EBBS AND FLOES OF SEALS

USING AERIAL PHOTO-MOSAICS TO TRACK CHANGES IN ABUNDANCE OF HARBOR SEALS ON ICE

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1 How hard can counting be?

Quite. Seals hauled out on ice are more difficult to count than those on land because • Seals are on constantly shifting ice • Seals are often dispersed over large areas, up to 100 sq km • Glacial haulouts can have more than 1000 animals • When surveyed from land seals can be obscured by rough ice • Glacial fjords are remote and difficult to access • Present methods rely on statistics for "missed seals".

2 Are glacial seals important?

Yes. Tidewater glacial fjords in Alaska are habitat for the largest aggregations of harbor seals in the world, many numbering in the 1000s • These sites are important whelping, nursing and molting areas • Glacial seal populations, such as in Glacier Bay, have inexplicably declined in recent decades • Glacial haulouts represent up to 15% of Alaska's statewide abundance • These seals are an essential cultural and nutritional resource for many Alaska Native people.

3 Why bother with a new method?

Because of challenges in counting seals at glacial sites, and no standard method, there is not an adequate time series from which to determine the conservation status of seals • Current methods (e.g., sampling or visual estimates) result in counts with large margins of error • These sites are increasingly being disturbed by tour vessels with potential survival risks to pups • Most glaciers are receding rapidly and may soon ground • There is a need for a cost-effective, timely, and reproducible method that also tracks ice cover.

4 A new method: 1 plane | 2 altitudes | 2 pilots | 3 ice haulouts | 3 cameras | 3 days | 6 total counts

The DHC-6 Twin otter is great for tight turns and slow speeds

1400 & 2500 ft (that's 427 & 762 m)

the 3 furthest south in Alaska 90 to 200 km south of Juneau

Off-the-shelf Canon EOS MKIIIs 21 MP!

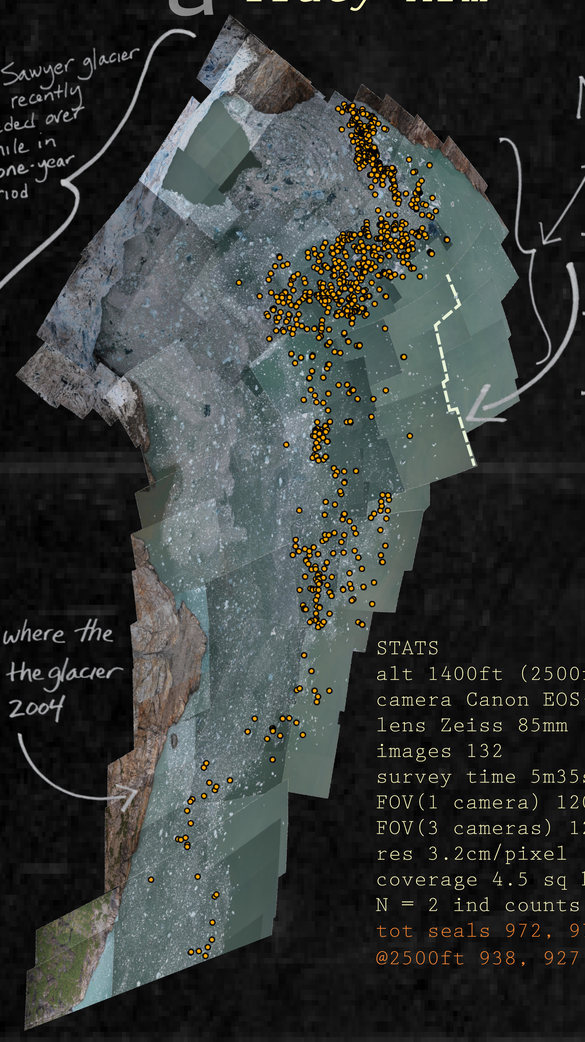
20-22 Aug 2010 (during seal molt) 1200-1600 h

2 @ each site

The gist:
- We used an array of 3 off-the-shelf digital cameras to photograph the entire floating ice habitat in wide swaths over 2 or 3 aerial transects
- We completed surveys in a few minutes thus minimizing ice movement, allowing for a mosaic to be constructed, and eliminating the errors of missing or double counting seals
- We flew at two altitudes to assess effects on image quality and thus countability; each image was counted twice by independent observers.

a *Tracy Arm*

S. Sawyer glacier has recently receded over a mile in a one-year period



Here's where the face of the glacier was in 2004

Mosaic methods
- merge 5-6 images/block in Photoshop (50-75 mb)
- stitch blocks together along seams of the camera array in ArcMap
- need 15-20 overlapping ice features (control pts) to create a accurate seam
- scan full mosaic marking the location of each seal

● = seal location

STATS
alt 1400ft (2500ft not shown)
camera Canon EOS-1Ds M3
lens Zeiss 85mm
images 132
survey time 5m35s
FOV(1 camera) 120x181m
FOV(3 cameras) 120x~500m
res 3.2cm/pixel
coverage 4.5 sq km
N = 2 ind counts
tot seals 972, 970
@2500ft 938, 927

b *Endicott Arm*

more recently it's not uncommon to find no ice floating in Endicott

STATS
alt 2500ft
images 61
survey time 4m51s
FOV(1) 215x323m
FOV(3) 215x~900m
res 5.7cm/pixel
coverage 2.9 sq km
N = 2 ind counts
tot seals 242, 244

Comparison of images @ different altitudes

2500ft

vs

1400ft

c *LeConte Bay*

During the 90's LeConte glacier was the fastest receding in N. America (since 1996 the face is more than 120m shorter!)

STATS
alt 2500ft
images 191
survey time 4m50s
FOV(1) 215x323m
FOV(3) 215x~900m
res 5.7cm/pixel
coverage 6.5 sq km
N = 2 ind counts
tot seals 1979, 1980

5 New counts vs old counts

Seal abundance appears to be increasing at Tracy and LeConte but declining at Endicott. These data, combined with observations of changes in ice cover, suggest that glacial calving rates influence habitat use by seals.

	Year				
Haulout Area	1993*	1997*	1998*	2002	2010
Tracy Arm	149	690		427	972
Endicott Arm	260	970		470	244
LeConte Bay	546		1085	1904	1980

** Prior to 2002 seal numbers were estimated visually by plane and are more prone to observer biases than subsequent counts from aerial images comprising full coverage. Values above are max counts during August surveys.*

6 What we found, learned, or otherwise discovered

- ***Logistical lessons:*** The Twin Otter, and 3-camera array, were effective tools for collecting aerial imagery in a challenging environment. The plane and pilots performed beyond expectations and the camera system worked smoothly allowing for high quality imagery over a sizable area in a short time.
- ***Analytical lessons:*** Seals were seemingly more "countable" at 1400 vs 2500 ft, as reflected in the increased counts at higher resolutons, but increases were < 3%. There is a greater time investment in creating a mosaic of images at 1400ft (16-24 hrs) vs 2500ft (8 hrs); counting took 3-6 hours depending on workstation speed and number of seals.
- ***What we learned:*** Seals that use glacial fjords must adapt to dramatic changes in ice cover across decadal and even daily time scales. Rapid recession of glaciers at Tracy and LeConte has resulted in reportedly high ice concentrations in recent years and new habitat which corresponds with highest abundance. These new areas of high density ice may provide some insulation against disturbance by tour vessels - which is a concern at Tracy Arm (~300 vessel visits/yr), is becoming a concern at Endicott (vessels divert there when Tracy is inaccessible), and is not yet a concern at LeConte (vessel traffic is likely low but is not monitored).

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