Passive acoustic monitoring in Cordell Bank National Marine Sanctuary reveals large commercial shipping vessels and vocalizing baleen whale species are primary drivers of the low-frequency ambient soundscape

Samara M. Haver, Leila T. Hatch, Danielle Lipski, Robert P. Dziak, Sofie M. Van Parijs, Joseph Haxel, Scott A. Heppell, Jaime Jahncke, Megan F. McKenna, David K. Mellinger, William Oestreich, Zoe Rand, Lauren Roche, John Ryan, Jeffrey D. Adams, Jason Gedamke

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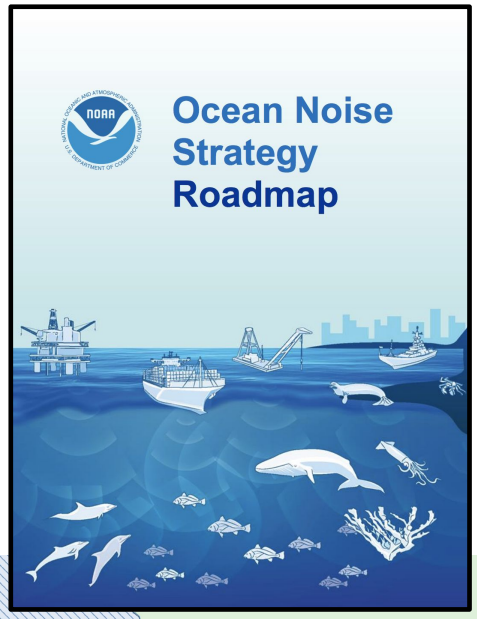
Passive Acoustic Monitoring in Cordell Bank NMS



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PREV

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Seasonal trends and primary contributors to the low-frequency soundscape of the Cordell Bank National Marine Sanctuary

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Samara M. Haver[1,b], Zoe Rand[1], Leila T. Hatch[2], Danielle Lipski[3], Robert P. Dziak[4], Jason Gedamke[5], Joseph Haxel[6], Scott A. Heppell[1], Jaime Jahncke[7], Megan F. McKenna[8], David K. Mellinger[6], William K. Oestreich[9], Lauren Roche[6], John Ryan[10], *and* Sofie M. Van Parijs[11]

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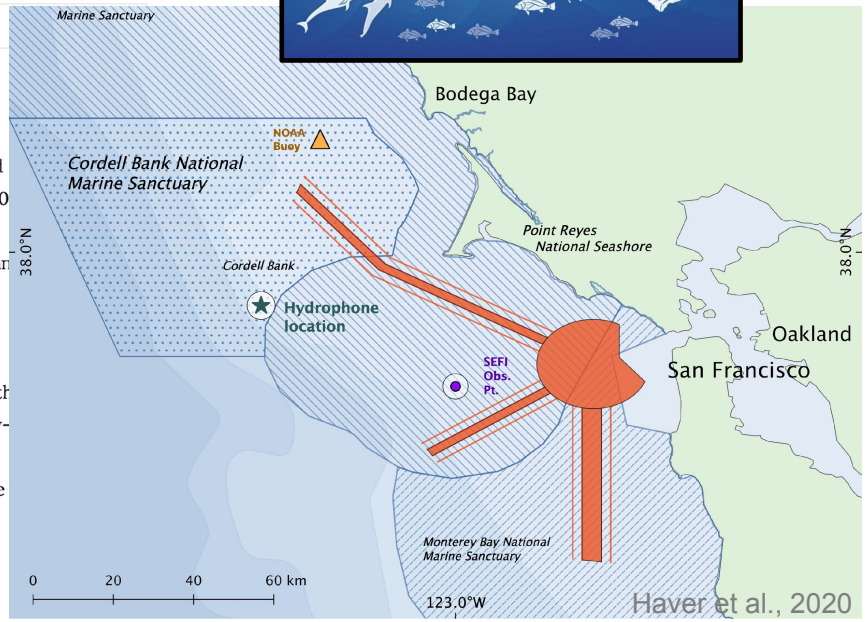
TOPICS
- Acoustic noise
- Acoustic ecology
- Acoustic modeling, simulation and analysis
- Bioacoustics of mammals
- Oceanography
- Signal processing
- Anthropogenic
- Aquatic ecology
- Vocalization
- Animal sounds

