Harbor Seal Research in Glacier Bay National Park

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Abstract. Harbor seals (*n*=79) were captured and a subset were fitted with VHF and satellite tags, and dive recorders in 2004 during the first of a multi-year study addressing potential causal factors contributing to their precipitous decline in Glacier Bay. Preliminary analyses suggest that harbor seals generally tend to forage near their haul-outs during the spring and summer; however, during fall and winter some seals made more extensive movements outside of the park.

Introduction

Glacier Bay National Park has historically supported one of the largest breeding populations of harbor seals (*Phoca vitulina richardii*) in Alaska. Harbor seals are an important apex predator and the most numerous marine mammal in the park; however, seals have declined by more than 70 percent in the park since 1992 (Mathews and Pendleton, 2006). The magnitude and rate of decline exceed all reported declines of harbor seals in Alaska, with the exception of that at Tugidak Island (Pitcher, 1990), and show no signs of reversal despite the implementation of various management strategies (e.g., reduction in commercial fishing, cessation of subsistence harvest, vessel restrictions). In contrast to the population trend in Glacier Bay, harbor seals in two other areas of southeastern Alaska (near Sitka and Ketchikan) are stable or increasing (Small and others, 2003).

In 2004, a long-term multi-agency study was initiated intended to identify potential causal factors contributing to the decline by collecting data on a diversity of ecological, behavioral, and physiological parameters. As part of the first year of this effort, harbor seals were captured in spring and autumn and fitted with either (1) long-term (5-year) VHF implant transmitters to quantify 'vital rates', including survival and reproductive success, (2) external VHF transmitters and Time Depth Recorders (TDRs) to address fine-scale movements, habitat use, foraging ecology, and dive behavior, or (3) Satellite Depth Recorders (SDRs) to assess large-scale movements and winter dive behavior. Here we describe the number of seals captured during 2004 and the type of instruments deployed on a subset of those seals. We also provide preliminary analyses of movements of seals in and outside the park during summer/autumn 2004. Data on a diversity of other parameters that will help provide insight into the causal factors associated with the decline in harbor seal numbers observed in Glacier Bay—data such as survival, diet, health and condition, genetics, available forage, disturbance, and contaminants—will continue to be collected and analyzed over the next 6 years.

Methods

Harbor seals were captured using multifilament nylon nets at terrestrial (reef) sites, and monofilament nets that are less detectable in glacial silt were used in ice (glacial iceberg) habitat. Biological samples (blood, skin, hair, blubber biopsies) were collected from all captured seals to assess health, condition, contaminants, diet (fatty acid profiles of blubber and stable isotope signatures from blood and hair), disease exposure, immunocompetency, and genetics. VHF transmitters (Telonics IMP 300-L) were surgically implanted under the skin and blubber layer of harbor seals (Lander and others, 2005). VHF implant transmitters were equipped with mortality sensors and, to extend battery life for 5 years, emit a signal only from 10:00 to 14:00 when seals are most likely to be hauled out and more easily located. VHF implant transmitters allow for long-term monitoring of vital rates, such as survival, as individual animals can be monitored via radio tracking for up to five years. To facilitate long-term monitoring, land-based datalogger stations (Advanced Telemetry Systems, R4500S) were established in Johns Hopkins Inlet and near Spider Reef Complex to continuously monitor the presence/absence of radio-tagged seals.

Other seals were fitted with external head-mounted VHF transmitters, which emit a signal continuously. Head-mounted VHF transmitters were deployed to determine foraging locations, behavior, and habitat use of harbor seals within the park. Some seals also received archival Time-Depth Recorders (TDRs; Wildlife Computers, MK-9). TDRs were programmed to record depth, temperature, and light every two seconds. TDRs were shed during the molt and recovered using vessels, floatplanes, and kayaks. Data from TDRs quantify the dive behavior of harbor seals and, coupled with foraging locations, will elucidate fine-scale foraging behavior and identify important foraging habitat.

Foraging areas of harbor seals were determined by conducting real-time VHF-tracking of seals from the R/V *Capelin* and from aerial surveys. Vessel surveys occurred during 4-day periods every other week from May to July in 2004 (*n*=25 days). Aerial surveys were conducted every other week to obtain better spatial coverage. During vessel-tracking

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surveys, radio frequencies were scanned continuously. When a radio signal was detected, an attempt was made to visually locate the harbor seal on the surface of the water. GPS tracks and behavioral observations were recorded while following foraging seals. Seals were followed for at least 1 hour to ascertain their behavior. Foraging locations of harbor seals will ultimately be paired with dive behavior to provide fine-scale foraging ecology data for harbor seals in Glacier Bay.

