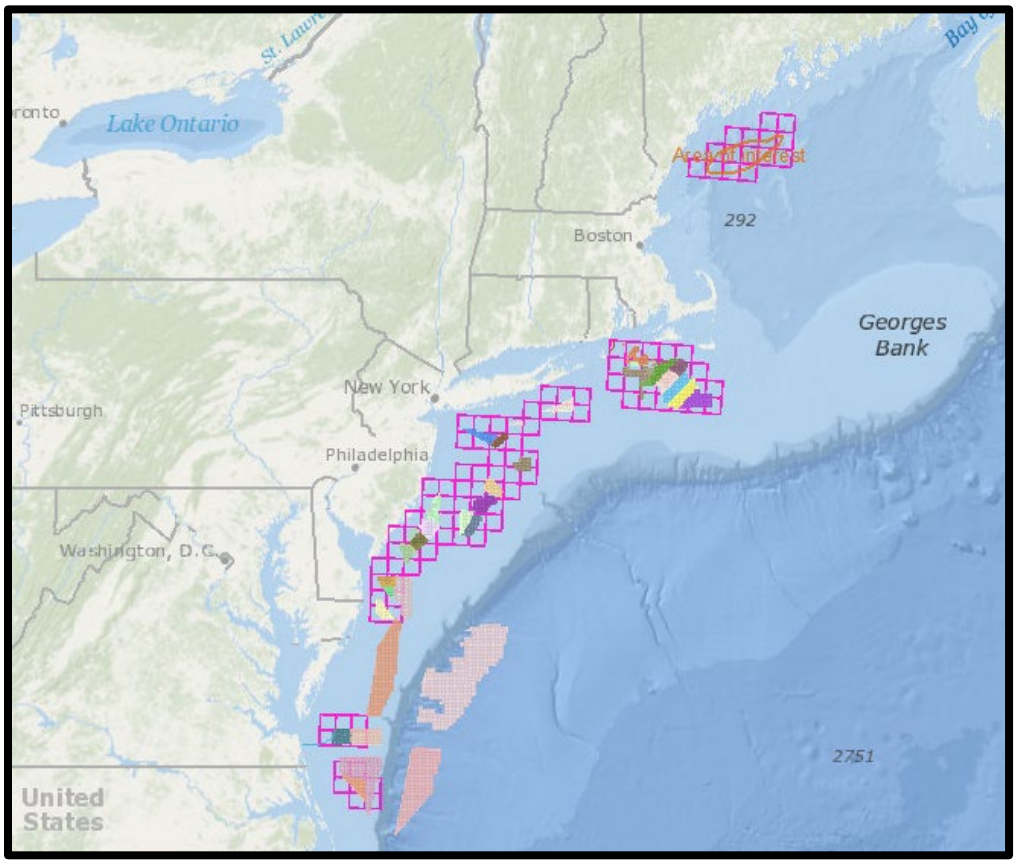
OCS Study
BOEM 2022-055

Improving Monitoring, Data Consistency, Archiving, and Access for Improved Regional Integration of Renewable Energy Science

Workshop Summary on Passive Acoustic Monitoring Data Standards and Management March 7 and 9, 2022

August 2022



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BOEM
Bureau of Ocean Energy Management

OCS Study
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Workshop Summary on Passive Acoustic Monitoring Data Standards and Management March 7 and 9, 2022

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WORKSHOP IN BRIEF

On March 7 and 9, 2022, the Bureau of Ocean Energy Management (BOEM) convened the second of two workshops entitled "Improving Monitoring, Data Consistency, Archiving, and Access for Improved Regional Integration of Renewable Energy Science: Passive Acoustic Monitoring and Marine Mammals."

Approximately seventy-six (76) people attended the virtual workshop with participants including state and federal agencies, academics, and offshore wind developers. Attendees' expertise included offshore wind development, federal permitting, study design and statistics, marine biology and ecology, marine mammal biology and behavior, and marine species advocacy. The workshop was facilitated by Patrick Field, Senior Mediator at the Consensus Building Institute (CBI).

THE OBJECTIVES OF THE WORKSHOP

- Draw lessons on regional marine mammal monitoring from elsewhere
- Identify existing and expected deployments of PAM and identify what we might learn and cannot learn from such efforts and where data gaps might exist, we might want to collectively fill
- Explore process for increasing data coordination, management, and access
- Define specific clear action steps, likely in stages, to move toward a shared data approach to PAM data on the US eastern seaboard

For additional information, the Workshop agenda can be found in Appendix A.

In summary, the workshop participants:

- Discussed potential applications of an acoustic case study from Alaska to monitoring marine mammals on the East Coast.
- Reviewed a regional ocean grid design and acoustic technologies.
- Discussed PAM deployment challenges including but not limited to cost, ship time, equipment availability, other competing needs, supply chain issues, operations, and maintenance.
- Explored the potential questions that could be answered and what questions would not likely be answered with current and planned PAM deployments.
- Explored process for increasing data coordination, management, and access.

- Honed metadata and data processing practices; and
- Nearly all participants agreed a regional approach to data management is important and would be feasible over time, and suggested improvements and refinements to the proposed approach (a list of workshop participants can be found in Appendix B).

SESSION 1 | MARCH 7, 2022

WELCOME AND WORKSHOP GOALS

BOEM Marine Biologist Kyle Baker provided an overview of why BOEM convened these workshops on Passive Acoustic Monitoring (PAM) and reminded participants of the scope and focus of this workshop: exploring a regional approach from the Gulf of Maine to the Carolinas, using PAM for monitoring of marine mammals. Mr. Baker shared his hope that these workshops would advance OSW science, foster common ground, and result in relationships and partnerships between scientists and stakeholders that would extend beyond the workshop.

PRESENTATION: CONTEXT SETTING - MULTISECTOR WORK ON PAM AND A REGIONAL SCIENCE PLAN FOR MARINE MAMMAL MONITORING

Emily Shumchenia, Regional Wildlife Science Collaborative (RWSC), provided an overview of the purpose and goals of the workshop and emphasized that the workshop was building from previous workshops and efforts to advance monitoring, data consistency, and access for improved regional integration of renewable energy science. Previous workshops include:

- Improving Monitoring, Data Consistency, Archiving, and Access for Improved Regional Integration of Renewable Energy Science Workshop, June 2021
- New York Bight Passive Acoustic Monitoring Workshop, 2020
- MassCEC Research Framework Workshop, 2018
- BOEM Best Management Practices Workshop for Atlantic Offshore Wind Facilities and Protected Species, 2017
- BOEM Atlantic Ocean Energy and Mineral Science Forum PAM Session, 2016

She reviewed the workshop agenda and shared that the summary of workshop proceedings will help guide the inclusion of PAM in the upcoming RWSC science plan, an inclusive guide of research priorities and how to get them done.

Ms. Shumchenia noted that RWSC is also working to provide research support for ongoing and pending research efforts. She highlighted that all RWSC-supported projects have access to and follow best practices to ensure whoever is doing the research can see the regional scale changes that are occurring. In closing, she emphasized the importance of coming together as a scientific community to build workflows and best practices to use moving forward to standardize approaches to PAM.

PRESENTATION: ARCTIC/CHUKCHI SEA MARINE MAMMAL CASE

Darren Ireland, LGL Ecological Research Associates, presented a case study of passive acoustic monitoring of sea marine mammals off the Northern coast of Alaska. The presentation included an overview of the methodology and findings of the PAM project which was funded and supported by the project developers of oil and gas lease areas off the Chukchi Sea and Beaufort Sea. Mr. Ireland shared some of the key aspects of the project:

- **Objectives:** Project objectives were driven by the Marine Mammal Protection Act (MMPA) and included avoiding potential impact to subsistence hunting in the project area. Monitoring included mitigation monitoring to minimize and estimate the level of potential "take" authorized under the MMPA and research monitoring to observe occurrence, distribution, seasonal patterns, variation.
- **Design:** PAM arrays were primarily designed to analyze the impacts of offshore activities on marine mammals closer to the shore and to understand broader scale movements, patterns of distribution, and seasonal variance of animals throughout the Chukchi Sea.
- **Methods:** Monitoring methods included visual observations from vessels, aerial surveys, and passive acoustics – both field verification of sound sources and broader scale acoustic detections.
- **Activities:** Monitoring activities included geophysical surveys (deep penetration seismic and "shallow hazards" high-resolution geophysical) and exploration drilling activities including mud-line cellar excavation, anchor handling, and support vessels.
- **Outcomes:** Outcomes included documentation and confirmation of seasonal patterns of presence and large-scale movements during bowhead whale and walrus migrations.
- **Key Results**:
    - Documentation of variation in seasonal timing and location of bowhead whale migration. In one case, aerial surveys identified a feeding aggregation to the north which was present within the acoustic data.
    - Because avoidance of areas where seismic activities were taking place was a concern, the team wanted to know how far whales deflect from their typical

migration path and how long does it take them to return to their typical migration path. The number of calls dropped substantially in the presence of sound exposure. However, once animals stop calling, it makes detection very difficult. The team was looking for detection responses but what we discovered was a change in call behavior.

- Additional results concluded that natural processes drove bowhead distribution more strongly than anthropogenic sounds. Avoidance if ice turned out to be a major behavioral response aside from human activity.

Mr. Ireland summarized that PAM was most useful in detecting large-scale movements and seasonal and annual variations but is more limited to detect distributional responses to anthropogenic sounds due to behavioral responses. In closing, he emphasized that multiple streams of evidence provided stronger inference and ecological insights than the PAM data by itself.

PANEL: WHAT LESSONS MIGHT WE DRAW FOR THE US ATLANTIC COAST

Emily Shumchenia, RWSC, moderated a panel discussion about what lessons from the Arctic/Chukchi sea marine mammal case presented by Darren Ireland could be applied to the Atlantic Coast. Panelists included:

- Cynthia Pyć, Vineyard Wind
- Alexander Conrad, Center for Marine Acoustics, BOEM
- Manuel Castellote, NOAA
- Howard Rosenbaum, Wildlife Conservation Society
- Joel Bell, US Navy

Moderator questions are in plain text and answers from panelists are *italicized*.

What are your initial reactions??

- Manuel Castellote: *We need to keep in mind the difference in the environment between Alaska and the East Coast. We were focused on bowhead whales and walruses and designed our study differently than we would have on the East Coast. The ice has a strong influence on the movements and behaviors and can be helpful to study marine mammals because they tend to avoid the ice. PAM accuracy is hampered by distance. The instruments are good for a concentrated area but would be difficult for larger areas. How often should the results be published? The analysis is tedious. It took someone 5 years to go through 3 months of data and that is another cost. It is important to be clear and define what you need to inform study design decisions.*
- Darren Ireland: *Ask yourself: "What questions are you trying to answer? What are your goals?" Design your studies to fit your goals.*

- Cynthia Pyć: *We designed a similar study nearby for the same animals in slightly different ways and learned that their behaviors were different depending on whether they were migrating or feeding.*

What are some challenges with analyzing the data??

- Alexander Conrad: *You want to know what your question is and organize your analysis plan to attempt to get a binary yes/no, but you need to keep doors open and keep track of what you are doing for repeatability and to answer new questions. Record keeping is essential. Years later, we found out that one of our recorders failed for a particular period and we needed to go and manually adjust the data.*

How can we better coordinate data?

- Cynthia Pyć: *Before, during, and after construction, we are required to put data in an archived PAM. There might be some opportunities to participate in regional monitoring but the goals for this are not clear. Until we understand the goals, it's hard to say how the data could be used. We'll be recording during construction to see if what was predicted is aligned in the field to make sure the animals are not exposed to levels above required. Monitoring of marine mammals in the field includes real time observations on vessels and real time observation during construction around the pile driving. We're doing a lot of other data collection as well and we're thinking about a regional data collection effort outside of vocalizing marine mammals. We believe there is opportunity, but it is somewhat unclear how the data streams will work together for regional benefit.*
- Joel Bell: *Operational mitigation including lookouts on ships and visual assessments are established under letters of operation. Research and monitoring falls under MMPA. We are trying to understand the potential impacts of sound from surveys and explosions to individual animals and populations. To do that, we are gathering data and looking at responses of individual animals through visual surveys and some PAM. Even if the study area isn't the whole east coast, it is still too big for one group to tackle alone. We need many people to do what they can and then we need to put all those pieces together.*

What about design without all the convenient limits? How should we approach this? Should we focus on smaller areas near lease areas??

- Cynthia Pyć: *The data collection effort in the Chukchi also looked at many things and species. The project area is still a very large area – more on the order of half of the eastern seaboard.*
- Darren Ireland: *The results of the Chukchi Sea array are a good indicator of what you could learn in similar areas, especially pertaining to broad movements, patterns, and distribution.*
- Manuel Castellote: *The Marine Strategy Framework Directive in the EU is using a combination of surveys and monitoring to focus surveys on key locations and then develop models for broader areas. Every country in Europe is trying to understand how the EU can set rules related to ambient noise that can be followed by a wide range of countries and resources. Instead of setting a static approach – they set what needed to be monitored and allowed countries to do that in whatever way they wanted. They have been successful in letting the countries adapt to their own resources and location and the EU could be a good model for how to do it on the East Coast.*

Do we have enough information to know what a PAM program could look like?

- Howard Rosenbaum: *There have been many efforts to couple data sets. We all face challenges in analyzing data sets that have been developed without clear goals. It gets down to sampling, but you need a bigger view and vision. We need better:*
    - *Coordination across PAM systems, agencies, developers, etc.*
    - *Integration with other techniques to complement PAM*
    - *Motivation because people need to want to make it happen*
    - *Compliance, requirements, and mitigation due to shifting baselines, changing behaviors, climate change, mortality events, etc.*

  This is a work in progress and the same questions are coming up in NARW dialogues with DOE. The agencies need to be leaning in and talking to one another.

PARTICIPANT POLL: WHAT IS THE MOST IMPORTANT LESSON YOU DRAW FROM THE ALASKA CASE FOR THE US EAST COAST?

Table 1. Mentimeter Poll asking participants "what is the most important lesson you conclude from the Alaskan case study to the U.S. East Coast?"

Participant Answers
The Chukchi deployments are spatially relevant in that the size of the area monitored well exceeds the Northeast Atlantic and there are far fewer recorders deployed than what was proposed in the Van Parijs, et al. paper.
Multiple threads of data collection are necessary (acoustic and visual detections, prey mapping, oceanographic/ecological, etc.). Understanding disturbance of marine mammals by an activity must be assessed in light of these threads.
The importance of designing the array and its localization capability to answer a research question.
Understanding what questions we want to answer - specifically in each state and more broadly across the East Coast - is a critical first step, but also the place (regionally) where we are getting stuck.
Have specific plans of how and when raw (or extremely rare) data is going to be shared with the wider public. There were early promises of acoustic data sharing from the Alaskan projects that haven't entirely panned out.
The integration of different data streams.
Define the questions you want to answer and your approach to answering them before deploying PAM.
I thought it was interesting to point out that they couldn't answer some of the spatial questions once calling rates were impacted by construction noise levels.
Multiple data streams are far more effective - PAM can't tell the whole story. Also, the behavior of whales in a focal area will impact study design.
One needs ample resources to "do this right".
Study design is important to know that you are collecting data that will allow you to answer the intended question.
That we (in VA) will never have enough funds available to monitor our area that way AK was.
You need to consider environmental and behavioral context to fully understand what is happening.
There are many great parallels here that we can learn from.

PRESENTATION AND DISCUSSION: FOLLOW-UP FROM WORKSHOP #1 - GRID DESIGN AND REGIONAL STUDY DESIGN

Brief review of grid design and acoustic technologies, Sofie van Parijs, NOAA

Dr. Sofie van Parijs, NOAA, provided a review of grid design and acoustic technologies discussed during the first PAM workshop related to species of interest, data collection techniques and technologies, and system requirements.

Study Designs, Statistical Power, and Considerations, Len Thomas, UK

Dr. Len Thomas, UK, delivered a brief presentation on study designs, statistical power and related considerations. The presentation emphasized the importance of identifying research goals and focused on optimizing monitoring programs. Dr. Thomas also discussed what conclusions can be made from PAM data as well as nuisance factors affecting encounter rates such as false positivity rates, detection probability, and animal vocalization rates. The presentation included an overview of the difference between three study design types: targeted, space-filling, and grid. Dr. Thomas also discussed Project WOW which is in the early stages of study design to look at instances of marine mammal displacement from construction of turbines. He emphasized that while a grid design is constrained by financial feasibility, we often miss out on important data if we only design to our assumptions because our scenarios and assumptions are often wrong. In closing, Dr. Thomas pointed out that a grid is always the optimal design even as grid spacing could change.

Next Steps from BOEM's Perspective – Kyle Baker, BOEM

Kyle Baker, BOEM discussed next steps from BOEM's perspective related to grid design and regional study designs. He shared that BOEM has heard concerns about the NMFS and BOEM recommendations paper. He explained that the pace of OSW development is moving swiftly and emphasized his understanding that BOEM needs to stay ahead on science and data management issues which he explained is why BOEM hosts workshops like these. He acknowledged the need for a review with NOAA as a stepping-stone to develop a regional PAM strategy. He highlighted that a regional PAM strategy is not intended to be requirements for developers or impede new ideas or technologies but rather a tool to foster collaboration and innovation. He explained that BOEM is interested with working with NOAA on the grid design as a starting block that all stakeholders can all move forward from. He reviewed BOEM's next steps which include:

- Stay informed by stakeholder input through things like this workshop
- Support the development of consistent standards
- Identify PAM priorities, design, maintenance, and products throughout the process.

In closing, he called attention to the paper published in Frontiers in Marine Science, *NOAA and BOEM Minimum Recommendations for Use of Passive Acoustic Listening Systems in Offshore Wind Energy Development Monitoring and Mitigation Programs*, explaining that the paper is a good source of information and place to start the conversation until we develop newer products and strategies.

PANEL: PAM DEPLOYMENT CHALLENGES – DEVELOPER, STATE, AND FEDERAL PERSPECTIVES

Renee Reilly, NJ DEP, moderated a panel discussion on PAM deployment challenges such as cost, ship time, equipment availability, other competing needs, supply chain issues, operations, and maintenance. Panelists included:

- Laura Morse, Orsted
- Erica Staaterman, BOEM Center for Marine Acoustics
- Sofie VanParijs, NOAA
- Erin Summers, Maine Department of Marine Resources
- Helen Bailey, University of Maryland Center for Environmental Science
- Kate Press-McClellan, NYSERDA

Panelists discussed the key challenges they see related to PAM deployment and challenges and costs associated with cable arrays. Below is a brief synthesis of key discussion threads, organized by theme.

Table 2. Stakeholder perspective on key challenges related to PAM deployments.

Developer Perspectives
▪ Deployments are subject requirements to Section 106. We can't just place things anywhere – we can't place equipment with the turbines, so we need to avoid those and archaeological resources. What is the flexibility under a grid design approach if we can't be in a specific location? ▪ When we think about the supply chain for PAM equipment, these risks are growing significantly. Having numerous deployments could be problematic. ▪ From a cost perspective, we have to balance that with other monitoring we do: sea turtles, avian, fish, air, etc.

Federal Perspectives
■ Some of the key challenges are supply chain issues, shipping times, and uncertainty with federal budgets to allocate funding. ■ Supply issues aren't so challenging anymore. We have purchase agreements with vendors set up for 5-year periods which makes it easier for planning purposes.
State Perspectives
■ Communicating with all affected stakeholders is key. It was helpful to coordinate with fishermen to share information. We need to communicate with developers to know what activities are happening when and where. ■ Acoustic recorders with good batteries and longer lifespans are good such that you have a longer period of data collection out at sea, but there is a longer period where there could be an issue with a recorder, and you might be losing that data without realizing until afterward. ■ NOAA and BOEM were very helpful when NYSERDA put together an RFP for 2 years of passive acoustic monitoring. ■ Hopes that the upcoming 2-year PAM project in New York will collaborate with existing projects, including those in Jersey.

Table 3. Stakeholder perspectives on challenges and costs associated with cable arrays of PAM devices.

Developer Perspectives
■ The Neptune and Venus arrays are examples of cable arrays. ■ Cable arrays are multi-million-dollar projects that require significant installation costs. ■ The costs for these arrays include vessel costs, project management costs, data analysis costs, and tying in cabled ocean observatories to industrial fiber/power cables. ■ Costs can be reduced if they are considered in the early phases of engineering designs, but they are still significant. ■ You must consider benthic disturbance, sediment movement, Section -106, and most importantly fisheries interaction. These are all core challenges to developers deploying their own export cables and inner-array cables.
Federal Perspectives

- A cabled array might allow us to gather data on higher frequencies without some of the drawbacks of other methods like glider-based methods.

In closing, Dr. Erica Staaterman, BOEM, shared that the RWSC Marine Mammal Subcommittee monthly meetings could continue the conversation about coordinating field activities with scientists and other stakeholders implementing that research. She invited participants to attend the subcommittee meeting later this month.

PRESENTATION: CURRENT AND NEAR-TERM DEPLOYMENT

Emily Shumchenia, RWSC, provided a brief overview of what is likely to be deployed from now until 2026 and what coverage that might provide for PAM up and down the seacoast. She shared that after the first PAM workshop, she worked to fill in the map grid with current PAM deployments based on information available online at Northeastoceandata.org and Portal.midatlanticocean.org (See Figure 1 and Figure 2).

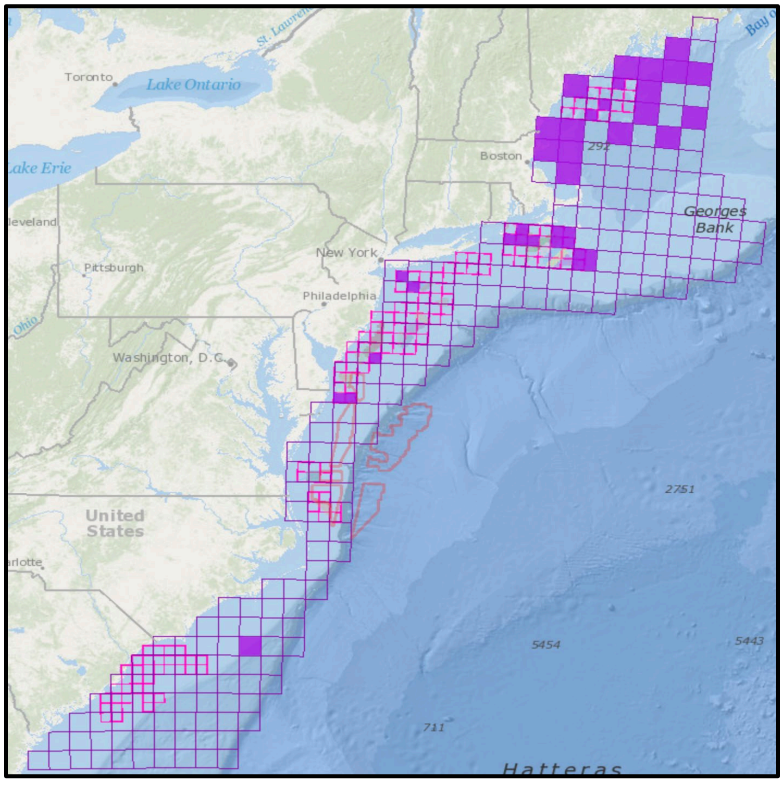


Figure 1. Current PAM deployments. See www.northeastoceandata.org

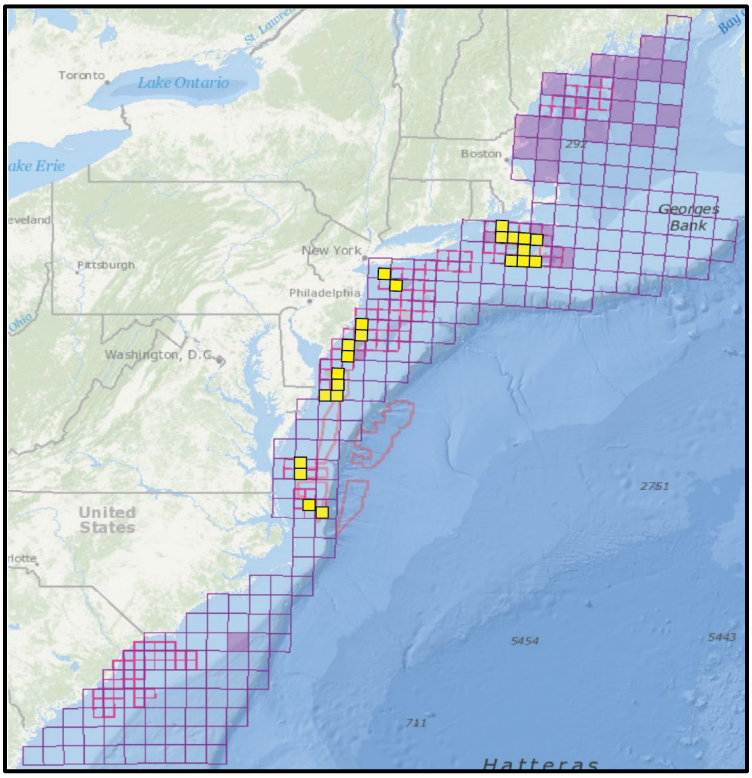


Figure 2. Likely OSW Developer Deployments through 2026

RWSC made some assumptions about when PAM devices might be deployed on future devices and the timing, they are requiring them and noted Ms. Shumchenia noted this map is a proof of concept for sharing ideas about where to deploy devices to fill in the gaps over time.

BREAKOUT DISCUSSIONS: WHAT CAN WE LEARN FROM PAM?

After building a better group understanding of where future PAM efforts will be targeted, participants were then organized into breakouts to discuss what research questions the planned deployments could help answer and what questions they will likely be unable to answer. The following subsection provides a brief synthesis of key discussion threads raised in breakout discussions, organized by theme. Attendees worked in four small groups. Breakout groups included participants across the sectors attending, and each included state and federal agencies, OSW developers, and academics. A discussion summary of key points is included just below

Table 4. Key workshop outcomes on what we can learn from PAM.

Questions Planned Deployments Can Answer
■ The current design can help characterize what is out there currently ■ Will help us better understand ambient noise, operating turbines, before and after construction ■ Historical data can help explain scale ■ Some areas could be used as proxies for similar areas ■ Realtime data will be helpful for mitigation ■ Temporal and spatial uses of areas change ■ Some questions already answered by recent papers looked at broad scale changes – those types of questions could be continued to be answered by future PAM deployment as well as fine scale changes ■ To answer offshoots of basic questions, like those related to whale distributions, we would need additional methods. PAM devices need to be integrated into a multi-platform approach such as gliders, aerial digital and visual, etc. ■ PAM could act as an early warning survey to be followed by gliders, surveys, or visual surveys
Questions and Considerations for Planned Deployments
■ It would be helpful to prioritize lists of species in addition to NARW ■ Space considerations for where we put these: fishing grounds, shipping lanes, etc. ■ Gliders are good for infill ■ Additional complementary methods such as low-impact satellite tagging on other mammals ■ Who is the project manager to help design and manage this entire effort? RWSC? ■ We haven't refined the questions well enough. If we refine the research questions, it helps even if those questions change, and we had incorrect assumptions.
Limitations of Planned Deployments
■ PAM is good but not perfect; We can identify some of these animals some of the time but not all the time. ■ Looking at the 2026 map, you can see there are many gaps. Maybe we should fill those with additional devices. ■ We will need additional data streams to understand the WHY behind marine mammal movements and the connection between climate change ■ The time and resources to collect, analyze, distribute, etc. this data will be significant ■ Would offshore wind displace NARW – where is the best place to put acoustic buoys to answer this question? You need more data collection methods other than acoustic streams to understand the why.

After the breakout discussions, Pat Field facilitated a debrief with participants. Participants shared several reflections:

Intermediate Impacts

- An attendee observed that it takes a few years to build the field during construction and complete a study on measurable shifts and if we want to compare before and after conditions, we won't know what the intermediate impacts are for several years. During that time, there could be many impacts so, how can we start to answer the questions before the array is entirely built?

Primary and Secondary Research Questions

- One attendee noted their surprise that there isn't a clear understanding of the primary question. In their view, the primary question is "Is there a measurable shift in whale distribution because of OSW or another stressor (shipping, climate, etc.)?", and secondarily, "If they move, where do they go?".
- A third attendee shared that the desire for more learning from panelists and the scientific community leads to much bigger questions than the primary questions of "What are the impacts to behavior and distribution of marine mammals from OSW activities?"

PARTICIPANT POLL: WHAT CAN WE LEARN?

To close Day 1, participants responded to two poll questions regarding what we can and cannot answer with PAM deployments. The questions and answers appear in the tables below.

Table 5. Poll question and participant answers to what key questions we want to try and answer with PAM deployments.

What is the key question we want to try and answer with PAM deployments and perhaps other tools?
Is there a change in distribution and abundance of marine mammals because of a project's development and operations activities?
Baselines distributions for key targeted species, seasonality and changes through time, noise characteristics and changes through time.
Is the spatial and temporal occurrence of cetaceans affected by wind farm construction and operation?
Are there changes in large whale distribution and occurrence related to offshore wind farm construction and operations?
Are wind farms negatively affecting marine mammals? Easy to ask not to answer.
Are there large-scale changes in baleen whale distribution over time, associated with OSW and other changes (natural; human-caused) over the next decade or so, with PAM being one tool (of many) to address this?

Will NARW distribution and habitat use change because of the build out of OSW with negative or positive impacts to NARW?
Whoever is putting up the money really gets to decide the question. But if I could decide, it would be how can we develop density models that integrate PAM and visual data?
Define and detect change in broad-scale movement patterns and put them in context with regional and other oceanographic and prey field changes.
Presence/distribution of baleen whales over time. If shifts coincide with wind (construction, operation, etc.), more and potentially different methods will be needed.
Is there a measurable change in baleen whale distribution because of offshore wind development?
Generally, the question is how will wind farm installation and operation affect marine mammals, but it needs to be broken down into simpler, smaller parts such as: is there displacement during construction and for how long?
Is there a measurable shift in baleen whale distribution and abundance in space and time?
Does wind farm construction and/or operation change where and when (and what species) of whales change their space use?
Is there a measurable shift in baleen whales (or other species) distribution due to OSW and/or other factors (shipping, climate, etc.)?
How are baleen whale distributions affected by wind farm developments and ongoing operations. How is this disentangled from climate change effects?
Has the construction of wind farms changed the distribution of mysticetes?
What are short and long-term, small- and large-scale changes in marine mammal distribution in the face of offshore wind development (with a focus on baleen whales)?
Will baleen whale distributions change related to OSW?
Does the presence of offshore wind farms cause change in large whale distribution regionally and locations (leases)?
Phase 1 question: Is there a measurable shift in whale distribution & abundance before, during and after OSW construction. Phase 2: If so, in what direction. Phase 3: why?
How are marine mammal habits impacted by development in the ocean spatially and temporally?
How do baleen whales use the space (cumulatively, not within a given project area)?
Is there a change in occurrence or distribution associated with offshore wind development - both construction activities and long-term?
Is offshore wind impacting marine mammals?
Is there a measurable shift in baleen whales' distribution, abundance, and behavior due to OSW and/or the cumulative impacts of OSW and other factors?
Can we detect any differences in baleen whale distribution through PAM due to offshore wind energy development?
What are the patterns of distribution and movement of key marine mammal species within the AOCS and how are they changing?
Is there a change in animal distribution?
What are the spatial and temporal distributions of baleen whales and what is driving those distributions?

Table 6. Poll question and participant answers of what key questions we are unable want to answer with PAM deployments.

What questions are we unable to answer with the current PAM deployments?
There are no current deployments specific to evaluating wind impacts.
More detailed questions related to movement, in-depth questions about behavior, and key questions that require other types of data (behavior, knowledge of particulars for individuals --e.g., sex, age, some essential life functions).
Still challenges using acoustics alone to differentiate amongst some dolphin species.
Aside from additional presence/absence and ambient noise data, more deployments are needed for longer periods to answer the questions (assuming the power analysis won't tell us differently).
Too few deployments to understand current spatial and temporal occurrence.
Current deployments don't align with OSW development (only have 2 windfarms out there). Thus, there needs to be ore thought on how OSW "fits" with current deployments and stressors (natural, human-made) and gaps where new deployment is needed.
With current deployments (or currently planned) we won't be able to determine whether changes in NARW distribution or habitat use are due to what particular factor(s) (climate change, OSW, increased shipping, etc.).
We are unable to determine absolute abundance or density, or how it differs across time or space, using the current PAM deployments, due to not having sufficiently addressed the questions that Len posed this morning (items 2-4 of his slides).
Habitat use patterns when animals are not vocalizing or the scale of use in terms of individuals.
Where did the animals go? What was the cause of their displacement? Did they stop calling, or move?
Right now, I don't think we have the power to (statistically) answer much of anything.
Causation - may be able to get a correlation but attributing any change in distribution or abundance to a specific factor is going to be very, very difficult.
Maybe: why the change has occurred. Maybe: is it a negative effect, or how negative, to the individual and the stock or population as a whole.
We can't answer questions on species abundance, we can't answer small scale changes in distribution, we can only look at broad scale questions.
The planned developer deployments as well as the existing deployments shown will not answer the key questions - change in distribution. I think you need a repeated glider program that samples key cells on a regular (monthly? Weekly?) basis.
How any observed shifts may or may not result in fitness/population level consequences.
Isolation of effects other than wind farms, e.g., climate change, that may drive changes in large whale distribution.
Cannot answer why whales shifted in the direction they did.
What other ecological drivers might be causing changes in animal distribution?
Very limited ability to make any significant inferences from current deployments aside from very specific to individual locations.
Whether any observed impacts or changes are related to offshore wind activity.
Not much info on behavioral changes.
Large scale distribution and movement patterns.

SESSION 2 | MARCH 9, 2022

DISCUSSION: SUMMARY OF SESSION 1

To open Session 2, CBI Facilitator Patrick Field presented a summary of the discussions and polls from Session 1. Below is a brief synthesis of Session 1 key discussion highlights and themes from the poll responses.

What are the priority questions for this workshop?

- What is a regional scale approach for PAM?
- How might we manage PAM data regionally across sectors?

What question(s) we are trying to answer?

- Are there large-scale changes in baleen whale distribution over time, associated with OSW and other changes (natural; human-caused) over the next decade or so, with PAM being one tool (of many) to address this?
- Phase 1 question: Is there a measurable shift in whale distribution & abundance before, during and after OSW construction. Phase 2: If so, in what direction. Phase 3: why?

What questions are we unable to answer with the current PAM deployments

- PAM may be able to get a correlation but attributing any change in distribution or abundance to a specific factor is going to be very, very difficult.
- The planned developer deployments as well as the existing deployments shown will not answer the key question - change in distribution.
- More detailed questions related to movement, in-depth questions about behavior, and key questions that require other types of data (behavior, knowledge of particulars for individuals --e.g., sex, age, some essential life functions). The “Why's”.
- What other ecological drivers might be causing changes in animal distribution?

One attendee noted that if one of our objectives is to get to density and abundance using PAM, then significantly more work will be required. Another attendee shared that hopes that we will be able to spot patterns with the regional-scale grid and emphasized that interpreting those patterns (are we seeing a change in density or propagation, etc.) will require additional work.

To capture the different methods and scales by which different questions might be answered, Emily Shumchenia prepared the following summary table.

