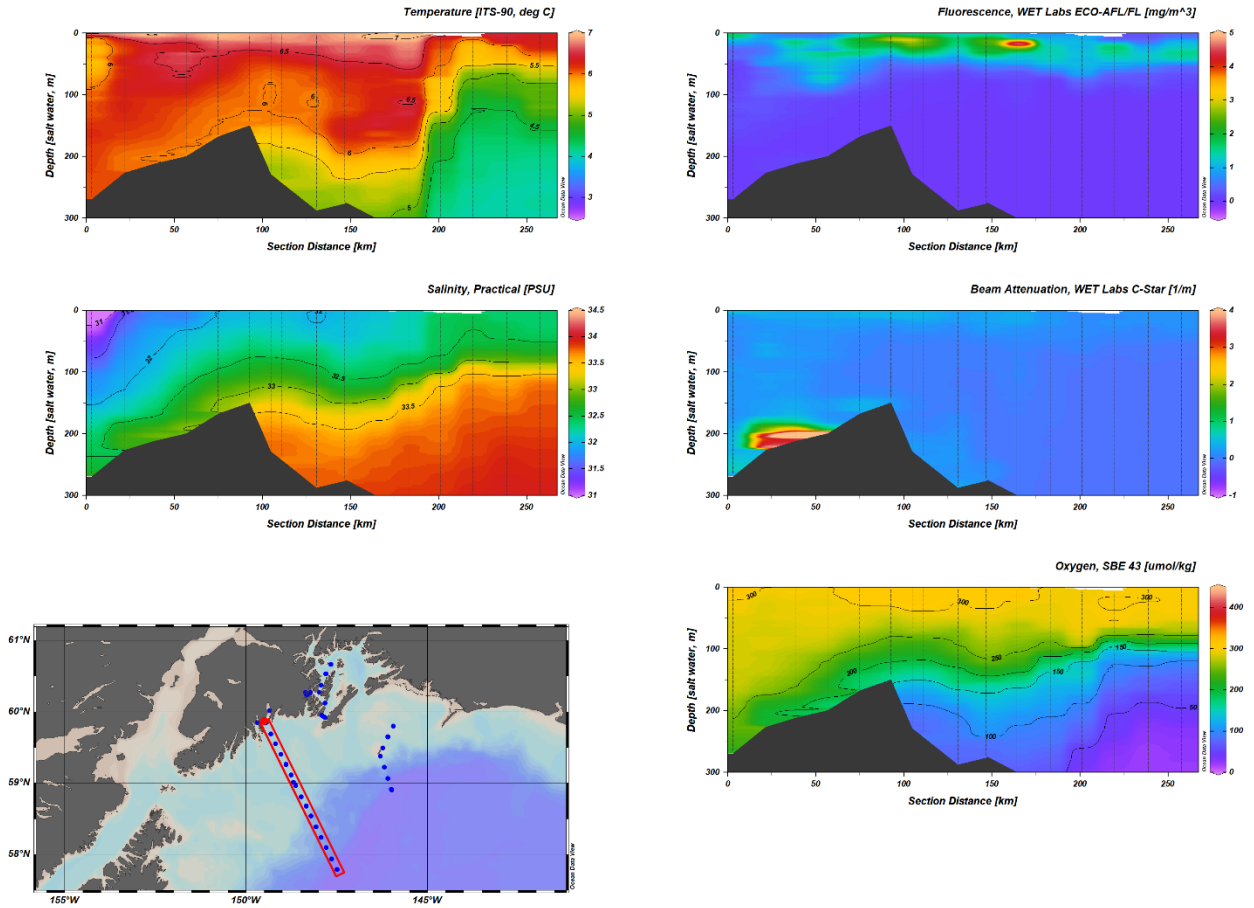

Figure 2. Seward Line transect physical hydrography from the May cruise.

