ATTACHMENT B. Annual Project Report Form (Revised 11.21.19)

1. Project Number:

19120114-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

Kenneth O. Coyle, University of Alaska Fairbanks

4. Time Period Covered by the Report:

February 1, 2018-January 31, 2019

5. Date of Report:

March 2020

6. Project Website (if applicable):

www.gulfwatchalaska.org

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

7. Summary of Work Performed:

In 2019, the Seward Line program continued its expanded spatial extent, with the additional mid-summer cruise added by the National Science Foundation's (NSF's) Long-term Ecological Research (LTER) support. Both the spring and fall cruises executed from the *R/V Tiglax* had poor weather that resulted in lost stations. All shelf stations were completed during summer from the *R/V Sikuliaq* but work during summer within Prince William Sound (PWS) was reduced to only our intensive work at the PWS2 station due to time constraints. For reporting efficiency not all data from the additional transects lines will be reported here; however, all the data will be available publicly and to Gulf Watch Alaska (GWA) scientists through the workspace. Further details appear within the cruise reports posted at https://nga.lternet.edu/about-us/documents/.

In overview, 2019 saw a return to warm sea surface temperature, a reduced/delayed spring bloom and an increase in contributions by warm-water zooplankton species, although many resident zooplankton species also appeared to increase.

During May surface temperatures were roughly between 6.5-7.0°C, with temperatures averaged across the upper 100 m of the Seward Line 0.6°C above the 22-year mean. Despite warm temperature nitrate concentration in surface was still high and chlorophyll was low, suggesting the spring bloom had not yet occurred (Fig. 1).

By July, surface temperatures had warmed to 14-15°C (and even warmer to the east), and the Alaska Coastal Current has begun to intensify by spreading across the shelf to at least the shallow ridge at GAK6. Based on 2017, Gulf of Alaska Integrated Ecosystem Research Project (GOA-IERP) and Global Ocean Ecosystem Dynamics (GLOBEC) summer observations, these surface temperatures were highly anomalous. By summer we could see the absence of nitrate in surface waters. A pronounced subsurface chlorophyll maximum typical of summer, bit unusual in its magnitude, had developed across the line (Fig. 2).

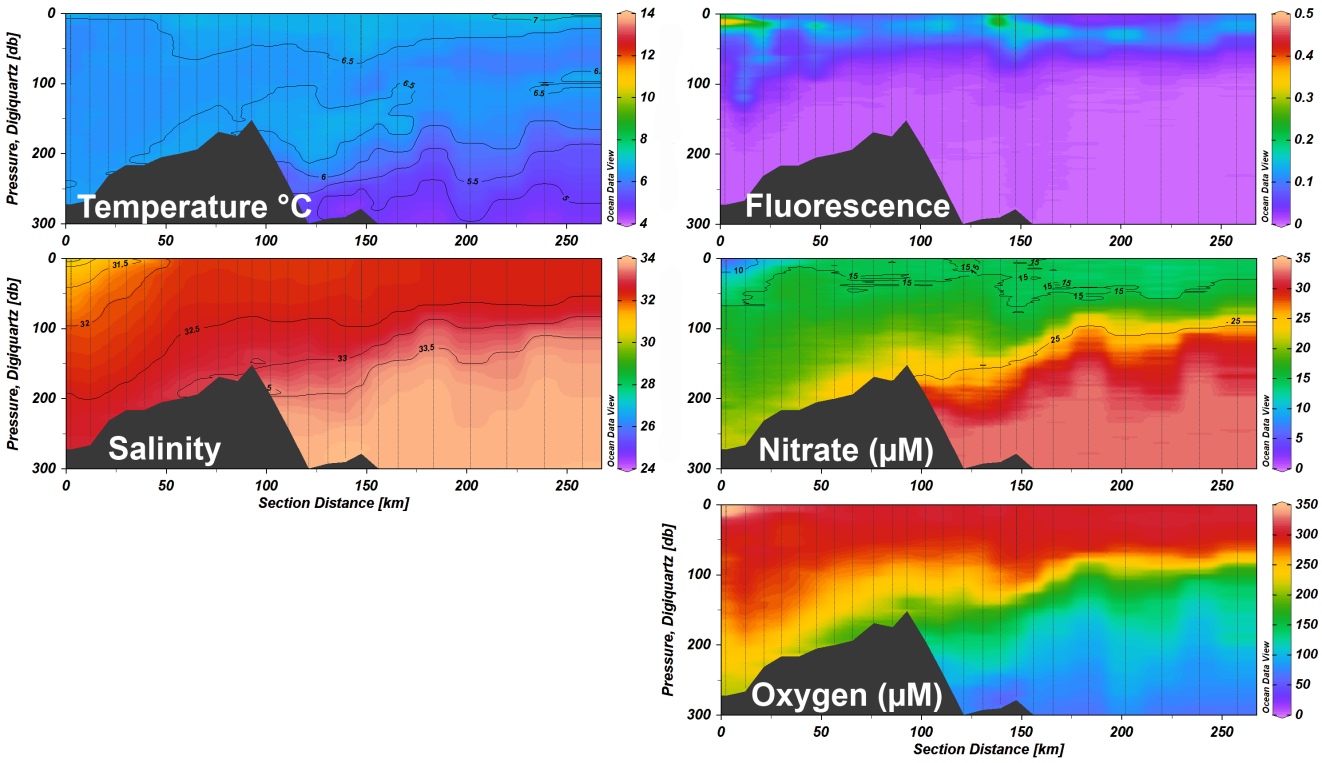

Figure 1. Hydrographic sections over upper 300 m of the Seward Line transect, May 2019.

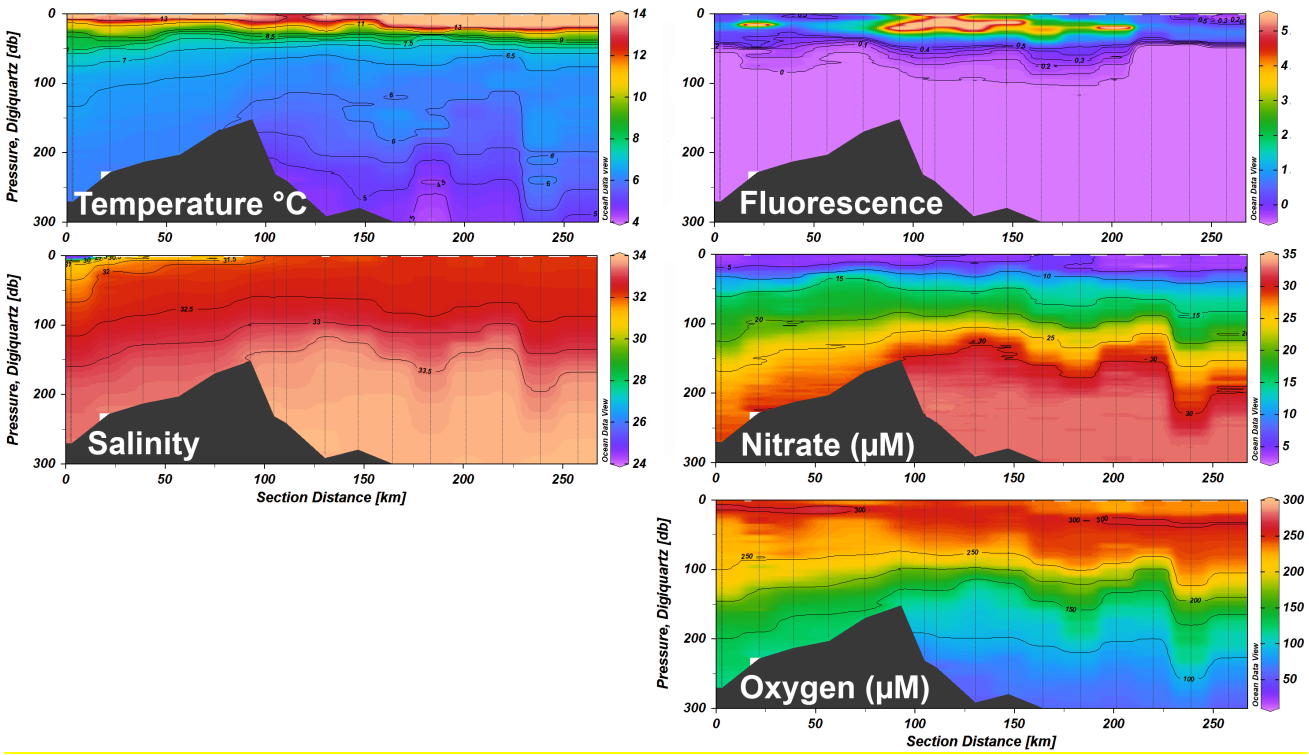

Figure 2. Hydrographic sections over upper 300 m of the Seward Line transect, July 2019.

