**Summary**

The timing of pupping and lactation are related to a species' life history traits, and to maternal strategies to maximize energy transfer to offspring while minimizing other threats. Shifts in timing, can influence environmental and demographic changes with implications for survival. Though individual-based studies are most informative, they are logistically complicated and prohibitively expensive and recently tested proxies for timing of breeding from cross-sectional sampling have shown to be useful. Using aerial photography, we developed a non-invasive method for estimating the timing of breeding at harbor seal (Phoca vitulina richardii) pupping sites in Alaska, which is the halfway point of the pupping season, and this method provides an alternative to methods at terrestrial sites that involve repeated sampling. We used aerial photographs to develop a non-invasive method and estimate the timing of pupping and weaning, which is the halfway point of the pupping season.

**Background**

Harbor seals (Phoca vitulina) haul out on ice calved from glaciers. Mothers nurse their precocial pups on the ice for 2-4 weeks, though estimates to date are based on studies at terrestrial sites only.

The glacial ice fields of Icy and Disenchantment Bays, near Yakutat, Alaska, host some of the largest aggregations of harbor seals in the world. Disenchantment Bay is visited by over 150 cruise ships during pupping and molting; only a few tour ships visit Icy Bay annually.

Despite outward similarity in the natural habitat of these adjacent fjords, observations point to some striking differences with respect to the seals and the environment:

- During the annual molt, Icy Bay hosts about 3X the number of seals as Disenchantment Bay; patterns in estimated abundance across 16 years at the two sites are similar (Fig. 1, left).
- During pupping, high-altitude photos suggest similar numbers of seals use the two sites but estimates of productivity seem to be dramatically lower at Disenchantment Bay; and
- Despite similar glacial cycles of seasonal advance and retreat, glaciers in Icy Bay are rapidly thinning and retreating (causing increased calving) while the dramatic lower at Disenchantment Bay is composed of a higher proportion of mothers in better condition which are able to pup earlier and nurse pups longer with less supplemental foraging. This method provides an alternative to methods at terrestrial sites that involve repeated sampling and tagging of animals, and represents the only practical means of studying ice-associated seals.

**Methods and Data**

A GPS-linked, Digital SLR camera mounted in a DHC-Beaver captured non-overlapping images (4 cm/pixel) every ~2 sec representing 80m X 120m ground coverage with a total ground coverage of 10-20%

About 30K pups (9700 pups) were mapped and measured over 49 surveys from May to July 2004 and 2005 @ Icy Bay, 34 @ Disenchantment Bay); 1712 pups were photographed suckling; 37 newborn pups were observed. Standard lengths were estimated by superimposing polyines over seals using 5 standard body anchor points (photo, left). Pups were first classified based on size (see below), and then confirmed by color and nursing behavior; mothers were classified based on relative size and association with pups.

**The Findings**

We found that the timing of pupping was earlier at Icy Bay (up to 7-13 days) compared to Disenchantment Bay (Figs. 4 and 5).

Our measure for progression of weaning (% pups unattended) points to mothers weaning pups more gradually at Icy Bay with pups expected to become independent later than Disenchantment Bay (Fig. 4).

**The Take Home**

It was surprising to find evidence that seals at seemingly similar and nearby glacial fjords differ in timing of breeding...will be explored to examine the potential errors caused by differences in sampling frequencies across sites and years.