The Alaska Department of Fish and Game (ADF&G) Marine Mammals Research Program has conducted research for ~50 years and established some of the most important baseline datasets on Alaska marine mammals currently available. In general, our research focus has been directed at obtaining marine mammal biology/ecology information that State and Federal Scientists need to implement effective management programs. The ADF&G research program has consistently undertaken collaborative research projects that contribute significantly towards the management and conservation of marine mammals throughout Alaska. Our research has provided critical information required to better understand how commercial fisheries, predation, oil and gas activities, and environmental variability (i.e., regime shifts and climate change) may influence marine mammal populations, including SSLs that are listed under the Endangered Species Act. Recently, we submitted a 3-year research proposal in response to a Federal Funding Opportunity (FFO). The FFO had a number of research priorities that aligned with ADF&G interests, especially our significant interest in further study of the SSL populations in the “mixing zone” between the eastern and western Distinct Population Segments (Figure 1), such as those at White Sisters. As such, our proposal was recommended for 3-year funding.

Steller sea lions (*Eumetopias jubatus*; SSL) are the largest member of the Otariid (eared seal) family and they range from California all the way to Japan with the center of their distribution and a large portion of their population being located in Alaska. SSL’s inhabit waters over the continental shelf and beyond and come ashore at specific traditional resting or breeding sites called haulouts and rookeries, respectively. Beginning in the 1970’s, there was a well-documented but poorly understood rapid decline in overall SSL counts that eventually landed them on the Endangered Species List in 1990 as a threatened species. In the mid-1990’s, the National Marine Fisheries Service (NMFS) used genetic data (Bickham *et al.* 1996, Loughlin 1997) to determine the existence of 2 stocks or distinct population segments -an eastern and western (eDPS and wDPS). The division between these two stocks was designated at 144° west-Cape Suckling, Alaska- an area mostly void of SSL at that time. The stable or increasing eastern DPS kept the threatened status while the once abundant western DPS continued on a precipitous and persistent range-wide decline of over 80% which resulted in them being uplisted to endangered status in 1997; the cause(s) of the decline remain unknown. With the exception of the central and western Aleutian Islands, wDPS SSLs stabilized during the 2000s and in some regions showed modest increases (Fritz *et al.* 2013). Meanwhile, researchers determined that eDPS populations had been increasing since the 1970’s (Calkins *et al.* 1999, Pitcher *et al.* 2007, Mathews 2011) and in 2013 eDPS sea lions were removed from the U.S. Endangered Species List (Federal Register, 2013).

Understanding the cause of the decline in wDPS sea lions has eluded scientists over the last several decades. A number of ideas have been tested and then rejected partly or entirely: starvation, predation, over harvest, poaching, emigration, etc. Current best science seems to indicate multiple factors are likely contributing to the overall wDPS downward trend. Among
the current possibilities are increased contaminant loads, reduced reproductive rate, and decreased recruitment to adulthood. For the most part, individual sea lions appear virtually identical, but managers tasked with determining reproductive or recruitment rates require repeated monitoring, or sampling, of known individuals. The only method currently available to do this is through permanent marking by hot-branding. Branding is quick (3–4 seconds per digit) and reliable, producing a permanent mark that is visible from a distance, thereby eliminating the necessity of recapturing and handling individuals.

A major emphasis of ADF&G’s SSL program is long-term, year-round research on marked animals. Resighting marked individuals throughout the year allows for the collection of important demographic data—mark/recapture studies are a staple among wildlife managers. The recent priorities outlined in the FFO support our research priorities and objectives and that of our collaborators at the Marine Mammal Lab (MML): estimation of vital rates, assessing residual or emerging threats to the population, documenting the current genetic makeup of SSL rookeries, and understanding site use by eDPS and wDPS animals. The region of particular interest for genetics and site use is within the ‘mixing zone’ region of northern Southeast, which includes Graves Rocks in Glacier Bay National Park and White Sisters in Tongass National Forest.

In order to model the population dynamics of SSLs to estimate age-specific survival and natality, and compare these rates among rookeries and stocks, it is necessary to repeatedly identify individual known-age animals throughout their lifetime. Our researchers and collaborators throughout the SSL range have investigated numerous noninvasive methods of identifying individual animals throughout their lives (e.g. natural marks, pelage or whisker patterns, difference in fore flipper margins, etc.), however these methods have not proved successful (Blejwas and Kelly 2004; K. Hastings and K. Pitcher, unpublished data, ADF&G, 2004). Less invasive means such as flipper tags, hair dyes, satellite tracking devices, artificial patterns shaved in their pelage, etc. have been ephemeral at best—occasionally a flipper tag will stay with an animal into adulthood but the information contained on the tag is long since worn away. To this day, branding sea lions and using mark/recapture analyses remains the only means for estimating long-term age-specific population parameters (Merrick et al. 1996).

Estimation of vital rates through mark/resight techniques is a long-term process. For SSLs, there is a three to four year delay before juvenile survival can be estimated and many additional years before age-specific estimates of survival and fecundity can be generated for adult age classes. This requires a long-term commitment of resources by project managers and funding agencies, large sample sizes of marked animals, and a dedicated brand-resighting effort. Through our multi-year grant obtained under the FFO, we now have 3 years of dedicated funding for branding and brand-resighting in Alaska to help inform management decision over the decades ahead.
OBJECTIVES

1) Install small, unobtrusive, time-lapse cameras at a number of Southeast Alaska sites as well as at Seal Rocks, in Prince William Sound, to document year round presence/absence of Steller sea lions, monitor behavior, and collect additional brand resight data.
   a) Camera system will remain intact year round and will require visits 2-3 times/year (summer, fall, and spring) to exchange memory cards and batteries.

