

Passive Acoustic Monitoring in California's National Marine Sanctuaries

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National Marine Sanctuary Webinar Series

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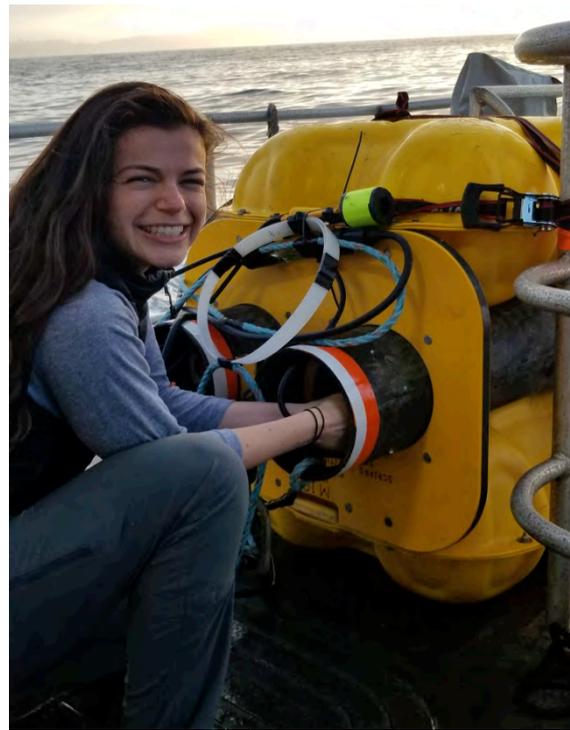
Who we are



Samara Haver



Angela Szesciorka



Vanessa ZoBell

Sound Waves



When we hit the drum, membrane of drum vibrates producing sound.

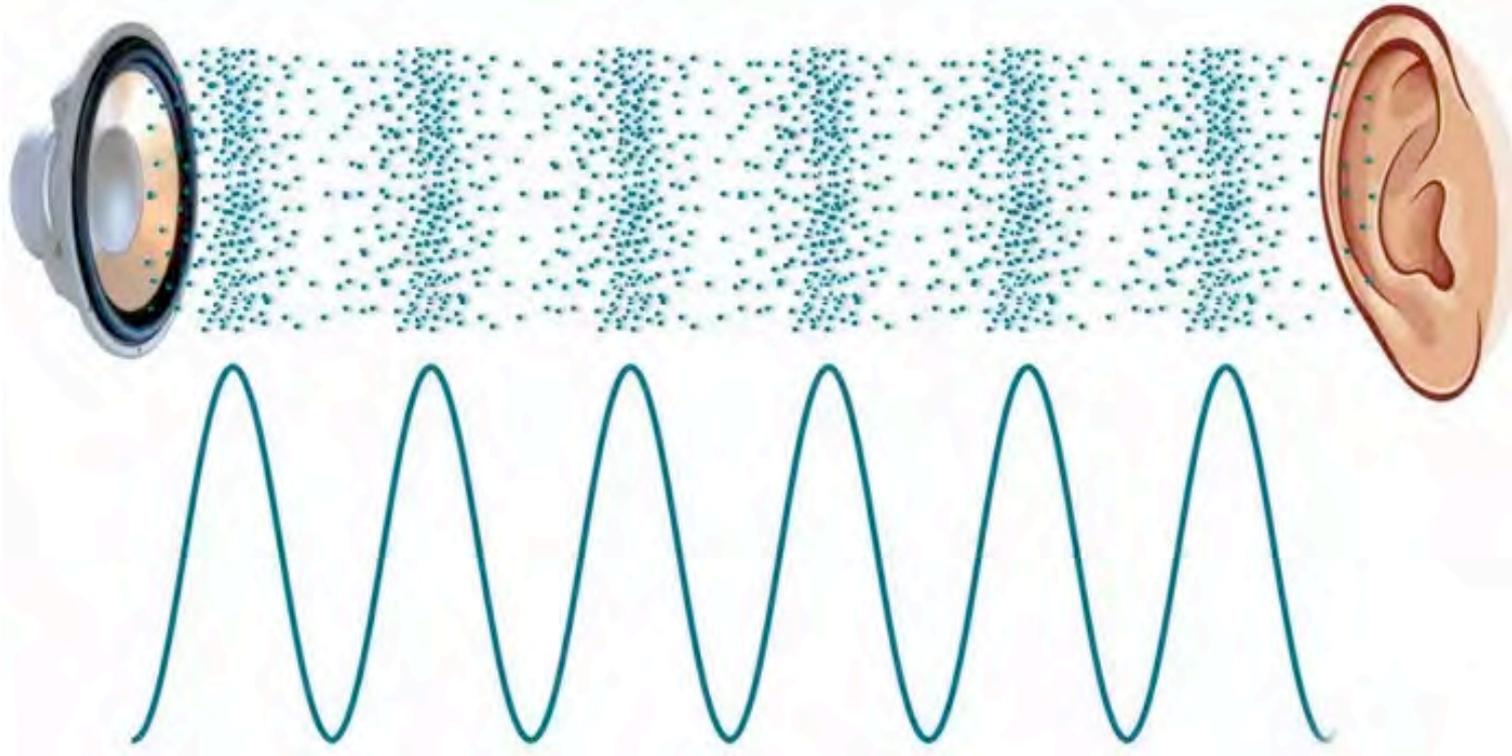


When we play a guitar, the string on it makes to and fro motion and produces sound.

