

What it sounds like from over here:

Perspectives on cross Atlantic listening interests

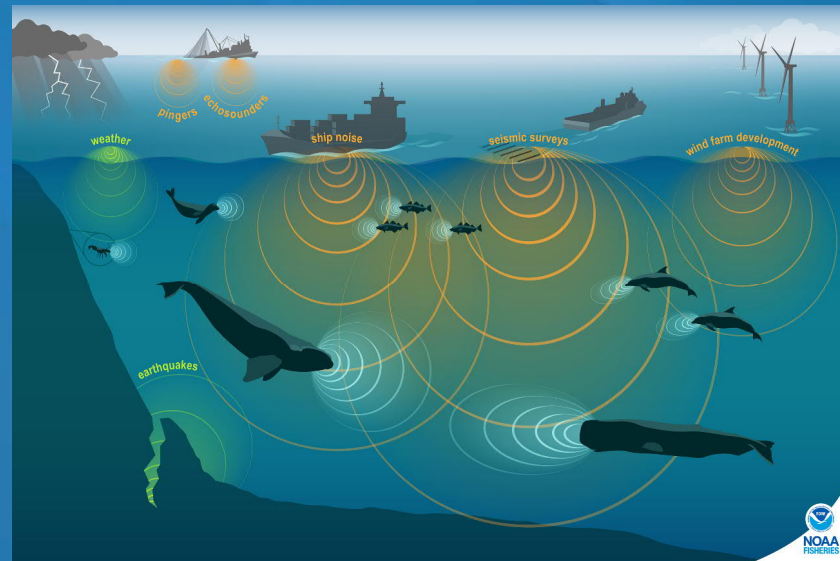
Leila Hatch
US National Oceanic and Atmospheric
Administration

My interests



Further develop the use of underwater sound information as a tool for natural resource management

- Improve our ability to detect changes in the status of vocally-active species and their habitats due to changing climate and other human influences
- Support the design and monitor the effectiveness of approaches to reduce human impacts on marine life
 - Transition data to decision support for engineers and policy makers
 - Evaluate and improve marine protected area effectiveness





Where I work



The US National Oceanic and Atmospheric Administration (NOAA) is the lead federal agency responsible for reducing or eliminating impacts (including noise) on marine species in US waters

- Marine Mammal Protection Act
 - 95% permitting authority used to address acoustic impacts
 - Marine Mammal Health and Stranding Response Program
- Endangered Species Act
 - Federal agency consultations, Critical Habitat
- National Marine Sanctuaries Act
 - Federal agency consultations
- Magnuson-Stevens Fisheries Conservation and Management Act
 - Federal agency consultations, Essential Fish Habitat
- National Environmental Policy Act
 - Environmental Impact Assessment (NOAA research & other federal agency actions)

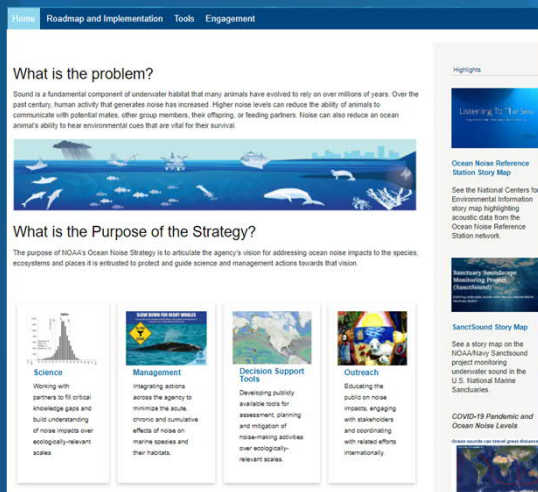
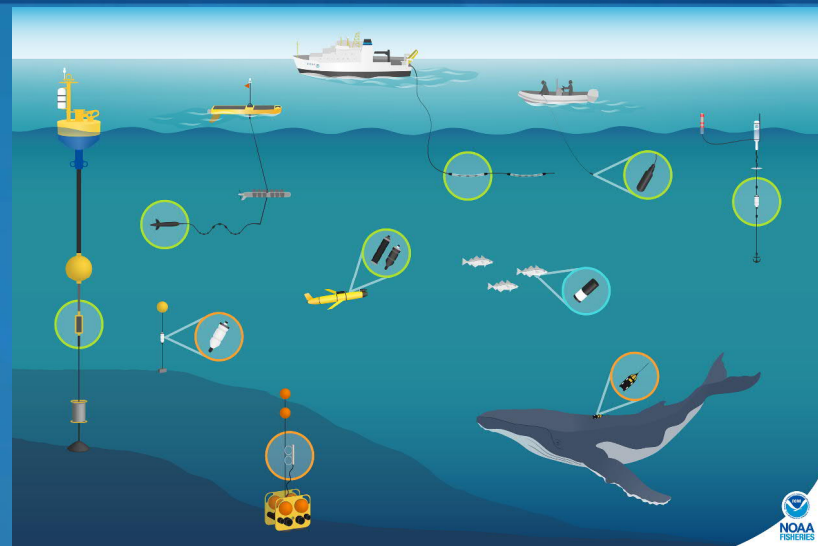