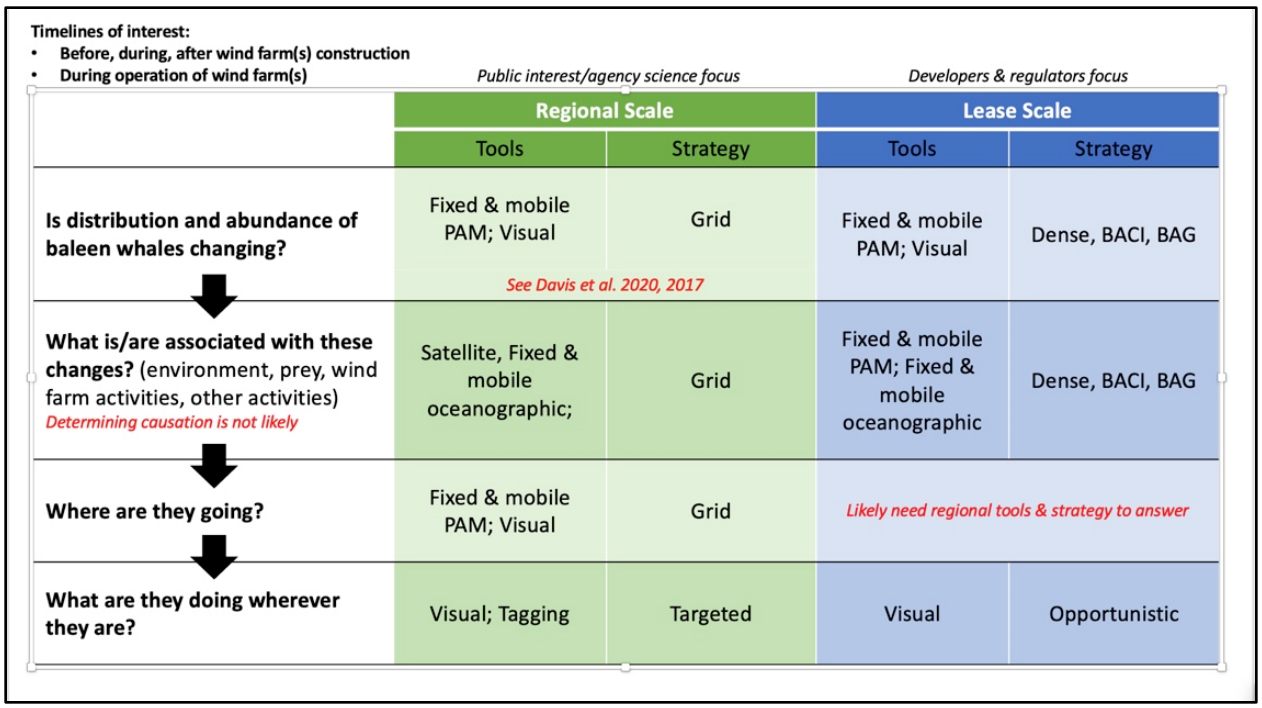


Figure 3. Tools, Questions and Scales for Marine Mammal Research

PANEL: PAM DATA CHALLENGES FROM SECTORS' PERSPECTIVES

Paul Phifer moderated a panel discussion about how to manage pre-COP and pre- and post-construction data gathering including, but not limited to, who does it, how do they do it, and when do they do it, what are challenges to consistency QA/QC, confidentiality, publication interests, and permit risk. Panelists included:

- Koen Broker, Shell
- Michael McCrander, Integral
- Erica Staaterman, BOEM Center for Maine Acoustics
- Megan Rickard, NY DEC
- Jake Kritzer, NERACOOS
- Abby Benson, USGS, Node Manager, OBIS-US
- Rob Bochenek, Axiom Data Science

Below is a brief synthesis of highlights and themes from the panel discussion.

What are the essential points for a data management system?

- A central data depository for raw and metadata including information about what has been collected, by whom, and how.
- Real-time, near real-time event logs sent to repositories is key data that is needed.
- Archival data would also be helpful.
- Standard data products and processing parameters which helps for repeatability down the road.
- Data standardization more broadly which allows us to make comparisons across organizations and projects and enables folks to ask new questions in the future.
- Large-scale risk characterization and management is the goal of having access to comparable data across projects.
- Standardization of collecting and integrating across geographies.

What are the challenges related to getting to where we need to be with a data management system?

- We have not coalesced as a community around best practice.
- Process should involve not just spending time/money on data collection, but also on analysis and standardization, and developing BMPs.
- Standardization issues are significant - not just across PAM - but also across different data types.
- Massive volumes of data are involved.
- Event logs that will be meaningful to the most folks.
- Creating libraries for interpretation and use of data.
- Proprietary data issues.
- Data backed up on external hard drives given the sheer volume of data.
- Data management needs to be put in place throughout, not just at the end, of projects
- Costs.
- Getting the right message to managers on how data should be used.

What are some of the lessons learned from Shell and "rescuing" data?

- Shell had data sharing agreements and made data available to AOOS but did not provide funding for the actual work that is require to archive. Funding will be very important for making data available. There are examples of how industry can fund data standardization, management, and provisions.
- Investigators prefer using their own data rather than others'
- Does the use really justify the associated costs?
- A lot of time involved is involved with "rescuing" data after the fact

What are some of the challenges and key components to setting up a PAM network?

- It would be good to have one central entity managing a network of projects and researchers.
- There are issues related to how data is accessed and how infrastructure is managed
- It will take many stakeholders working together to get this set up properly
- For OBIS, data providers align data themselves.
- There is a lot of room for collaboration with developers and issues related to confidentiality and publication rights, but they are manageable.
- There have been concerns expressed around data sharing agreements.
- There are business concerns with competition/advantages.
- For the data to answer questions and provide value to businesses, the data needs to be made available to the public.
- We need real-time answers to some questions so, the challenge is bigger than any one organization
- If we can't report on marine mammal abundance and distribution, then we can't report to parties that need data now for conservation.
- We won't understand marine mammal distribution and abundance with reports from individual projects - we need the raw data.

PRESENTATION: A VIEW OF PAM DATA FLOW

Erica Staaterman presented a graphic representing PAM data flow and asked participants to comment on whether the graphic was comprehensive and accurately represented the data flow process. She discussed the potential of a holistic data portal that could be fed from data points in multiple portals. She explained that ss long as the portals talk to each other, the raw data can end

up at PAM archive, noting that NMFS and BOEM will consult on pre-/post-COP monitoring so some of the data will live with them.

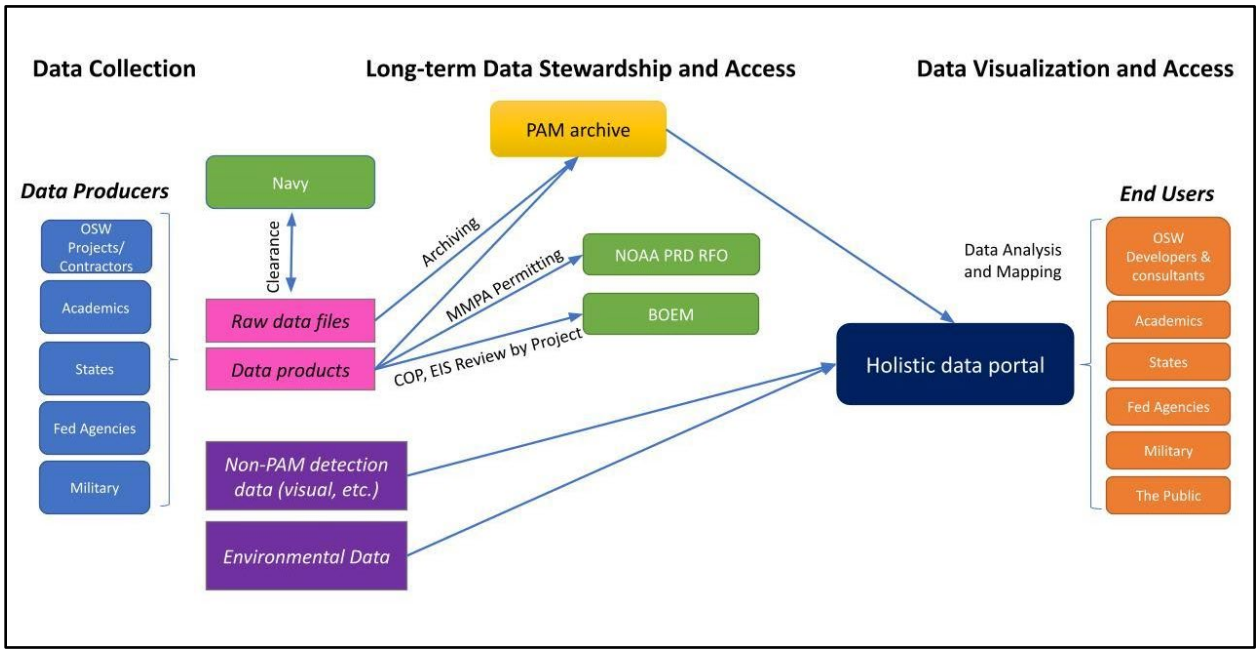


Figure 4. Diagram of PAM Data Flows

Below is a brief synthesis of feedback and questions shared by participants on the PAM data flow presentation.

- Collectors of data (consultants, companies themselves, etc.) should have a role in the analysis if they would like.
- The system will have to accommodate the fact that many data collectors own their data.
- It will be important to ensure other portals (e.g., mid-Atlantic Ocean portal) are in sync.
- Potential conflicts of interest need to be considered when listing people on publications.
- Include "states" as a green box in the center of the diagram along with the federal agencies because of permitting
- How will we account for or avoid non-PAM data ending up in PAM portals?

PRESENTATION: DATA PRODUCT EXAMPLES

Dr. Carrie Wall Bell, NCEI, shared examples of common data products, including international examples that could be develop with PAM data. She highlighted common ground with marine

mammal detectors, noting that data from different recorders can be processed similarly if you have the calibration metadata for each and understand performance metrics of each detector. The presentation also covered common ground with ambient noise metrics and how data from different recorders can be processed similarly if you have the calibration metadata for each recorder. Dr. Wall Bell also described how the large size of raw data files can be a challenge for making data accessible.

PRESENTATION: A POSSIBLE APPROACH TO RECEIVING, MANAGING, AND ACCESSING PAM DATA

Carrie Wall Bell, NCEI, then provided an overview of a possible approach to receiving, managing, and accessing PAM data. She noted that the process begins with recorder specifications and that calibration metadata are crucial. She walked through the various stages and the kinds of data that would need to be collected to archive data and its metadata in a way that would make it more usable and comparable across data sets. She noted that for some aspects are non-negotiable since they are required for archiving, such as geospatial location of recorders. She explained that metadata standards don't have to follow specific naming standards, but other fields would need to follow the conventions outlined in the proposed approach, noting the importance of all data coming to NCEI in a standard and consistent way. She talked through the key archival needs and how the process would work, including a Navy review to ensure any defense-sensitive data was scrubbed or managed. The attached chart indicates the metadata NCEI needs to properly describe the passive acoustic data and a general workflow.

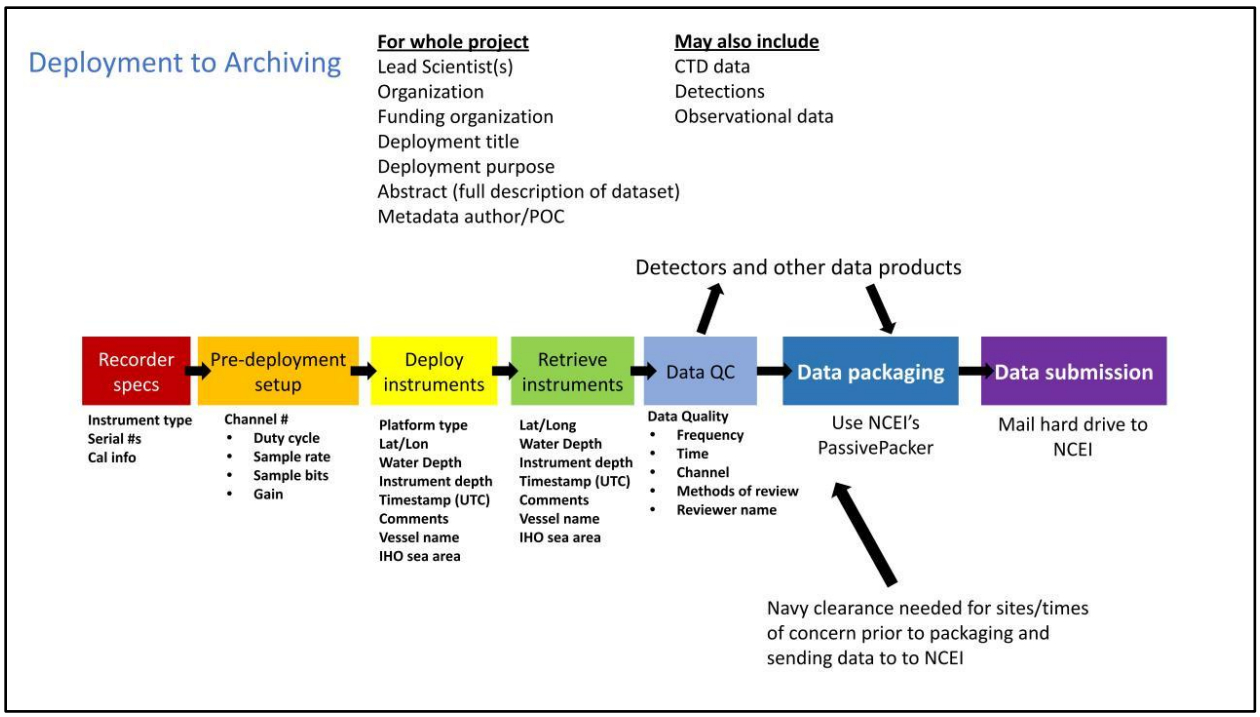


Figure 5. PAM Deployment to Archiving of PAM Data

Below is a brief synthesis of highlights and themes from the discussion following the presentation on outlining a possible approach to receiving, managing, and accessing PAM data. Participant comments and questions are *italicized* and answers from Carrie Wall Bell are in plain text.

- *Is NCEI hooked up with Globus (instead of mailing hard drives)?*
  - We tested it but had issues with firewalls that hindered our workflow. We are happy to look again.
- *Is this approach intended for raw data only or processed data as well?*
  - Mostly raw data, but we are archiving data products as well.
- *Only passive acoustic data?*
  - Yes, but it doesn't matter how it is collected (that would be metadata).
- *Cost to NCEI for posting data?*
  - Approximately $145/TB. Other costs include additional staff time, managing complex data, working on the workflow, etc.

BREAKOUT DISCUSSIONS: WHERE TO FROM HERE ON DATA PRODUCTS, COORDINATION, MANAGEMENT, AND ACCESS

After building a better group understanding of the proposed standardized community approaches to data management, participants were then organized into breakouts to discuss what approaches to data could be operationalized in the coming months and years.

The following subsection provides a brief synthesis of key discussion threads raised in breakout discussions, organized by theme. Attendees worked in four small groups. Breakout groups include participants across the sectors attending, and each included state and federal agencies, OSW developers, and academics.

Areas to Improve the Approach

- Understanding what data could be used for
- Getting clearer on the questions we're trying to answer: What is spatial and temporal distribution of large whales? What oceanographic features are changing?
- Project specs at the beginning of projects need to be included
- We could delay the public release of data to allow people to complete publications

Roles and Responsibilities

- Whoever is funding the data gathering can point to the standard to allow collectors to understand the process and purpose
- Users can fund based on their needs and uses
- A designated entity should be created to be the place where analysts can pull data from

What are the Incentives to Participate?

- People need to be collaborating, rather than doing everything individually
- Some incentives are already in place e.g., conservation value for NGO's

What Would Keep People from Participating?

- The lack of technical support
- What happens when the data goes live?
- How can someone prevent unintended uses of their data?

- We don't want to collect data without knowing how it will be used
- Language in current lease agreements is not clear about what developers are required to do. Would an elective workflow be effective?

Costs

- It's a federal requirement, so there should be federal support for long term maintenance, management, and ownership of the data. It is difficult for states, academics, and other agencies to have that kind of long-term financial plan.
- How can BOEM and other federal agencies tap into the money that is raised during the lease sale process and allocate some of those funds for data archival and access purposes?

Potential Products That Would be Useful

- Marine mammal presence
- Ambient environmental levels over time
- Ocean planning products, some of which aren't yet on regional portals
- Seasonal presence and distribution and variability
- Products for researchers to communicate and share with each other
- Pairing PAM data with other data to get at drivers of change in species presence/distribution over time.
- Other researchers with specific data skills/interests can create their own products

Data Accessibility and Tracking Uses

- Some groups want environmental data to be readily accessible but don't want to make PAM data available for immediate release. Seems like those do not match.
- Concerns around providing unrestricted access to raw data without knowing who the user is and what they intend to do with the data.
- Some users need some coding/calibration support.

PARTICIPANT POLLS: FEEDBACK ON A REGIONAL DATA MANAGEMENT APPROACH

Participants were asked a series of questions about their level of support and feedback on a regional data management approach.

Table 7. Participant poll on data archiving.

Question 1: Do you think a community approach/standards for archiving data is worthwhile?	
Response	*# of Responses*
Yes	34
Maybe	1
No	0
Question 2: Are you willing to archive raw data AND data products at NCEI?	
Response	*# of Responses*
Yes	24
Maybe	7
No	0
Question 3: For archiving and managing these data over time, those costs should be borne by...	
Response	*# of Responses*
Federal Government	16
A partnership of stakeholders (like a NOPP)	14
Submitters of the data	1
Users of the data	1
State government	0

Table 8. Participant poll on factors decreasing the likelihood of support for a regional data management approach.

Question 4: What conditions would DECREASE the likelihood of your support for this regional data management approach?
A lack of consensus, otherwise it seems to be a no-brainer
Complication and cost of data submission
Cost
Cost
Cost
Cost for use/access
Cost to submit or access without sponsor support
Cost would be the main concern.
End user or data sharer costs
Forcing data producers to pay for storage/contribution
Having to bear too high of a financial cost or if it takes too much personnel time to achieve. Inability to flag use conditions (eflag use conditions (embargo for a period) mbargo for a period)
If all stakeholders don't agree to come onboard
If costs were placed on contributor and data ownership not preserved

If it was overly cumbersome to use it or had some stipulations that otherwise discouraged the easy sharing of data. If it was too expensive for anyone to use, either as a contributor or user
Lack of a data usage agreement for contributors & end users
Lack of a simple way to submit and use data and costs
Lack of clear priorities for data collection and clarity about processing and use
Lack of data collection and analysis objectives, and defined data products to achieve goals
Lack of transparency and access
Not having very specific protocols for data collection; not having data use protocol
Price would be a consideration in all directions. Cost to data owners is discouraging, but so is making it
The involvement of other industrial sectors in the funding of data collection
Too many restrictions on community-wide data access - withholding data

Table 9. Participant poll on the likelihood of support for a regional data management approach.

Question 5: What conditions would INCREASE the likelihood of your support for this
A clear vision of how the regional data might be analyzed
Clarity on how the data collected can help to achieve the dual goals of helping to protect the resources while facilitating timely and cost-effective development of the wind energy resources
Clear goals for the use of the data for regional analysis
Coalescing on common standards for processing data so we can compare across projects
Community consensus; commitment to long-term existence; clear communication process with
Community involvement, Costs, Ease of use
Community standards all sectors agree to
Costs borne by receiver; data ownership preserved
Ease of use. e.g., streamlined interfaces making it easy to submit or access data or data products
Ensuring a level playing field for all participants. Reduced analysis costs by providing easy access to well organized data
Funding for giving support to future users. Discounts on using data from others if there is a charge for
Good coordination and facilitation
Long term funding support
Requirement that all the data collectors submit their data to it. But at the same time, it must solve the hard problems needed to make that worthwhile rather than an irritating burden
Standardization
Standardized data collection and data management standards. Defined data products and reporting objectives. Sampling requirements narrowly focused on objectives
Strong standards, ease of use, financial support
User friendly access to data and funding to analyze data
Wide ranging buy-in, coordination, and support

After the polls were administered, facilitator Pat Field shared some observations and reflections on the poll results:

- There is a strong desire to get on the same page with community best practices while cost is a big concern.
- This is a broad emerging agreement for the Administrator and administration but no clear funding mechanism.
- There are wide ranges of costs, e.g., for a recorder: how long you want it out there, where does it go, continuous/cycled, type and quality of mooring, etc.
- Key questions around cost relate to what the requirements are.
- There are incentives for different models for managing the cost.

NEXT STEPS

The following were some possible next steps identified in the Workshop.

1. The RWSE could pursue with its marine mammal subcommittee optimization of the grid design.
2. The RWSE could form a marine mammal acoustic work on standardizing data requirements for PAM.
3. OTHER

CLOSING REMARKS

Emily Shumchenia, RWSC, briefly shared some next steps after the workshop to make further advancements on improving monitoring, data consistency, archiving, and access for improved regional integration of renewable energy science.

- A RWSC subcommittee meeting will take place at the end of March

To close the workshop, Kyle Baker, BOEM, thanks participants for their participation and collaboration in making significant progress on this important effort.

- A workshop report will be developed and posted under Workshops and Literature Synthesis on BOEM's website at https://www.boem.gov/renewable-energy-research-completed-studies.

APPENDIX A AGENDA FOR SECOND PAM ACOUSTICS WORKSHOP

Objectives of the Workshop:

- Draw lessons on regional marine mammal monitoring from elsewhere
- Identify existing and expected deployments of PAM and identify what we might learn and cannot learn from such efforts and where data gaps might exist, we might want to collectively fill
- Explore process for increasing data coordination, management, and access
- Define specific clear action steps, likely in stages, to move toward a shared data approach to PAM data on the US eastern seaboard

DAY 1, March 7: Session #1: Case Study and Lessons Learned

Session Objective: Draw lessons on regional marine mammal monitoring from elsewhere

12:30 PM ET Welcome and Objectives for the Day

12:35 Why are we all here?

BOEM, CBI, Workshops Facilitator and RWSE, MM Subcommittee

- Past work
- Structure of this workshop

12:50 Context Setting: Multisector work on PAM and a regional science plan for Marine Mammal monitoring

Emily Shumchenia, RWSE

- The interests and needs for differing sectors around PAM and the data it creates
- RWSE role and how this workshop supports the work of the Marine Mammal Subcommittee

1:10 Arctic/Chukchi Sea Marine Mammal Case

Presenter, Darren Ireland (LGL)

- Presentation

1:45 Panel: What Lessons might we draw for the US Atlantic Coast

Panelists: Cynthia Pyć, Vineyard, Alexander Conrad, Center for Marine Acoustics, BOEM, Manuel Castellote, NOAA, Howard Rosenbaum, Wildlife Conservation Society, Joel Bell, Navy

- Moderator: *Emily Shumchenia, RWSE*

2:15 BREAK

DAY 1, March 7: Session #2: Current and Near-Term PAM Deployment

Session Objective: Identify existing and expected deployments of PAM and identify what we might learn and cannot learn from such efforts and where data gaps might exist, we might want to collectively fill

2:30 Workshop #1: Grid Design and Regional Study Designs

- Brief review of grid design and acoustic technologies, *Sofie van Parijs, NOAA*
- Study Designs, Statistical Power, and Considerations, *Len Thomas, UK*
- Next Steps from BOEM's Perspective – *Kyle Baker, BOEM*

3:00 PAM Deployment Challenges from Developer's Perspective, States, Federal

Panelists: Laura Morse, Orsted, Erica Staaterman, BOEM Center for Marine Acoustics, Sofie VanParijs, NOAA, Erin Summers, Maine, Helen Bailey, Maryland, Kate Press-McClellan, NYSERDA

- Moderator: *Renee Reilly, NJ DEP*

3:30 Current and Near-Term Deployment

Presenter, Emily Shumchenia, RWSE

- Overview of what is likely to be deployed from now until 2026 and what coverage does that provide for PAM up and down the seacoast?
- Questions

3:45 We can we learn? Break outs across Sectors

- What are the research questions that we can answer given the planned deployments? What are we likely to be unable to answer?
- Additional questions include:
    - What are data collection challenges for this approach?
    - What is the role of related acoustic tools like gliders in this work?

- How do we ensure we are not too data rich but information poor after this kind of investment?

4:30 Report Outs from Breakouts

- What can we learn, what can we not learn, and what are key geographic gaps to fill?
- Next steps?

4:55 Summary of Day #1, Overview of Day #2,

5:00 Adjourn

DAY 2, March 9: Session #3: Data Management

Session Objectives:

- Explore process for increasing data coordination, management, and access
- Hone metadata and data processing practices
- Define specific clear action steps, likely in stages, to move toward a shared data approach to PAM data on the US eastern seaboard

12:30 PM ET Welcome and Objectives of the Day

12:35 Review of Day #1 and Brief Reflections: *Patrick Field, CBI*

12:45 PAM Data Challenges from Sectors' Perspectives

- *Panelists: Koen Broker, Shell, Michael McCrander, Integral, Erica Staaterman, BOEM Center for Maine Acoustics, Megan Rickard, NY DEC, Jake Kritzer, NERACOOS, Abby Benson, USGS, Node Manager, OBIS-US, Rob Bochenek, Axiom Data Science*
- Moderator*: Paul Phifer*

1:30 A View of PAM Data Flow

- Infographic Brief Presentation, *Erica Staaterman, BOEM*
- Discussion: Anything we missed or got wrong? Where do you see yourself in this workflow?

1:45 Data products

- Examples of common data products, including international examples, *Carrie Wall Bell, NCEI*
- Brief initial discussion

2:05 **A Possible Approach to Receiving, Managing and Accessing PAM Data**

Presenter, Carrie Wall Bell, NCEI

- Presentation
- Questions and Discussion

2:20 **Break**

2:25 **Where to from Here on Data Products, Coordination, Management, and Access**

- What will you use the data products for?
- What do you like and what would you improve about the proposed approach?
- Report Outs and discussion
- Mentimeter Polling Questions

3:30 **Next Steps and Actions**

- What steps do we need to take, and by whom, to move this kind of approach forward?

4:00 **Adjourn**

APPENDIX B WORKSHOP PARTICIPANTS

First Name	Last Name	Organization	March 7	March 9
Helen	Bailey	University of Maryland Center for Environmental Science	X	
Kyle	Baker	BOEM	X	X
Susan	Barco	Virginia Aquarium & Marine Science Center	X	X
Joel	Bell	US Navy	X	X
Robert	Bell	University of Maryland Center for Environmental Science		X
Abby	Benson	U.S. Geological Survey		X
Kwame	Boadi	Dominion Energy	X	
Lisa	Bonacci-Sullivan	NYDEC	X	X
Debbie	Brill	MGEL	X	X
Avalon	Bristow	Regional Wildlife Science Entity	X	X
Koen	Broker	Shell Renewables and Energy Solutions	X	X
Tiffini	Brookens	Marine Mammal Commission	X	X
Colleen	Brust	NJ Marine Fisheries Administration	X	X
Scott	Carr	JASCO Applied Sciences	X	X
Ali	Carter	American Clean Power Association	X	X
Manuel	Castellote	University of Washington & NOAA AFSC	X	
Brandon	Chambers	CBI		X
Mary	Cody	BOEM	X	X
Alexander	Conrad	BOEM	X	X
Corrie	Curtice	Duke University MGEL	X	X
Jaclyn	Daly	NMFS	X	X
Sam	Denes	Bureau of Ocean Energy Management	X	X
Robert	DiGiovanni	Atlantic Marine Conservation Society	X	
Jennifer	Dupont		X	X
Carter	Esch	NOAA	X	X
Patrick	Field	CBI	X	X
Michelle	Fogarty	Equinor	X	
Greg	Fulling	BOEM	X	X
Caleb	Gaston	Dominion Energy	X	X

Shane	Guan	BOEM	X	X
Jenna	Harlacher	NOAA PR1/ OAI	X	
Megan	Hayes	Atlantic Shores Offshore Wind	X	X
Kyle	Hilberg	Atlantic Shores	X	X
Darren	Ireland	LGL Ecological Research Associates, Inc.	X	
Laurie	Jodziewicz	US Wind, Inc.	X	X
Isabel	Kaubisch	Attentive Energy	X	X
Susan	King	Dominion Energy	X	
Erin	LaBrecque	Marine Mammal Commission	X	X
Nate	Lash	CBI	X	
scott	lawton	Domninion Energy	X	X
Beth	Levy	US Navy	X	X
A. Michael	Macrander	Integral Consulting	X	X
Bruce	Martin	JASCO Applied Sciences	X	X
Laura	McKay	Virginia Coastal Zone Management program	X	X
Jennifer	Miksis-Olds	UNH	X	X
Laura	Morse	Orsted	X	X
Anita	Murray	Wildlife Conservation Society	X	X
Nick	Napoli	NROC		X
Douglas	Nowacek	Duke		X
Chris	Orphanides	NOAA Fisheries	X	
Susan	Parks	Syracuse University	X	X
Robert	Pauline	noaa.gov	X	
Kelsey	Potlock	NMFS	X	X
Kate	Press	NYSERDA	X	
Cynthia	Pyć	Vineyard Wind	X	X
Reneé	Reilly	NJDEP	X	X
Melinda	Rekdahl	WCS	X	X
Aaron	Rice	Cornell University	X	X
Meghan	Rickard	NYSDEC	X	X
Jason	Roberts	Duke University	X	X
Howard	Rosenbaum	Wildlife Conservation Society	X	X
Jordan	Rutland	BOEM (OREP)	X	X
Amy	Scholik-Schlomer	NOAA Fisheries	X	X
Emily	Shumchenia	RWSE	X	X

Nick	Sisson	NOAA Fisheries	X	X
John	Spiesberger	Scientific Innovations, Inc.	X	
Erica	Staaterman	BOEM	X	X
Erin	Summers	Maine Department of Marine Resources	X	X
John	Swenarton	Dominion Energy	X	X
Len	Thomas	University of St Andrews	X	X
Dominic	Tollit	SMRU Consulting	X	X
Sofie	Van Parijs	NOAA	X	X
Prassede	Vella	MA CZM	X	
Kathy	Vigness-Raposa	INSPIRE Environmental	X	X
Carrie	Wall	CU/NCEI	X	X
Stephanie	Watwood	Navy	X	X
Ann	Zoidis	Tetra Tech	X	X

APPENDIX C WORKSHOP PRESENTATIONS

C1. Passive Acoustic Monitoring along the Atlantic Seaboard (Patrick Field)

C12. Passive Acoustic Monitoring During Offshore Oil and Gas Exploration Activities in Arctic Alaska 2006 -2015 (Darren Ireland)

C44. Passive Acoustic Monitoring for Offshore Wind: Applications for Marine Mammals (Sofie Van Parijs)

C63. Current PAM deployments (Emily Shumchenia)

C71. Day 2 Introduction: Underlying Key Enterprise (Patrick Field)

C78. Data Collection to Data Visualization (Carrie Wall-Bell)


PAM Workshop #2
Passive Acoustic Monitoring along the Atlantic Seaboard
March 7 and March 9
12:30pm-5pm ET

PAM Workshop Logistics

Welcome!

The meeting will begin shortly.

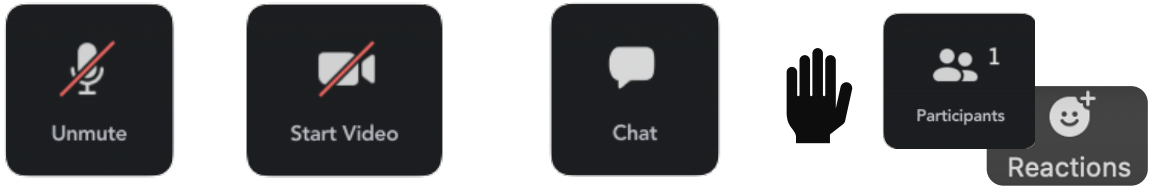
Technical Difficulties?

- Use the Zoom Chat,
- or Nate Lash, nlash@cbi.org

Instructions for Getting Started:

- ❑ **Rename yourself and add your Affiliation (e.g., Pat Field, CBI)**
- ❑ **Use only <u>one</u> audio source** – either computer or phone.
- ❑ **Wear headsets / earbuds** to cut down on ambient noise.
- ❑ **Please MUTE yourself** at all times, except when speaking.
- ❑ **Orient yourself** to Zoom meeting controls**:**

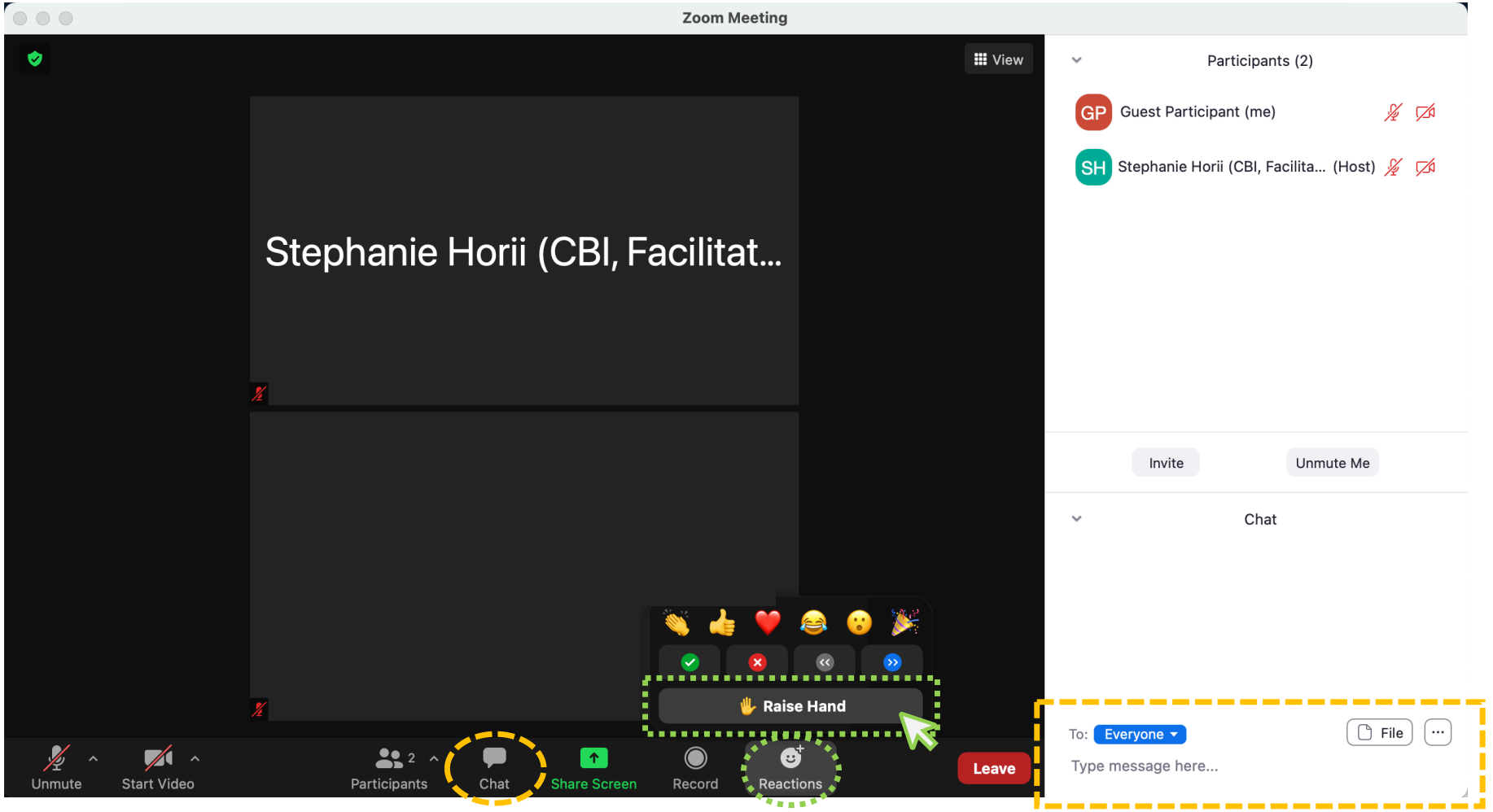
Unmute/Mute **Start Video** **Zoom Chat** **Raise Hand (via Participants or Reactions)**



How you can participate today:

- **Verbal:** Get into the queue w/ Raise Hand function
- **Written:** Submit questions in Chat Box