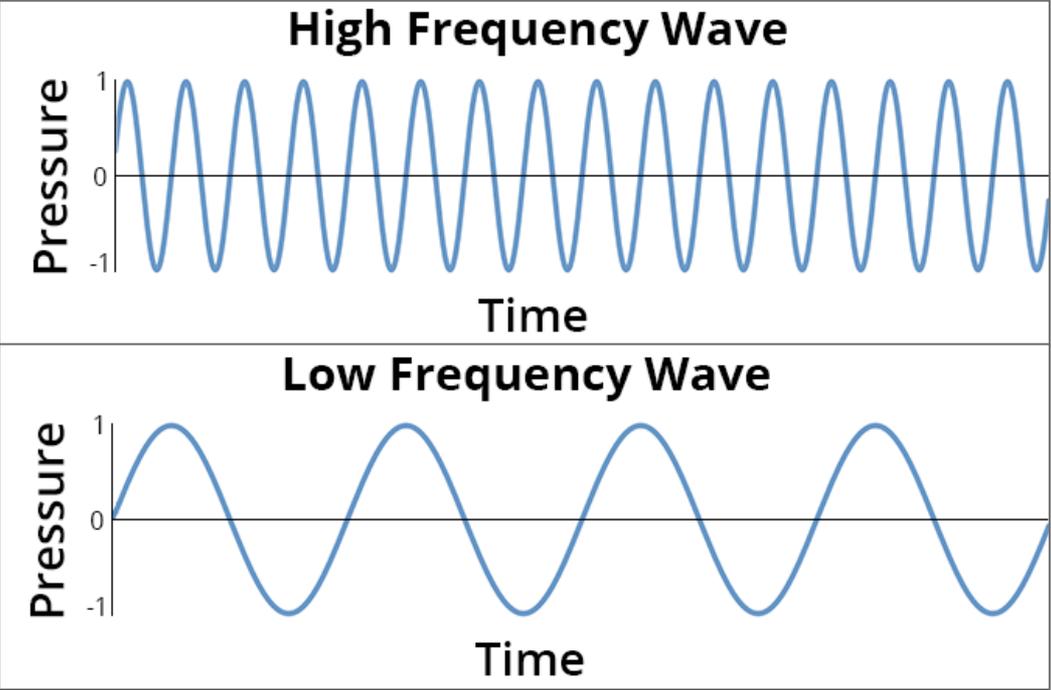
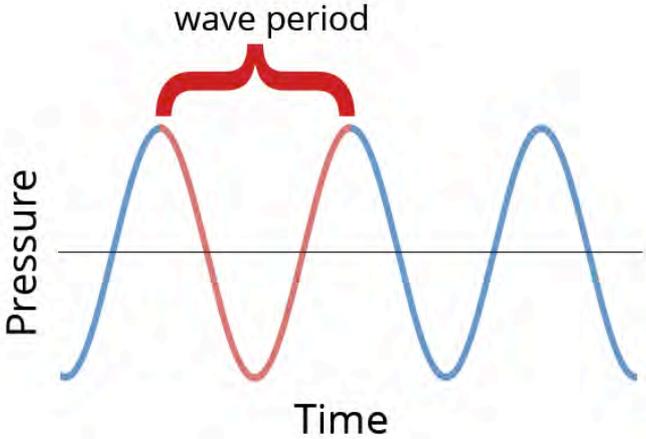


Sound produced by vibrating prong of tuning fork.

What is sound?

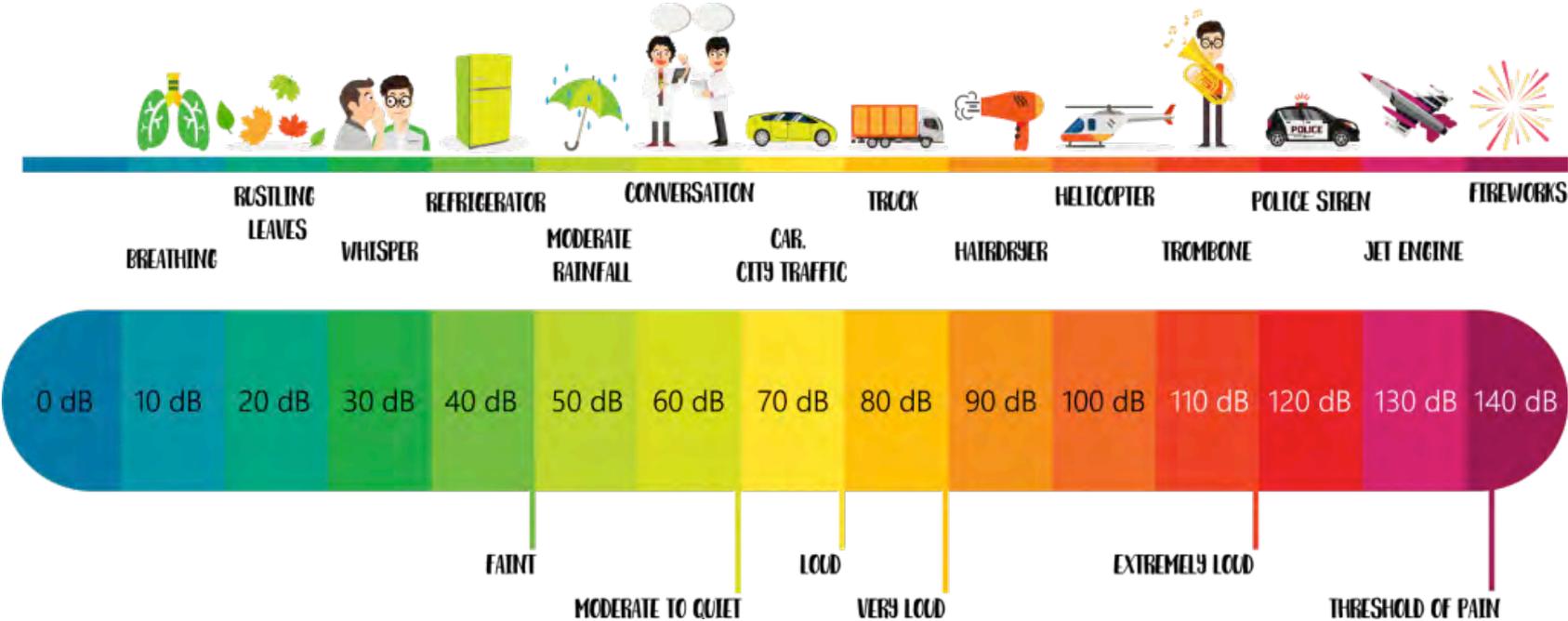


Measuring Sound: Frequency

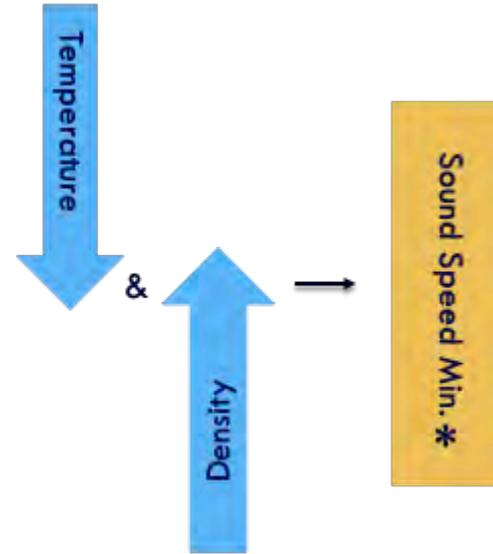
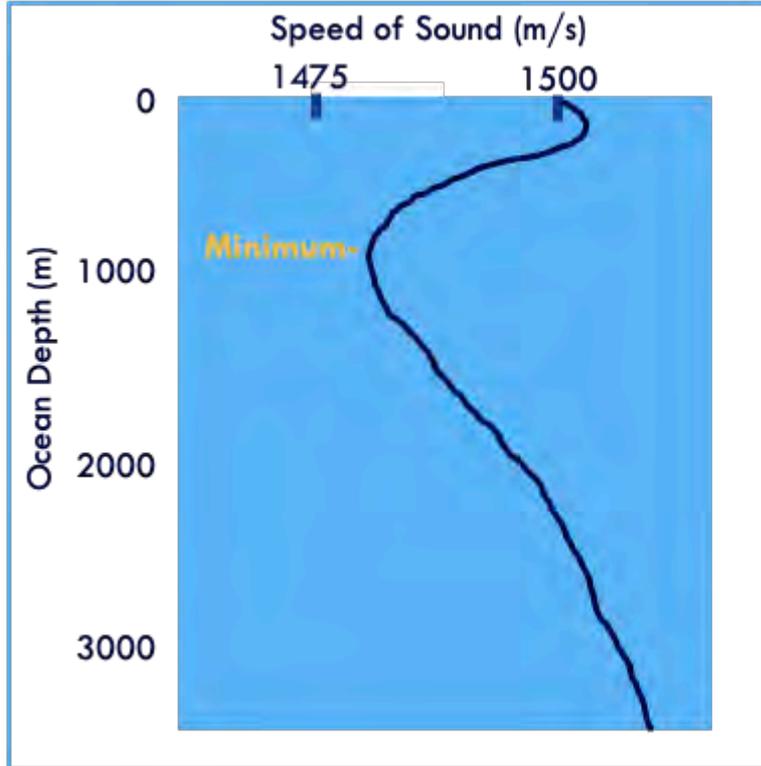


