Estimated annual calving rate indices for Cook Inlet beluga whales 2005-2009

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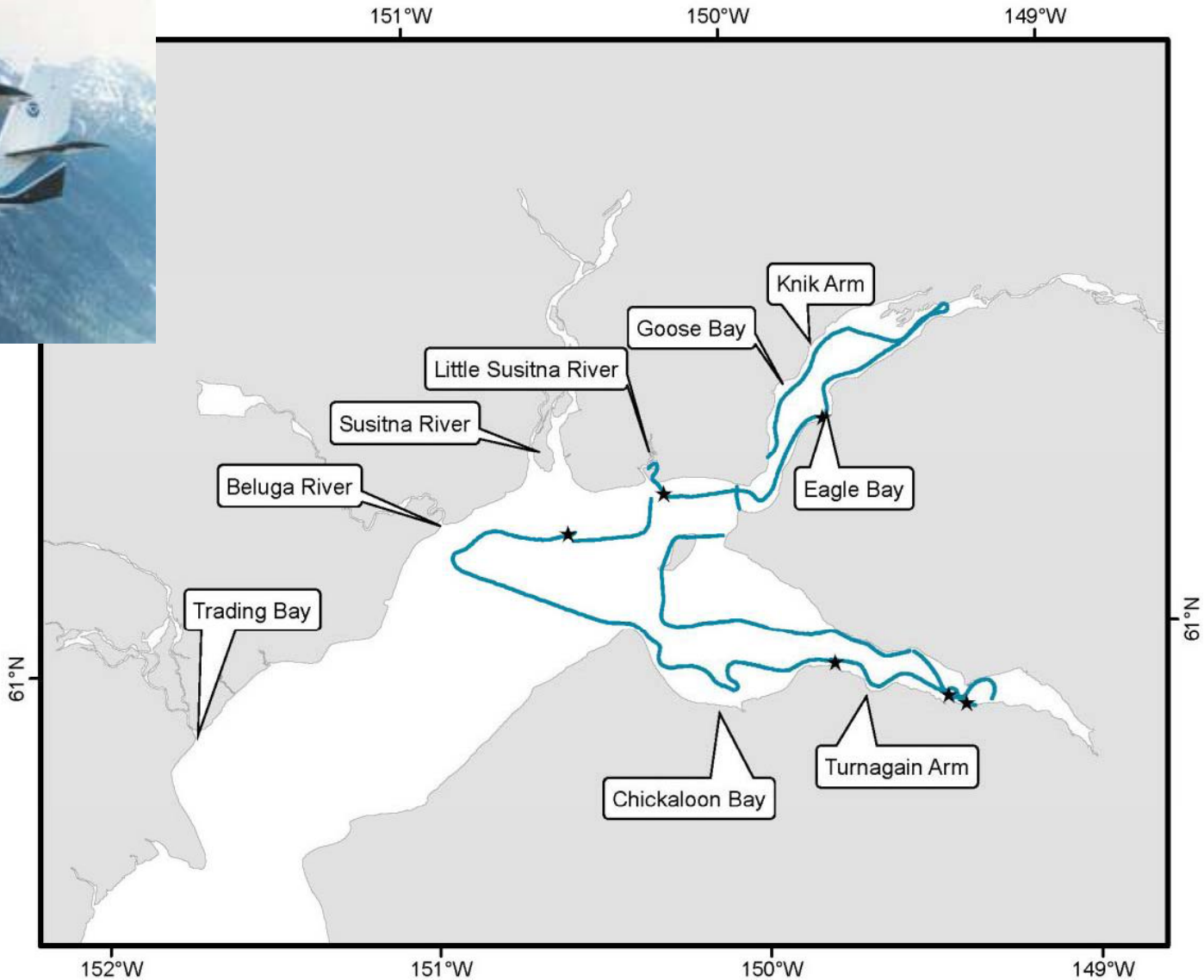
19 August 2010 survey upper Cook Inlet