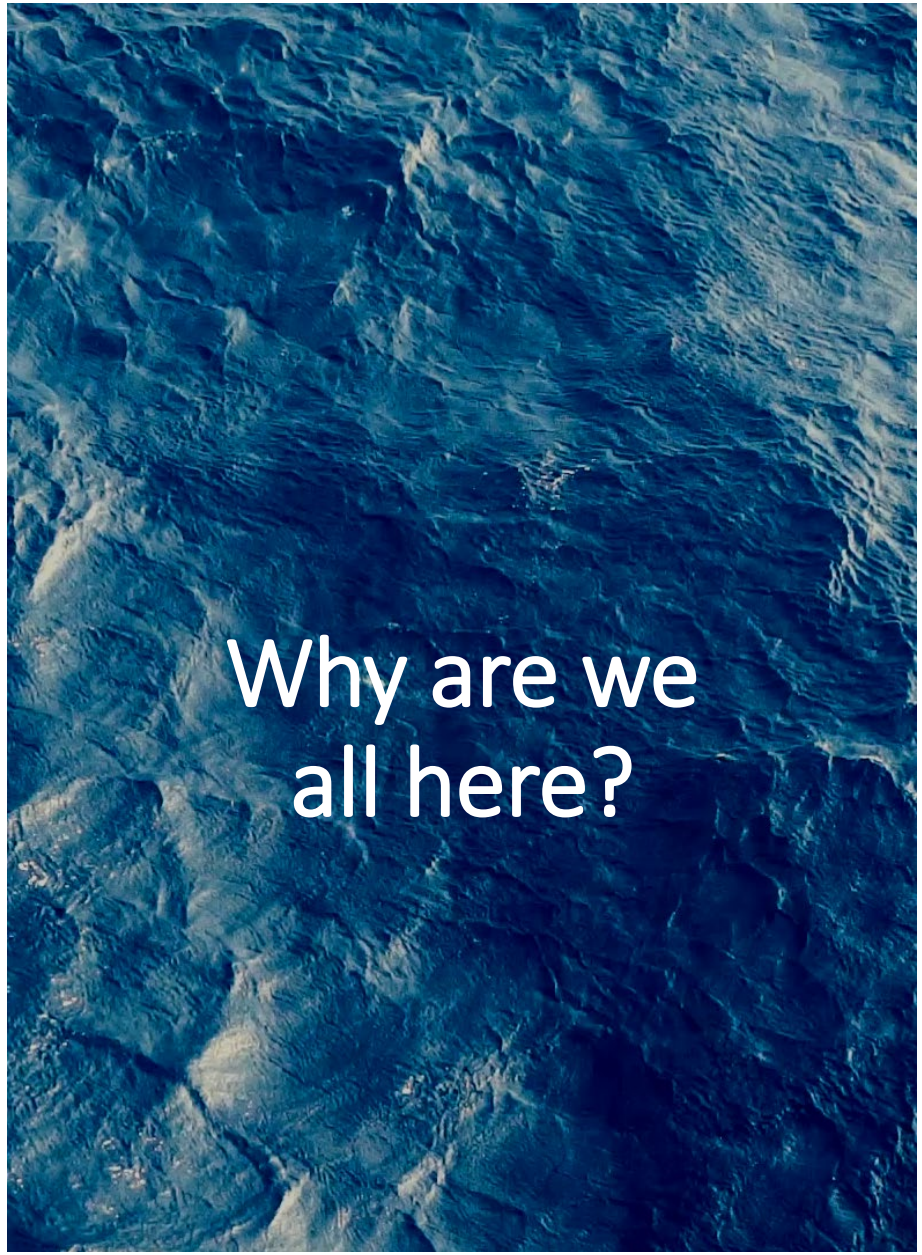
Zoom Orientation



(older versions of Zoom may require using the Participants button to find the Raise Hand icon)

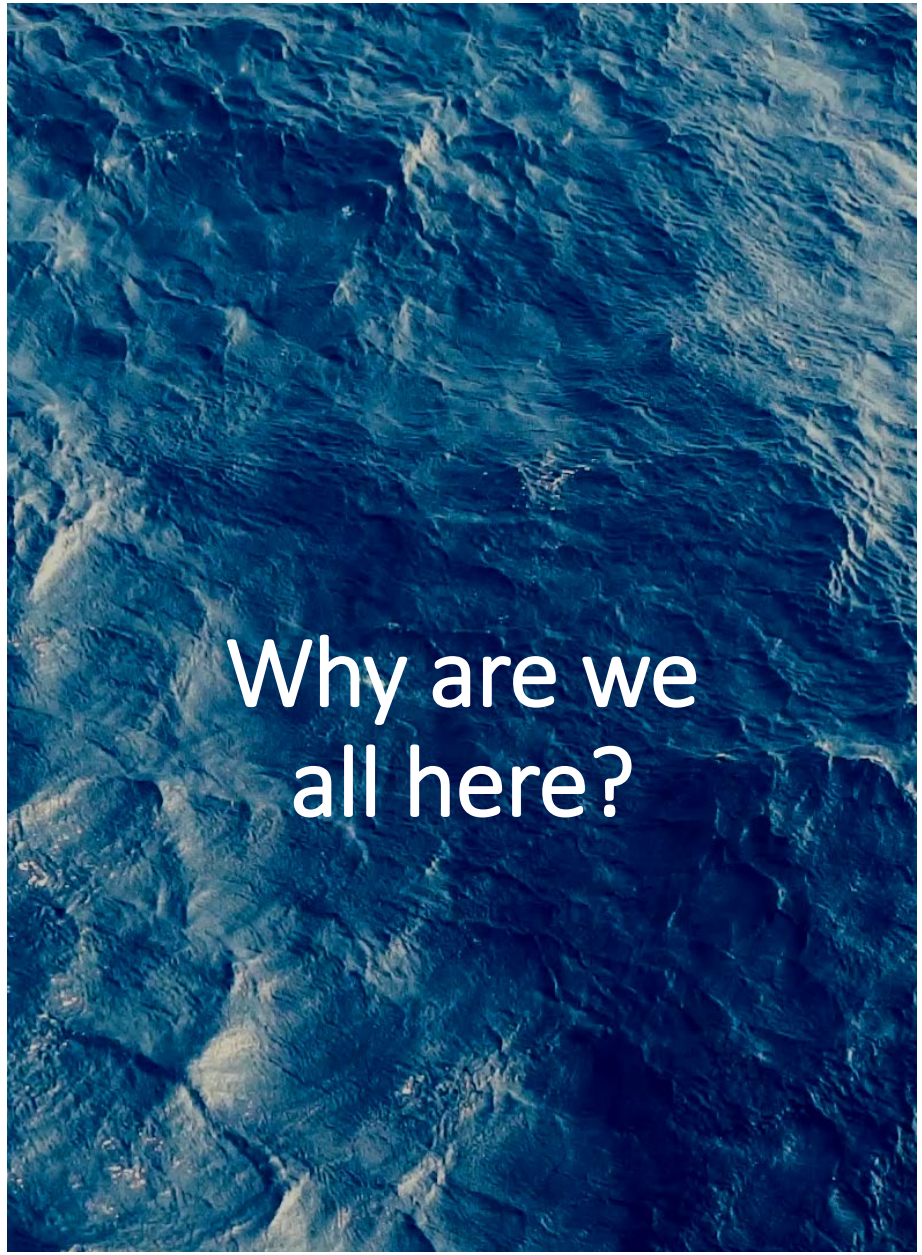
- Listen and learn
- Engage please!
- Robust conversation welcome; with mutual respect
- Focus on the science and the technical – not policy
- Leave your emails, napping, laundry (ok, maybe laundry) and other work for breaks
- Feel free to snack while we work
- One person speak at a time

C4



Who is “we”?

- Second BOEM-funded workshop series on this topic (more in a minute)
- CBI coordination and facilitation, with RWSE and multi-sector workshop planning team
- Invitations to PAM experts; industry members, consultants, states, federal agencies
- RWSE Marine Mammal Subcommittee



To build on recent workshops:

- June 2021 Workshop **“Improving Monitoring, Data Consistency, Archiving, and Access for Improved Regional Integration of Renewable Energy Science”**

- 2020 New York Bight Passive Acoustic Monitoring Workshop
- 2018 MassCEC Research Framework Workshop
- 2017 BOEM Best Management Practices Workshop for Atlantic Offshore Wind Facilities and Protected Species
- 2016 BOEM Atlantic Ocean Energy and Mineral Science Forum PAM Session

Structure of this Workshop

Day 1 – March 7, 12:30-5pm ET

Session #1: Arctic/Chukchi Sea Case Study and Lessons Learned - Panel Discussion

Session #2: Current and Near-Term PAM Deployment – Panel Discussion & Breakout Groups

Day 2 – March 9, 12:30-5pm ET

Session #3: Data Management – Panel Discussion and Proposed Workflows and Approach

Breakout Groups to discuss and hear feedback on Proposed Workflows and Approach

Multisector work on PAM & RWSE Marine Mammal Science Plan

- States have been meeting to coordinate on PAM deployment logistics
- Developers and federal agencies have met to clarify PAM paper
- RWSE is developing a Marine Mammal Science Plan, with assistance from Marine Mammal Subcommittee

- PAM is one of many tools, should be integrated with other approaches
- The RWSE Marine Mammal Subcommittee is looking to these workshop proceedings for detailed guidance/input on the PAM piece for inclusion in the Science Plan

RWSE Role

Science Plans

- Reflect research needs of the four RWSE Sectors (federal, state, industry, eNGO) with input from experts and research community
- Will include best practices for:
  - Select methods and/or analyses
  - Data and metadata standards
  - Data management, storage, and sharing

Research Support

- Convene experts and stakeholders to advise on project approaches, methods, analyses, uses in decision-making
- Ensure projects are consistent with ongoing research in the region/on the topic
- Ensure projects have access to and follow RWSE best practices

Arctic/Chukchi Sea Marine Mammal Case

Darren Ireland

What lessons might we draw for the US Atlantic Coast?

Panel:

- Cynthia Pyć, Vineyard Wind
- Alexander Conrad, Center for Marine Acoustics, BOEM
- Manuel Castellote, NOAA
- Howard Rosenbaum, Wildlife Conservation Society
- Joel Bell, Navy

Darren Ireland
Sr. Wildlife Biologist, VP

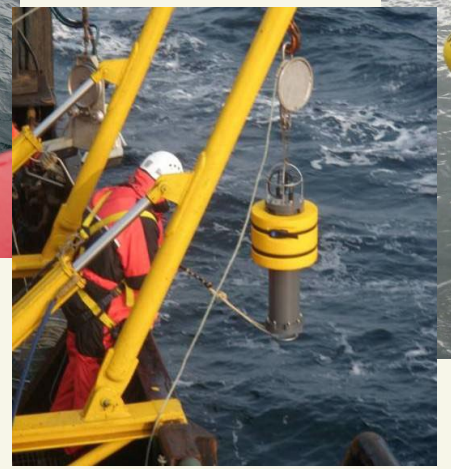
Ecological Research Associates, Inc.

Passive Acoustic Monitoring During Offshore Oil and Gas Exploration Activities in Arctic Alaska

2006 - 2015

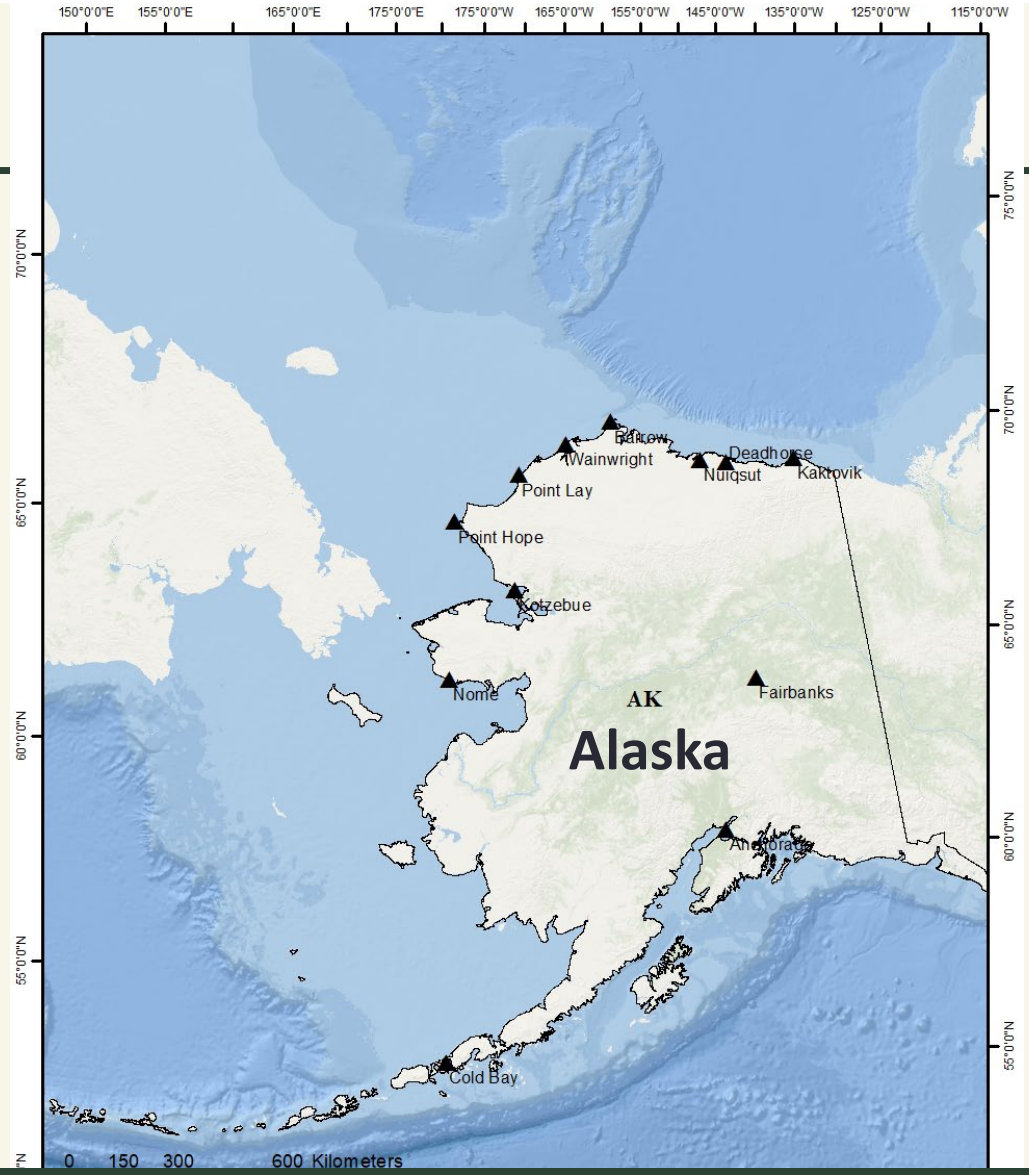
Outline

- Location and Activities
- Monitoring Objectives
- Monitoring Methods
- Selected Results and Lessons Learned



- Work supported by:
  - Shell, ConocoPhillips, Statoil (Equinor), Ion Geophysical, Eni., and others

Location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Fairbanks
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Cold Bay
0 150 300 600 Kilometers

Location


Chukchi Sea
Beaufort Sea
Barrow
Wainwright
Deadhorse
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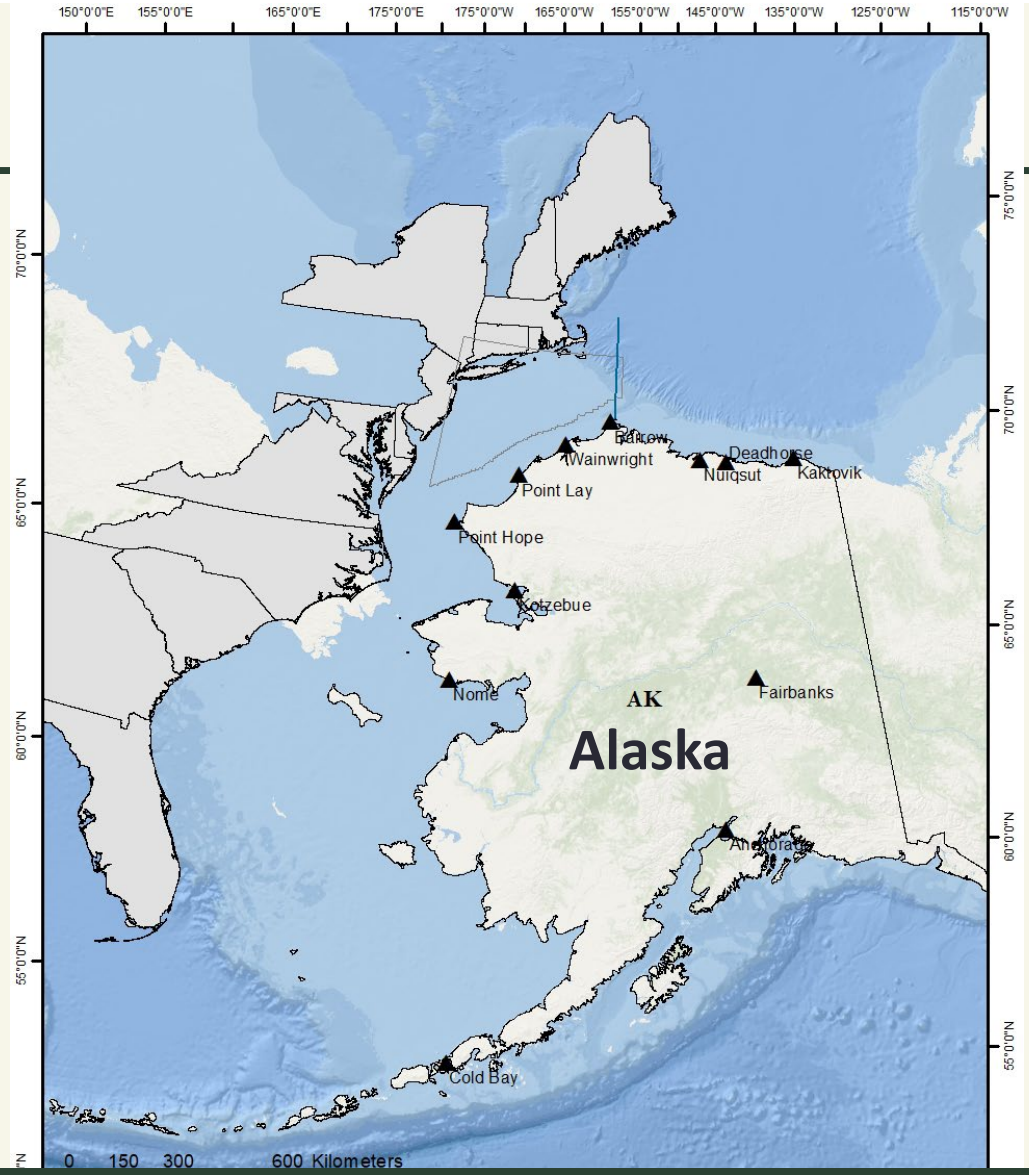
Location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Monitoring Objectives

Mitigation Monitoring

- Minimize and estimate level of potential "take" authorized under the MMPA
  - Observe for marine mammals and implement mitigation
  - Measure sounds produced by the activities
- Avoid potential impacts to subsistence hunting
  - Improve understanding of potential for such impacts

Research Monitoring

- Occurrence
- Distribution
- Seasonal patterns
- Inter-annual variation and associated drivers
  - sea ice, wind, etc.
- Larger scale impacts
  - "over the horizon"
  - Determine received sound levels at which animals show avoidance

Monitoring Methods

Three Categories

- **Vessel-based visual observations**
  - Unaided eyes, 7x50 binoculars
  - “Big Eye” 25x150 binoculars
  - Night Vision, IR
- **Aerial surveys**
  - Visual and photographic
- **Passive acoustics**
  - Sound source/field verification
  - Acoustic detections

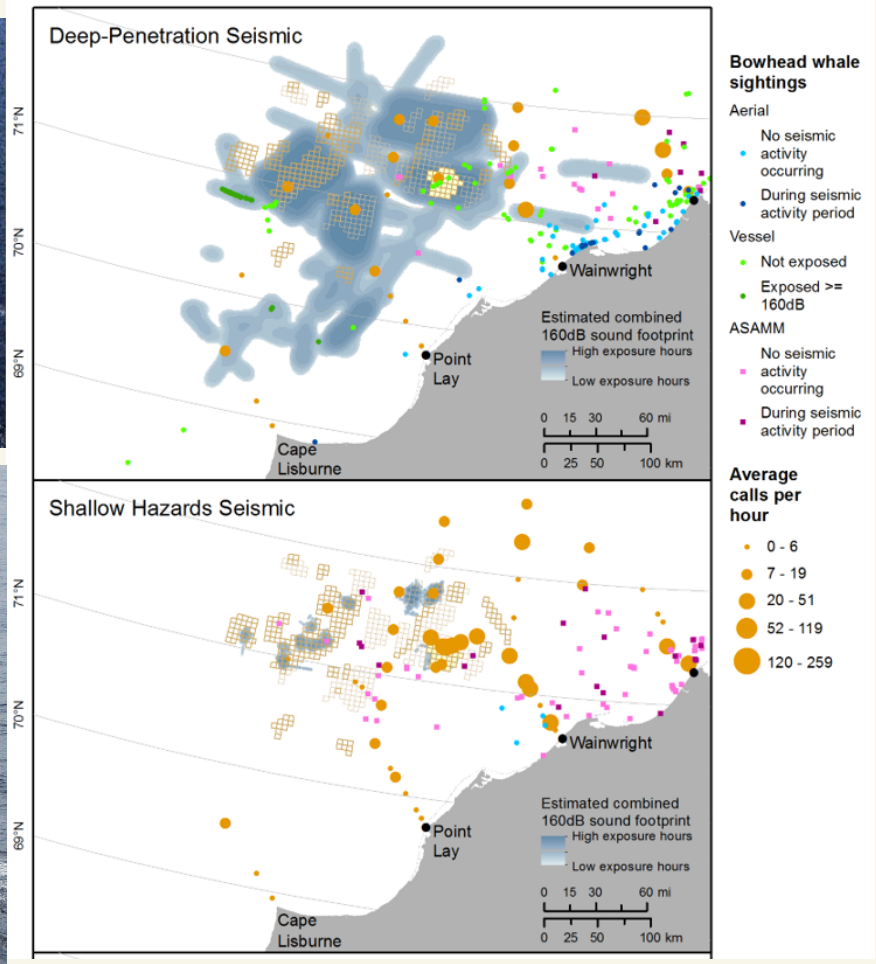
Activities Conducted – Chukchi Sea

Geophysical Surveys

- Deep Penetration Seismic
- High-Resolution Geophysical (HRG)
  - a.k.a. “Shallow Hazards”

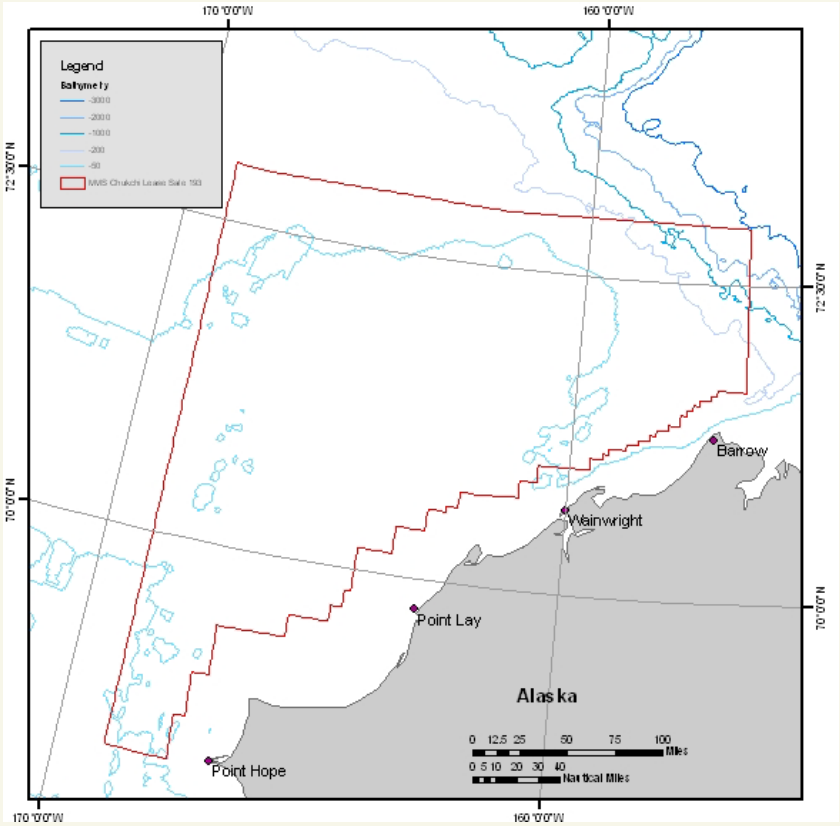
Exploration Drilling

- Drilling
- Mud-line Cellar Excavation
- Anchor Handling
- Support Vessels

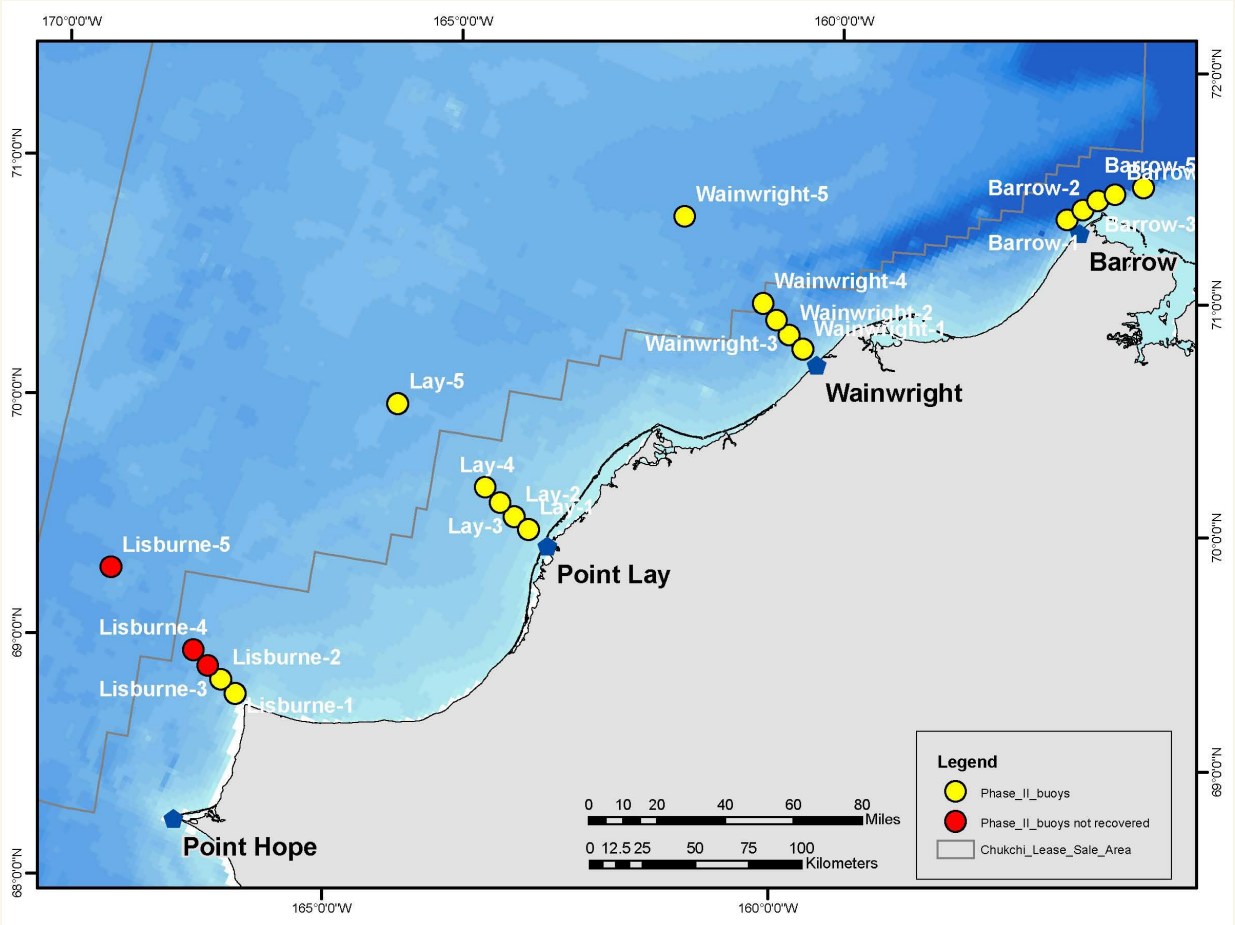


Chukchi Sea PAM Array Origins

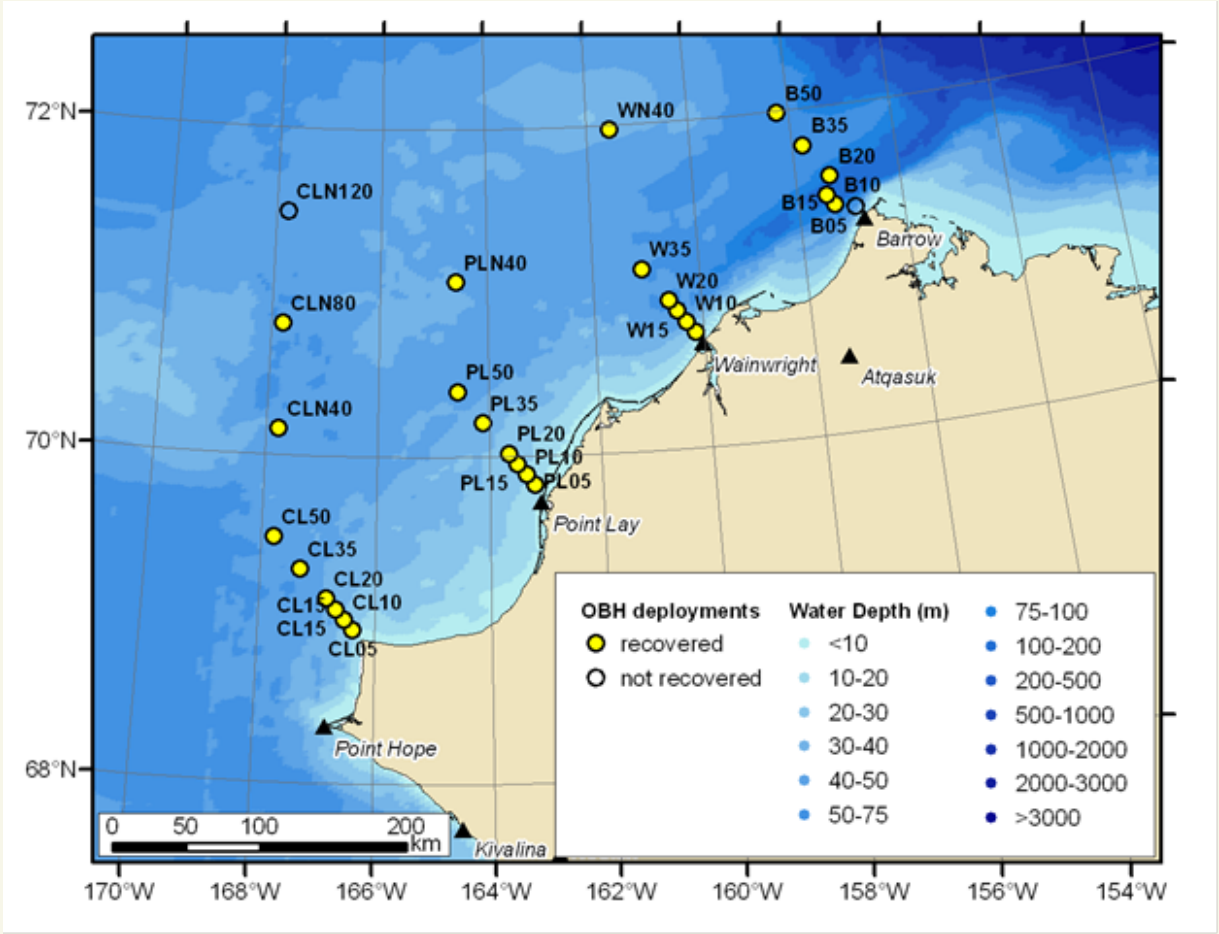
- Primary Concern –> Potential Impacts on Coastal Subsistence Hunting



Chukchi Sea PAM Array Origins



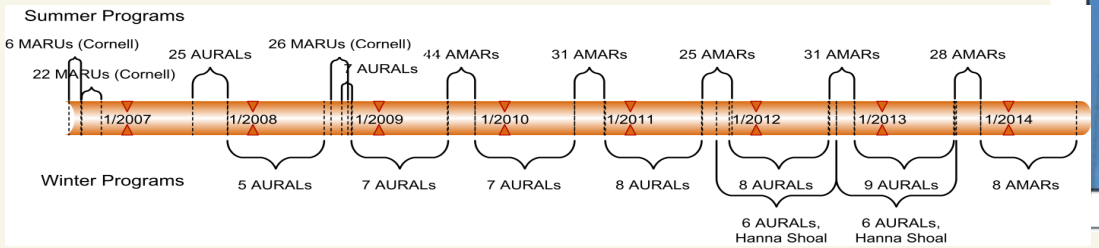
Chukchi Sea PAM Array Origins

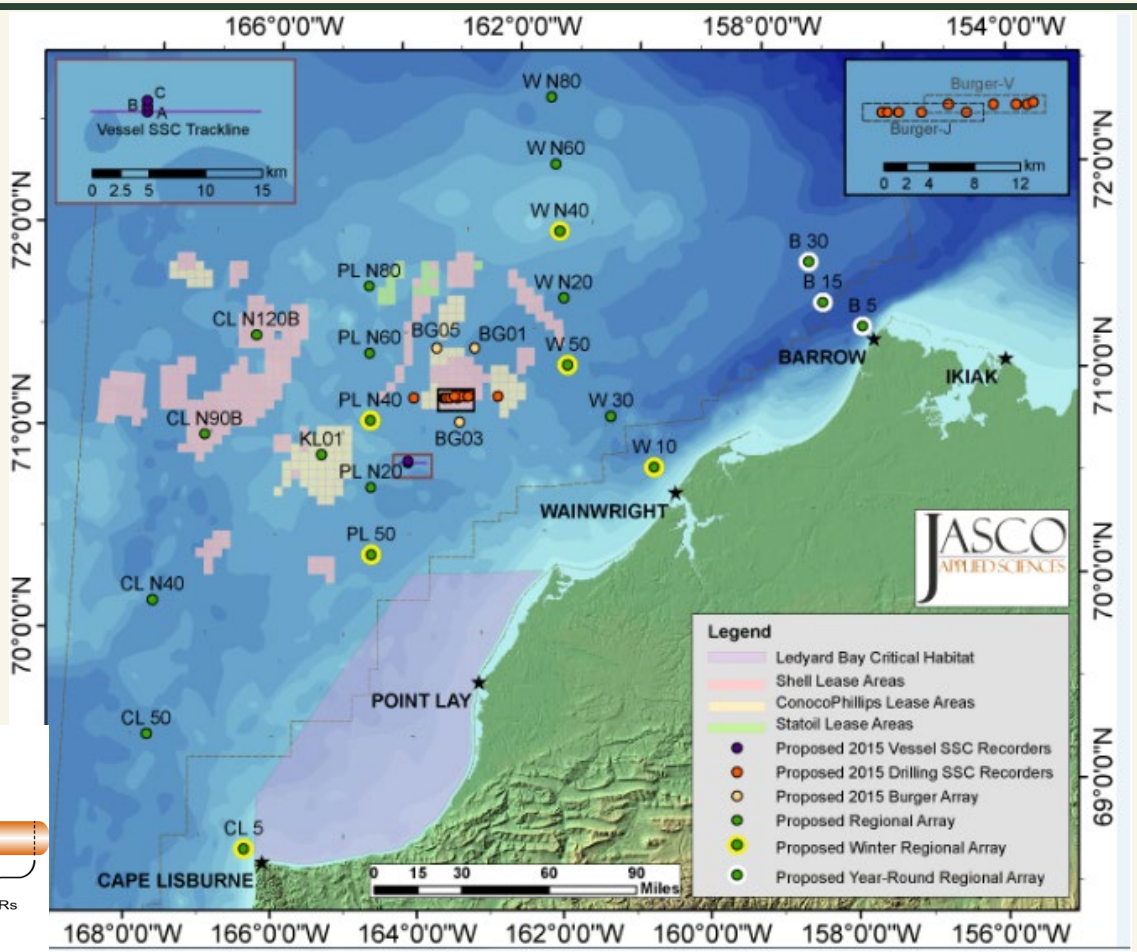


Passive Acoustic Monitoring

Chukchi Sea "Net Array"

- Understand marine mammal presence and received sound levels in subsistence use areas from anthropogenic activities farther offshore
- Understand patterns of distribution and movement
- Understand large-scale acoustic footprint of geophysical survey and drilling activity sounds relative to ambient sounds.