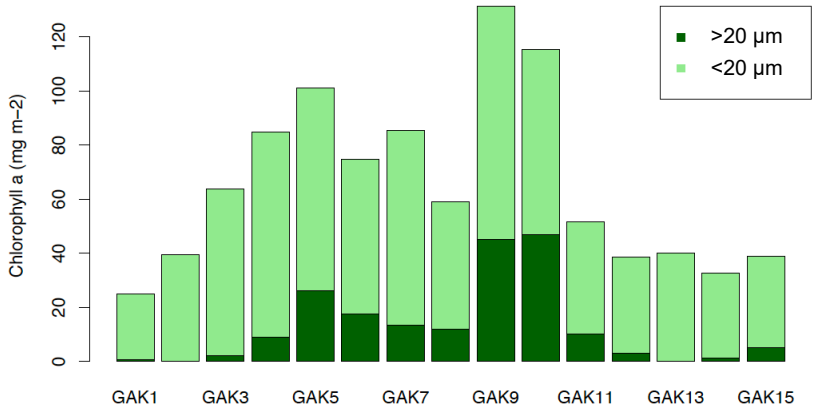

Figure 3. Extracted integrated chlorophyll along the Seward Line, May 2025 separated into the fraction above 20 µm and below 20 µm.

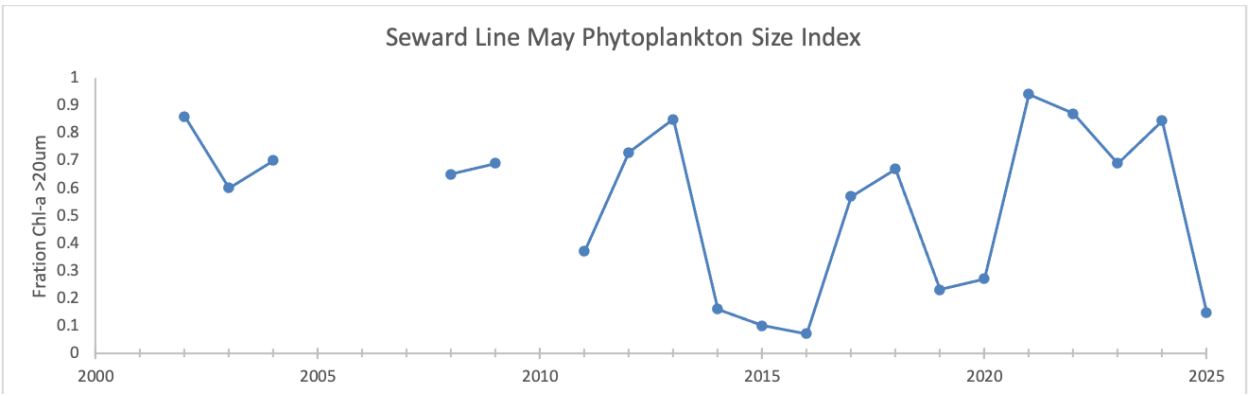

Figure 4. Spring bloom phytoplankton size index time-series along the Seward Line.

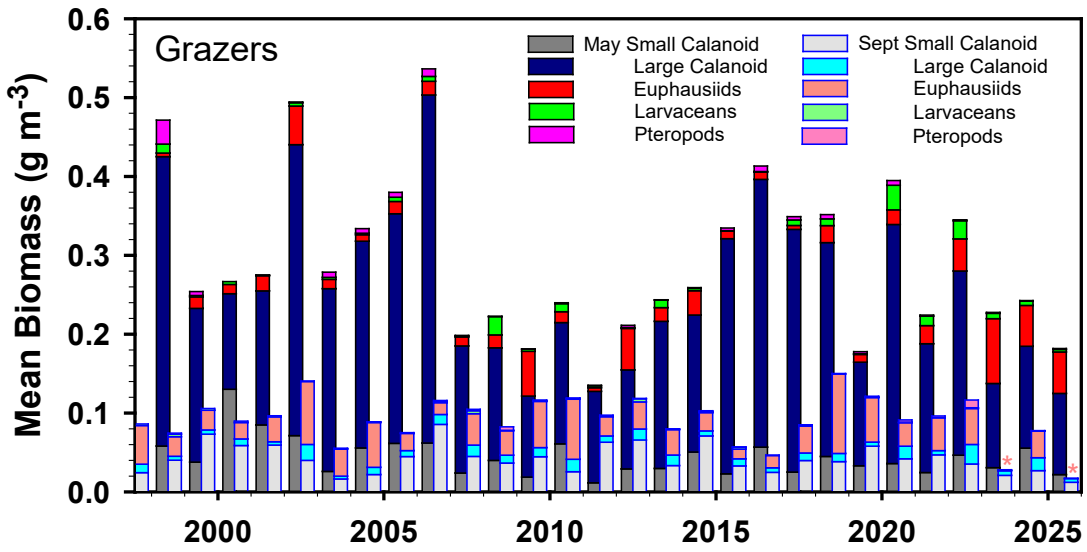

Figure 5. Average zooplankton wet-weight biomass along the Seward Line for major crustacean component. Data from 2023-2025 are preliminary, based on a subset of the stations sampled. Fall 2023 lacks euphausiid data due to equipment failures, fall 2025 euphausiid data are not yet ready to report upon.