Blue lines indicate flight paths

Black stars indicate groups

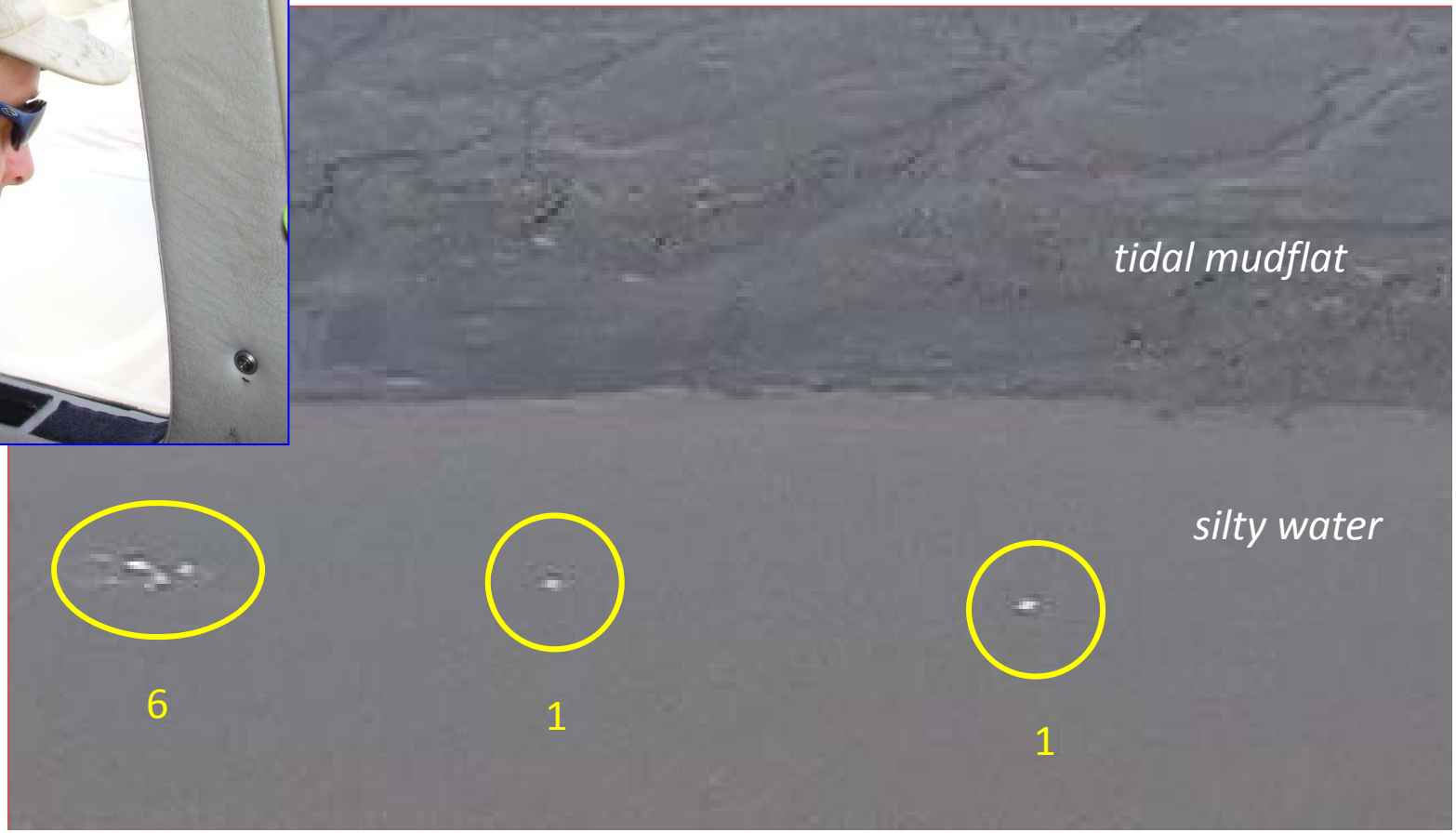


Belugas in upper Cook Inlet as seen from the air.

Once a group is found it is circled and counted 4-10 times to get muliple counts and video records.

Two independent observers search simultaneously for whales and whale groups

How many belugas are in that group?