ABSTRACT

Passive acoustic monitoring of ocean soundscapes can provide information on ecosystem status for those tasked with protecting marine resources. In 2015, the National Oceanic and Atmospheric Administration (NOAA) established a long-term, continuous, low-frequency (10 Hz–2 kHz) passive acoustic monitoring site in the Cordell Bank National Marine Sanctuary (CBNMS), located offshore of the central United States of America (U.S.) west coast, near San Francisco, CA. The California Current flows southward along the coast in this area, supporting a diverse community of marine animals, including several baleen whale species. Acoustic data analysis revealed that both large vessels and vocalizing baleen whales contribute to the ambient soundscape of the CBNMS. Sound levels fluctuated by month with the highest levels in the fall and lowest levels in the summer. Throughout the year, very low-frequency (10–100 Hz) sound levels were most variable. Vessels and whales overlap in their contributions to ambient sound levels within this range, although vessel contributions were more omnipresent, while seasonal peaks were associated with vocalizing whales. This characterization of low-frequency ambient sound levels in the CBNMS establishes initial baselines for an important component of this site's underwater soundscape. Standardized



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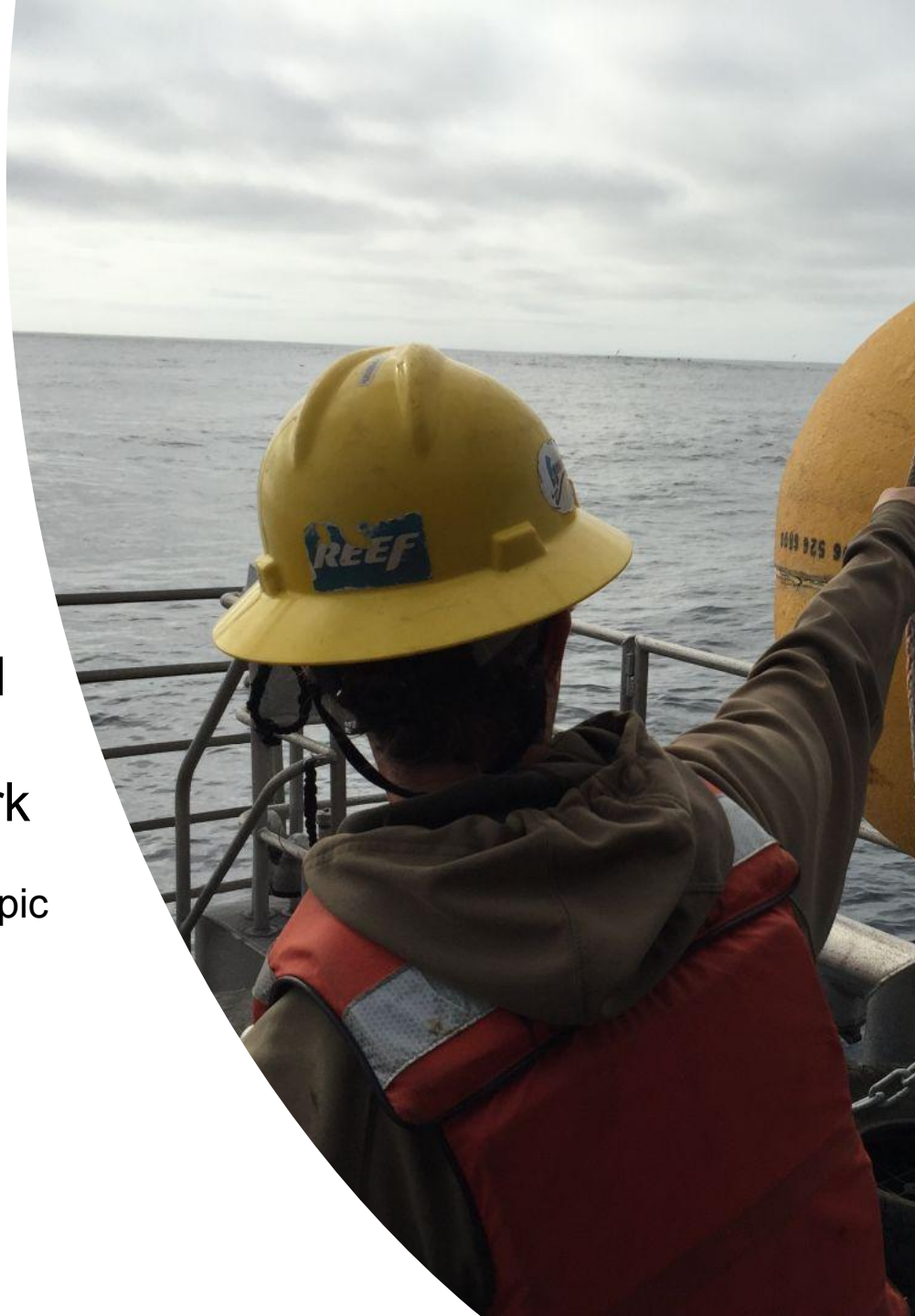
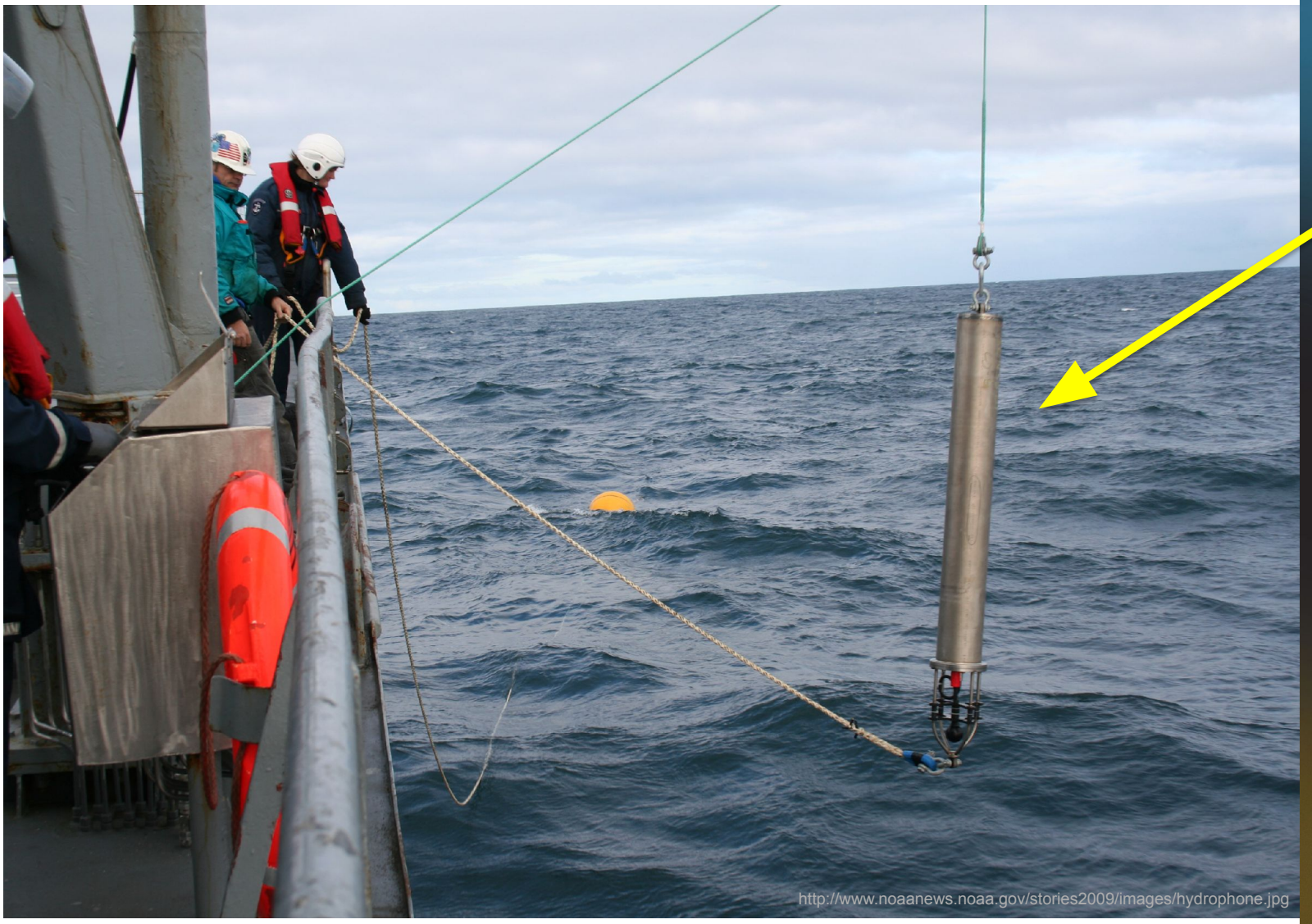
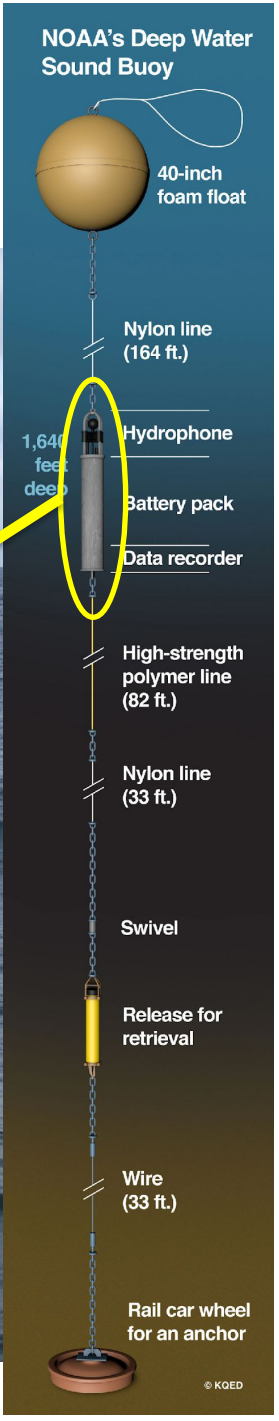
Why Passive Acoustic Monitoring (PAM)?