NOAA's Ocean Noise Strategy



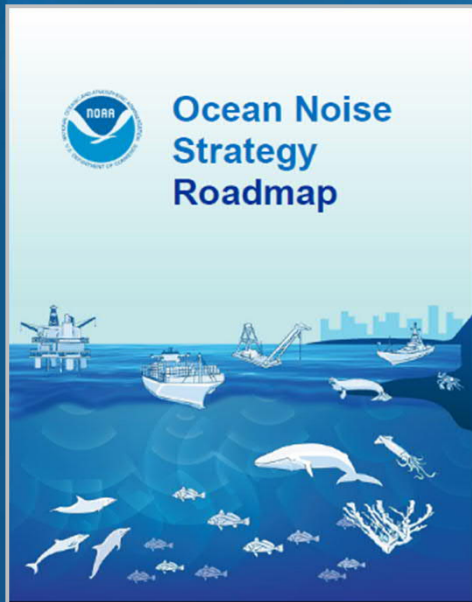
1. **MANAGEMENT:** NOAA's actions are integrated across the agency & minimizing the acute, chronic & cumulative effects of noise on marine species and their habitat
2. **SCIENCE:** NOAA & federal partners are filling common knowledge gaps & building understanding of noise impacts over ecologically-relevant scales



3. **DECISION SUPPORT TOOLS:** NOAA is developing publically available tools for assessment, planning & mitigation of noise-making activities over ecologically-relevant scales
4. **OUTREACH:** NOAA is educating the public on noise impacts, engaging with stakeholders & coordinating with related efforts internationally



NOAA's Ocean Noise Strategy Roadmap



NOAA Roadmap

- Summarizes status of science and management of noise impacts on protected marine taxa.
- Aligns NOAA's capacities and authorities to enhance effectiveness and consistency in the agency's actions and communication with stakeholders.
- Explains basis for broadening the agency's approach to noise management to better protect *acoustic habitat* and mitigate chronic and cumulative impacts.
- Recommends specific approaches and actions for addressing priority management and science needs.

Recommendations from the Executive Summary

The Roadmap recommended 11 priority next steps towards achieving of the Strategy's four goals.

1. Identification and utilization of a full range of NOAA authorities to better manage the impacts of noise on trust resources.
2. Development of national guidance for acoustic impact thresholds and other management tools.
3. Increased use of programmatic approaches through MMPA and ESA to allow for better consideration of multiple activities, longer timeframes, and acoustic habitat impacts.
4. Improving management effectiveness for acoustic habitat through incorporation of place-based authorities as they relate to species or habitat focused goals.
5. Utilization of National Marine Sanctuaries to develop increased capacity for preserving, restoring, and maintaining natural acoustic habitats through new management measures, regulations, dedicated scientific research, and outreach programs.
6. Expansion of existing international partnerships with regulated agencies and industries to promote use of quieter technologies.
7. Establishment of a NOAA-led, long-term, standardized and calibrated acoustic monitoring network across the agency.
8. Development of an archival database to house NOAA passive acoustic metadata, raw data, and outputs of standardized data analysis routines.
9. Enacting monitoring requirements for compliance processes that reflect comprehensive science goals, and further identifying actions that may be taken at different scales to address varying resources and capabilities.
10. Developing NOAA 'in-house' capacity for predictive sound field and sound exposure modeling.
11. Standardization of data analysis routines and output metrics for soundscape measurements.

Guiding a decade (2016-2026) of NOAA ocean noise-related, science, management, decision-support and engagement

oceannoise.noaa.gov



NOAA's Ocean Noise Strategy Progress



NOAA's Ocean Noise Strategy: 2019 Progress Report

NOAA developed the Ocean Noise Strategy to guide the agency towards more effective and comprehensive understanding and management of ocean noise impacts on marine life in the years 2016-2026.