Measuring Sound: Intensity

THE DECIBEL SCALE



Sound Fixing and Ranging Channel

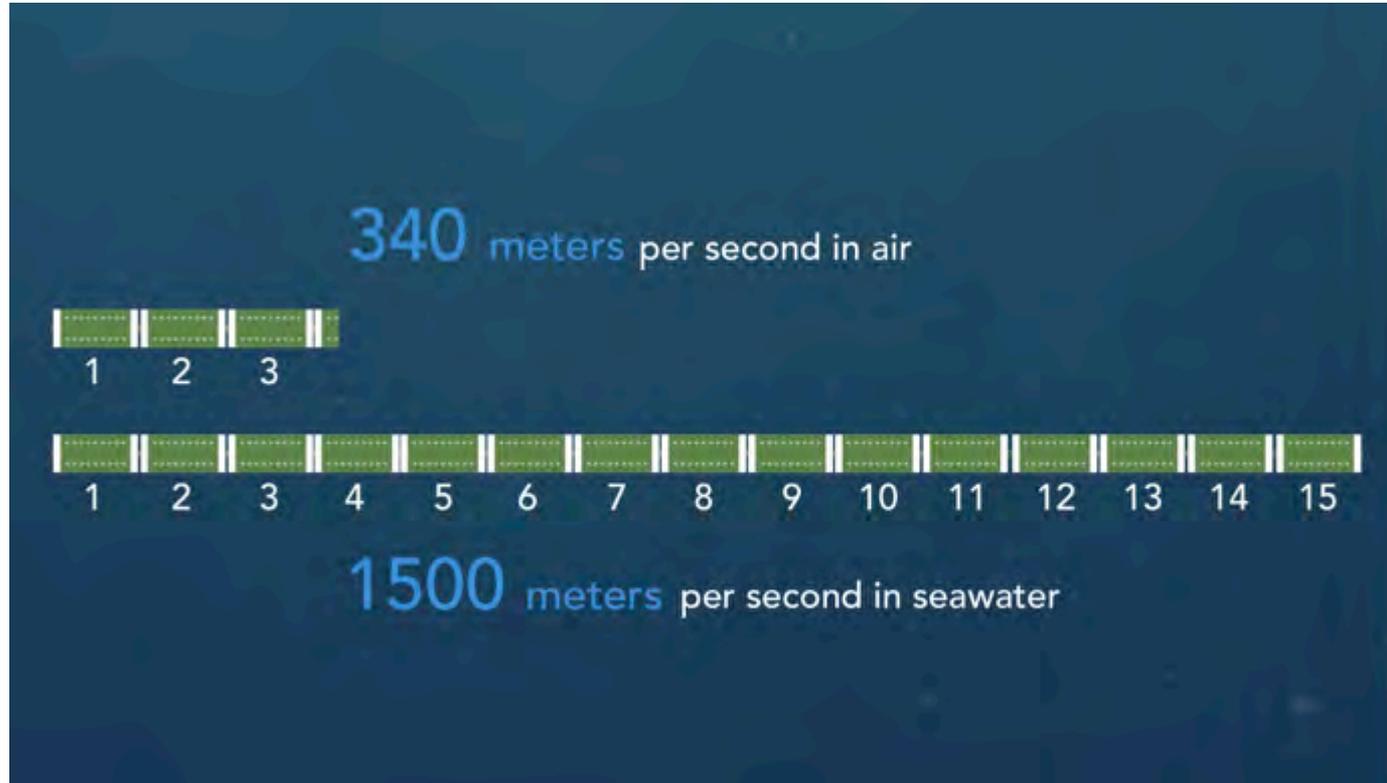


POLL

What happens to sound underwater?

- 4 x faster
- 2 x slower
- Same speed

What happens to sound underwater?



DISTANCE SUNLIGHT TRAVELS IN THE OCEAN

sea level



sunlight (euphotic) zone
Sunlight rarely penetrates beyond this zone.

200 meters



twilight (dysphotic) zone
Sunlight decreases rapidly with depth.
Photosynthesis is not possible here.