Although cooling has typically begun by September, during 2019 temperatures remained warm (12-13°C). Despite these warm surface temperatures, and strong stratification, temperatures averaged across the upper 100 m were slightly below normal over the shelf (particularly in the Alaska Coastal Current) but distinctly above average off the shelf (by 1.9°C at GAK13), resulting in overall means across the line's upper 100m of only 0.2°C above the 23-year mean. The Alaska Coastal Current remained apparent out to the mid-shelf. Nutrients remained depleted in the surface layer and a narrow and minor subsurface chlorophyll maximum was apparent across most of the line (Fig. 3).

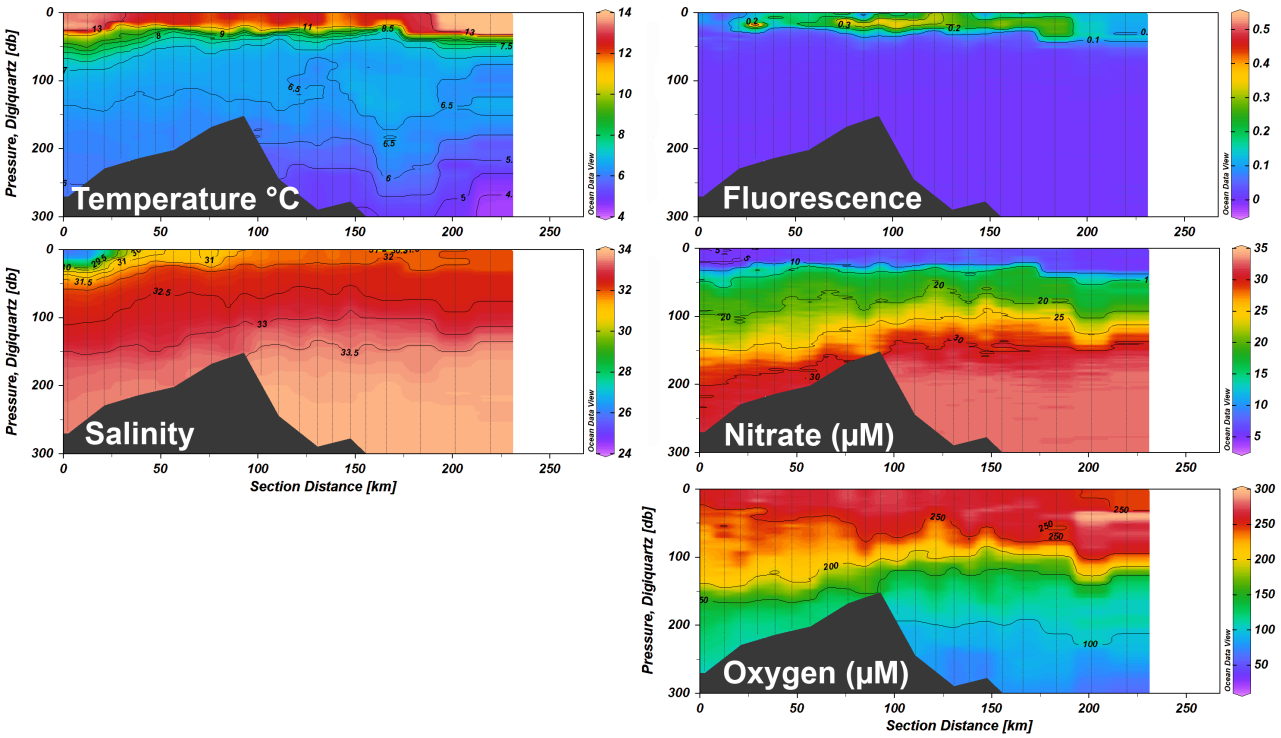

Figure 3. Hydrographic sections over upper 300 m of the Seward Line transect, September 2019.

Spring 2019 integrated (0-75 m) chlorophyll-a concentrations were generally low except on the inner Seward (GAK) line where large cells dominated, in association with the Alaska Coastal Current (Fig. 4). For context, spring bloom integrated chlorophyll-a can approach or exceed 400 mg m^{-2}. Elsewhere most cells (>80%) were in the small size fraction, a somewhat unusual spring scenario that appears to be associated with anomalously warm temperatures. In contrast higher values, dominated by large cells, were found in PWS and along the Kodiak Line.

July 2019 integrated (0-75 m) chlorophyll-a was low at most stations except on the inner Seward Line where large cells dominated. The high chlorophyll fluorescence suggested by the *in situ* conductivity and temperature at depth (CTD) fluorometer was not reflected in bottle-based extractions of chlorophyll-a.

September 2019 found low integrated (0-75 m) chlorophyll-a at nearly all stations, although again values increased on the inner Seward Line in association with large-cells, and in Montague Strait in PWS. Due to weather the outer Kodiak line was not sampled.

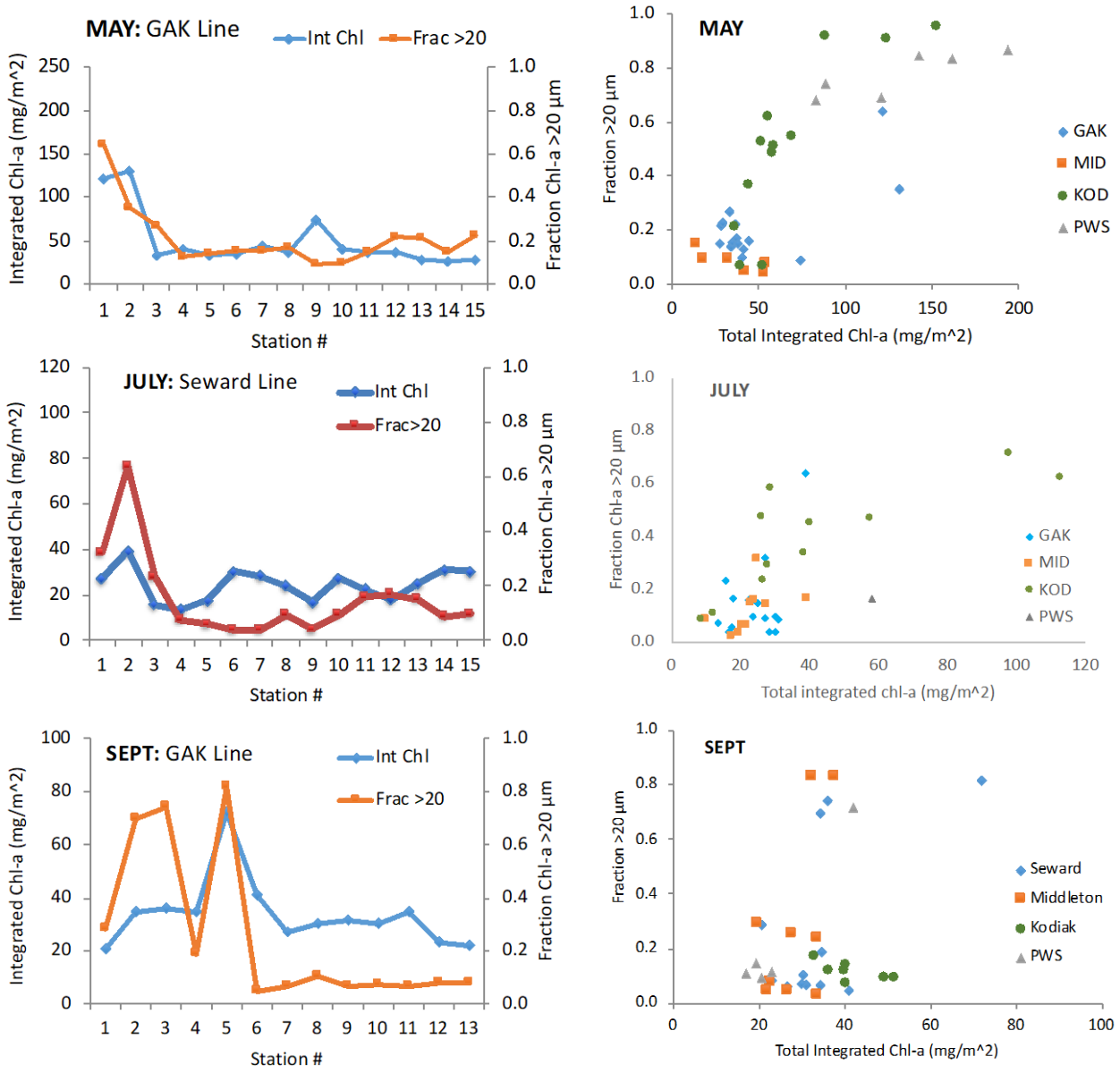

Figure 4. Chlorophyll-a concentrations (integrated Chl-a [mg m^{-2}] and fraction >20 µm) for May, July and September 2019 for Along the Seward Line. Data from other sampling lines included for reference on right hand panels.

