Understanding the ecological role of baleen whales in a rapidly changing Antarctic marine ecosystem

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FRIEDLAENDER LAB
BIOTELEMETRY AND BEHAVIORAL ECOLOGY
Know where you come from

• Ann Pabst (UNCW) → Knut Schmidt Nielsen
  Functional Morphology, Anatomy & Physiology
Know where you come from

- Andy Read (Duke) ➔ David Gaskin: Behavioral Ecology
Know where you come from

- Brian Skinner (Yale) \(\rightarrow\) Douglas Mawson: Antarctic Explorer, & Geology
Philosophy

Anatomy

Behavior

Ecology

Conservation & Education
Ecological Foundation

- Cetaceans are the largest animals to have ever lived
- Morphological, physiological, and behavioral adaptations for bulk feeding
- Decisions
  - How does the distribution and behavior of prey affect cetacean foraging ecology
- Environment
  - How does the physical and biological landscape affect cetacean behavioral ecology
My Ecological Mantra

- Telemetry is an incredible tool to measure and understand cetacean ecology
  - fine and broad spatio-temporal scales

- Understanding cetacean ecology requires an understanding of their environment
  - inter-disciplinary collaboration is essential

- Analytical and visualization tools can provide context and convey information
  - Scientific community, curriculum for classes, public outreach and education
Art Meets Science
‘Once a painting is visually inventoried in as much detail as an analytical approach is introduced, using visual cues to draw conclusions and interpretations about the painting’s content... the conclusions depend upon keen and thorough observation of fact, in an open-minded and unbiased manner, until the inventory is complete and the process changes from one of assemblage to interpretation’

Friedlaender & Friedlaender 2013
Objectives

- Quantify the movement patterns and behavioral ecology of baleen whales
- Relate foraging behavior to dynamic environmental features
- Understand population growth and health
- Evaluate the effects of disturbance (e.g. climate migration) on baleen whales
- Use knowledge to promote education and enhance conservation/policy measures
Quantitative whale movement ecology

Understanding movement causes and consequences for species distribution and behavior
Multi-Sensor Tags

- non-invasive
- suction cups
- up to 48 hours
- time, depth, temperature
- 3-axis accelerometers, magnetometers, gyros
- sensors sample up to 400 Hz
- audio to 242 kHz
- 2k Video
- VHF
- GPS
Humpback Whales
Foraging

- Predator foraging strategies depend on:
  - Physical constraints
  - Prey behavior
- Behavior leading to prey capture vary
  - Timing, duration, constitution
- Plasticity in appetitive behaviors
  - Leads to higher predation rates
- Example…
Tag Data
Combining video & movement data to study maneuverability and prey type

Depth, Pitch, Roll, Heading

Whale Tag Analysis

- **Trackplot** (Ware et al. 2006)
  - Visualize underwater movement patterns
- **Behavioral Sequencing**
  - Link observed and tag behaviors
- **Ribbons indicate the orientation of the whale**
- **Red and blue teeth are fluke strokes**

Dive profile of humpback whale. Ribbon indicates path of whale through water column. Red polygons indicate fluke-stroke above mid-line and green polygons indicate below mid-line. Arrows show direction of travel.

~80% descent in free-glide
~30% ascent in free glide

Ware et al. 2010
Using sound to find feeding
Quantifying foraging behavior

Friedlaender et al. 2009, 2015, Ware et al. 2010
Bottom Feeding
Mom & Calf
Playing with tag data
Bubble net feeding in Antarctica
How do you eat?
Prey Mapping

- Link fine-scale foraging behavior with prey

- Use echosounders to determine: distribution, abundance, and density of krill

Foraging Decisions

Friedlaender et al. 2015, Tyson et al. 2015

Behavioral State vs. Time Local by year

- travel
- rest
- feeding
- exploratory

Night
- 2200 GMT 1800 Local
- 0000 GMT 2000 Local

Day
- 1500 GMT 1100 Local
- 1700 GMT 1300 Local
Conservation
Human-Whale Interactions

- Entanglement in fishing gear
  - Bottom set lines
  - Mid-water nets