- CBNMS mooring first deployed October 2015
- Part of larger calibrated network
  - Including 3 other National Marine Sanctuaries: Channel Islands, Olympic Coast, and Stellwagen Bank
- Many advantages of PAM:
  - Year-round effort
  - Not limited by weather or daylight
  - Minimal disturbance to environment
    - Only during deployment and retrieval
    - No surface expression



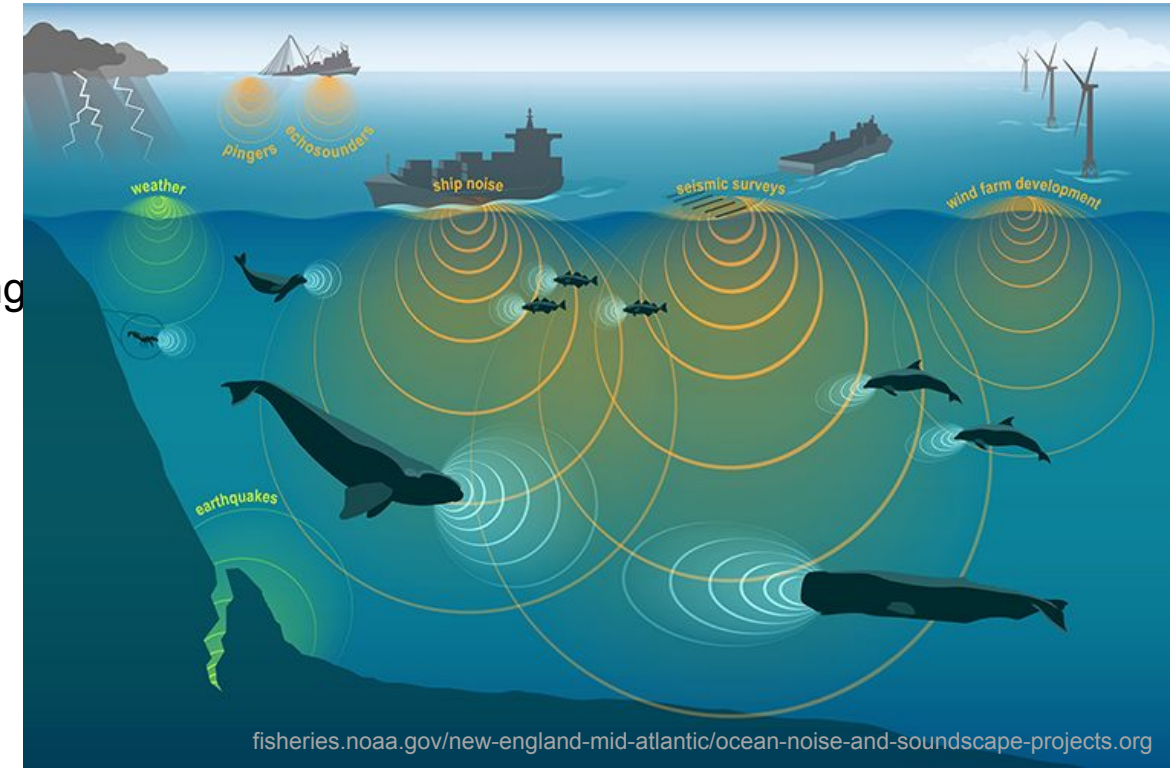
Hydrophone Mooring



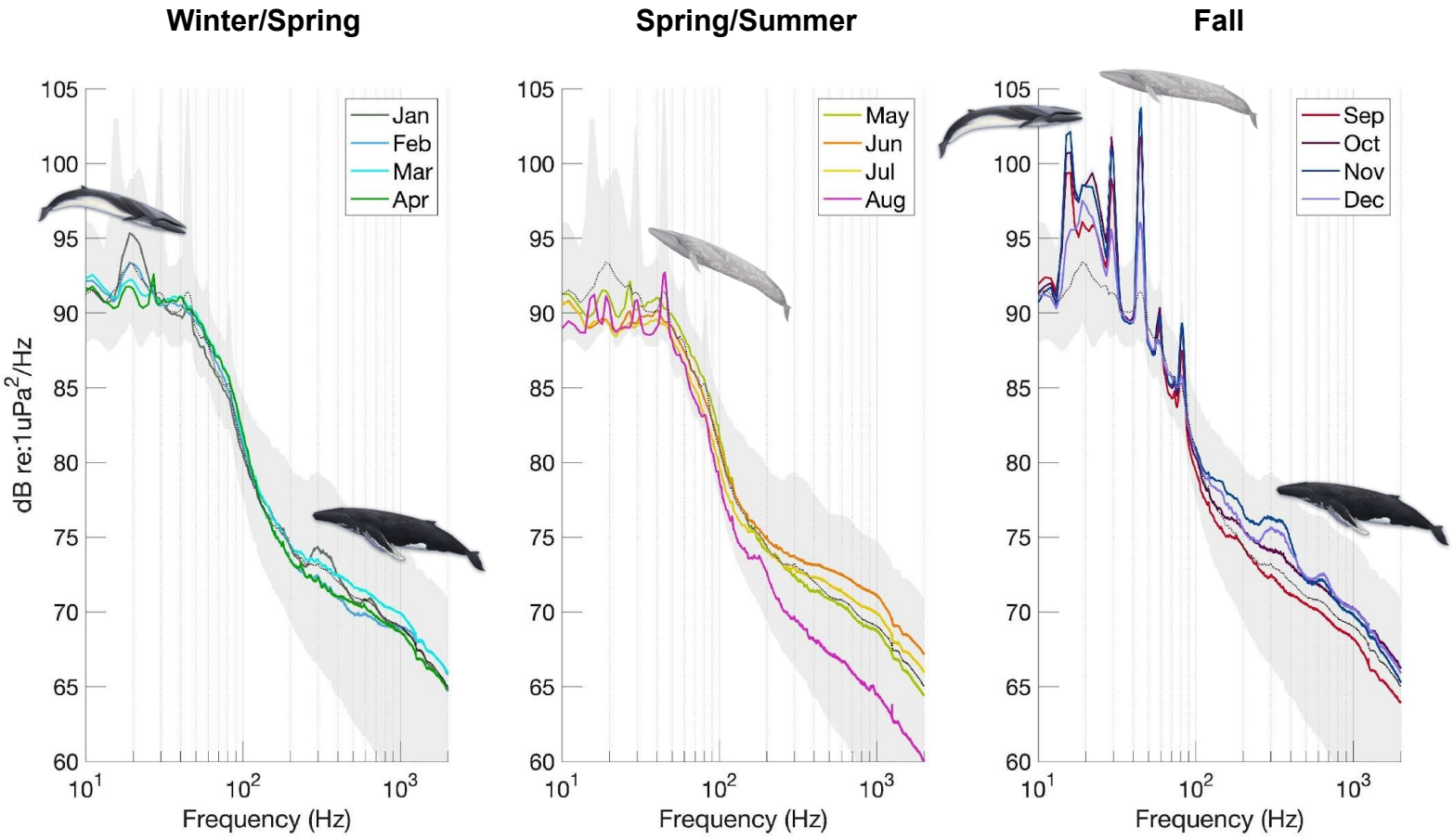


Characterizing the Soundscapes of CBNMS & GFNMS

1. Low-frequency soundscape is dominated by whales
   - Seasonal patterns of blue and fin whale vocalizations
   - Humpback whale song and vocalizations heard year-round
   - Visual survey & acoustic monitoring detections were temporally offset