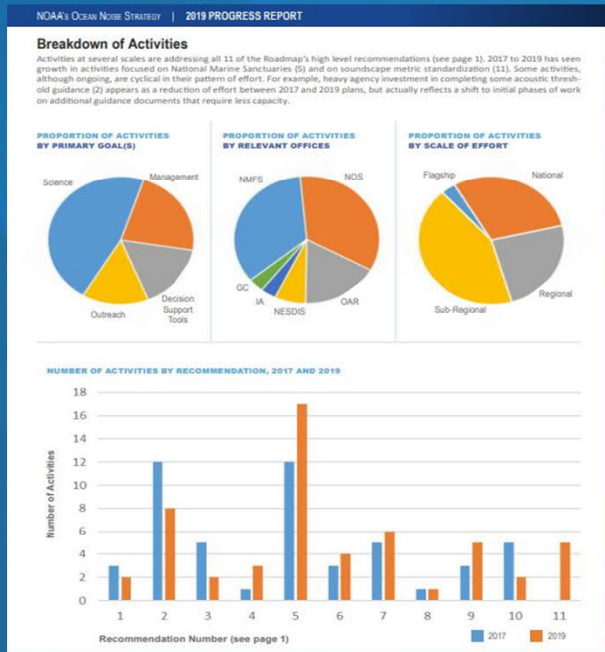
Strategy Goals
The Strategy's Roadmap identifies four goals, which, if achieved, would significantly improve NOAA's capacity to address the impacts of noise on fish species and habitats over this decade:

- SCIENCE:** NOAA and external partners are filling shared critical knowledge gaps and building understanding of noise impacts over ecologically-relevant scales.
- MANAGEMENT:** NOAA's actions are integrated across line and program offices and are minimizing the acute, chronic and cumulative effects of noise on marine species and their habitat.
- DECISION SUPPORT TOOLS:** NOAA is developing publicly available tools for assessment, planning and mitigation of noise-making activities over ecologically-relevant scales.
- OUTREACH:** NOAA is educating the public on noise impacts, engaging with stakeholders and coordinating with related efforts internationally.

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4. Improving management effectiveness for acoustic habitat through incorporation of place-based authorities as they relate to species or habitat focused goals.
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U.S. Department of Commerce | National Oceanic and Atmospheric Administration



NOAA's Ocean Noise Strategy | 2019 PROGRESS REPORT

A Closer Look at Work Plan Examples

Finalize and Support Implementation of Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing

Following the 2016 release of these Acoustic Guidelines and the subsequent related Executive Order, stakeholder input was sought, scientific working groups were convened, and decision support tools were developed to aid in implementation.

SCALE OF EFFORT

- National

PRIMARY GOALS

- Management
- Decision Support Tools

MORE INFORMATION

- Chapter 1, Strategy Roadmap

RELEVANT OFFICES

NOAA Fisheries:

- Office of Protected Resources
- Office of Science and Technology
- Regional Offices
- Regional Science Centers

Cover of the 2018 Technical Guidance document. Photo: NOAA Fisheries Office of Protected Resources

Cook Inlet Beluga Whale Critical Habitat Noise Measurements

Deployed acoustic recorders at 6 sites between 2017-2019. Data is being used to document overlap between anthropogenic noise and beluga whale presence. Analyses have identified major sources of anthropogenic noise, documented soundscape characterization over time (e.g. daily/monthly/seasonal variability) both at a single location, and between the sites, and is being used to develop occupancy modeling to assess spatial displacement.

SCALE OF EFFORT

- Regional

PRIMARY GOALS

- Science

MORE INFORMATION

- Chapter 3, Strategy Roadmap

RELEVANT OFFICES

NOAA Fisheries:

- Alaska Fisheries Science Center
- Alaska Regional Office

Example visualization of Digital Acoustic Recording Tag data. Photo: NOAA Fisheries/Manuel Castelletto

SanctSound—Soundscape Monitoring, Measurement and Integration: Developing Capacity to Protect Acoustic Habitats in National Marine Sanctuaries

Utilizing deployment of calibrated acoustic monitoring equipment to sample Atlantic and Pacific sites, this project is capturing main contributors to local soundscapes, further developing soundscape characterization metrics, archiving data at NCEI, integrating acoustic metrics with other habitat characterization metrics and applying resulting products to NOAA management fora.

SCALE OF EFFORT

- Flagship

PRIMARY GOALS

- Management
- Science
- Decision Support Tools

MORE INFORMATION

- Chapter 2, Strategy Roadmap

RELEVANT OFFICES

National Ocean Service:

- Office of National Marine Sanctuaries
- Sanctuary Sites

NOAA Fisheries:

- Headquarters Offices
- Regional Science Centers

Map of SanctSound monitoring sites. Photo: NOAA Office of National Marine Sanctuaries

2016

2021

2026

Growth in scientific basis for decision-making

Diversify and increase management capacity



Priorities for 2021-2026



1. Sustain and grow baseline sound monitoring and public access to resulting data

- Institutionalized sources of support
- Standardization in measurement and modeling techniques

2. Advance analysis, integration and interpretation methods to answer applied questions, e.g.:

- How many human users are there in/affecting my protected area, and how are they contributing to background noise levels?
 - *What we have:* Levels for deeper waters and transiting large vessels
 - *What we need:* More composite metrics (detections, other tracking) for shallower more diverse human use area
- How are marine animals responding to changing climate?
 - *What we have:* Detections for a few things and a few scales (singing whales, calling fish)
 - *What we need:* More holistic metrics for community shifts
- How is the damaged/degraded reef responding to restoration efforts?
 - *What we have:* Rates for a few things and a few scales (snapping shrimp, parrotfish)
 - *What we need:* More holistic metrics for community shifts

