

# Over-winter migratory behavior of juvenile harbor seals from Glacier Bay National Park



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## Background

- About 10% of the harbor seal population in Alaska is associated seasonally with glacial ice calved from tidewater glaciers.
- Little is known regarding the over-wintering migratory behavior of seals that occupy glacial fiords during summer.
- Glacier Bay is a recently deglaciated fiord comprised of several tidewater glaciers and historically has supported one of the largest breeding aggregations of harbor seals in Alaska.
- From 1992-2002, numbers of harbor seals declined by over 60% in Glacier Bay National Park (Mathews & Pendleton 2006, *Mar. Mamm. Sci.* 22).

## Objectives

- Our objectives were to assess the over-winter migratory behavior of juvenile female harbor seals captured in Johns Hopkins Inlet (JHI) in Glacier Bay National Park (GBNP).

## Methods

- In 2006 Sept, juvenile female harbor seals (n = 15) were captured in JHI in GBNP.
- Seals were equipped with head-mounted satellite transmitters (Spot 5, Wildlife Computers) that collect location and haulout statistics.
- Satellite transmitters were programmed to transmit for 24 hours every other day (duty cycle), yielding a 270-day battery life expectancy.

## Data Filtering & Location Accuracy

- Data were filtered using the **Douglas Argos-Filter Algorithm** which ingests satellite tracking data and removes implausible locations based on distance, velocity, and turning angle thresholds.
- The following parameters were applied to the filtering algorithm:
  - spatial redundancy = 5 km
  - maximum sustainable rate of movement = 10 km/hr
  - always retain Argos location class qualities  $\geq 1$

Table 1. Argos satellite locations by location quality-class before and after accuracy filtering.

Argos Location Class	Estimated Accuracy (meters)	All Argos locations		All filtered locations		Best filtered location/duty cycle	
		N	%	N	%	N	%
3	<150 m	799	12.6%	799	13.8%	442	57.0%
2	150 m < 350 m	868	13.7%	868	15.0%	155	20.0%
1	350m < 1000 m	658	10.4%	658	11.4%	68	8.8%
0	> 1000 m	263	4.2%	219	3.8%	14	1.8%
A	no estimate	1283	20.3%	1166	20.1%	61	7.9%
B	no estimate	2403	38.0%	2059	35.5%	33	4.5%
Z	invalid location	34	0.5%	25	0.4%	0	0.0%
<b>Total</b>		<b>6323</b>	<b>100.0%</b>	<b>5794</b>	<b>100.0%</b>	<b>775</b>	<b>100.0%</b>

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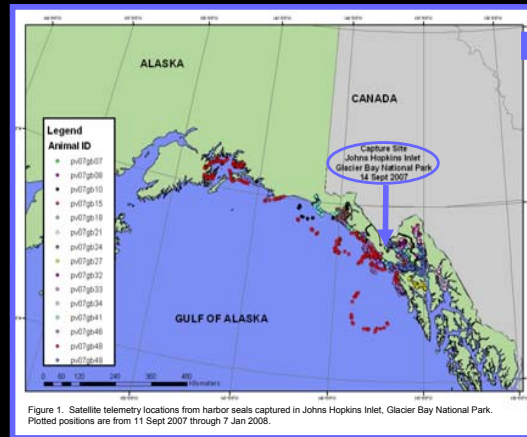


Figure 1. Satellite telemetry locations from harbor seals captured in Johns Hopkins Inlet, Glacier Bay National Park. Plotted positions are from 11 Sept 2007 through 7 Jan 2008.

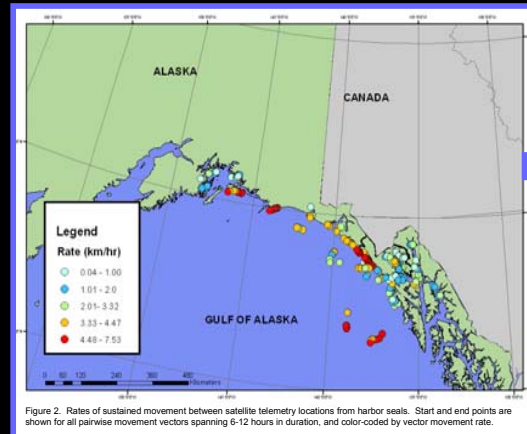


Figure 2. Rates of sustained movement between satellite telemetry locations from harbor seals. Start and end points are shown for all pairwise movement vectors spanning 6-12 hours in duration, and color-coded by vector movement rate.

