ATTACHMENT B. Annual Project Report Form (Revised 11.21.19)

1. Project Number:

20120114-L

2. Project Title:

The Seward Line – Marine Ecosystem monitoring in the Northern Gulf of Alaska

3. Principal Investigator(s) Names:

Russell R Hopcroft, Principal Investigator, University of Alaska Fairbanks

Seth L Danielson, University of Alaska Fairbanks

4. Time Period Covered by the Report:

February 1, 2020-January 31, 2021

5. Date of Report:

March 2021

6. Project Website (if applicable):

www.gulfwatchalaska.org

https://nga.lternet.edu/research/gulf-of-alaska-ecosystem-observatory-geo/

7. Summary of Work Performed:

Overview: In the past year, despite COVID-19 health restrictions and mitigation, we successfully completed all three planned cruises from the *R/V Sikuliaq*. Although all cruises where scaled-back in scope, the scope-reductions mainly pertained to Northern Gulf of Alaska (NGA) Long Term Ecological Research (LTER) enhancements and the 2020 cruises accomplished all the traditional sampling of the Seward Line and Prince William Sound. On these, we collected samples from vertical profiles for the analysis of macronutrients, particulate organic carbon and nitrogen, chlorophyll, high performance liquid chromatography (HPLC) analysis of phytoplankton pigment, microbial genomics, and phyto/microzooplankton. We also determined primary production at 10 (summer) or 5 (fall) of the Seward Line and Prince William Sound stations. Particle size spectra were not determined during the majority of these casts due to instrumentation failures. Samples for the analysis of iron parameters (dissolved Fe, soluble Fe, total dissolvable Fe, total particulate Fe, leachable particulate Fe, organic Fe-binding ligands) were collected from a subset of matching vertical profiles. Dissolved inorganic carbon was measured at a subset of stations. Zooplankton was sampled at all stations generally using three different net sizes, with lipid volumes and physiological states determined for *Neocalanus* copepods (as available) at each intensive station. Our largest net targeting macro-jellies during summer and fall was also deployed but had only a small fraction of that collected during the prior two years. Underway data was collected concurrently, the specific parameters depend on the specific vessel used, but have included weather, ocean physics and currents, nitrate, ocean optics, pCO_2, multi-frequency acoustic backscatter, multibeam bathymetry, and the distribution of seabirds and marine mammals. Seabirds and marine mammals were surveyed on both cruises.

During 2020 we recovered and redeployed the Gulf of Alaska Ecosystem Observatory (GEO) mooring. All fixed depth instrumentation collected data successfully. Like 2019, the real-time surface expression succumbed to the weather challenges of the Gulf of Alaska in early December, breaking away from the subsurface components.

Full details of cruises, and their observations are found at: https://nga.lternet.edu/about-us/documents/.

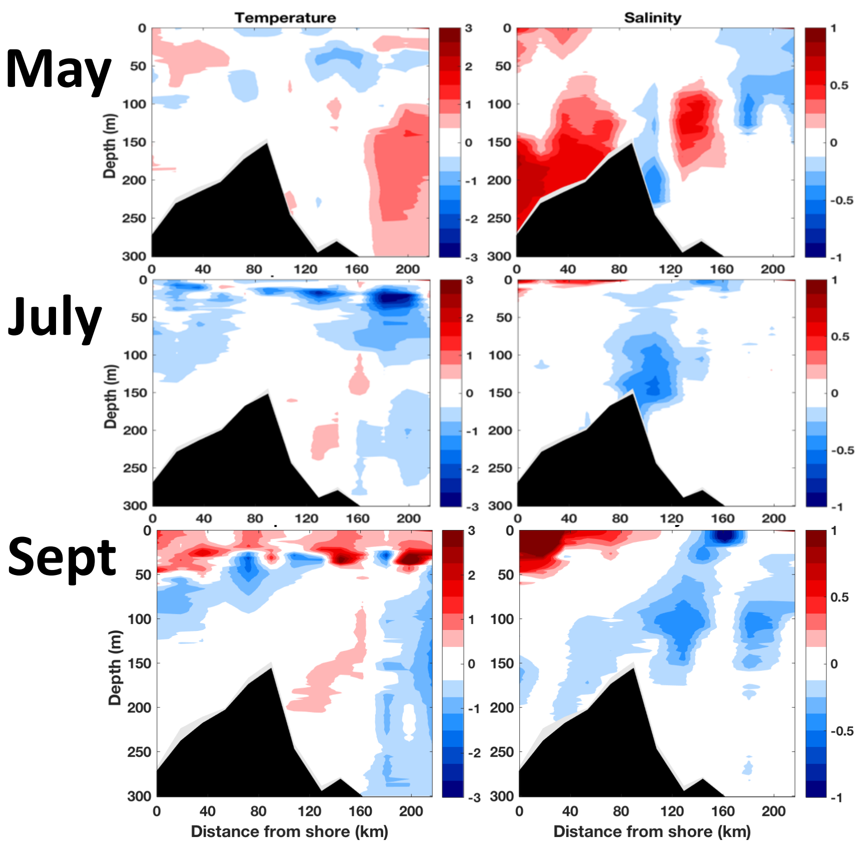

Figure 1. Temperature and salinity anomalies for the Seward Line transect during May, July, and September 2020.

Physics: During May 2020 surface temperature and salinity were relatively normal in the upper 100m, but salty water was trapped at depth on the inner shelf, as illustrated in Fig 1. Summer conditions were also relatively normal although the thermocline appears to be located somewhat shallower than normal on the outer half of the line. During September, in surface waters temperature and salinity appeared above average, but we note the cruise was executed almost 2 weeks earlier than normal.

Inorganic Carbon: There was no spring sampling for inorganic carbon. Results from summer and fall are not yet available.

Macronutrient: Given the limited field operation capacity during 2020, we were lucky to be able to sample the Seward Line for macronutrients during the spring, summer, and fall cruises. Analysis of these samples has been completed and quality control is underway. During spring, nutrient levels in surface waters reflected the patchiness observed along the line, with some offshore stations exhibiting lower nutrient concentrations in surface waters compared to mid-shelf stations. During late summer/fall 2020 we observed a signal of sedimentary denitrification in the inner shelf stations, where the bottom-most samples had a deficit in nitrate concentrations compared to the observed phosphate. This feature was also observed during fall 2019 (Fig. 2).

Iron: Samples for iron analysis were collected during summer and fall. Analysis is underway for various iron parameters.