Biomass of microzooplankton (cells ≥15 µm in largest dimension) along the Seward Line was generally higher in May and September than in July (Fig. 5, note y-axis scale differences). In May, large chloroplast-retaining ciliates were noted at most stations. Specialist diatom consumers were abundant at GAK-5 in September. Overall, the 2019 microzooplankton community was quite ciliate-rich (Fig. 5, right panels), a community structure associated with anomalously warm conditions and phytoplankton communities dominated by small cells. Compared to 2018, biomass was comparable during spring, then lower during summer and fall.

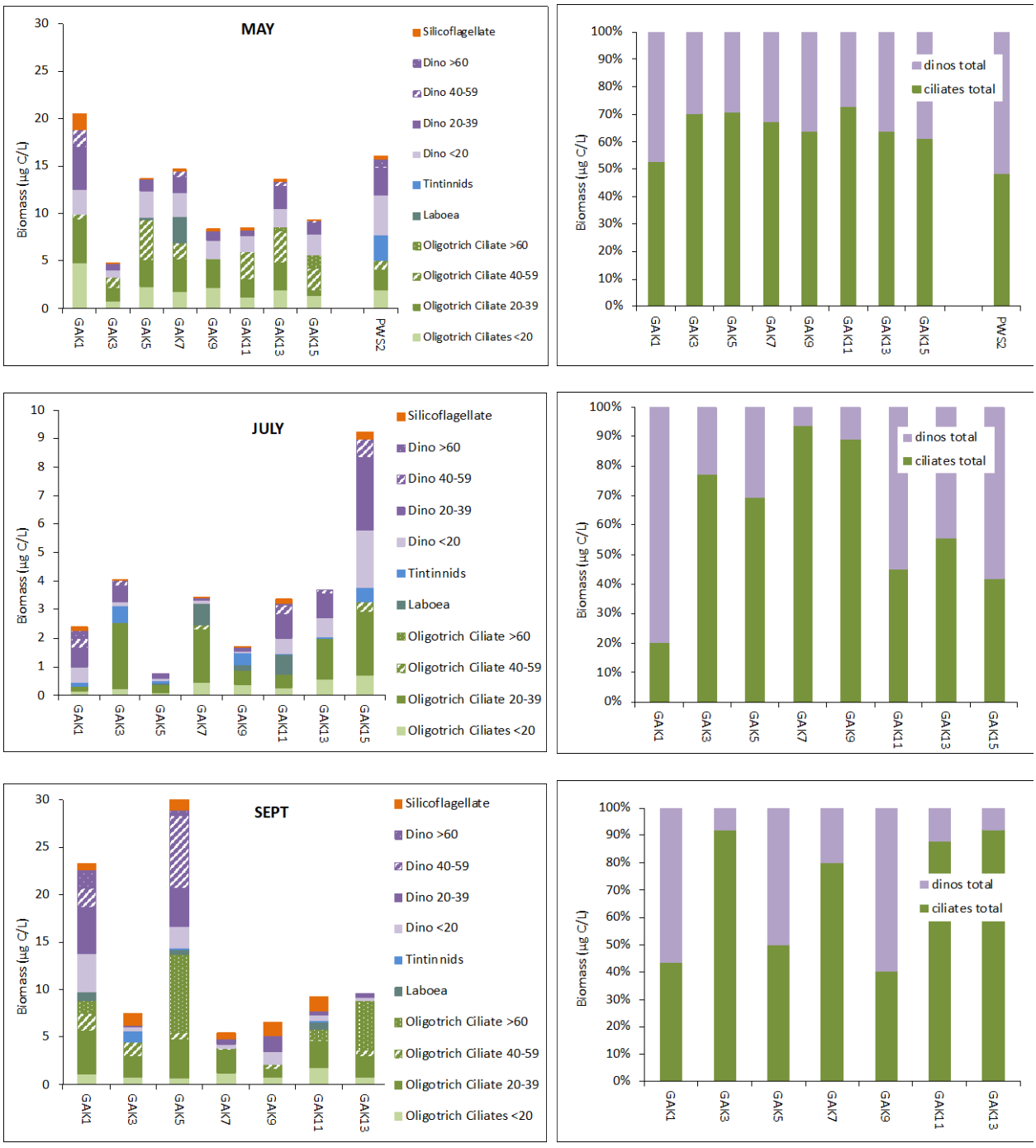

Figure 5. Microzooplankton biomass along the Seward Line in May, July and September 2019. Note that Y-axis scales differ.

Sample analysis for 2019 continues and is suggesting a shift from a dominance by *Neocalanus plumchrus*, to co-dominance with *N. flemingeri* during May, with their combined numbers of this keystone lipid-rich species above normal (Fig. 6). Re-analysis of subsets of older samples hope to better understand changing dominance between these species. *Neocalanus cristatus* may also be having a better than average year.

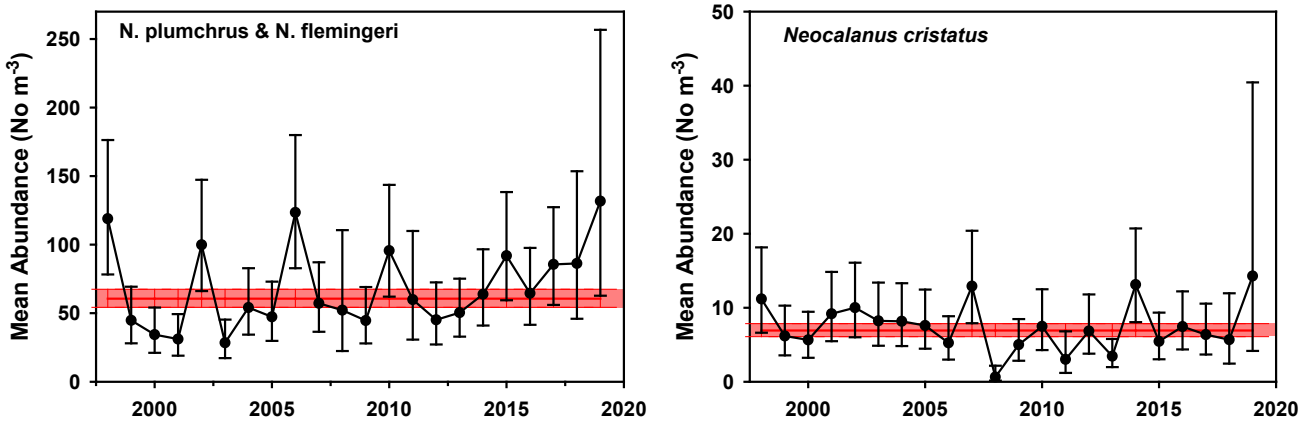

Figure 6. Mean abundance of copepod species Neocalanus flemingeri plus N. plumchrus (left) and N. cristatus (right) from 1998 to 2019 on the Seward Line.

There was a return to high numbers of southern copepods during 2019, particularly for the September cruise, but also as low numbers during May, consistent with warm surface temperatures observed throughout the Gulf. (Fig. 7). Observations of low numbers of other California Current species occurred during 2019.

