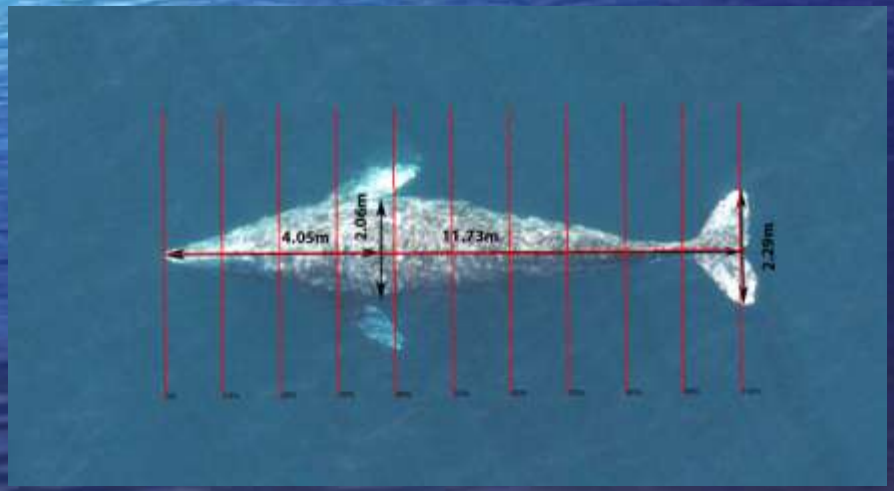
Wayne Perryman

Aerial Photogrammetry and Health Assessments on Gray and Blue Whales



Outline

- Technologies for field aerial photography
- Three Case Studies
  - Gray Whales
  - Right Whales
  - Blue Whales
- Options for photographic platforms

Photogrammetry

Photogrammetry is the art, science and technology of obtaining reliable information about physical objects and the environment through the processes of recording, measuring and interpreting photographic images.

Film Based Camera Systems

1. The data I will present here were taken from measurements of animals photographed with large aerial cameras designed for low altitude military reconnaissance

2. Days of film based imaging are over

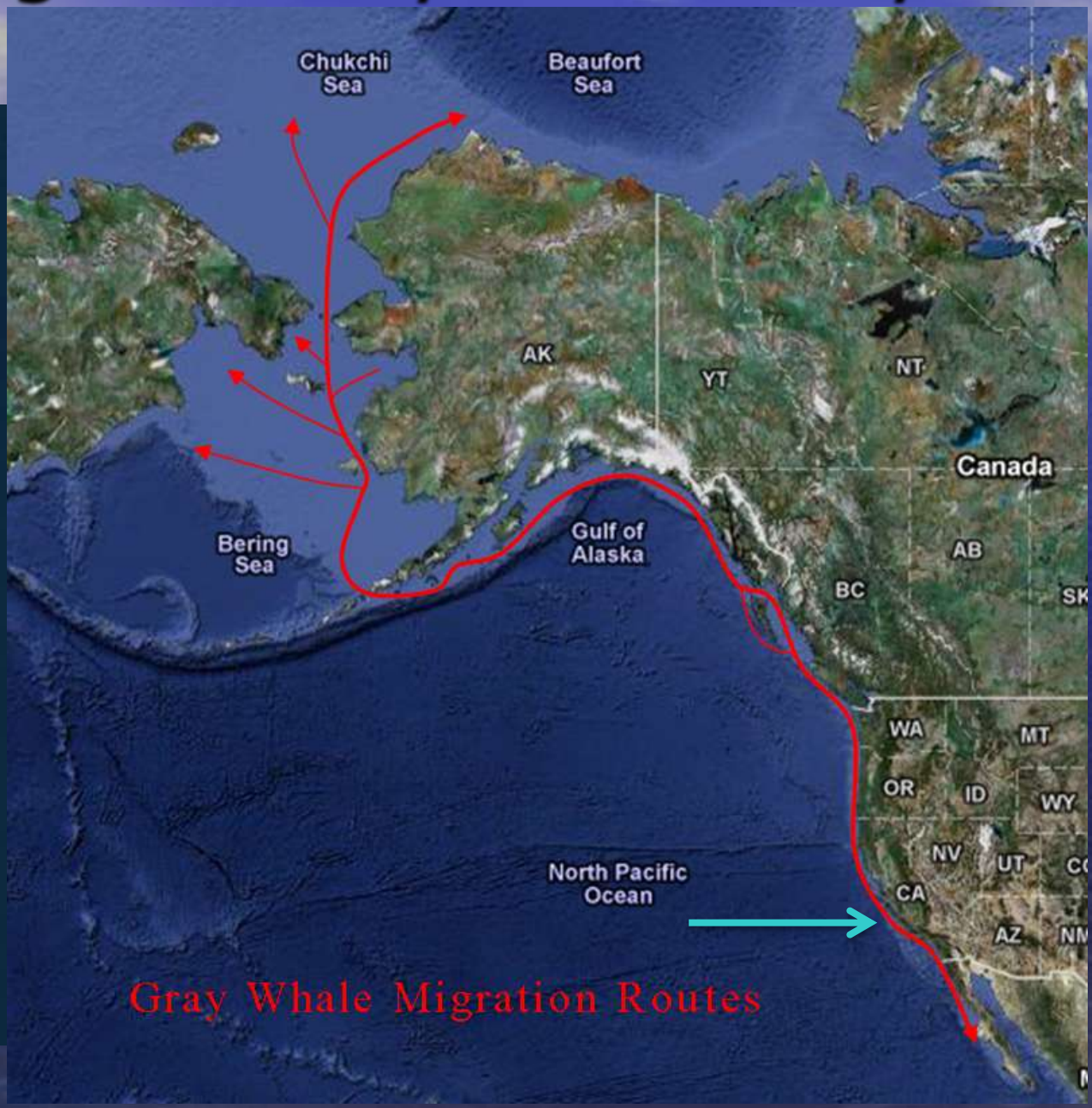
3. Systems required radar altimeters, separate DAS systems, and integrated power and control systems