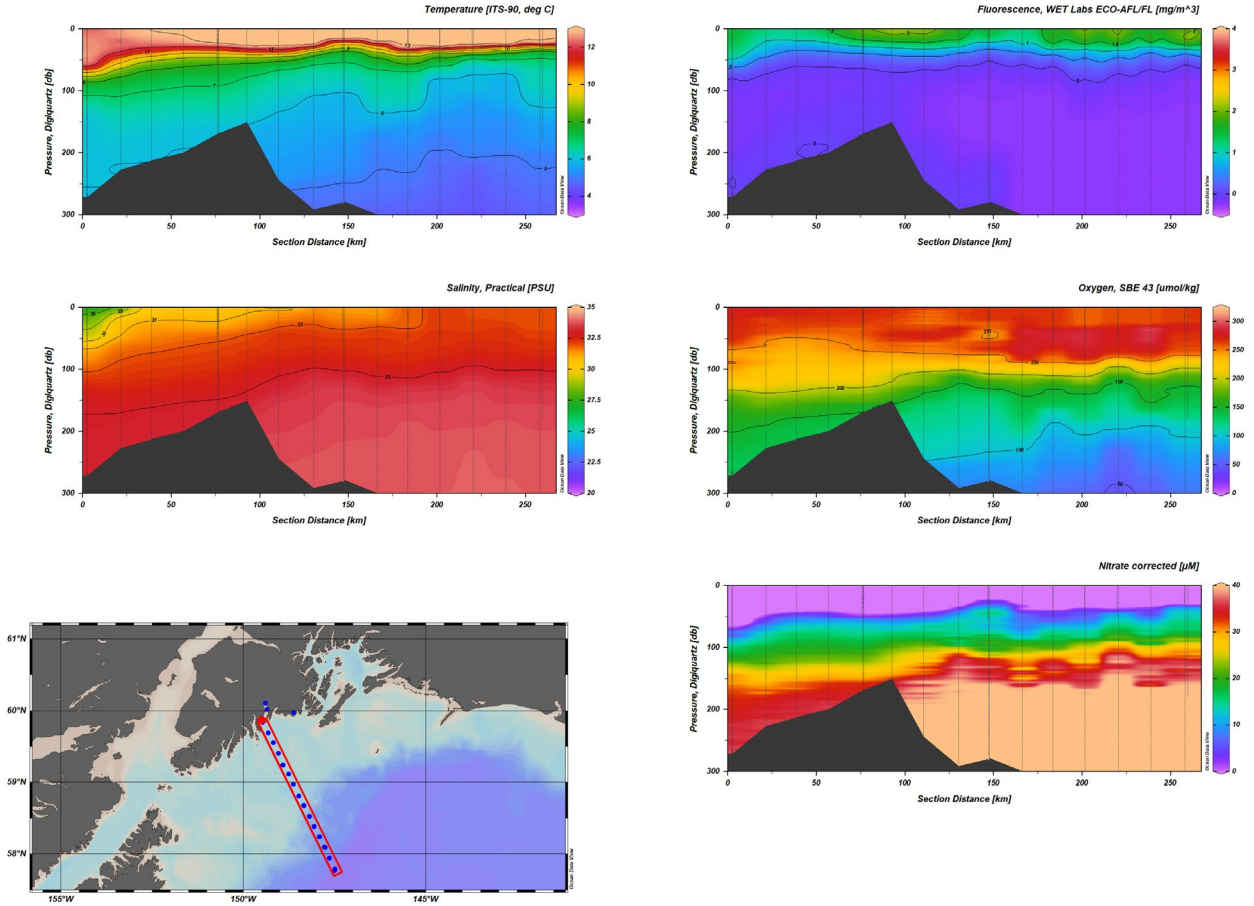

Figure 6. Seward Line transect physical hydrography from the fall (Sept) cruise.