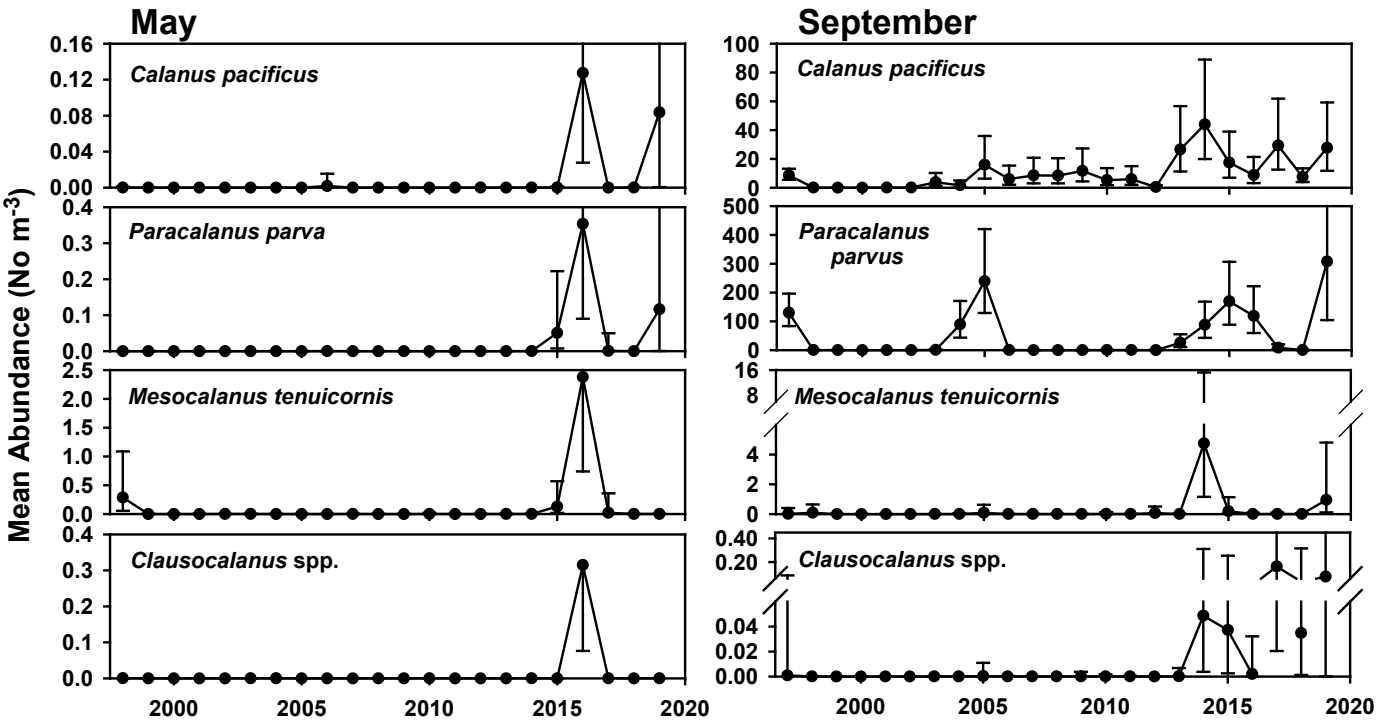

Figure 7. Mean abundance of southern copepod species recorded during May (left) and September (right) on the Seward Line from 1998 through fall of 2019.

During 2019, we continued use of the Methot net to target macro-jellies during summer and fall cruises within the near surface layer. Results continue to show that biomass of these larger predators (Fig. 8) is much higher than expected. Failure to sample the offshore ends of both the Seward and Kodiak Lines during September made it impossible to confirm 2018's observation that larger jellies appeared to accumulate offshore during fall.

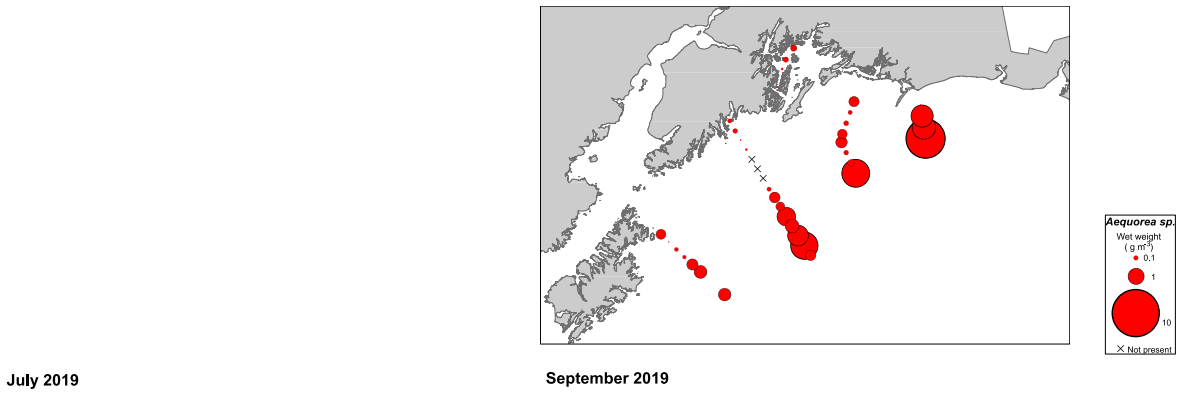

*Figure 8. Macro jellies (*Aequorea *sp.) collected by using a large Methot net during Seward Line and LTER sampling during July and September 2018.*

Seabirds and Marine Mammals

Dr. Kathy Kuletz and Elizabeth Labunski, U.S. Fish and Wildlife Service (USFWS), and Dan Cushing, Pole Star Ecological Research LLC, conducted visual surveys for seabirds and marine mammals during three 2019 northern Gulf of Alaska Seward Line / LTER cruises, following standard USFWS survey protocol. To maximize coverage, we conducted additional surveys during acoustic mooring deployments (Scripps Institute of Oceanography) in the days immediately before the spring and after the fall cruises. Across the three seasonal surveys we conducted a total of 5,043 linear km of transects (Fig. 9). Averaged across all survey transects, the mean density (all bird species combined) was 10.3 birds km^{-2}, with higher average density in fall than in spring and summer (Table 1).

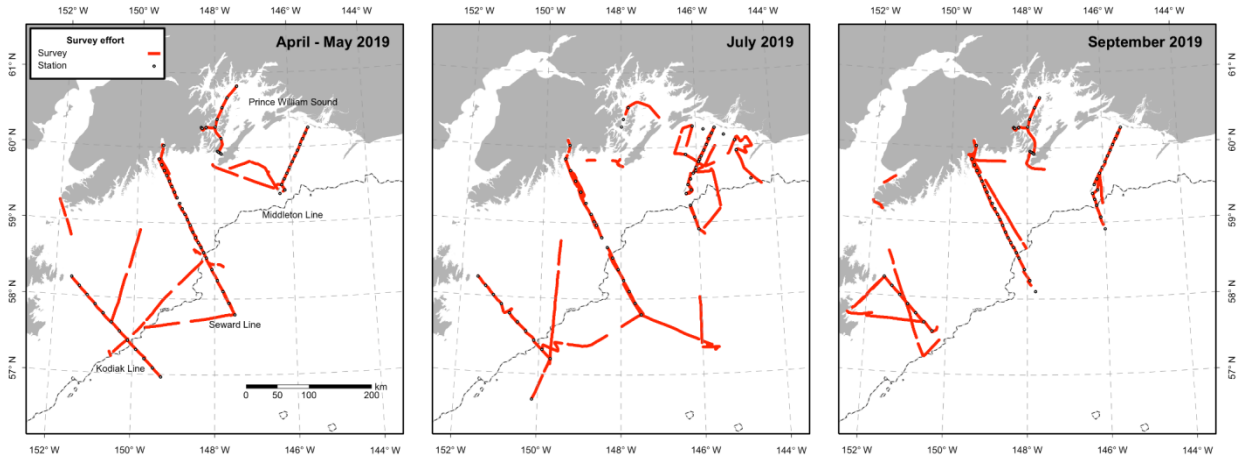

Figure 9. Transects sampled for marine birds and mammals during Seward Line / long-term ecological research *sampling in April-May, July, and September 2019.*

Including both on- and off-transect observations, avian species richness was highest during fall, and similar during spring and summer. Terrestrial and aquatic bird species were observed migrating over the ocean during all seasons, but especially during spring. Omitting non-marine birds and including only seabirds, sea ducks, and phalaropes, (both on- and off-transect) we observed 39 species in spring, 37 in summer, and 44 during fall. Of the six Seward Line / LTER cruises conducted in 2018 and 2019, the highest number of seabird species was observed during fall 2019.