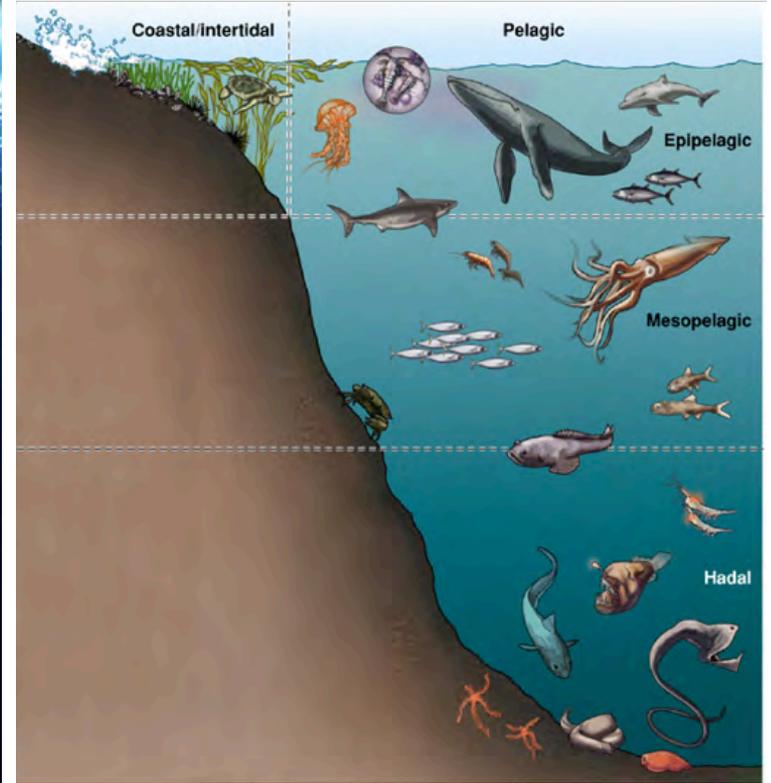
1000 meters



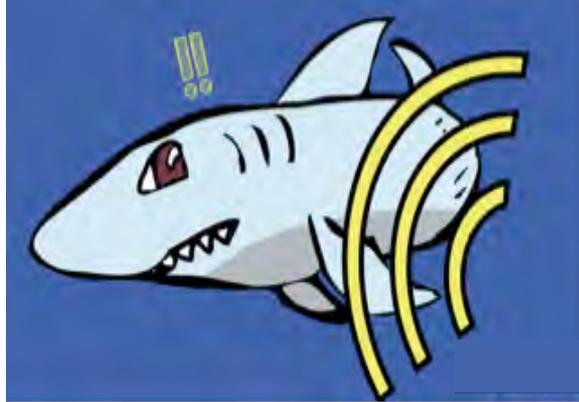
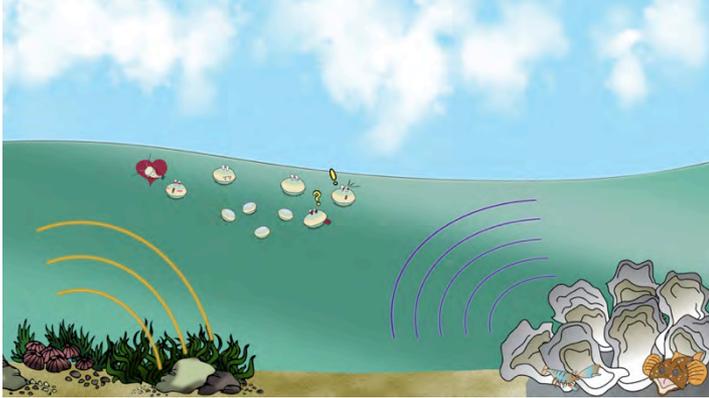
midnight (aphotic) zone
Sunlight does not penetrate at all.
This zone is bathed in darkness.



Importance of sound in the ocean



How animals use sound

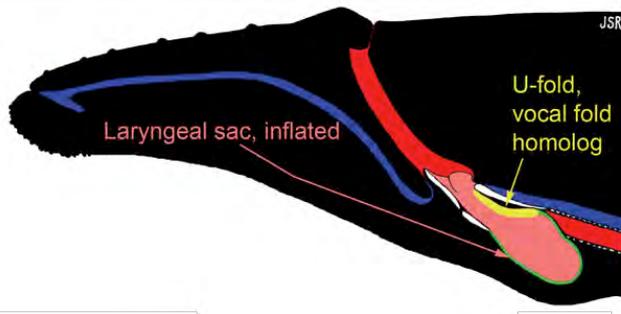
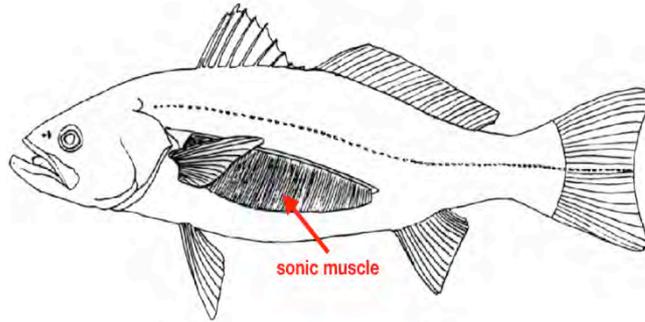


Sound can be used
“passively” and
“actively”

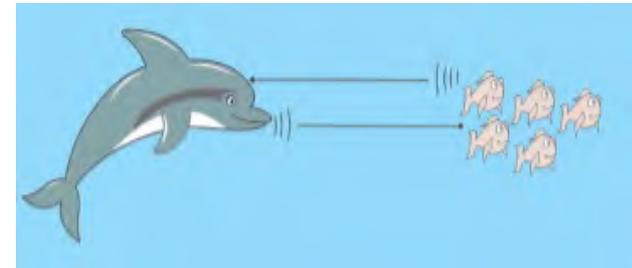
- Settlement cues
- Foraging
- Defense
- Navigation
- Migration
- Communication
- Courtship/Mating



Sound production in aquatic animals



- Muscular vibration
- Stridulation
- Percussion on substrate
- Vocalization
- Echolocation



Toothed whales off California



Harbour porpoise



Dall's porpoise



Common dolphin



Bottlenose dolphin



Pacific white-sided dolphin



Pantropical spotted dolphin



Risso's dolphin



Sperm whale



Dwarf sperm whale



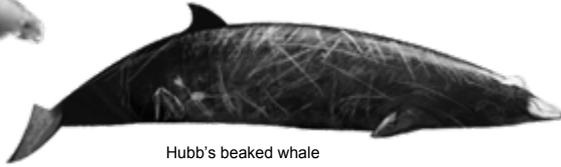
Pygmy sperm whale



Striped dolphin



Northern right whale dolphin



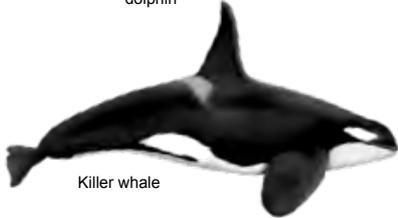
Hubb's beaked whale



Baird's beaked whale



Rough-toothed dolphin



Killer whale



Ginkgo-toothed beaked whale



Blainville's beaked whale



Pilot whale



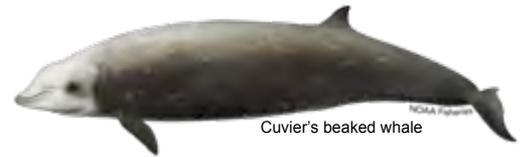
False killer whale



Stejneger's beaked whale



Perrin's beaked whale



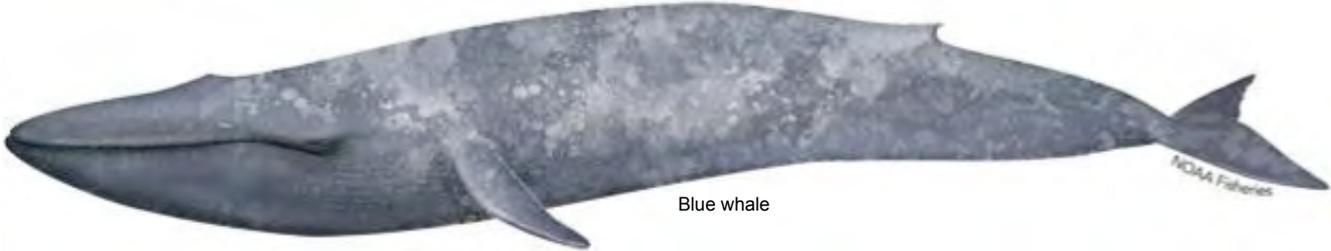
Cuvier's beaked whale

NOAA Fisheries

Baleen whales off California



Sei whale



Blue whale



Humpback whale



Bryde's whale



Minke whale



Fin whale



Gray whale

POLL

Which of these are known to sing?