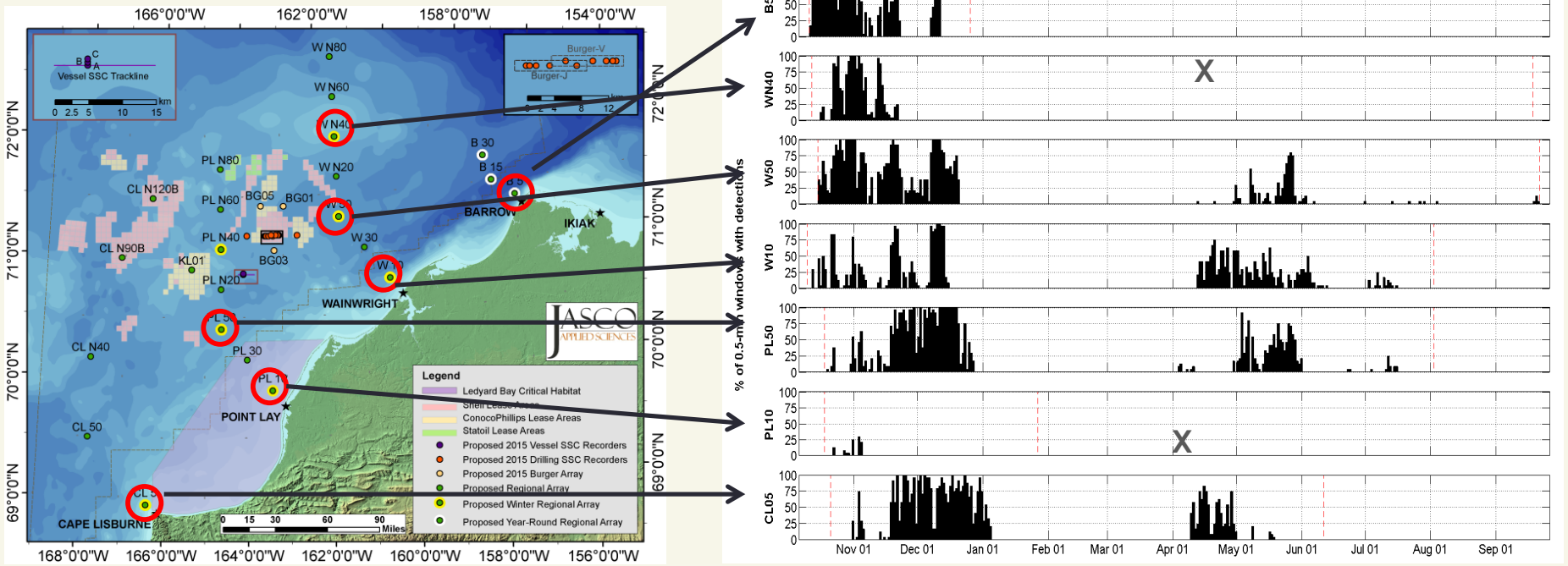




Passive Acoustic Monitoring

Key Results of Chukchi Sea Net Array

- Documented seasonal patterns of presence and large-scale movements
  - Bowhead Fall and Spring Migrations

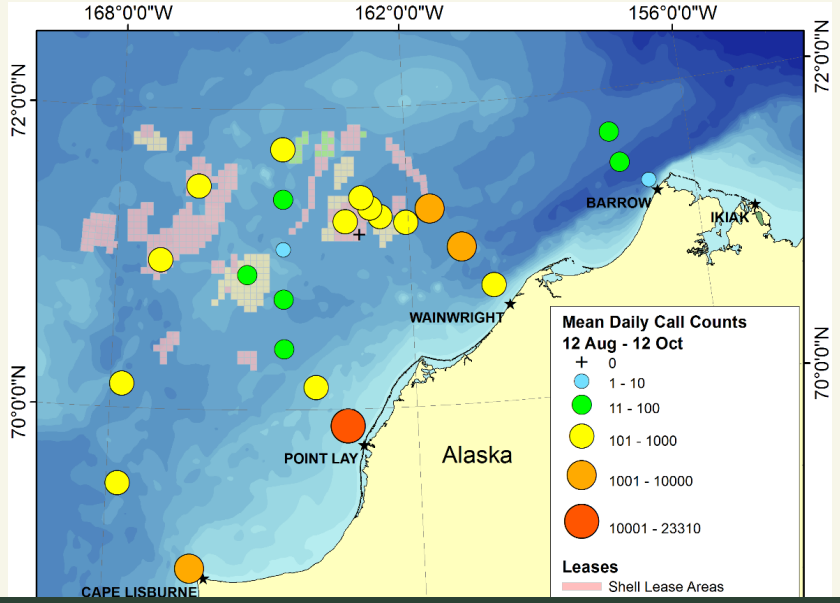


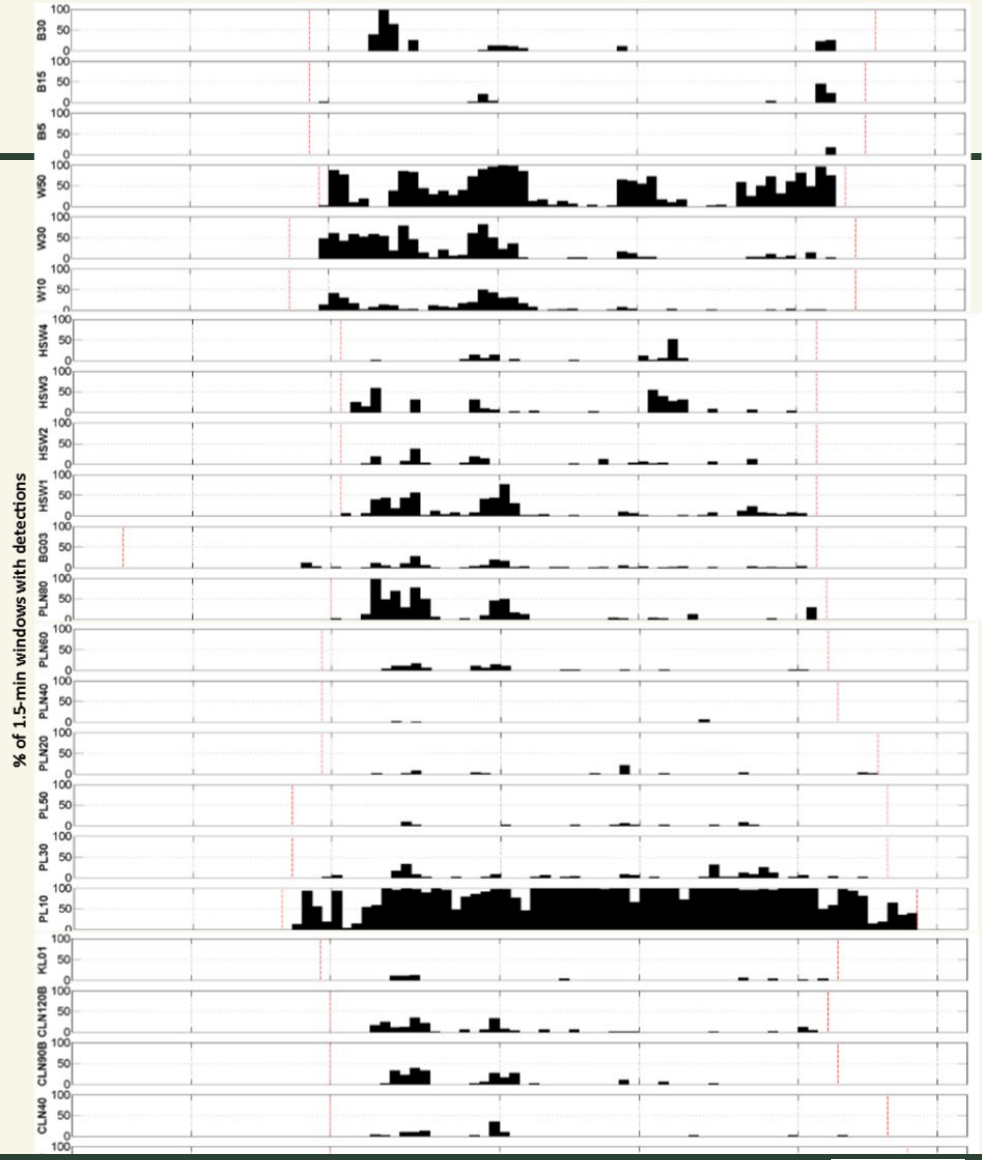
Oct 2013 to Oct 2014

Passive Acoustic Monitoring

Key Results of Chukchi Sea Net Array

- Documented seasonal patterns of presence and large-scale movements
  - Bowhead Fall and Spring Migrations
  - Walrus Fall Migration

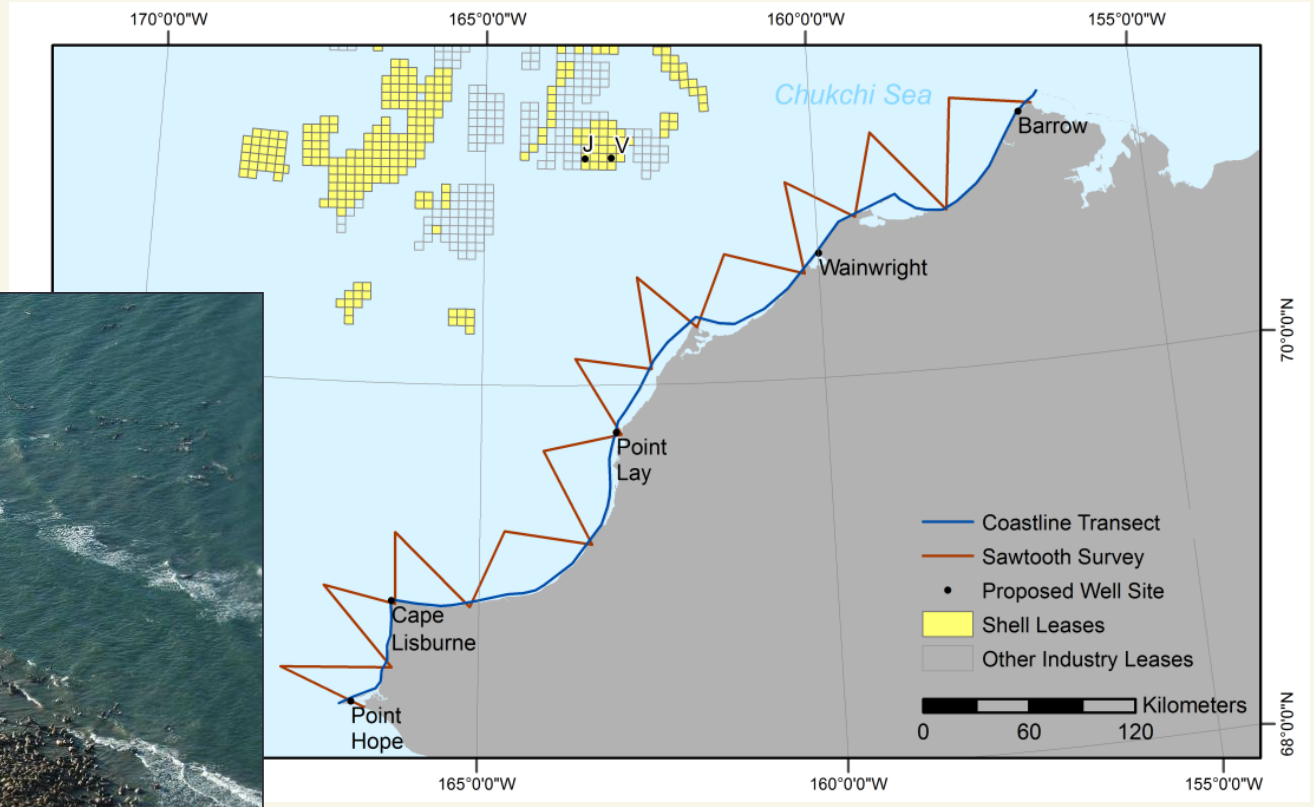




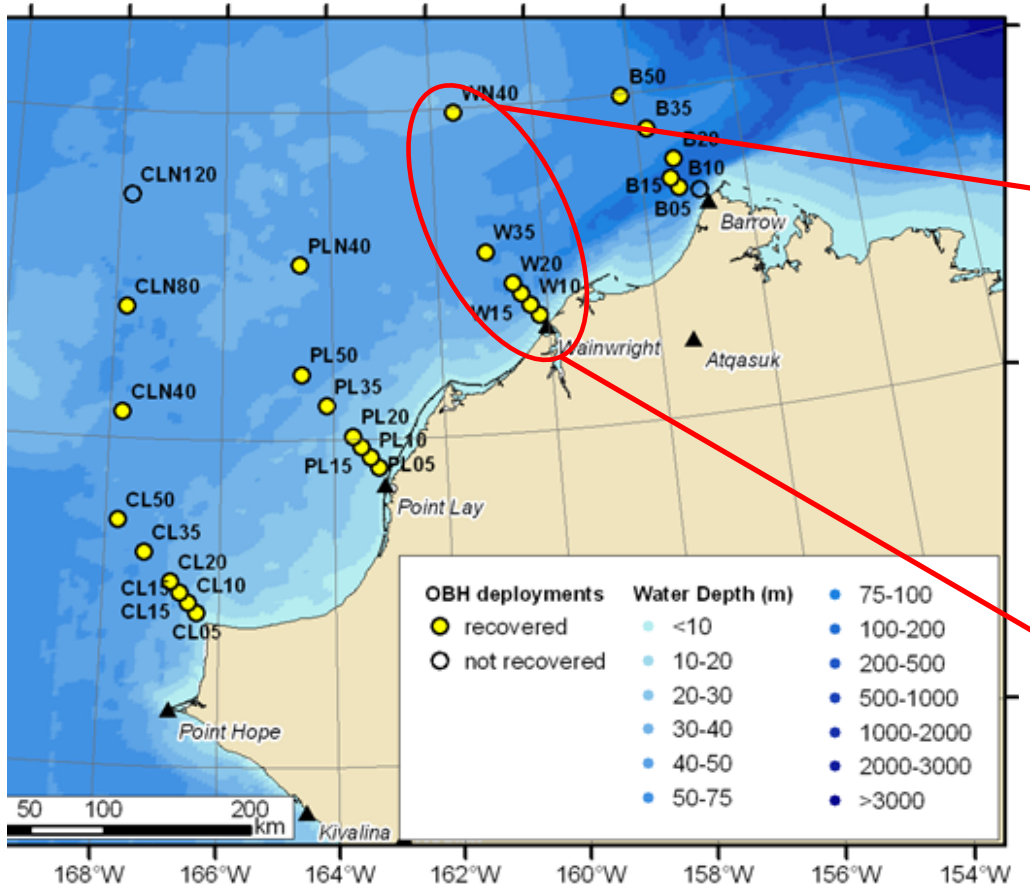
Aerial Surveys

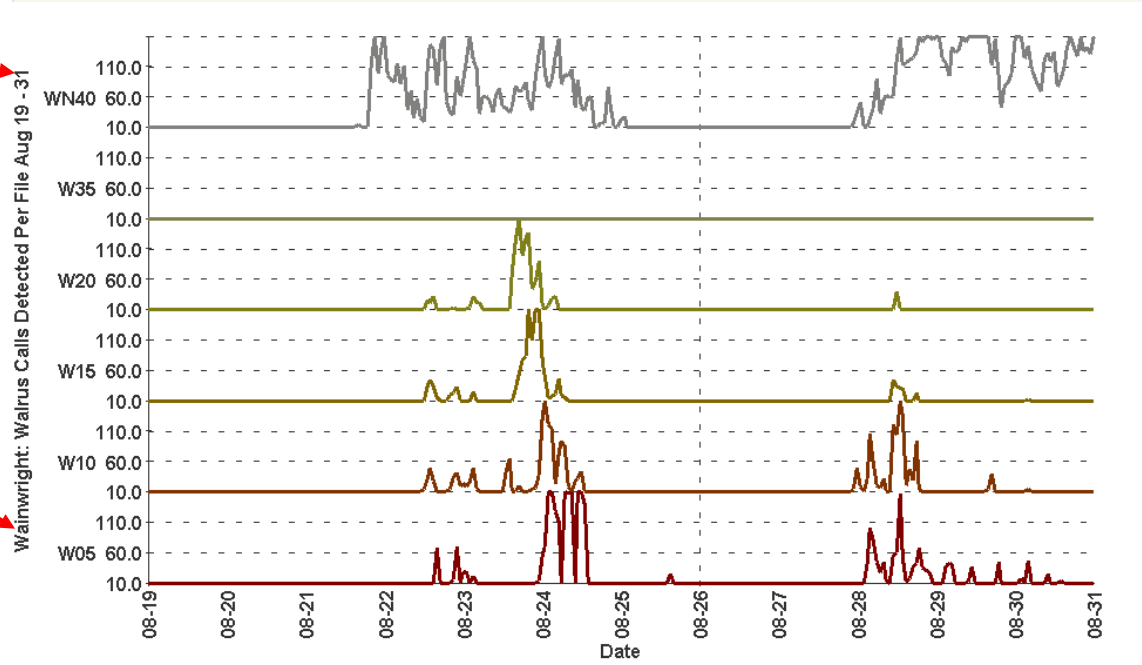
Chukchi Sea Coastal Surveys

- Understand presence of marine mammals in subsistence use areas
  - Look for evidence of avoidance of anthropogenic sounds

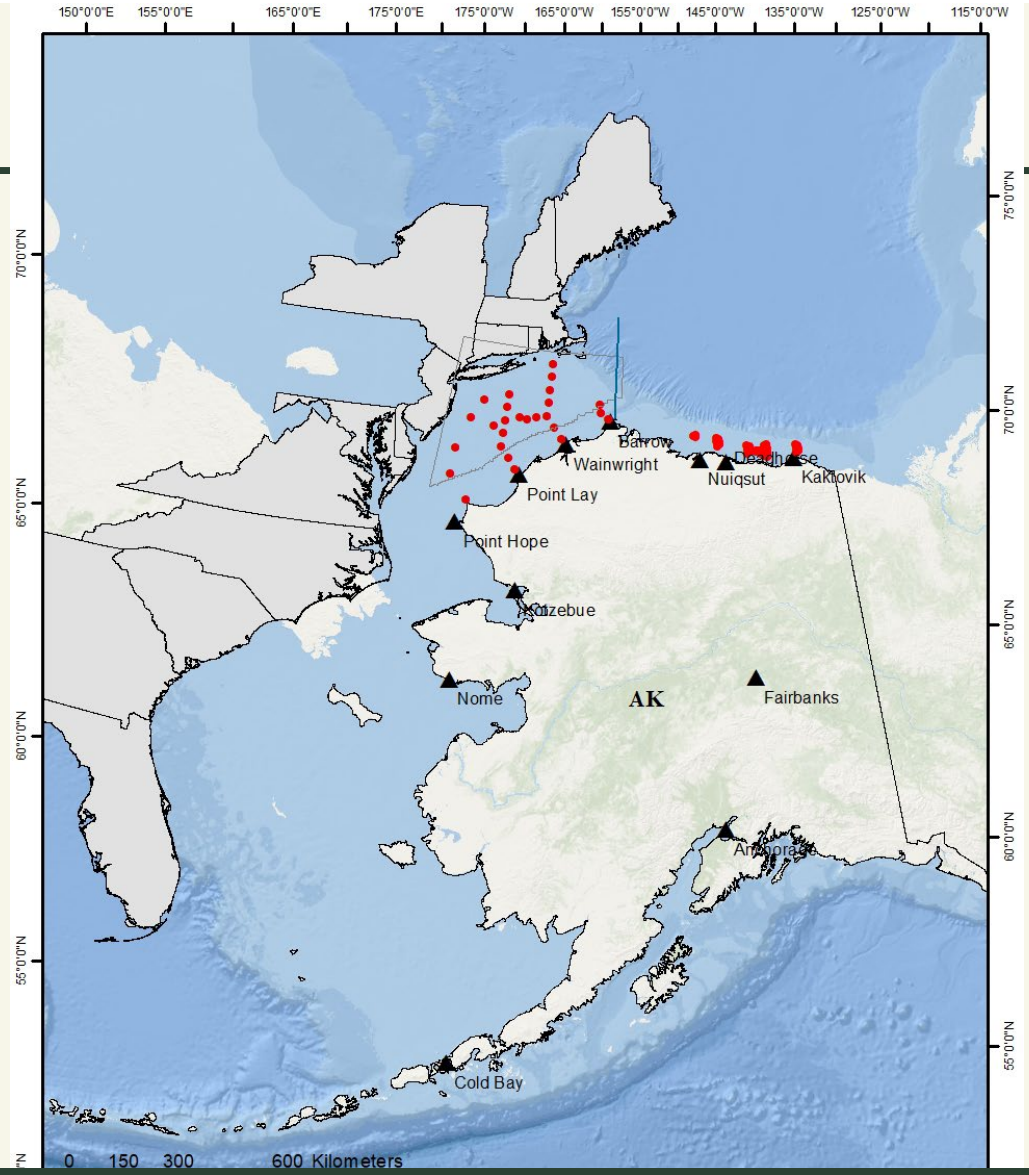


Chukchi Sea PAM Array Origins





Location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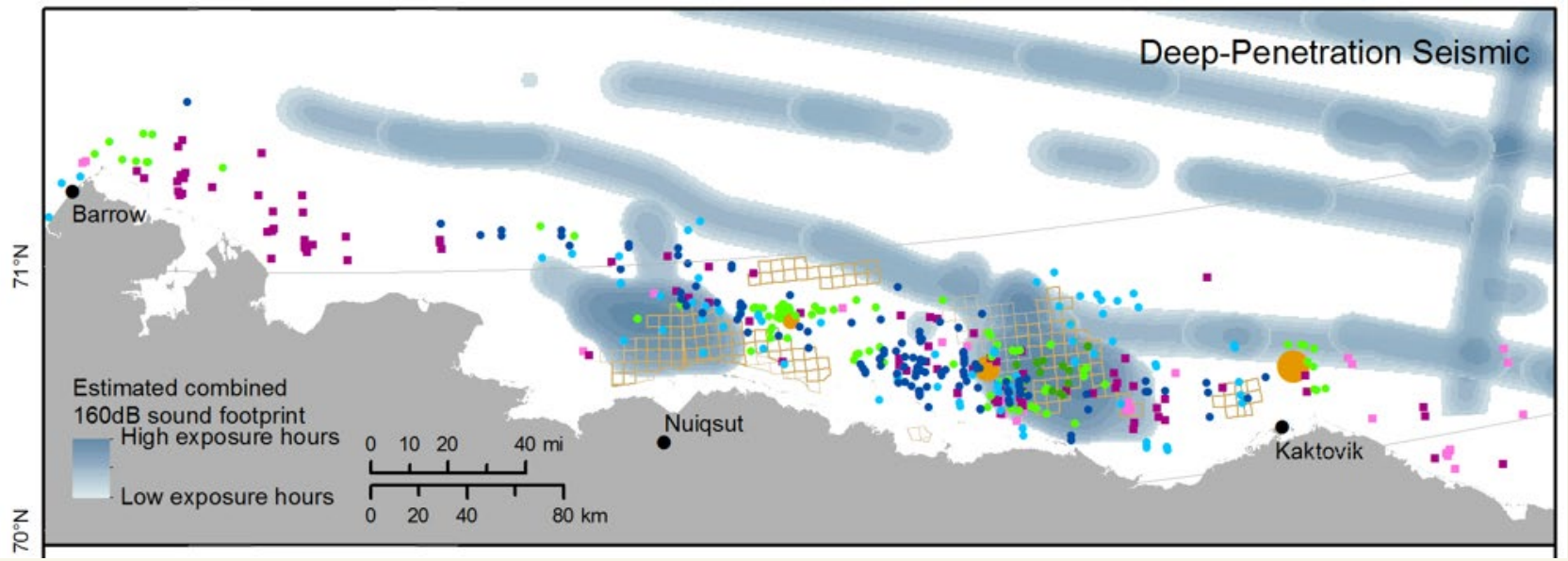
Activities Conducted – Beaufort Sea

Geophysical Surveys

- Deep Penetration Seismic
- High-Resolution Geophysical (HRG)
  - a.k.a. “Shallow Hazards”

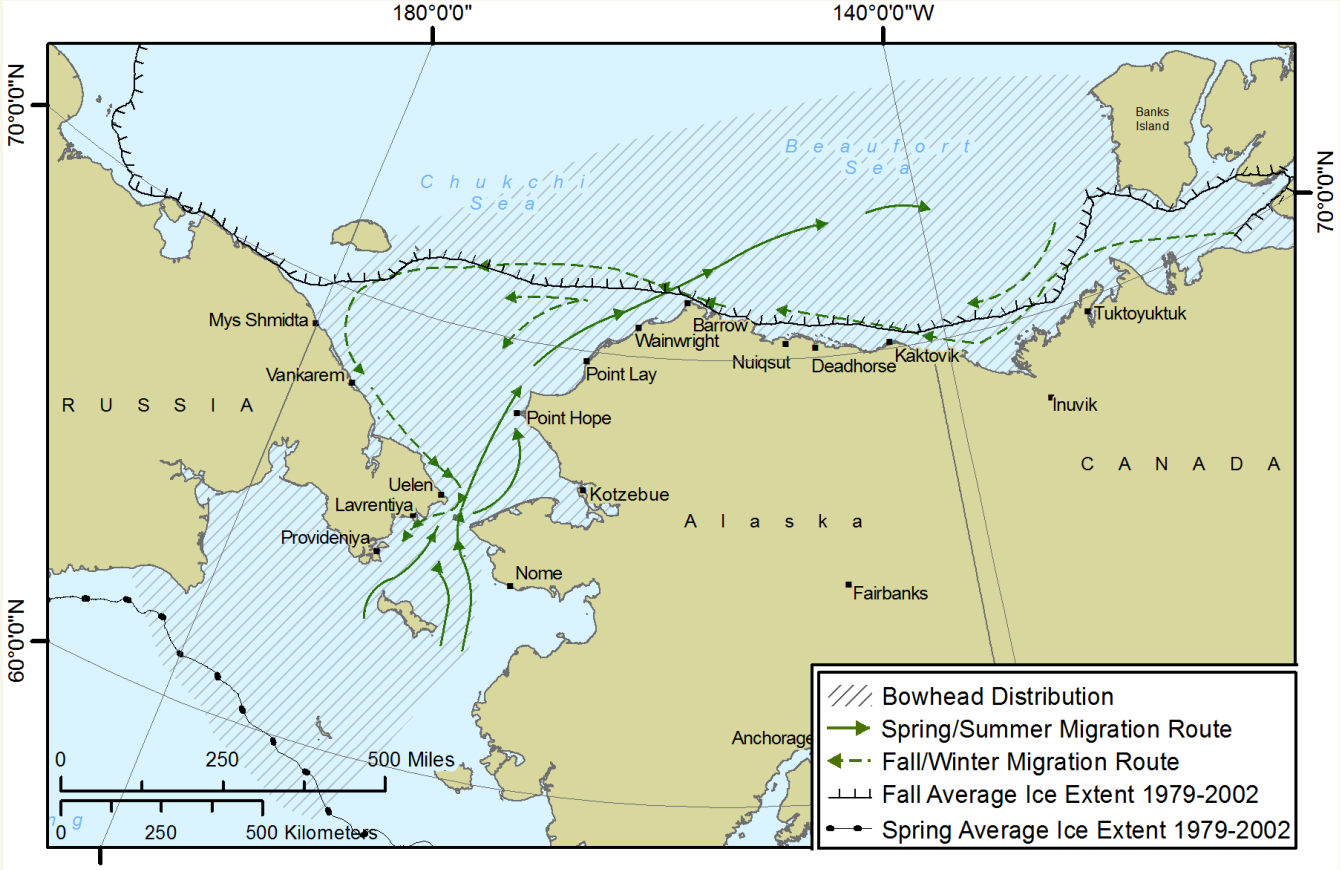
Exploration Drilling

- Drilling
- Mud-line Cellar Excavation
- Anchor Handling
- Support Vessels



Beaufort Sea PAM Array Origins

- Bowhead whale fall migration



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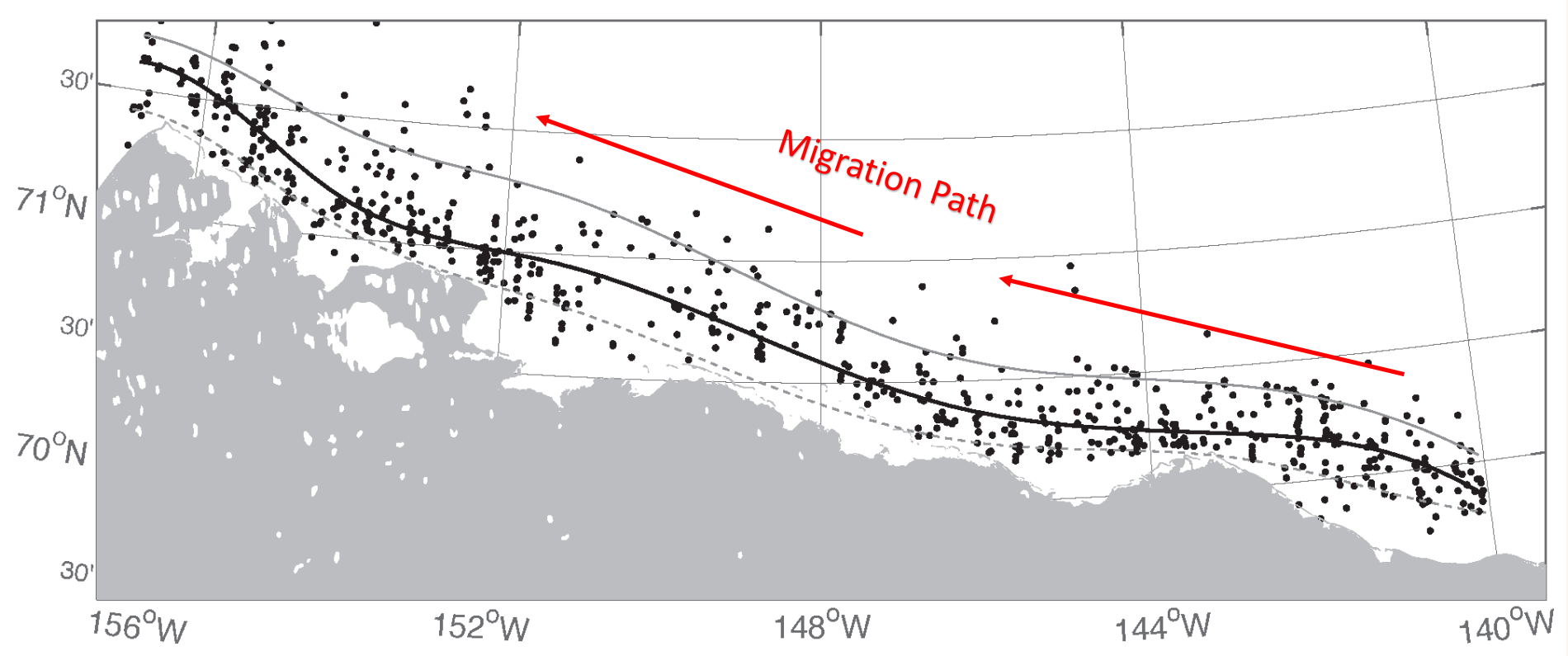
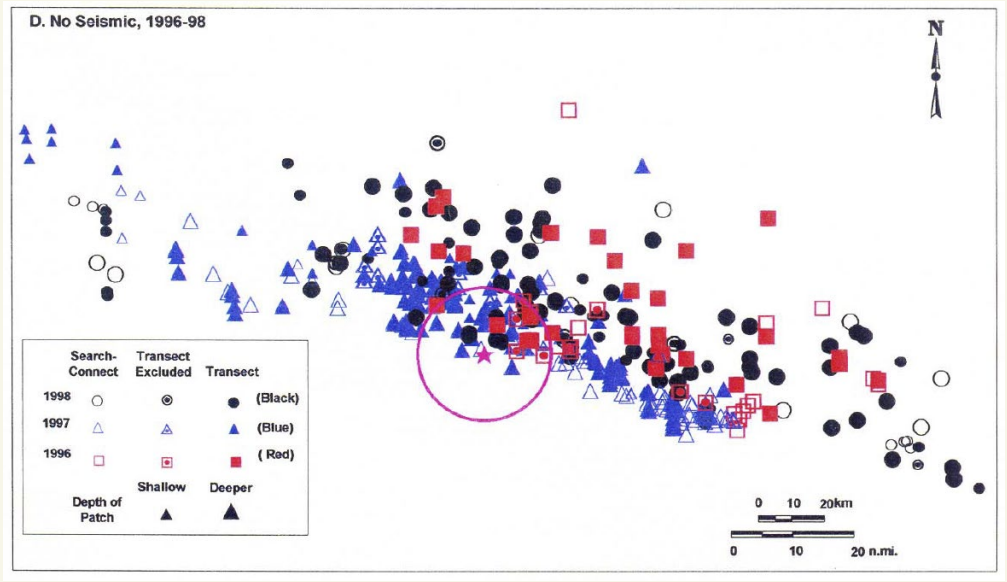
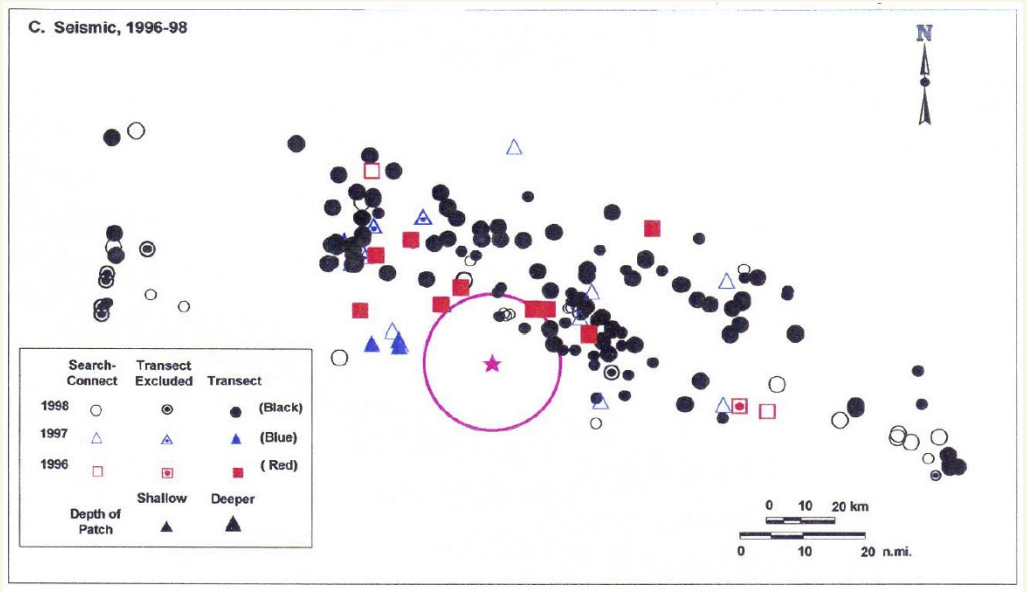


Beaufort Sea PAM Array Origins

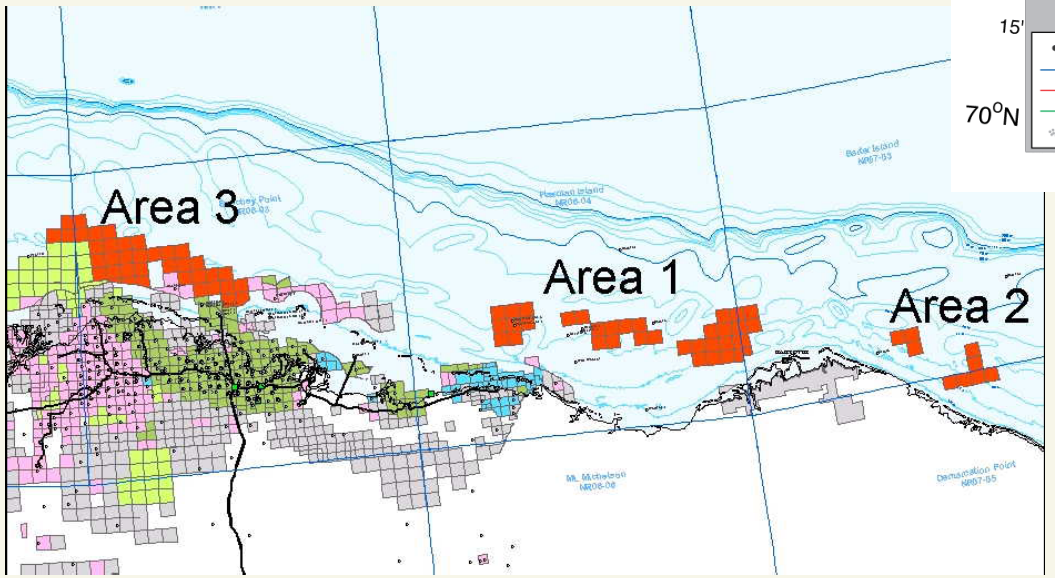
- Primary Concern –> Disturbance of Fall Bowhead Whale Migration
- Questions:
  - How far do whales deflect from their typical migration path
  - How long does it take them to return to their typical migration path