Digital Imaging Systems

Female Mammals – Reproduction Results in Changes in Shape

- Two examples of changes in shape experienced by female mammals
- Because female humans continue to feed through birth and lactation, the shape changes they experience are less dramatic than in most large cetaceans
- Most large cetaceans are “capital breeders” so they store up fat during the feeding season to support them during first 4 months of lactation
- First step in photogrammetric measures of condition is to demonstrate detection of these changes in shape

Photogrammetry Case Study 1 – Gray



Gray Whale Measurements

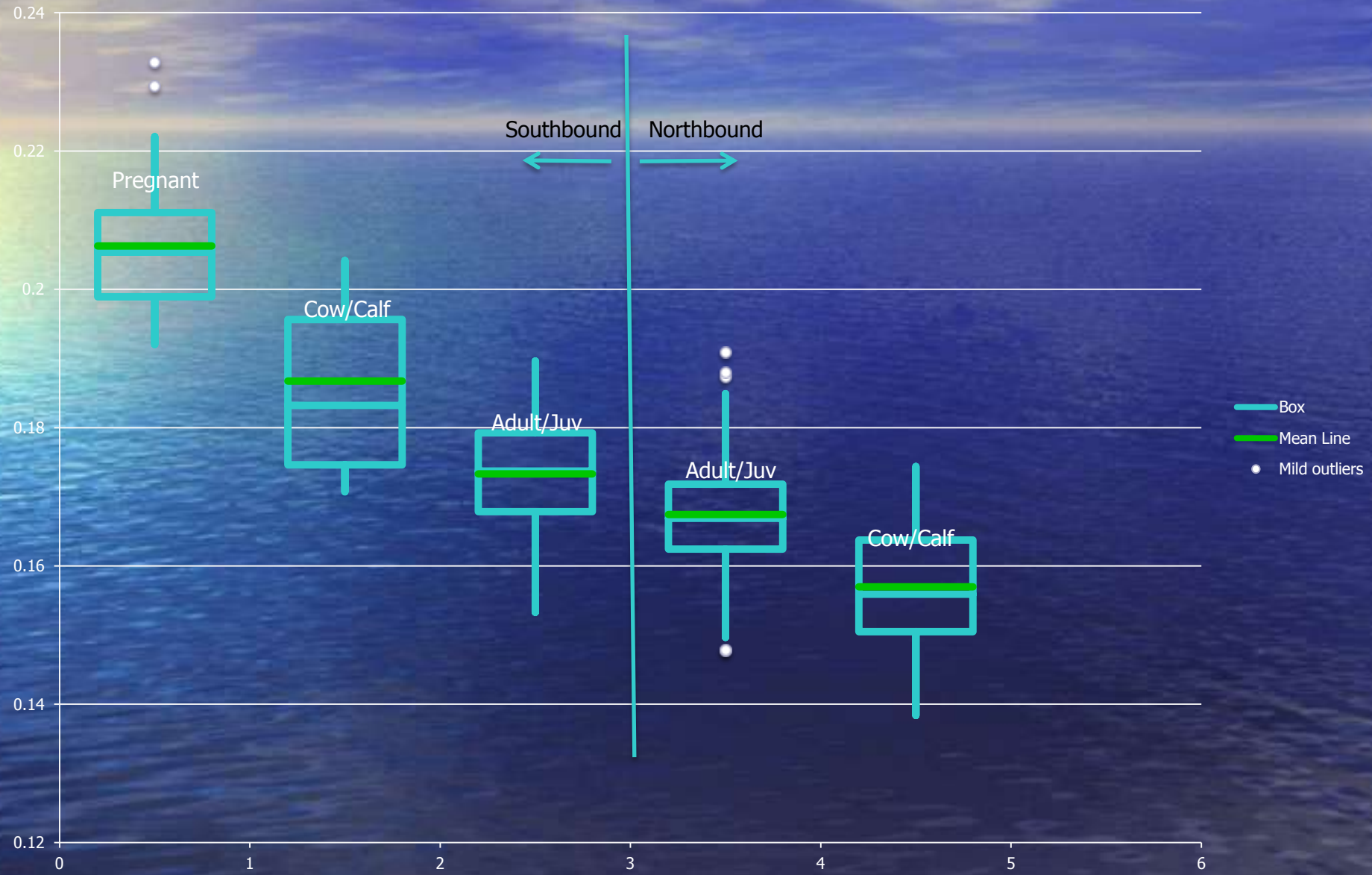
Southbound

Condition Index
Data From Flights
1996-1998

max width / length

Southbound Pregnant

Width to Length Ratios for Migrating Gray Whales 1996-1998



Gray Whale Photogrammetry – Phase I

1. Reproductive condition in gray whales can be detected from measurements of length and width in vertical aerial photographs