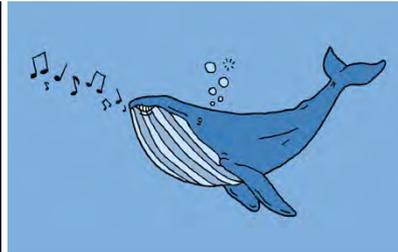
- Toothed whales
- Baleen whales





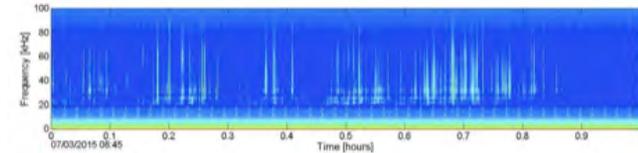
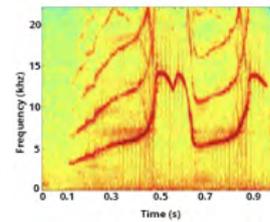
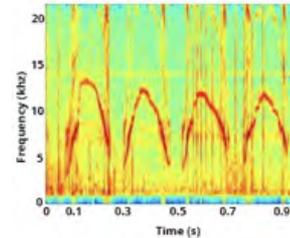
Baleen whales

- Low frequency
- Song
- Do not echolocate

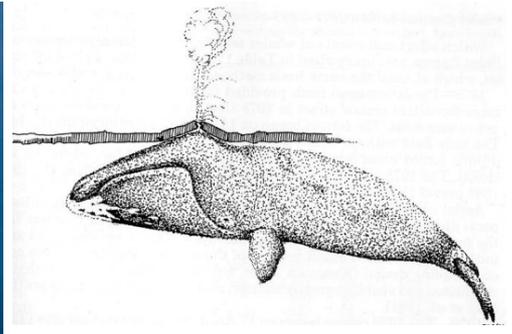
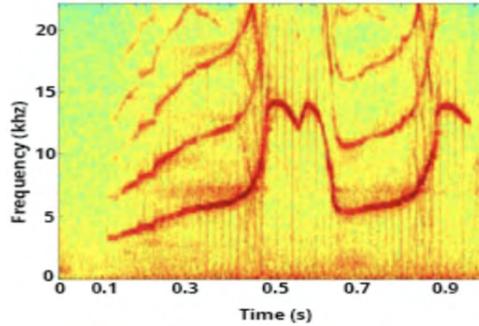
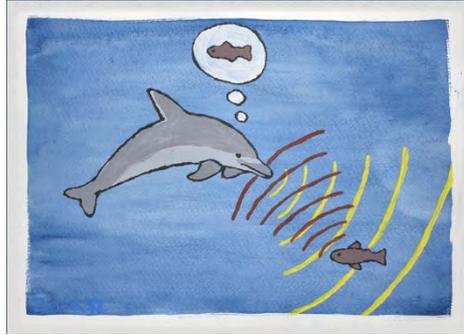


Toothed whales

- High frequency
- Clicks
- Whistles
- Echolocate



How do whales and dolphins use sound?



Abiotic Sounds in the Ocean

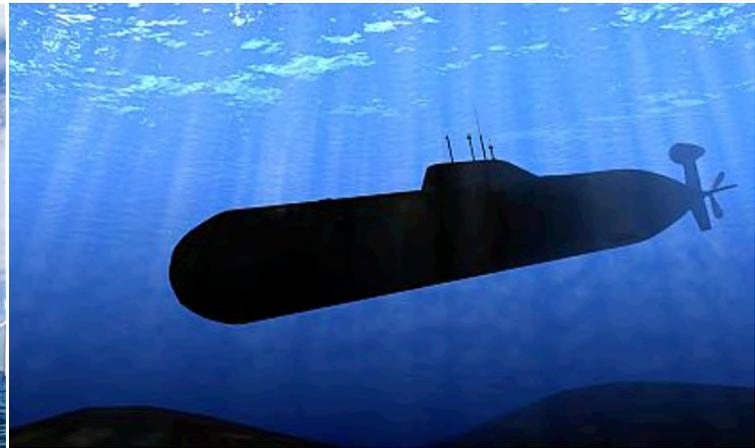


POLL

Which of the following generates sound or noise in the ocean?

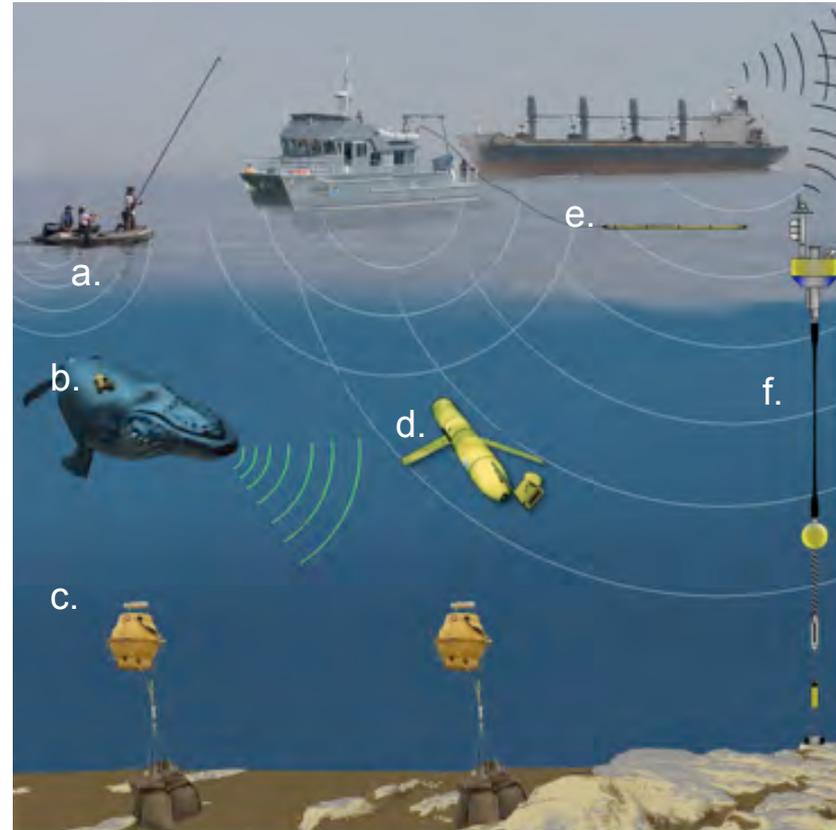
- Bubbles
- Wind Turbines
- Ships
- Waves
- All of the above

Human-generated noise



How do we collect data?