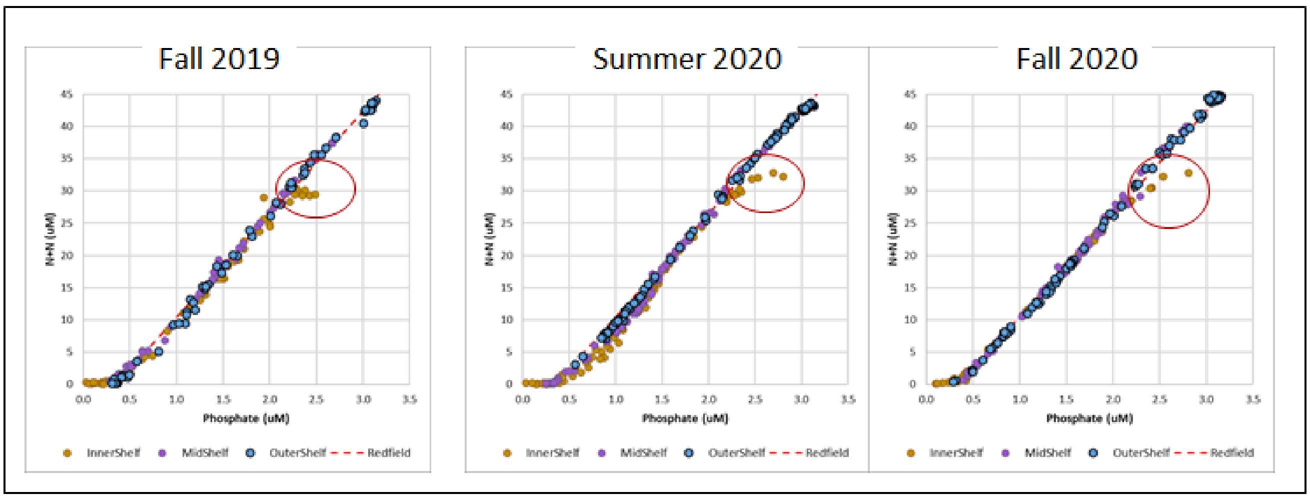

Figure 2. Seasonal relationship of nitrate plus nitrite (N+N) vs. phosphate along the Seward Line. Red ovals indicate inner shelf samples with a deficit in N relative to phosphate, suggesting denitrification within inner shelf sediments.

Particulate matter: Nothing available yet from 2020 for particulate matter. Sediment trap samples from 2020 are still undergoing analysis.

Phyto- and Microzooplankton: COVID-19-related restrictions and delays mean that we have less to share than usual. Because the phyto- and microzooplankton team could not participate in the spring 2020 cruise due to Alaska State travel restrictions, only size-fractionated chlorophyll and microzooplankton samples were collected. Sampling on all but the summer cruise was restricted to the Seward Line and Prince William Sound; the Kodiak Line was not sampled at all during 2020. Sample analysis for all three 2020 cruises has been delayed by shutdowns at the various laboratories that process these samples. Microzooplankton samples from 2020 are currently being analyzed at Shannon Point Marine Center; dissolved organic carbon, particulate organic and inorganic carbon, and HPLC samples have all been sent to partner laboratories and are awaiting analysis at those facilities.

Early May 2020 found the shelf with low chl-a concentrations and mainly small (<20 µm) phytoplankton cells (Fig. 3 top), even though macronutrient levels were still relatively high (near-surface nitrate 6-10 µM; silicic acid 11-18 µM). Highest chl-a was observed near the shelf break; these and the lower chlorophyll slope stations all had mainly large cells. This shelf-slope dichotomy is unusual in our 11-year time series (Fig. 4).

The summer 2020 water column was strongly stratified with a clear subsurface chlorophyll maximum (SCM) layer on the shelf and nearly all chl-a in cells <20 µm (Fig. 3 middle). Although this was not an unusually warm summer, the small cell dominance was even more pronounced than during summer 2019, which experienced a short-lived marine heatwave. In addition, we saw unusual very small (<5 µm) cryptophytes at a number of stations; these were not observed in summers 2018 or 2019.

Seawater dilution experiments in summer 2020 showed that small phytoplankton in the Copper River plume region had intrinsic growth rates proportional to nitrate concentrations. However, in contrast to 2019, large phytoplankton in the river plume grew slowly even when enriched with macronutrients, suggesting that something about river chemistry and/or the ambient shelf community differed between the two years. Microzooplankton grazing in the plume was markedly higher in summer 2020 than in 2019.

The spatial distribution of total chl-a in fall 2020 was similar to that in summer, with some evidence of mixing of the SCM throughout the upper 20 m. However, the size composition of the phytoplankton community contrasted with summer, showing a higher proportion of large (>20 µm) cells in the Alaska Coastal Current and near the shelf break (Fig. 3 bottom).