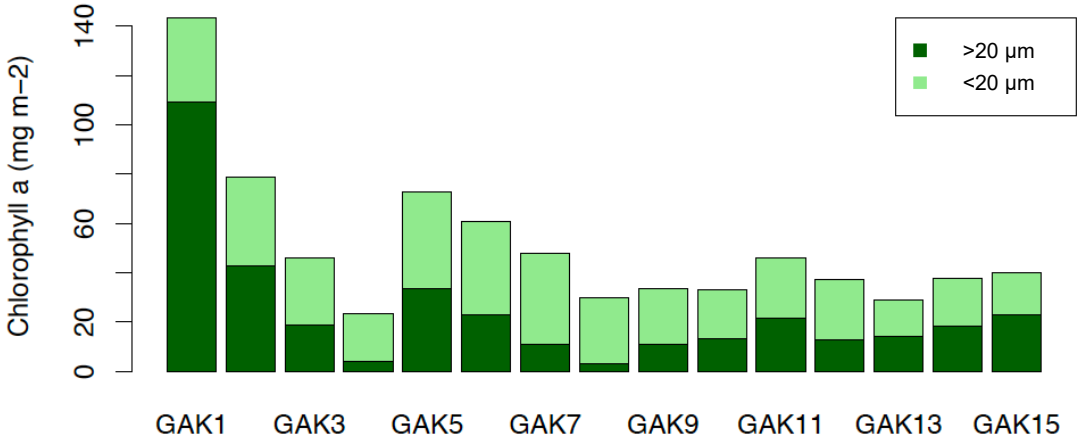

Figure 7. Extracted integrated chlorophyll along the Seward Line, September 2025, separated into the fraction above 20 µm and below 20 µm.

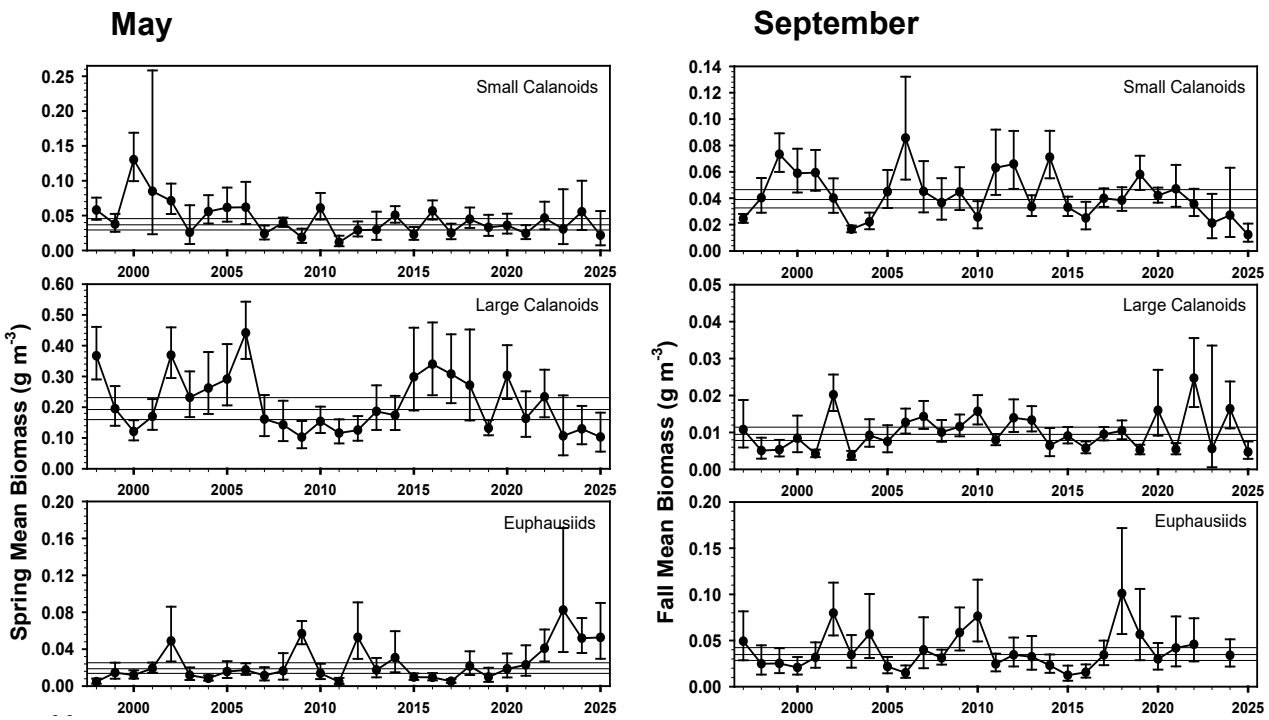

Figure 8. Biomass of major zooplankton categories during May (left) and September (right). Horizontal lines represent the *long-term mean and its 95% confidence interval. Fall 2023 lacks euphausiid data due to equipment failures, fall 2025 euphausiid data are not yet available.*

2. Products

Peer-reviewed publications:

Brauner, M., J. Cohen, B. R. Briggs, and G. M. Hennon. 2025. Identifying potential keystone microbes from co-occurrence networks in the Gulf of Alaska. Frontiers in Marine Science 12. https://doi.org/10.3389/fmars.2025.1646100.