2. We found evidence for the same pattern of segregation by age and reproductive condition reported from scientific whaling (Rice and Wolman 1971)

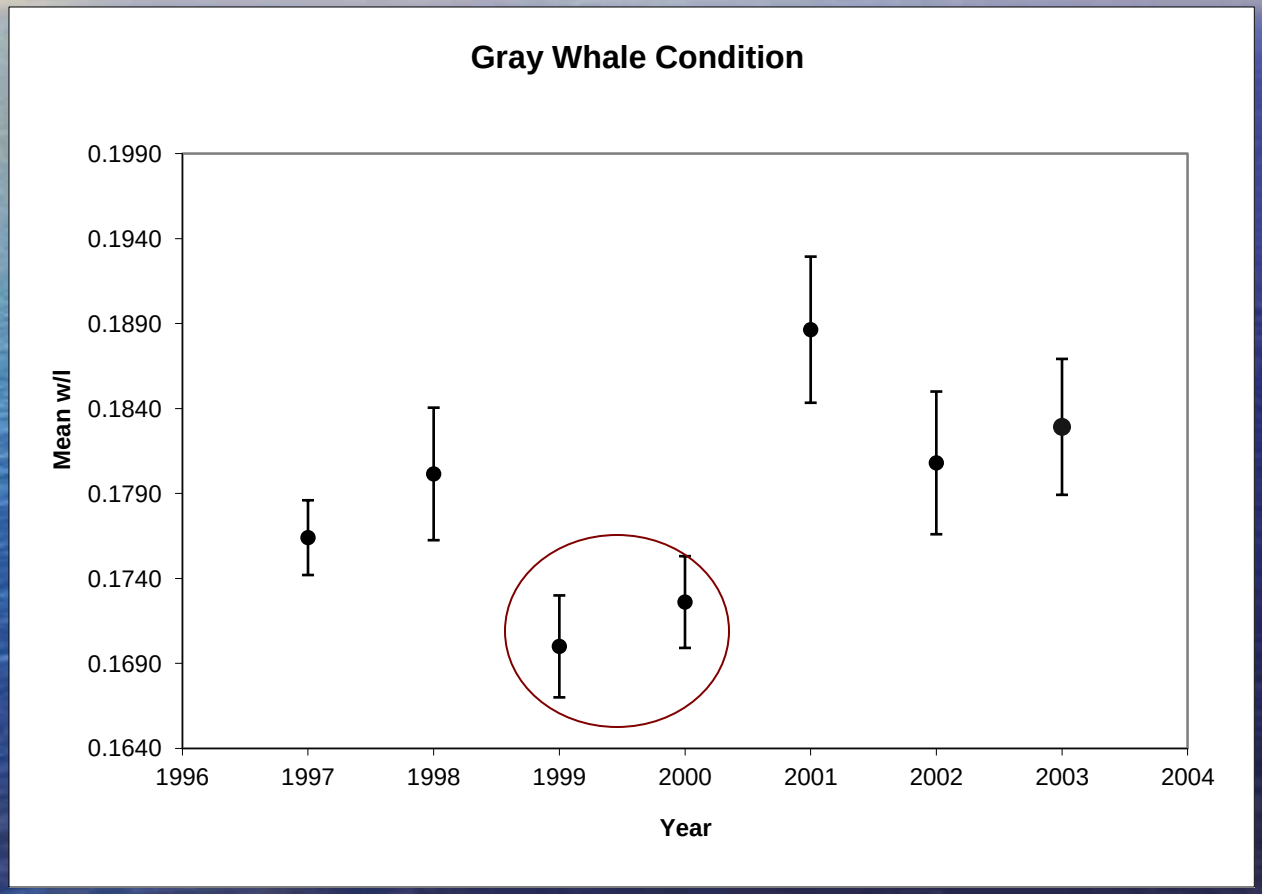
3. Northbound adults and juveniles were found to be significantly thinner relative to their length than southbound whales (about 45 - 50 days interval)

4. Can vertical aerial photographs be used as a primary data source for tracking population level changes in gray whale condition?

Gray Whale Nutritive Condition

- We were able to conduct annual aerial photographic sampling of southbound gray whales from 1997 – 2003
- In 1999 and 2000 strandings of eastern No. Pacific gray whales increased from mean of about 25 whales to nearly 300
- Can data from photographic sampling inform us on underlying cause of this "mortality event"?

