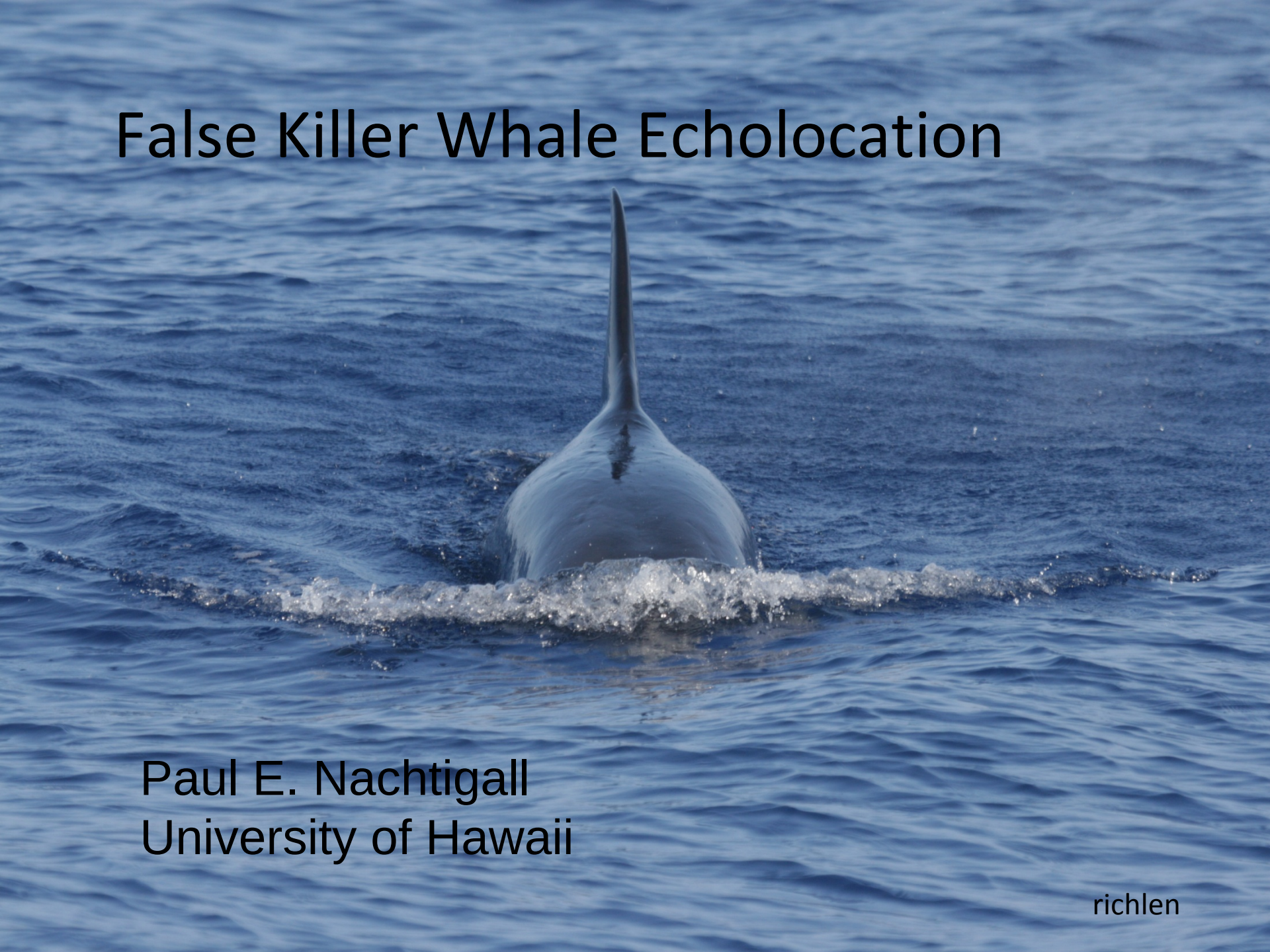
False Killer Whale Echolocation



Paul E. Nachtigall
University of Hawaii

richlen

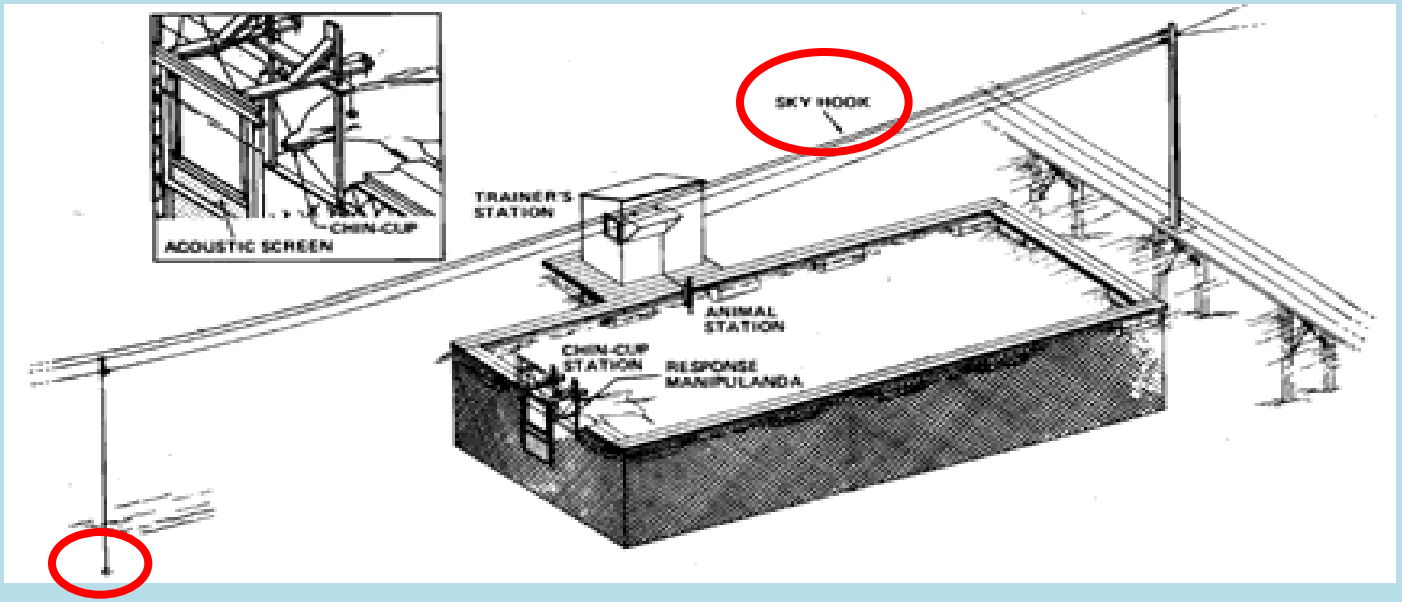
Best echolocation detection/
discrimination tested