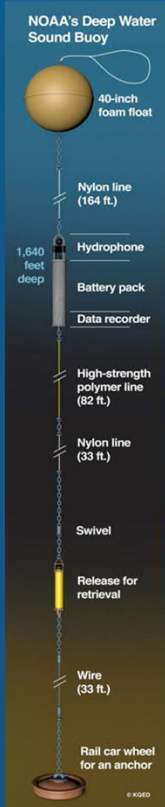
3. Increase capacity to evaluate and predict the consequences of chronic and accumulated noise exposure for marine species and ecosystems

- Integrate with cumulative impacts across stressors

4. Sustain and grow national and international capacity to advance quieting and other impact mitigation approaches

- Support proactive partnerships with industries
- Support development of new regulatory mechanisms

Listening to detect change: baselines



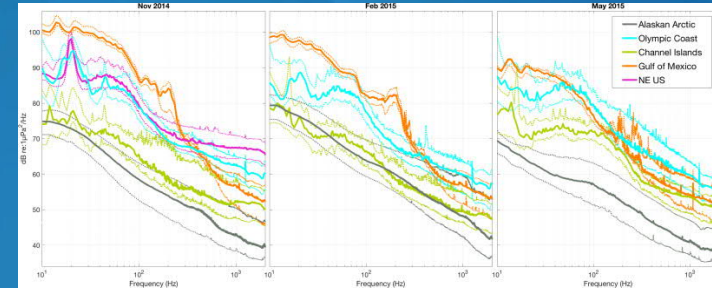
Noise Reference Station Network

Low frequency, long-term passive acoustic monitoring

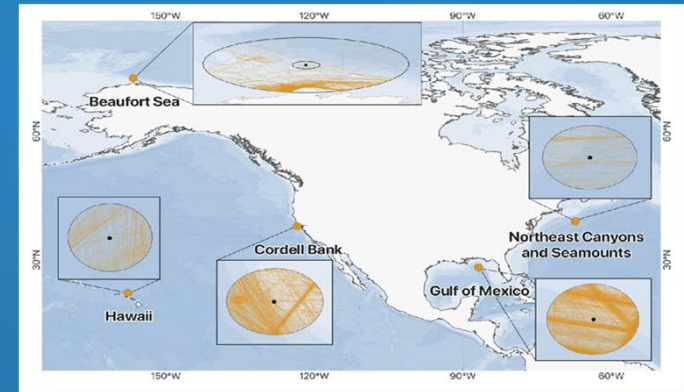
- 12 sites in all EEZ regions
- Ongoing since 2014

Addressing needs:

- Characterization and comparison of soundscapes broadly across U.S. waters
- Empirical validation of predictive soundscapes
- Assessment of long-term trends and changes in soundscapes



Haver et al., Marine Policy 2018



Haver et al., Submitted 2021

Listening to detect change: baselines



Sanctuary Soundscape Monitoring Project (SanctSound)

Exploring underwater sounds within the U.S. National Marine Sanctuary System

<https://sanctuaries.noaa.gov/science/monitoring/sound/>

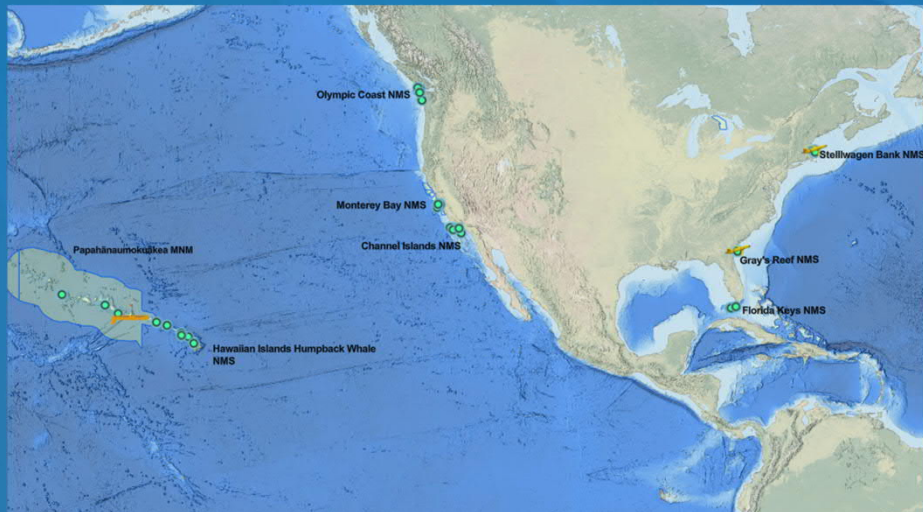
Why are we listening? Where are we listening? What are we measuring? What are we hearing? How far can we hear? What are we learning? Who are we?