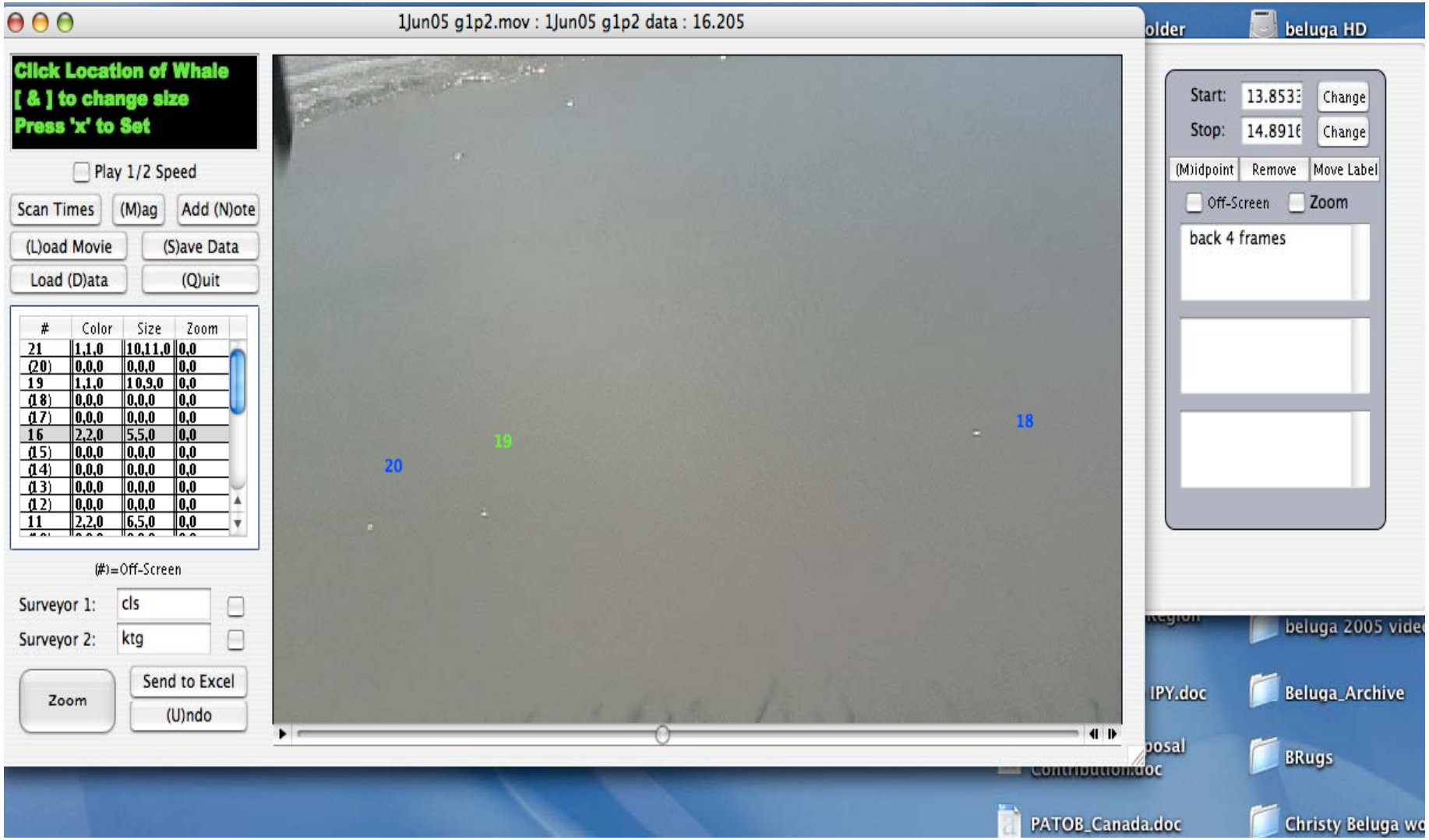
Video data and analyst counts

- A wide angle video records the entire group
- A zoomed video records a sub sample of the group
- Two analysts count whales independently from video records
- 4-8 passes of a group result in 4-8 video records of the group and 8-16 counts of the group by analysts

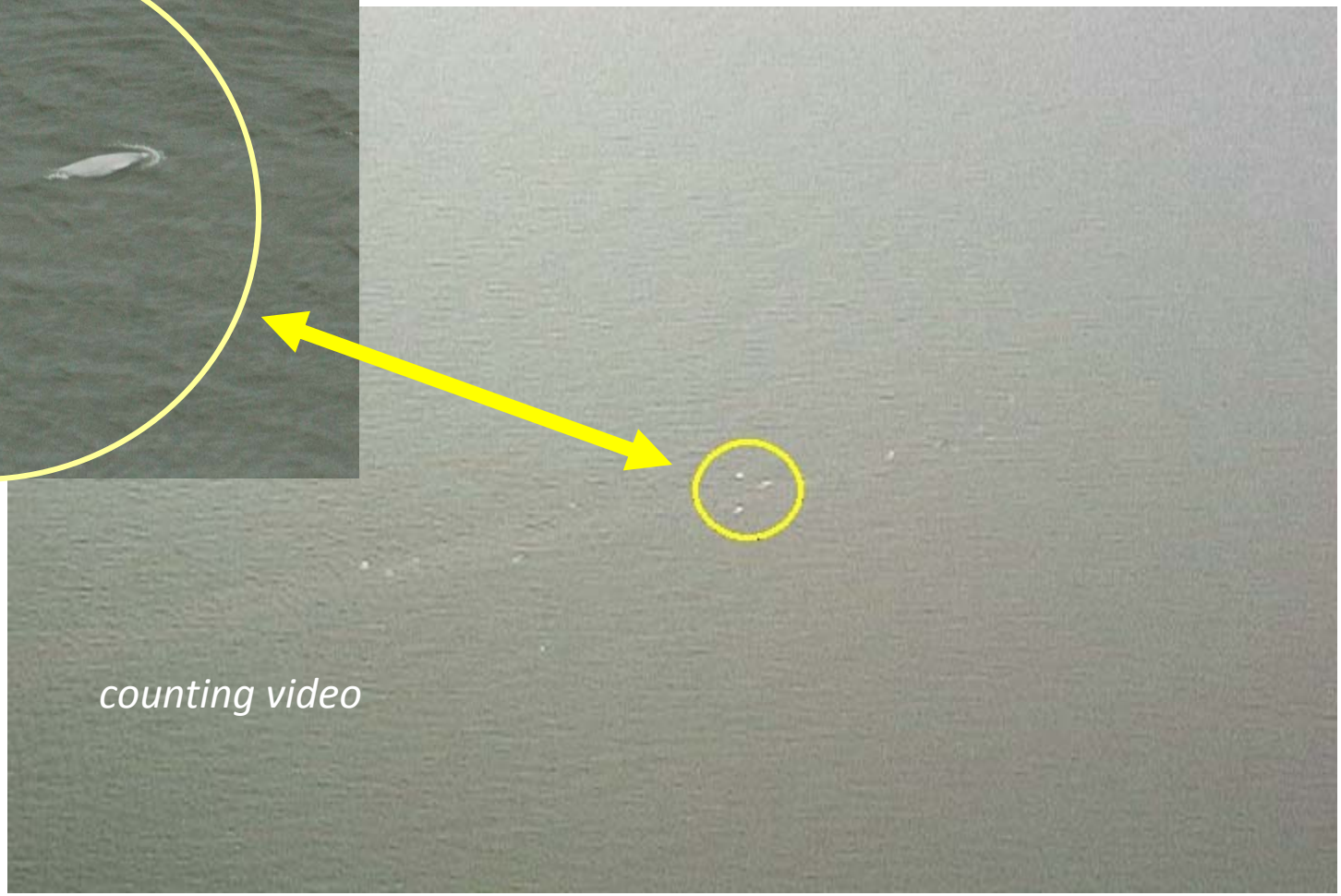
Paired wide angle and zoomed video cameras provide a consistently nested view of the entire beluga group and a high resolution sub sample of the group

