

# Advancing our understanding of Hawaii's humpback whales through drones and bio-logging tags



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# Humpback whale tagging research at HIHWNMS



- Tags are used to study humpback whale behavior, acoustic signaling and the effects of anthropogenic noise

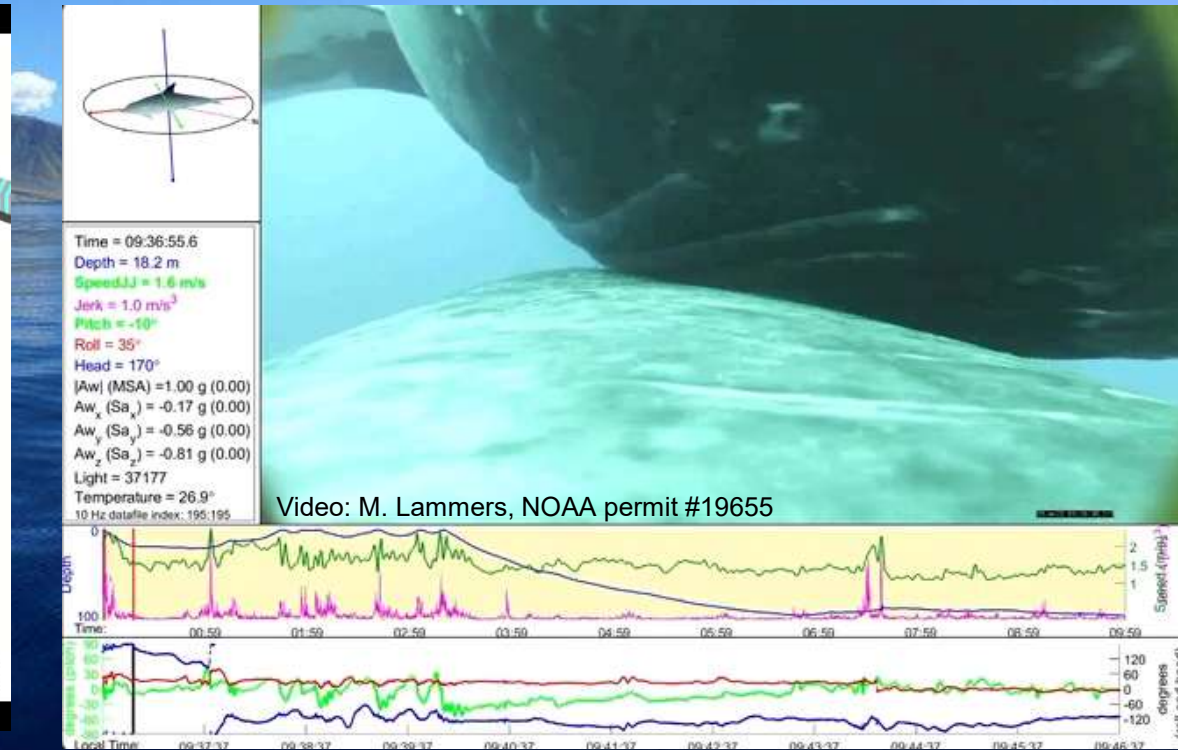
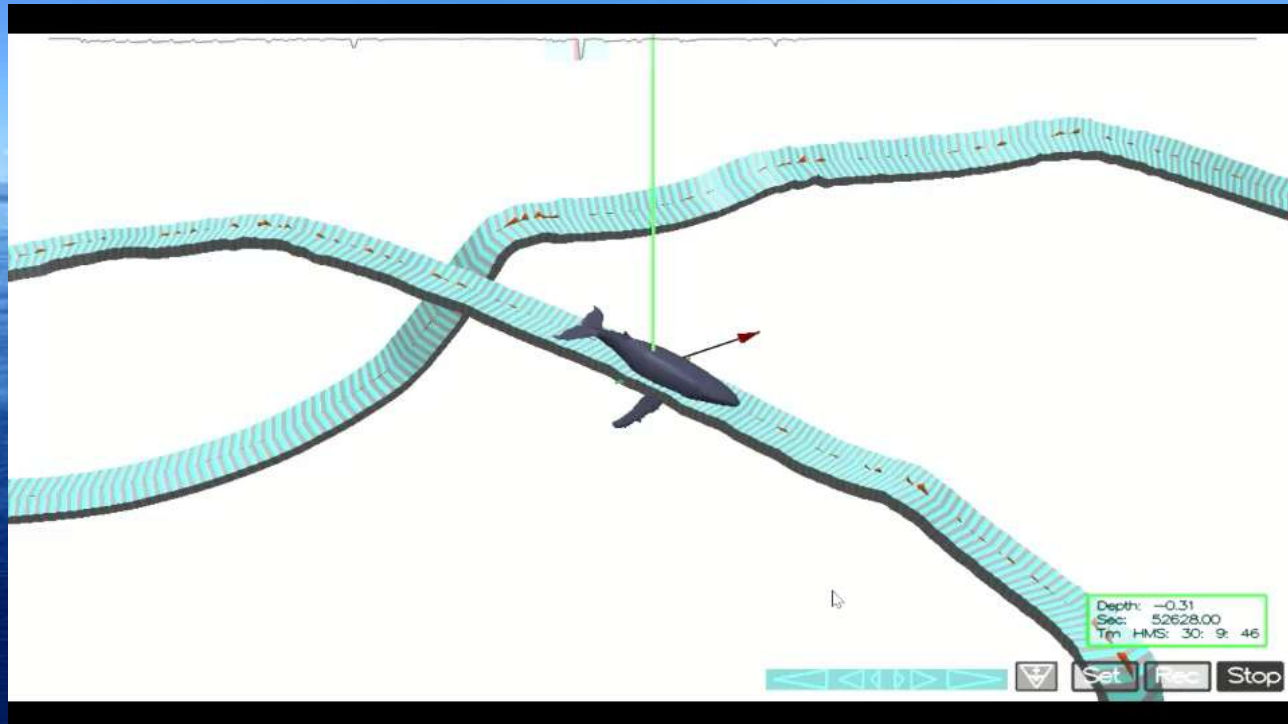