Broadband mainly shallow-water monitoring

- 30 sites in 7 sanctuaries & 1 marine monument
 - Listening gliders in 3 sites
- 2018-2022, continuation in discussion
- Sound propagation modeling (effective listening range)

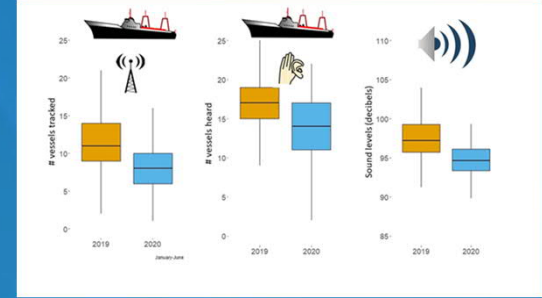
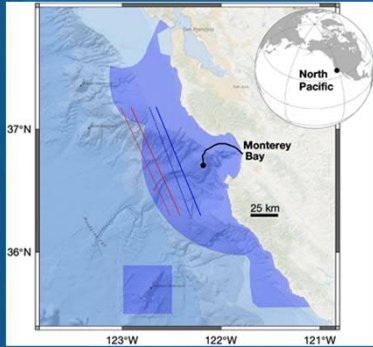
Addressing needs:

- Standardized data collection and analysis
- Developing indicators to support condition reporting (status & trends, resources & stressors)
- Building public access and understanding



Since fall 2018, teams of partners have been deploying and retrieving stationary recorders and autonomous underwater vehicles off NOAA vessels to collect underwater sounds from across the sanctuary system.
Photo Credits: NOAA, University of Connecticut, and U.S. Navy.

Listening to detect change: COVID

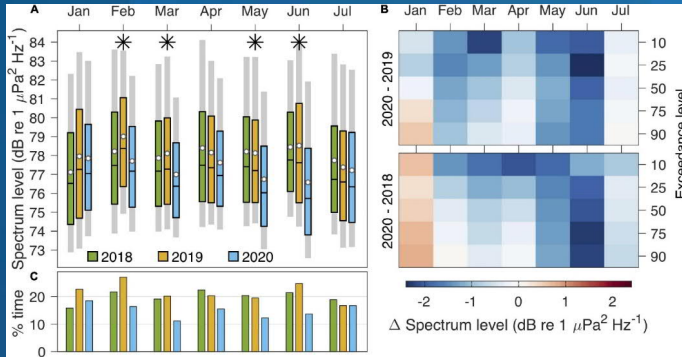


Quantifying 2020 changes in sound levels

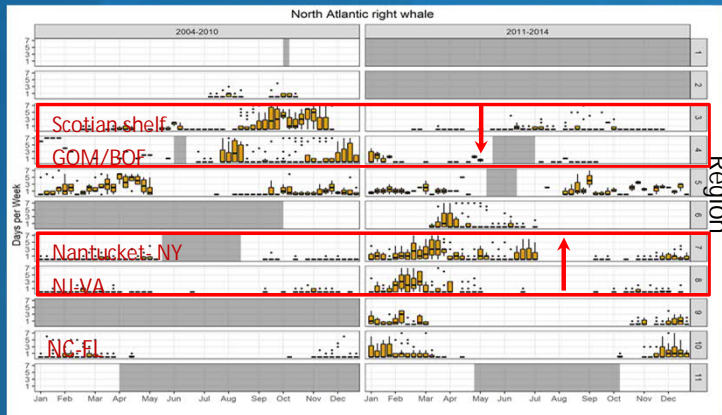
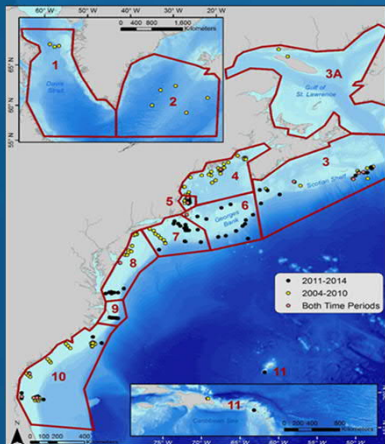
- National evaluation: highly variable
- Multi-site evaluation: mid latitude spring humpback whale feeding habitats (Stellwagen and Monterey Bay National Marine Sanctuaries)
- Single site analysis: Monterey Bay Aquarium Research Institute deep water cabled hydrophone

Addressing needs:

- Relating economic and sound-derived measurements
- Quantifying and highlighting the ephemeral nature of noise pollution
- Exploring implications for marine animals