Abundance of total seabirds (all species combined) was higher during the April-May 2019 cruise than during April-May 2018, with much of the increase due to greater numbers of short-tailed shearwaters in 2019 (Fig. 10). Short-tailed (and sooty) shearwaters breed in the southern hemisphere and migrate to the North Pacific in April-May after completing their breeding season during the austral summer.

During the spring 2019 cruise, short-tailed shearwaters were abundant near Albatross Bank, east of Kodiak Island. During 2018, this area was sampled at the beginning of the cruise (April 18-21), while in 2019, it was sampled at the end (May 6-8). We have previously noted increased numbers of short-tailed shearwaters beginning in early May, and it is possible that spatial differences in sampling in relation to seasonal timing could account for this difference between years.

Table 1. Summary of survey effort and observations during 2019 Seward Line / LTER cruises.

Cruise	Km surveyed	Mean birds km^{-2}	No. bird species (on-transect / off-transect)	No. mammal species (on-transect + off-transect)
April-May	1,422	8.5	39 / 10	9
July	2,168	8.5	32 / 16	9
September	1,453	15.0	38 / 14	9

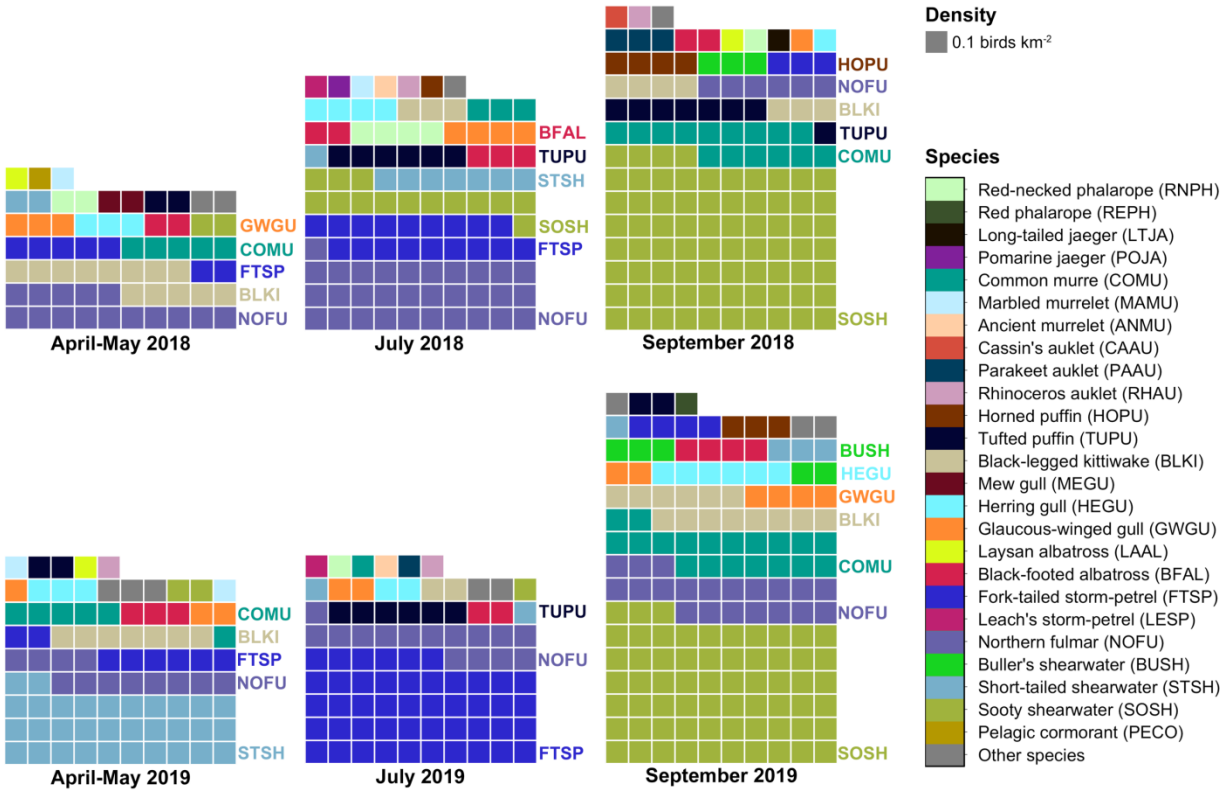

Figure 10. Seabird species composition and abundance during 2018 and 2019 Seward Line / long-term ecological research cruises.

In contrast to the Kodiak Line, the Seward Line was sampled on nearly identical dates in spring of 2018 and 2019. In the vicinity of the Seward Line, abundance of total seabirds during spring 2019 was the lowest of any year since 2007 (Fig. 11), with low density values for several species including common murre, fork-tailed storm-petrel, tufted puffin, glaucous-winged gull, and the two shearwaters.

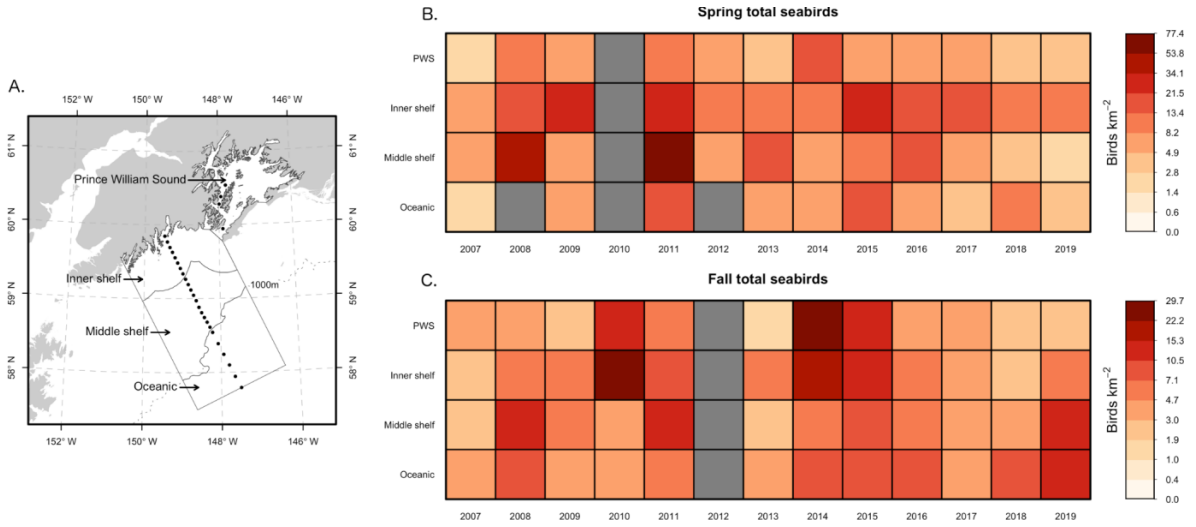

Figure 11. Seabird abundance in four geographic strata during 2007-2019 spring and fall Seward Line cruises. Grey colored cells indicate no survey effort.

While we observed flocks of short-tailed shearwaters over Albatross Bank in May 2019, during the July 2019 cruise we encountered few shearwaters. This contrasts with the large flocks of short-tailed shearwaters foraging with numerous humpback whales over Albatross Bank during July 2018. Sooty shearwater numbers were also much lower than the previous summer. The two shearwater species made up 3% of total birds in July 2019, while they comprised 24% in July 2018.