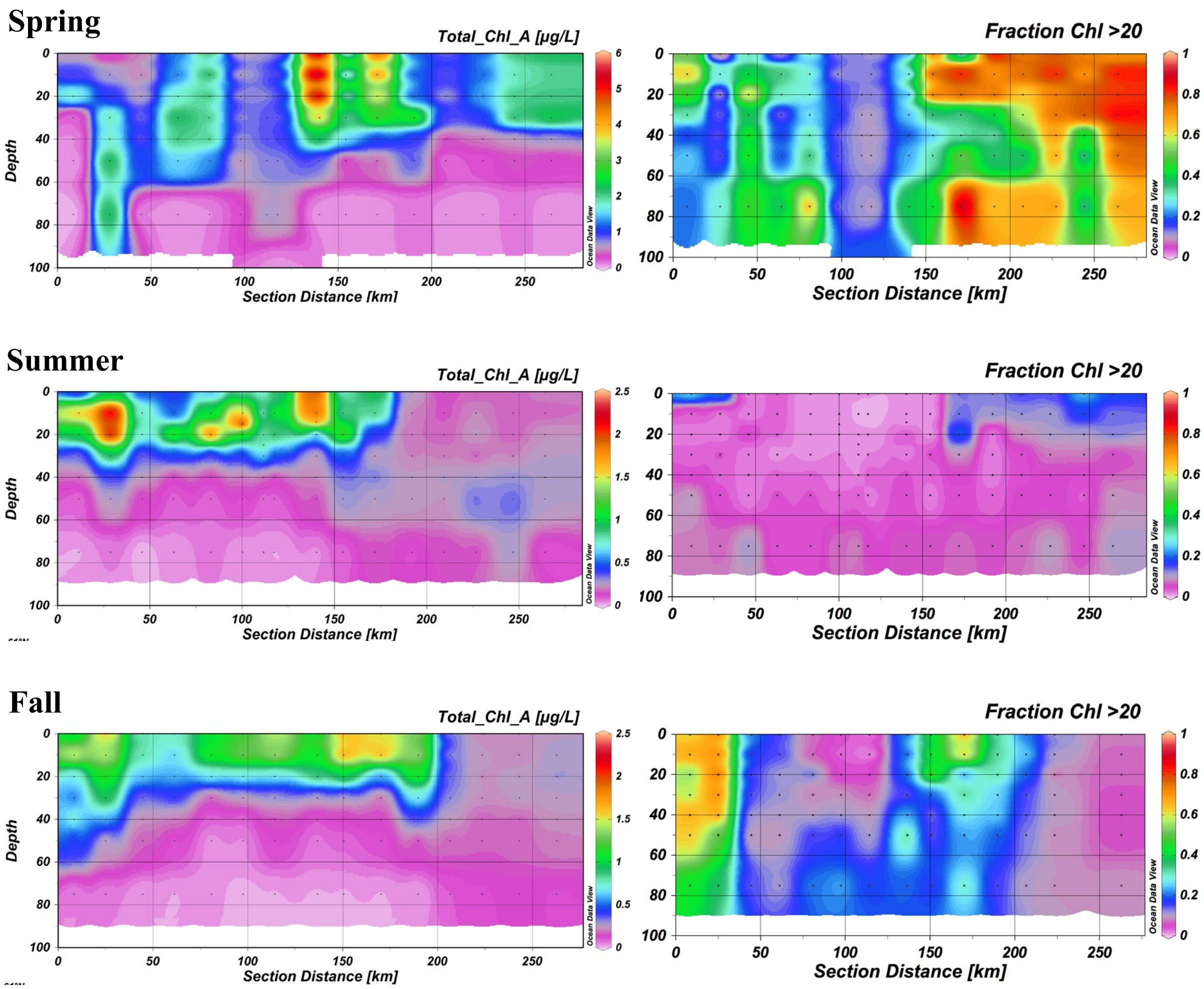

Figure 3. Seward Line hydrographic sections showing total chl-a (left panels) and fraction of chl-a in cells >20 µm (right panels) for spring (early May), summer (early July) and fall (early September) 2020.

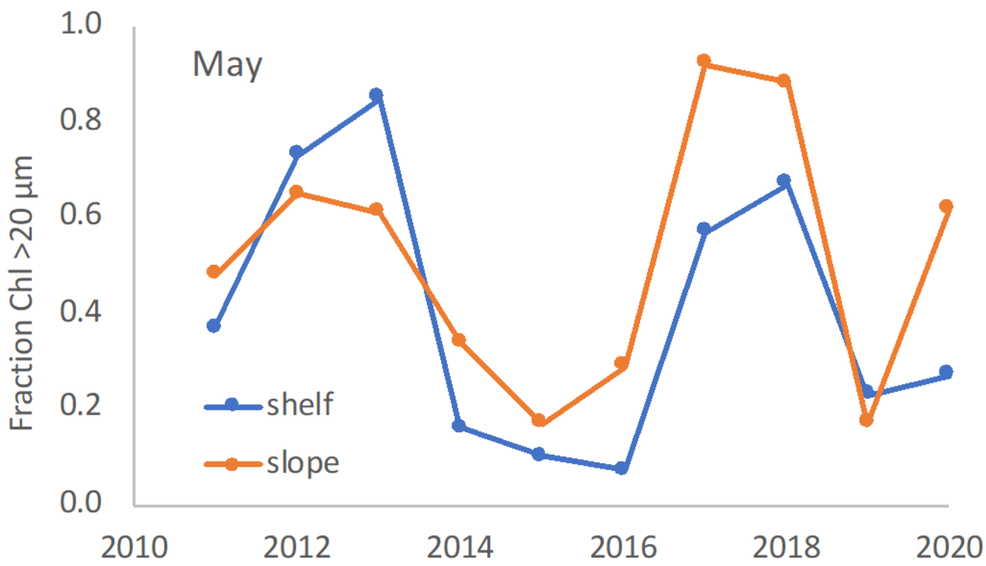

Figure 4. Time series of chl-a size composition (fraction >20 µm) for early May on the Seward Line. Data for shelf (GAK 1-9) and slope (GAK 10-13) stations are averaged. Very low proportions of large cells in early May are associated with anomalously warm conditions in 2014-16 and 2019.

Zooplankton: During 2020 all three surveys, zooplankton were sampled along the Seward Line, but the Middleton Line was only sampled during summer. Analysis of 2019 and 2020 samples are still underway, although preliminary results are available for spring and fall cruises (Fig. 5). After low biomass of large copepods during spring 2019, their biomass during 2020 was relatively typical. Small copepod biomass was somewhat low in spring and summer of 2020, and euphausiid biomass was relatively typical in spring (fall 2020 not yet available). Several species of southern affinity were present during fall and generally represented a low percentage of the shelf community (1-7%) but were highly abundant at the most offshore stations where they contributed ~50% of the calanoid copepod community. The biomass represented by the macro-jellies was low compared to the last two years, although this may simply be a reflection of the lower number of stations sampled during 2020.

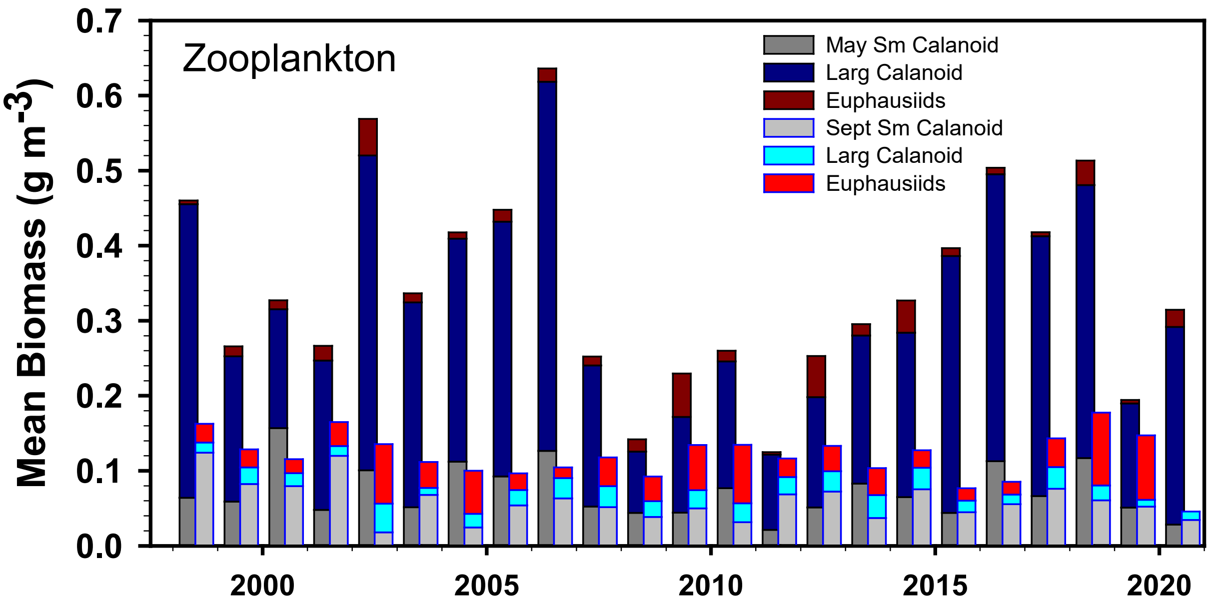

Figure 5. Biomass of major crustacean zooplankton observed along the Seward Line during May and September. At present, data for 2020 is based on about a quarter of the stations, and about half of the stations for 2019.