Collecting video

Computer-enhanced counts of belugas from video data: repeatable and documented



Images from zoomed video are compared to the counting video to determine the fraction missed due to image size

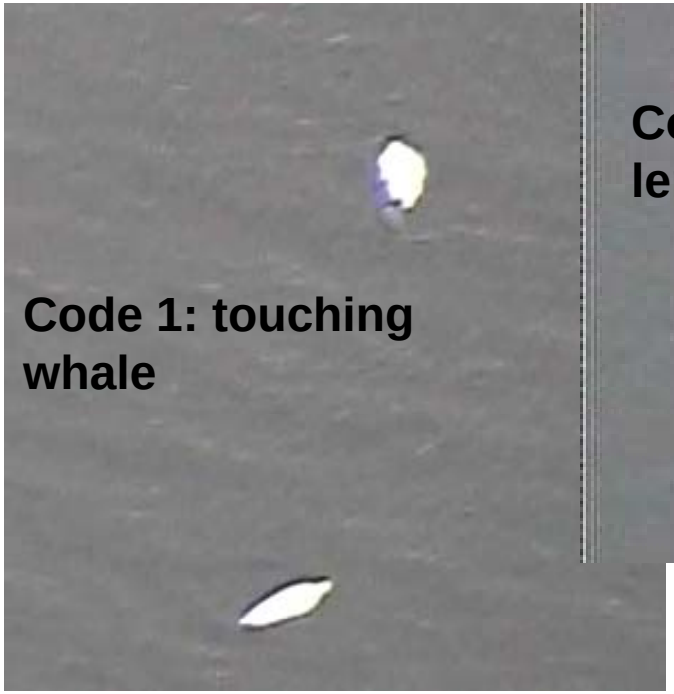


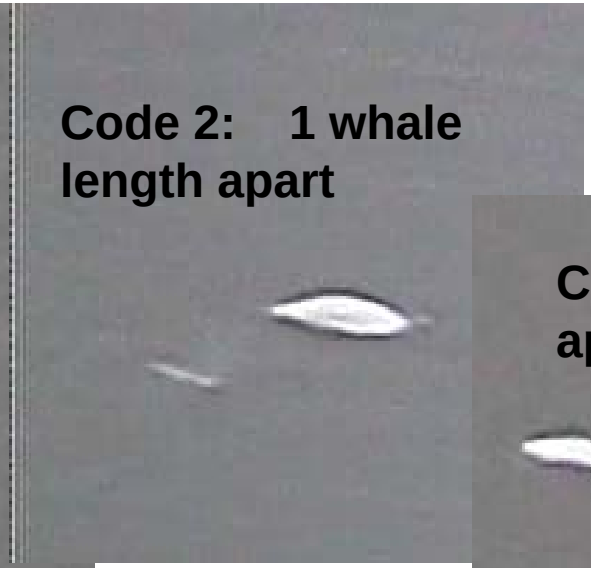
Light and dark gray whales are clearly visible in the zoomed video (note that the dark whale would have been missed in the counting video)

Clues that an image represents a calf

- Image size: Calf length is half to 2/3 of adult length. View angle oblique and only portion above surface visible.
- Image color: Usually dark gray but light color calves are seen and dark juveniles and young adults have been seen.
- Proximity to adult: Young of the year calves are closely associated with adults.