Discrimination
changed with Hearing and Age

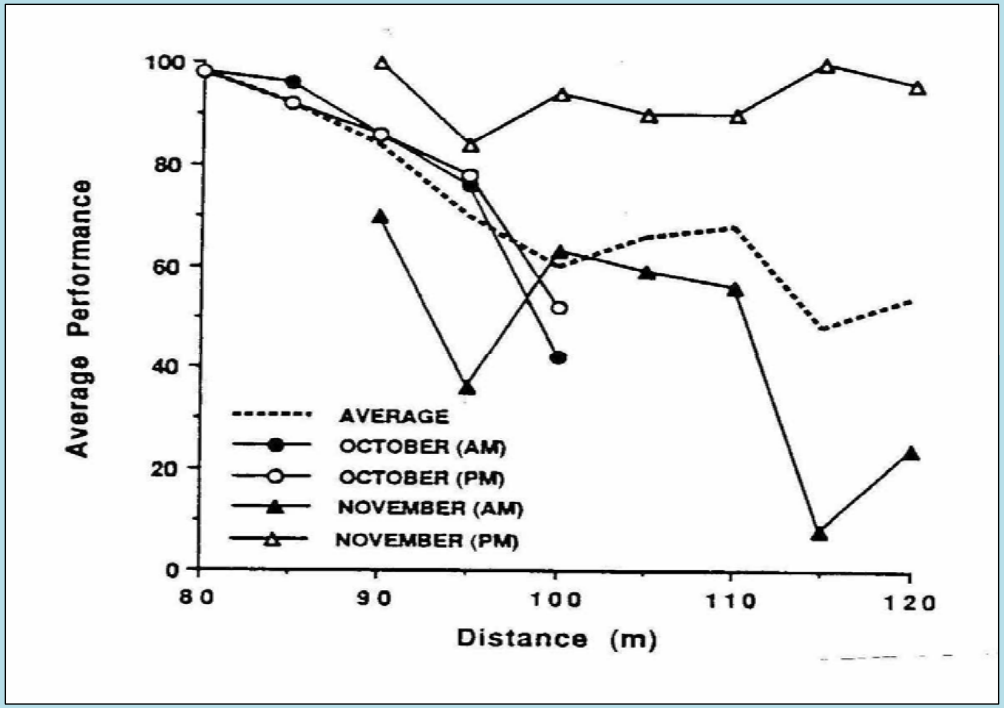
Whale controls own hearing during
Echolocation

Can be disrupted with loud sound
-mostly a masking effect.

Distance detection



Distance detection

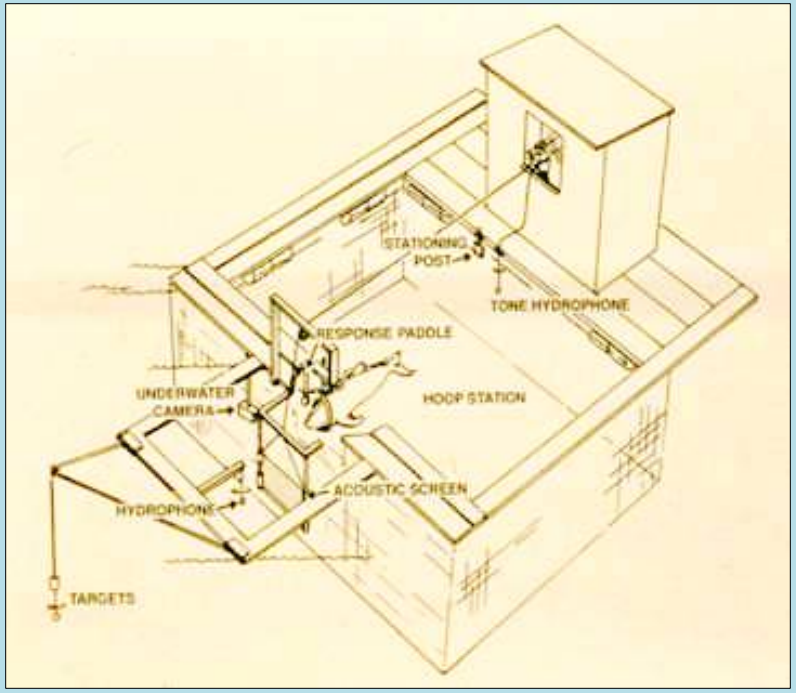


1. Detected a 3 inch water-filled stainless steel sphere (-32 dB target) beyond 120 meters (m)

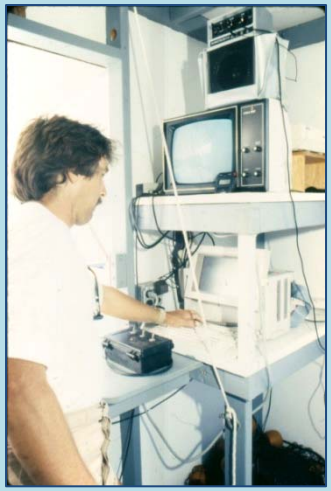
2. Detection varied with time of year and sound propagation conditions