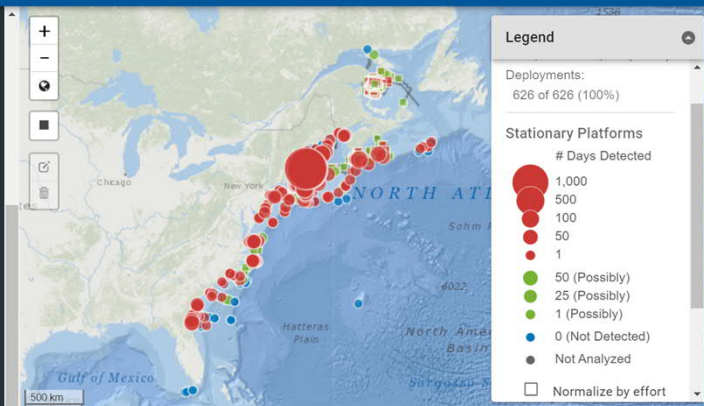
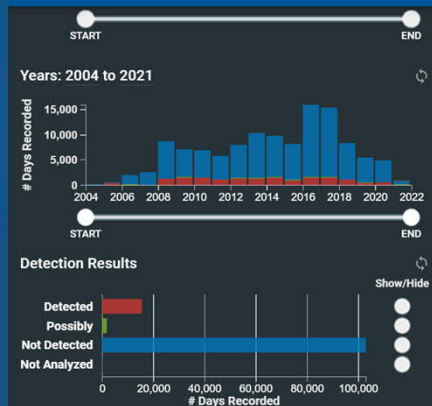


Listening to detect change: climate



Davis et al. 2017. Scientific Reports

Passive Acoustic Cetacean Map



Coordinated arrays (multiple partners)

- Northeast Fisheries Science Center multi-decade baleen whale monitoring US east coast
- Portal to view acoustic detections

Addressing needs:

- Changes in animal distributions in response to changing environmental conditions
 - Who can shift (time, space) and still make a living?
 - Who can't?
 - Changes in effectiveness of mitigation measures



