# **Fine-scale Habitat Use of Cetaceans**

Ari S. Friedlaender Duke University Marine Laboratory, Beaufort, NC Biologging: Fine-Scale Habitat Use of Cetaceans



# Thank you





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# Line-up

- Foraging
- Humpback whales
   Adaptations
- Advances in how we study whales
   Tag technology
- Visualizing underwater behaviors
- Linking whale foraging to prey, ecosystems, and conservation

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# Foraging

- Predator foraging strategies depend on:
  - Physical constraints
    - How big your mouth is
    - What type of teeth/baleen you have
    - How deep you can dive
    - How you can capture prey
  - Prey behavior
    - How many prey are available
    - How are prey distributed
    - How do prey respond to predate





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#### What the heck is going on down there?



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# How do whales find their food?





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# Echosounders

- Sound scattered is a function of
  - species, size, orientation, number of individuals
- This approach can be used to measure the density and biomass
  - <u>School backscatter</u> target strength = # of prey





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### Humpback Whales (Megaptera novaeangliae)

- Wide distribution
- Individually indentified
- Migrate from breeding to feeding grounds
- Unique adaptations
  - Larger flukes
  - Long, oar-like flippers
- Variety of feeding behaviors

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# DTAG

- Small, lightweight
- Non-invasive
- Up to 24 hours
- Pressure (depth)
- Pitch, roll, heading (50 Hz)
- 3-axis accelerometer
- 3-axis magnetometer
- Stereo hydrophones

   Up to 192 kHz





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# Old school time-depth plot



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# 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



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# Surface and deep feeding



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# Using sound to find lunges



## Using sound to find feeding





# Surface feeding



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W196 track with prey:

**3** separate foraging bouts



**Behavior Type** 

non-surface

+ surface feeding

196a

120 kHz NASC

High : 2602.51

Low : 1.77684 Stellwagen Bank National Marine Sanctuary ++

ПЛ

0 0.5

lkm\_

### **Bubble-Net Feeding**





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# Humpback Whale Foraging



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### How do you eat?



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### Humpback Whale Feeding



Figure 5. Hypothesized bottom feeding and prey flushing by humpback whales on Stellwagen Bank. Diving in water depths of <40 m, a humpback rolls to the right and contacts the bottom with the right dorso-lateral surface of the upper jaw. This action causes sand lance, *Ammodytes dubius*, to flush from their burrows in beds of shell hash (close-up view in inset) into the water column, where they are preved on by the whale as well as other predators. (Illustration by E. P. Oberlander.)

uerto Varas, Chile, March 2012 duke university marine lab

### **Bottom Feeding**



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### **Bottom Feeding**





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# Day vs Night Feeding

Timing of Surface and Bottom Foraging Events



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# Summary

- Humpback whales have unique adaptations that allow for extraordinary feeding strategies
- Combining tag data, prey mapping, and visualization technology
  - Better understanding of humpback whale foraging
  - Relationships between whales and their environment
  - Protection, conservation, and management