Fork-tailed storm-petrels were especially abundant during July 2019 (Fig. 10). Dense aggregations of storm-petrels occurred near the shelf-break; thousands of storm-petrels foraged along with fulmars and albatrosses at the mouth of Stevenson Trough, which lies north of the Kodiak Line between Albatross Bank and Portlock Bank, and numerous storm-petrels also occurred along the Seward Line, offshore of Amatuli Trough. In total, however, total seabird numbers were 17% lower in July 2019 than in 2018. Of the three 2019 cruises, abundance of seabirds was highest during September. This was also the case in 2018 (Fig. 10). In both fall cruises, large flocks of sooty shearwaters and common murres, along with numerous northern fulmars and baleen whales, were observed foraging over Albatross Bank. Total abundance was 15% higher in September 2019 than September 2018 (Fig. 12). There were more fulmars observed during fall 2019 than in 2018, and higher numbers of black-footed albatross, and several gull species. Buller's shearwater (a fall seasonal migrant from Pacific temperate and tropical waters) were more abundant over the inner shelf region than during any previous September cruises. Near the Seward Line, abundance of seabirds was relatively high during fall 2019 compared to 2007-2018, especially in the middle shelf and oceanic regions.

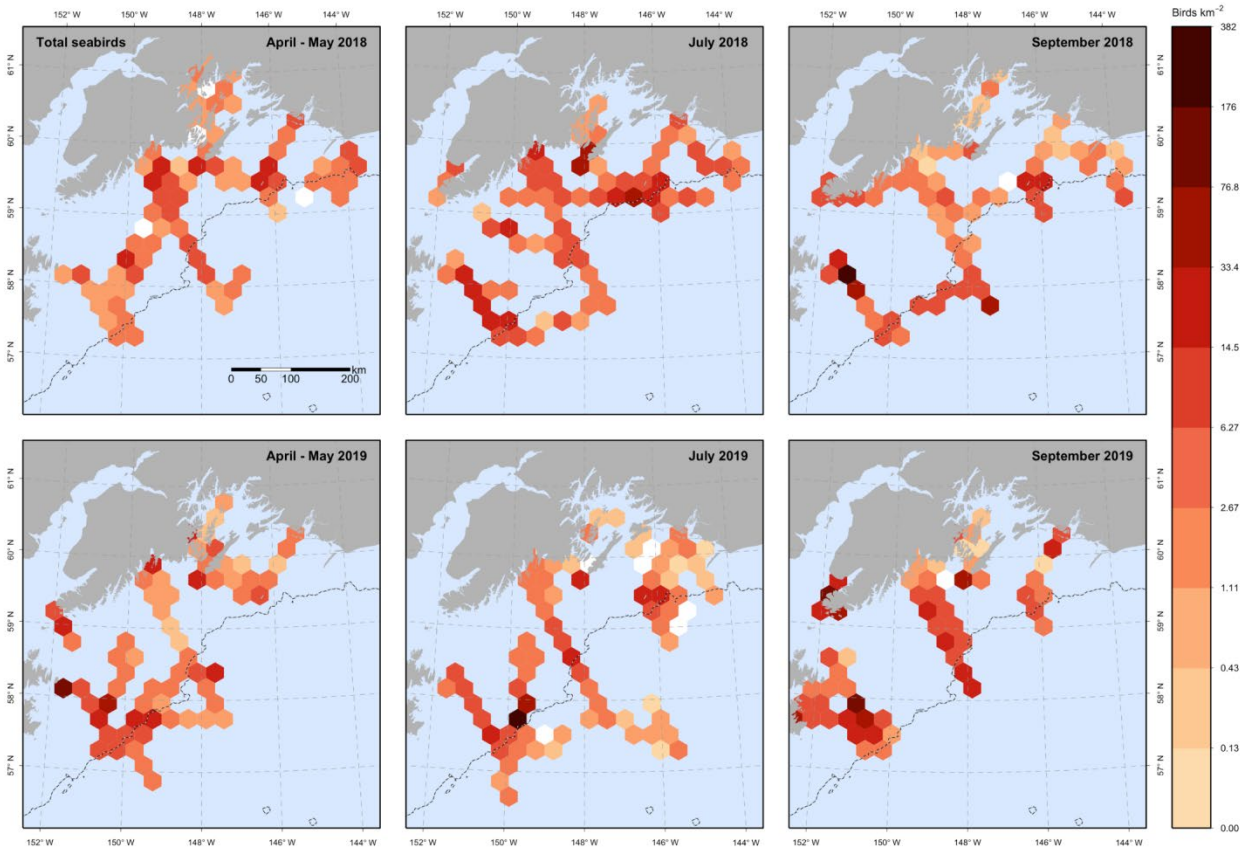

Figure 12. Seabird distribution and abundance during 2018 and 2019 Seward Line / LTER cruises.

The six 2018-19 Seward Line / LTER cruises allowed us to observe seasonal progression of spatial hot spots of bird abundance over two years (Fig. 12). In all cruises, spatially localized hot spots occurred near Middleton Island and at Cape Cleare. There were locations along the shelf-break with high seabird abundance during all six cruises, and birds were especially concentrated along the shelf-break during July 2019. Thousands of foraging birds and groups of whales occurred over Albatross Bank during September of both years, with birds also concentrated in this area in July 2018 and May 2019. Moderate numbers of birds occurred over the bank in July 2019, and low numbers were seen in April 2018. Birds were also concentrated in Lower Cook Inlet, especially during the fall.

Seabird abundance in the Alaska Coastal Current-influenced coastal area from Kayak Island to the Kenai Peninsula was variable within and among years. During 2018, numbers of birds near the coast increased from spring to summer, especially near locations of breeding colonies, such as at Resurrection Bay and the Copper River Delta, and then decreased during fall, as birds apparently dispersed from breeding sites. During spring 2019, birds concentrated near coastal colonies. However, abundance along the coastal region was much lower in July 2019 than in 2018. While low numbers of birds occurred in the Copper River plume during July 2019, during September flocks of murres occurred in this area, closely associated with fronts.

Several locations stand out as locations of relatively high seabird species richness across multiple cruises (Fig. 13). These include Albatross Bank, especially during fall, and the vicinity of Middleton Island, except during Spring 2019 (though the Middleton line was incomplete during this cruise). In addition, seabird species richness at the inner stations of the Seward Line, was high during summer and fall. There were more pronounced hot spots of seabird species richness during summer and fall than during spring.

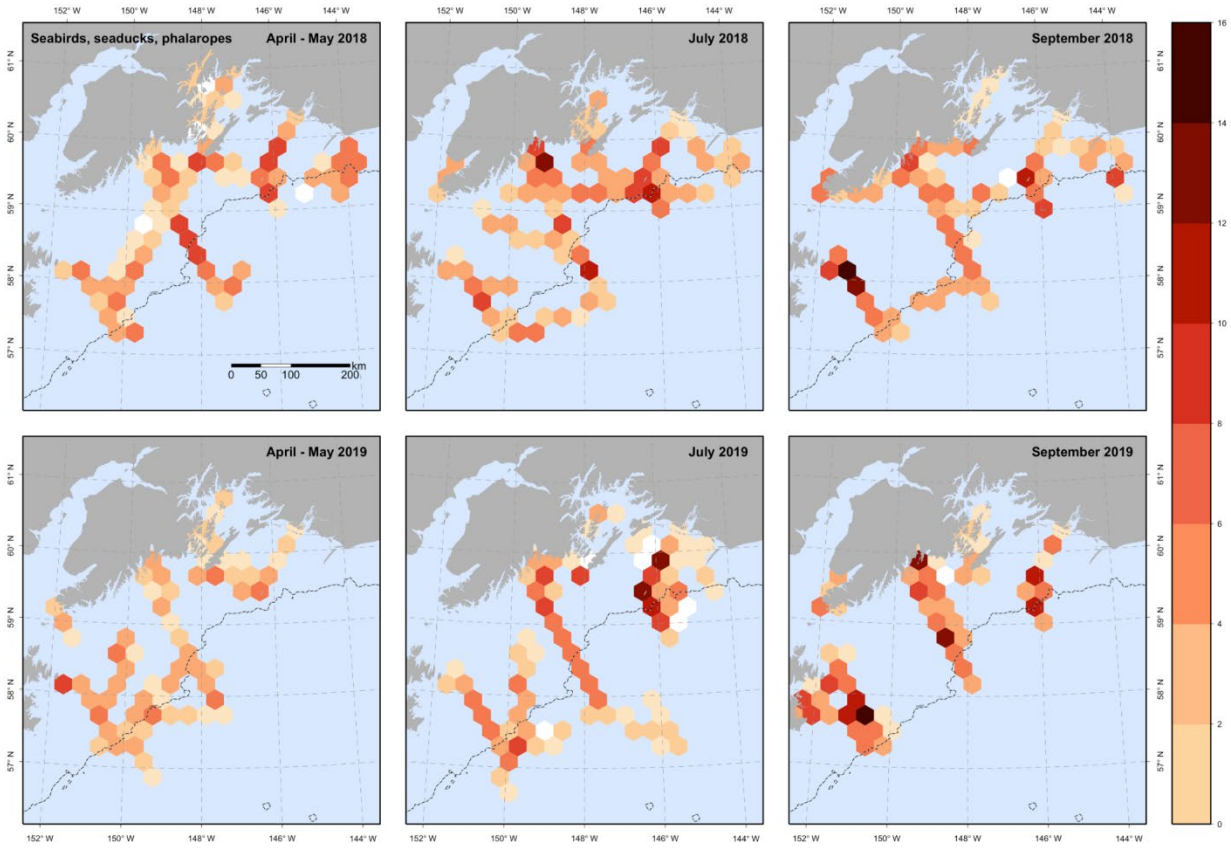

Figure 13. Seabird species richness during 2018 and 2019 Seward Line / LTER cruises.

