LOCATION, LOCATION, LOCATION: IS THE LARGEST HARBOR SEAL HAULOUT IN THE WORLD ANY DIFFERENT FROM THE OTHERS?

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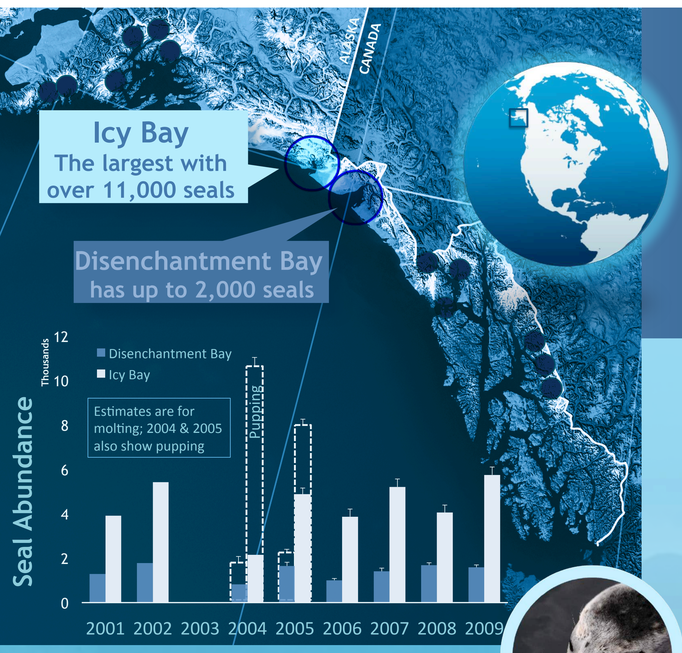
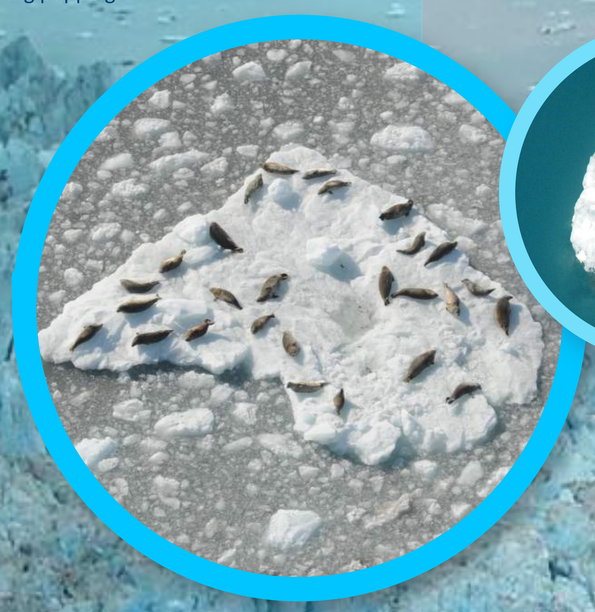


Abstract

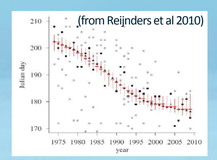
Harbor seals (*Phoca vitulina*) are a wide-ranging pinniped, occupying diverse habitats across the majority of coastlines in the northern Pacific and Atlantic oceans. One of the most remote places they inhabit is the northeastern Gulf of Alaska, a 500-km stretch of exposed coastline with sparse human settlements and few embayments. One of these, Icy Bay (IB: ice field apx. 75 km ^{2}), has tidewater glaciers that provide floating ice, supporting the largest aggregation of this species in the world (>11,000 seals). A nearby, much less abundant, glacial haul-out (Disenchantment Bay [DB: apx. 70 km ^{2}]; 2,000 seals) allows for a comparison of life history traits of the two populations and their ice habitat, to help explain the difference in use. We hypothesize that better habitat quality at IB promotes higher pup survival and ultimately population size. Using aerial-vertical photographs from 49 surveys over two years at the two sites, we mapped and measured the lengths of about 30,000 seals, including about 10,000 pups, and characterized their ice habitat. We found peaks in ice coverage corresponding to the early pupping period (mid-May) followed by a seasonal decline; IB consistently had twice the ice coverage, and ice bergs used by seals were twice the size of those in DB. Growth rates of pups were similar, but pupping phenology was advanced by 7-13 days at IB. Larger mothers tended to pup earlier; those at IB left pups unattended (an indication of weaning) later compared to DB. Our findings suggest that IB supports more seals due to more reliable ice conditions for hauling out. Over time, this may have led to better condition and higher productivity of females, earlier breeding, longer lactation, and higher pup survival. Differential recruitment, immigration, and other effects stemming from disturbance could also favor IB, given that DB has ~100 annual cruise ship visits during pupping.