# Humpback whale tagging research at HIHWNMS



- Tags are used to study humpback whale behavior, acoustic signaling and the effects of anthropogenic noise
- Movement data (accelerometer, magnetometer, pressure) are used to study the whale's behavior in 2D or 3D
- Video-enabled tags provide social contextual information for the movement and acoustic data

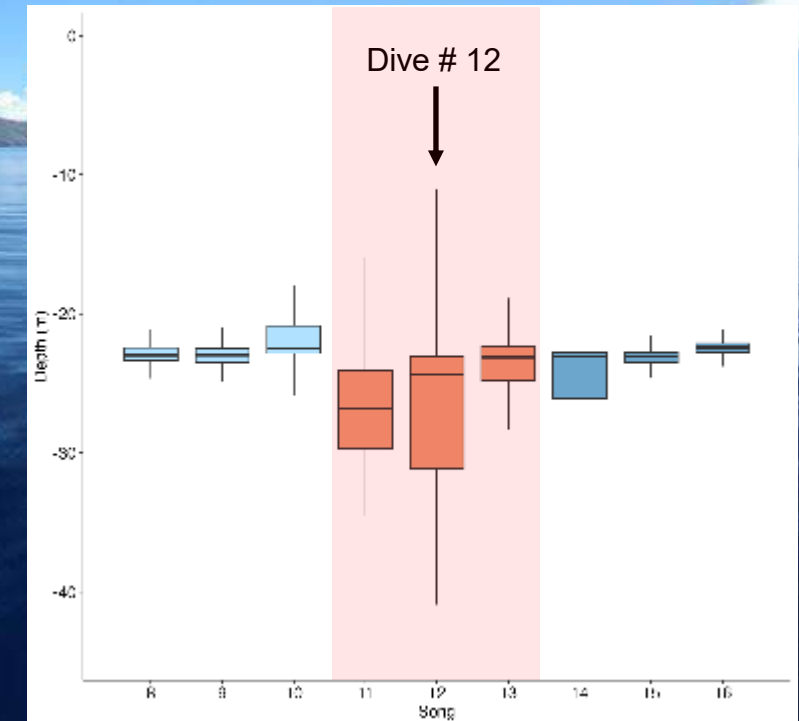
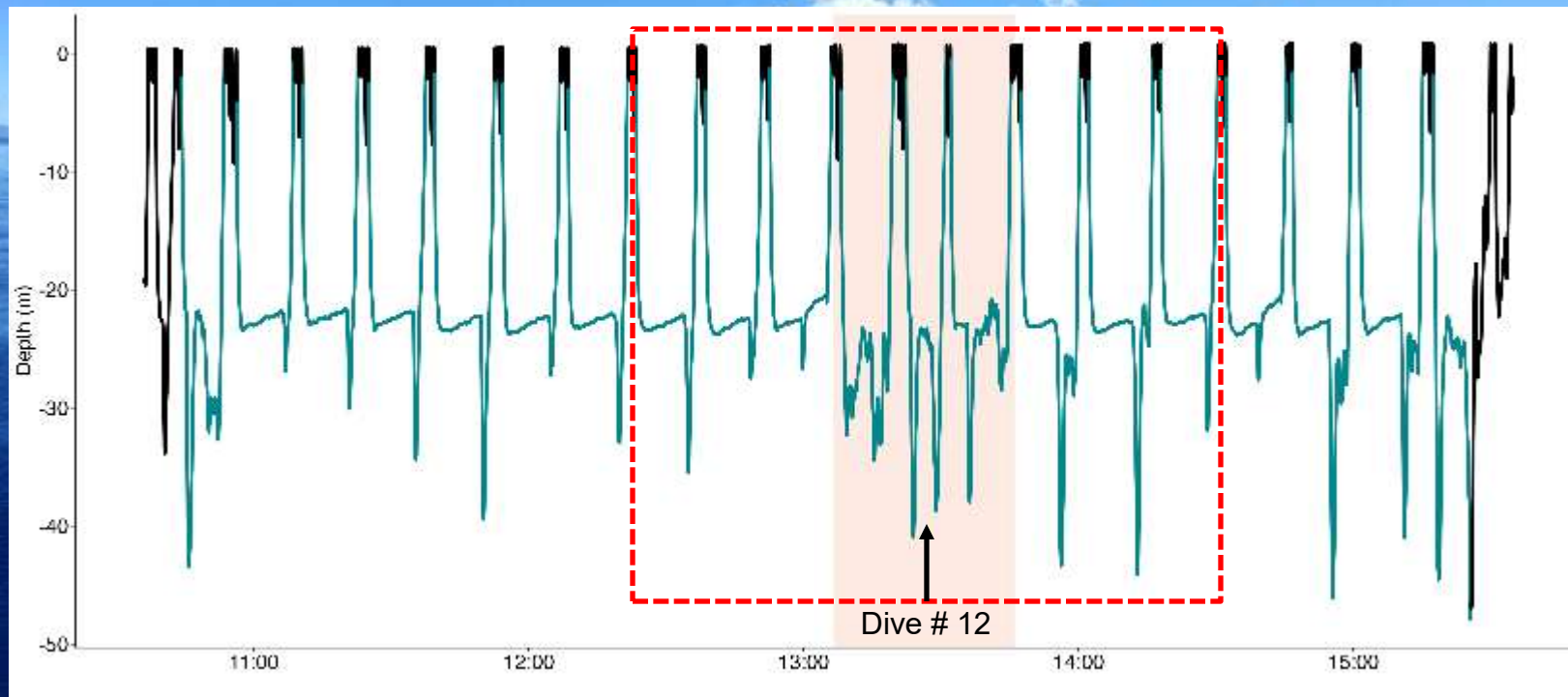




# Behavioral response to noise – dive profile



- Tagged whale performed 20 stereotyped dives during which he sang
- Three of the dive cycles occurred while noise from a nearby tug/barge could be heard in the background
- Dives were deeper and more variable during the barge's approach and one dive was cut short by ~ 5 min