- *Passive Acoustic Monitoring*
 - Pros:
 - Detect animals when we can't see them
 - Less effort/cost for long-term data
 - Cons:
 - Can only determine presence
 - Can't count animals
 - Some sounds unknown
- Many tools to listen to underwater sound:
 - a. Dip hydrophones
 - b. Acoustic tags on animals
 - c. Bottom mounted recorders
 - d. Autonomous gliders
 - e. Towed arrays/hydrophones
 - f. Real-time buoys



Why listen to NMS?

- Passive acoustic monitoring can help:
 - Determine when animals are nearby
 - Characterize human-generated sources
 - Evaluate tools to conserve habitats



Current Research in California NMS

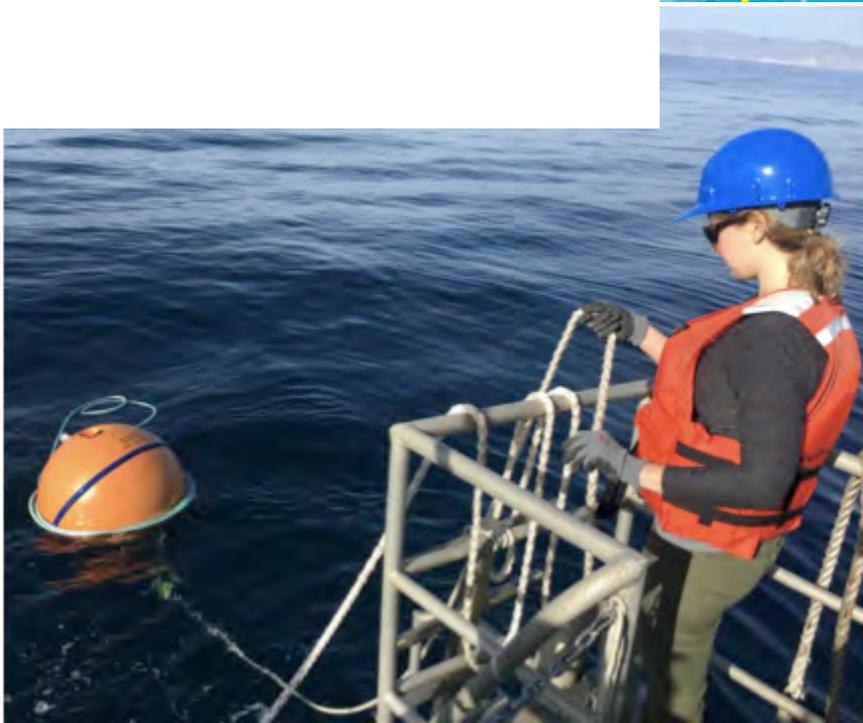
- **Soundscapes**
- **Whales**
- **Ships**

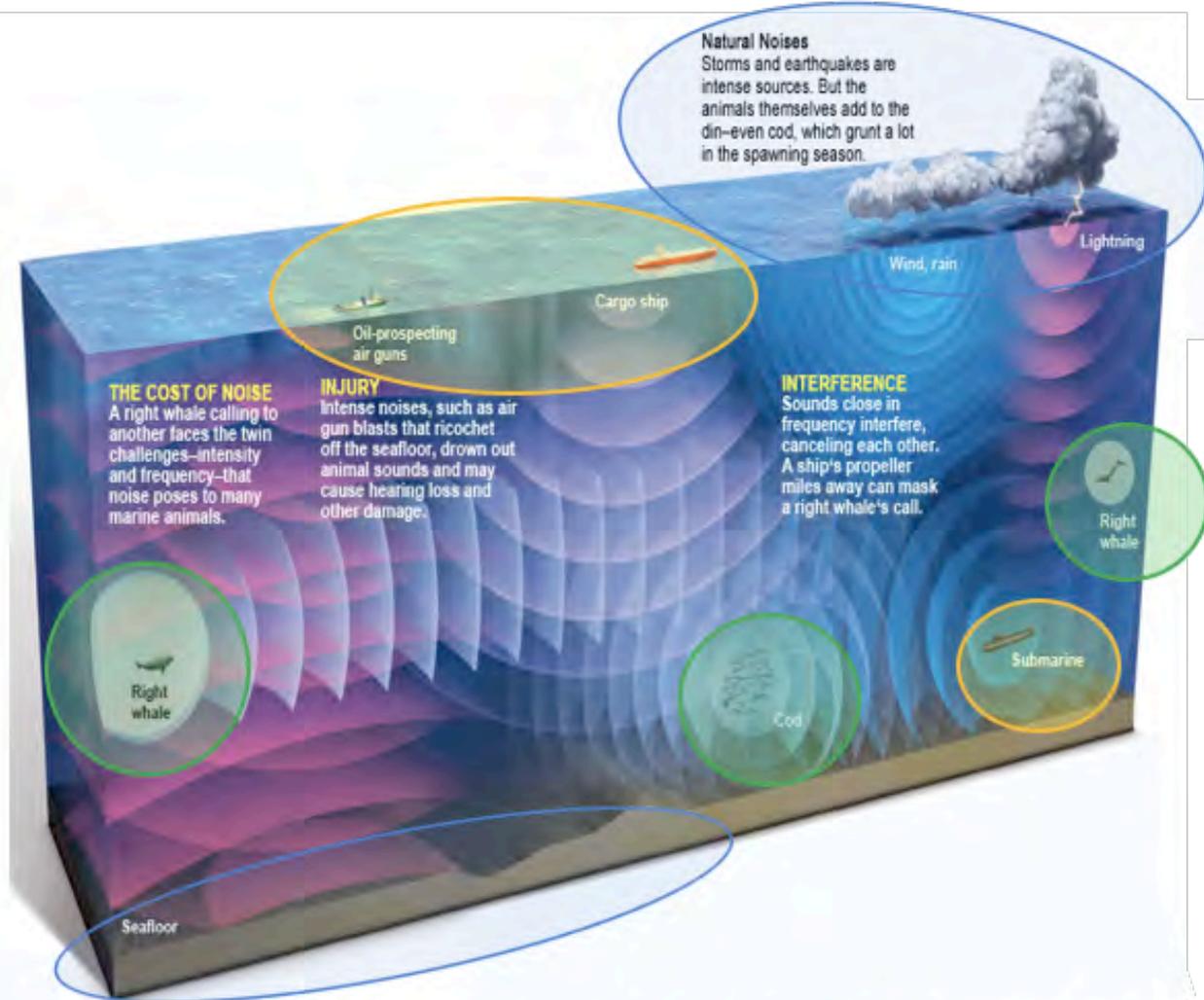
Current Research in California NMS

- **Soundscapes**
 - What is making sound?
 - How do sources and levels compare in different areas?
- **Whales**