2. Vessel noise is consistent year-round
   - Matches results from AIS
3. Anthropogenic noise may negatively impact natural environment
   - Nearby large ports are noisy
   - Excess noise can be harmful for whales and other animals



Seasonality of Ambient Sound Levels



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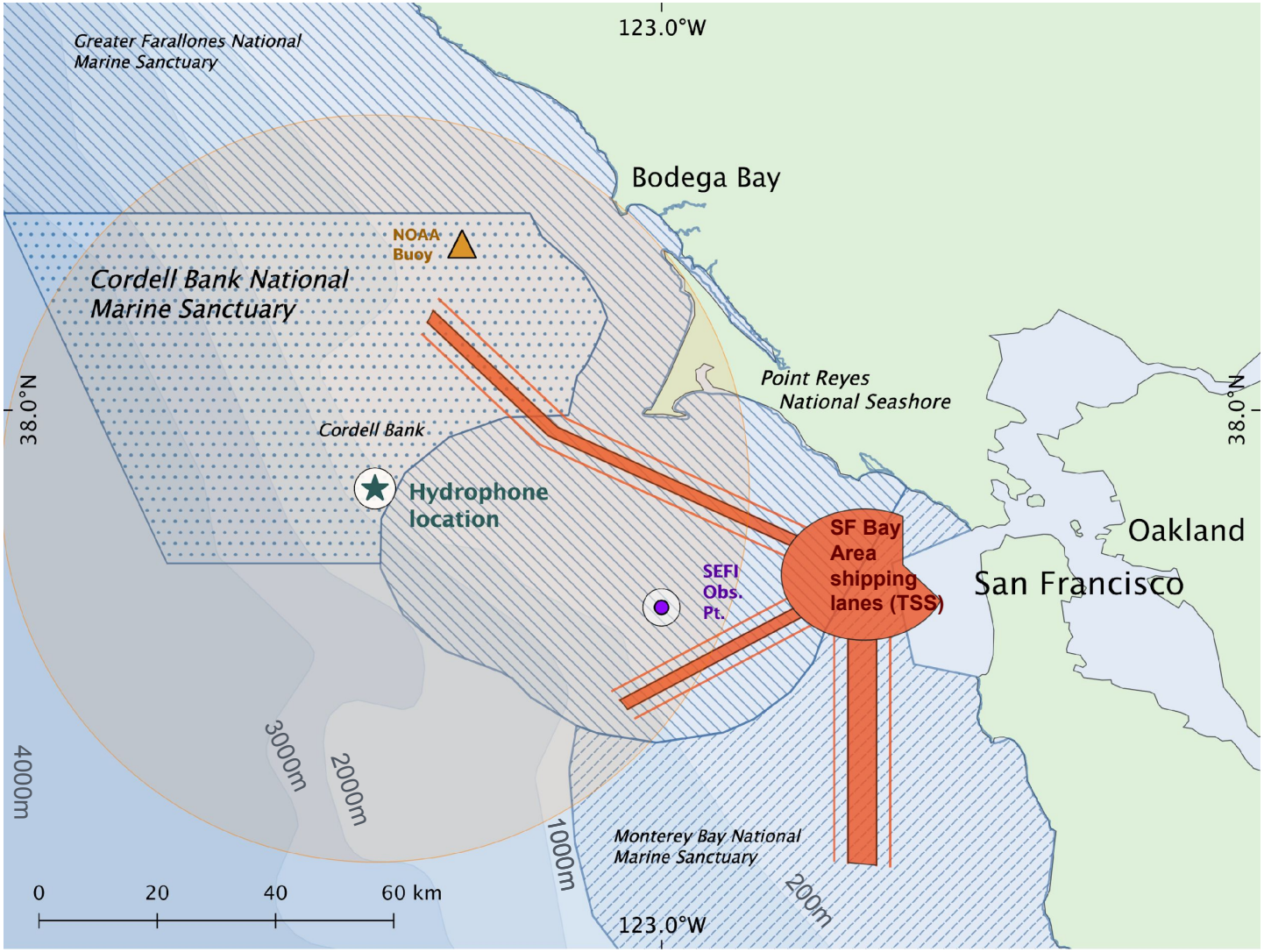
Acoustic Impact of Vessel Activity