STUDY AREA:

Figure 1. Steller sea lion, *Eumetopias jubatus*, distribution. Note the division between the wDPS/eDPS at Cape Suckling (144°W) and the “Mixing Zone” which includes animals from both DPS. White Sisters is located in the mixing zone.
Figures 2&3. Seal Rocks, located at 60.163, -146.837 in Hinchinbrook Entrance area of Prince William Sound, is home to a Steller sea lion (*Eumetopias jubatus*) rookery. We propose to place 1-2 time-lapse cameras on a site overlooking the rookery so that we can monitor sea lion populations year-round.
Figure 4. Waterlevel view of Seal Rocks taken from the southeast corner looking northwest. A time-lapse camera system will be mounted near the high point of the island (yellow arrow) so we can monitor year-round Steller sea lion presence/absence.

Figure 5. The elevated orientation of the time-lapse camera will provide broad views of the cobble rookery area seen in this image.
BUDGETING & PERMITTING

Funding for this project is provided through a 3-year NOAA grant via FFO NOAA-NMFS-AK-2016-2004624. Research is authorized under MMPA permit 18537 and ADF&G IACUC 2015-38.

MATERIALS & METHODS

A crew of ADF&G researchers will be surveying all Prince William Sound Steller sea lion rookeries and haulouts during July 6-14, 2016. This is the approximate time that these surveys have been conducted during past years and they will continue during this general timeframe in the future. Cameras will initially be deployed at the remote sites during this survey.

The camera is comprised of a 12 megapixel High Definition Canon DSLR camera fitted with a 70-300mm zoom telephoto lens. A high capacity SD card (up to 256mb) and an auxiliary lead acid battery are included to help extend the functional deployment time. All these parts are contained inside a 40x20x33cm (16”x8”x13”) top-load Pelican-Case 1430 which has a small clear acrylic window and sunscreen on the side. A compact external 20watt solar panel ensures that the auxiliary battery is at maximum capacity during daylight hours. The Pelican-Case itself, or the wooden base it is attached to, is thru-bolted to the rock surface of the island (Figures 6&7) using several 1.25cm (½”) expansion bolts. Upon completion of the study, we will remove the expansion bolts from the rock and return the site to a natural state.

Alternative methods: Securing the system to the rock solely via heavy weights or perhaps glue/epoxy, are not expected to withstand high wind/sea states encountered throughout the year (see inset photo in Figure 5). The wind/waves are big enough, especially during fall/winter, that the rocks can be scoured clean. Basically if we don’t bolt it down, it won’t be there when we return.

Many coastal Alaskan sites, including Seal Rocks, have Coast Guard Aids to Navigation (ATONs) associated with them. These can sometimes serve as a deployment site for equipment similar to ours, but unfortunately such structures at Seal Rocks are not in an ideal location for monitoring the majority of sea lions found there.

A temporary floating camera platform is also not feasible for the same reasons we have to bolt the system to the rock- any buoy/anchor arrangement designed to withstand wind/waves big enough to scour the rocks clean would be incredibly massive. We don’t expect many visitors to notice our cameras because they will be mounted “inside” the rookery zone that most boaters avoid entirely or else they risk putting themselves in violation of the Marine Mammal Protection Act. Our system has a small footprint (<1m³) and can be camouflaged to some extent using a combination of paint, vegetation, and netting. The cameras will be pointed down toward the sea lion rookery which should reduce any confusion as to whether it is a law enforcement tool.
It is not feasible to deploy a live human observer to record these data daily from a boat or on shore, regardless of conditions or duration, nor is it realistic to obtain the data we need from the public or private industry staff. Although we do receive a number of greatly appreciated opportunistic brand photos from these groups, this generally occurs only during summer which does not meet our need to understand *year-round* use by animals born at different rookeries in Alaska. Time-lapse cameras will record quality data during all daylight hours, *year-round*, regardless of the conditions- a time-lapse camera doesn’t get sea sick, cold, or fatigued.

High capacity SD memory cards and supplemental solar power, allows the camera system to collect data for >6 months without requiring servicing. This allows us to be able to monitor the site virtually uninterrupted, year-round. As such, we expect to service it 2-3 times every year: in July during our resight cruise and again in spring and fall depending upon weather.

**Figure 6.** The 40x20x33cm (16”x8”x13”) dunn colored watertight case in this photo contains a time lapse camera capable of photographing sea lions on the haulout below for approximately 6 months at a time without requiring servicing. Not visible, a single solar panel (approximately 60x60x90mm) hangs below the camera, collecting energy from the sun and increasing the battery life. We propose to install similar systems at Seal Rocks. Time-lapse cameras allow us to monitor post branding activities, provide data for our vital rates studies, document seasonal site use based on sex, age, and natal rookery (through photographs of branded animals), and year-round presence/absence.
Figure 7: Time-lapse cameras (the 40x20x33cm dunn colored watertight cases in these photos) can be mounted in pairs, using the same base, with each camera trained on a different portion of the haulout. This method keeps the overall footprint the same so we are obtain double the data without doubling the impact. The best method for securing cameras is by drilling and bolting into the rock, but in areas where that is not permissible we have had to resort to using adhesive or epoxy to secure our base, and removable climbing gear (e.g. pitons, nuts, cams, etc) wedged into existing cracks to secure our guywires.

COLLECTIONS

The only collection associated with our study is that of digital photos of the study site and any animals that are in the camera’s field of view. All photos will be copied to archival discs and stored at ADF&G in Anchorage, AK.
LITERATURE