Echolocation Discrimination and High Frequency Hearing Loss

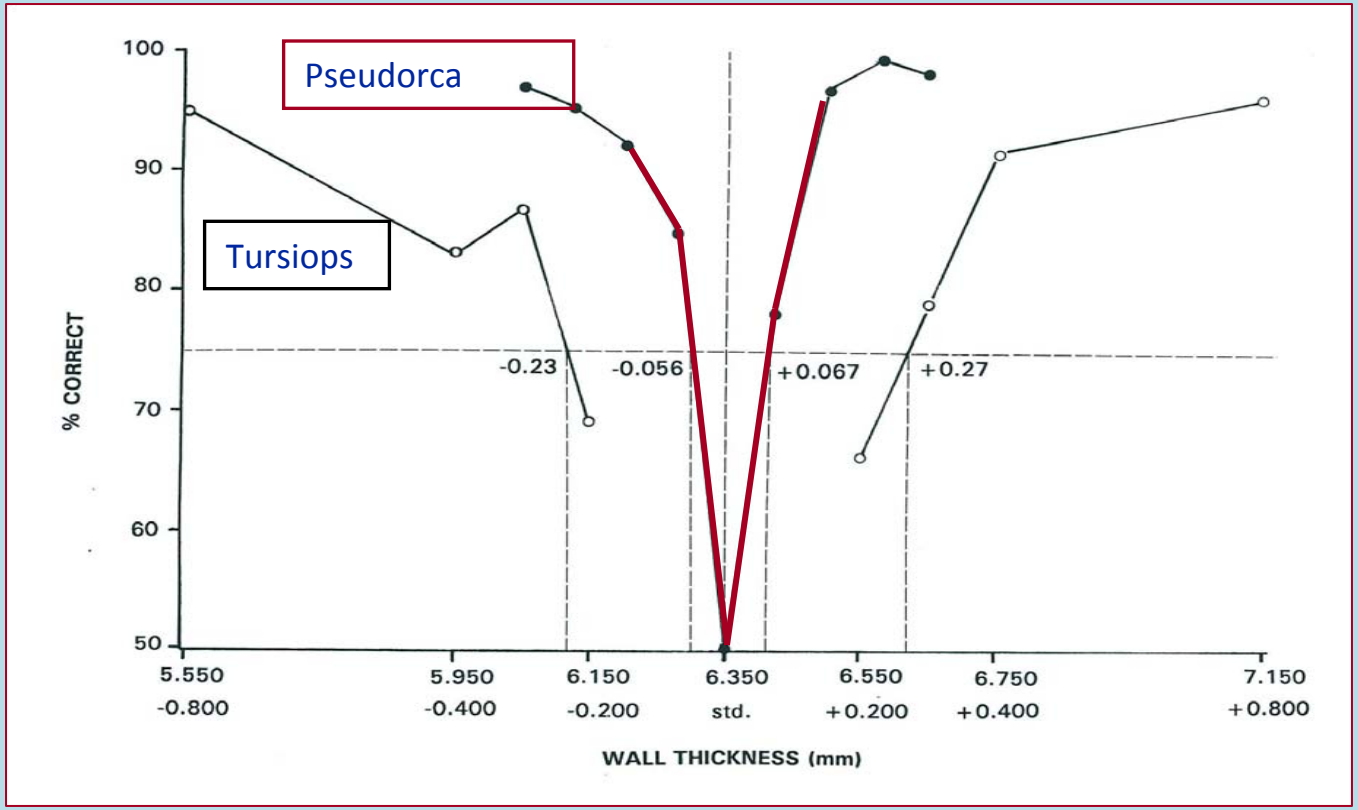
Discriminating the wall-thickness of aluminum cylinders