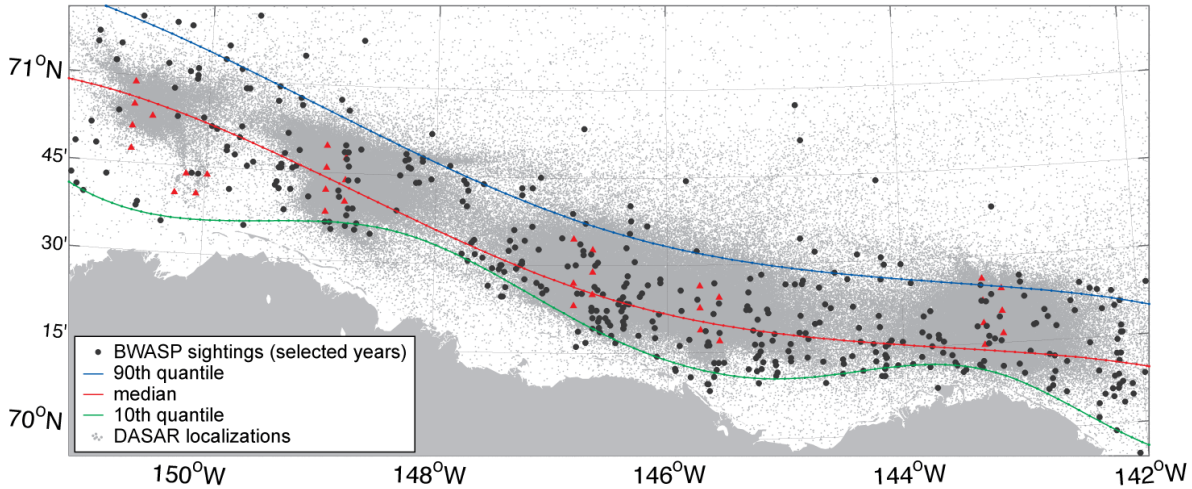


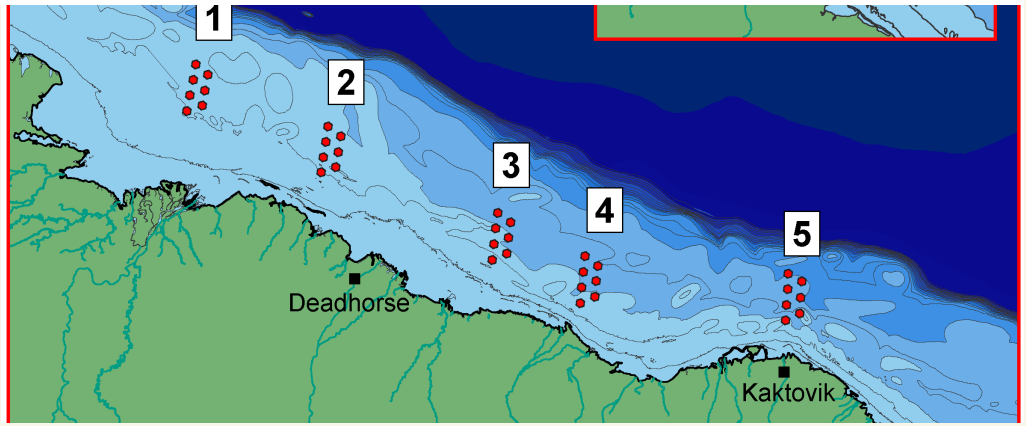


Beaufort Sea PAM Array Origins

- Array Location Determination



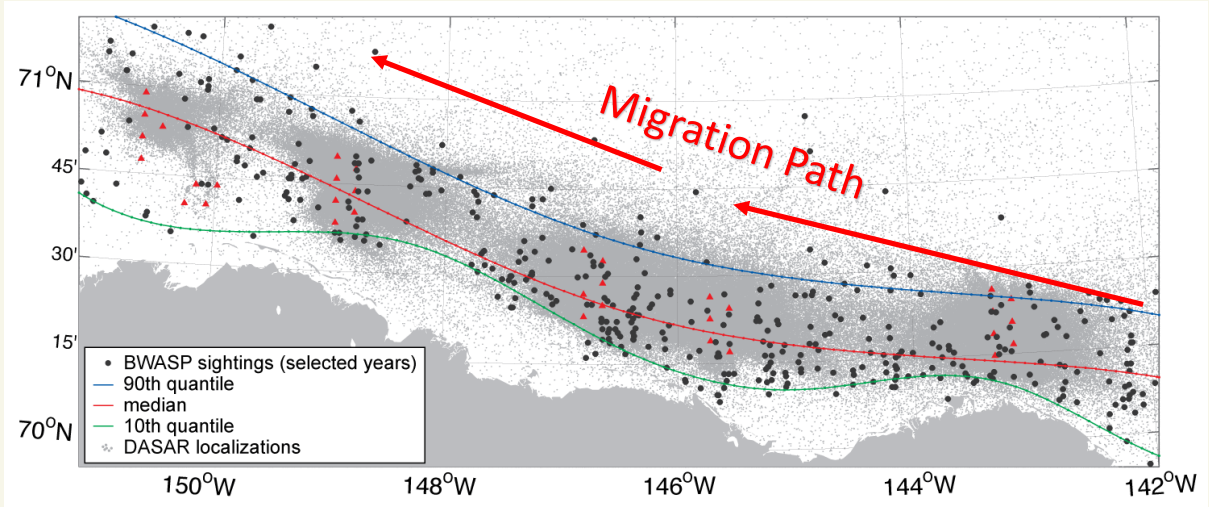


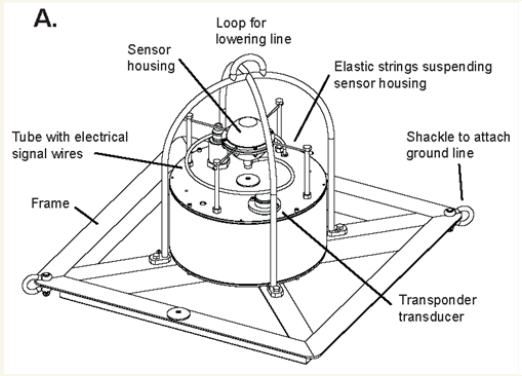


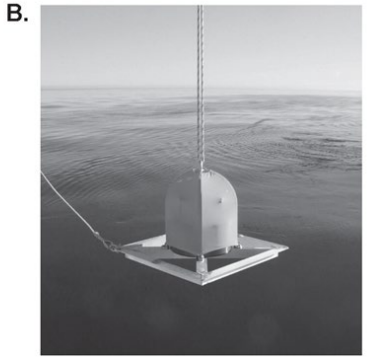
Passive Acoustic Monitoring

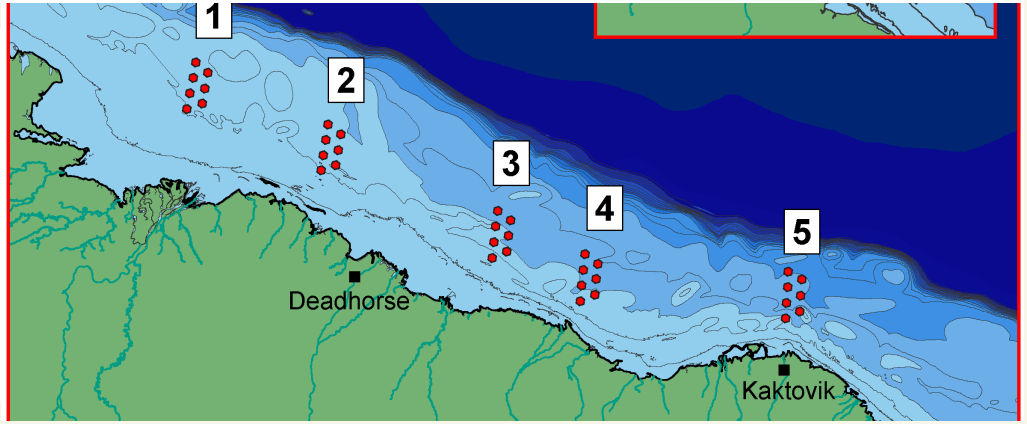
Beaufort Sea

- Document variation in seasonal timing and location of bowhead whale migration
- Detect avoidance response or “deflection” of the migratory path caused by anthropogenic activities and how long “downstream” it persists





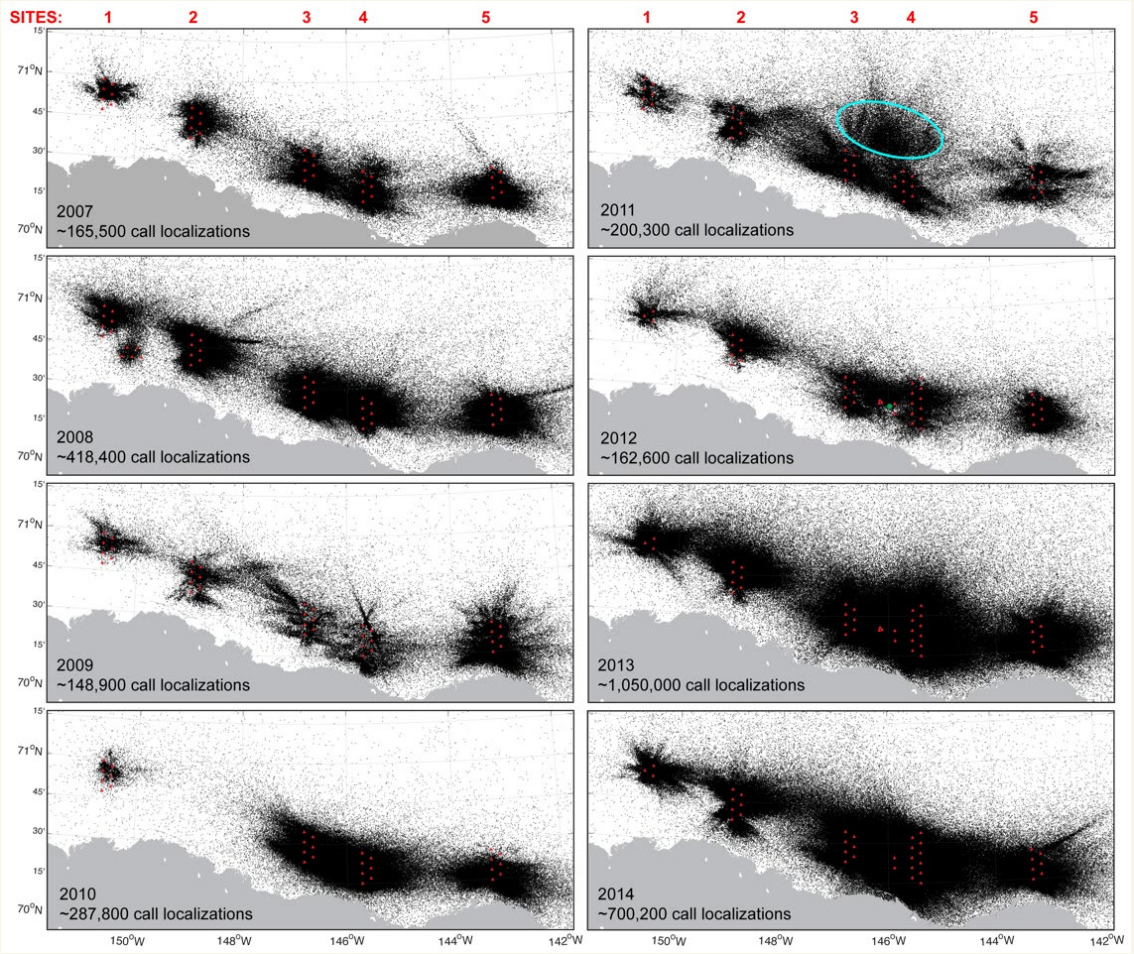




Passive Acoustic Monitoring

Key Results of Beaufort Sea DASAR Arrays

- Document variation in seasonal timing and location of bowhead whale migration
- Detect avoidance response or “deflection” of the migratory path caused by anthropogenic activities and how long “downstream” it persists



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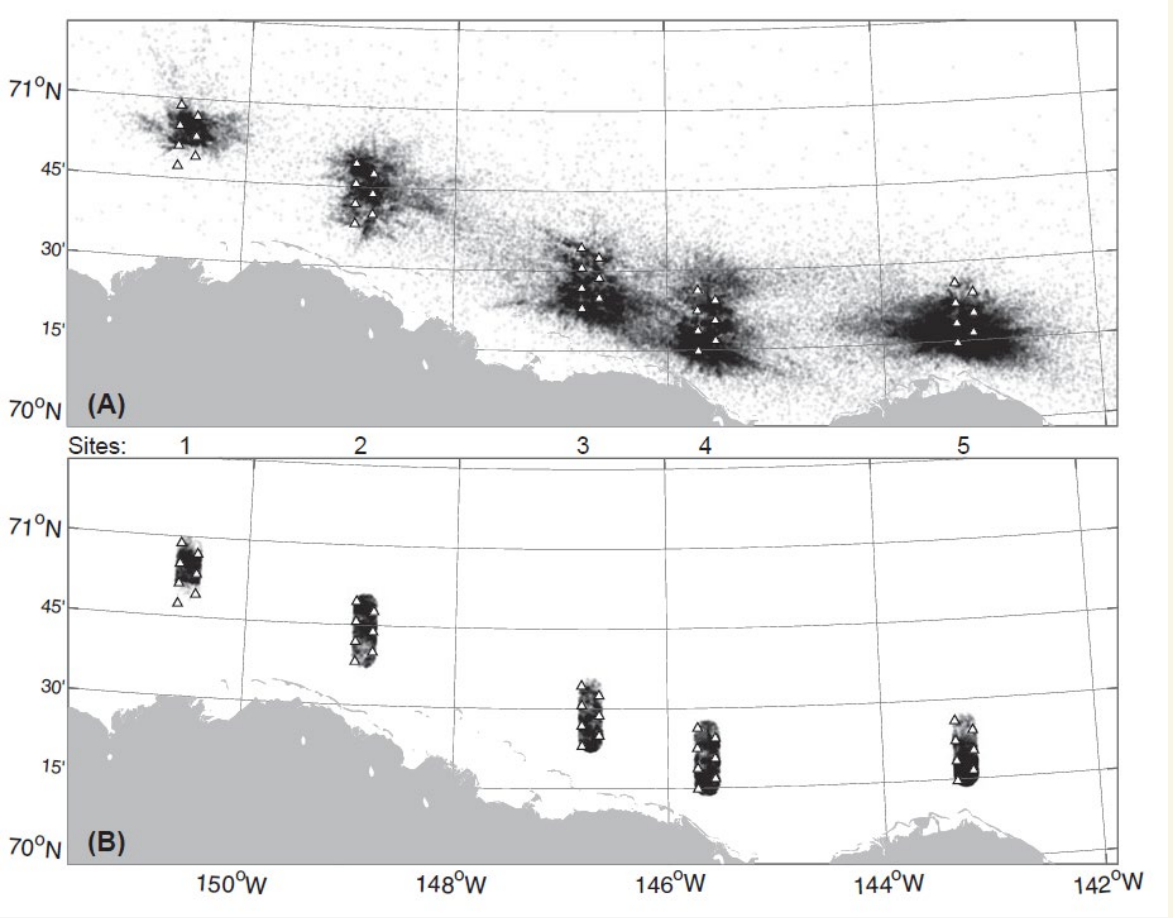

Passive Acoustic Monitoring

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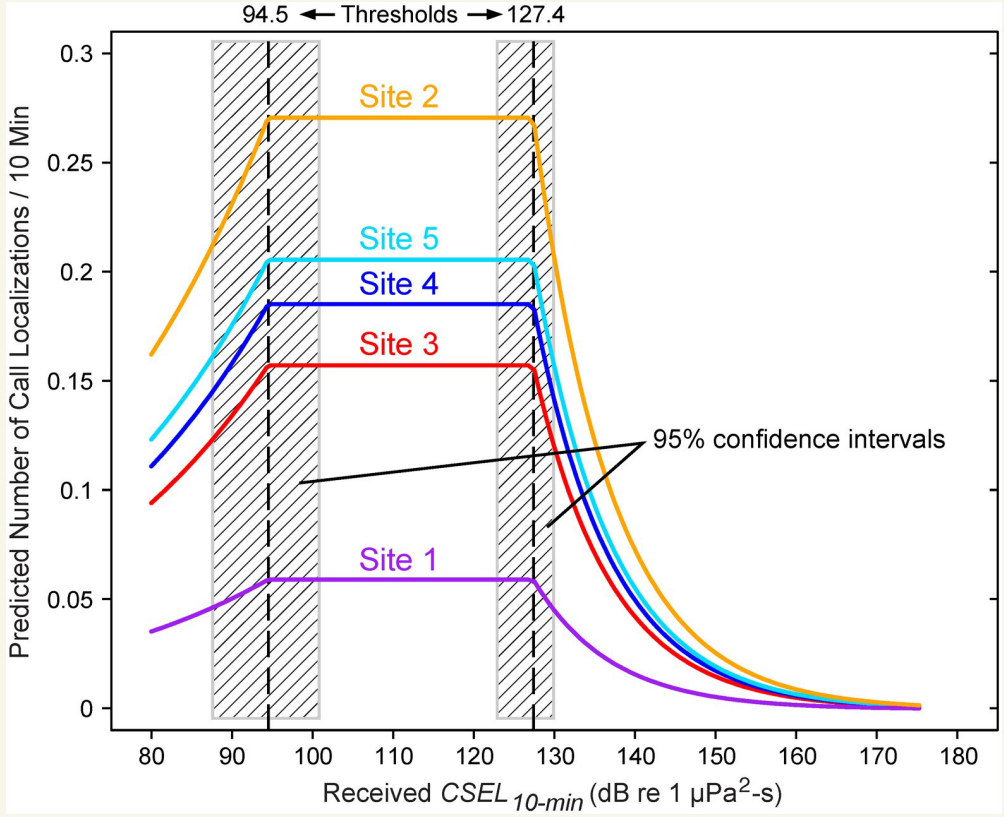
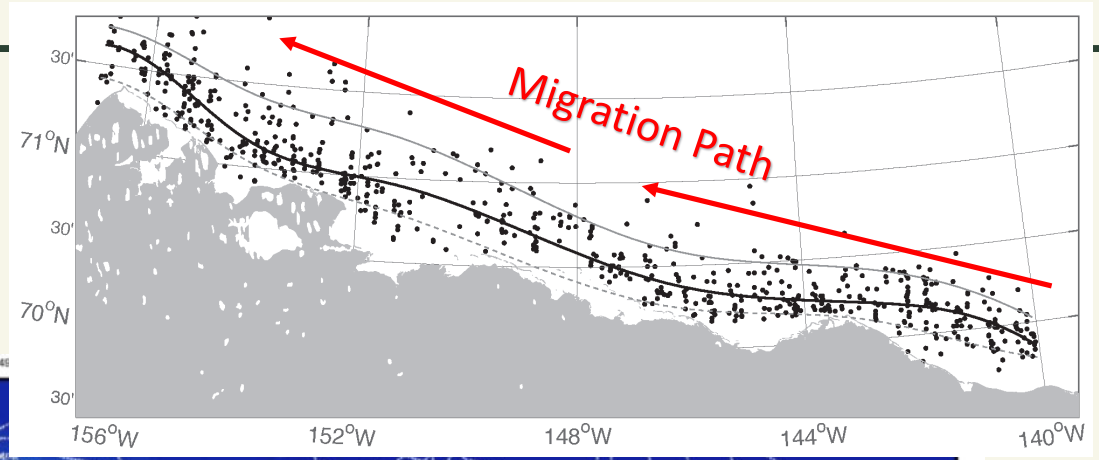
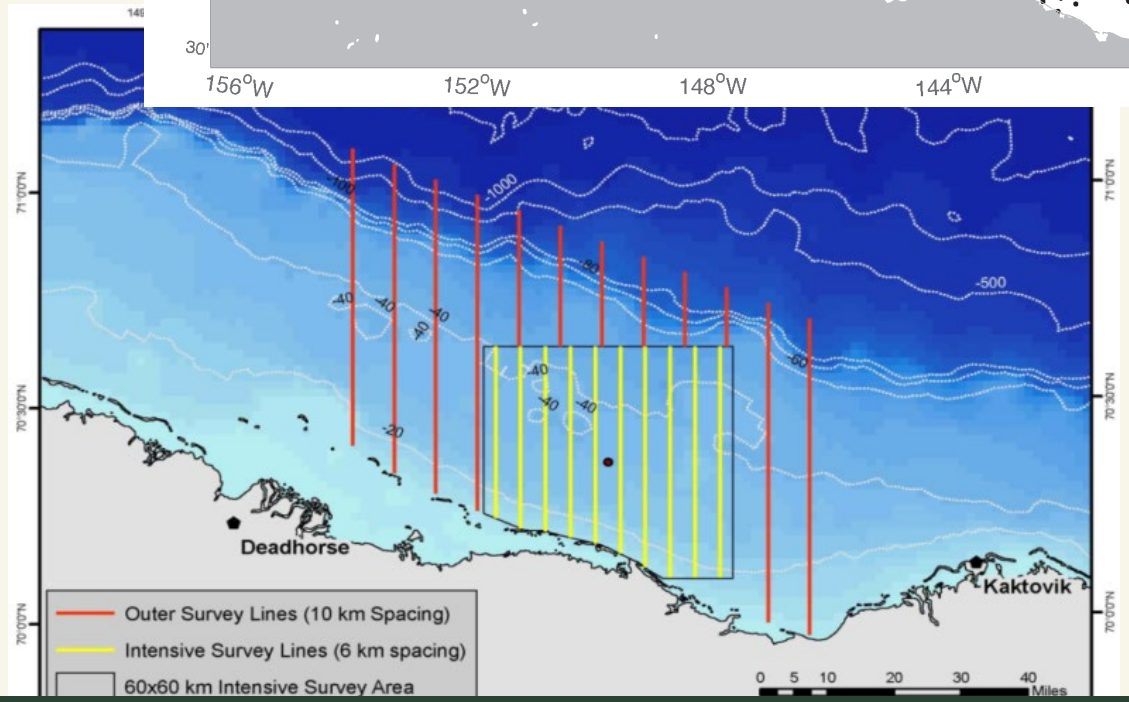


Aerial Surveys

Beaufort Sea Surveys

- Detect avoidance responses to anthropogenic sounds and potential "deflection" of the bowhead migration
  - At what received sound level do bowheads avoid activities?
  - How long does departure from typical migratory route persist?

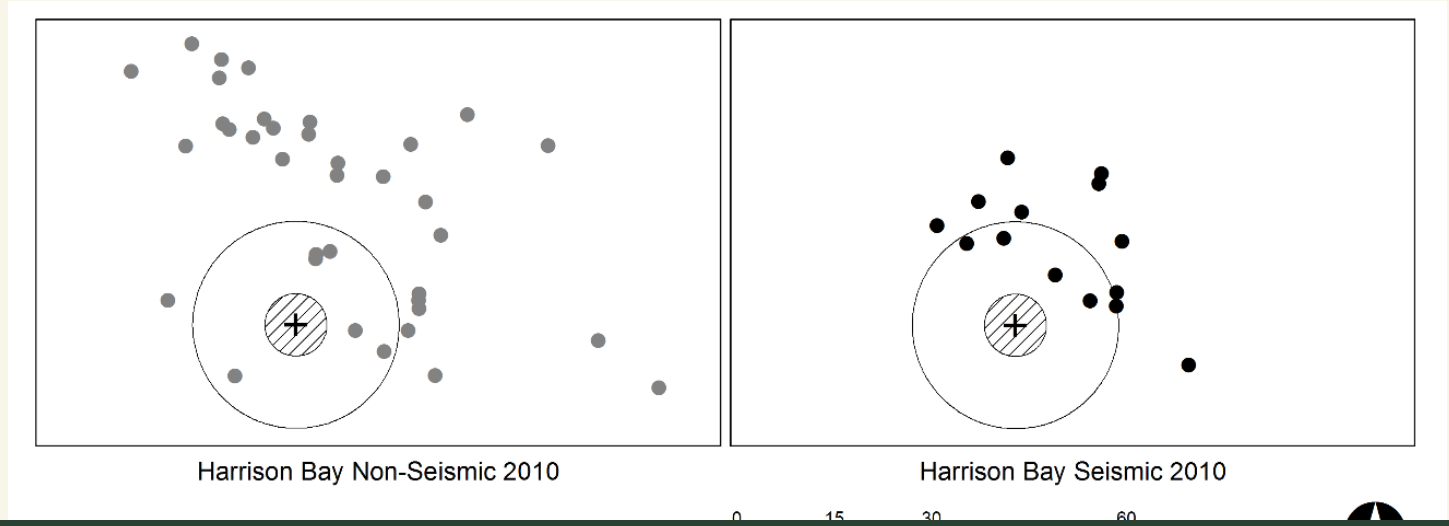




Aerial Surveys – Key Results

Key Results from Aerial Surveys

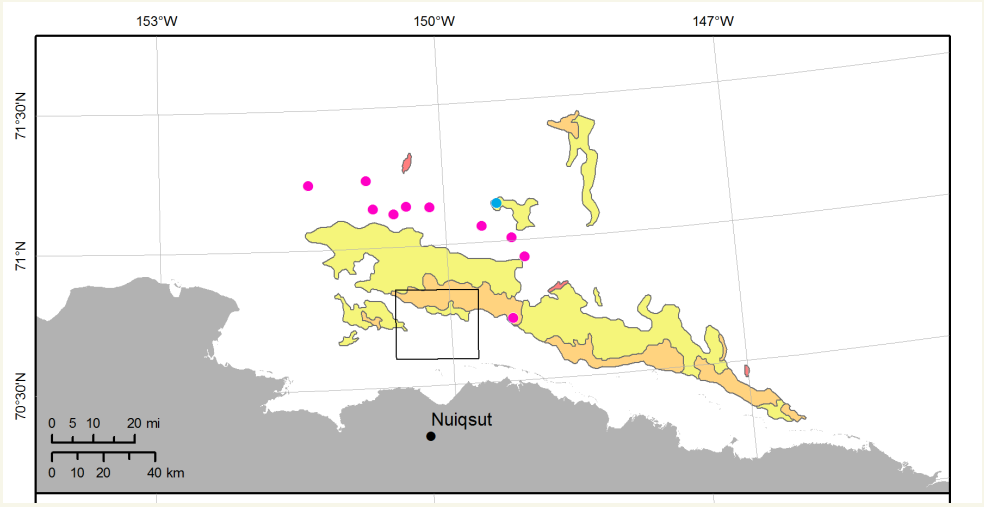
- Bowhead whales did not show avoidance at or below the 120 dB received level
  - Potential avoidance distance of 20-30 km is consistent with previous results from 1990's when a smaller seismic array was used

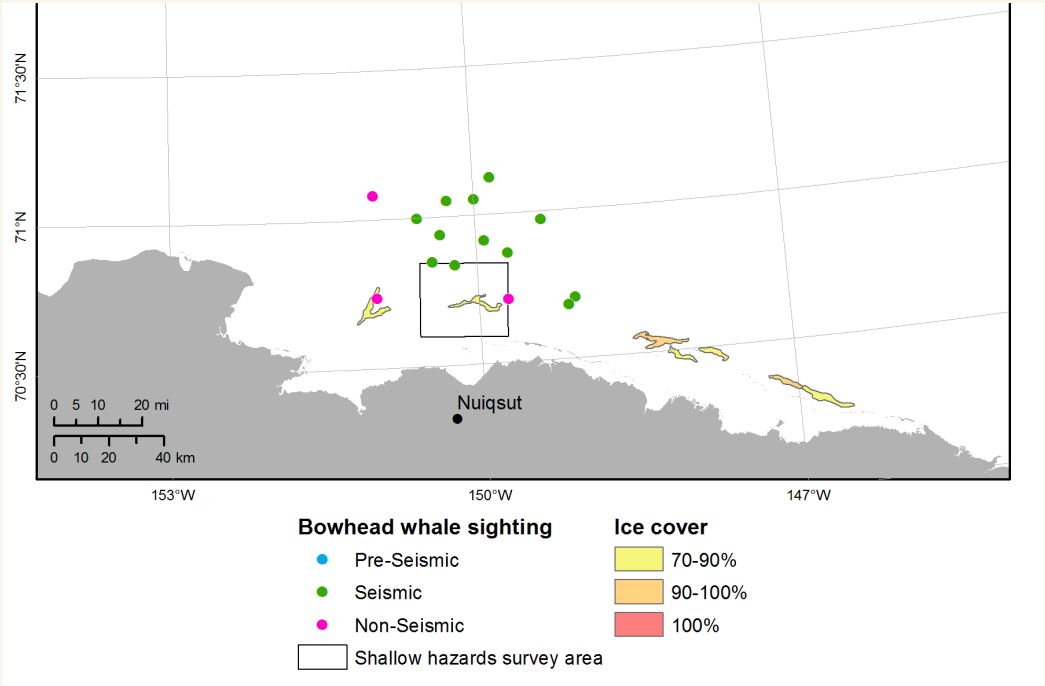


Aerial Surveys – Key Results

Key Results from Aerial Surveys

- Natural processes drove bowhead distribution more strongly than anthropogenic sounds
  - Feeding bowheads tolerated pulsed sound of 150 to >170 dB SPL
  - Avoidance of heavy sea ice concentration

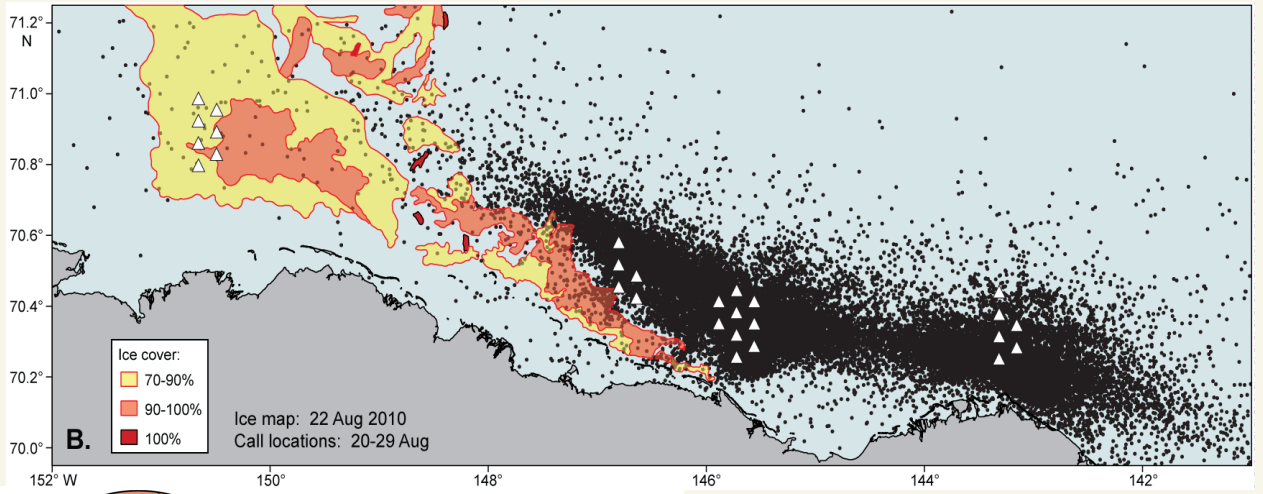


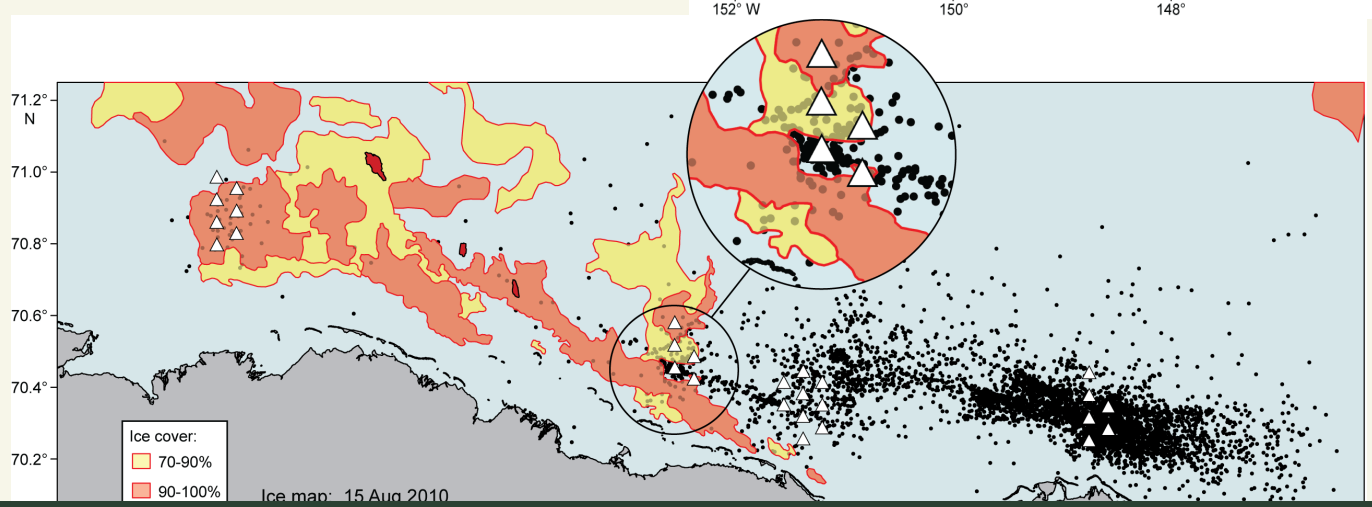


Aerial Surveys – Key Results

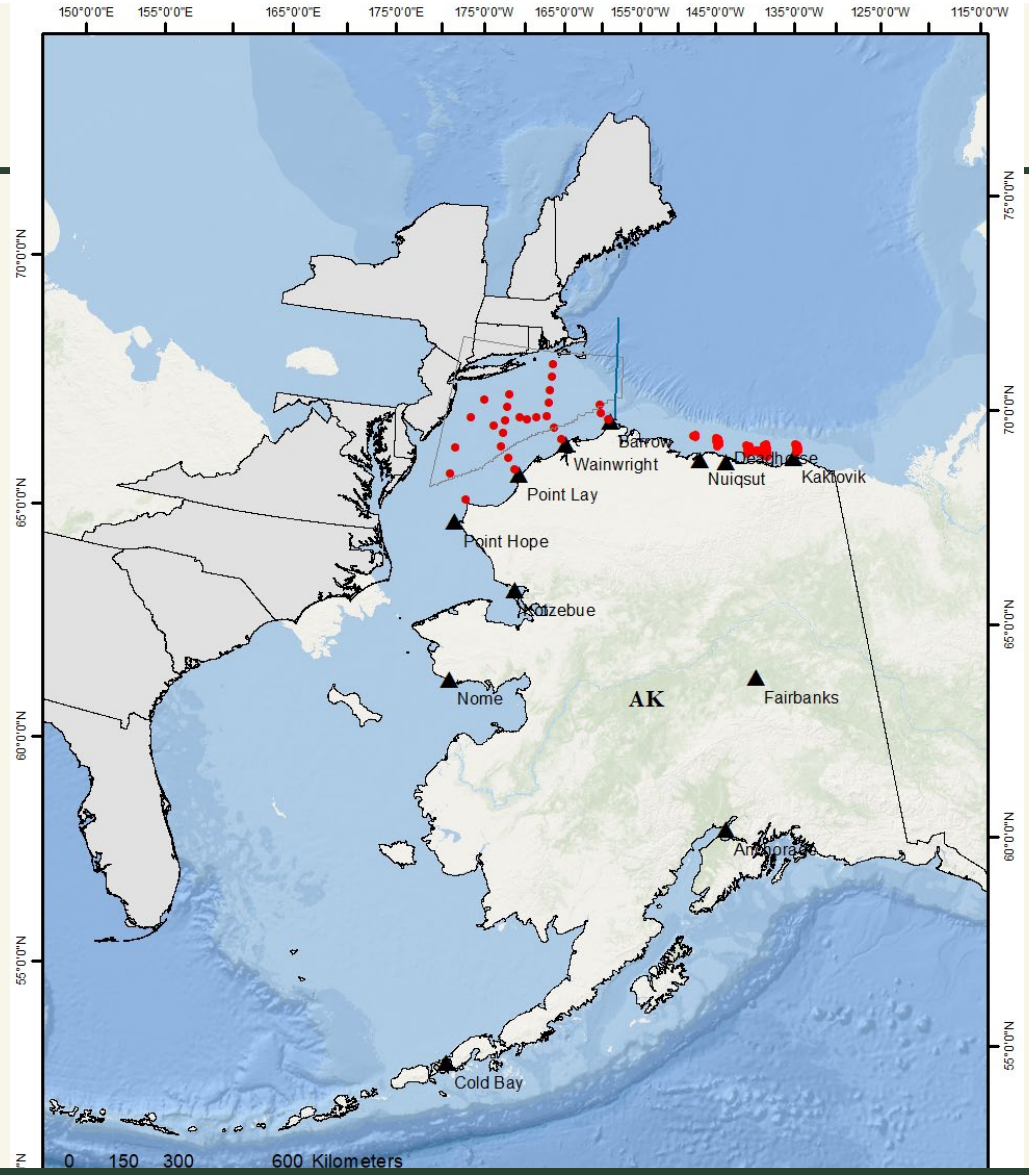
Key Results from Aerial Surveys

- Natural processes drove bowhead distribution more strongly than anthropogenic sounds
  - Feeding bowheads tolerated pulsed sound of 150 to >170 dB SPL
  - Avoidance of heavy sea ice concentration