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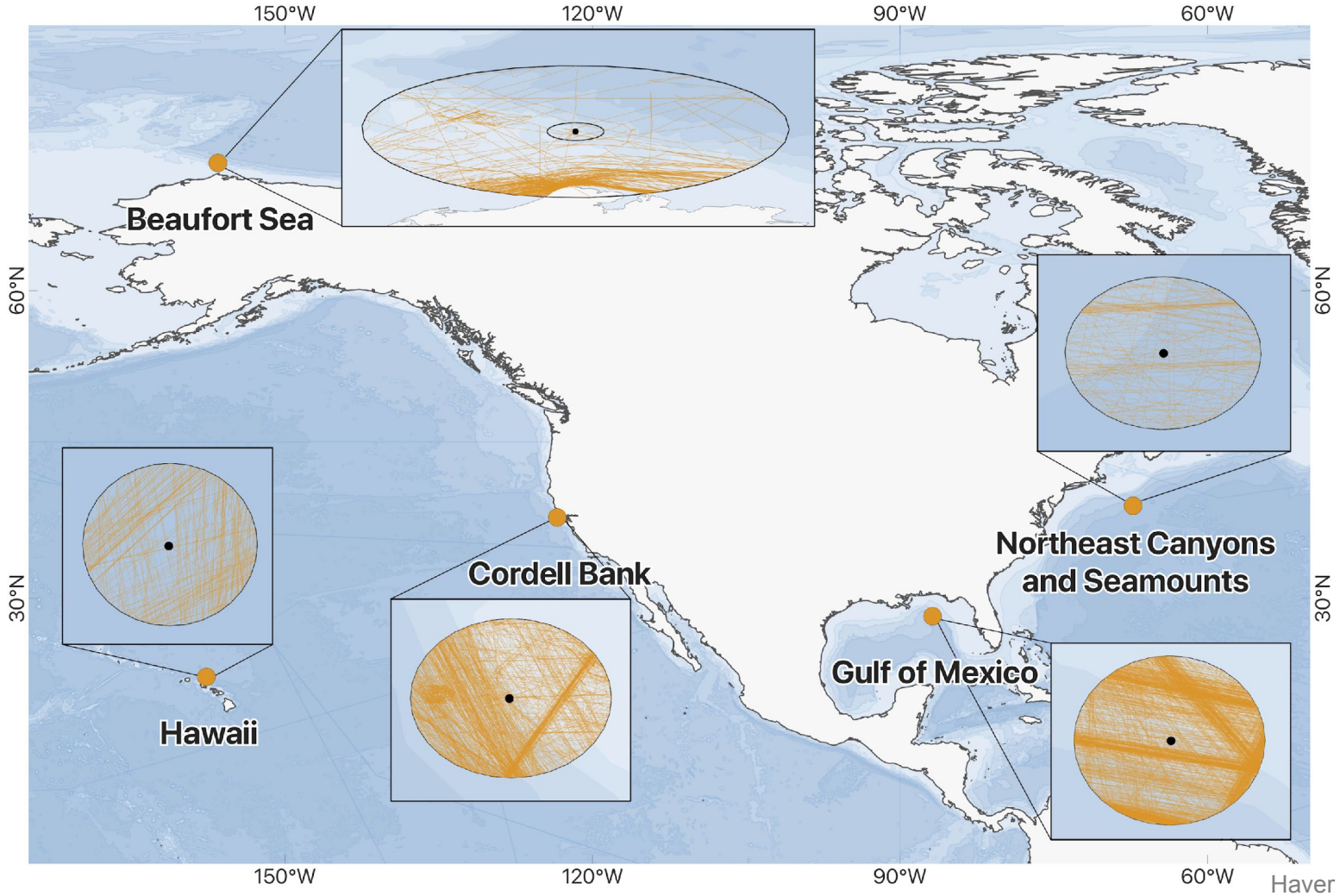
Comparing Ambient Sound and Vessel Activity