1992

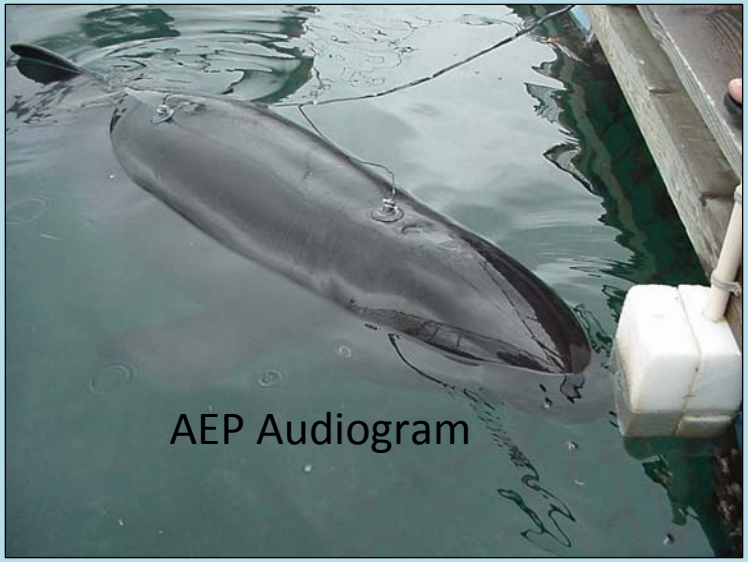


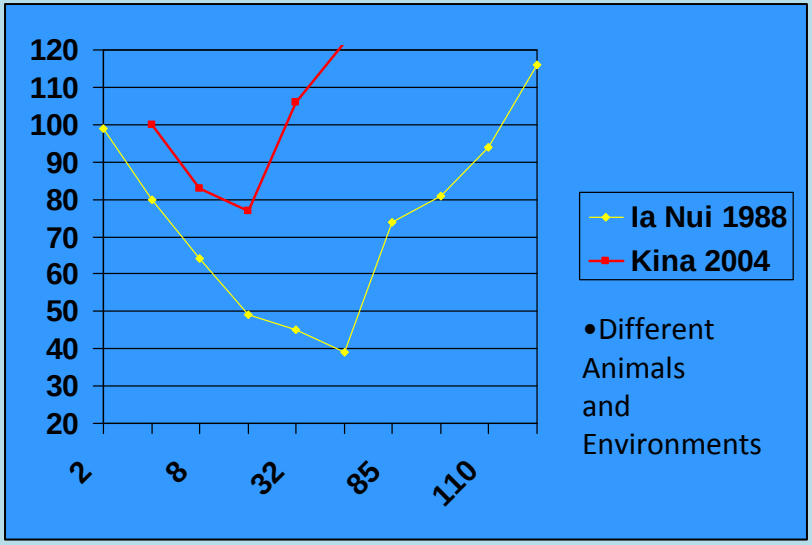
The Unexpected Results



False killer whale much better than expected

Hearing Seventeen Years Later





Kina developed presbycusis

Corresponding echolocation performance loss with hearing loss

Peak performance after practice wall-cylinder thickness difference discrimination – Targets thicker than standard

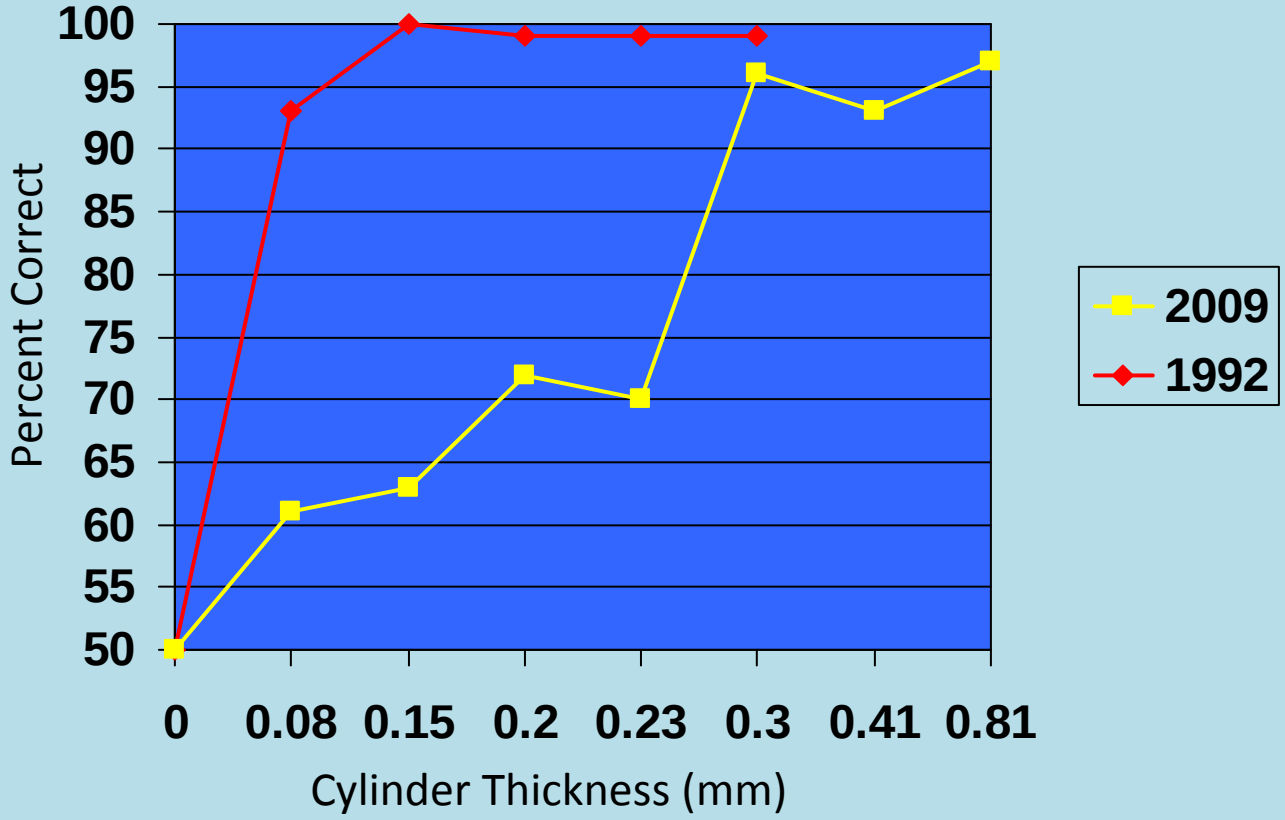
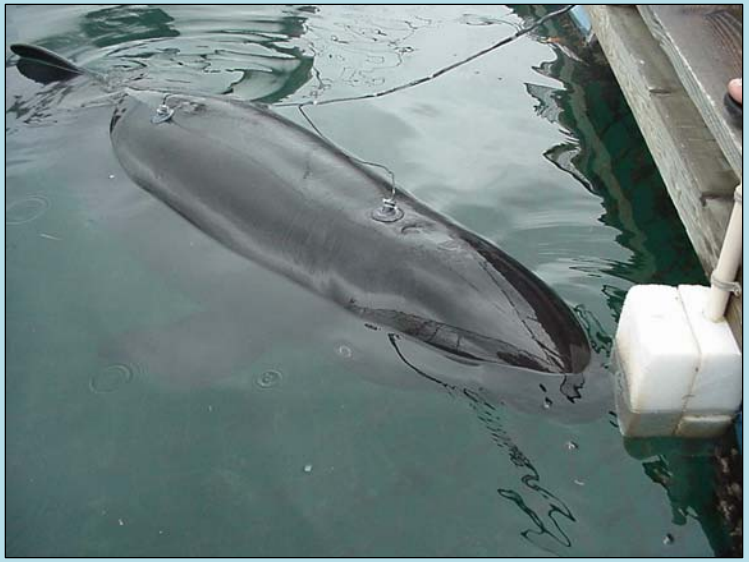
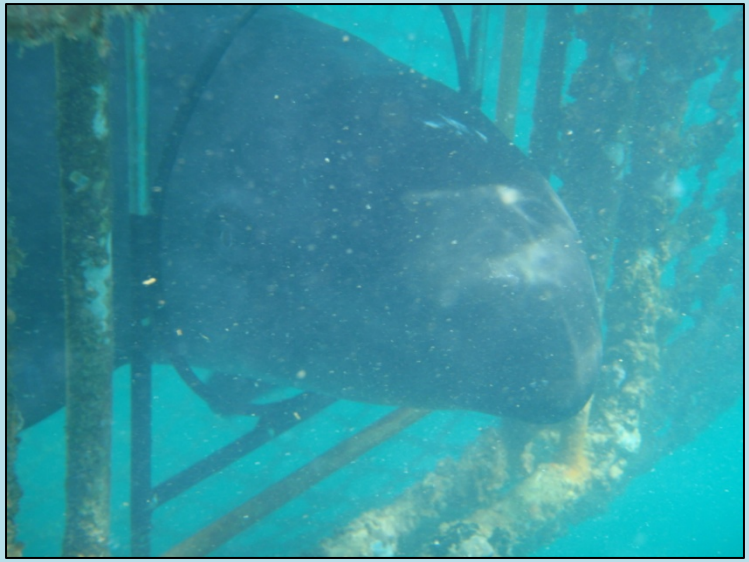