We had several notable seabird species observations during summer and fall 2019. During July 2019, we had four sightings of dark-bellied gadfly petrels over the continental slope east of Kodiak. Photos of these sightings are being reviewed by species experts. The most likely of several possibilities is that these sightings were of Murphy's petrel (*Pterodroma ultima*). If confirmed, these observations would be the first confirmed record of this species in Alaska, and about 3.5° latitude higher than the previous northernmost record of this species. During the fall cruise, a juvenile red-footed booby (*Sula sula*) flew by the ship near Middleton Island. The red-footed booby is a pantropical seabird species, with the closest breeding locations in the Hawaiian Islands and Islas Revillagigedo, Mexico; this is the fourth Alaska record, all since 2015. We also observed a Manx shearwater at Cape Cleare. Manx shearwater is primarily an Atlantic species. First observed in the

Pacific Ocean in the 1970s, sightings have been increasing in number but remain rare, and breeding sites remain unknown. In addition, we observed 23 flesh-footed shearwaters (annual to semi-annual in Alaska), most near Middleton Island. We also had a total of 11 sightings of south-polar skuas (*Stercorarius maccormicki*); this species is not annual but occurs at irregular intervals in Alaska and this is an unusual number to occur in Alaska in one season.

During each of the three 2019 cruises, we observed a total of 9 species of marine mammals (Table 1). Odontocete (toothed whale; Fig. 14) species observations were dominated by Dall's porpoise, which was distributed from PWS to the continental slope, with lower abundance on the shelf in the Kodiak area than elsewhere. Orcas were also widely distributed. Sperm whales were especially abundant during spring and were primarily seen over the continental slope. A sperm whale was photographed near station KIP2 (depth 585m) in PWS. This was the second observation of a sperm whale in PWS during Seward Line cruises; a sperm whale was also observed and photographed at station PWS1 in Knight Island Passage (depth 350m) during Spring 2016.

Fin whales were the most abundant baleen whale (Fig. 15). Most fin whales were observed over the outer shelf. However, fin whales also occurred in outer Resurrection Bay during spring and fall, and inside PWS in spring. Such coastal fin whale observations have been infrequent during prior Seward Line cruises, especially within PWS. Humpback whales were observed in coastal areas including PWS, Cape Cleare, and Kachemak Bay, but also on the shelf east of Kodiak, and near Middleton Island. Minke whales were more abundant during spring than during summer or fall, which also occurred in 2018.

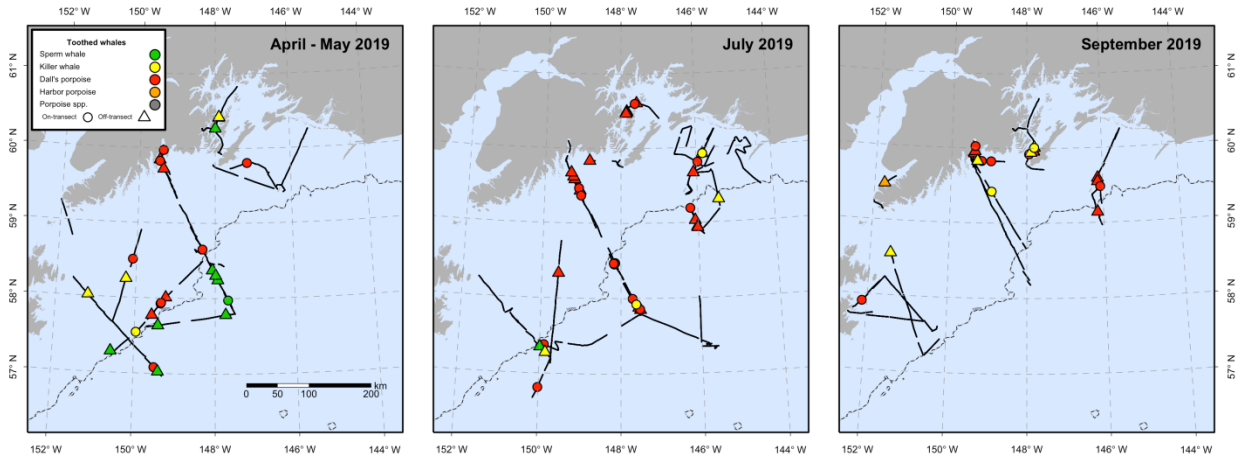

Figure 14. Odontocete whales observed on the Seward Line / long-term ecological research cruises during 2019.

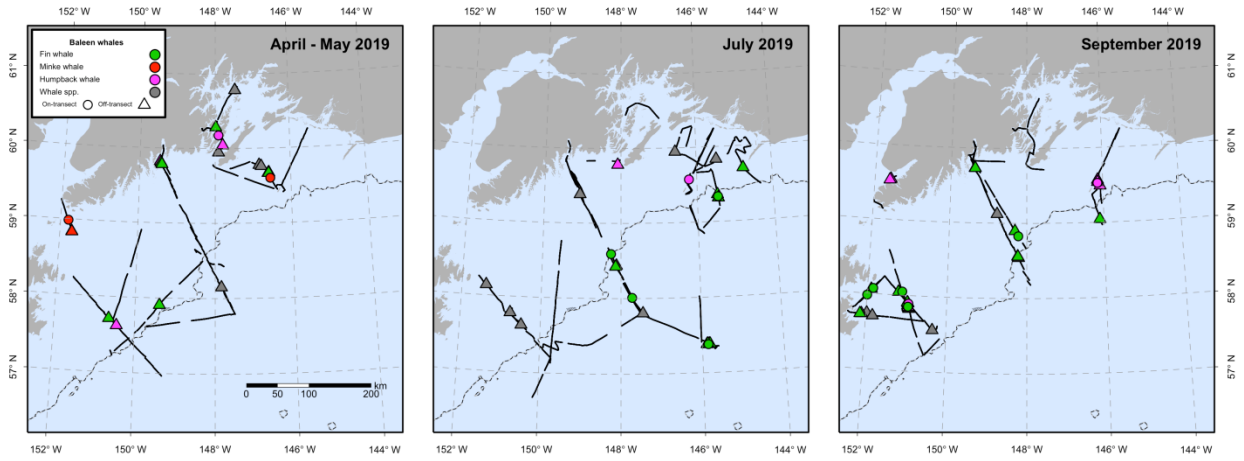

Figure 15. Baleen whales observed on the Seward Line / long-term ecological research cruises during 2019.

Large numbers of Harbor Seals were observed in Icy Bay in PWS, where hundreds of seals were hauled out on glacial ice in Nassau Fjord (Fig. 16). Harbor seals were also frequently observed during intensive sampling of the Copper River plume during July. Northern fur seals were widely distributed over shelf and offshore domains, with more fur seals observed during the spring and summer than during fall. Steller sea lions were intermittently observed over the shelf and at haulouts.