Seabird and marine mammals: We conducted visual surveys for seabirds and marine mammals during two of the three 2020 northern Gulf of Alaska Seward Line / LTER cruises. Due to COVID-19 restrictions, a seabird observer was not able to join the spring cruise. However, we successfully conducted surveys during the July and September cruises (Fig. 6). During July, we completed 1370 linear km of surveys, including along the Seward Line, the Middleton Line, in Prince William Sound, and during a focal study of the Copper River plume region. This was our third cruise during the month of July. In general, the highest concentrations of birds occurred near the shelf-break and in coastal waters within 15 km of the shore, while the lowest densities occurred over the middle shelf and in the high-nutrient low-chlorophyll offshore waters on the outer Seward Line (Fig. 6). Along the Seward Line, densities of total seabirds (all species combined) averaged 6.8 birds km^{-2}, which was lower than was seen during the previous two years of summer surveys. Densities were higher along the Middleton Line, with 9.4 birds km^{-2}, which was near the mean observed over the three years.

During the fall cruse, we conducted 756 km of surveys, including the Seward Line and Prince William Sound. This was our 14th September survey of the Seward Line. Densities of total seabirds during the September 2020 cruise was 6.1 birds km^{-2}, which was near the long-term average of 5.5 birds km^{-2}. This contrasted with 2019, which was the highest year observed (12.0 birds km^{-2}). The highest abundances were observed near the shelf-break, and relatively high densities were also observed in near-coastal waters and over the relatively shallow rise that occurs mid-shelf at the head of Amatuli Trough (Fig. 6). Planktivorous seabirds were unusually abundant during the September

2020 cruise, with the highest numbers of for fork-tailed storm-petrels, parakeet auklets, and Cassin's auklets observed over fourteen years of surveys. We observed seven species of marine mammals during the summer cruise and five during fall. The most frequently observed species were killer whales and harbor seals, respectively.

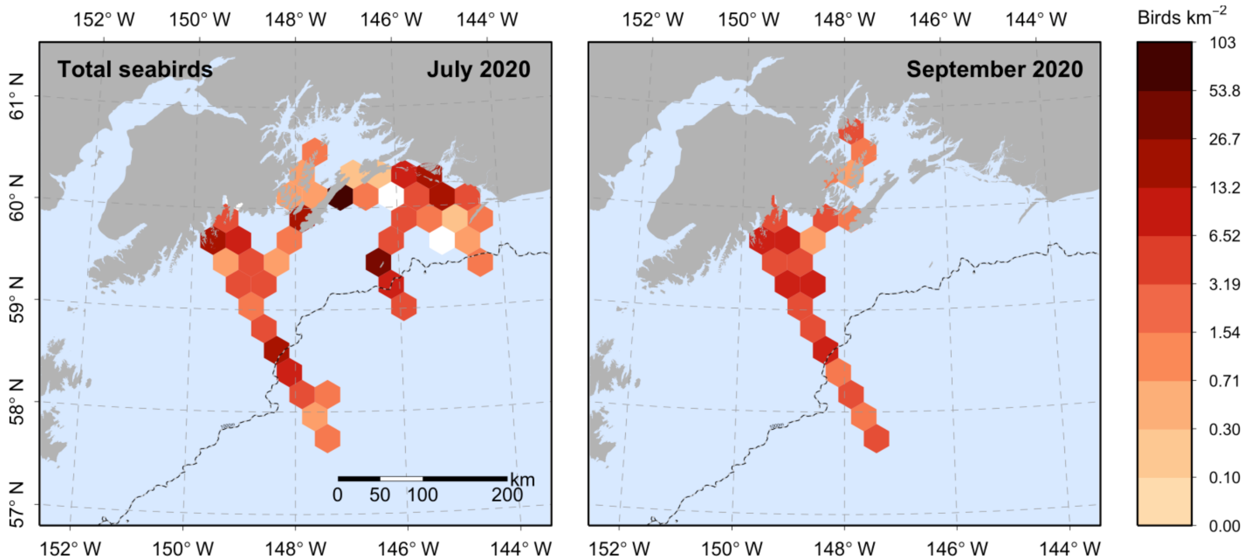

Figure 6. Total bird density (birds km^{-2}) during 2020 Long Term Ecological Researce cruises in July (left) and September (right).

8. Coordination/Collaboration:

A. Projects Within a Trustee Council-funded program

1. Within the Program

Principal Investigator (PI) Hopcroft leads the Environmental Drivers component for the GWA program and maintains regular discussion with other Environmental Drivers projects on what each was observing over the year.

The Seward Line project links tightly with the GAK1 mooring (project 20120114-I, PI Danielson), providing a cross shelf context for its observations. It complements the Continuous Plankton Recorder (project 2020114-D, PI Ostle) and Prince William Sound and Lower Cook Inlet/Kachemak Bay oceanographic long-term monitoring efforts (projects 20120114-G, PI Campbell, and 20120114-J, PIs Holderied and Baird) by providing more detailed oceanographic evaluation of the Gulf of Alaska shelf and the major passages in Prince William Sound than is provided by the other projects. These components overlap relatively little in their sampling locations - enough to ensure comparability between datasets, but not enough to be duplicative and wasteful of resources. The addition of monthly sampling in Resurrection Bay aligns sampling periodicity with the other Environmental Driver components.

The additional monthly sampling in Resurrection Bay and at GAK1 provide oceanographic context for the GWA Nearshore activities underway within Kenai Fjords National Park. The new sampling line added through National Science Foundation (NSF) LTER funding now connects seabird work at Middleton Island (project 20120114-C, PIs Arimitsu and Piatt) into the Environmental Drivers sampling domain.

The inclusion of a marine bird and mammal observer aboard the Seward Line and LTER surveys in spring and fall provides direct connections to the Pelagic component projects of GWA.