Photo: Sam Ridgway



Hearing Can Be Measured Directly While an Animal Echolocates Using AEP Measures



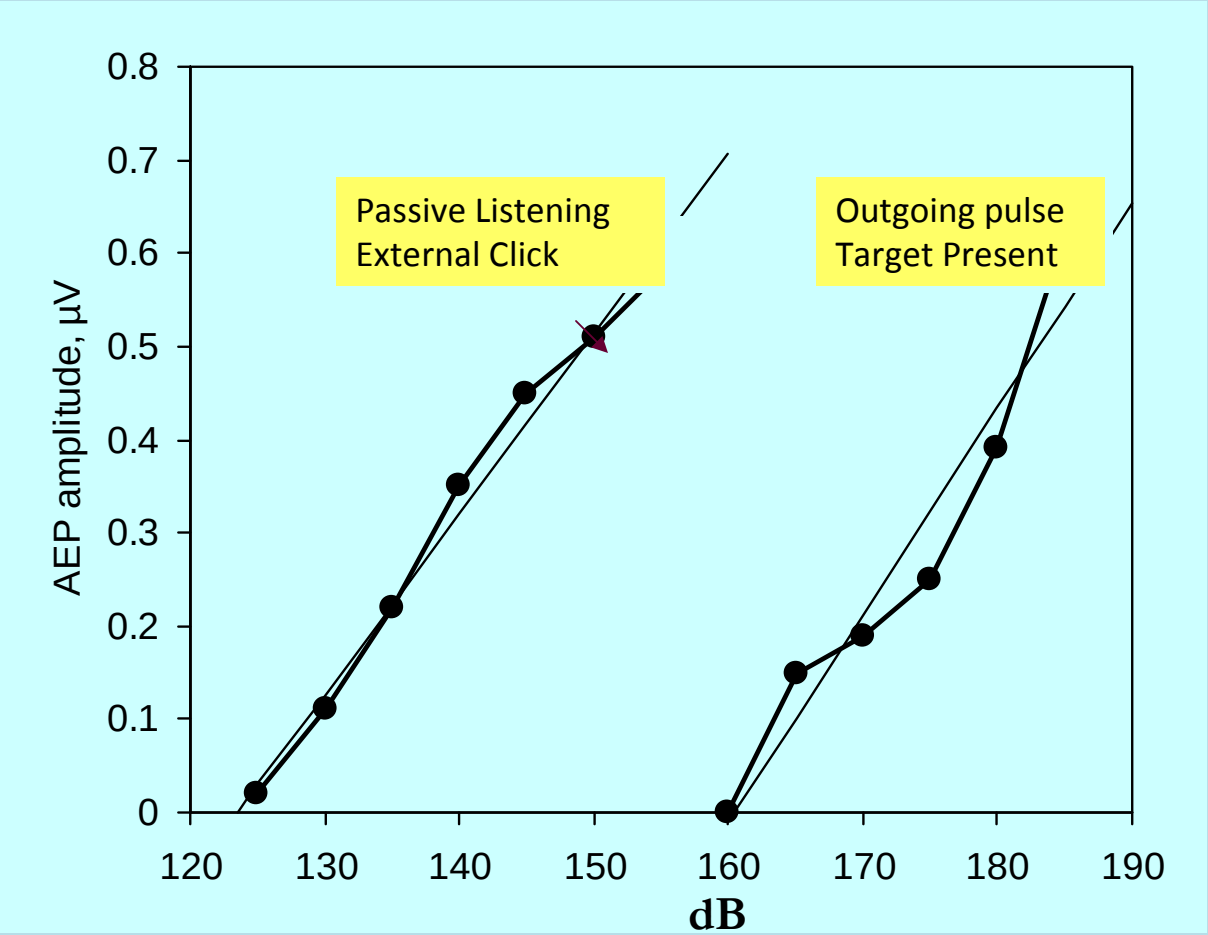
Nachtigall, P.E. and Supin, A. Ya .(**2008**) A false killer whale adjusts its hearing while it echolocates. The Journal of Experimental Biology *211*, 1714-1718

Odontocetes make Loud echolocation clicks!