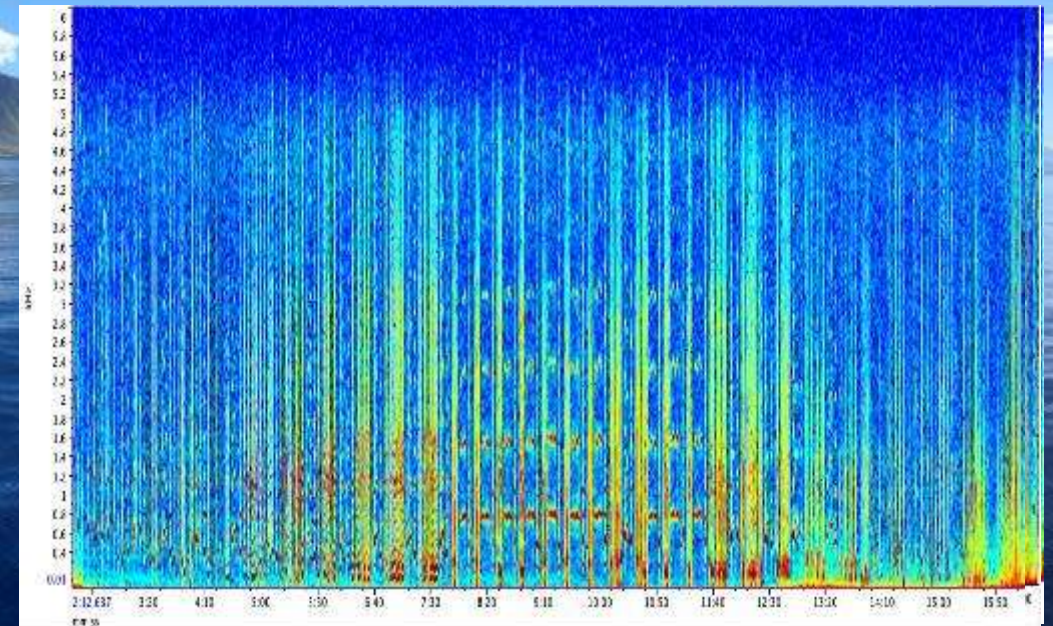
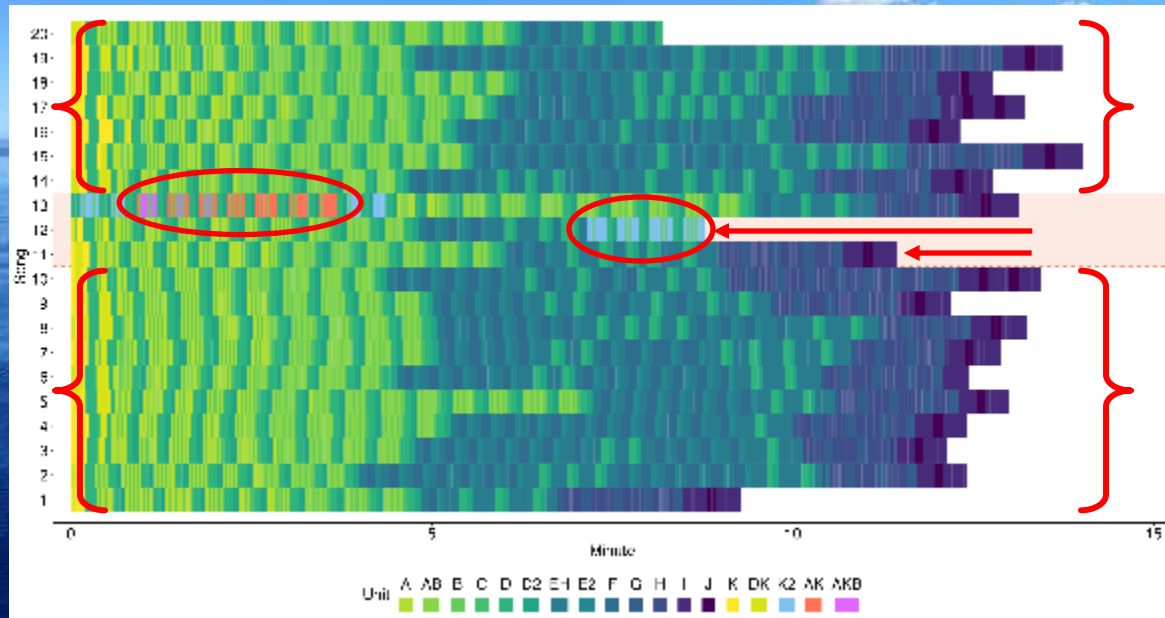




