ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
PO Box 115526
Juneau, AK 99811-5526

Alaska Department of Fish and Game
Wildlife Restoration Grant

GRANT NUMBER: AKW-22

PROJECT NUMBER: P1.0

PROJECT TITLE: Steller sea lion recovery

PERIOD OF PERFORMANCE: July 1, 2017 – June 30, 2020 (Year 3 by no-cost extension)

REPORT DUE DATE: September 28, 2020

PRINCIPAL INVESTIGATOR: Michael Rehberg

Authorities: 2 CFR 200.328
2 CFR 200.301
50 CFR 80.90

I. SUMMARY OF WORK COMPLETED ON PROJECT

Objective 1: Contribute to estimates of population abundance and vital rates of Steller sea lions.

Accomplishments:

To this end, this grant supported four activities.

First, a set of three aerial surveys of the ephemeral, spring Steller sea lion aggregations at the Alsek/Doame/Akwe rivers on the outer coast south of Yakutat were conducted during 3 days in March – April 2019 using flights from Juneau. The images collected and analyzed by this WSFR grant are being used to, for the first time, document the hundreds of California sea lions swimming north from British Columbia and points south each spring for this very short, intense feeding event.

This aggregation of mammals and birds coincides with a large eulachon run along the coastline and has grown over the past 10 years. Sea lions are drawn to this location from throughout the Gulf of Alaska: one sea lion satellite tagged at Sitka by NOAA Fisheries visited the location in early March, and brand resights indicate sea lions drawn from southern Southeast Alaska through the Alaska Peninsula.

Completing the analysis of these aerial photos is underway using support from another grant. The objective of this analysis is to use these high-resolution images to determine

the proportion of sea lions hauled out in this area that are California sea lions, and the proportion that are Steller sea lions. Until we began using higher-resolution images to perform these counts, it had not been clear that both species of sea lions occurred at this location.

Second, during 2017 and 2018, we used our Spring 2017 SDR to expand our reproductive rate surveys westward to Kodiak Island, a region that is otherwise un-surveyed. We prioritized surveys at two large rookeries: the Barren Islands south of Cook Inlet, and Marmot Island off Kodiak. This provided coverage of an area that has seen recent (December 2017) 17% drop in pup production. During these surveys, we confirmed 125 brand-resights. This WSFR grant made surveys in the Gulf of Alaska possible, covering an area with recent population issues that our Federal colleagues were not able to monitor due to their greater survey needs in the Aleutian Islands.

Third, during several day-long trips, we travelled by skiff to service and download the remote time-lapse cameras installed at Graves Rocks rookery and South Marble Island haulout, Glacier Bay (Figure 1). The seasonal Graves Rocks camera was re-installed for each breeding season (this camera is exposed to high winter surf and removed each fall.) The Marble Island camera was also serviced annually, and at the Park Service's request, its position was moved to a less visible location (below). Analysis of photos collected for by the South Marble Island camera is complete; analysis of the Graves Rocks camera continues under a separate grant.

Figure 1. Remote time-lapse camera installation at South Marble Island.

Finally, we took delivery of an APH-28 hexacopter system (Aerial Imaging Solutions, LLC) purchased under this grant by SDR. This system is compatible with the imaging hexacopters in use by our collaborators at the NOAA Marine Mammal Laboratory, to ensure data are compatible and due to their known success using this system.

During Year 3 we planned to train in its use and integrate it with our ongoing survey work; however, pandemic related travel restrictions (Alaska to Seattle) and funding limitations prevented this training from happening. The hexacopter is being used as a resource for upcoming grant proposals that will be able to fund its use in the field, namely, continued brand-resight surveys and a set of new proposals to assess marine mammal interactions with Alaska's increasing mariculture farm development.

Objective 2: Determine population structure and habitat use of Steller sea lions.

Accomplishments:

In order to collect skin samples for the purpose of genetic analysis, initially in support of the DNA methylation method for aging, and ultimately for other population structure and vital rates analysis, this year we developed our ability to collect skin samples using remotely-delivered biopsy darts. Starting with the April 2019 capture cruise, and other training, we trained and qualified two additional personnel under our research permit to collect skin biopsy samples using biopsy darts. Biopsy darting continued into Year 3 and collected samples are being held frozen until analysis. Laboratory analysis depends on a separate grant for which a proposal is in review.

Objective 3: Conduct a pilot project to examine retention time of new telemetry instruments that may provide information on movements, dive behavior, and environmental data as a means of long-term monitoring of adult and subadult Steller sea lions.