The false killer whale can hear echoes from small targets louder than they hear their outgoing signals of 180 dB that create the echoes from those targets

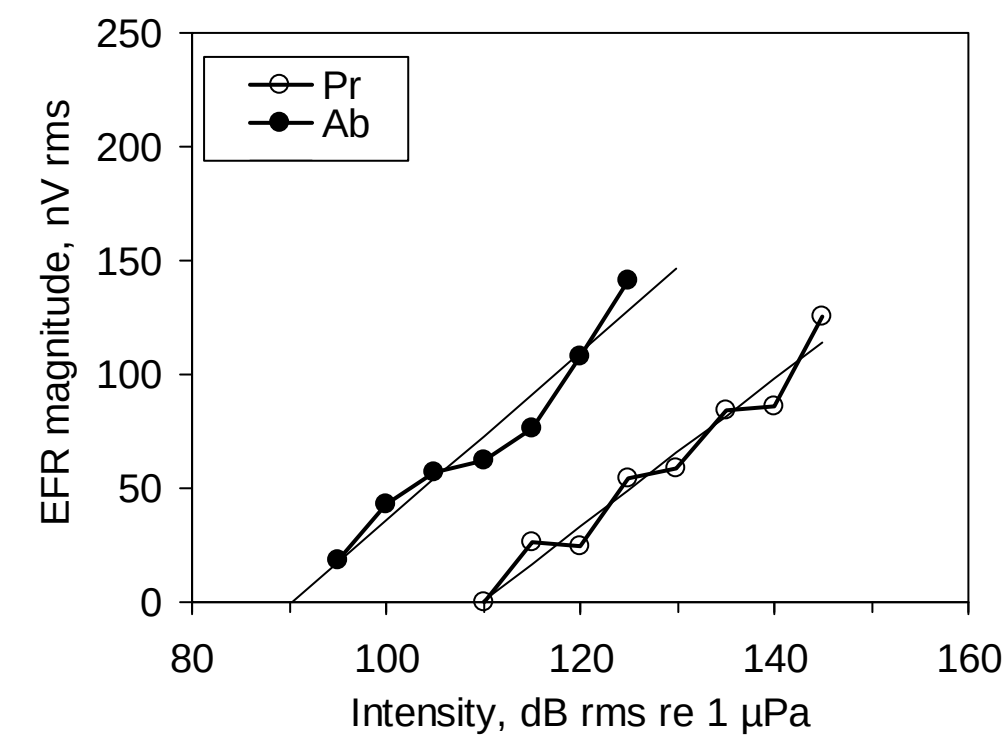
ANATOMICAL DAMPENING

How well does the animal hear its own outgoing pulse as compared to an equivalent external click?



Animal hears own echolocation clicks about 40 dB down

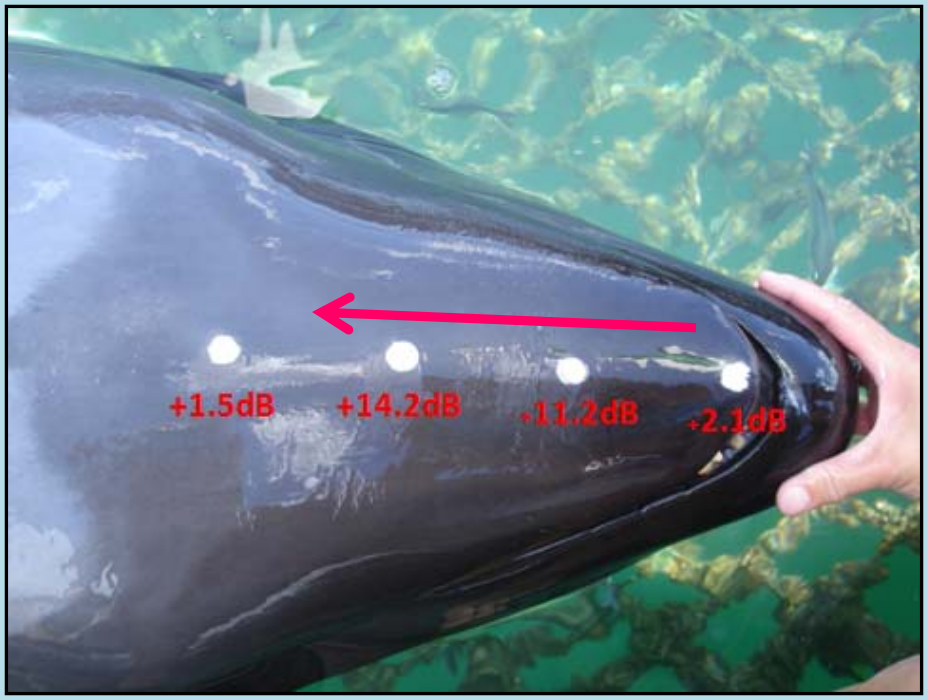
Active Hearing Control
Hearing difference of 22.5 kHz tone with targets present and targets Absent