<https://apps-nefsc.fisheries.noaa.gov/pacm/#/>

Listening to improve predictions

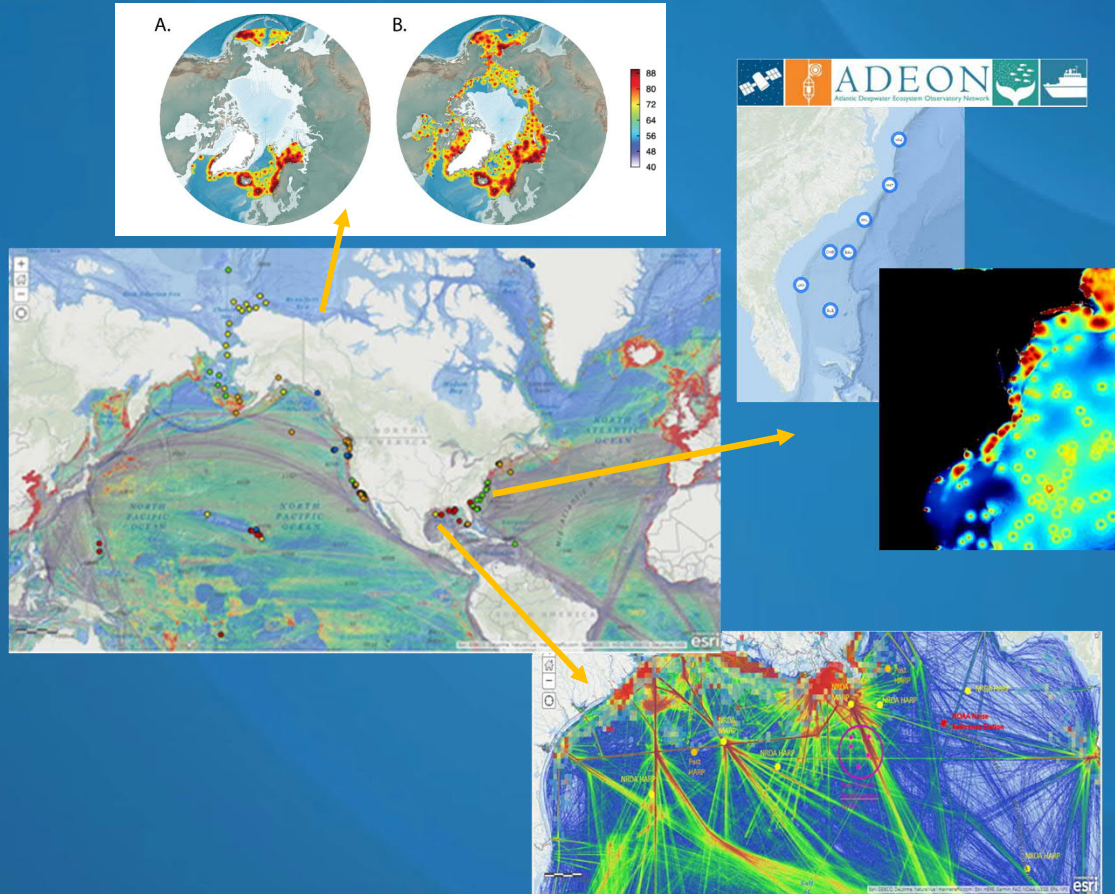


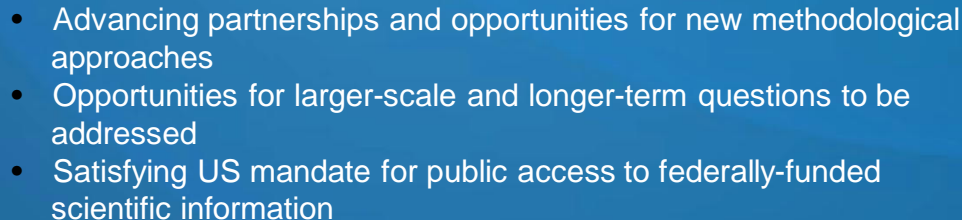
Large-scale soundscape mapping and use of empirical datasets

- ADEON: Mid-South Atlantic
 - *Completed:* ship & wind modeling
- Arctic Council
 - *Ongoing:* ship, wind and excess noise modeling
- NRDA: Gulf of Mexico
 - *Coming soon:* ship, seismic & wind modeling

Addressing needs:

- Providing input values for modeling
- Ground-truthing model output
- Advancing cross-project standardization dialog and documentation
- Advancing web-based access to mapping products
- Advancing interpretive statistics and visualization summaries for decision support
 - Mitigation evaluation





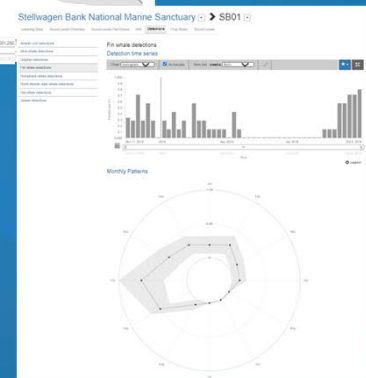
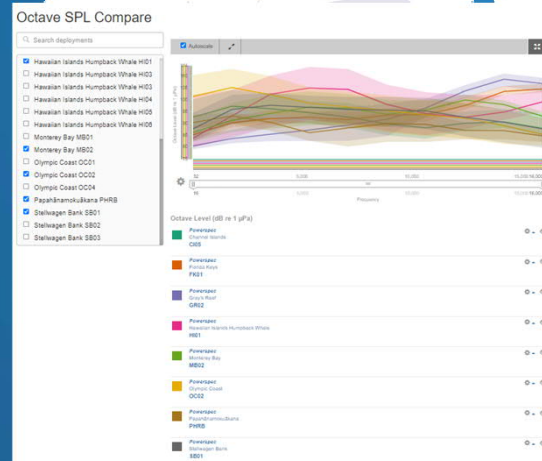
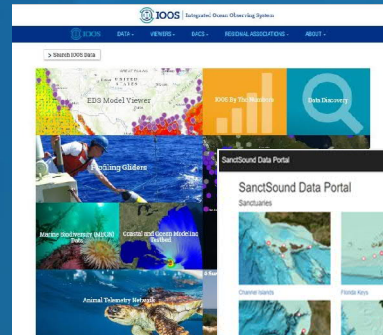


Making acoustic information explorable



Web Portal for Sound Data

- SanctSound portal under development @ioos.us
- Levels, detections, propagation modeling, ancillary data, sound clips
- Single site and comparison ability



Addressing Needs:

- Advancing integration of sound-derived ocean observations within variables
- Advancing development of new methodologies for extracting environmental signals of interest
- Satisfying US mandate for public access to federally-funded scientific information