Accomplishments:

During Year 2, we confirmed that the new, flipper-mounted satellite tags are working successfully on adult male Steller sea lions (Figure 2) and retention is good. Flipper mounted tags use semi-permanent attachments through the flipper, similar to the numeric ear tags used on terrestrial mammals. These tags permit year-round, and potentially multi-year, tracking of sea lion locations, which is not currently possible with fur-mounted instruments that molt off every autumn. During Year 3, we expanded the use of these flipper-mounted tags by deploying them on seven adult female Steller sea lions (Figure 3). To date, the attachments have been successful: one of 3 adult males tagged in April 2019 is still transmitting, and 6 of 7 adult females tagged in October 2019 are still transmitting, in September 2020. This project is the first time Steller sea lions have been tracked through the winter, through a breeding season, past their annual August fur molt, and into a second winter.

Prior to these deployments, we worked with the manufacturer to test and alter flipper-tag programming to fix problems we identified in previous deployments. Flipper tags had been rapidly burning through their transmission allotments and failing earlier than predicted. The fixes accomplished during this project appear to have solved this issue for the current deployment. We also worked to confirm whether these tags can be used successfully on Steller sea lions. Because the tags were originally designed for seals

that haul out on ice, the manufacturer had warned us that electrical problems would occur when used on land-associated seals. During this deployment, we have confirmed this is not a problem for Steller sea lions.

Finally, we confirmed that flipper tags provided equivalent and accurate indications of where Steller sea lions haul out as the temporary, higher-resolution head-mounted GPS tags. This means flipper tags – which can last years instead of months – will be suitable to track long-term Steller sea lion movement across multiple years and through the breeding season.