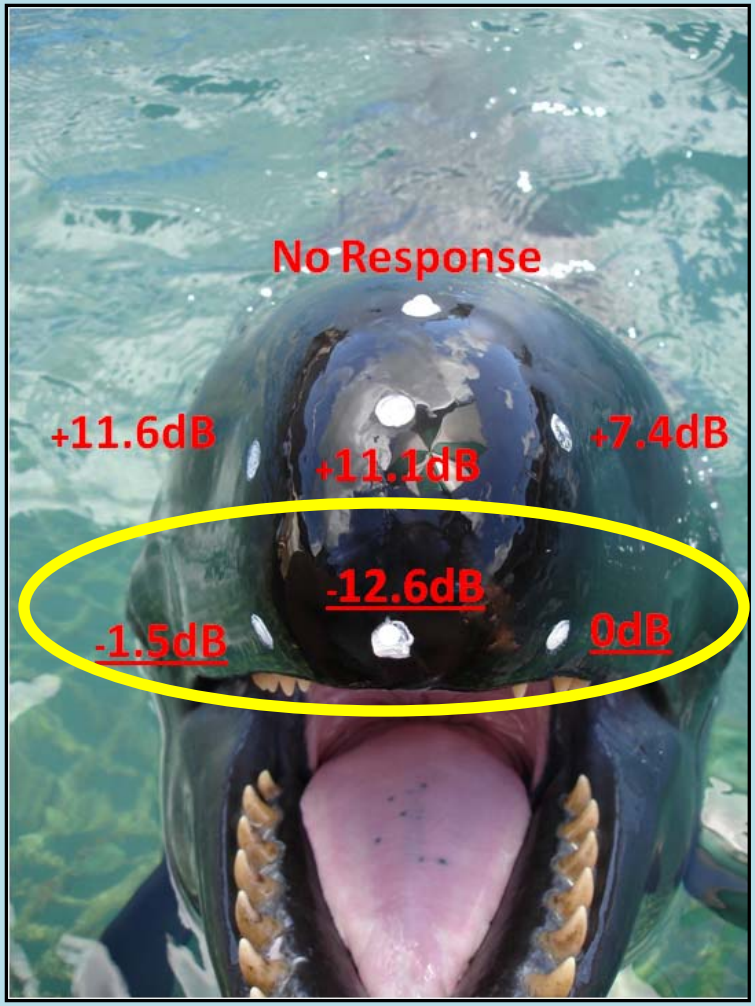


Whale hears tone 20 dB better when targets are absent and she is echolocating than when targets are present and she is echolocating.