Beluga Colors


Code 1: touching whale

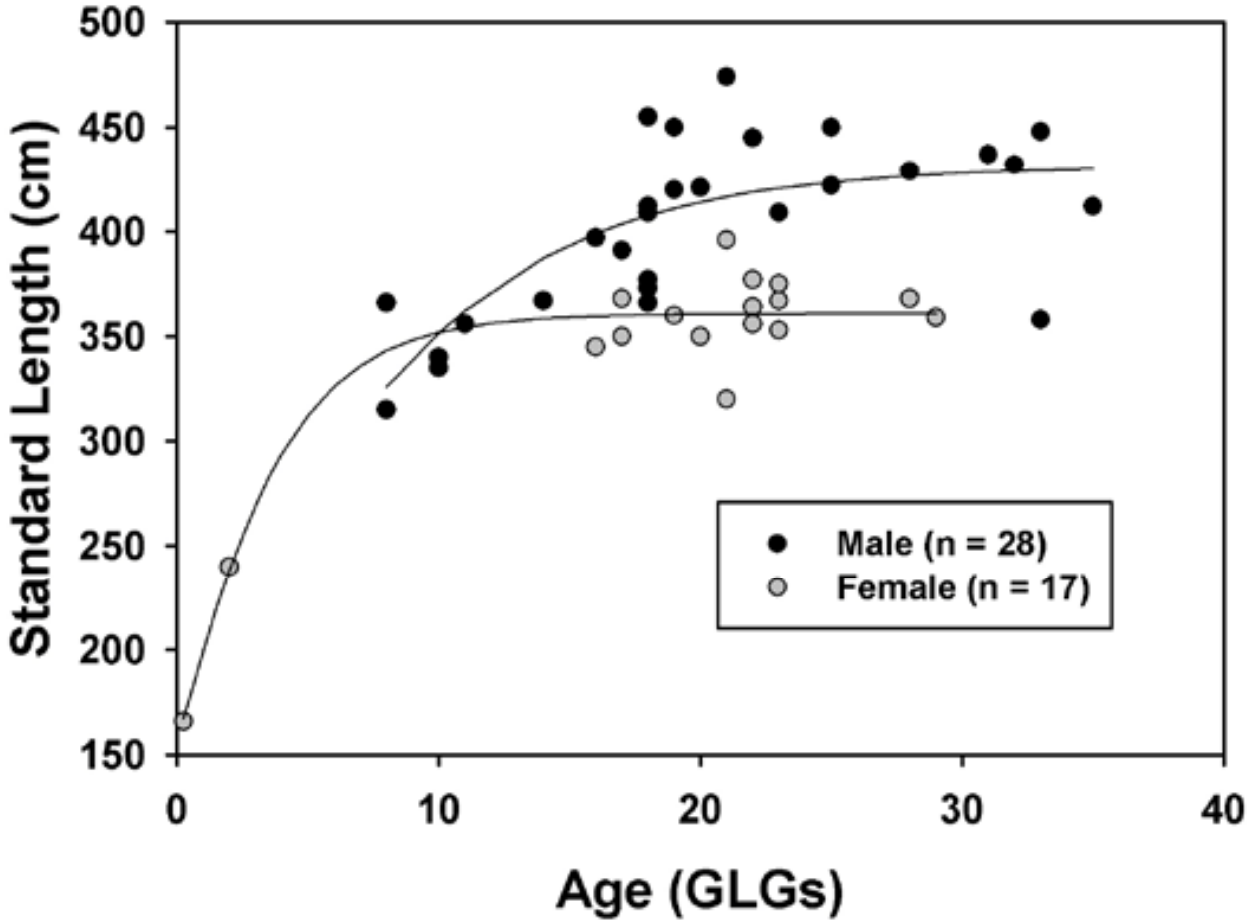

Code 2: 1 whale length apart

Code 3: 2-3 whale lengths apart

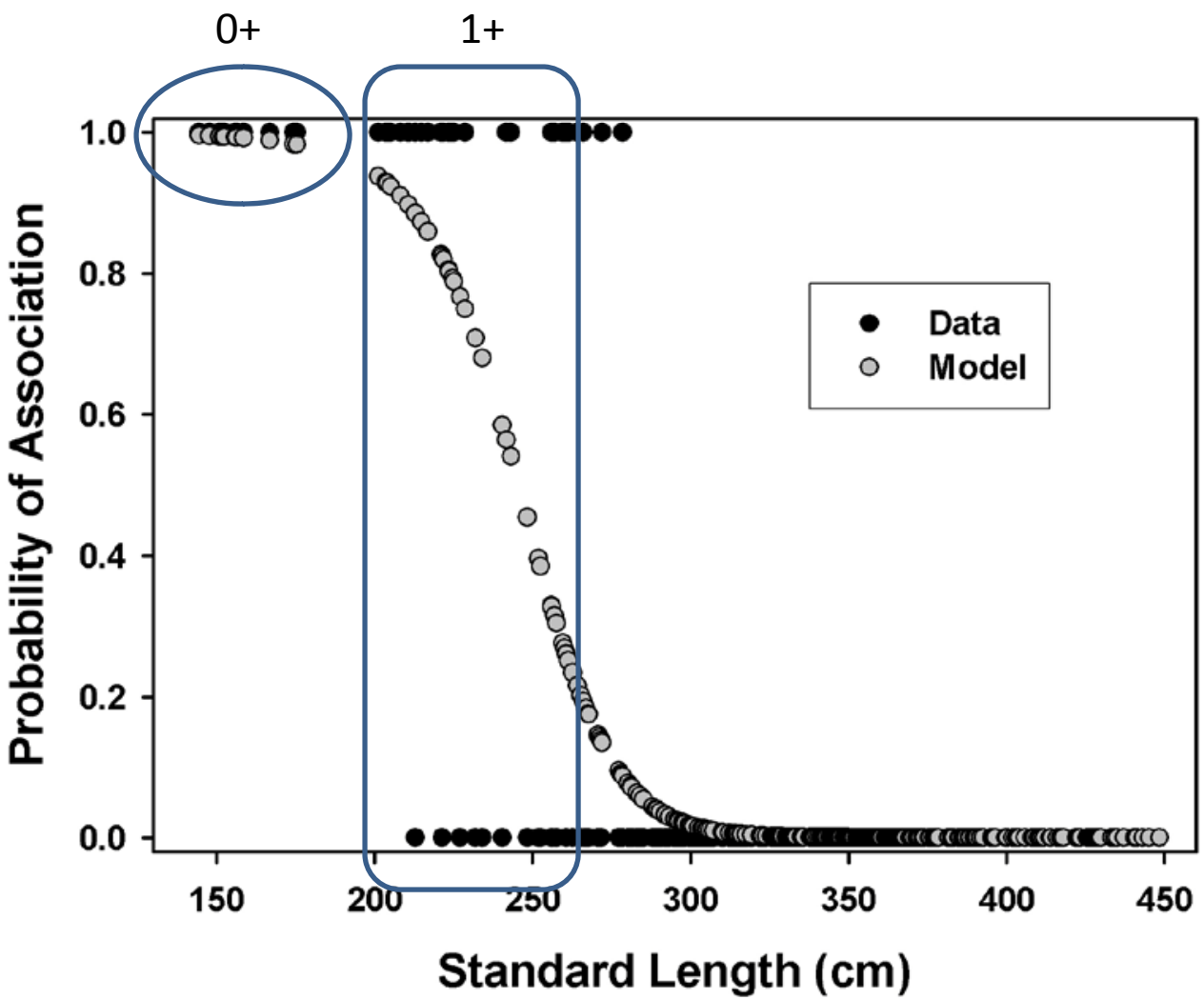
Code 4: In same field of view

Code 5: Alone in field of view

Gompertz growth curves for male and female belugas whales sampled in Cook Inlet (Suydam 2009)



Probability by length that a calf in the eastern Chukchi Sea stock will be associated with an adult (Suydam 2009)



Remaining Pieces of the Puzzle