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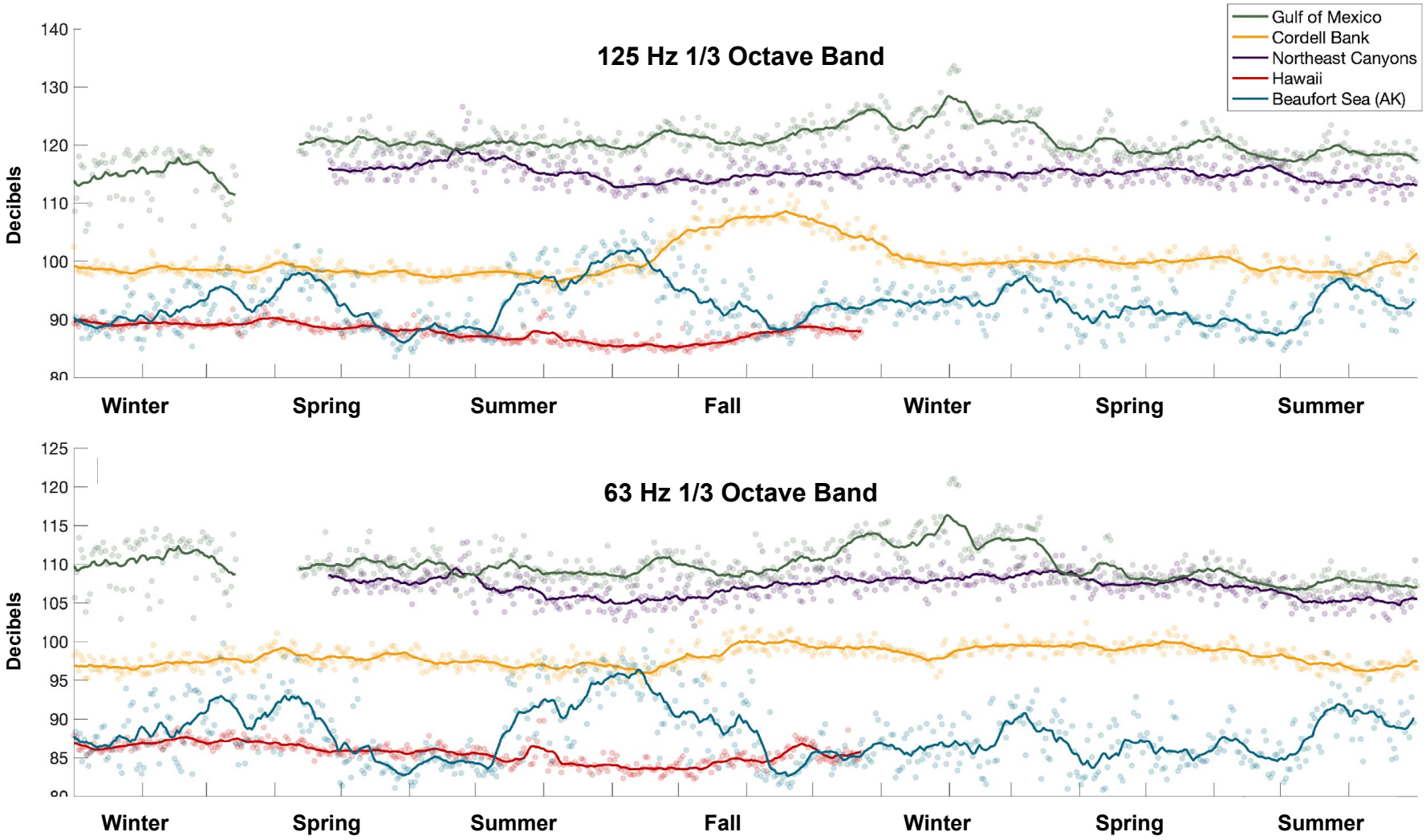
Acoustic Impact of Commercial Shipping



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Implications for Conservation

- Whale management
  - PAM reveals species nearby through the year
- Vessel noise vs. whales
  - Blue and fin whale chorusing detected above ambient, but unknown impact to other species
- Need more information about spatial distribution of whales when we hear them
  - Implications for vessel speed-reduction, etc.

Images: NOAA ONMS

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