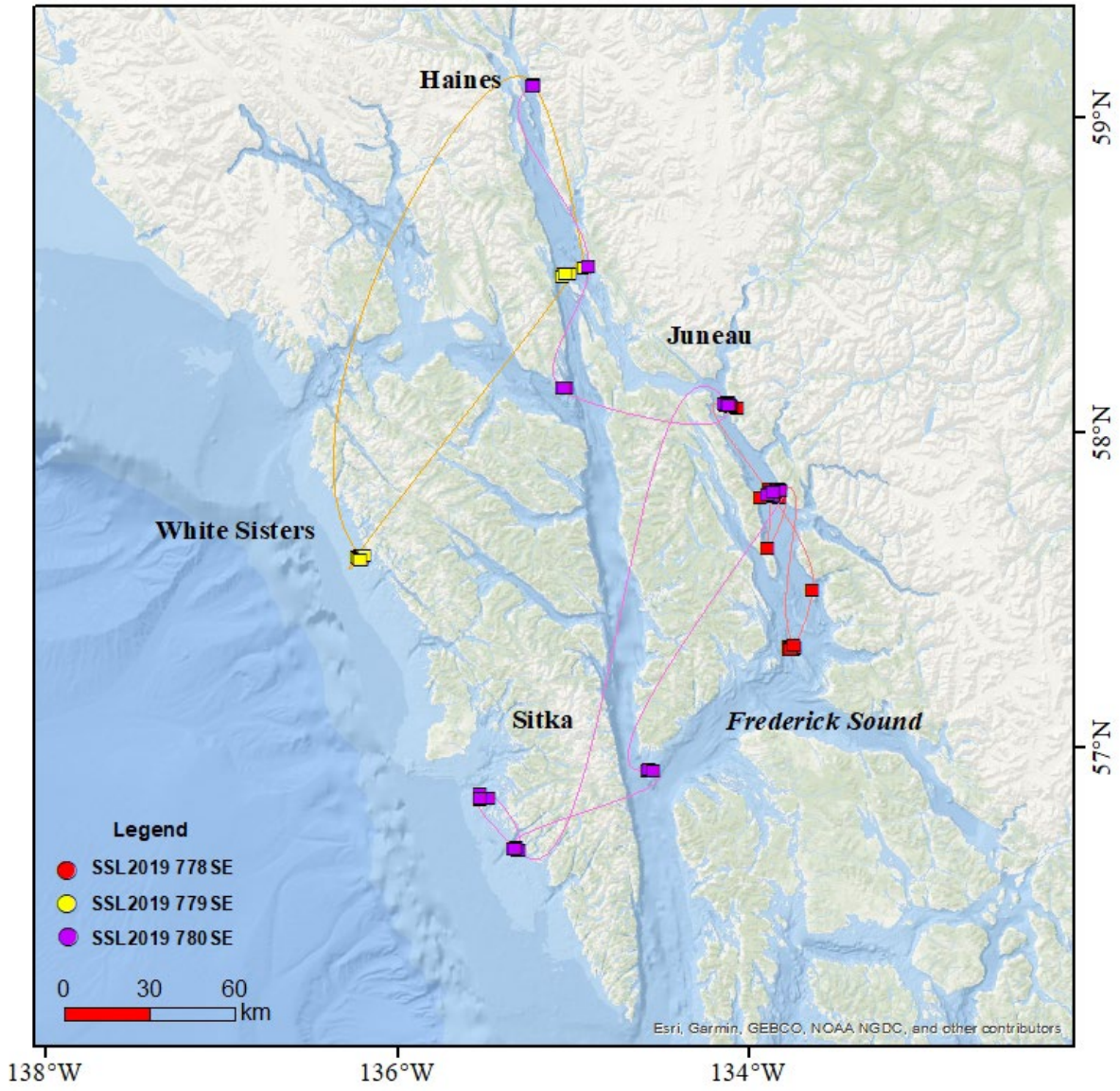

Figure 2. All location data collected by flipper-mounted satellite tags for 3 adult males captured in Southeast Alaska during April 2019. Because flipper tags are only exposed to the air while an animal is hauled out, radio signals are only transmitted for location collection at haulout locations. These data captured all sea lion movements between haulouts as recorded by the higher-resolution, temporary head-mounted GPS tags attached to the same animals.

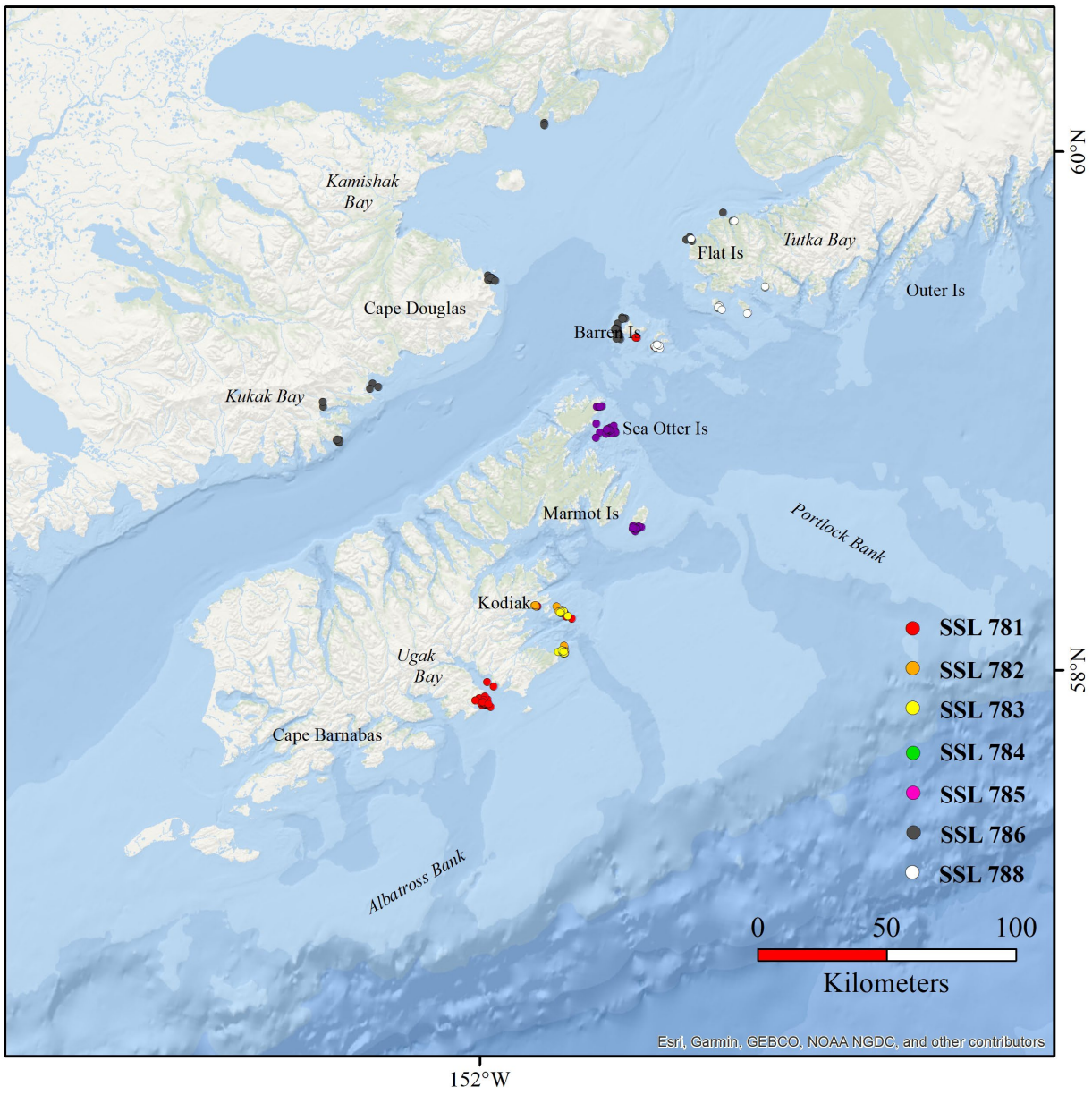

Figure 3. All location data collected by flipper-mounted satellite tags for 7 adult females captured in the Gulf of Alaska during October 2019. Six of 7 tags are operating in September 2020.