Finally, during the autumn capture trip, a subset of harbor seals were fitted with externally attached Satellite-Depth Recorders (SDRs) that record data on location and dive behavior, and are up-linked to ARGOS satellites. SDRs provide important information about large-scale movements during the fall and winter (e.g., to and from the park) that cannot be efficiently obtained from the VHF transmitters.

Results

Capture Effort

During the spring capture trip (April 10-24) a total of 33 seals were captured at terrestrial haulout sites. Twenty-one seals received VHF implant transmitters. Sixteen seals (11 females, 5 males) were equipped with external VHF transmitters; 10 of those females also received TDRs. The majority of captures occurred within the Beardslee Islands with some captures at Leland and Boulder Islands, and Geikie Rock. Nine of 10 TDRs were recovered after they were molted (late June and July). Data from the TDRs are currently being analyzed to determine dive behavior.

During the fall capture trip (September 26 to October 8) the majority of capture effort was in Johns Hokins Inlet with 42 of 46 seals captured there, including many young-of-the-year. In addition to captures in Johns Hopkins Inlet (JHI), four harbor seals were captured near Kidney Island in the Beardslee Islands. Twenty-nine seals received subcutaneously implanted VHF transmitters. Thus, combining the spring and autumn trapping efforts, a total of 25 seals from each habitat (ice, terrestrial) were fitted with implant transmitters in 2004. In addition, six seals (five captured in JHI, one off Kidney Island) received an SDR.

Capture activities had no discernable effects on the behavior or health of seals. Seals fitted with implant and VHF transmitters were often observed hauling out at the same areas where they were captured, within hours or days after they were released. VHF tracking surveys from airplane and boat revealed that seals regularly hauled out at the sites of capture throughout the summer. Furthermore, all pregnant females captured during April were later seen with pups during tracking efforts indicating that capture efforts likewise had no effects on pupping or mother-pup interactions.

Preliminary Analysis of Movements

During April–July 2004, a total of 424 radio-telemetry locations were obtained on 15 of 16 (94 percent) seals with VHF headmounts and 19 of 21 (90 percent) seals with VHF implants. Most harbor seals tagged with head-mounted VHF transmitters generally remained in the lower bay near haulouts in and around the Beardslee Island Wilderness Complex (fig. 1). However, there were several large scale movements of seals within the park. One adult female, pregnant when she was captured in April, moved from her haulout sites in the lower bay to Johns Hopkins Inlet (JHI) and was observed there with a pup (fig. 2). A yearling female and a yearling male also moved from the lower bay to JHI, and one subadult female moved to Adams Inlet. Each of

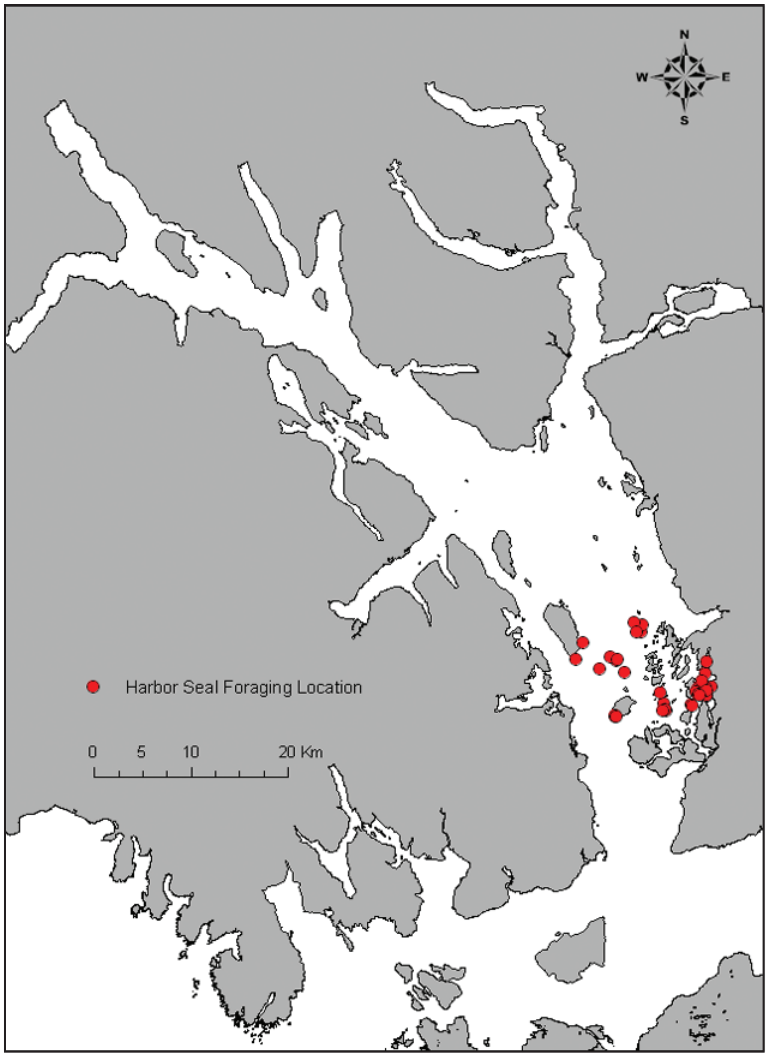

Figure 1. Foraging location of seals captured at terrestrial sites in the lower Glacier Bay in April 2004. Locations represent data collected May-July.