Background

Tidewater glacial fjords host some of the largest aggregations of harbor seals in the world, with the largest being in Icy Bay, Alaska, USA (see fig left). Factors leading to inter-site variation in abundance are poorly known but clues may be found by comparing seals' life history traits between sites with contrasting use. Life history traits, particularly those related to productivity, are expected to differ across such populations and could shed light on underlying differences in habitat quality (e.g., carrying capacity).

In previous studies, one such trait, timing of pupping, has been suggested as proxy for body condition of pre-parturient females, with rapid shifts in timing pointing to changes in habitat quality (see fig. at right).



(Figure shows a 3-week shift in max pup count over 3 decades)

Differences in timing of pupping may help explain differences in seal abundance between sites

Higher habitat quality (haulout, prey, predation) → Better female condition → Earlier parturition

- Longer lactation and/or greater milk delivery
- Bigger pups
- Better pup survival (i.e., population growth)

Phenology could be a useful tool for illuminating differences between populations across space similar to changes in a single population across time.

Hypotheses

- Higher quality habitat (foraging and/or haulout) at Icy Bay enhances female condition which in turn leads to earlier pupping, longer lactation, bigger pups, higher pup survival and ultimately a larger population.
- Better habitat would also directly benefit pups through more efficient nursing and energy conservation.

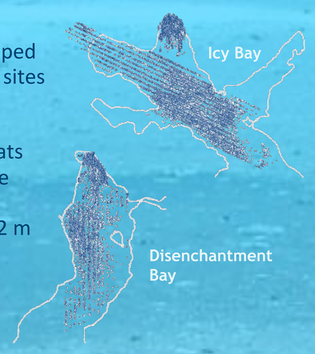
How'd we get the data?

Field Methods

- DHC-Beaver flew transects 200m apart at 1000 feet at 100 knots.

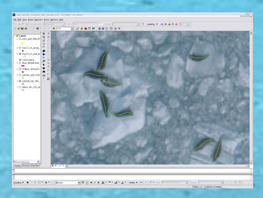
- A GPS-linked, digital SLR camera, mounted in belly port, captured images of 80m X 120m ground coverage at 4cm/px resolution every 2 sec.

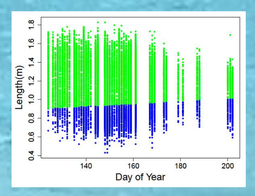
- N = 29,884 seals were mapped over 49 surveys at the two sites in 2004 & 2005. Usable ice cover was estimated by overlaying standard quadrats on images and counting the points that intersected ice suitable for hauling out (> 2 m longest dimension).



Analytical Methods

- Images were projected and scaled in a GIS, and seals' body lengths and the longest dimension of the ice were estimated by superimposing polylines.





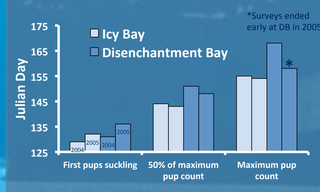
- Pups were discriminated using a sample of known pups (suckling; N = 1,099) in conjunction with length data on known yearlings (N=48); classification was improved by modeling pup growth.