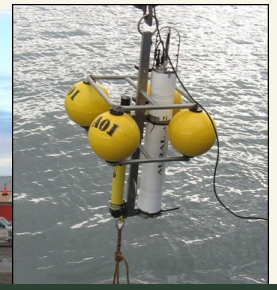


Location


150°0'0"E
155°0'0"E
165°0'0"E
175°0'0"E
175°0'0"W
165°0'0"W
155°0'0"W
145°0'0"W
135°0'0"W
125°0'0"W
115°0'0"W
75°0'0"N
70°0'0"N
65°0'0"N
60°0'0"N
55°0'0"N
Barrow
Wainwright
Point Lay
Nuiqsut
Kaktovik
Point Hope
Kotzebue
Nome
AK
Fairbanks
Anchorage
Cold Bay
0 150 300 600 Kilometers

Summary

- Vessel-based observations
- Aerial surveys useful for detecting changes in distribution
  - limited by brief temporal coverage of any given location
- PAM useful for detecting seasonal and inter-annual variation and large-scale movements
  - Little ability to detect distributional responses to anthropogenic sounds due to behavioral responses (change in calling rate) by bowheads
- Multiple streams of evidence provide stronger inference and ecological insight



Passive Ac

NOAA

PAM Applications for Offshore Wind

Focus of this workshop:

MITIGATION OF IMPACTS

- Real-time detection of marine mammals
- PAM may be combined with other tools (visual PSOs, AUVs, drones)
- Localization generally preferred
- Shut down of operations when animals in the area
- Decrease vessel strike risk

REGIONAL MONITORING
(Regional 'over horizon' monitoring)

- Large scale ecological monitoring focused on species presence, distribution, and shifts in patterns
- Long term PAM design

SOUND FIELD VERIFICATION

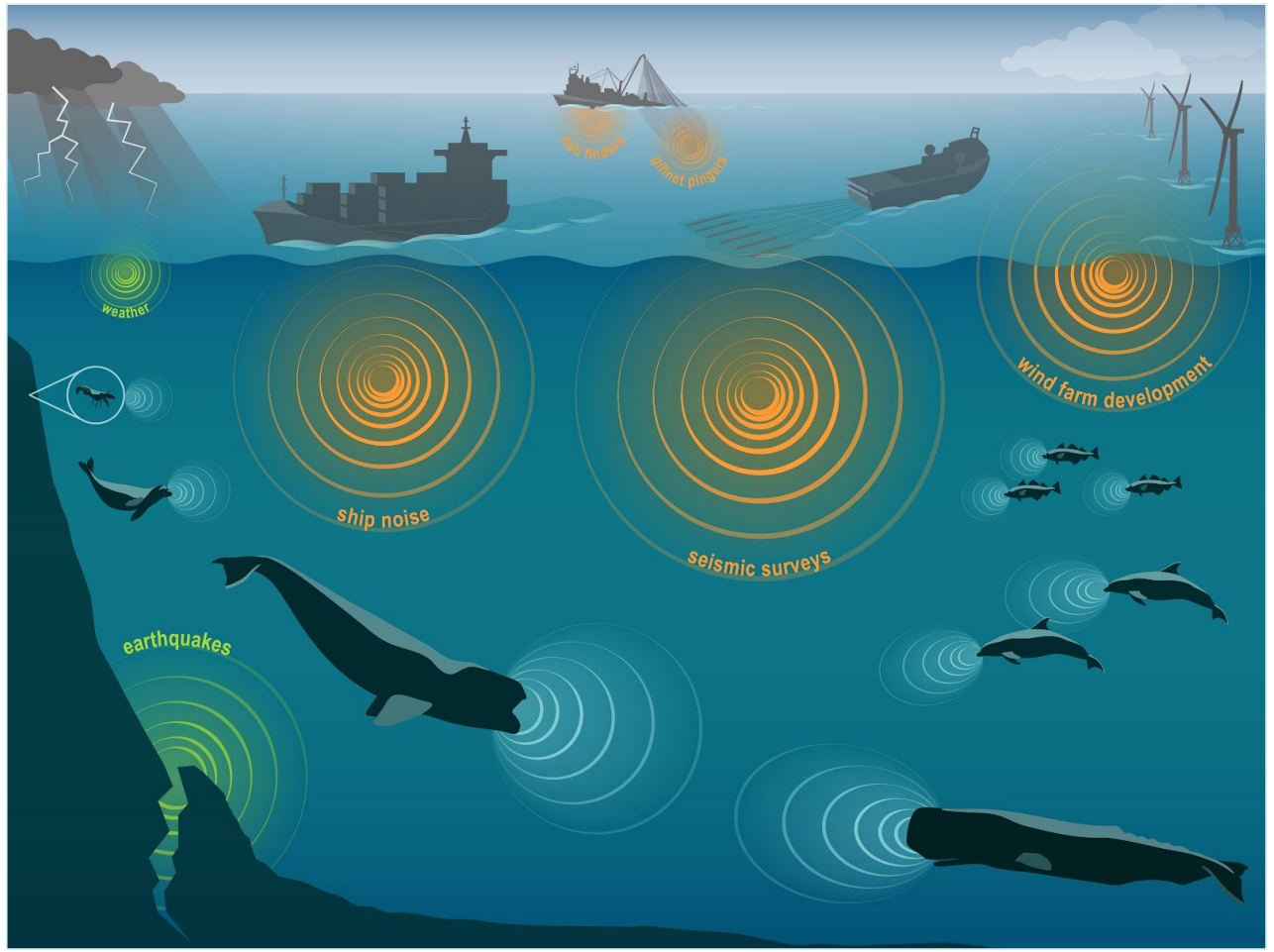
- Measuring sounds from pile-driving
- Compare to model results
- Required for IHAs

Questions to Consider when using PAM

1. **What are your Species of Interest?**
2. What ar
   What ar
   What is y

1. Multi-Species & Ecological Focus

-
-)
- Other marine mammals
- Soniferous Fish
- Invertebrates



- Anthropogenic Sounds
- Environmental

Questions to Consider when using PAM

1. Wha
2. **What are your PAM Recording Technologies ?**
   What ar
   What is y

2. PAM Data Collection: technologies

ARCHIVAL

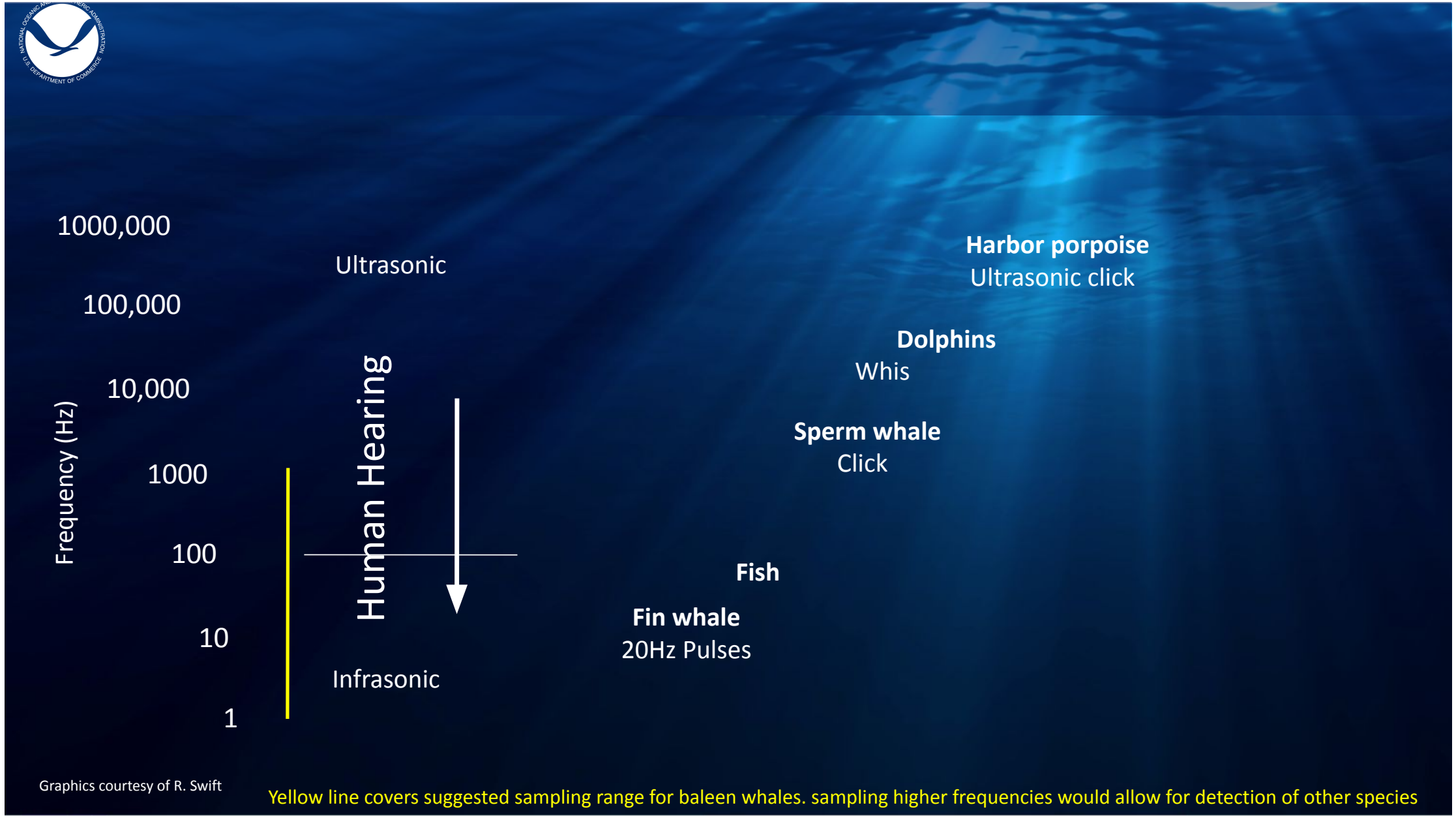
- Bottom-mounted recorders
- Acoustic tags
- Telemetry tags (active)

REAL TIME

- Moored buoys
- Gliders
- Towed Arrays
- Drop hydrophones
- Drifting buoys

Questions to Consider when using PAM

2. What ar
3. **What are your PAM System Requirements?**
   What is y

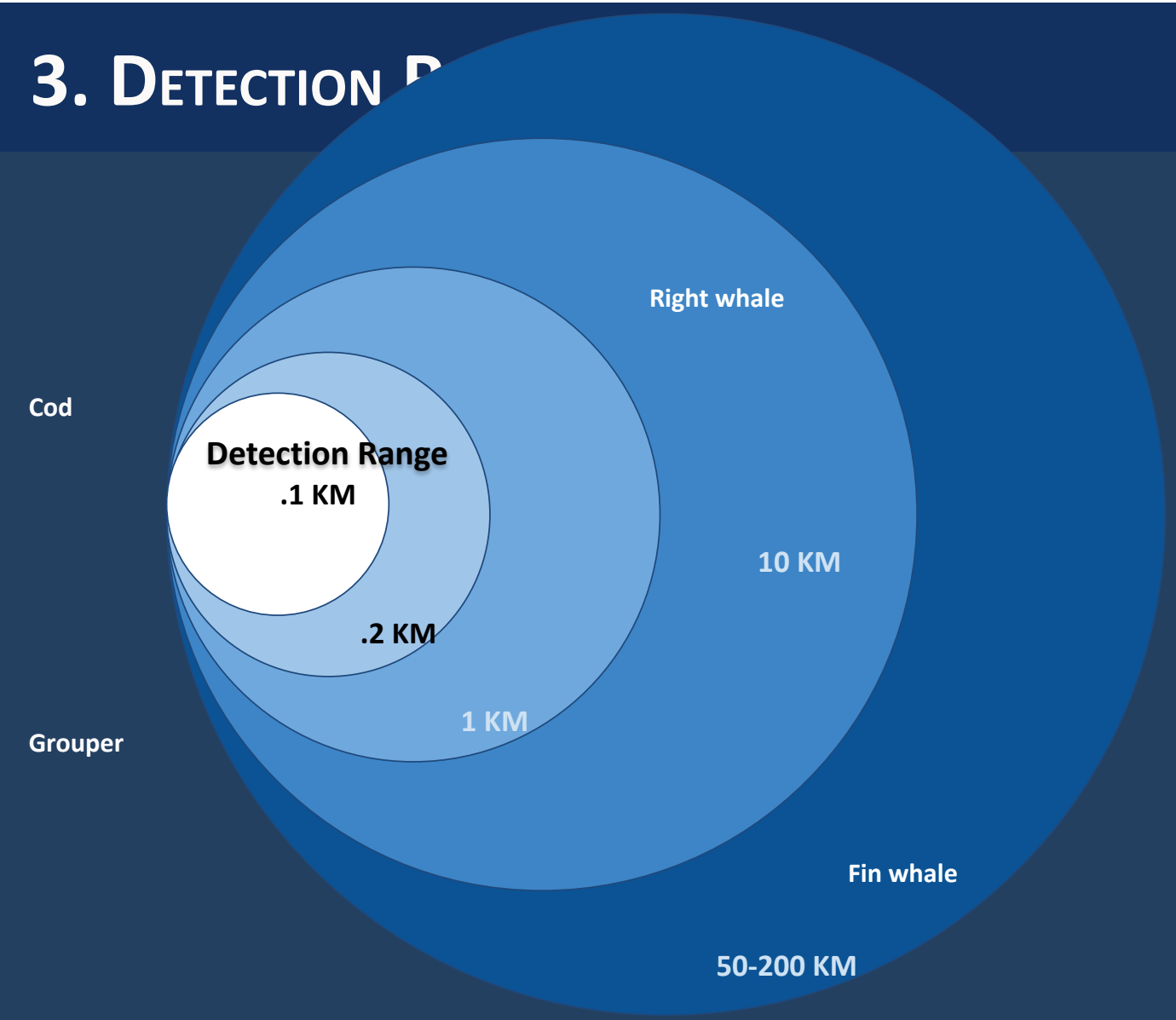


Graphics courtesy of R. Swift

Yellow line covers suggested sampling range for baleen whales. sampling higher frequencies would allow for detection of other species

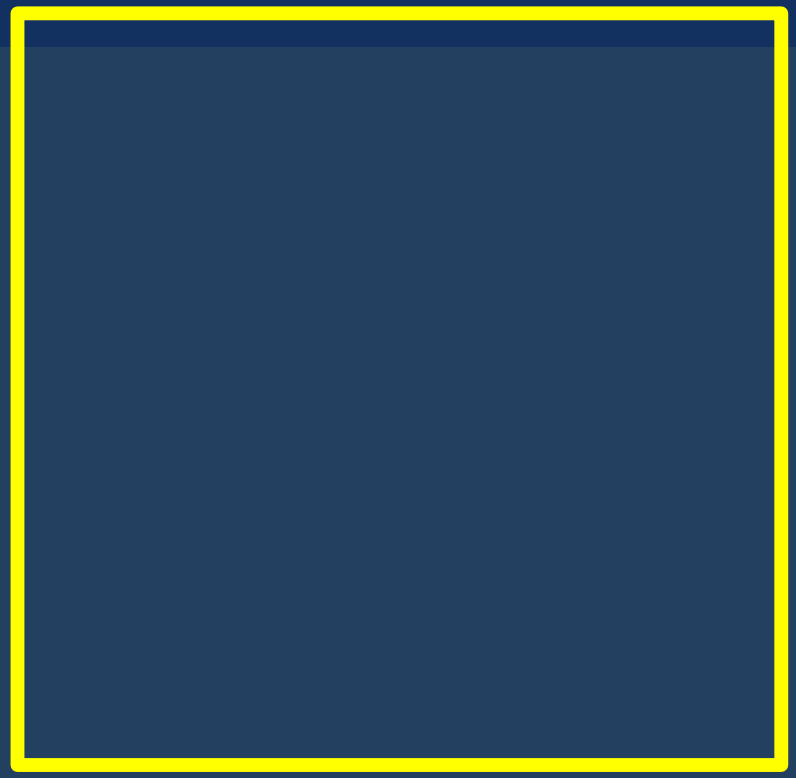
3. Detection R

How far c
species be hear



Right whales ar
Prioritizing design f

3. Detection Ranges for NARW



Therefore,we estimated that the **detection** range of the MARU array was 25 km for **right whales.** Morano et al. 2020 Con Biol.

Tennessen & Parks 2016 *Endangered Species Research* 30 (2016): 225-237.

Hansen et al. in pr

“ up-calls pr
sensor 312 w
overcome the masking e
noise - Palmer

Desharnais et al. 2000.. "A scenario for right whale detection in the Bay of Fundy." In *OCEANS 2000 MTS/IEEE Conference and Exhibition. Conference Proceedings (Cat. No. 00CH37158)*, vol. 3, pp. 1735-1741. IEEE,

5 to 9 km

Questions to Consider when using PAM

2. What ar
   What ar
4. What is your PAM Data Collection Design?

Changing Distributions - Baleen Whales

2004 – 2014

Opportunistic design

but data collection primarily focused on areas important to NARWs

North A

fin whales

blue whales

humpback whales

sei whales

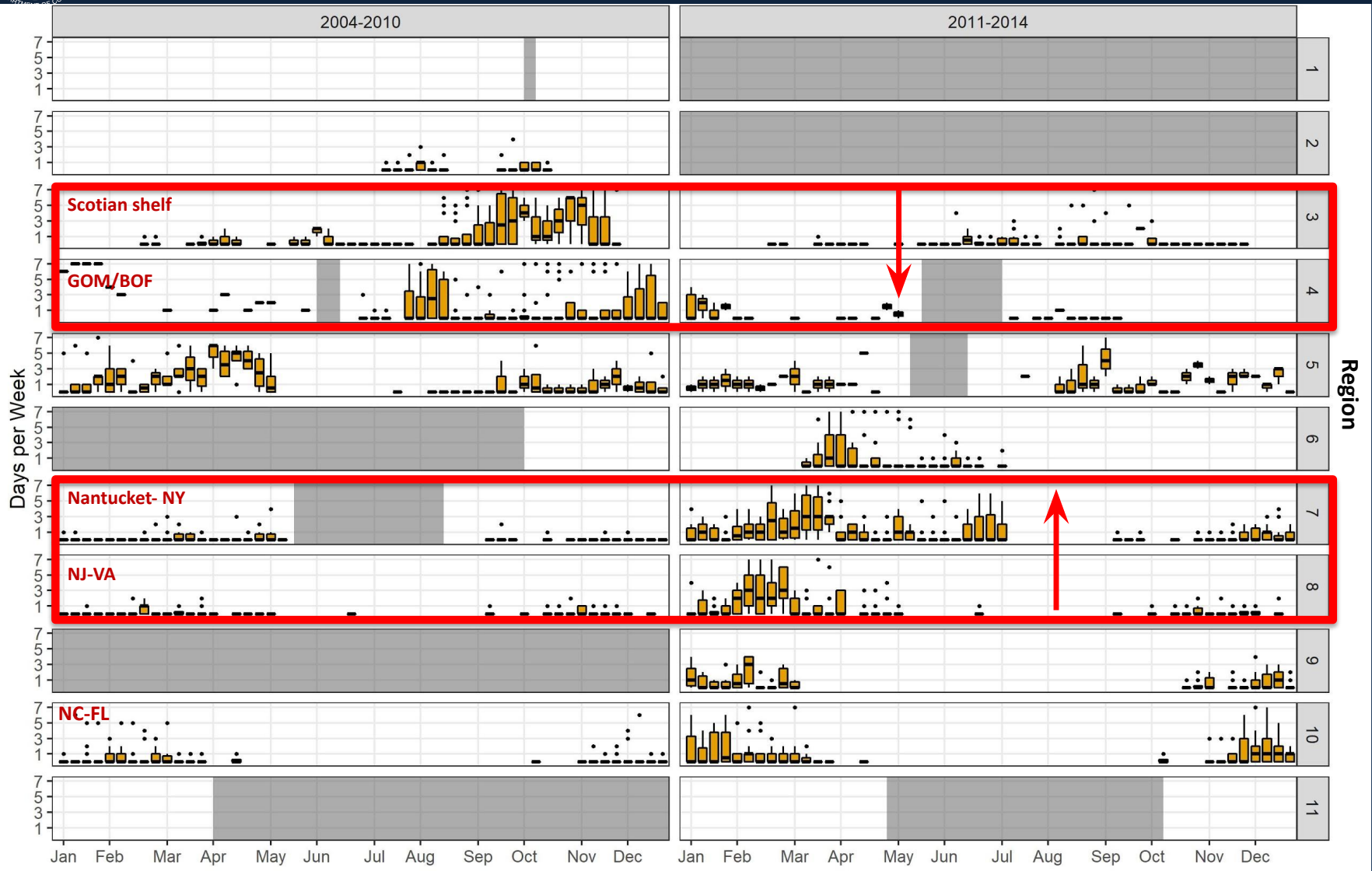
Multi Sector Collaboration

Interna

Baleen Whales: Temporal


NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
DEPARTMENT OF COMMERCE

NARW Shifts Across Time

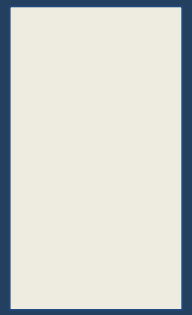


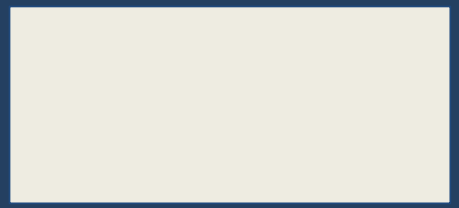
PAM Data Collection Design - Proposed Regional