"Mortality Event" – Population Condition (w/l)

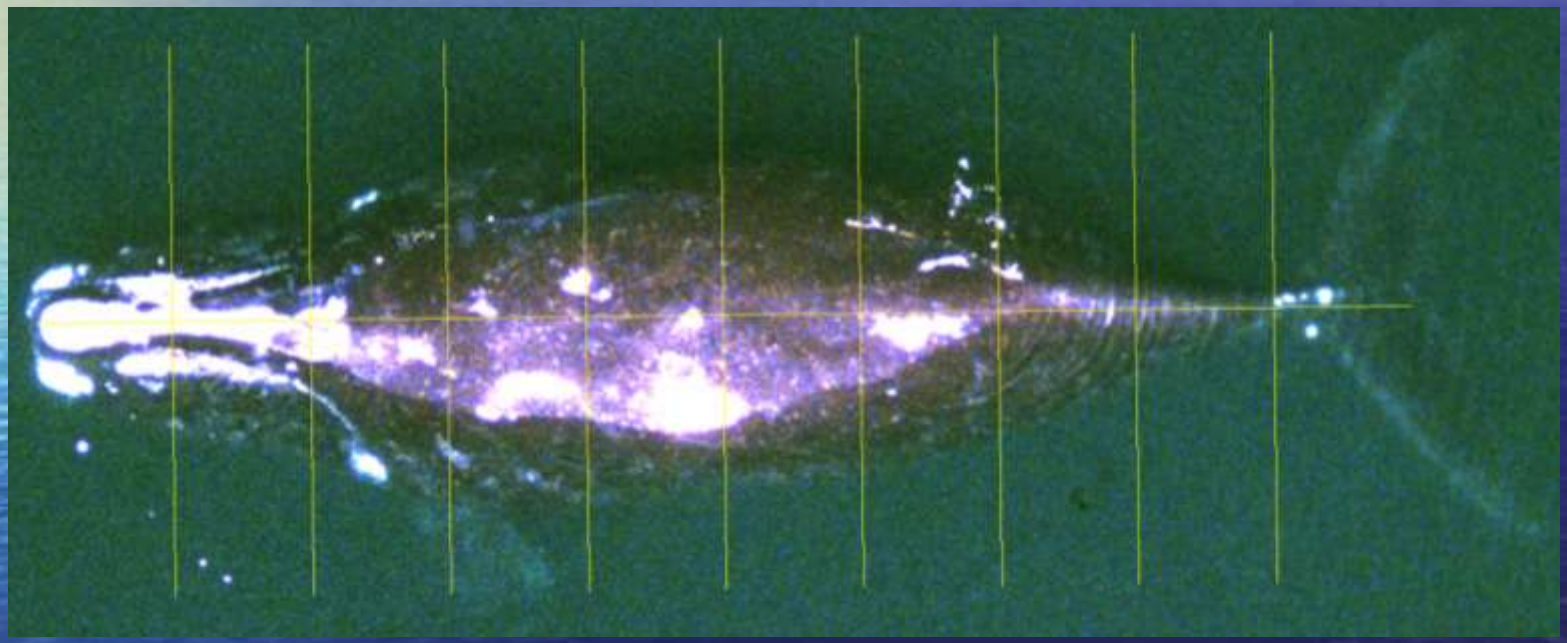


* Pregnant females, cows with calves and whales < 10 m excluded from analysis

Photogrammetry Case Study 2 – Right Whales (*Eubalaena glacialis & E. australis*)

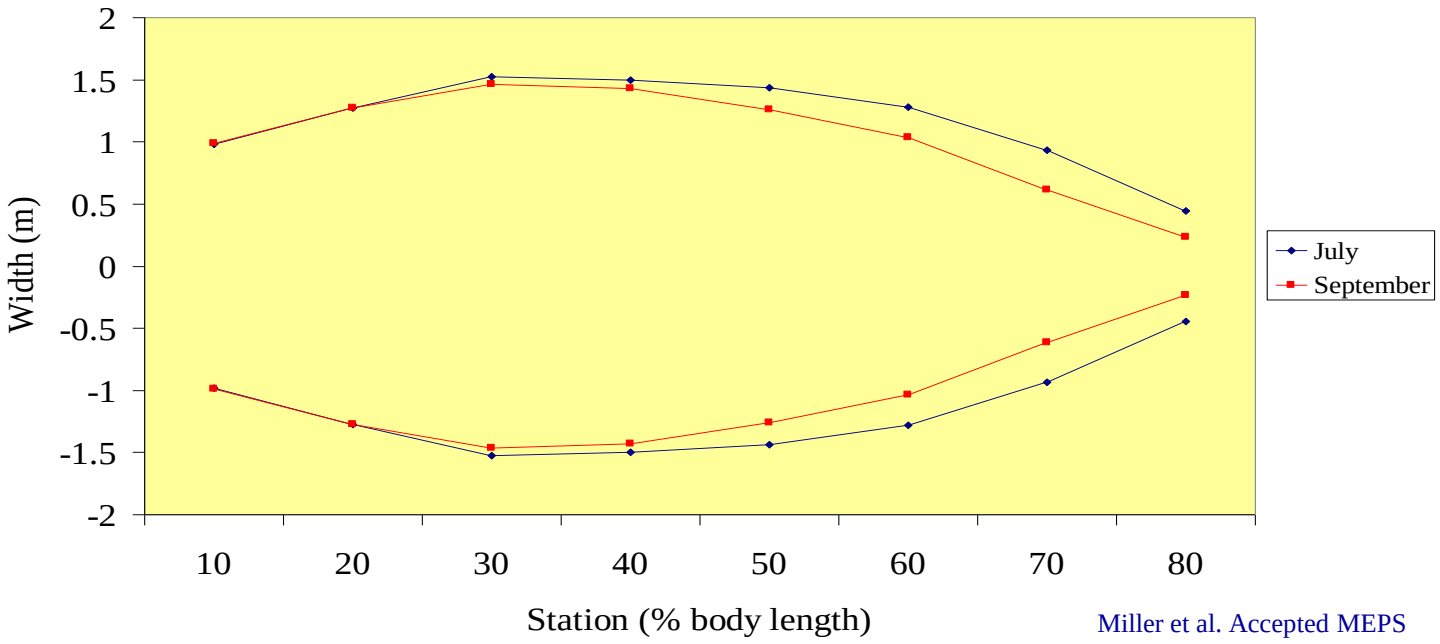
- Most of this work was done by Dr Carolyn Miller (WHOI)
- Less arbitrary on site of width measurements
- To study dependence on stored reserves you need to look at more than one period in their life history (feeding grounds/calving grounds)