Objective 4: Assess foraging areas and diet of Steller sea lions.

Accomplishments:

To this end, this grant supported two activities.

First, using frozen, whole scat samples contributed to us by the NOAA Marine Mammal Laboratory, we contracted with the COHO Lab at the Alaska SeaLife Center to determine the prey taken by sea lions using DNA techniques. The COHO Lab designed primers, a necessary first step in DNA prey analysis, for the 27 prey items we requested. A primer is required for each prey species we wish to identify using this method.

The COHO lab extracted 120 scat samples (Figure 4). These samples represent sea lion foraging off Long Island, near Kodiak, during March 2014. This is the pre-sample of sea lion diet collected before the current, reduced Steller sea lion pup counts observed in this area, and before the major "blob" phenomenon – high water temperatures that are affecting potential sea lion prey abundance and diversity. Due to pandemic restrictions and funding limitations, we were unable to collect additional scats during March 2020. We are pursuing funding to collect this second set of scats, which would represent how sea lion diet has changed during the present "blob" event.

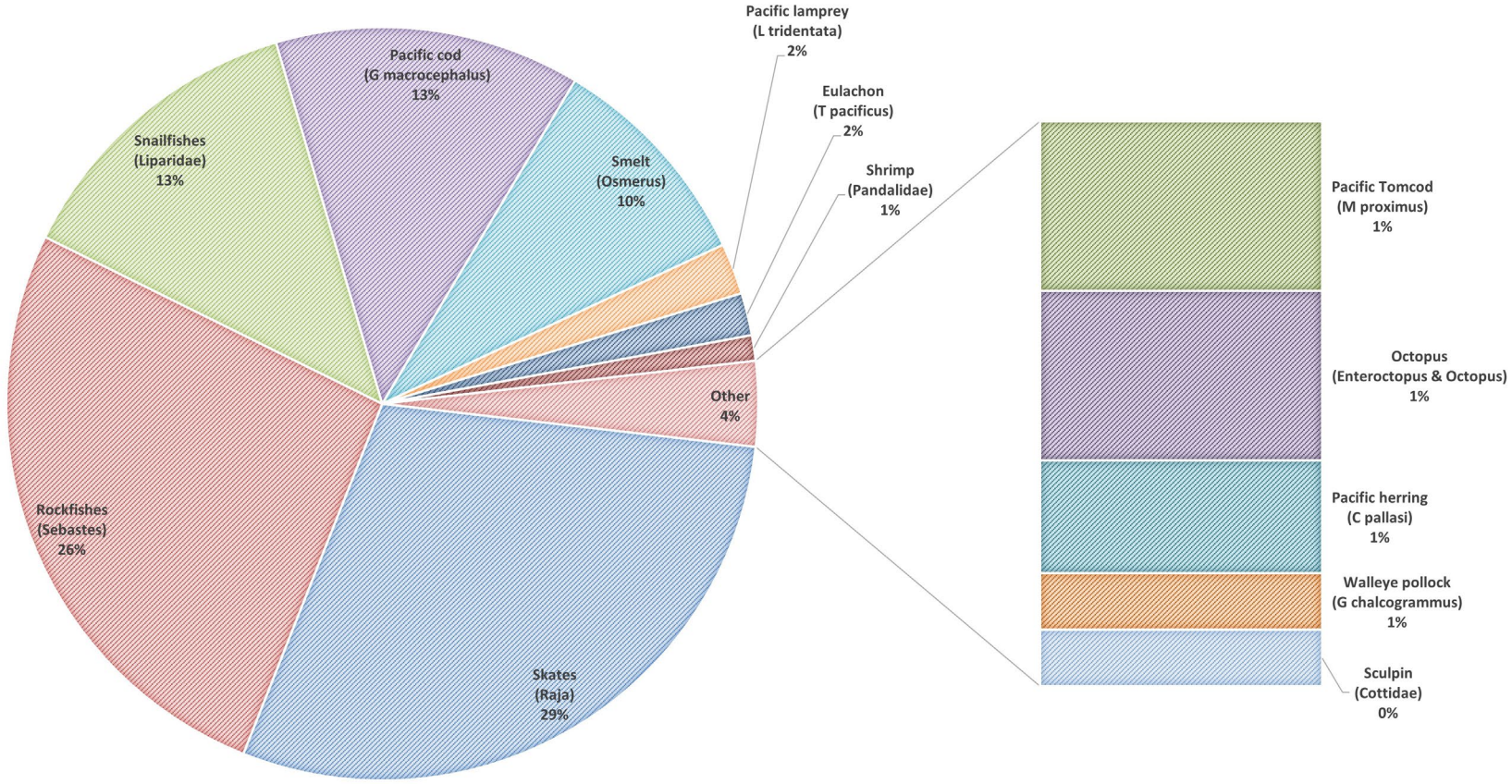

Figure 4. Proportions of Steller sea lion prey species identified using genetic analysis of n=120 scats collected at the Long Island sea lion haulout, spring 2014. Analysis by the Alaska SeaLife Center COHO Lab looked for a set of 27 possible prey items, based on previous hard-parts based diet analyses in the region.