Hearing Directionality/Sound Paths

This whale hears best
At the tip of her ‘nose’
Just above her mouth

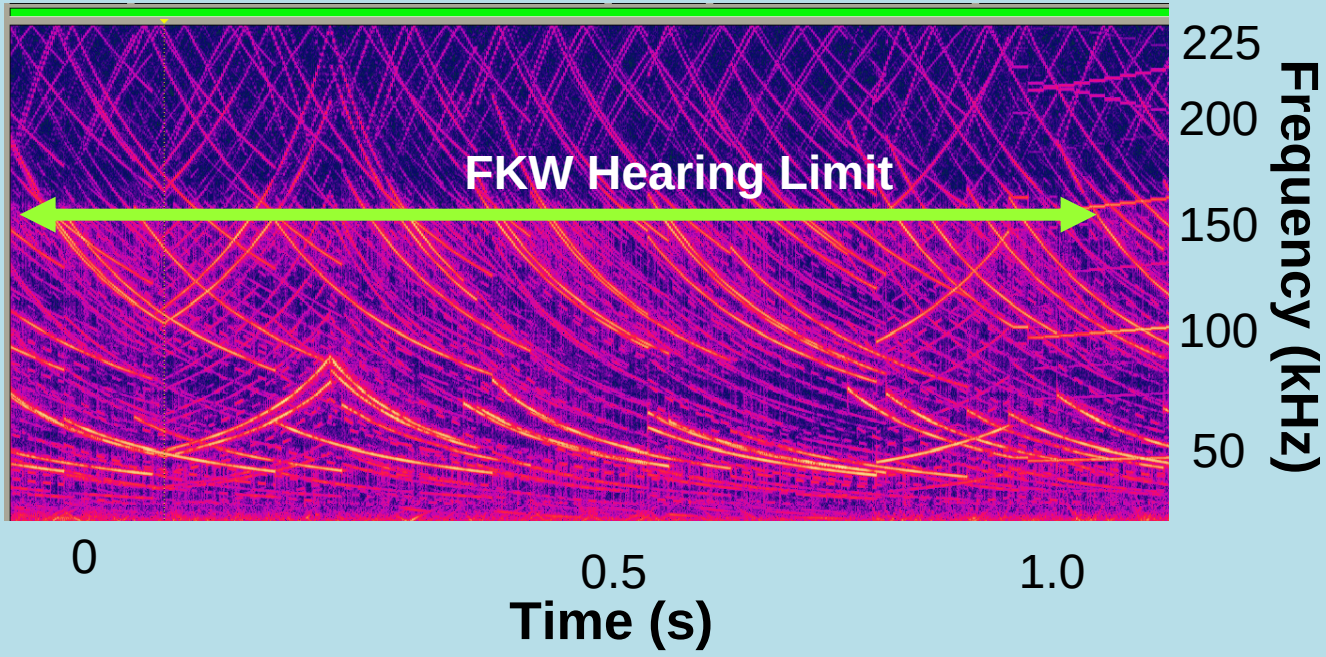




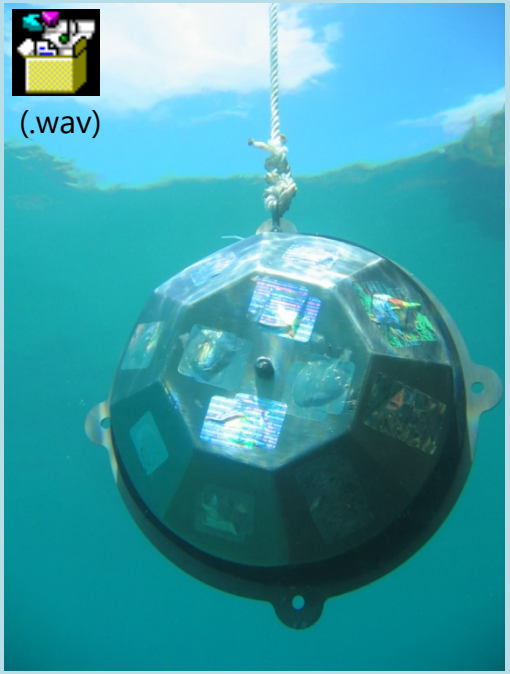
Save Wave Pinger
Our questions

- What are the acoustic characteristics of the pinger called the *SaveWave Longline Saver* ?
- What are the effects of this device on the echolocation performance of a false killer whale ?
- Could this device be used in the field ?

Acoustic Characteristics



(.wav)



- Broadband (up to 225 kHz)
- Manufacturer's information
  - SL 155 dB re: 1µPa, from 5 to 180 kHz
- High SL recorded up to 182 dB

Results

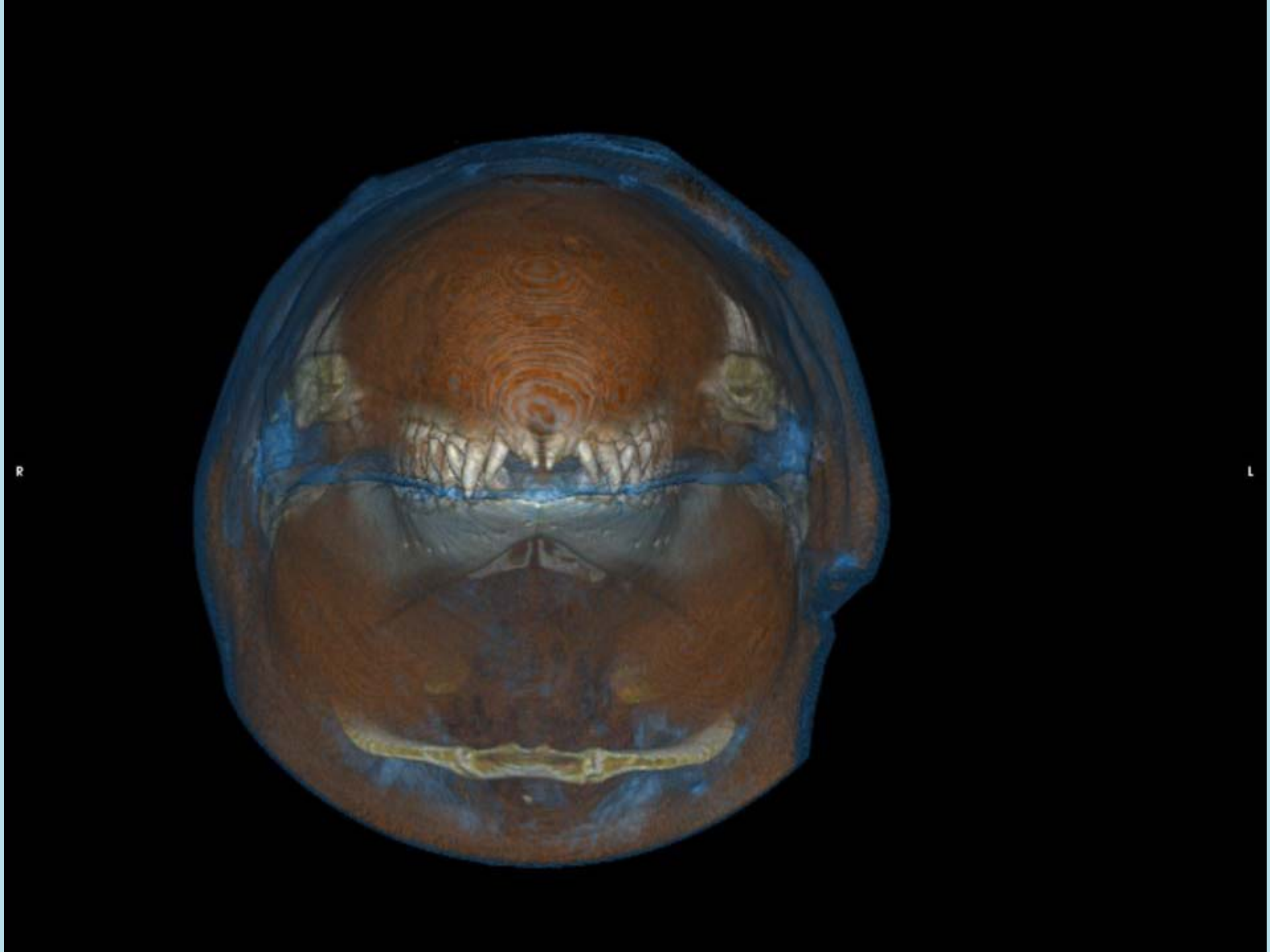
If the sound is loud enough it can mask the echolocation and reduce performance.

If you move the device 30 m away it is no longer effective

This was a very short preliminary study

Suggested Echolocation Experiments

- Range at which a hook can be detected in a fish by a FKW
- Can the hooks be made brighter with foam coating – does the range increase?
- Observation of echolocation foraging behavior acoustic and visual
- Acoustic observation of whistling and echolocation behavior with Dtags


R
L