The coordinates and related grid cell

Structured grid/array design

PAM Data Collection Design - Proposed Regional





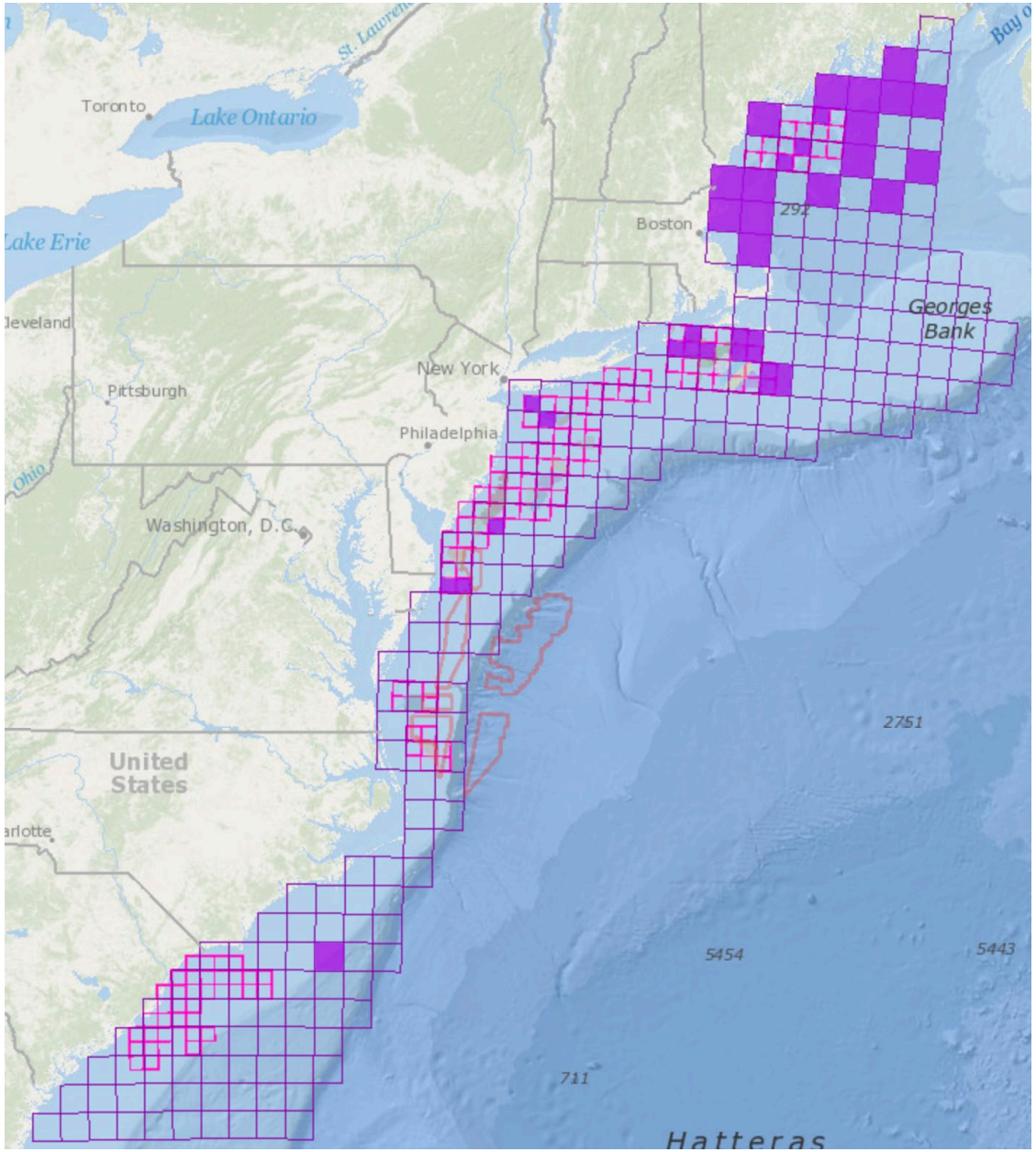
24/7 monit
small area pr
continuous sit

Provides spar
sample da
area - grea

PAM Data Collection Design - Other examples

Category A Monit
ediction,

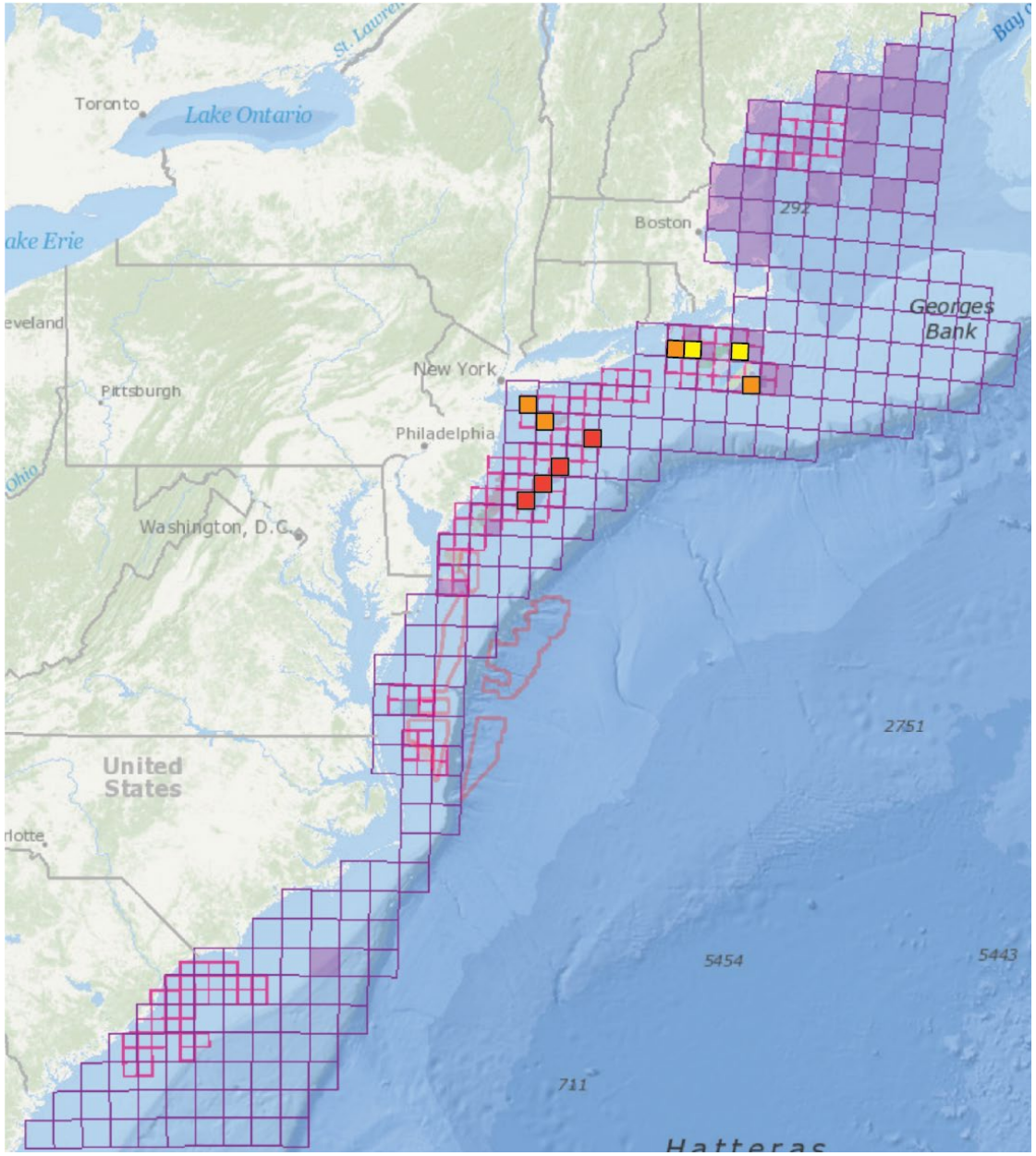
PAM Monit



Current PAM deployments

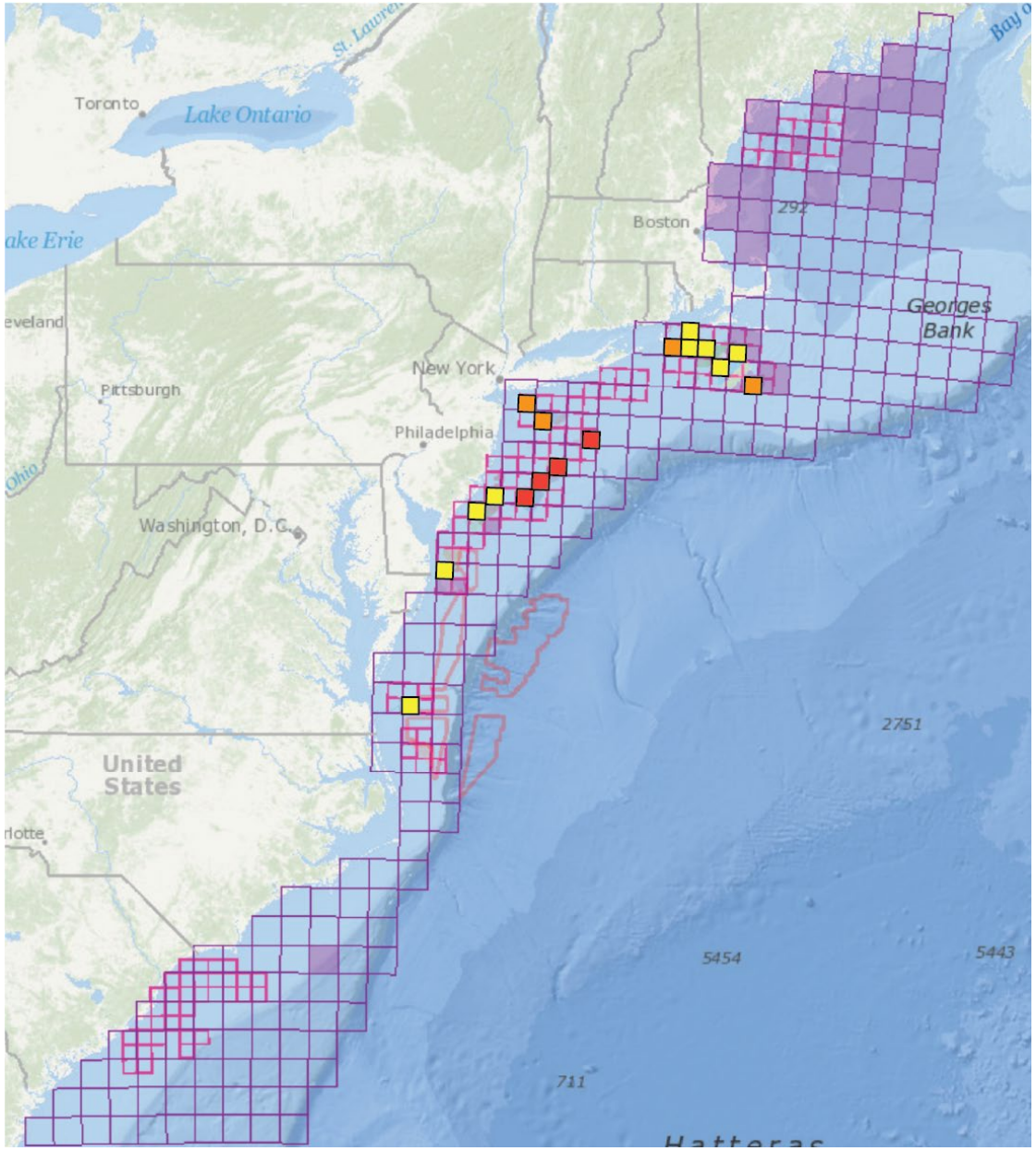
www.northeastoceandata.org

portal.midatlanticocean.org



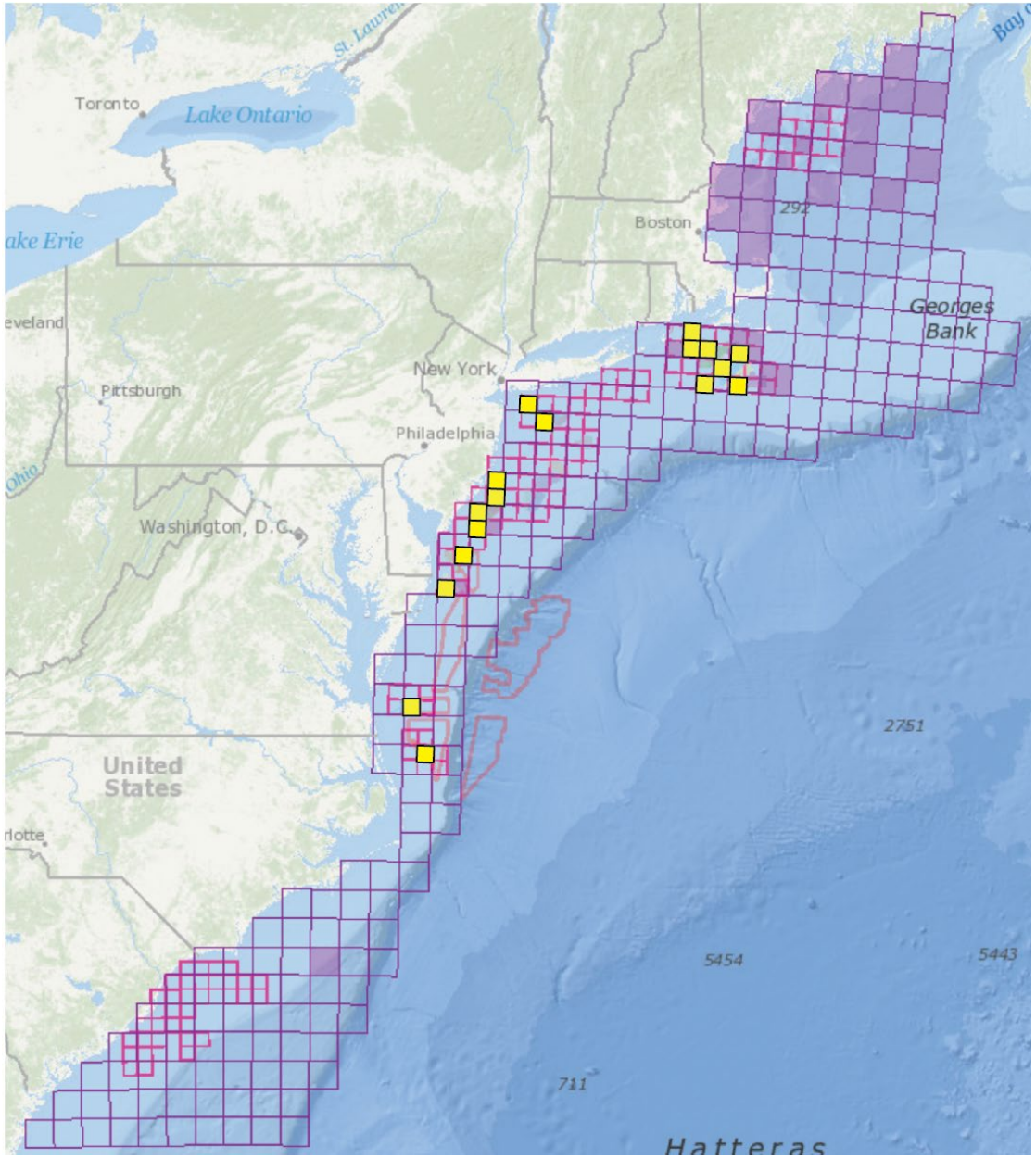
2023

- Developers
- Project WOW
- NYSERDA



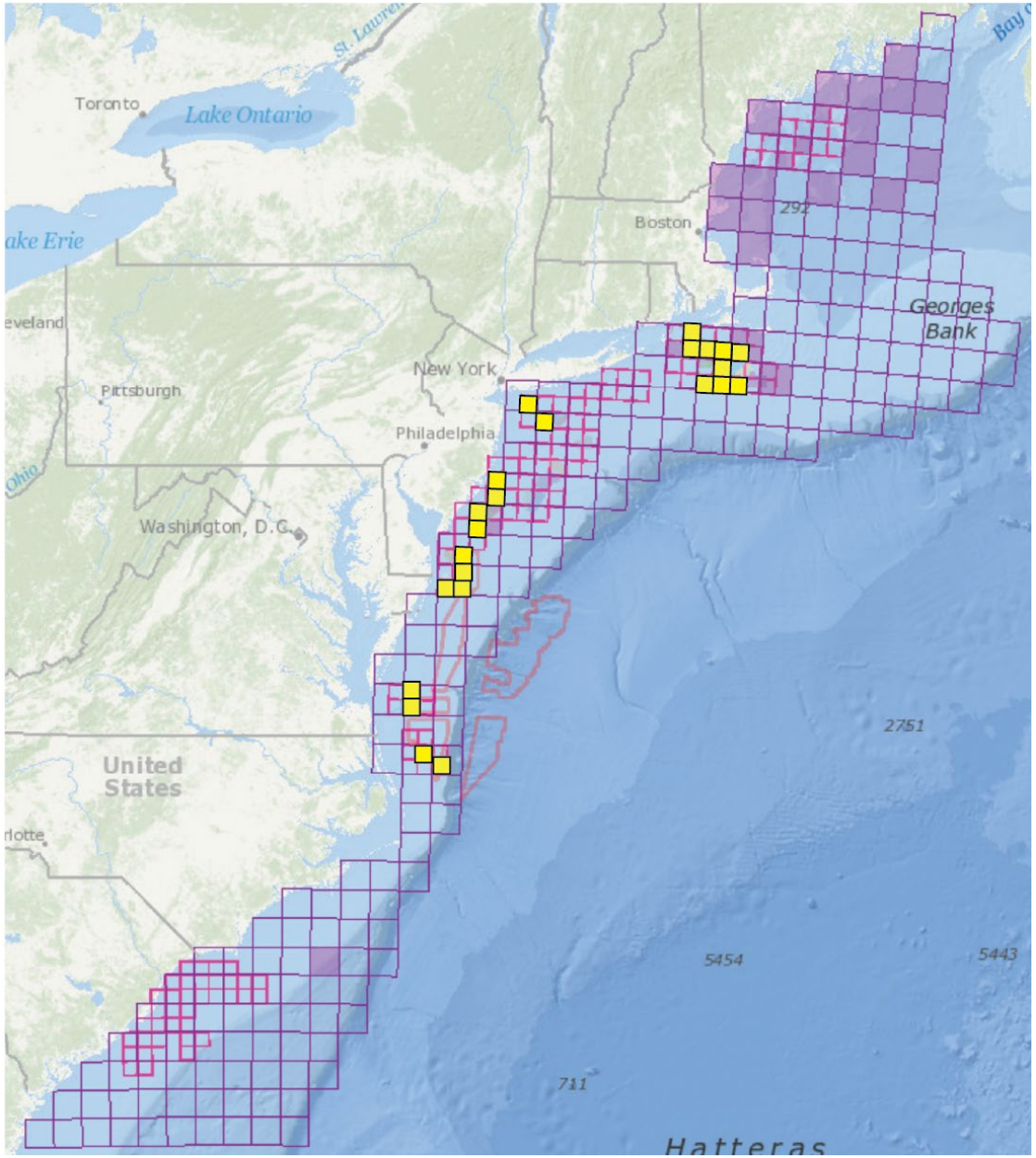
2024

- Developers
- Project WOW
- NYSERDA



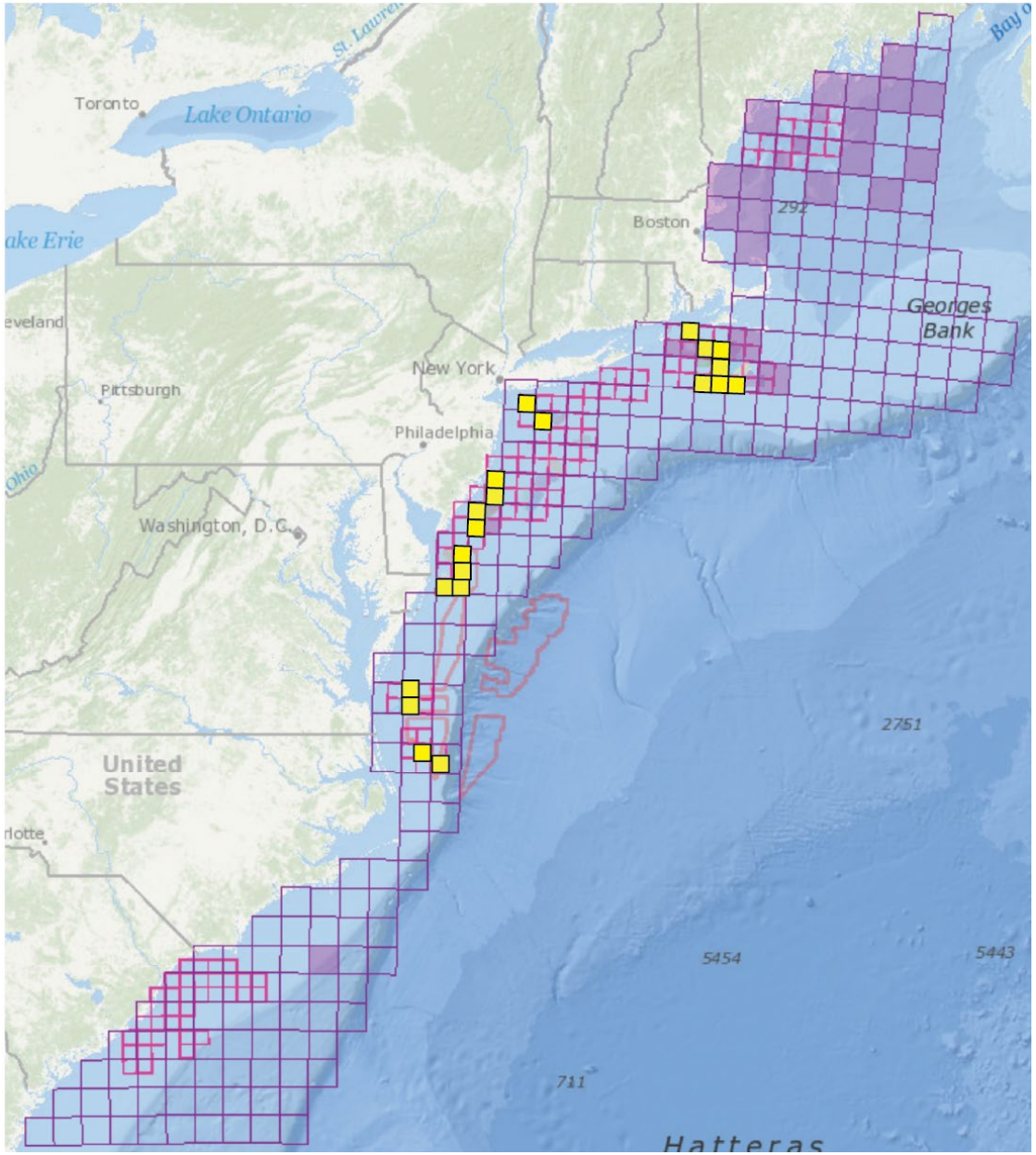
2025

- Developers



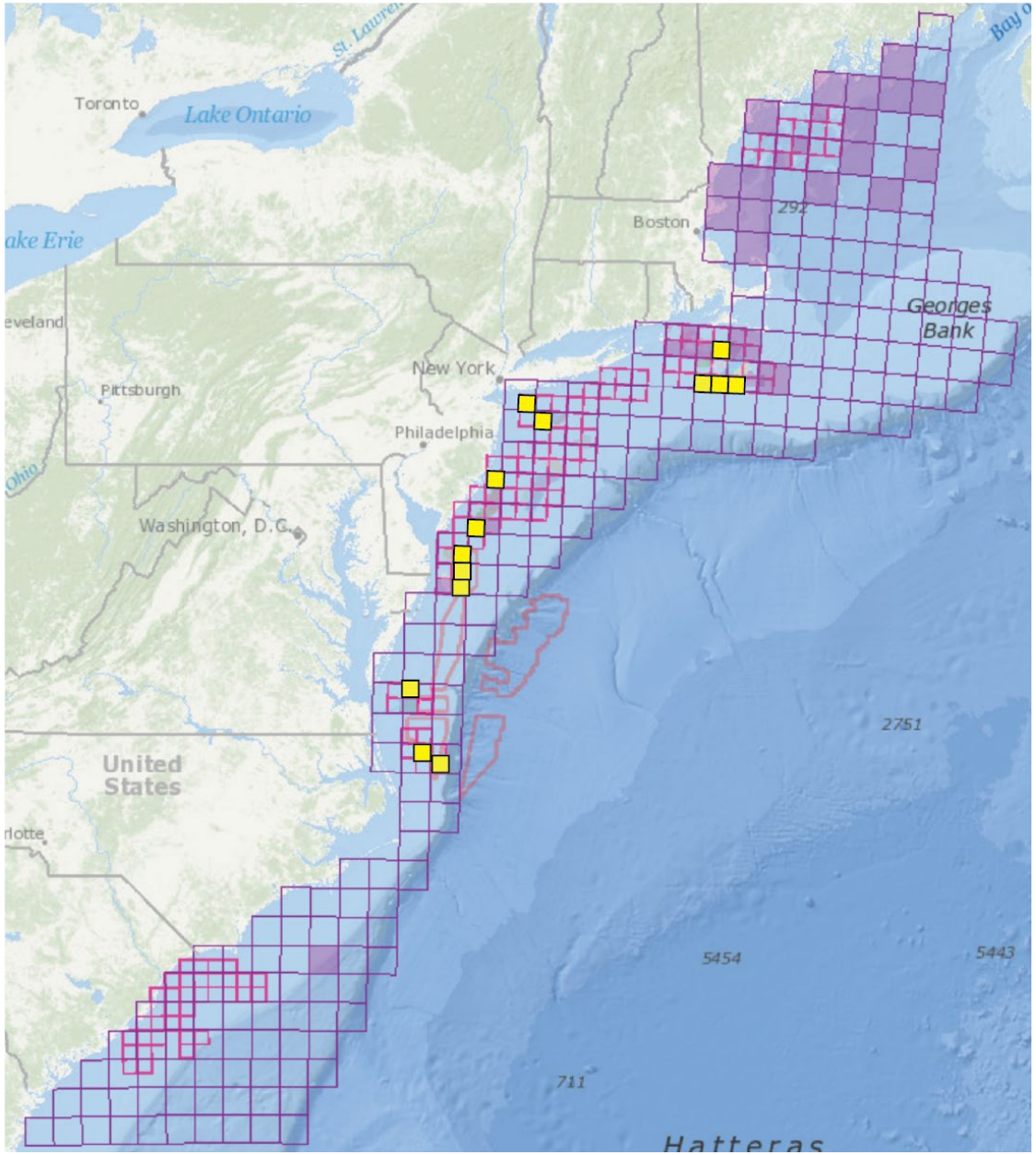
2026

- Developers



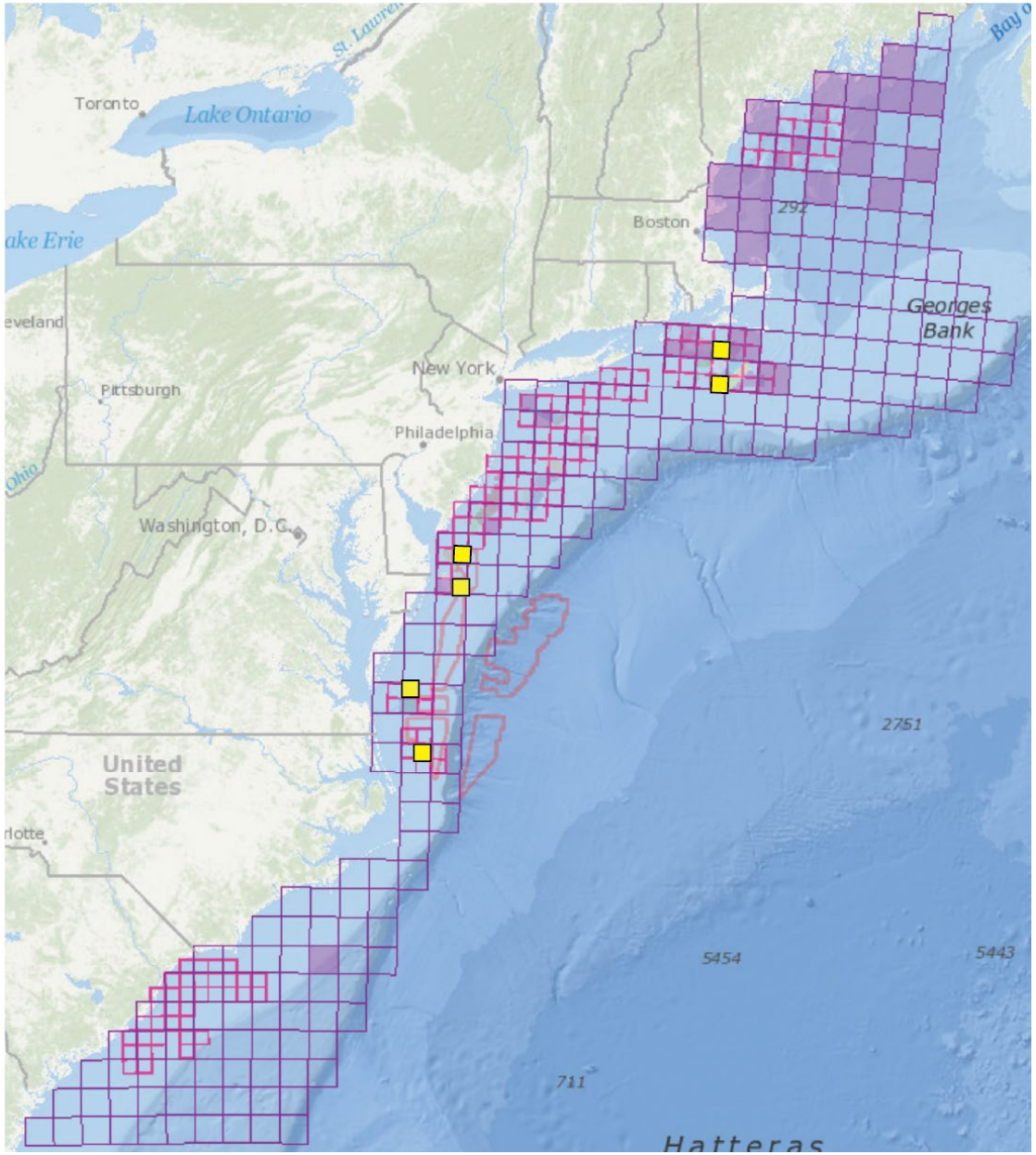
2027

- Developers



2028

- Developers



2029

- Developers

Underlying Key Enterprise

What are the priority questions to be asked at what scale with what methods and study design and by whom?

- For this workshop
  - What is a regional scale approach for PAM?
  - How might we manage PAM data regionally across sectors
- For the MM Subcommittee of the RWSE
  - Advancing the question above

Arctic Lessons Learned

- Understanding what questions we want to answer - specifically in each state and more broadly across the East Coast
- Multiple threads of data collection are necessary (acoustic and visual detections, prey mapping, oceanographic/ecological, etc.).
- You need to consider environmental and behavioral context to fully understand what is happening
- Importance of designing the array and its localization capability to answer research question.
- That we (state xx) will never have enough funds available to monitor our area that way Alaska was.
- I thought it was interesting to point out that they couldn't answer some of the spatial questions once calling rates were impacted by noise levels

Question(s) we are trying to answer?

Many variations of the below questions offered:

- Are there large-scale changes in baleen whale distribution over time, associated with OSW and other changes (natural; human-caused) over the next decade or so, with PAM being one tool (of many) to address this?
- Phase 1 question: Is there a measurable shift in whale distribution & abundance before during and after OSW construction. Phase 2: If so, in what direction. Phase 3: why?

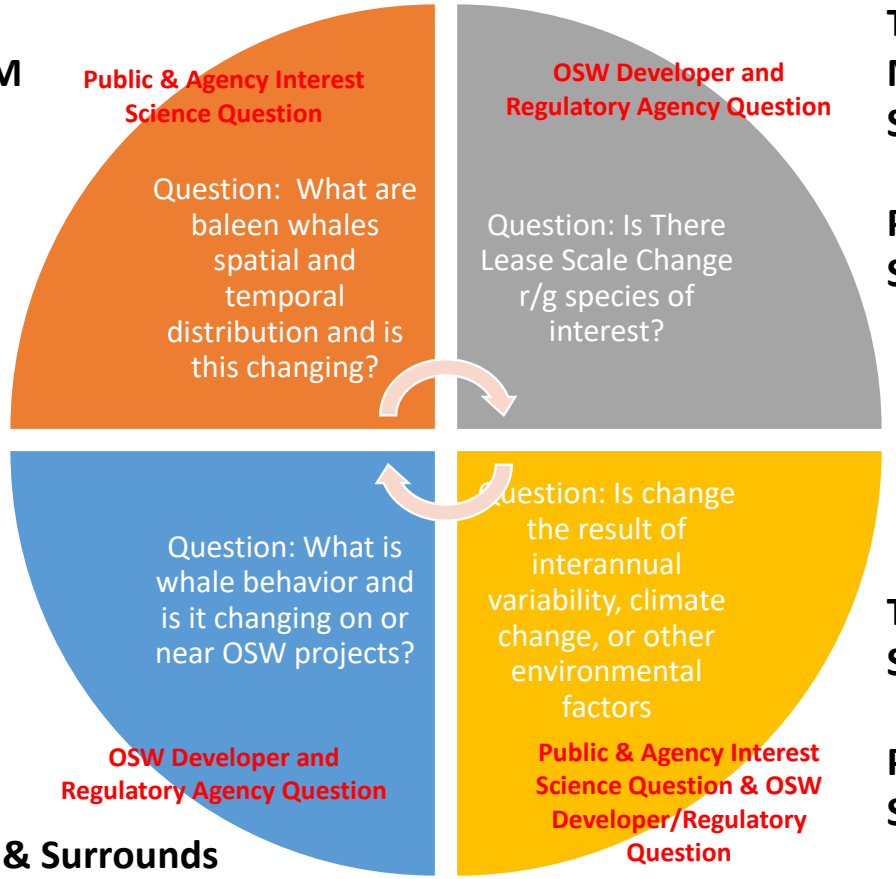
Questions Current Deployments cannot Answer

- Causation - may be able to get a correlation, but actually attributing any change in distribution or abundance to a specific factor is going to be very, very difficult
- The planned developer deployments as well as the existing deployments shown will not answer the key questions - change in distribution
- What other ecological drivers might be causing changes in animal distribution?
- More detailed questions related to movement, in-depth questions about behavior, and key questions that require other types of data (behavior, knowledge of particulars for individuals --e.g., sex, age, some essential life functions). The 'Why's'

WOULD LIKE TO KNOW: Is there a change in distribution and abundance of baleen whales along the Eastern Seaboard as a result of an OSW project's construction, presence, and operations?

Tools:
Mobile & fixed PAM
Shipboard & aerial surveys

Pattern: Broad
Uniform Grid
Scale: Regional



Tools:
Mobile & fixed PAM
Shipboard & aerial surveys

Pattern: denser/ gradient (BACI/BAG)
Scale: Project Area and Surrounds

Tools:
Tagging, visual & Aerial surveys

Pattern: N/A
Scale: Project Area & Surrounds

Tools:
Satellite, mobile & fixed oceanographic

Pattern: grid or otherwise
Scale: Project to Regional

BUT: Many impacts such as shipping, DoD activities, climate change, fishing, interannual variability, in addition to OSW. Thus, distribution and change detection possible, association with impacts maybe, causation extremely difficult

Timelines of interest:

- **Before, during, after wind farm(s) construction**
- **During operation of wind farm(s)**

Public interest/agency science focus | *Developers & regulators focus*

	Regional Scale		Lease Scale	
	Tools	Strategy	Tools	Strategy
Is distribution and abundance of baleen whales changing?	*See Davis et al. 2020, 2017*		Fixed & mobile PAM; Visual	Dense, BACI, BAG
↓				
What is/are associated with these changes? (environment, prey, wind farm activities, other activities) *Determining causation is not likely*	Satellite, Fixed & mobile oceanographic;			
↓				
Where are they going?	Fixed & mobile PAM; Visual		*Likely need regional tools & strategy to answer*	
↓				
What are they doing wherever they are?	Visual; Tagging			

Today's Focus and Purpose

- Explore process for increasing acoustic data coordination, management, and access

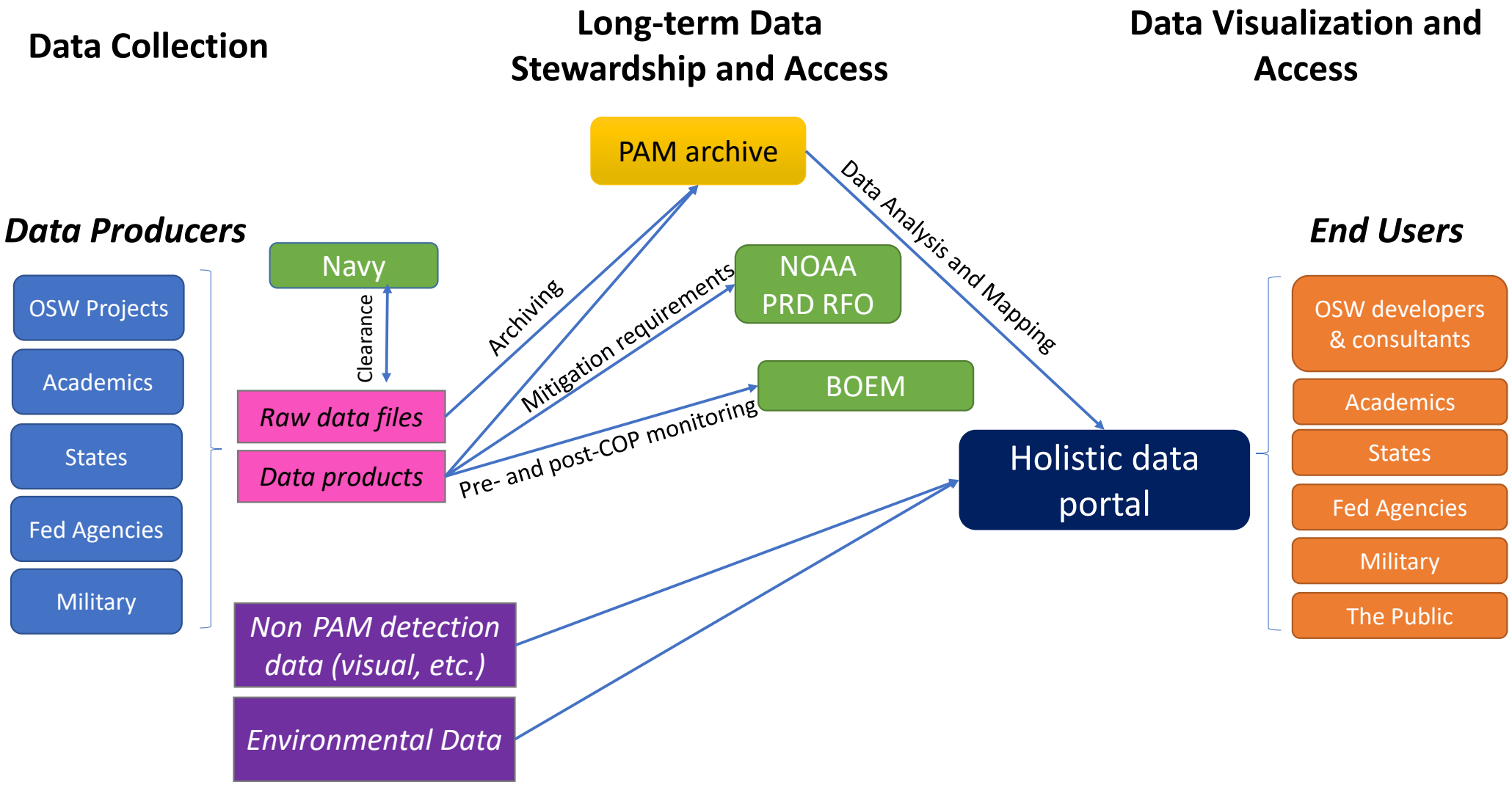
- Define specific clear action steps, likely in stages, to move toward a shared data approach to acoustic data on the US eastern seaboard

Data Collection to Data Visualization

The following graphic illustrates the general flow of data, actions and actors from collection to visualization

Question #1: Anything we missed?

Question #2: Where do you see yourself in this data flow?


Data Collection
Long-term Data Stewardship and Access
Data Visualization and Access
Data Producers
End Users
OSW Projects
Academics
States
Fed Agencies
Military
Navy
Clearance
Raw data files
Data products
Non PAM detection data (visual, etc.)
Environmental Data
PAM archive
Archiving
Mitigation requirements
NOAA PRD RFO
BOEM
Pre- and post-COP monitoring
Data Analysis and Mapping
Holistic data portal
OSW developers & consultants
Academics
States
Fed Agencies
Military
The Public

Data Products

- What do we mean by data products?
- Bringing in environmental variables
- Link to international efforts

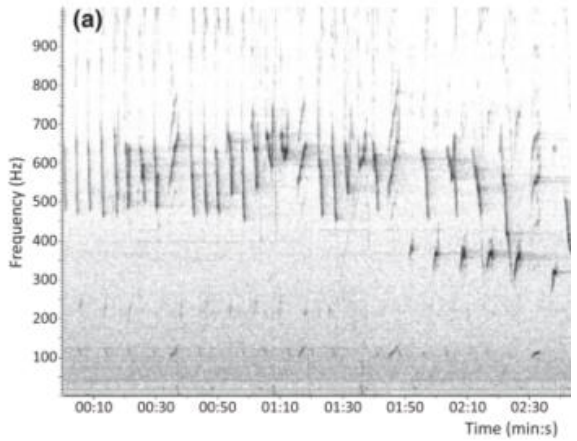
What do we mean by “data products”?

Each product becomes its own time-series that can be further explored with other covariates

- Species detections
  - Baleen whales
  - Odontocetes
  - Fishes
- Ambient noise metrics
  - Decidecade bands
  - Octave bands
- Vessel presence
  - Vessel noise bands

Common ground with marine mammal detectors

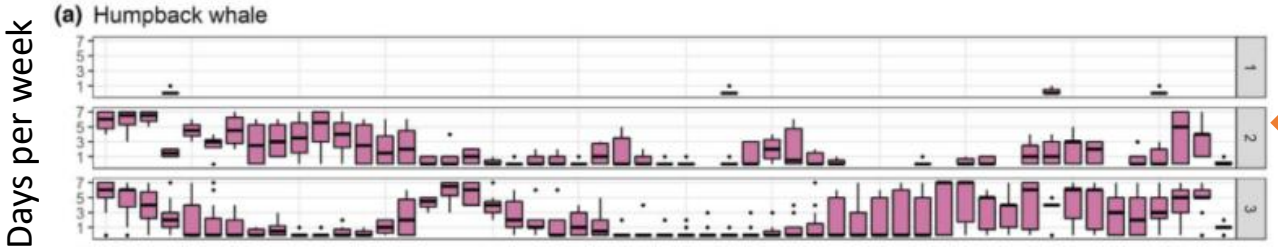
Data from different recorders can be processed similarly as long as you have the calibration metadata for each and understand performance metrics of each detector



Raw acoustic data

Exploring movement patterns and changing distributions of baleen whales in the western North Atlantic using a decade of passive acoustic data

Genevieve E. Davis[1,2] | Mark F. Baumgartner[3] | Peter J. Corkeron[4] | Joel Bell[5] | Catherine Berchok[6] | Julianne M. Bonnell[7] | Jacqueline Bort Thornton[5] | Solange Brault[2] | Gary A. Buchanan[8] | Danielle M. Cholewiak[1] | Christopher W. Clark[9] | Julien Delarue[10] | Leila T. Hatch[11] | Holger Klinck[9] | Scott D. Kraus[4] | Bruce Martin[10] | David K. Mellinger[12] | Hilary Moors-Murphy[13] | Sharon Nieukirk[12] | Douglas P. Nowacek[14,15] | Susan E. Parks[16] | Dawn Parry[9] | Nicole Pegg[7] | Andrew J. Read[14] | Aaron N. Rice[9] | Denise Risch[17] | Alyssa Scott[7] | Melissa S. Soldevilla[18] | Kathleen M. Stafford[19] | Joy E. Stanistreet[13] | Erin Summers[20] | Sean Todd[21] | Sofie M. Van Parijs[1]



Time-series of acoustic detections

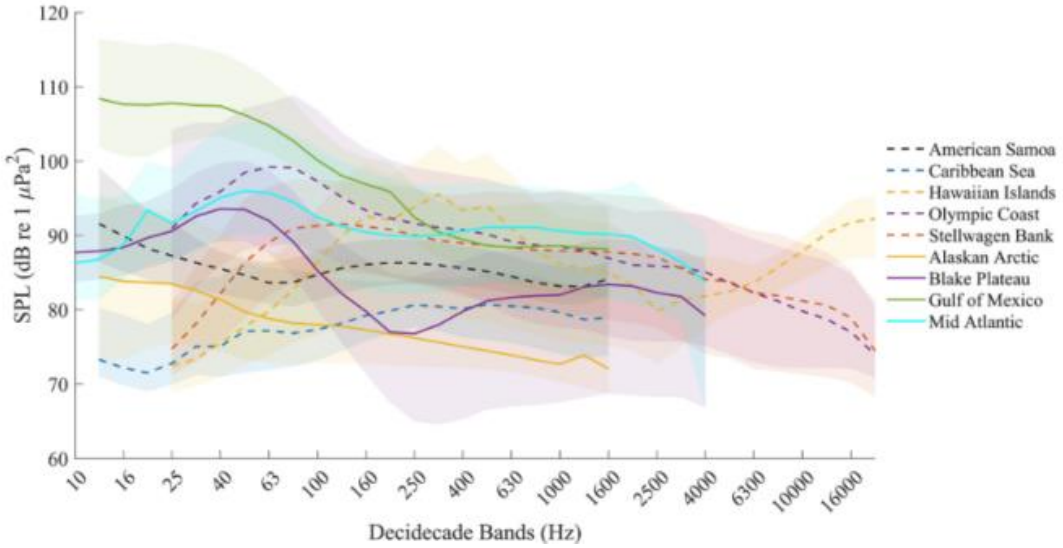
Months of the year

Common ground with ambient sound metrics

Example of data analysis that can be done with common methods for data processing and common data products

The Next Wave of Passive Acoustic Data Management: How Centralized Access Can Enhance Science

Carrie C. Wall[1,2], Samara M. Haver[3,4], Leila T. Hatch[5], Jennifer Miksis-Olds[6], Rob Bochenek[7], Robert P. Dziak[8] and Jason Gedamke[9]*



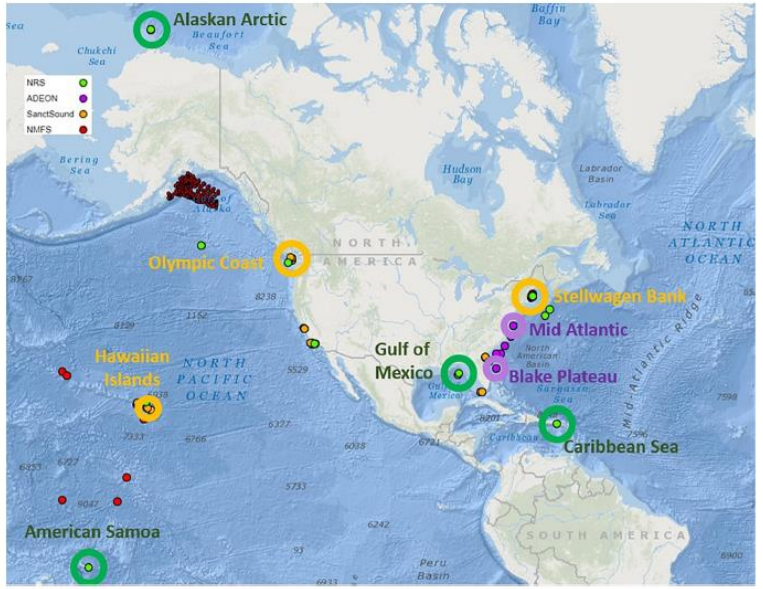
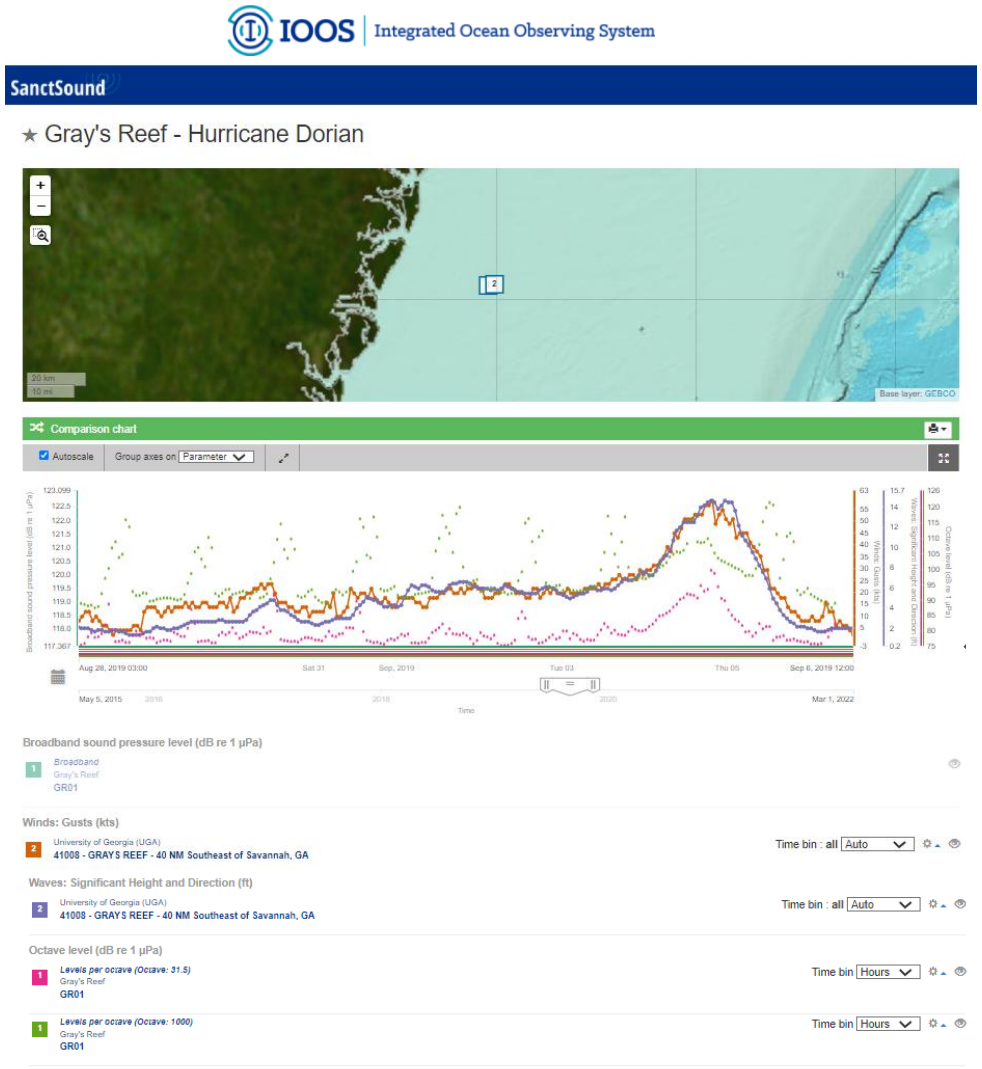


FIGURE 1 | Recording sites selected from the NCEI passive acoustic archive for analysis across the NRS (green open circles), ADEON (purple open circles), and SanctSound (orange open circles) projects. The red circles represent datasets collected by National Oceanic and Atmospheric Administration (NOAA) Fisheries Science Center monitoring programs.