Right Whale Widths



Measured width at 8 sites (sites spaced at 10% of length intervals) and used principal components analysis to locate most informative site

Width measurements from along the body of an individual southern right whale mother during the first and third month of lactation - Ea A



Miller et al. Accepted MEPS

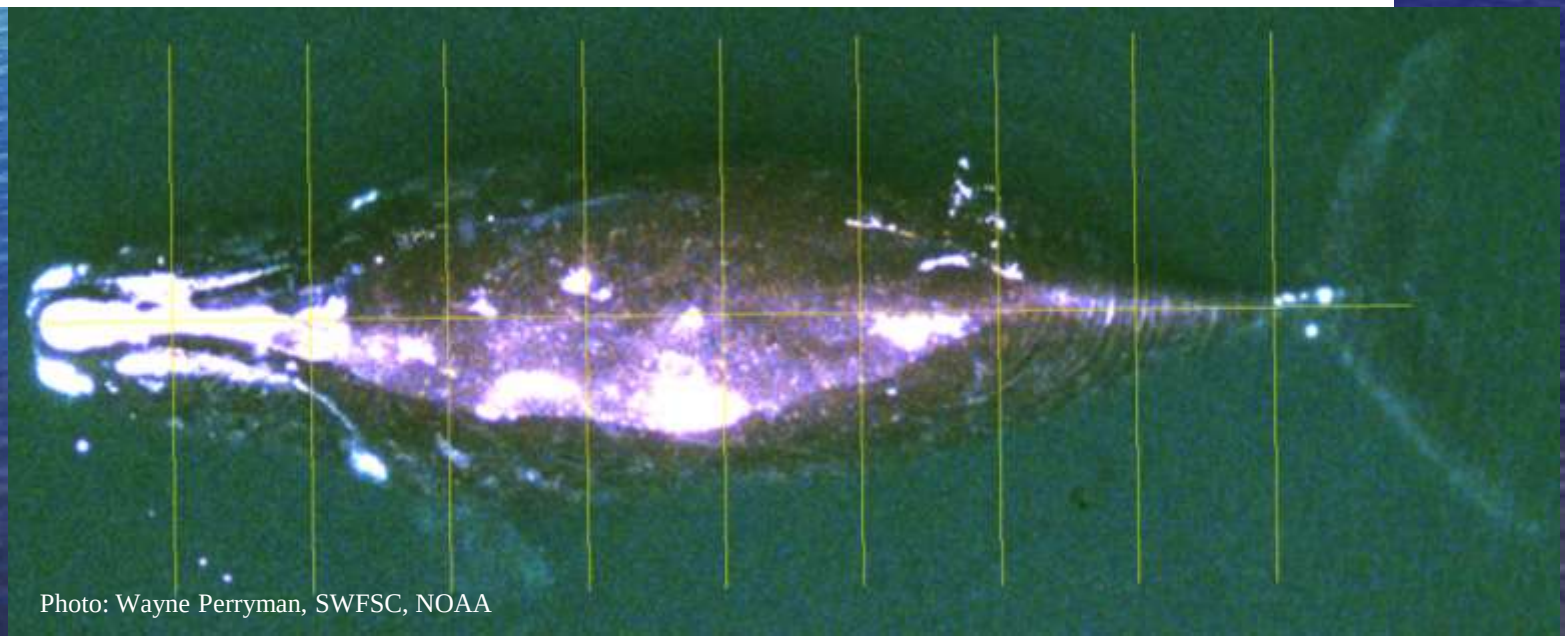
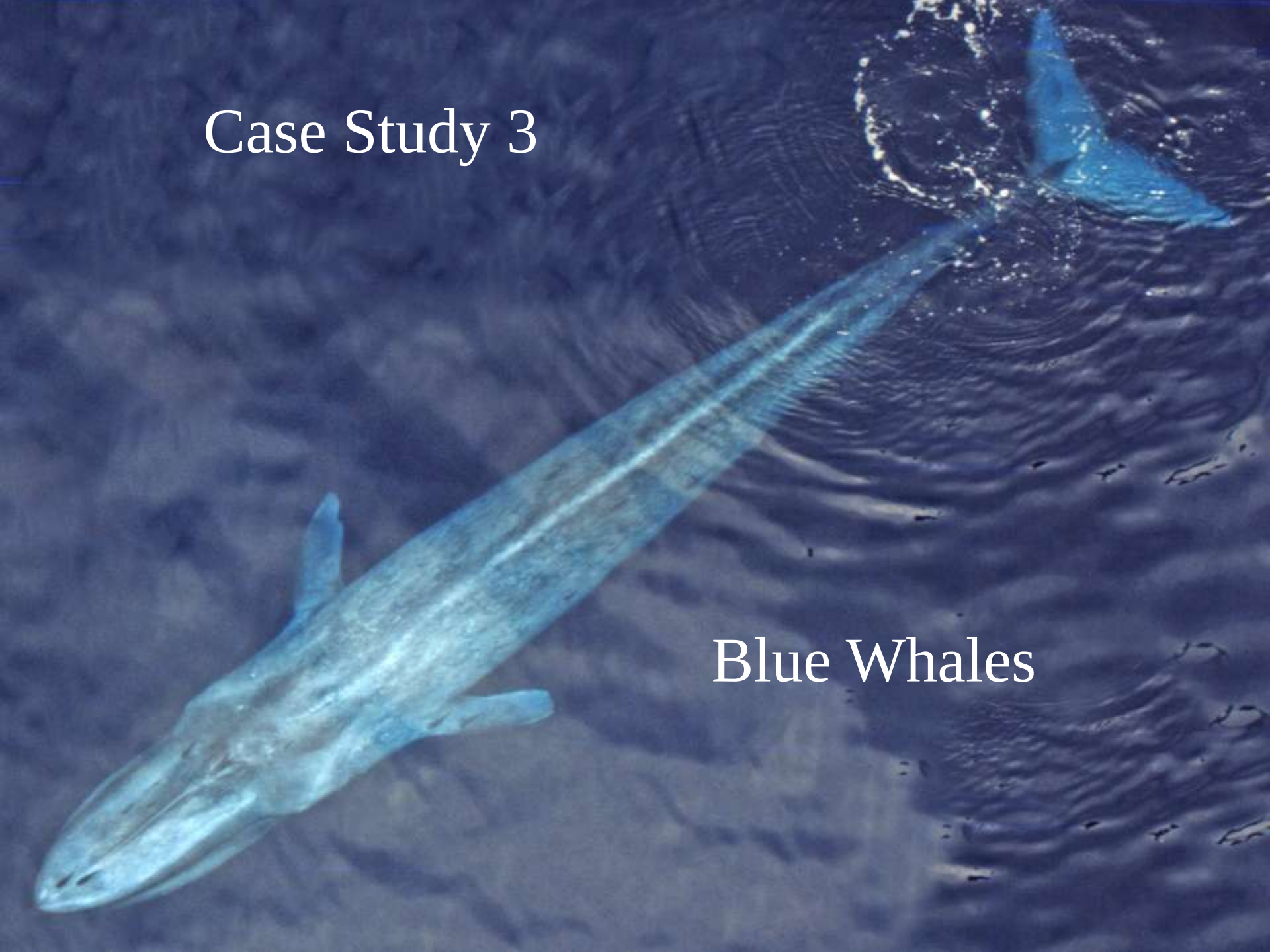