# Acoustic observations – song structure



- Song structure (units, phrases & themes) was very consistent during the 10 cycles before the tug/barge
- When noise was present, the songs were cut short, and new units were produced
- Once the noise subsided, the new units disappeared, and the song structure returned to normal



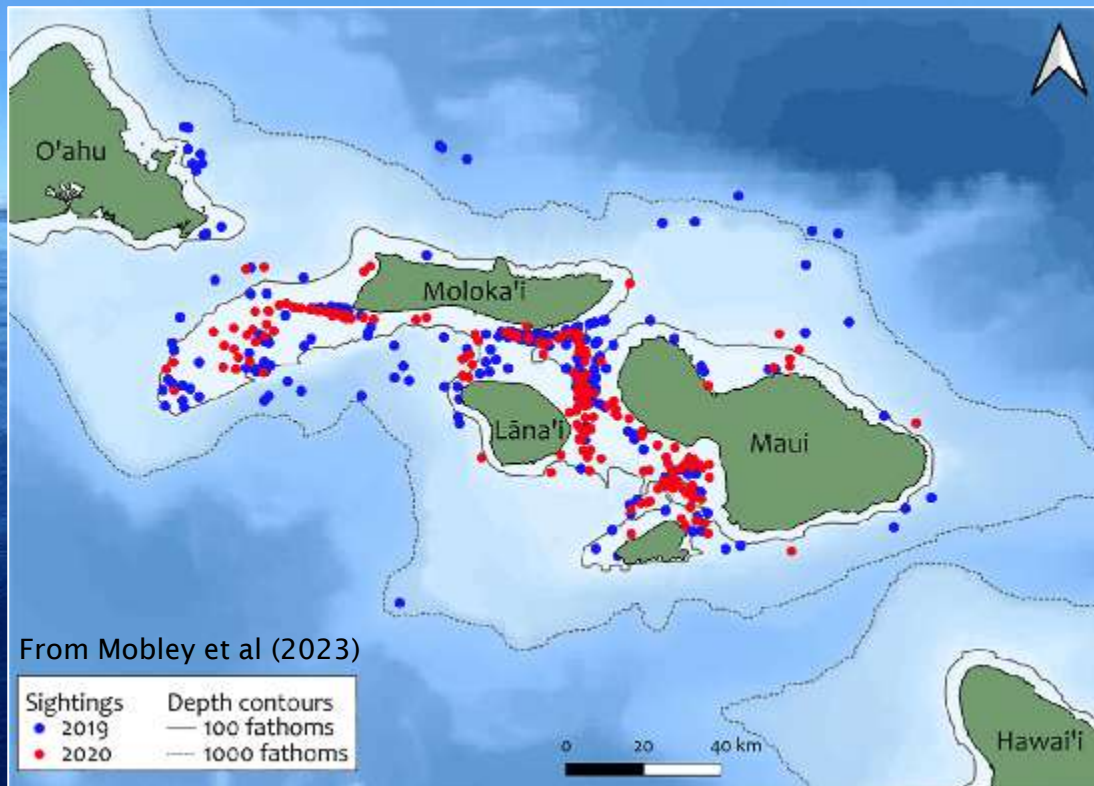
From: Lammers et al. (in press) "The exposure and response of Humpback Whales to vessel engine noise on the Hawaiian breeding ground." *The Effects of Noise on Aquatic Life IV*. Springer



# Behavioral response to vessel noise



- Maui waters are used extensively by whales, but also by vessels involved in fishing, transportation & ecotourism
- An experiment was designed to examine the behavioral response of whales to vessel noise





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Video: C. Zadra, NOAA permit #26593



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- An experiment was designed to examine the behavioral response of whales to vessel noise
- Stationary whales are drone tagged to minimize disturbance
- Whales are then exposed to playback experiments using recorded vessel noise and social sounds