- **Ships**

Sound Monitoring

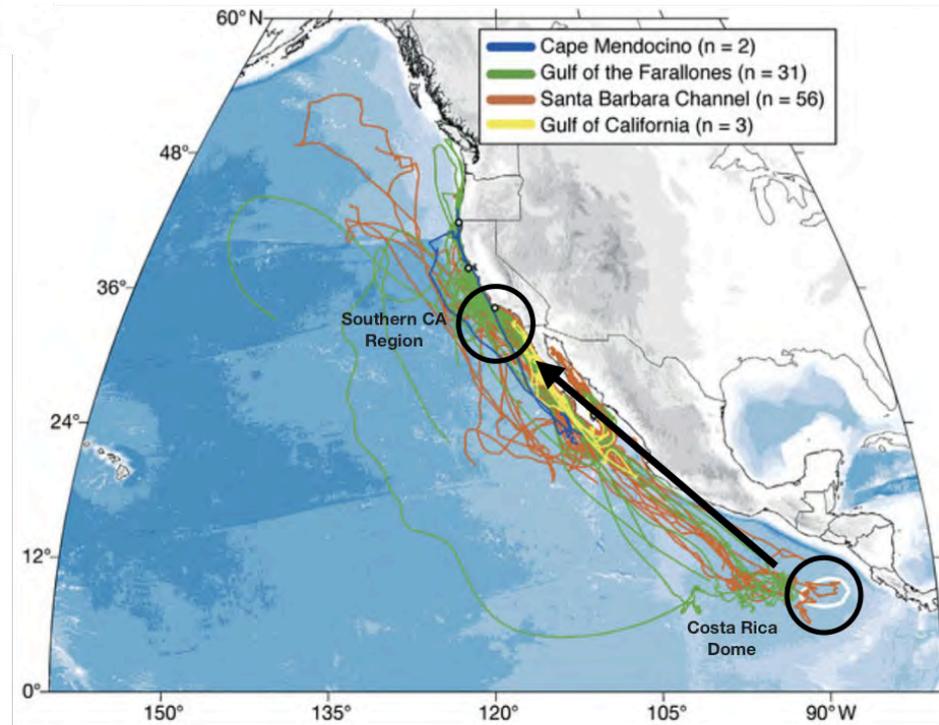




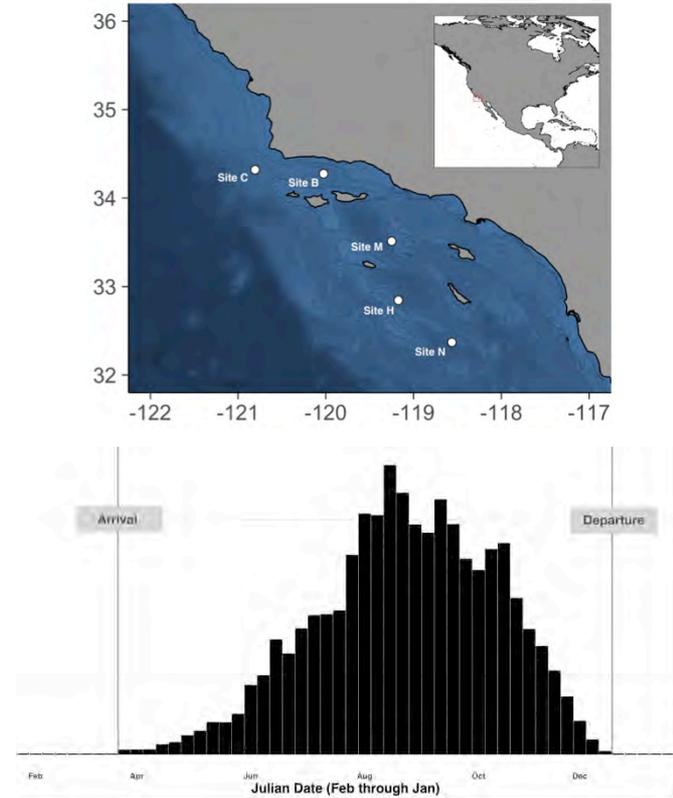
Current Research in California NMS

- Soundscapes
- **Whales**
 - Migration timing
 - Whale behavior
 - Interactions with ships
- Ships

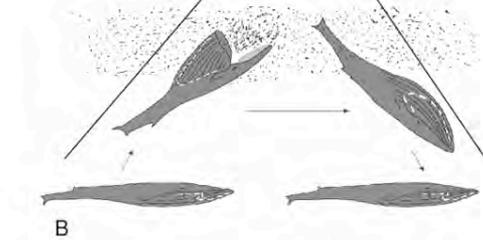
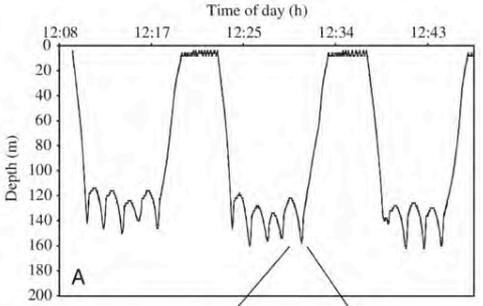
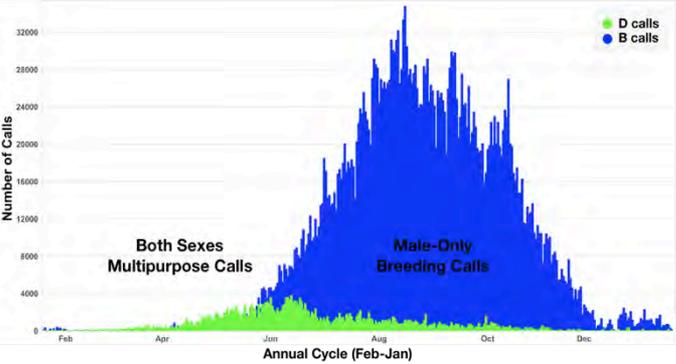
Blue whale research: migration timing