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Second, using satellite tags attached to the heads and flippers of Steller sea lions, we identified putative foraging areas for 3 adult male Steller sea lions (Figure 5). The more general, coarse flipper tag results are described under Objective 3, above. The detailed head-mounted tag results are described here.

The head-mounted satellite tags we attached to sea lion fur provide data including GPS locations (to ~25 meters), the depth, duration, and shape of individual dives, whether a sea lion is hauled out or at-sea, and a temperature profile of the water column. These data, combined with environmental characteristics we plot on maps (such as seafloor depth, seafloor features, currents, and the shoreline), provide inference about locations important for sea lion foraging. These data were analyzed and results are summarized in several figures.

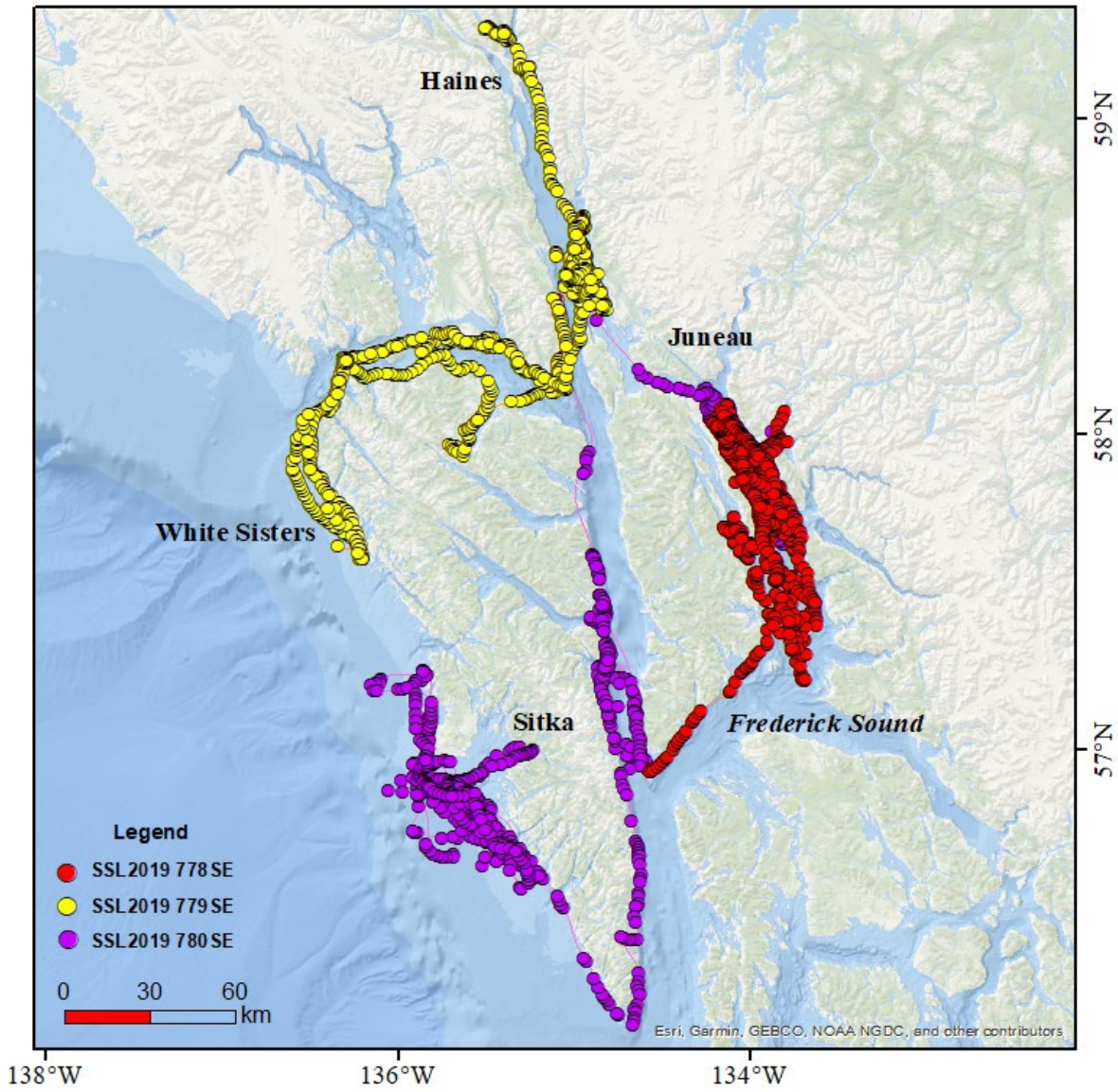

Figure 5. All GPS-quality locations reported for three Steller sea lions captured in Southeast Alaska. Sea lion # 778 was tracked 15 April – 8 August 2019, remained in inside waters and did not visit a breeding rookery. Sea lion #779, captured near Tenakee, was tracked 17 April – 10 August and did spend time on the White Sisters breeding rookery before moving north to Lynn Canal. Sea lion #780, tracked 20 April – 10 August, moved to the outside coast and spent the spring foraging off Sitka sound, but did not visit a breeding rookery.