Mother and calf behavior

- Does the mother change her surfacing behavior to accommodate the calf? To some extent when the calf is less than a month old.
- Does the mother bring the calf to the surface to breath without surfacing herself? Yes.
- How does this change with the age of the calf? In the first month a calf will surface every 5-6 seconds on average by three months of age it is breathing with the mother for the most part.

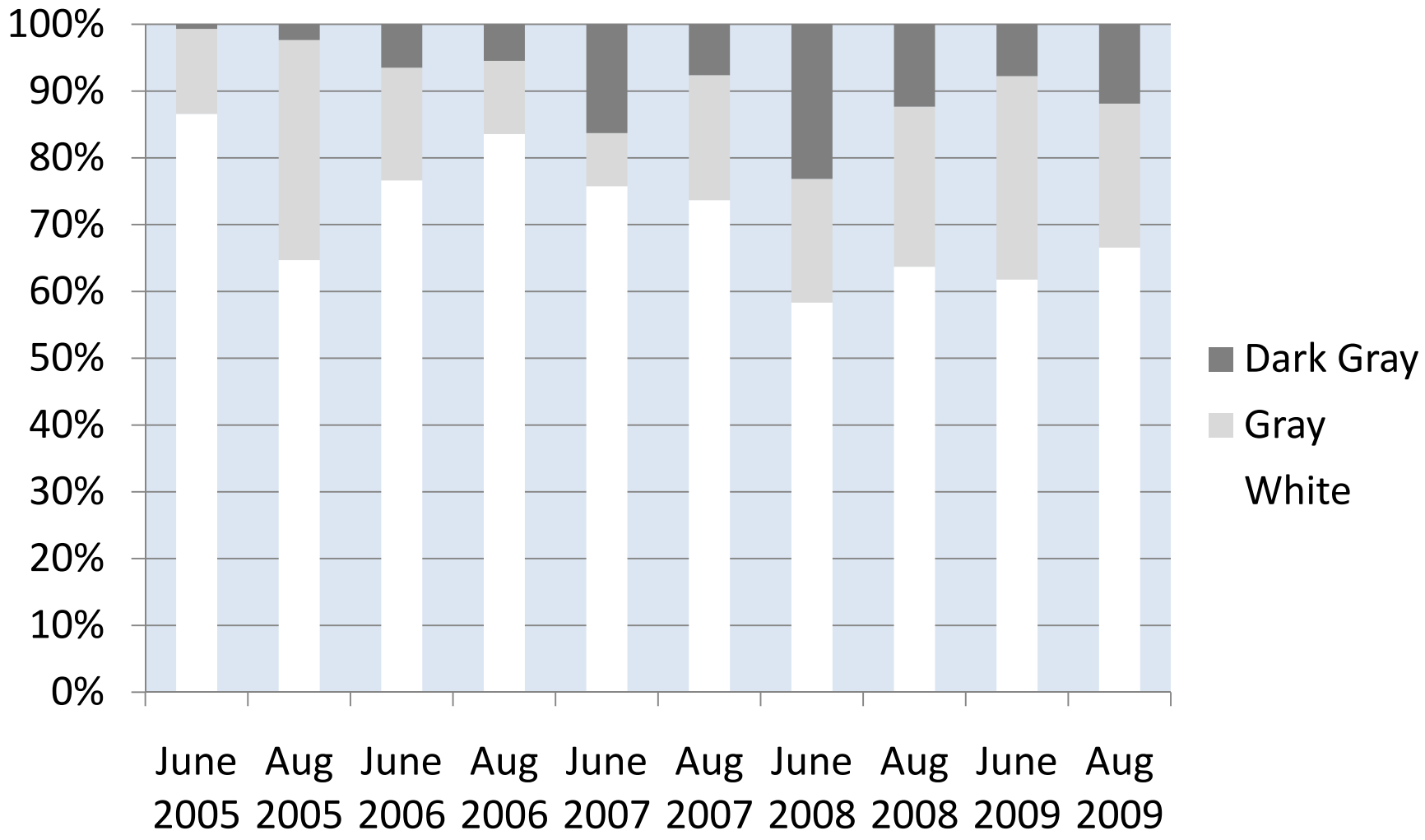
Why an index?