Photo: Wayne Perryman, SWFSC, NOAA

Right Whale Photogrammetry

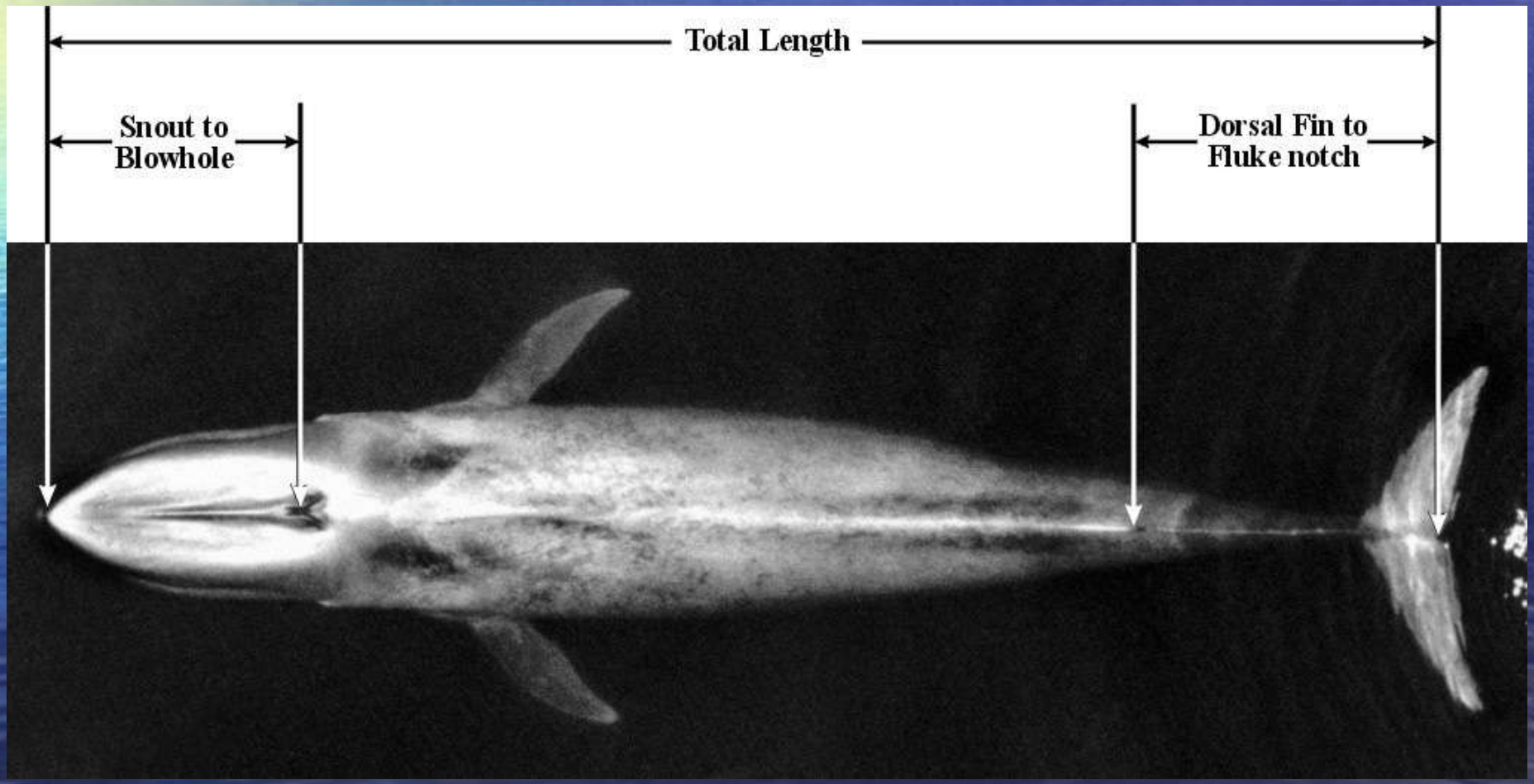
- Found that by looking at width data taken from several sites along the body you can determine most informative spot to measure (60% of distance from rostrum to flukes)
- Reproductive females thinned significantly during lactation (*Eubalaena glacialis & E. australis*)
- Took an individual based approach to monitoring condition