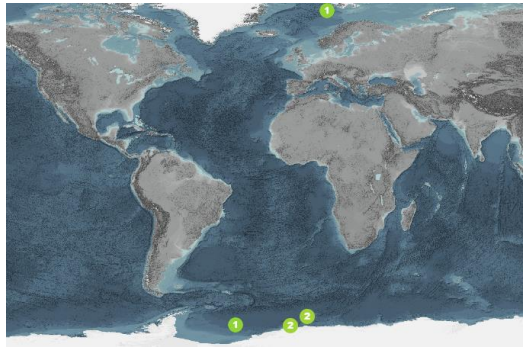


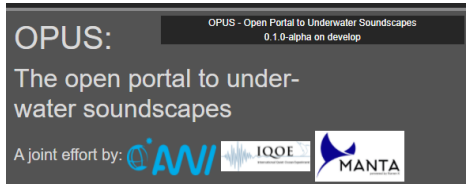
Introducing environmental variables

Example of a visual interface that connects acoustic data products with environmental parameters to tell a fuller picture of the environment – and what is impacting ambient sound levels

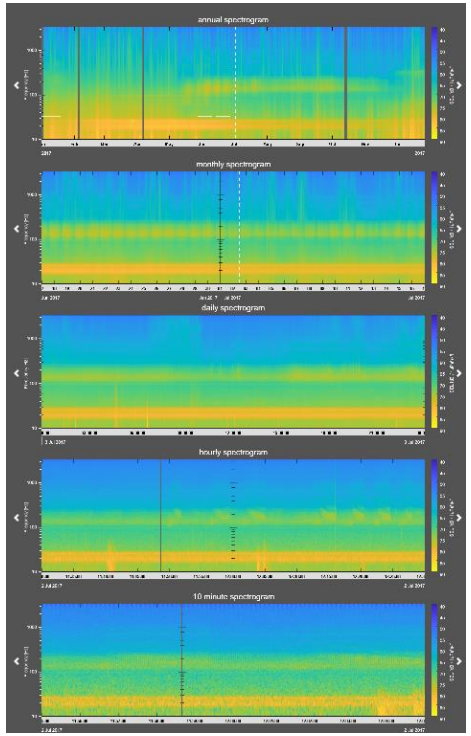
International Efforts

- European effort to standardize cetacean detections into a single portal
- Portal coming spring 2022



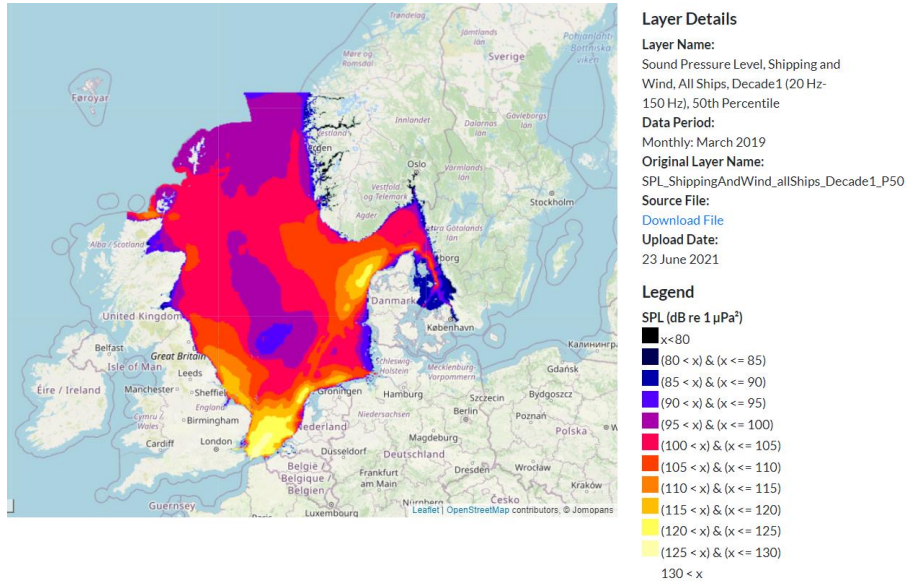


- IQOE-lead project
- Visualization of calibrated processed data
  - Powered by MANTA open-source software
- Spectrograms on variable time-scales to visualize ambient noise quickly



International Efforts

- Underwater sound measurement system for harbors and water ways
  - Sound level measurements
  - Marine mammal detection and notification
  - Vessel detections and associated levels
  - Generates reports
- Web access to current and archival measurements/results restricted to clients



- Joint monitoring programme for ambient noise in the North Sea (Jomopans) portal
- Visualize mapped results of sound metrics
- Tools to calculate Good Environmental Strategy (GES)

A Possible Approach

From Deployment to Archiving, a possible approach

This is NCEI's workflow, but does not have to be the only approach

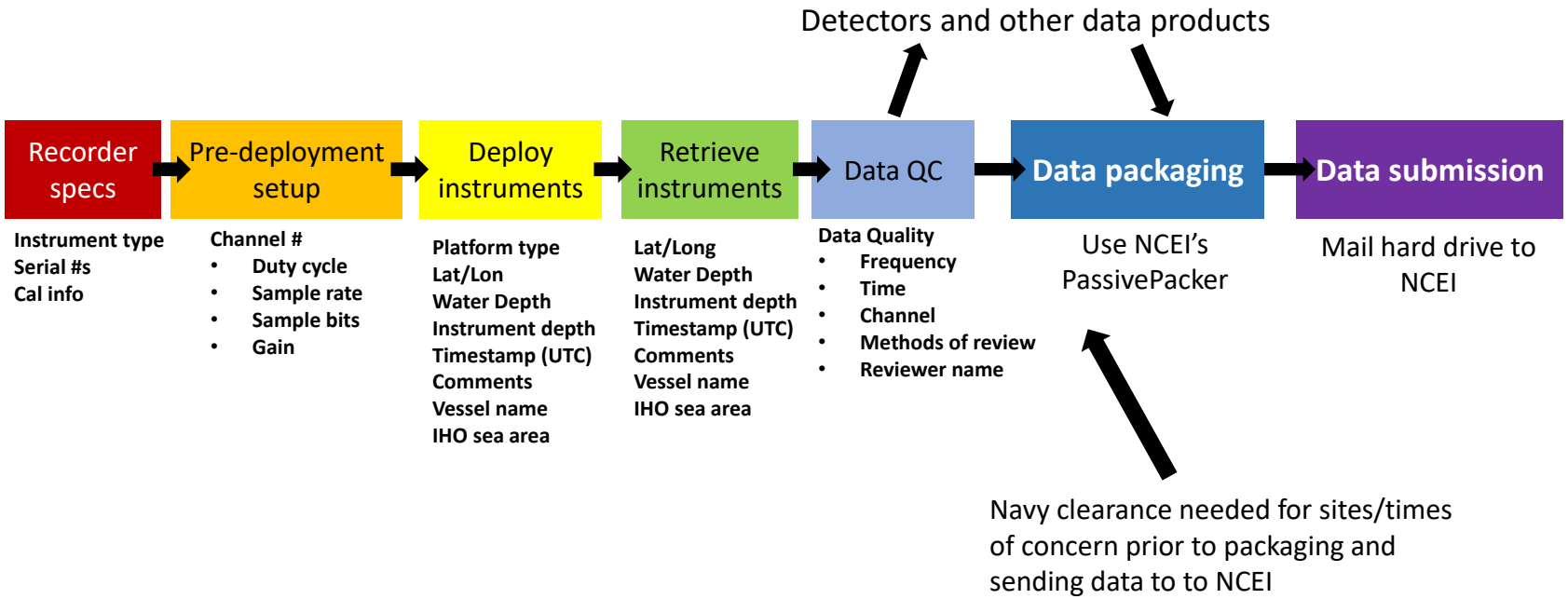
Ask questions, propose additions or alternatives

Let's explore together what it might take

Deployment to Archiving of Raw Data

For whole project
Lead Scientist(s)
Organization
Funding organization
Deployment title
Deployment purpose
Abstract (full description of dataset)
Metadata author/POC

May also include
CTD data
Detections
Observational data

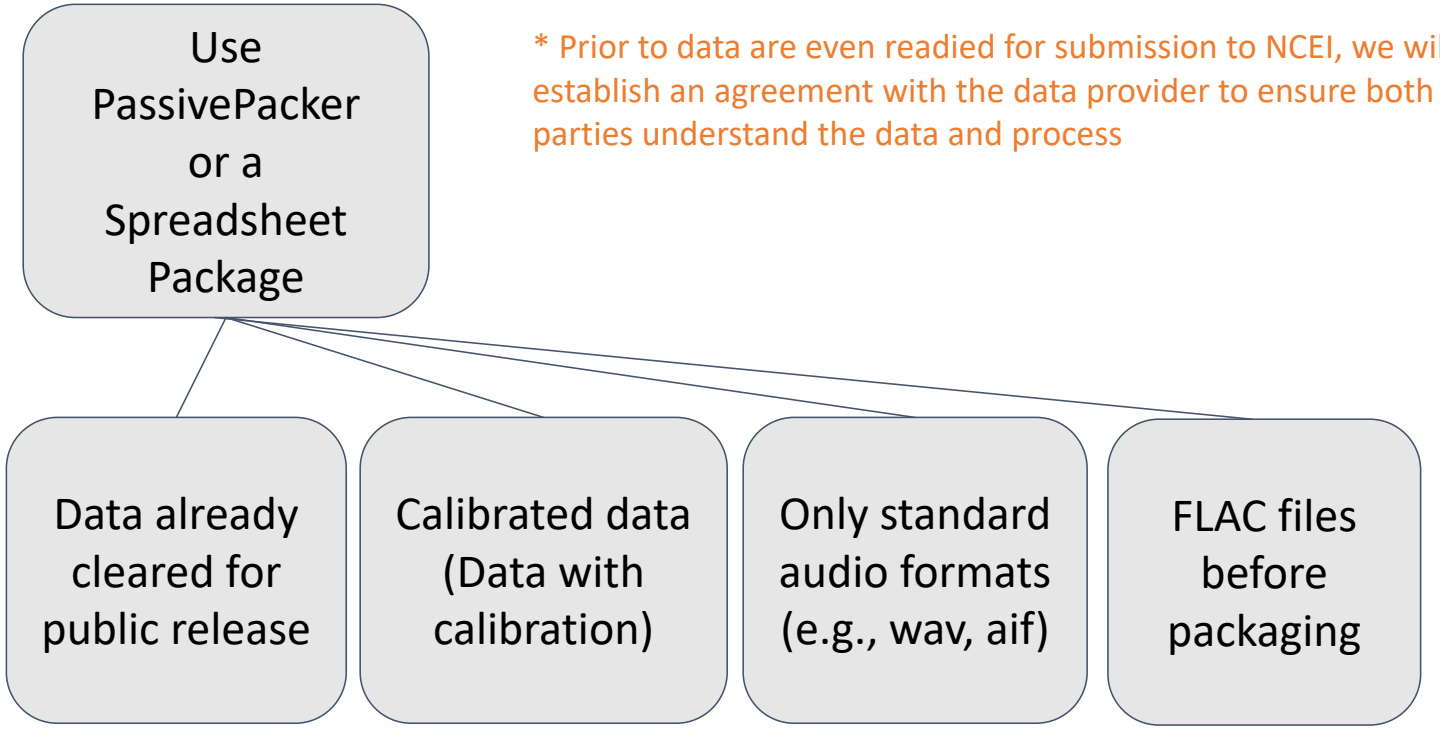


Metadata standards

For example:

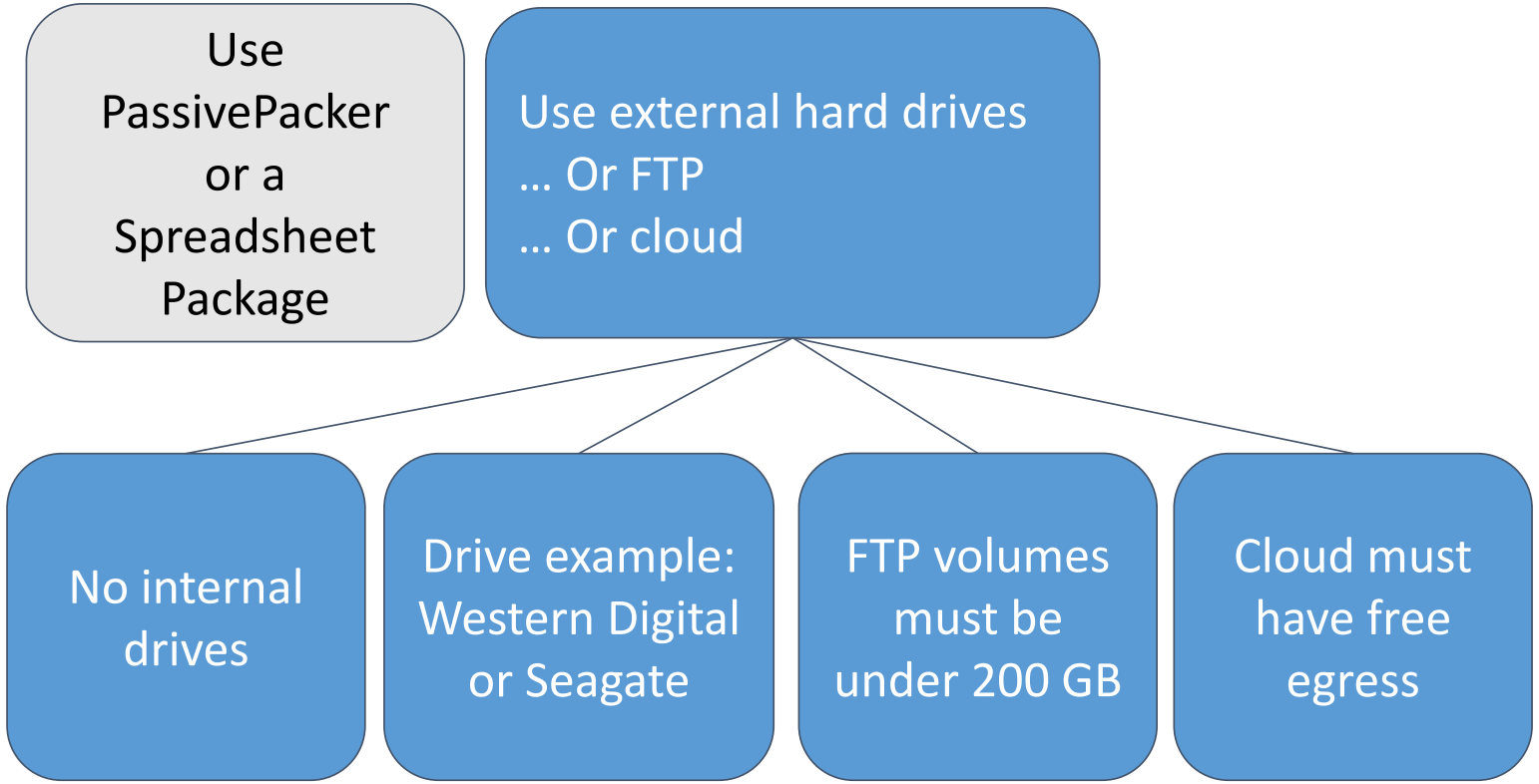
MONITORING_START_DATETIME	The start date time in the ISO8601 format (YYYY-MM-DDThh:mm:ssZ) for the start of usable data for that deployment (i.e. the recorder is on and in the water). Z in date time refers to date time stamps in UTC time zone. See https://en.wikipedia.org/wiki/ISO_8601 for further information on ISO8601 formats and time zones.	DATETIME in ISO8601 format (YYYY-MM-DDThh:mm:ssZ)	2006-01-06T00:00:00Z
MONITORING_END_DATETIME	The end date time, in ISO8601 format (YYYY-MM-DDThh:mm:ssZ), for the end of usable data for that deployment (i.e. the recorder is off or no longer in the water).	DATETIME in ISO8601 format (YYYY-MM-DDThh:mm:ssZ)	2006-03-29T00:00:00Z
DEPLOY_LAT and RECOVER_LAT	Latitude of recorder, in decimal degrees (DD). For mobile data, this field will be blank and will refer to the GPS submitted data instead.	Numeric in DD	42.4697
DEPLOY_LON and RECOVER_LON	Longitude of recorder, in decimal degrees (DD). For mobile data, this field will be blank and will refer to the GPS submitted data instead.	Numeric in DD	-70.2403
DEPLOY_BOTTOM_DEPTH and RECOVER_BOTTOM_DEPTH	Water depth (meters) where the recorder is located (may be blank for mobile data).	Numeric	-66.4

Archive Guidelines: Getting data ready

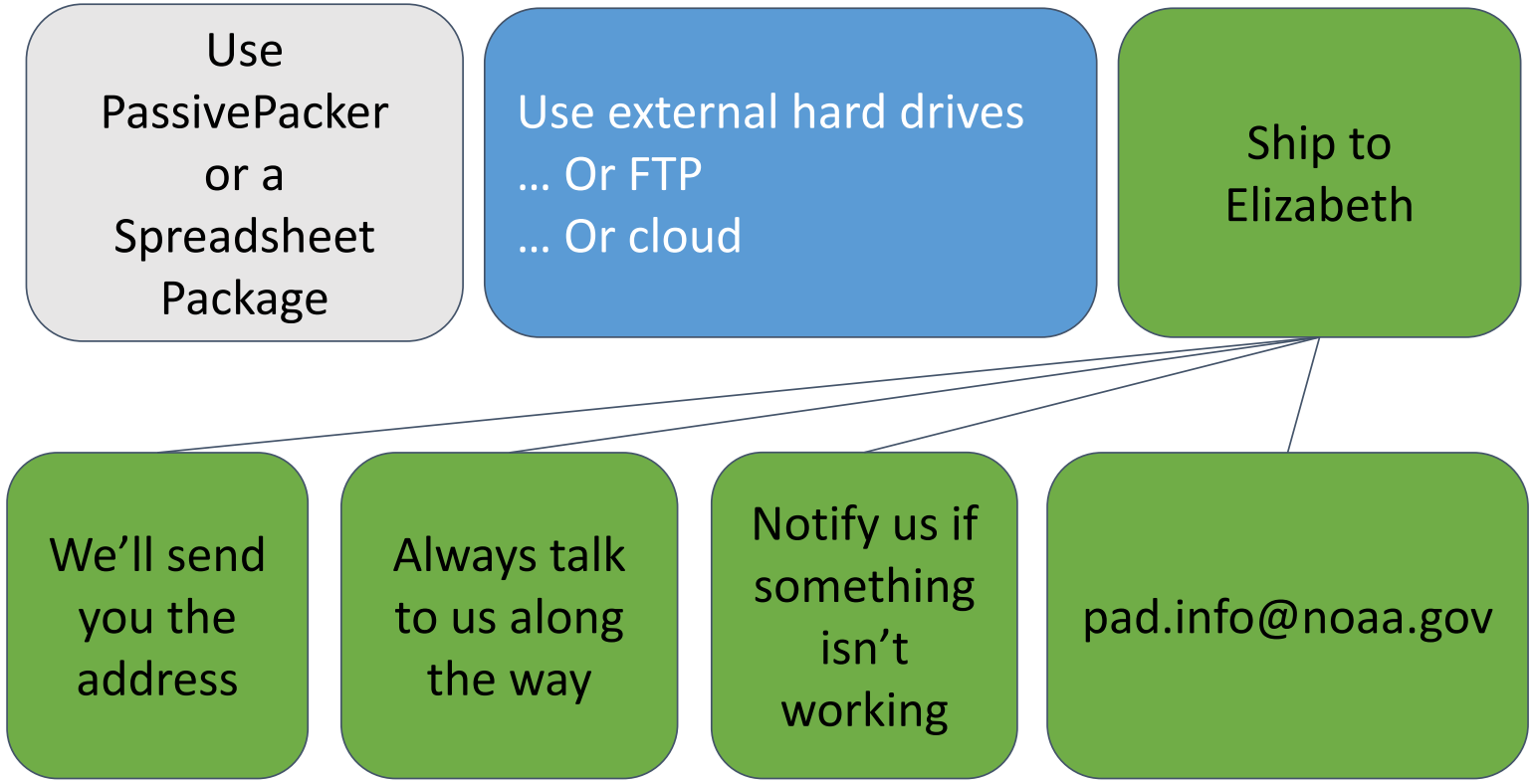


* Prior to data are even readied for submission to NCEI, we will establish an agreement with the data provider to ensure both parties understand the data and process

Archive Guidelines: Ways to send data

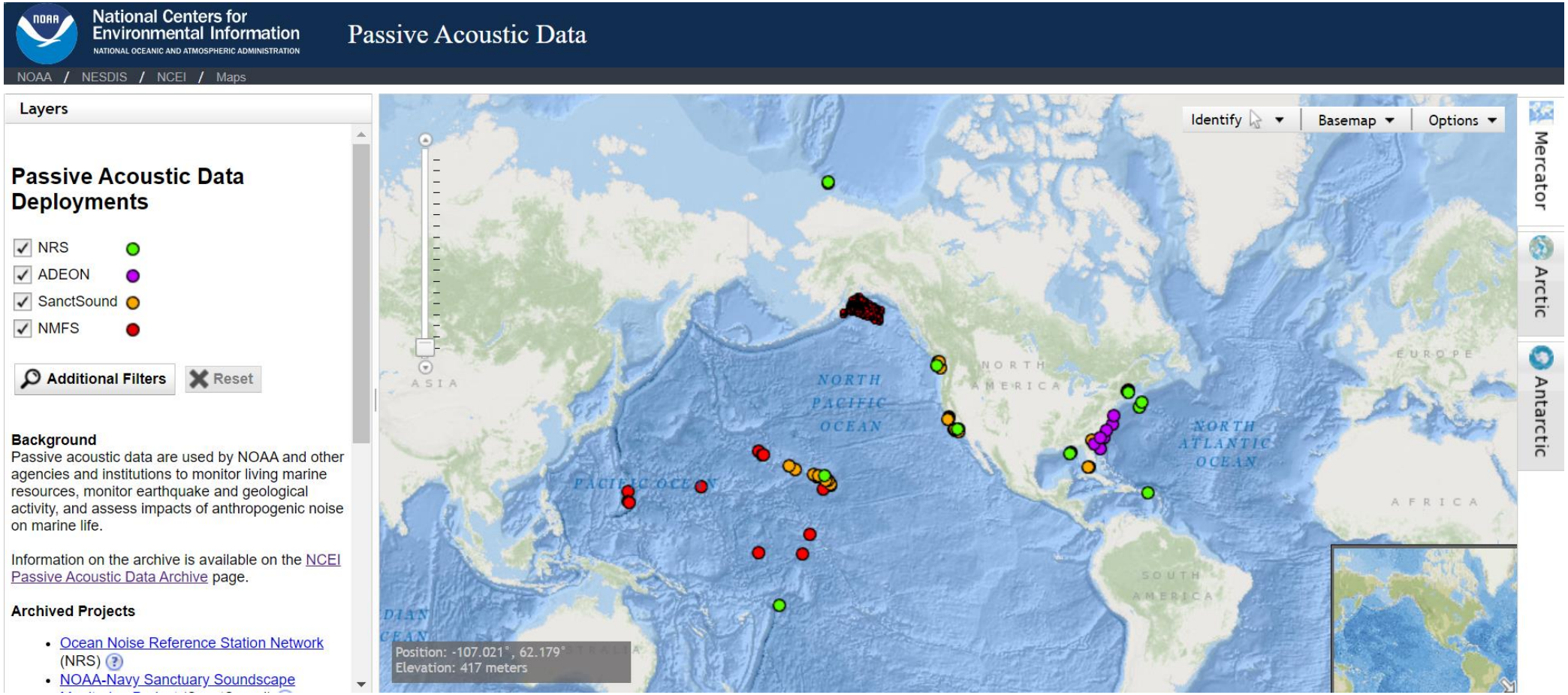


Archive Guidelines: Communicate with our team



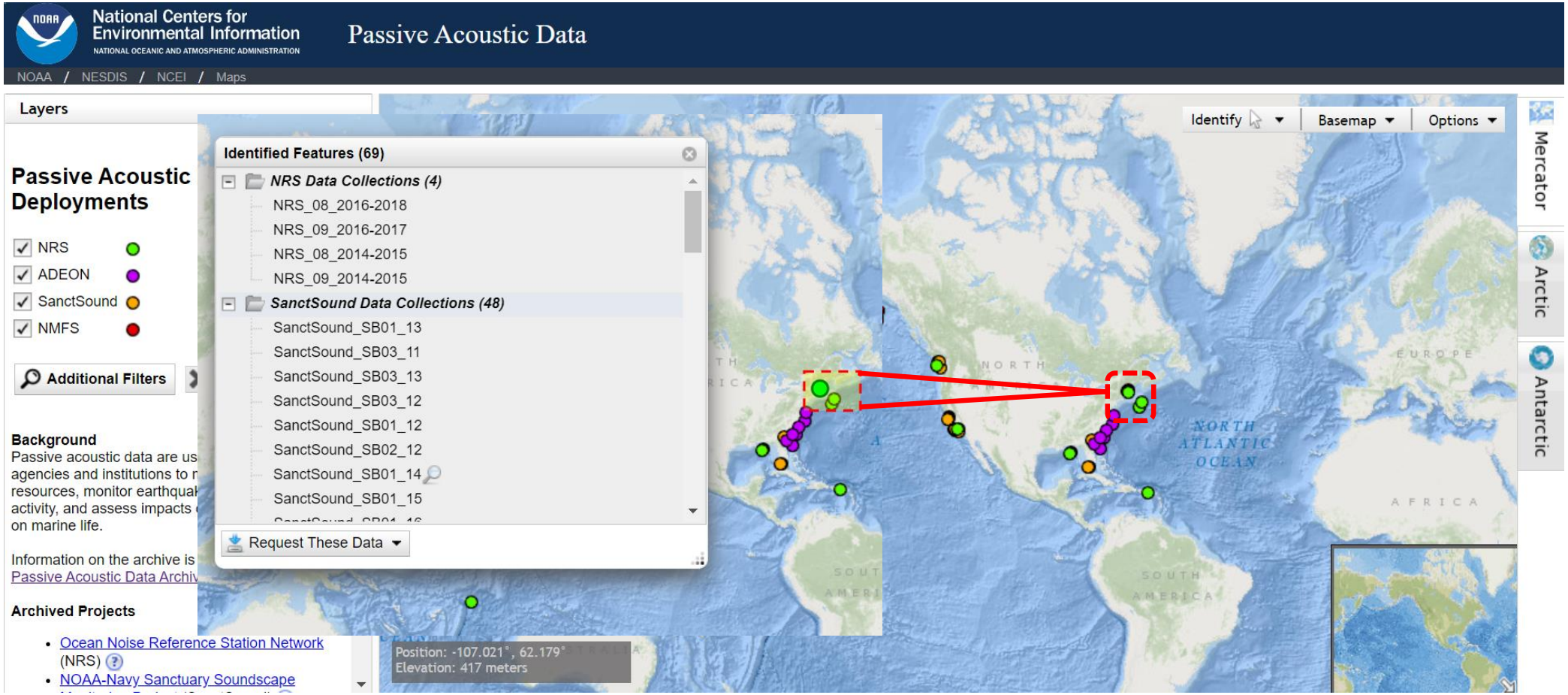
NCEI Passive Acoustic Map Viewer

www.ncei.noaa.gov/maps/passive_acoustic_data/



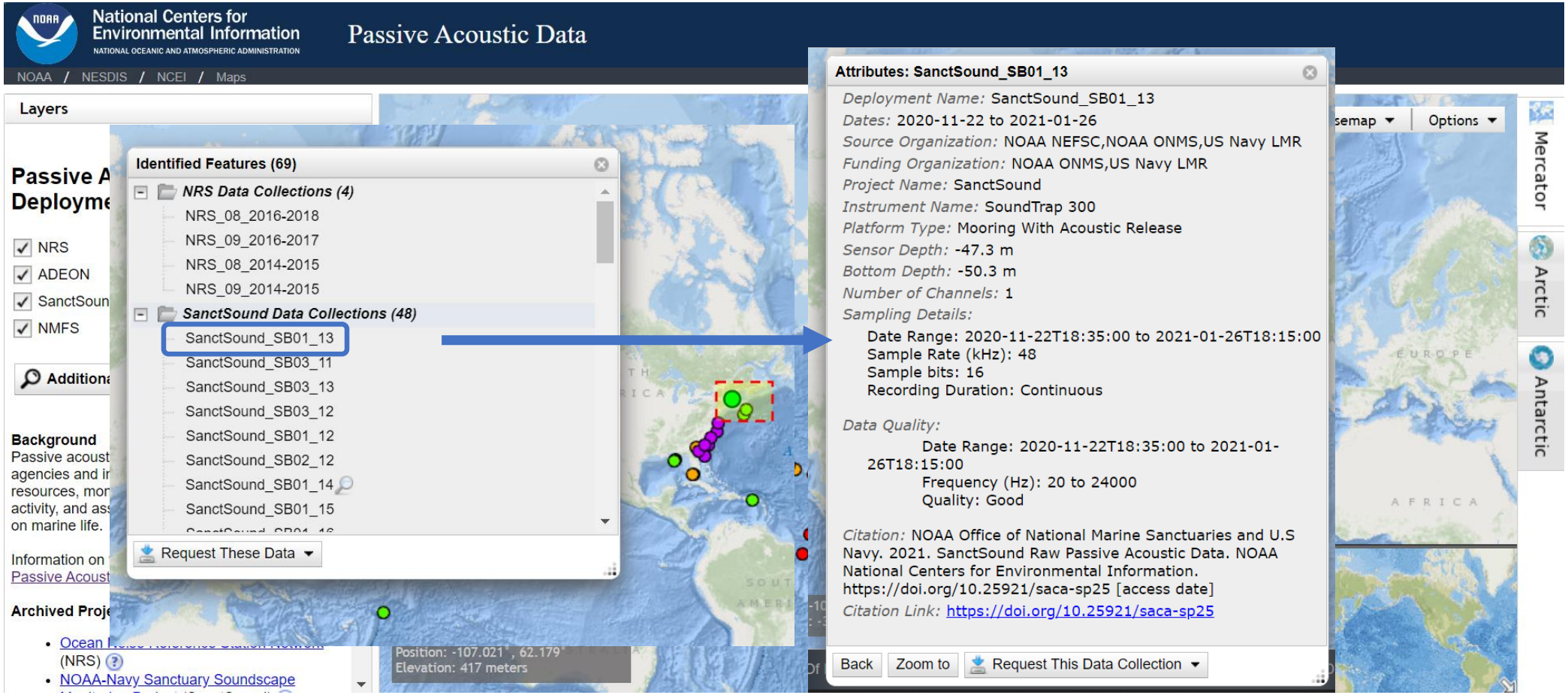
NCEI Passive Acoustic Map Viewer

www.ncei.noaa.gov/maps/passive_acoustic_data/



NCEI Passive Acoustic Map Viewer

www.ncei.noaa.gov/maps/passive_acoustic_data/



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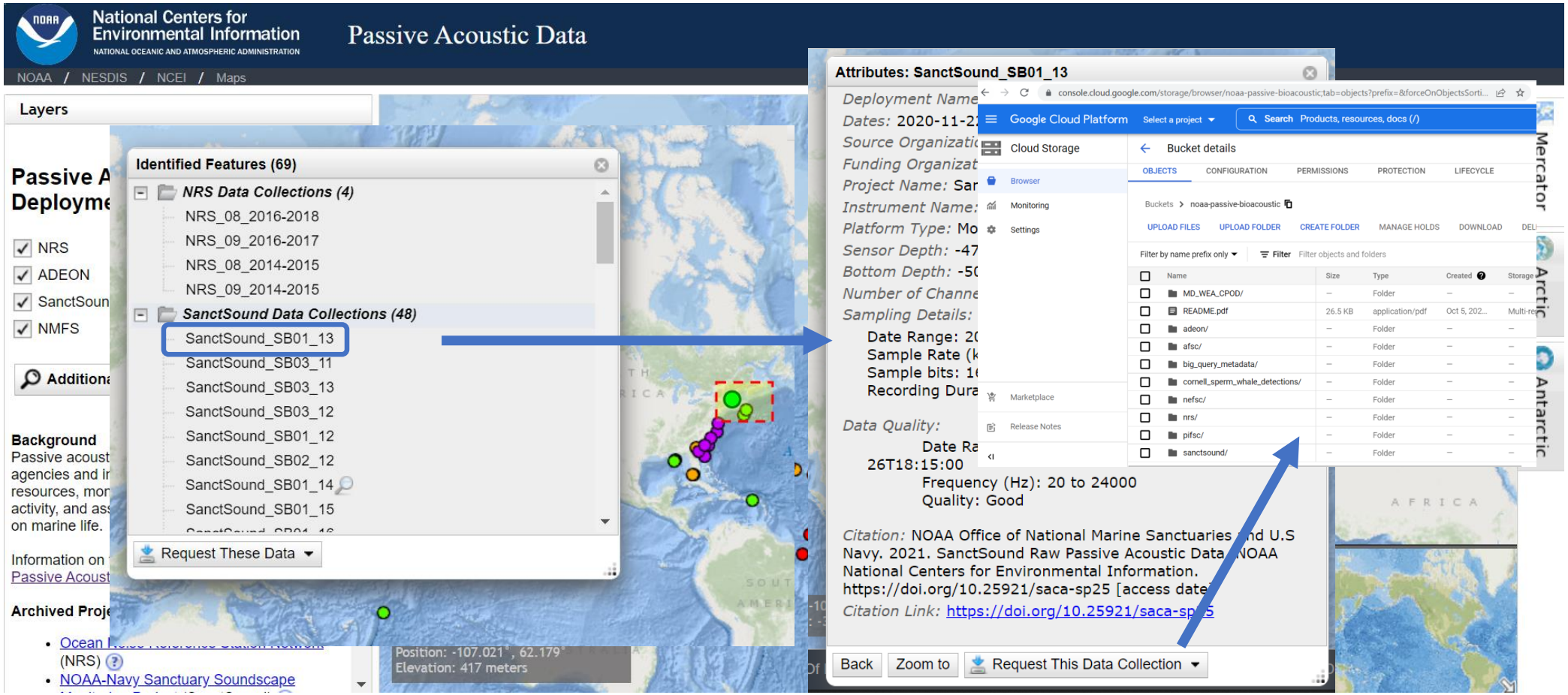

U.S. Department of the Interior (DOI)

The DOI protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

Bureau of Ocean Energy Management (BOEM)

BOEM's mission is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.