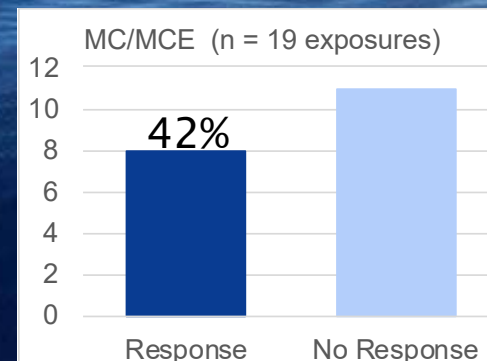
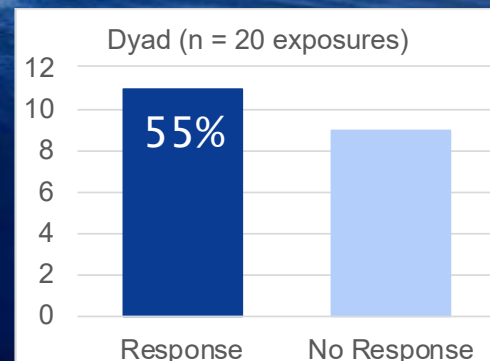
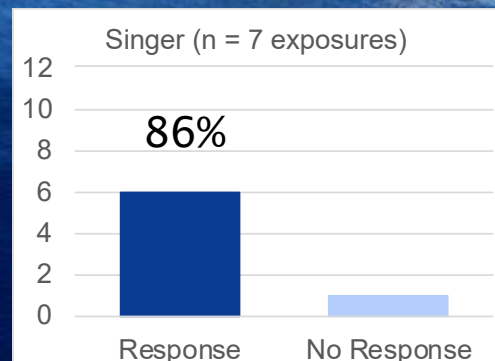
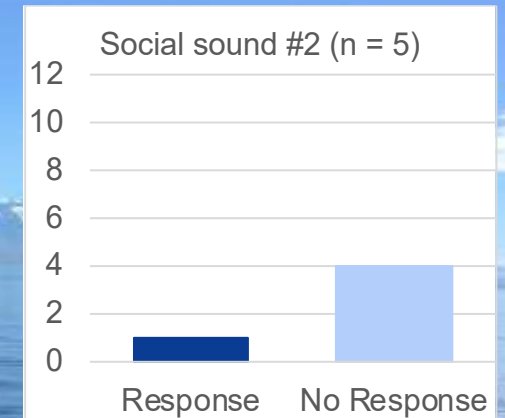
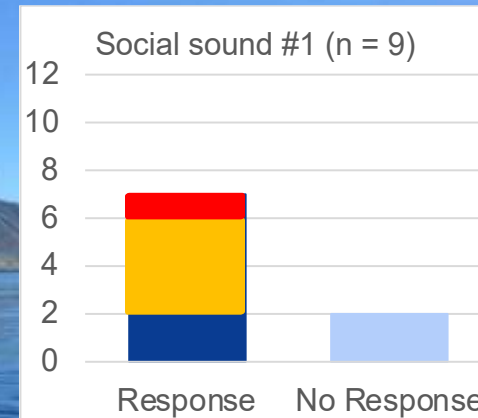
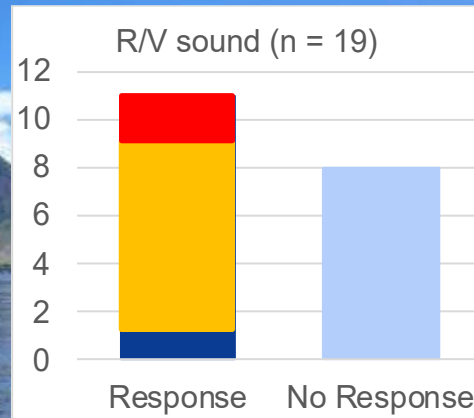
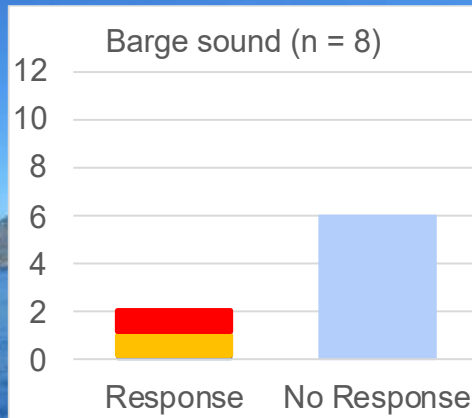


# Behavioral response to vessel noise



- Response rate varied among sound types; higher response rate to fast R/V sound and social sound #1
- Response rate also varied among whale pod types; singers were most sensitive to acoustic disturbance

■ = Mild & temp.  
■ = Mod. & temp.  
■ = Strong & trans.