Case Study 3
Blue Whales

Ongoing Research Effort

- First aerial photographic study was designed to collect data on size and body proportions (Gilpatrick and Perryman 2008)
- Currently examining film and digital images to establish base line shape data sets
- These whales feed year round and we are sampling on feeding/weaning grounds

Blue Whale Morphology



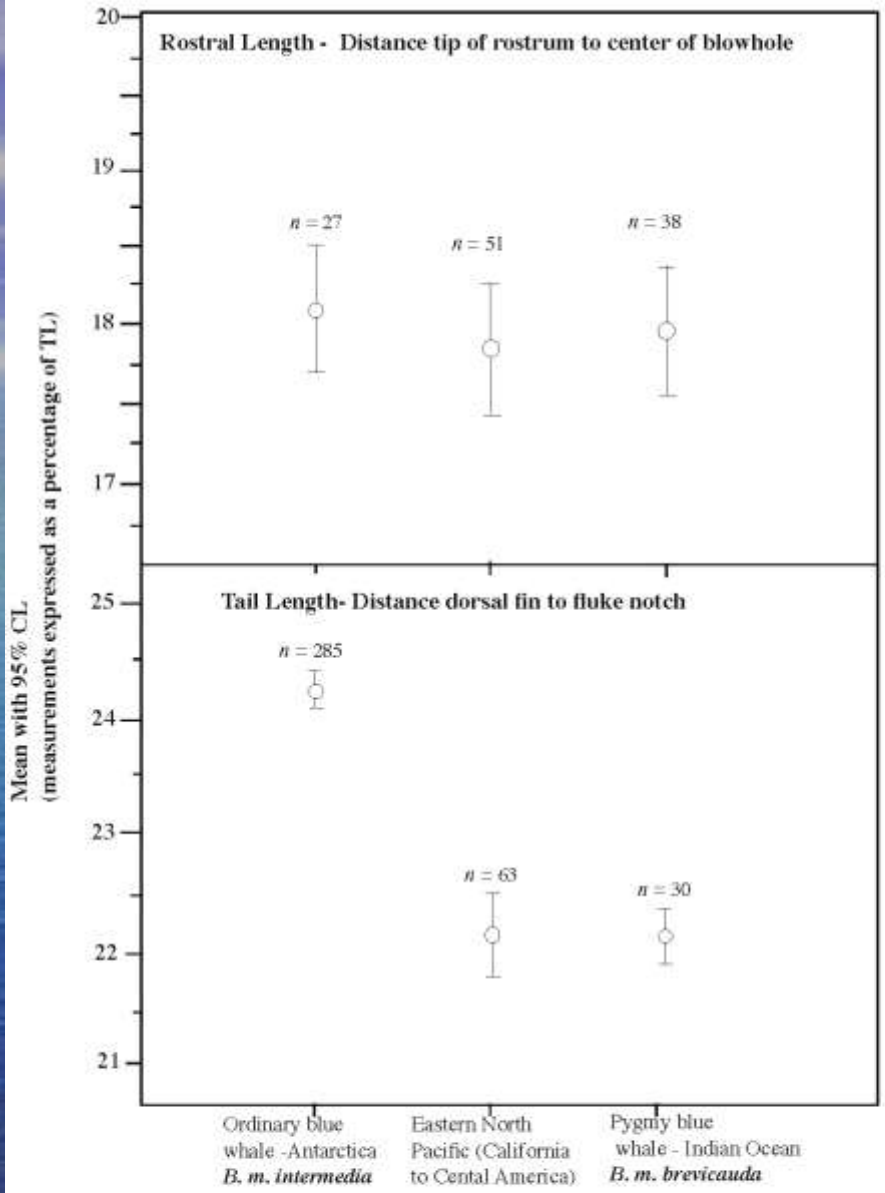
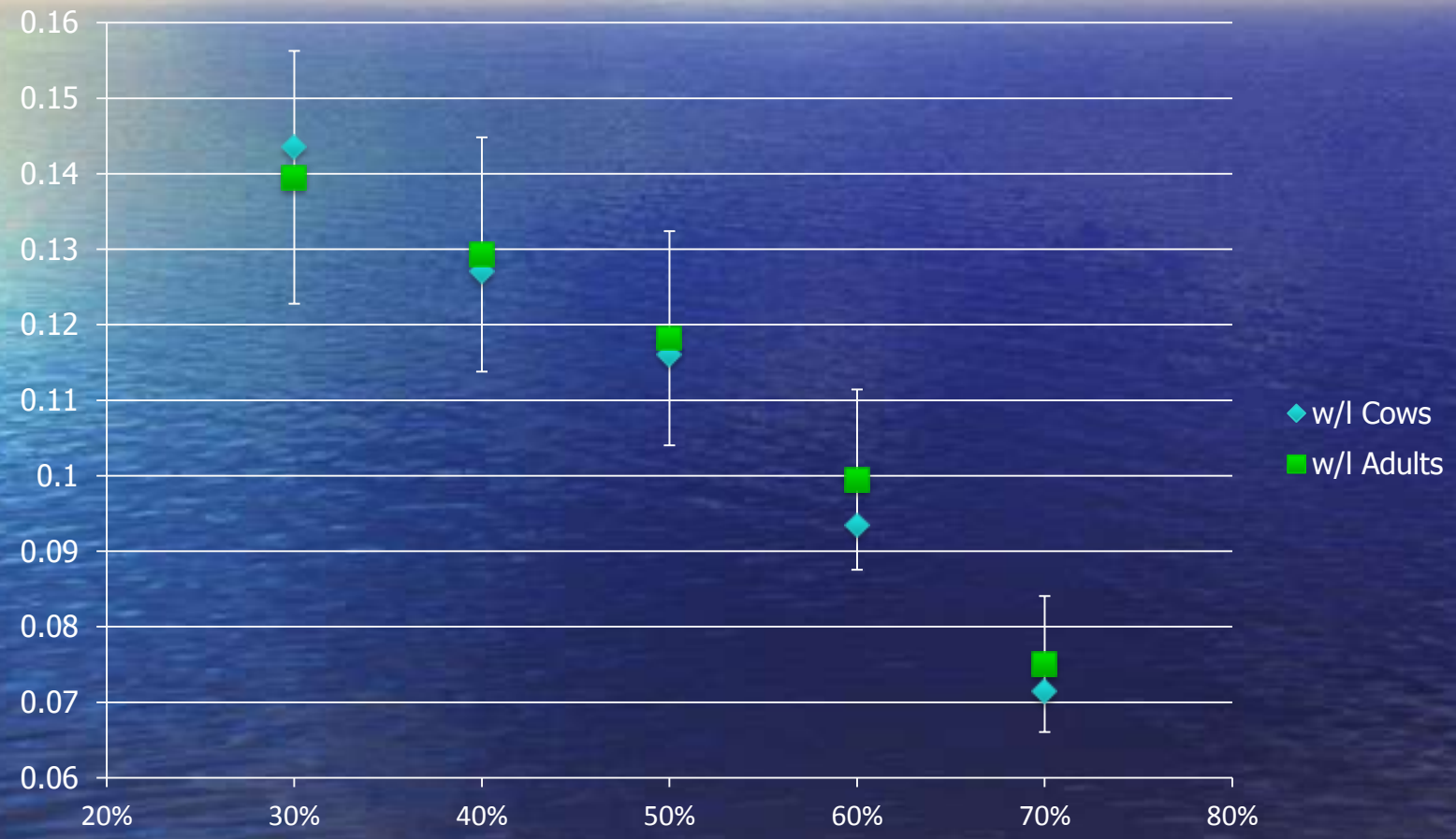


Fig. 6. Mean with 95% CL for measurements of rostrum (top) and distance from dorsal fin to fluke notch (bottom) expressed as a percentage of the whale's total length. To avoid biases attributable to changes in body proportions with increased body length, statistical analyses were limited to larger blue whales (≥ 19.5 m TL for North Pacific and pygmy; ≥ 21.5 m TL for ordinary blue whales).


Blue Whale Condition Study

Width/Length – Cows and other Adults



Lessons Learned

- Consider the shape of the animal that you are measuring and the question you are asking before you decide where to measure (Is this animal pregnant? or Is this animal skinny?)
- Questions that you can ask about population condition (reproductive and nutritive) depend on when you sample (breeding/calving grounds versus feeding grounds)
- Shape changes significantly within seasons so try to sample over the same short period of time across multiple years

Manned Platforms are not the Only Option

Workshop discussion topic?

Gray Whale Condition Study

- Gray whales passing our shores southbound include a mix of pregnant females, cows with calves, adults and juveniles
- Some of these groups can be recognized based on shape