these seals was observed again in the Beardslee Island later in the summer.

Of six seals outfitted with SDRs in September/October 2004, only two remained within the park as of October 18, 2004. With the exception of the seal tagged in the Beardslees (an 18-year-old male), all other SDR-tagged seals traveled beyond Glacier Bay during the winter (fig. 3) and four seals spent the majority of their time outside the park. One subadult male remained in Icy Strait. A yearling female ventured from Cross Sound and the outer coast of Yakobi Island to Whitestone Harbor, Chichagof Island. One adult female traveled as far as Berners Bay when salmon were known to be running in that area (~ 300 km from John Hopkins where she was captured) An adult female spent the majority of the winter in Port Frederick, returning to Adams Inlet in Glacier Bay the following spring (fig. 3).

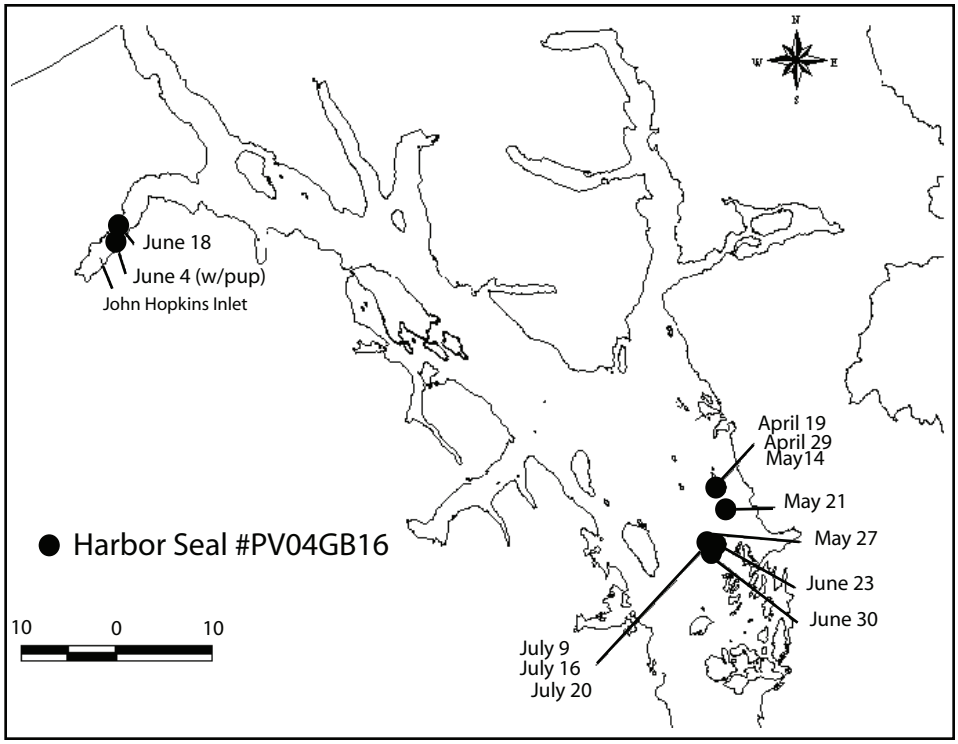

Figure 2. Migration of a pregnant female harbor seal #PV04GB16 captured in April at Leland Island. The harbor seal moved to Johns Hopkins Inlet where she was observed with a pup and later returned to the lower bay.

Focal Animal Observations

From April to July 2004, 36 focal observations were made of 15 of 16 harbor seals with VHF headmounts. A total of 44 percent of focal observations were made around Hutchins Bay/Kidney Island area, suggesting that this area serves as important foraging habitat for harbor seals. All seals (6 females and 1 male) observed foraging in Hutchins Bay were captured at Kidney Reef, suggesting that seals in the lower bay do not forage far from their haul-out sites. Four of six females were pregnant when captured and all were later observed with pups in the Hutchins/Kidney Area. An additional 22 percent of the focal observations were made around South Willoughby/Boulder Island area and included 4 seals (3 females and 1 male), 3 of which were captured at Boulder Island and one at Geikie Rock. Other areas where focal observations were made include Eider/Spider Island area (14 percent), Flapjack Island (11 percent), and south Strawberry Island (8 percent).