- Secchi depth in Cook Inlet <10 cm (4 in.) so belugas are only visible at the surface.
- Surfacing interval of adults with calves and of calves are not quantified. Less than adults without calves but changing as the calf ages.
- Calves will also surface separately, so there is not a direct correspondence between calves and adults.

Images analyzed

Year	Sum of calves	Sum of noncalves	Total
2005	3	228	231
2006	18	221	239
2007	109	1021	1130
2008	68	294	362
2009	65	603	668
Grand Total	263	2367	2630

Ratios of images by color 2005-2009

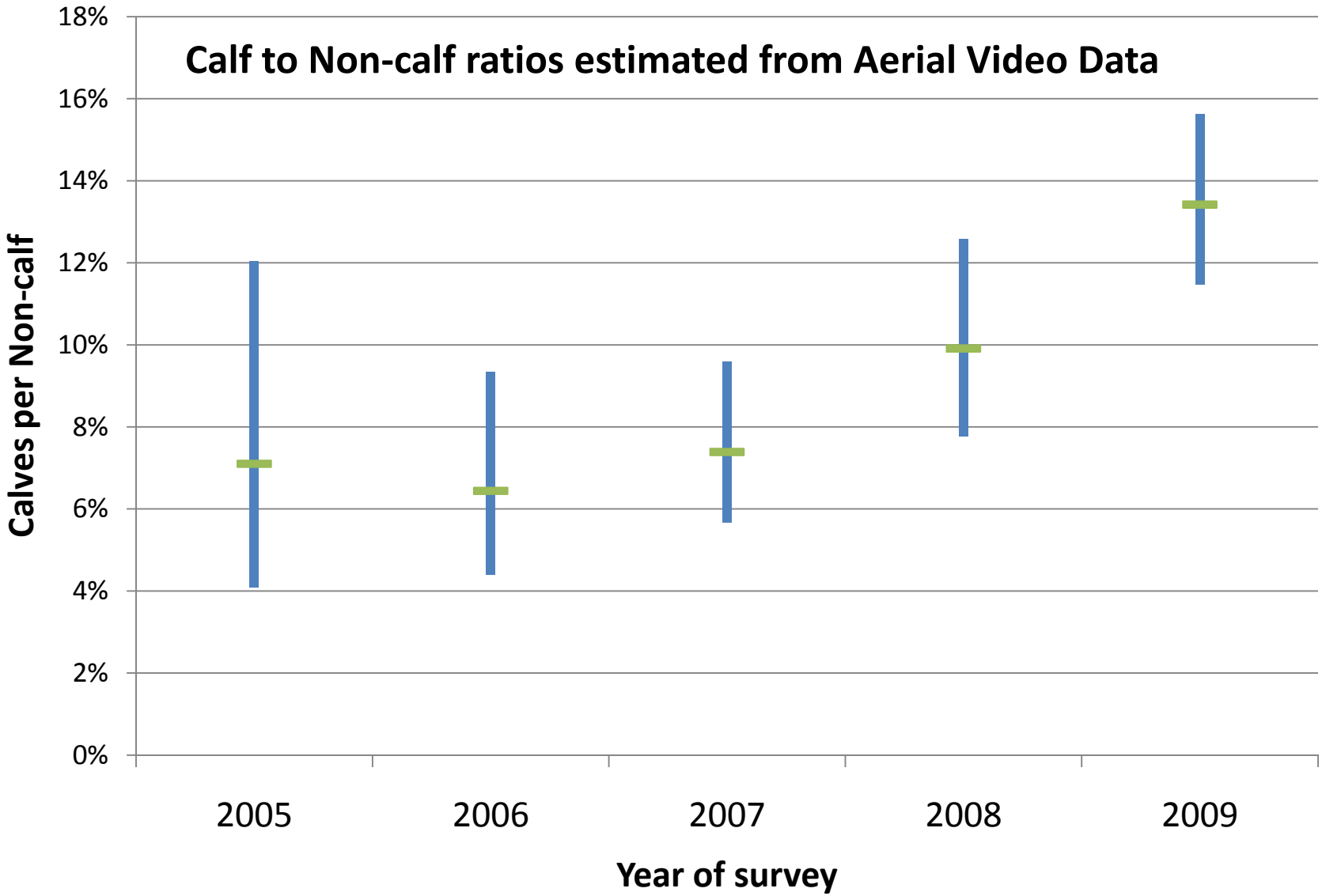


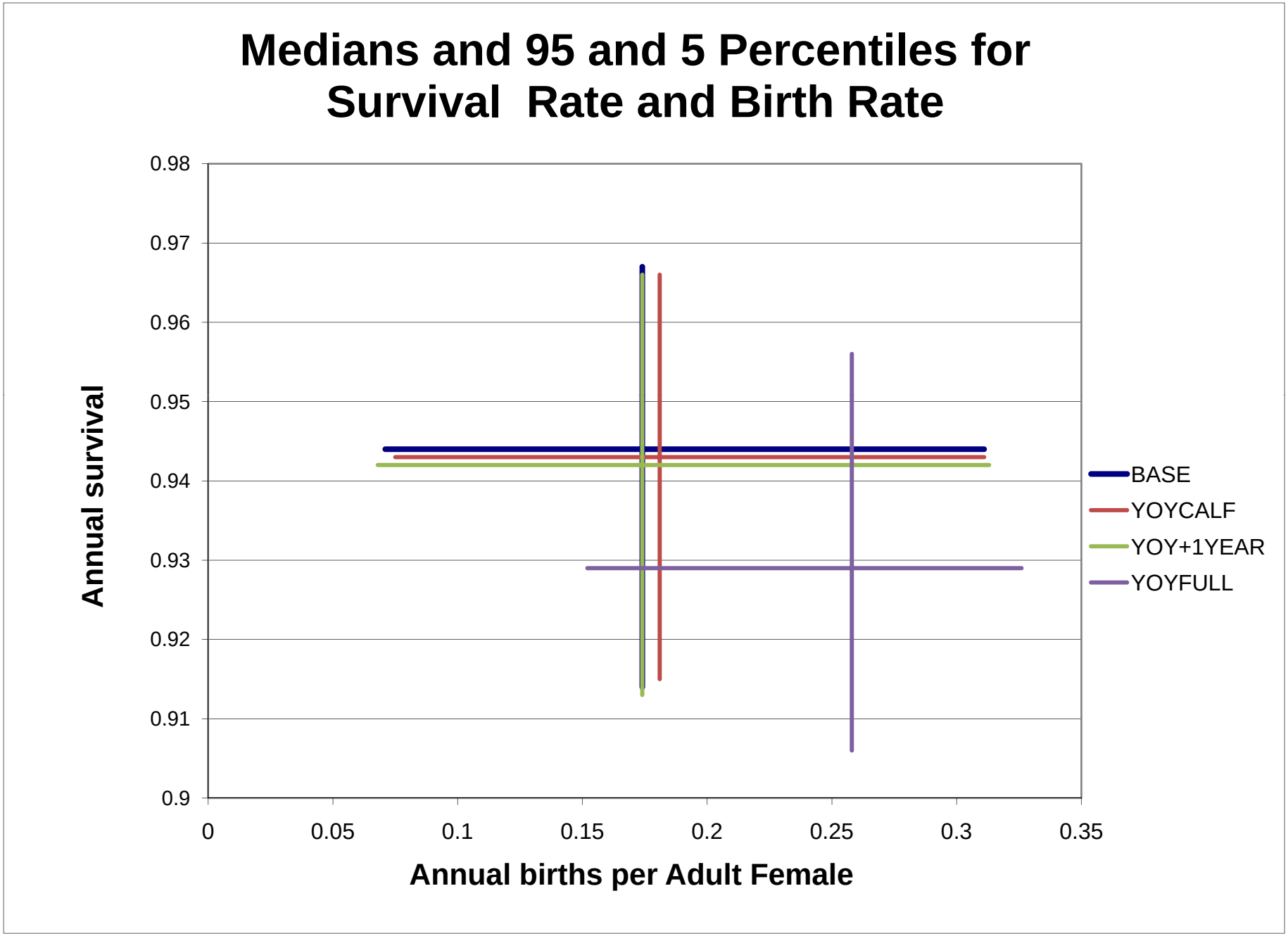
Average Relative Image Size by Proximity to Adult during June Survey

Proximity to adult	Ratio to adult length	Estimated length if adult is 350cm
Touching adult	78%	273
Within a whale length apart	74%	260
2-3 whale lengths apart	85%	297
In the same field of view	87%	306
Alone in field of view	95%	332
Adult	100%	350

Average Relative Image Size by Proximity to Adult: August Survey

Proximity to adult	Ratio to adult length	Estimated length if adult is 350cm
Touching adult	65%	228
Within a whale length apart	90%	316
2-3 whale lengths apart	83%	290
In the same field of view	77%	270
Alone in field of view	65%	227
Adult	100%	350


Calf to Non-calf ratios estimated from Aerial Video Data
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
Calves per Non-calf
2005
2006
2007
2008
2009
Year of survey


Medians and 95 and 5 Percentiles for Survival Rate and Birth Rate
Annual survival
0.98
0.97
0.96
0.95
0.94
0.93
0.92
0.91
0.9
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
Annual births per Adult Female
BASE
YOYCALF
YOY+1YEAR
YOYFULL

Thank you