This project was the first to track an adult male Steller sea lion during its breeding fast (Figure 6). While holding a territory on a breeding rookery, males remain stationary and are thought to fast, consuming little if any prey. These data present tracking of a male sea lion during its entire breeding fast, 7 weeks, and observations were made 24 hours per day, adding some context to the fasting behavior. Between 9 May and 26 June, covering the heart of the breeding season, male #779 spent 7 weeks hauled-out on the White Sisters breeding rookery.

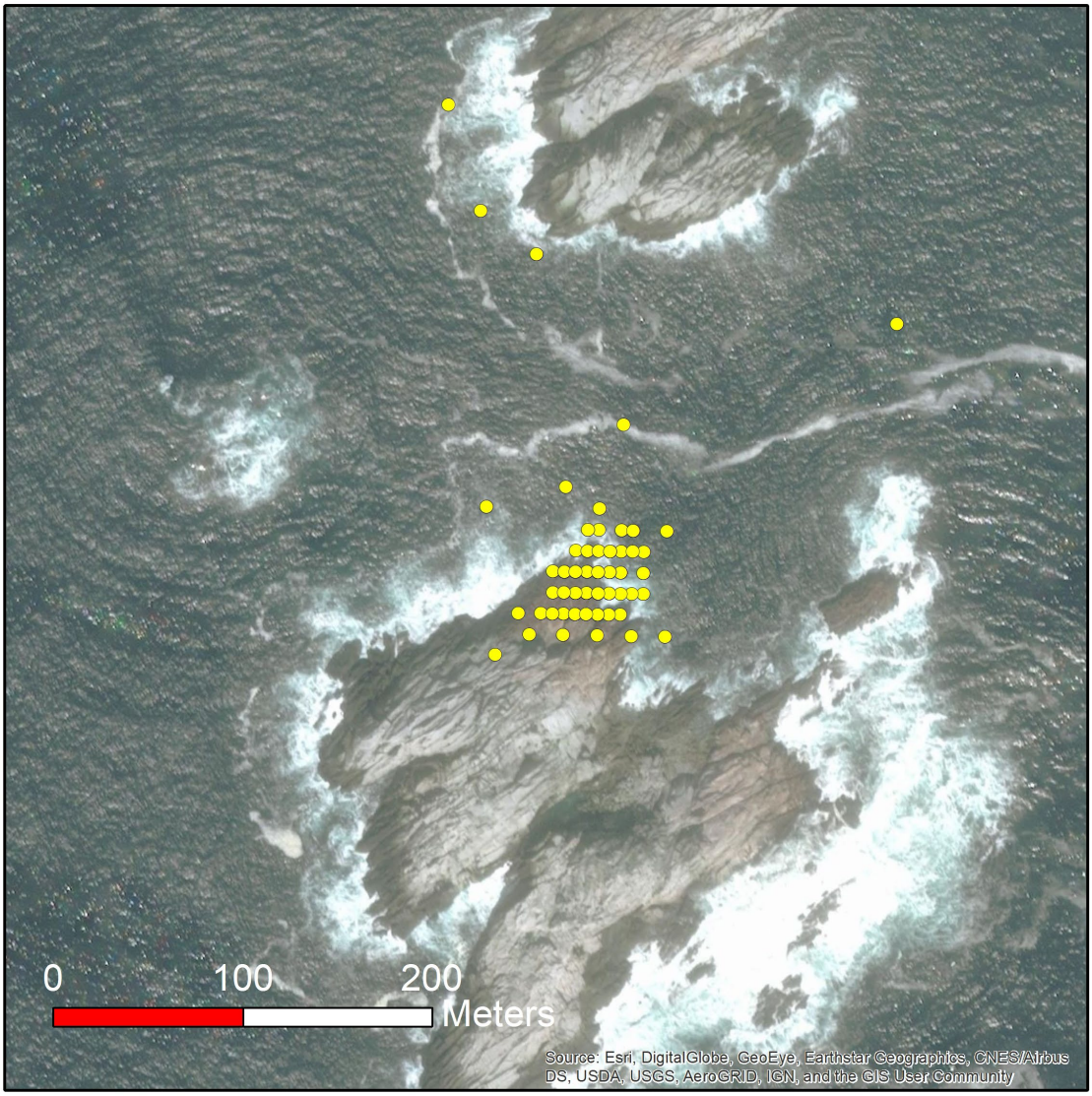

Figure 6. Sea lion #779, captured near Tenakee, spent 7 weeks hauled out on the White Sisters breeding rookery. This map is zoomed in to show all GPS locations, which were at the same position while on land, and showed a handful of brief, short distance trips into the water.