Kléparski, L., C. Ostle, S. D. Batten, N. Djeghri, C. Hauri, R. Pagès, and S. Strom. 2025. How marine heatwaves are reshaping phytoplankton in the Northeast Pacific. Limnology and Oceanography 70:2447-2463. https://doi.org/10.1002/lno.70137.

Lax, G., E. C. Cooney, V. Zlatogursky, M. Mtawali, V. K. L. Jacko-Reynolds, S. Bjornson, Holt, V. G. Hurdeal, D. Giannotti, and P. J. Keeling. 2026. Phylogenomic tree of Cercozoa based on single-cell transcriptomes from 100 uncultured cells. BMC Biology https://doi.org/10.1186/s12915-026-02536-4.

Ortega, E. L. S., A. Meier, S. L. Danielson, K. McMonigal, A. M. Aguilar-Islas. 2025. Drivers of spatiotemporal distributions of macro- and micronutrients (Fe, Ni, Cu, Zn) in the Northern Gulf of Alaska. JGR Oceans 130:e2025JC022558. https://doi.org/10.1029/2025JC022558.

Ortega, E. L. S., I. Reister, S. L. Danielson, and A. M. Aguilar-Islas. 2025. Surface macro- and micro-nutrients within the Copper River plume region respond to along-shore winds. Marine Chemistry 270:104508. https://doi.org/10.1016/j.marchem.2025.104508.

Waga, H., T. Kelly, W. Burt, S. Strom, and B. Lowin. 2025. Bio-optical retrievals of primary production using a shipboard underway system in the northern Gulf of Alaska. Optics Express 33:46873–46891. https://doi.org/10.1364/OE.573466.

Reports:

Hopcroft, R. R. 2026. Spring and fall large copepod and euphausiid biomass: Seward Line. *In* B. E. Ferriss, editor. Abbreviated Ecosystem Status Report 2025: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Gulf of Alaska, North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501.

Questel, J. M., R. R. Hopcroft, R. W. Campbell, and C. Ostle. In review. Decadal variability in zooplankton communities: Comparison of four zooplankton time-series from the Northern Gulf of Alaska (2012-2021). Synthesis report for EVOSTC.

Popular articles:

No new contributions for this reporting period.

Conferences and workshops:

Belcher, S., and A. Aguilar-Islas. 2026. Seasonal particulate phosphorus dynamics in the northern Gulf of Alaska. Poster presented at the Alaska Marine Science Symposium, Anchorage, Alaska, January.

Cabanelas, A., J. Conroy, M. Décima, B. Dias, G. Hennon, R. R. Hopcroft, T. Kelly, M. Ohman, O. Schofield, D. Steinberg, M. Stukel, and H. Sosik. 2025. Latitudinal variability and long-term responses of pelagic community structure to climate forcing across four marine LTER sites. Oral presentation at Association of Sciences of Limnology and Oceanography Aquatic Sciences Meeting, Charlotte, North Carolina, March.

Cushing, D. 2025. An application of Dynamic Factor Analysis to at-sea seabird abundance time-series in the northern Gulf of Alaska. Invited virtual seminar, Farallon Institute, Petaluma, California, February.

Cushing, D., M. Arimitsu, S. Danielson, S. Hatch, R. Kaler, E. Labunski, S. Whelan, and R. Suryan. 2026. Seabird distributions and diets reflect ecosystem integration of climate forcing. Oral presentation at the Alaska Marine Science Symposium, Anchorage, Alaska, January.

Hennon, G. M. M., M. Brauner, B. R. Briggs, E. Bruch, J. Cohen, and J. Fellman. 2026. Co-occurrence networks across the Gulf of Alaska suggest variability in ecosystem

resilience. Poster presented at the Alaska Marine Science Symposium, Anchorage, Alaska, January.