Note: Preliminary results



# Studying whale hearing with tags



- The hearing abilities of large whales is difficult to study and therefore still poorly understood
- In human or captive animal studies the subject can be asked or trained to respond when a sound is heard
- When training is not possible, electrophysiological methods can be used (e.g. ABR/AEP)
- Is there a way to measure the hearing of a free-ranging cetacean? **YES!**

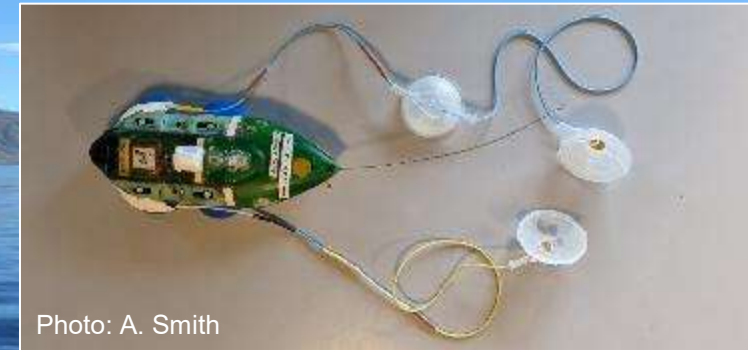


Photo: A. Smith



Photo: UC Santa Cruz



Photo: Sea World



Photo: A. Smith



# Studying whale hearing with tags



- Meet Gyrosaurus!
- A drone-based, dual gyroscope release mechanism developed by Ocean Alliance
- Successful deployment of ABR tag on mother on Feb. 4, 2026



Photo: M. Lammers



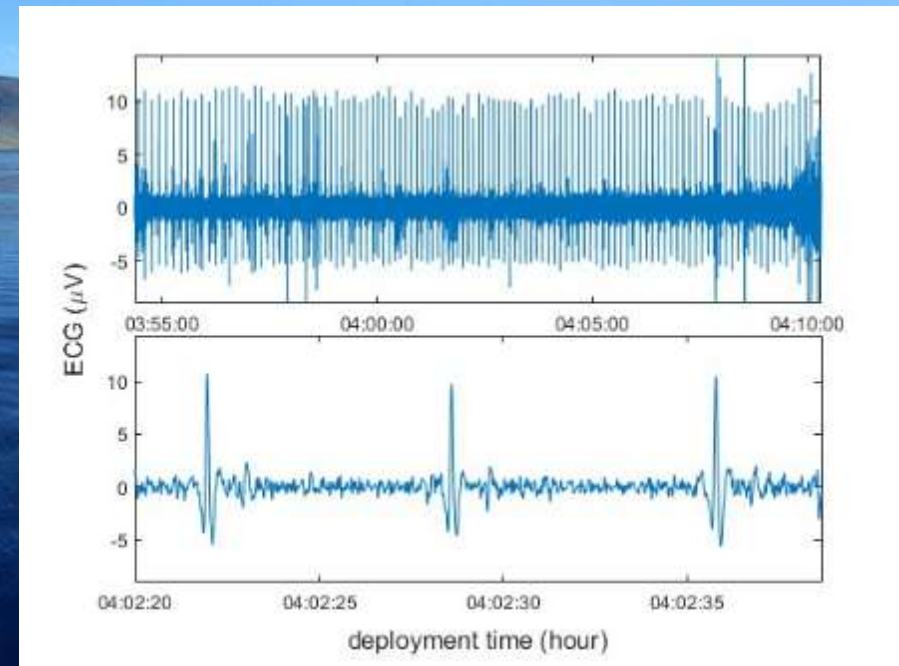
Video: C. Zadra, NOAA permit #26593



# Studying whale hearing with tags



- Placement of electrodes is critical for ABR measurement!
- Pilot effort demonstrated that the drone deployment system works and precise placement is possible
- In addition to ABRs, tag also records heart rate, which may also be used to study hearing



# Thank You

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Photo: Ed Lyman, NOAA permit #14682