The Seward Line project contributed data and analysis to three of the GWA science synthesis publications, two of which are published or in press as of the preparation date of this report.

2. Across Programs

a. Herring Research and Monitoring

The Seward Line makes physical and biological data available to the Herring Research and Monitoring program.

b. 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 (see below).

B. Individual Projects

The Seward Line project does not coordinate or collaborate directly with *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) individual projects, though data collected by the project are available for use and project team members are available to assist upon request.

C. With Trustee or Management Agencies

The Seward Line/LTER is co-funded by GWA, North Pacific Research Board, Alaska Ocean Observing System, and NSF, all sharing common goals of understanding environmental drivers on the Gulf of Alaska shelf and the major passages of Prince William Sound.

We provided a platform for visual seabird surveys and marine mammals during three 2018 northern Gulf of Alaska LTER cruises, in collaboration with US Fish and Wildlife Service, Kathy Kuletz.

Seward Line/LTER cruises provide bongo collections for larval fish assessment to National Oceanic and Atmospheric Administration (NOAA) Alaska Fisheries Science Center's EcoFOCI group. LTER and NOAA share data on several projects.

Like other Environmental Driver component projects, Seward Line data are available to Alaska Department of Fish and Game biologists for salmon forecasting,

The Seward Line contributed two indicators to NOAA's Gulf of Alaska Ecosystem Status Report to the North Pacific Fisheries Management Council: (https://apps-afsc.fisheries.noaa.gov/REFM/docs/2020/GOAecosys.pdf): 1) Seward Line May temperatures and 2) spring and fall large copepod and euphausiid biomass along the Seward Line.

9. Information and Data Transfer:

A. Publications Produced During the Reporting Period

1. Peer-reviewed Publications

Arimitsu, M., J. Piatt, S. Hatch, R. Suryan, S. Batten, M.A. Bishop, R. Campbell, H. Coletti, D. Cushing, K. Gorman, R. Hopcroft, K. Kuletz, C. Marsteller, C. McKinstry, D. McGowan, J. Moran, W.S. Pegau, A. Schaeffer, S. Schoen, J. Straley, and V. von Biela. 2021. Heatwave-induced collapse of forage fish species disrupts energy flow to top pelagic predators. Global Change Biology. https://onlinelibrary.wiley.com/doi/abs/10.1111/gcb.15556

Danielson, S.L., D.F. Hill, K.S. Hedstrom, J. Beamer, and E. Curchitser, 2020. Coupled terrestrial hydrological and ocean circulation modeling across the Gulf of Alaska coastal interface. Journal of Geophysical Research-Oceans https://doi.org/10.1029/2019JC015724.

Hauri, C., C. Schultz, K. Hedstrom, S. Danielson, B. Irving, S.C. Doney, R. Dussin, E.N. Curchitser, D.F. Hill, and C.A. Stock, C.A. in press. A regional hindcast model simulating ecosystem dynamics, inorganic carbon chemistry, and ocean acidification in the Gulf of Alaska. Biogeosciences Discussions https://doi.org/10.5194/bg-2020-70

Litzow, M.A., M.E. Hunsicker, E.J. Ward, S.C. Anderson, J. Gao, S. McClatchie, S. Zador, S. Batten, S. Dressel, J. Duffy-Anderson, E. Fergusson, R.R. Hopcroft, B.J. Laurel, and R. O'Malley. 2020. Evaluating ecosystem change as Gulf of Alaska temperature exceeds the limits of preindustrial variability. Progress in Oceanography 186: https://doi.org/10.1016/j.pocean.2020.102393.

Roncalli, V., M.C. Cieslak, R.R. Hopcroft, and P.H. Lenz. 2020. Capital breeding in a diapausing copepod: A transcriptomics analysis. Frontiers in Marine Science 7 doi:10.3389/fmars.2020.00056

Suryan, R.M., M.L. Arimitsu, H.A. Coletti, R.R. Hopcroft, M.R. Lindeberg, S.J. Barbeaux, S.D. Batten, W.J. Burt, M.A. Bishop, J.L. Bodkin, R.E. Brenner, R.W. Campbell, D.A. Cushing, S.L. Danielson, M.W. Dorn, B. Drummond, D. Esler, T. Gelatt, D.H. Hanselman, S.A. Hatch, S. Haught, K. Holderied, K. Iken, D.B. Iron, A.B. Kettle, D.G. Kimmel, B. Konar, K.J. Kuletz, B.J. Laurel, J.M. Maniscalco, C. Matkin, C.A.E. McKinstry, D.H. Monson, J.R. Moran, D. Olsen, W.A. Palsson, W.S. Pegau, J.F. Piatt, L.A. Rogers, N.A. Rojek, A. Schaefer, I.B. Spies, J.M. Straley, S.L. Strom, K.L. Sweeney, M. Szymkowiak, B.P. Weitzman, E.M. Yasumiishi, and S.G. Zador. In press. Ecosystem response persists after a prolonged marine heatwave. Scientific Reports.

<u>Thesis/Dissertations</u>

Mendoza-Islas, H.M. 2020. Abundance, composition and distribution of predatory gelatinous zooplankton in the Northern Gulf of Alaska. MS Thesis University of Alaska Fairbanks.

Mazur, Clay M. 2020. Comparing the bioavailability of a natural and synthetic iron source: Do past experiments accurately model phytoplankton response to episodic iron addition. Western Washington University.

Kandell, A. 2020. Spatial and temporal variability of dissolved aluminum and manganese in surface waters of the northern Gulf of Alaska. MS. Thesis, University of Alaska Fairbanks.