Holmes, J., M. P. Buil, and J. Fiechter. 2025. Exploring Drivers of Low Frequency Variability of the Northeast Pacific Boundary Currents. Poster presented at the University of California Santa Cruz Ocean Sciences Undergraduate Research Symposium, Santa Cruz, California, Spring.

Hopcroft, R. R., C. A. Smoot, and A. Poje. 2025. Patterning of zooplankton communities as revealed by 25 years of observations along the Seward Line in the Northern Gulf of Alaska. Oral presentation at Association of Sciences of Limnology and Oceanography Aquatic Sciences Meeting, Charlotte, North Carolina, March.

Hopcroft, R., C. Smoot, and A. Poje. 2026. Zooplankton communities in the northern Gulf of Alaska: Seward Line observations through 2025. Poster presented at the Alaska Marine Science Symposium, Anchorage, Alaska, January.

Meier, A., K. McMonigal, S. L. Danielson, and A. Aguilar-Islas. 2026. Quantifying the relationship between nutrient fluxes and turbulence in the northern Gulf of Alaska. Poster presented at the Alaska Marine Science Symposium, Anchorage, Alaska, January.

Steinberg, D., J. Conroy, A. Cabanelas, M. Décima, B. Dias, G. Hennon, R. R. Hopcroft, T. Kelly, M. Ohman, O. Schofield, H. Sosik, and M. Stukel. 2025. Marine plankton size spectra and trophic transfer efficiency at pelagic Long-term Ecological Research (LTER) sites across a latitudinal gradient. Oral presentation at Association of Sciences of Limnology and Oceanography Aquatic Sciences Meeting, Charlotte, North Carolina, March.

Stukel, M., A. Cabanelas, J. Conroy, M. Décima, B. Dias, G. Hennon, R. R. Hopcroft, T. Kelly, M. Ohman, O., Schofield, H. Sosik, and D. Steinberg. 2025. Investigating trophic amplification at long-term marine time-series sites. Oral presentation at Association of Sciences of Limnology and Oceanography Aquatic Sciences Meeting, Charlotte, North Carolina, March.

Wells, K., S. L. Danielson, K. McMonigal, H. Statscewich, and R. Hopcroft. 2026. Developing techniques to reveal turbulence in the northern Gulf of Alaska with shadowgraph imaging. Poster presented at the 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:

Seward Line data are being delivered according to the National Science Foundation requirement of two years or less from collection date. In practice most datasets are delivered to Axiom each

May, ~2 years after the collection field season. Some datasets are delivered more quickly. The entire data catalogue may be found at: https://search.dataone.org/portals/NGALTER.

Data sets and associated metadata

Aguilar-Islas, A., and M. Kaufmann. 2025. Dissolved inorganic nutrient data from stations sampled on NGA-LTER seasonal cruises, 2018-2023. Research Workspace. 10.24431/rw1k586.

Danielson, S. L. 2025. Water columns properties measured by CTD sensors during seasonal cruises in the Gulf of Alaska for the Northern Gulf of Alaska LTER project, 2018-2024. Research Workspace. https://doi.org/10.24431/rw1k459.

Hennon, G., A. Piatt, and K. Dilliplaine. 2025. Picoplankton and nanophytoplankton concentrations as determined from flow cytometry analyses on water samples collected on Northern Gulf of Alaska LTER site seasonal cruises, 2019-2023. Research Workspace. 10.24431/rw1k8f2.

Hopcroft, R. 2025. Environmental drivers: Seward Line. Gulf of Alaska data portal: https://gulf-of-alaska.portal.aoos.org/#metadata/e25fe1f2-1c98-44f6-856f-5d61c87c0384/project.

Hopcroft, R. R. 2025. Gelatinous zooplankton abundance and wet weight biomass observations from research cruises for the Northern Gulf of Alaska (NGA) LTER site, 2018-2023. Research Workspace. 10.24431/rw1k58z.

Hopcroft, R. R. 2025. Zooplankton abundance and biomass observations determined traditional microscopy, from Multinet samples collected during research cruises for the Northern Gulf of Alaska LTER site, 2018-2023. Research Workspace. 10.24431/rw1k591.

Hopcroft, R. R. 2025. Zooplankton abundance and biomass observations obtained from the QuadNet, as analyzed by traditional microscopy, during NGA LTER seasonal cruises in the Northern Gulf of Alaska, 2018-2023 Research Workspace. 10.24431/rw1k587.