During this time, adult male #779 spent all its time hauled-out in the same location on the rookery. We know from previous work that this location on the island contains actively breeding males and females. The male left the haulout only 6 times during these 7 weeks, during very short duration trips, and in all cases remained within 250 meters of the rookery. Diving during these swims was extremely limited relative to most male behavior; the number of dives per trip ranged from 2 to 11. The GPS-quality locations provided by these new satellite tags made this observation possible. Overall, this male targeted prey continuously while it was not at the rookery busy defending its breeding females.

Inside the coastal fjords of Southeast Alaska, the seafloor provides diverse opportunities for prey, demonstrated by non-breeding male #778 (Figure 7): clusters of deep diving occur over seafloor canyons, showing sea lions targeting benthic prey (e.g., squid, cod) while shallow diving in otherwise deep water indicate pelagic prey (e.g., salmon, herring) are being taken.

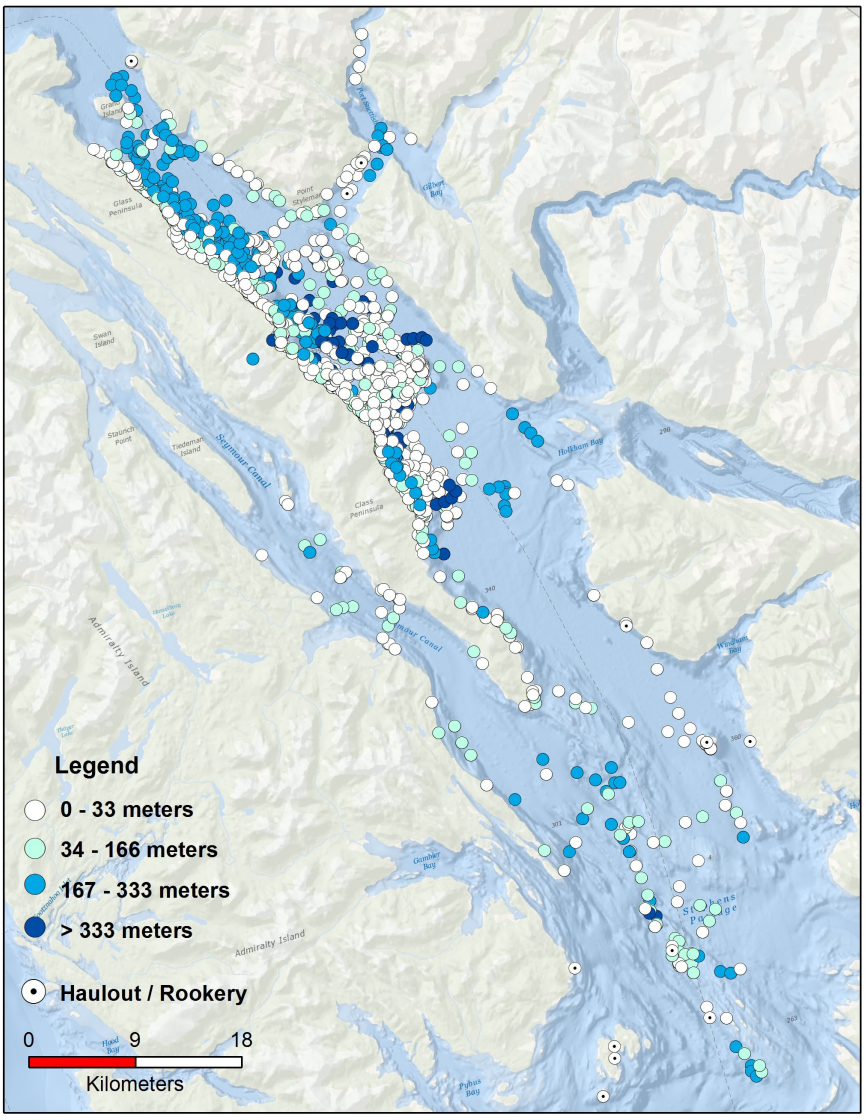

Figure 7. Adult male #778 adjusts its diving behavior to suit the seafloor bathymetry and distribution of prey during its long residence in the Frederick Sound – Stephens Passage area. Southeast Alaska provides diverse foraging habitats within a small area.

Objective 5: Document marine debris and fisheries interactions with Steller sea lions.