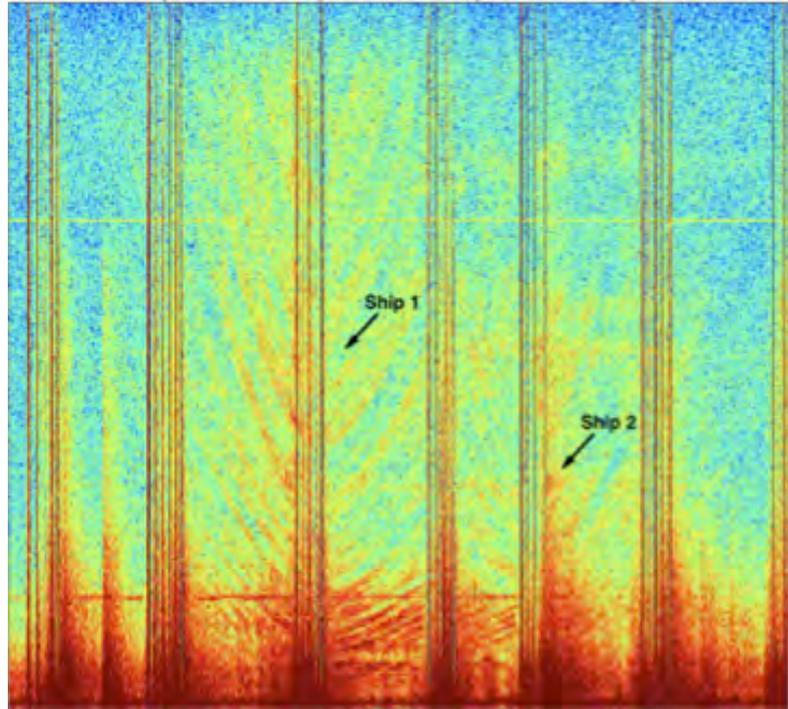
Bailey et al. 2009



Blue whale research: behavior



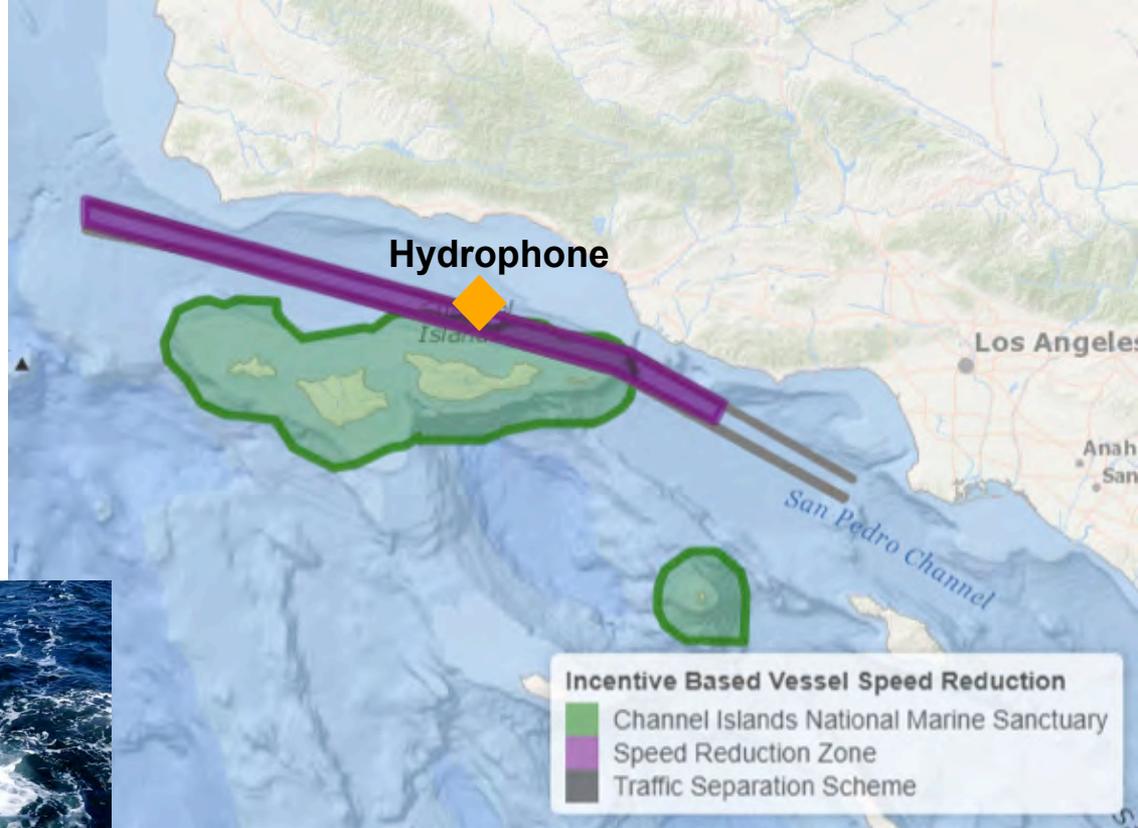
Blue whale research: ship interactions



Current Research in California NMS

- Soundscapes
- Whales
- **Ships**
 - Measuring ship noise near the Channel Islands NMS
 - Quantifying noise pollution reduction efforts

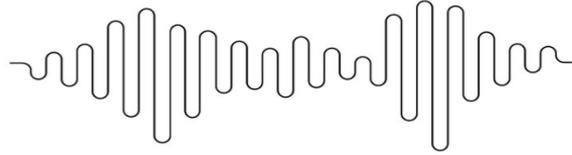
Noise Pollution Reduction Efforts in Channel Islands NMS



- Work with shipping companies to reduce noise pollution generated from commercial ships

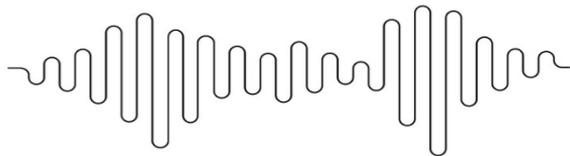
What did we learn today?

- What is sound?



What did we learn today?

- What is sound?

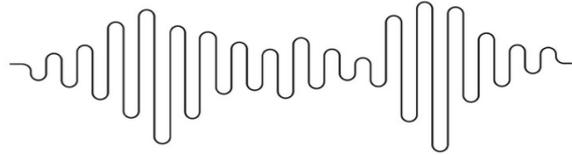


- What makes sound in the ocean?



What did we learn today?

- What is sound?



- What makes sound in the ocean?

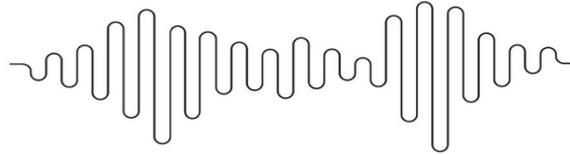


- How do scientists collect data?



What did we learn today?

- What is sound?



- What makes sound in the ocean?



- How do scientists collect data?



- Some amazing current research in National Marine Sanctuaries!



Thank you for listening! Questions?