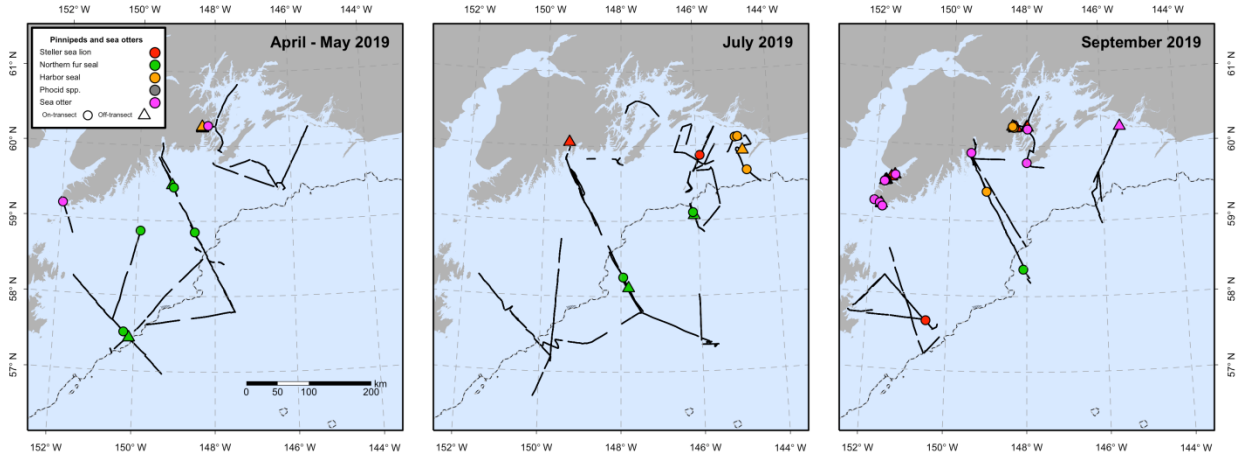

Figure 16. Pinnipeds and sea otters observed on the Seward Line / long-term ecological research cruises during 2019.

8. Coordination/Collaboration:

A. Projects Within a Trustee Council-funded program

1. Within the Program

Principal Investigator 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, providing a cross shelf context for its observations. It complements the Continuous Plankton Recorder and PWS and Lower Cook Inlet/Kachemak Bay oceanographic long-term monitoring efforts by providing more detailed oceanographic evaluation of the Gulf of Alaska shelf and the major passages in PWS 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 NSF LTER funding now connects seabird work at Middleton Island 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 two chapters in the GWA science synthesis report (Chapter 3: Arimitsu et al., Synchronous collapse of forage species disrupts trophic transfer during a prolonged marine heatwave and Chapter 4: Suryan et al., Ecosystem response to a prolonged marine heatwave in the Gulf of Alaska) submitted to the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) that is currently under review.

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.

B. Individual Projects

The Seward Line project does not coordinate or collaborate directly with 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 PWS.

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

Seward Line/LTER cruises provide bongo collections for larval fish assessment to 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://access.afsc.noaa.gov/REFM/REEM/ecoweb/index.php): 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

Coyle, K.O., A.J. Hermann, and R.R. Hopcroft. 2019. Modeled spatial-temporal distribution of production, chlorophyll, iron and nitrate on the northern Gulf of Alaska shelf relative to field observations. Deep-Sea Res. II 165:163-191.

Doyle, M.J., S.L. Strom, K.O. Coyle, A.J. Hermann, C. Ladd, A.C. Matarese, S.K. Shotwell, and R.R. Hopcroft. 2019. Early life history phenology among Gulf of Alaska fish species: strategies, synchronies, and sensitivities. Deep-Sea Res. II 165:41-73.

Lenz, P.H., and V. Roncalli. 2019. Diapause within the context of life-history strategies in calanid copepods (Calanoida: Crustacea). Biol. Bul. 237:170-179.

Ormseth, O.A., M.M. Baker, R.R. Hopcroft, C. Ladd, C.W. Mordy, J.H. Moss, F.J. Mueter, S.K. Shotwell, and S.L. Strom. 2019. Introduction to understanding ecosystem processes in the Gulf of Alaska, volume 2. Deep-Sea Res. II 165:1-6.

Roncalli, V., M.C. Cieslak, M. Germano, R.R. Hopcroft, and P.H. Lenz. 2019. Regional heterogeneity impacts gene expression in the sub-arctic zooplankter *Neocalanus flemingeri* in the northern Gulf of Alaska. Commun. Biol. 2:324.

Strom, S.L., K.A. Fredrickson, and K.J. Bright. 2019. Microzooplankton in the coastal Gulf of Alaska: regional, seasonal and interannual variations. Deep-Sea Res. II 165:192-202.

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. 2019. 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. 2019. The Seward Line – Marine ecosystem monitoring in the northern Gulf of Alaska. FY18 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 18120114-L. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Kuletz, K. 2019. II. Migratory Bird Management: Update on seabird mortality events and monitoring. Report B-7: U.S. Fish and Wildlife Service report to the North Pacific Fishery Management Council, October. U.S. Fish and Wildlife Service, Anchorage, Alaska.

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3. Popular articles

No new contributions for this reporting period.

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

1. Conferences and Workshops

Fredrickson, K., H. Busse, D. Walker-Phelan, C. Mazur, and S. Strom. 2020. Unexpected importance of the smallest phytoplankton in the northern Gulf of Alaska ecosystem. Poster presentation, Alaska Marine Science Symposium, January.

Kuletz, K. 2019. Seabird mortality events and distribution of select seabird species in the northern Gulf of Alaska. Oral presentation, Alaska Migratory Bird Co-management Council meeting, September 18-19, Anchorage.

Kuletz, K., B. Hoover, D. Cushing, J.A. Santora, W.J. Sydeman, R.R. Hopcroft, S.J. Danielson, and E. Labunski. 2019. Seabird distribution relative to biophysical oceanographic properties in North Pacific Ecosystems. Oral presentation, Annual meeting of the Pacific Seabird Group, March 2, Lihue, Kuai, Hawaii.

Mendoza-Islas, H., and R.R. Hopcroft. 2019. Abundance and distribution of gelatinous zooplankton in the Gulf of Alaska. Oral presentation, ASLO Aquatic Sciences Meeting, San Juan, Puerto Rico, February.

Mendoza-Islas, H., and R.R. Hopcroft. 2020. First year pollock and their zooplankton predators in the Gulf of Alaska. Poster presentation, Alaska Marine Science Symposium, January.

Smoot, C.A., and R.R. Hopcroft. 2020. Warm-water zooplankton in the Northern Gulf of Alaska: observations from the Seward Line. Poster presentation, Alaska Marine Science Symposium, January.

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 (Zador et al. 2019) 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). All 2018 datasets are on the Research Workspace and available on the Gulf of Alaska Data Portal now or by the end of April 2020, except for 2019 microscopic analyses (phytoplankton, microzooplankton and meso/macrozooplankton) data which require additional time for identification. Provisions for slightly later data deliver 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).

10. Response to EVOSTC Review, Recommendations and Comments:

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 2. Funding sources for Northern 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	

	EVOSTC	NSF LTER	NPRB	AOOS
Phytoplankton and Microzooplankton processing		X	X	
Zooplankton processing	X	X	X	
Seabird & Marine Mammal Observer	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 FY19.

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	$255.8
Travel	$3.9	$4.0	$4.1	$4.3	$4.4	$20.7	$9.4
Contractual	$8.0	$8.3	$8.6	$8.8	$9.0	$42.6	$25.0
Commodities	$2.3	$2.4	$2.5	$2.7	$2.8	$12.7	$14.6
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	$74.7
SUBTOTAL	$121.8	$124.9	$128.0	$131.2	$134.5	$640.3	$379.5
General Administration (9% of	$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	

Dr. Kuletz (project 19120112-M) was allocated new funds (**$8,000**) from the GWA program, via the Prince William Sound Science Center, to fund additional offshore surveys in summer 2019, as part of the Northern Gulf of Alaska LTER.

In September 2019, the EVOSTC approved funding for FY20 Marine Bird Surveys of PWS, which for the first time will include an add-on component for the spring and fall seabird surveys of the LTER. These funds will allow the seabird Seward Line surveys (funded by the North Pacific Research Board) to continue through the entire LTER sampling grid in spring and summer.

LITERATURE CITED

Zador, S., E. Yasumiishi, and G.A. Whitehouse, G.A. (editors). 2019. Ecosystem Status Report 2019. North Pacific Fishery Management Council. https://access.afsc.noaa.gov/REFM/REEM/ecoweb/pdf/2019GOAecosys.pdf.