Discussion and Conclusions

Analyses of habitat use and identification of critical foraging areas for seals that were radiotagged in April 2004 is ongoing and data presented here are preliminary. Foraging ecology studies will continue in 2005 and 2006 and ultimately locations will be integrated with dive data to provide fine-scale foraging ecology information and considered relative to vital rates, body condition, vessel traffic, and other potential causal factors associated with the decline.

Management Implications

This long-term multi-agency project will ultimately examine vital rates, movements, disturbance, contaminants, diet, health and condition, genetics, and available forage for harbor seals in the park, using a variety of methods and field equipment. These data sets will be integrated to address a suite of questions including whether seals with certain parameters (e.g., a particular diet, forage in a particular area, low body fat, elevated liver enzymes, high contaminant loads, genotype, etc.) have lower survival or reproductive rates, delayed maturation, or are more likely to leave the park. These results will also be compared with similar parameters of harbor seals in Prince William Sound and other areas. Results of this and related studies will (1) contribute to our understanding of the ecology, behavior, and life-history of harbor seals which is central to understanding causative factors in the decline and thus proper management, (2) be used to evaluate whether vessel-traffic restrictions (cruise ship, tour boat, private boat, kayak) around breeding areas are sufficient for protecting foraging habitat, and (3) produce bioenergetic models necessary to evaluate whether disturbance is sufficiently frequent and severe to adversely influence population fitness.

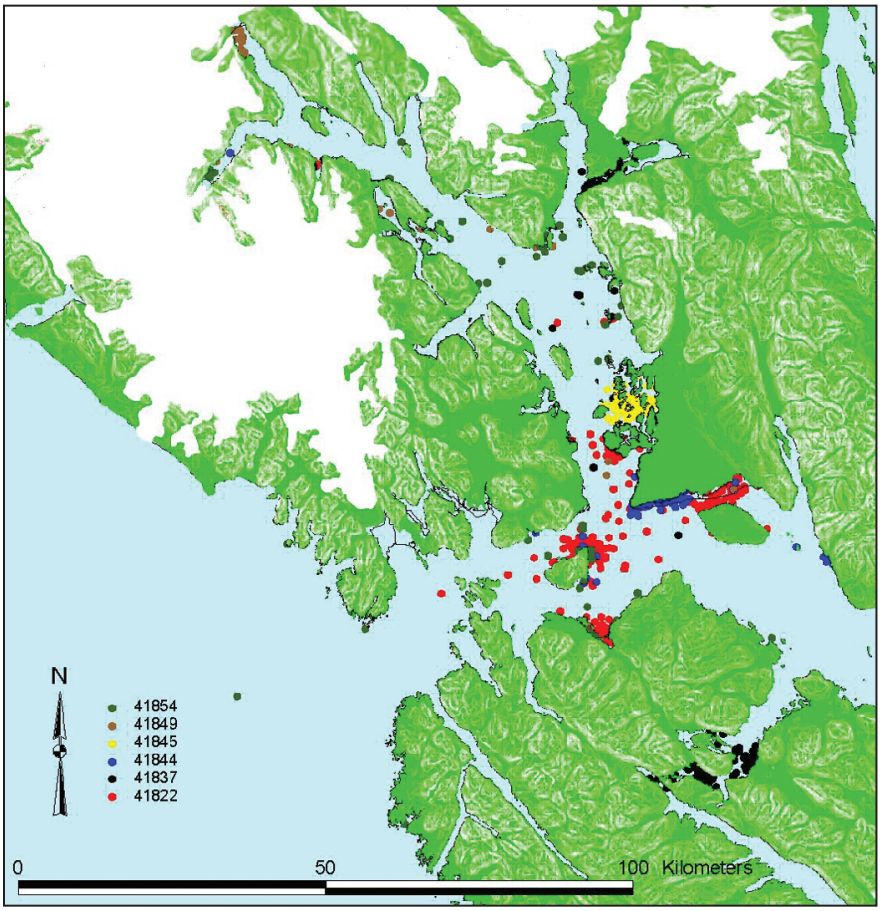

Figure 3. Movements of harbor seals as determined by satellite-linked depth recorders (SDRs). Seals were captured in Johns Hopkins Inlet (n=5) and in the Beardslee Islands (n=1) in September-October 2004. An 18-year-old male remained within the Beardslee Islands where he was captured. All other seals ventured outside of the park during the winter, with four seals spending the majority of the winter elsewhere. Several SDRs continued transmitting until May 2005.

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