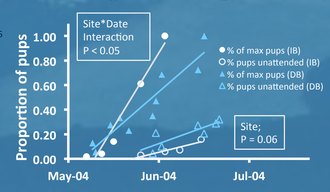
- Pups and yearlings close to the size threshold were inspected visually for differences in pelage color: gray seals were deemed pups; brown seals, yearlings.

What do the data say?

Timing of pupping

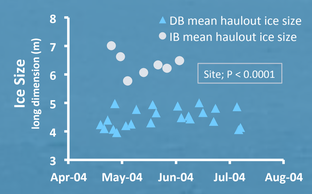
- Pupping was earlier at Icy Bay.
- Pups were left unattended earlier (pre-weaning) at Icy Bay.

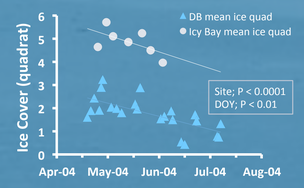




Ice habitat

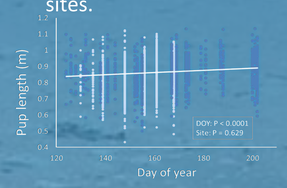
- Ice platforms were larger at Icy Bay
- Suitable ice cover was greater at Icy Bay





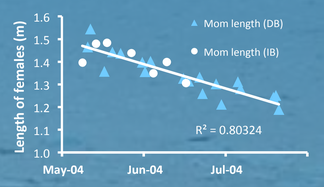
Pup growth

- Pup size and growth were not different between sites.



Female size

- Larger mothers gave birth earlier at both sites



Take home points

- More favorable ice conditions at Icy Bay could lead to better energy conservation and survival of all age classes but especially pups that are most vulnerable to heat loss.
- Overall advantages of the ice habitat at Icy Bay could over decades result in significant differences in population size compared to less advantageous sites.
- Measuring phenology as a tool for population monitoring merits further testing, especially in populations believed to be declining.
- Human influence in glacial fjords, especially vessel tourism, may compound impacts on populations already challenged by climate-driven habitat degradation.

Future data needs.....

- Empirical data on female and pup condition, possibly using a proxy for girth from vertical imagery.
- Telemetry data on where and how foraging occurs prior to parturition and possibly during nursing to learn about possible differences in foraging habitat.

Photos by: John Jansen and Dave Withrow

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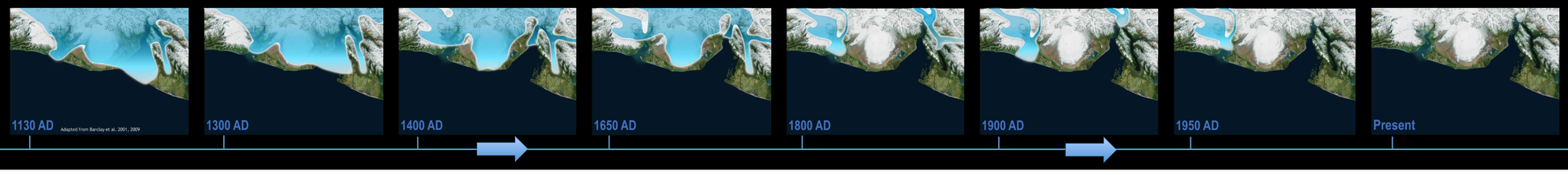
A Glacial Perspective

Looking back 900 years, studies of glacial dynamics present a different picture of these habitats, revealing a complex interplay between glacial movement (advancing or retreating) and the amount of ice usable by seals. Historically, there were periods when either or both bays were not suitable for hauling out on ice, and other periods when – unlike today – Disenchantment and Yakutat bays formed a much larger seal haulout, with likely much larger ice cover and many times more seals than currently at Icy Bay.