Additional Products not listed above:

Ortega, E. 2025. Dissolved and particulate nutrient dynamics in the Northern Gulf of Alaska: A productive subarctic shelf ecosystem. PhD dissertation, University of Alaska Fairbanks. http://hdl.handle.net/11122/16260.

Reister, I. 2025 Perspectives on Northern Gulf of Alaska freshwater pathways, wind, and linkages to phytoplankton biomass. PhD dissertation, University of Alaska Fairbanks. http://hdl.handle.net/11122/16270.

3. Coordination and Collaboration:

The Alaska SeaLife Center or Prince William Sound Science Center

The Seward Line project collaborates with Prince William Sound Science Center (PWSSC) at a programmatic level because members of the Gulf Watch Alaska-Long-Term Research and Monitoring (GWA-LTRM) program management team works for PWSSC and PWSSC is the fiscal agent for the University of Alaska's grant through the National Oceanic and Atmospheric Administration (NOAA). The Seward Line team has been working with PWSSC on a synthesis of zooplankton time-series.

EVOSTC Long-Term Research and Monitoring Projects

Seward Line is part of the GWA-LTRM program and coordinates with GAK1 (project 25120114-I, principal investigator [PI] Danielson), ocean acidification (project 25220202, PI Hauri), Prince William Sound oceanography (project 25120114-G, PI Campbell), and Prince William Sound marine bird surveys (25120114-M, PI Kaler) sampling and meets quarterly with other GWA-LTRM projects. The Seward Line team has been working with PWSSC, Cook Inlet/Kachemak Bay and the Pacific continuous plankton recorder program (including project 25120114-D, PI Ostle) to synthesize zooplankton time-series across the environmental drivers component. A draft is included elsewhere in the reporting package. We plan to use this as basis for a peer-reviewed manuscript to be submitted later this year.

EVOSTC Mariculture Projects

No new contributions for this reporting period.

EVOSTC Education and Outreach Projects

The Seward Line project has participated in meetings with members of the Community Organized Restoration and Learning (CORaL) Network funded by the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) to evaluate ways the programs can work together on outreach activities.

Individual EVOSTC Projects

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

Trustee or Management Agencies

The Seward Line coordinates with NOAA by proving samples for larval fish analysis from each spring cruise, and two-way sharing of data streams from physics to seabirds.

Native and Local Communities

Over the past year, the Northern Gulf of Alaska Long Term Ecological Research program has focused on creating learning experiences for schools along the coast of the Northern Gulf of Alaska, as well as for middle school students from across Alaska participating in the Alaska Native Science and Education Program (ANSEP).

4. Response to EVOSTC Review, Recommendations and Comments:

May 2025 EVOSTC Science Panel Comment:

No review, recommendations, or comments were provided in 2025. This project responded to comments in the FY24 annual report.

5. Budget:

Spending is behind plans and expectations because of the EVOSTC delay in releasing funds and delay in issuance of the NOAA grant during several fiscal years.

***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	$164,676	$168,792	$173,013	$177,340	$160,099	$843,922	$474,453
Travel	$1,555	$1,564	$1,573	$1,582	$1,592	$7,866	$6,692
Contractual	$6,000	$6,000	$6,000	$6,000	$6,000	$30,000	$22,114
Commodities	$1,059	$1,265	$1,476	$1,693	$1,915	$7,408	$9,091
Equipment	$0	$0	$0	$0	$0	$0	$0
Indirect Costs Rate = 25% non-equipment	$43,323	$44,405	$45,515	$46,654	$42,402	$222,299	$125,940
SUBTOTAL	$216,613	$222,026	$227,577	$233,269	$212,008	$1,111,494	$638,290
General Administration (9% of subtotal)	$19,495	$19,982	$20,482	$20,994	$19,081	$100,034	N/A
PROJECT TOTAL	$236,108	$242,009	$248,059	$254,264	$231,089	$1,211,529	
Other Resources (In-Kind Funds)						$0	

COMMENTS:
Spending is behind plans and expectations because of the EVOSTC delay in releasing funds and delay in issuance of the NOAA grant in FY22. The FY24 delay by NOAA in releasing grant funds until January 2025 meant that the Seward Line project did not receive FY24 funds from PWSSC until February 2025.

FY22-26	**Project Number: 25120114-L** **Project Title: Seward Line** **PI(s): Hopcroft & Danielson (UAF)**	**NON-TRUSTEE AGENCY SUMMARY PAGE**