2. Reports

Arimitsu, M., J. Piatt, R. Suryan, S. Batten, M.A. Bishop, R. Campbell, H. Coletti, D. Cushing, K. Gorman, S. Hatch, S. Haught, R. Hopcroft, K. Kuletz, C. Marsteller, C. McKinstry, D. McGowan, J. Moran, W.S. Pegau, A. Schaeffer, S. Schoen, J. Straley, and V. von Biela. 2020. Synchronous collapse of forage species disrupts trophic transfer during a prolonged marine heatwave. *In*: The Pacific Marine Heatwave: Monitoring During a Major Perturbation in the Gulf of Alaska. Long-Term Monitoring Program (Gulf Watch Alaska) Synthesis Report *Exxon Valdez* Oil Spill Trustee Council Program 19120114 (Eds: Suryan, R.M., M.R. Lindeberg, and D.R. Aderhold). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Hopcroft, R.R., S.L. Danielson, and K.O. Coyle. 2020. The Seward Line – Marine ecosystem monitoring in the northern Gulf of Alaska. FY19 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 19120114-L. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Suryan, R.M., M. Arimitsu, H. Coletti, R.R. Hopcroft, M.R. Lindeberg, S. Batten, M.A. Bishop, R. Brenner, R. Campbell, D. Cushing, S. Danielson, D. Esler, T. Gelatt, S. Hatch, S. Haught, K. Holderied, K. Iken, D. Irons, D. Kimmel, B. Konar, K. Kuletz, B. Laurel, J.M. Maniscalco, C. Matkin, C. McKinstry, D. Monson, J. Moran, D. Olsen, S. Pegau, J. Piatt, L. Rogers, A. Schaefer, J. Straley, K. Sweeney, M. Szymkowiak, B. Weitzman, J. Bodkin, and S. Zador. 2020. Chapter 4 Ecosystem response to a prolonged marine heatwave in the Gulf of Alaska. In M.R. Suryan, M.R. Lindeberg, and D.R. Aderhold, eds. The Pacific Marine Heatwave: Monitoring During a Major Perturbation in the Gulf of Alaska. Gulf Watch Alaska Long-Term Monitoring Program Draft Synthesis Report (*Exxon Valdez* Oil Spill Trustee Council Program 19120114). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

3. Popular articles

Bailey, A. 2020. Sikuliaq to embark on limited research cruise in May. UAF news and information. https://news.uaf.edu/sikuliaq-to-embark-on-limited-research-cruise-in-may/

Duncommbe, J. 2020. What it's like to social distance at sea. Eos Science News by AGU. https://eos.org/articles/what-its-like-to-social-distance-at-sea

Grimm, D. 2020. 'It will not be easy.' As labs begin to reopen, enormous challenges remain. Science News. https://www.sciencemag.org/news/2020/05/it-will-not-be-easy-labs-begin-reopen-enormous-challenges-remain

Long, K. 2020. At UAF, two major programs highlight the struggle. Fairbanks Daily News-Minor. http://www.newsminer.com/news/local_news/at-uaf-two-major-programs-highlight-the-struggle/article_2434858a-7c66-11ea-83be-2fd578cd2714.html

National Science Foundation. 2020. Ocean research in the time of COVID-19: Expedition to the Gulf of Alaska keeps vital research and data collection on course. NSF. https://beta.nsf.gov/science-matters/ocean-research-time-covid-19-expedition-gulf-alaska-keeps-vital-research-and-data

Pennisi, E. 2020. Pandemic carves gaps in long-term field projects. Science News. https://science.sciencemag.org/content/368/6488/220

B. Dates and Locations of any Conference or Workshop Presentations where EVOSTC-funded Work was Presented

1. Conferences and Workshops

Aguilar-Islas, A.M. 2020. The Northern Gulf of Alaska Long Term Ecological Research Site: Nutrient dynamics across the shelf from Kayak to Kodiak islands. University of South Florida. Invited talk. Tampa, FL.

Aguilar-Islas, A.M., M. Kaufman, and S. Strom, S. 2020. Nutrient dynamics and their influence in the Northern Gulf of Alaska. Ocean Sciences Meeting. San Diego, CA.

Arimitsu, M., J. Piatt, S. Hatch, R.M. Suryan, S. Batten, M.A. Bishop, R.W. Campbell, H. Coletti, D. Cushing, K. Gorman, S. Haught, R.R. Hopcroft, K.J. Kuletz, C. Marsteller, C. McKinstry, D. McGowan, J. Moran, W.S. Pegau, A. Schaefer, S. Schoen, J. Straley, and V.R. von Biela. 2020. Heatwave ‐ induced synchrony within forage fish portfolio disrupts energy flow to top pelagic predators. Alaska Marine Science Symposium, Anchorage, AK.

Brydie, A., and S.L. Danielson. 2020. Copper River discharges in the Northern Gulf of Alaska: freshwater distribution and evolution during the July 2019 freshet. Ocean Sciences Meeting. San Diego, CA.

Burt, W., R.R. Hopcroft, S.L. Strom, and S.L. Danielson. 2020. Quantifying phytoplankton biomass and productivity at unprecedented spatial scales in the Northern Gulf of Alaska

LTER Program using ship-board optical measurements. Alaska Marine Science Symposium. Anchorage, AK.

Burt, W., R.R. Hopcroft, S.L. Strom, and S.L. Danielson. 2020. Use of ship-board optical measurements to quantify plankton biomass and productivity across multiple trophic levels in the Northern Gulf of Alaska LTER program. Ocean Sciences Meeting. San Diego, CA.

Busse, H., S. Strom, and J. Fiechter. 2020. Grazing by mixotrophic nano- and dinoflagellates in the Northern Gulf of Alaska in response to gradients in light, inorganic nutrients, and prey availability. Ocean Sciences Meeting. San Diego, CA.

Coleman, D., and R.R. Hopcroft. 2020. Habitat utilization by diapausing copepods in the Northern Gulf of Alaska. Alaska Marine Science Symposium, Anchorage, AK.

Danielson, S.L. 2020. Freshwater in the Northern Gulf of Alaska: New model results and observations. NOAA Coastal Marine Modeling Branch seminar series, December 16.

Hernandez, A., and R.R. Hopcroft. 2020. The effects of environmental changes in the Northern Gulf of Alaska on the synthesis of lipid in *N.flemingeri* and *N.plumchrus* from 2018 to 2019. Ocean Sciences Meeting. San Diego, CA.

Kandel, A., and A.M. Aguilar-Islas. 2020. Temporal variability of dissolved aluminum and manganese in the Northern Gulf of Alaska. Ocean Sciences Meeting. San Diego, CA.

Mayer, K., C. Clarke-Hopcroft, and R.R. Hopcroft, R.R. 2020. Spatial and temporal patterns of zooplankton species in the Gulf of Alaska as revealed by image analysis. Ocean Sciences Meeting. San Diego, CA.

Lalande, C., S.L. Danielson, A. McDonnell, R.R. Hopcroft, and J. Grebmeier. 2020. Time - series measurements of export fluxes across the Bering Strait. Alaska Marine Science Symposium, Anchorage, AK.

Lindeberg, M., R. Suryan, D. Aderhold, K. Hoffman, R.R. Hopcroft, H. Coletti, and M. Arimitsu. 2020. Gulf Watch Alaska: Building partnerships to understand ecosystem change. Alaska Marine Science Symposium, Anchorage, AK.

Lowin, B., S.L. Strom, and W. Burt. 2020. Phytoplankton dynamics across hydrographic fronts and mesoscale features: Preliminary results from the new NGA-LTER Ocean Optics Program. Alaska Marine Science Symposium, Anchorage, AK.