Making acoustic data understandable

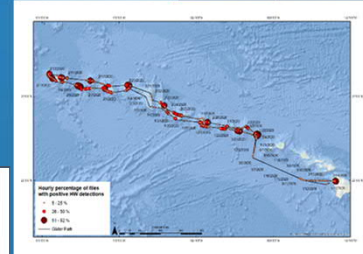
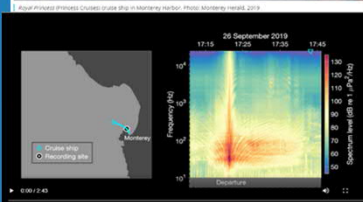
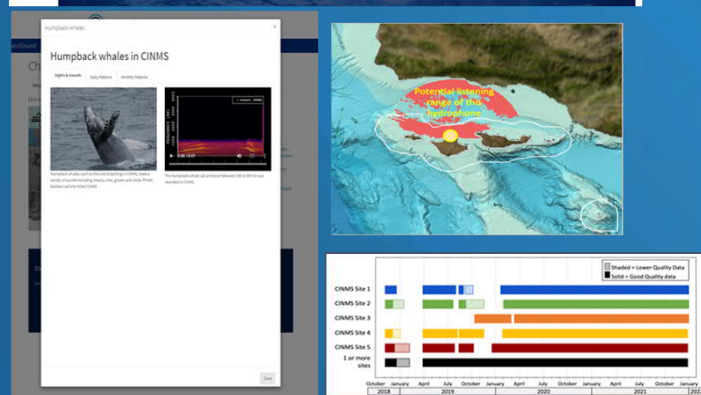
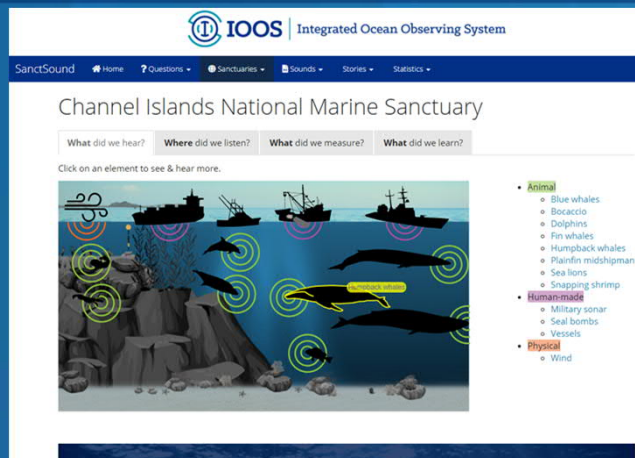


Public audience materials

- SanctSound web stories highlighting applications
- SanctSound landing pages @ioos.us
 - Curated information that can be explored interactively
 - Tutorials explaining data visualizations

Addressing Needs:

- Building public understanding and appreciation for underwater sound and marine conservation
- Providing materials for education
- Highlighting how listening supports decisions



SanctSound News Stories

SanctSound is a four-year project, managed by NOAA and the U.S. Navy, to better understand underwater sound within national marine sanctuaries. Since the fall of 2018, and through the spring of 2022, the agencies are working with numerous scientific partners to study sound within seven national marine sanctuaries and one marine national monument, in waters off Hawaii and the East and West coasts.

[Sanctuary Soundscape Monitoring Project Story Map](#)

[SanctSound: Listening to the \(Not So\) Silent World](#)

[Eavesdropping on Whales: How Acoustic Surveys Are Revolutionizing Humpback Whale Monitoring in Hawaii](#)

[Listening to the Ocean in the Time of COVID-19](#)

[One Fish, Two Fish, Quiet Fish, Loud Fish](#)

[Understanding Underwater Noise in Monterey Bay National Marine Sanctuary](#)

[Estimating Fishing and Diving Use at Gray's Reef by Listening to Boats](#)

[Boat visitation at Gray's Reef story map](#)

<https://sanctuaries.noaa.gov/science/monitoring/sound/>

Priorities for 2021-2026



1. Sustain and grow baseline sound monitoring and public access to resulting data

- Institutionalized sources of support
- Standardization in measurement and modeling techniques

2. Advance analysis, integration and interpretation methods to answer applied questions, e.g.:

- How many human users are there in / affecting my protected area, and how are they contributing to background noise levels?

-
-

- How

-

-

- How

-

-

3. Increase resilience of species and ecosystems

- Integrate with cumulative impacts across stressors

4. Sustain and grow national and international capacity to advance quieting and other impact mitigation approaches

- Support proactive partnerships with industries
- Support development of new regulatory mechanisms

**Opportunities for more
cross Atlantic collaboration?**



Frameworks to support collaboration



- UN Ocean Decade submission: Ocean Decade Research Programme on the Maritime Acoustic Environment
 - US federal Interagency Ocean Sound & Marine Life Working Group
- UN International Maritime Organization: CA led, US & AU co-sponsored proposal to work further on quieting commercial vessels
 - Canadian underwater radiated noise from shipping target setting group
- Global Ocean Observing System: Essential Ocean Variable implementation for sound
- ICES Working Group on Shipping Impacts in the Marine Environment: Holistic risk assessment, including noise
- Arctic Council's Protection for the Arctic Marine Environment: US-CA-WWF continuing work
- International Organization for Standardization: working groups and other forums for advancing comparable soundscape modeling and measurement metrics
- Galway Statement on Atlantic Ocean Cooperation (CA, US, EU)
 - JPI Oceans Joint Action: Italy and Germany led proposal, seismic mitigation focus
- International Meetings: panels/working groups convened at Oceanoise, Effects of Noise on Aquatic Life, Ocean Observations, etc.
- Others?

Thank you!
Happy to answer questions

Feel free to contact me:
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