Accomplishments:

ADF&G attempted but was unsuccessful in performing any disentanglements during calendar year 2019. However, we did invite two experts from the Marine Mammal Center (Sausalito, California) to collaborate and exchange knowledge with us during the April 2019 adult male captures. Their experience in "rescue response" type work on California sea lions provided valuable methods that we are working to adopt in both our research and disentanglement capture work. One such method is the "Incident Command Structure" which clarifies decision making and roles of a team during the fast-paced and unpredictable sea lion capture work we do. In turn, we provided them valuable experience with Steller sea lion capture before their planned work to teach entanglement response techniques in eastern Russia.

Objective 6: Determine the health of individuals and identify residual and emerging threats to Steller sea lions.

Accomplishments:

Health-related work and publication is reported elsewhere in this FPR.

II. SIGNIFICANT DEVELOPMENT REPORTS AND/OR AMENDMENTS.

This reporting period included three Significant Development Reports and one no-cost extension:

1. Incorporate in-kind match to Objective 1, Job/Activity 1d, *Collect brand-resight data in the Gulf of Alaska*. The Alaska Department of Fish and Game (ADF&G) received a substantial discount from Alaska Dream Ventures, Inc., for its brand-resight observation cruise funded by the WSFR.

2. Modify the approach to Job 1a, *Retrieve data, service and re-deploy time-lapse cameras* and Job 1b, *Analyze images to collect brand resight and count data on rookeries and haul-outs year-round from images*, by using unobligated funds to acquire and train on a UAS for remote aerial population and vital rates data collection. This contributes to Objective 1, *Contribute to estimates of population abundance and vital rates of Steller sea lions*. Jobs 1a and 1b were originally written to support purchase, installation, data analysis and maintenance of fixed, time-lapse remote cameras installed at Steller sea lion haulouts. These cameras monitor sea lion abundance and collect sea lion brand-resights, contributing to understanding the survival, reproduction, and movements of the population. These cameras have collected data that are currently being analyzed to determine counts and brand-resights, but we have funding on-hand for more cameras than we can practically deploy. We have learned from experience the limitations of

these fixed cameras, including vulnerability to winter storms, need for annual maintenance and the limited number of sites that fixed-position cameras can realistically cover. Using these presently un-obligated funds, we instead propose to purchase a remote unoccupied aircraft system (UAS, or "drone") and acquire training to operate the UAS. This system will conduct count and brand-resight surveys – tasks also currently performed in different fashion by our existing time-lapse cameras - and continue contributing to the success of Objective 1.

3. Modify the approach to Job 4a, *Analyze scat for diet indicators using DNA analysis*, by ending this project early. This objective was written to cover laboratory analysis of scat collected at the Long Island haulout near Kodiak Island during 2014 and 2020, in order to compare the diet of sea lions before the Gulf of Alaska warming event ("the blob") and after the warming event. Due to travel restrictions ADF&G was not able to travel to Kodiak in 2020 to collect the second round of samples required for this comparison. The cooperating laboratory we had contracted was temporarily closed and could not analyze additional samples. Both circumstances are due to pandemic related restrictions. We proposed to close this objective, as we now had in-hand the results of Year 1 analysis: a set of "primers" for potential sea lion prey, which are the signatures used to identify those prey DNA in sea lion scats, and a set of analyzed scat results identifying prey items used by sea lions in 2014. If possible, and we are able to secure outside funding, we would like to attempt completing this project during Spring 2021. (We are not requesting an extension to the project funded under this grant).

4. A no-cost extension was approved to extend this project into a Year 3, ending June 30, 2020.

III. PUBLICATIONS

There were no published journal articles produced during this grant. An article describing adult male foraging behavior is in preparation alongside an article describing adult female foraging behavior (collected by a separate grant), with both scheduled for completion by June 30, 2021. Data collected with support of this grant has provided essential data to larger research efforts, such as the long-term range wide brand-resight program, from which 3 publications on Steller sea lion vital rates and movements have been produced since 2018.

IV. REVIEW OF PRIOR RESEARCH AND STUDIES IN PROGRESS ON THE PROBLEM OR NEED

This project validated the utility of flipper-mounted satellite tagging for tracking Steller sea lions for more than one year. Lessons learned by this effort were used during deployment of 7 satellite flipper tags on adult female Steller sea lions in the Gulf of Alaska. Because the Gulf of Alaska, Bering and Chukchi Seas are now experiencing a major ecosystem disruption due to two years reduced sea ice and/or high ocean temperatures, continuing to monitor marine mammal responses to this ecosystem perturbation, and participating in broader, system- or multi-species research would be an

ideal and timely next step for the Marine Mammal Program. Broader than possible under agency-specific species or management mandates under other grants. The Marine Mammal Program could pursue marine systems- and seascape-scale research initiatives similar to the ADF&G Division of Wildlife Conservation's progress on terrestrial landscape ecology in recent years.

Expansion into other marine mammal work, including the interactions of marine mammals with the expanding Alaskan mariculture farming industry, and including additional species, such as Northern sea otter and harbor seal, are essential next steps.

Prepared by: Michael Rehberg, Wildlife Biologist IV

Date: September 25, 2020