Mazur, C., S. Strom, and A. Aguilar-Islas. 2020. Comparing the bioavailability of a natural and synthetic iron source: Do past experiments adequately model diatom growth in response to episodic iron addition. Ocean Sciences Meeting. San Diego, CA.

Mendoza-Islas, H.M., and R.R. Hopcroft. 2020. Abundance and distributions of gelatinous zooplankton in the Northern Gulf of Alaska. Ocean Sciences Meeting. San Diego, CA.

Monell, K., V. Roncalli, P.H. Lenz, and R.R. Hopcroft. 2020. Characterization of cell division during early oogenesis in copepod females emerging from diapause. Ocean Sciences Meeting. San Diego, CA.

Reister, I., and S.L. Danielson. 2020. Freshwater in the Northern Gulf of Alaska marine environment. Alaska Marine Science Symposium, Anchorage, AK.

Roncalli, V., M.C. Cieslak, A. Castelfranco, R.R. Hopcroft, D. Hartline, and P.H. Lenz. 2020 From suspended animation to fully active: Post-diapause transcriptomic restart in a high latitude zooplankter. Alaska Marine Science Symposium, Anchorage, AK.

Roncalli, V., M.C. Cieslak, P.H. Lenz, and R.R. Hopcroft. 2020. Energy allocation in a diapausing copepod: a transcriptomics analysis. Ocean Sciences Meeting. San Diego, CA.

Stidham, E., and R.R. Hopcroft. 2020. Seasonal abundance and biomass of pelagic tunicates and snails in the Gulf of Alaska and Prince William Sound. Alaska Marine Science Symposium, Anchorage, AK.

2. Public presentations

No new contributions for this reporting period.

C. Data and/or Information Products Developed During the Reporting Period, if Applicable

No new contributions for this reporting period. We continue to update annual ecosystem indicators for the NOAA Ecosystem Status Report (Ferriss and Zador 2020) as stated in section 8.C.

D. Data Sets and Associated Metadata that have been Uploaded to the Program's Data Portal

The Seward Line project submits data on physics (CTD data), chemistry (chlorophyll and nutrients), phytoplankton and zooplankton, and seabirds (through USFWS). To the best of our ability during COVID-19, all possible datasets are on the Research Workspace and available on the Gulf of Alaska Data Portal now or by the end of April, except for microscopic analyses (phytoplankton, microzooplankton and meso/macrozooplankton) data which require additional time for identification. Provisions for slightly later data delivery has been approved to align with LTER data delivery timetables for dataset from all sampling lines (https://portal.aoos.org/gulf-of-alaska#metadata/e25fe1f2-1c98-44f6-856f-5d61c87c0384/project).

Aguilar-Islas, A. 2020. Dissolved Aluminum and Manganese concentrations from sampling at select stations on seasonal cruises for the Northern Gulf of Alaska LTER site, 2018-2019. Dataset under review

Aguilar-Islas, A. 2020. Dissolved Inorganic Nutrient Data from seasonal cruises for the Northern Gulf of Alaska LTER site, 2018. Dataset under review.

Aguilar-Islas, A. 2020. Surface Dissolved Iron from seasonal cruises for the Northern Gulf of Alaska LTER site, 2018. Dataset under review

Danielson, S. 2020. Hydrographic, optical, and meteorological parameters measured by R/V Sikuliaq's underway systems during the Northern Gulf of Alaska LTER cruises, 2018 and 2019. https://doi.org/10.24431/rw1k45a .

Danielson, S. 2020. Temperature and salinity time series measurements from the GAK1 Mooring in the Northern Gulf of Alaska near Seward, AK. https://doi.org/10.24431/rw1k44x .

Danielson, S., and E. Dobbins. 2020. Water columns properties measured by CTD sensors during seasonal cruises in the Gulf of Alaska for the Northern Gulf of Alaska LTER project, 2018 and 2019. https://doi.org/10.24431/rw1k459.

Danielson, S., and E. Dobbins. 2020. Ocean currents measured by R/V Sikuliaq's Shipboard Acoustic Doppler Current Profiler (SADCP) during the Northern Gulf of Alaska LTER Spring 2018 cruise. https://doi.org/10.24431/rw1k43u.

Danielson, S., and H. Statscewich. 2020. Water temperature, salinity, and optical properties from an Acrobat towed vehicle during cruises for the Northern Gulf of Alaska LTER site, 2018 and 2019. https://doi.org/10.24431/rw1k471.

Hauri, C. 2020. Gulf of Alaska ROMS-COBALT Hindcast Simulation 1980 - 2013. https://doi.org/10.24431/rw1k43t.

Hauri, C., and B. Irving. 2020. Inorganic Carbon data from water samples collected during CTD casts at stations during the Northern Gulf of Alaska LTER seasonal cruises, 2018. https://doi.org/10.24431/rw1k45g.

Hopcroft, R., and C. Clarke-Hopcroft. 2020. Gelatinous zooplankton abundance and biomass observations from research cruises for the Northern Gulf of Alaska (NGA) LTER site, 2018. Dataset under review

Hopcroft, R., and C. Clarke-Hopcroft. 2020. Zooplankton abundance and biomass observations obtained from a 0.5 mm MultiNet, as analyzed by traditional microscopy, during research cruises in the Northern Gulf of Alaska (NGA) LTER Program, 2018. Dataset under review.

Hopcroft, R., and C. Clarke-Hopcroft. 2020. Zooplankton abundance observations collected from 150 um Quad-Nets, as analyzed by Zooscan, from research cruises in the Northern Gulf of Alaska (NGA) LTER Program, 2018. Dataset under review.

Hopcroft, R., and C. Clarke-Hopcroft. (2020). Zooplankton abundance observations collected from 505 um Bongo Net, as analyzed by Zooscan, from research cruises in the Northern Gulf of Alaska (NGA) LTER Program, 2018. Dataset under review.

Hopcroft, R., S. Danielson, and E. Dobbins. 2020. Temperature and Salinity measured by a flow-through thermosalinograph (TSG) during research cruises aboard the R/V Tiglax and R/V Wolstad for the Northern Gulf of Alaska (NGA) LTER site, 2018 and 2019. https://doi.org/10.24431/rw1k45o.

Hopcroft, R., C. Smoot, and C. Clarke-Hopcroft. 2020. Zooplankton abundance and biomass observations obtained from 150 um Quad-Nets, as analyzed by traditional microscopy, during research cruises in the Northern Gulf of Alaska (NGA) LTER Program, 2018. Dataset under review.

Kuletz, K., D. Cushing, and E. Labunski. 2020. Marine bird survey observation and density data from Northern Gulf of Alaska LTER cruises, 2018. https://doi.org/10.24431_rw1k45w.