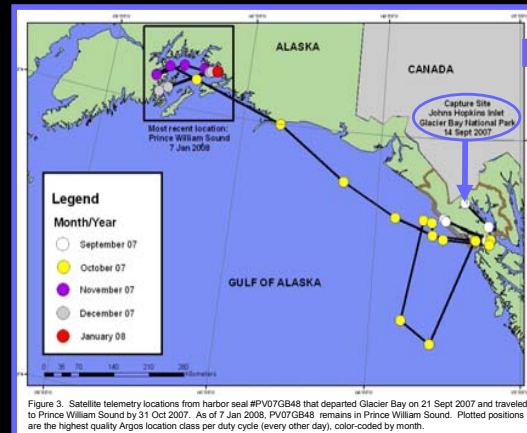


Figure 3. Satellite telemetry locations from harbor seal #PV07GB48 that departed Glacier Bay on 21 Sept 2007 and traveled to Prince William Sound by 31 Oct 2007. As of 7 Jan 2008, PV07GB48 remains in Prince William Sound. Plotted positions are the highest quality Argos location class per duty cycle (every other day), color-coded by month.

## Over-winter Migratory Patterns

- Multiple over-winter migratory patterns have emerged and include movements by seals to Lynn Canal (n = 4), Taku Inlet (n = 1), and Tenakee Inlet (n = 1) in northern Southeast Alaska (Figure 1).
- Some harbor seals made more extensive movements to areas in the Gulf of Alaska (GOA) including Yakutat Bay (n = 4), Icy Bay (n = 2), outer Baranof Island (n = 1), and Prince William Sound (n = 1) (Figure 1 & 3).
- Three harbor seals have remained within the Glacier Bay/Icy Strait area; however, none of the seals have reoccupied the capture site in JHI.
- The mean cumulative distance traveled from 15 Sept 2007 to 7 Jan 2008 was 1152 km  $\pm$  433 (range 522-2162 km) (Figure 4).
- Average distance between the highest quality location per duty cycle (every other day) was 22 km  $\pm$  29 (range 0-218 km) and began to decline in November (Figure 5).

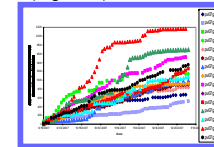


Figure 4

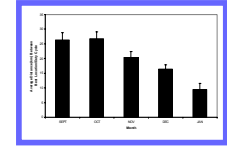


Figure 5

## Rates of Travel Relative to Oceanographic Features

- Rates of sustained movement by seals were highest ( $\geq 4.48$  km/hr, Figure 2) primarily along the northwest coast of the GOA near the Sitka Eddy where swimming was likely assisted by surface currents (Figure 6).
- Eddies in the GOA have been shown to influence the foraging and travel patterns of other upper-trophic level predators (Ream et al. 2005, *Deep-Sea Res. II*, 52).
- Slower rates of travel occurred primarily in protected inside waters, bays, and fiords.

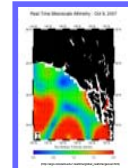


Figure 6

## The Longest Migration: Glacier Bay to Prince William Sound

- Seal # PV07GB48 traveled from Glacier Bay (GB) to Prince William Sound (PWS), an estimated cumulative distance of 1717 km from 21 Sept 2007 to 31 Oct 2007 (Figure 3).
- Migratory Timeline for Seal #PV07GB48**
  - 14 Sept 2007: Seal is captured in JHI and equipped with transmitter.
  - 21 Sept 2007: Seal departs GB.
  - 23-27 Sept 2007: Seal makes first foray to continental shelf margin.
  - 7-9 Oct 2007: Seal makes second foray to continental shelf margin near the Sitka Eddy.
  - 11-19 Oct 2007: Seal remains in Gulf of Alaska.
  - 23-29 Oct 2007: Seal travels from Cross Sound area to Cape Suckling.
  - 31 Oct 2007: Seal enters PWS.
  - 7 Jan 2008: Seal remains in Port Gravina in eastern PWS.

- This extensive migratory movement by seal # PV07GB48 exceeds movements previously documented for harbor seals in Southeast Alaska.