McDonnell, A., B. Irving, J. Pretty, and S. O'Daly. 2020. Particle abundance and volume size distributions from an Underwater Vision Profiler 5 aboard seasonal cruises for the Northern Gulf of Alaska LTER site 2018. https://doi.org/10.24431/rw1k45h.

McDonnell, A. (2020). Zooplankton abundance and volume size distributions from an Underwater Vision Profiler 5 aboard seasonal cruises for the Northern Gulf of Alaska LTER site 2018. Dataset under review.

Strom, S. 2020. Primary production estimates from research cruises for the Northern Gulf of Alaska LTER site, 2018. https://doi.org/10.24431/rw1k45b.

Strom, S., and K. Fredrickson. 2020. Dissolved organic carbon concentrations from NGA-LTER research cruises in the Gulf of Alaska, 2018-present. https://doi.org/10.24431/rw1k45c.

Strom, S., and K. Fredrickson. 2020. Chlorophyll-a concentrations from research cruises for the Northern Gulf of Alaska (NGA) LTER site, 2018. https://doi.org/10.24431/rw1k45f.

Strom, S., and K. Fredrickson. (2020). HPLC-derived pigment data from research cruises for the Northern Gulf of Alaska LTER site, 2018. Dataset under review.

Strom, S. 2020. Microzooplankton abundance and biomass from research cruises for the Northern Gulf of Alaska (NGA) LTER site, 2018. https://doi.org/10.24431/rw1k45e.

Strom, S., and K. Fredrickson. 2020. Particulate carbon concentrations from research cruises for the Northern Gulf of Alaska (NGA) LTER site, 2018-present. https://doi.org/10.24431/rw1k45d.

10. Response to EVOSTC Review, Recommendations and Comments:

Science Panel Comment (FY20): The SP appreciates the PIs creativity to get the surveys done under Covid restrictions. The SP also wishes to thank Dr. Coyle for his contributions to this project over the years and wishes him well in his retirement.

PI Response (FY20): Thank you. Our overall success did not come without a great deal of effort to make it happen, this includes the transition from having Ken Coyle as the night shift lead. We expect him to continue in a minor role as we transition curation of his databases. Although we had a transitory hiatus on some laboratory work we expect to fully use our allocated 2020 funds to support laboratory analysis of the samples collected. At present, we anticipate some return to normality in our operations FY21, with spring and summer cruises on *Sikuliaq* and a return to *Tiglax* during the fall.

Science Panel Comment (FY19): The Science Panel is pleased regarding the publications resulting from this project. In the FY19 work plan, we asked how the Long-Term Ecological Research (LTER) program is integrated with the GAK1, Seward line and nearshore monitoring, specifically activities and monitoring. We would like more clarification and details on what parts of this project are being funded by the LTER vs. EVOSTC.

PI Response (FY19): We agree it can be confusing to track who is contributing to the various parts of the oceanographic surveys being conducted in the northern Gulf of Alaska. EVOSTC funds the Seward Line transect in addition to transects in PWS during spring and fall cruises. The NSF funds the Northern Gulf of Alaska LTER program, which leverages EVOSTC spring and fall funding for the Seward Line and directly funds three additional transects upstream and downstream of the Seward Line, thereby greatly expanding the spatial coverage of oceanographic sampling (and seabird/marine mammal surveys - see 20120114-M). NSF LTER also fully funds the summer survey of all four sampling lines plus PWS (see updated Table 2).

The Seward line program has always been based on consortium funding (even during the joint NSF and NOAA GLOBEC years) and the LTER addition adds to the significant foundation that Gulf Watch Alaska (with EVOSTC/North Pacific Research Board /Alaska Ocean Observing System) have built. The sum of the parts is much greater than what one would be able to accomplish if GWA and LTER were run by two different groups on two different sets of cruises. For example, GWA and LTER both benefit greatly from shared vessel time (e.g., mobilization, demobilization, and transits). EVOSTC also benefits from LTER with the addition of ship time in PWS during summer ($50K/day). LTER brings a lot of funding for students so that data collected under GWA will find even more applications than would have been possible without the LTER expansion.

Table 1. Funding sources for Gulf of Alaska survey transects by spring, summer, and fall seasons.

	EVOSTC	NSF LTER	NPRB	AOOS
Spring Surveys				
Seward Line & PWS	X		X	
Cape Suckling, Copper River/Middleton Island, and Kodiak Island/Albatross Bank Lines		X		
Summer Surveys				
Seward Line & PWS		X		
Cape Suckling, Copper River/Middleton Island, and Kodiak Island/Albatross Bank Lines		X		
Fall Surveys				
Seward Line & PWS	X		X	
Cape Suckling, Copper River/Middleton Island, and Kodiak Island/Albatross Bank Lines		X		
Ship time		X	X	X
Nutrient & chlorophyll analysis	X	X	X	
Phytoplankton and Microzooplankton processing		X	X	
Zooplankton processing	X	X	X	

	EVOSTC	NSF LTER	NPRB	AOOS
Seabird & Marine Mammal Observer	X	X	X	
Logistics (travel, shipping, dock fees, etc.)	X	X	X	

11. Budget:

Please see provided program workbook. Cumulative spending is on target for end of FY21.

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
PROGRAM 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	$83.2	$85.2	$87.2	$89.3	$91.4	$436.3	$349.8
Travel	$3.9	$4.0	$4.1	$4.3	$4.4	$20.7	$10.3
Contractual	$8.0	$8.3	$8.6	$8.8	$9.0	$42.6	$30.1
Commodities	$2.3	$2.4	$2.5	$2.7	$2.8	$12.7	$14.8
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Indirect Costs (*25% of non-equip.*)	$24.4	$25.0	$25.6	$26.2	$26.9	$128.1	$99.8
SUBTOTAL	$121.8	$124.9	$128.0	$131.2	$134.5	$640.3	$504.8
General Administration (9% of subtotal)	$11.0	$11.2	$11.5	$11.8	$12.1	$57.6	N/A
PROJECT TOTAL	$132.7	$136.1	$139.5	$143.0	$146.6	$697.9	
Other Resources (Cost Share Funds)	$1,424.0	$1,438.0	$1,411.8	$1,466.0	$1,450.5	$7,190.3	

LITERATURE CITED

Ferriss, B., and Zador (editors). 2020. Gulf of Alaska Ecosystem Status Report for 2020. NOAA Alaska Fisheries Science Center annual report to the North Pacific Fishery Management Council. https://apps-afsc.fisheries.noaa.gov/REFM/docs/2020/GOAecosys.pdf.