OCS Study
BOEM 2024-064

Collaboratively Developing a Vision for a Pacific Passive Acoustic Monitoring Network for Marine Mammals

Workshop Summary
May 21-22, 2024

U.S. Department of the Interior
Bureau of Ocean Energy Management
Pacific Regional Office, Camarillo, CA

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BUREAU OF OCEAN ENERGY MANAGEMENT

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ABOUT THE COVER

View of the Golden Gate Bridge from the Baylis, a local sailing research vessel, during a sunset cruise after day 1 of the workshop. Photo taken by Ingrid Biedron.

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List of Abbreviations and Acronyms

3D	three-dimensional
AB	Assembly Bill
ADCP	Acoustic Doppler Current Profiler
AI	artificial intelligence
AURAL-M2	Autonomous Underwater Recorders for Acoustic Listening- Model 2
BACI	Before-After-Control-Impact
BOEM	Bureau of Ocean Energy Management
CalCOFI	California Cooperative Oceanic Fisheries Investigations
CBI	Consensus Building Institute
CeNCOOS	Central & Northern California Ocean Observing System
CETACID	Cetacean Caller-ID
CMA	Center for Marine Acoustics
COP	Construction and Operations Plan
CREEM	Centre for Research into Ecological and Environmental Modelling
DASBR	Drifting Acoustic Spar Buoy Recorder
DOI	Department of the Interior
ESA	Endangered Species Act
HARP	High-Frequency Acoustic Recording Packages
IOOS	Integrated Ocean Observing System
IRA	Inflation Reduction Act
kHz	kilohertz
km	kilometer
MBARI	Monterey Bay Aquarium Research Institute
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
MPA	Marine Protected Area
NCEI	National Centers for Environmental Information
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act

NGO	non-governmental organization
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NYSERDA	New York State Energy Research and Development Authority
OCS	Outer Continental Shelf
OPC	Ocean Protection Council
OPR	Office of Protected Resources
OSON	Ocean Sound Observation Network
OSU	Oregon State University
OSW	offshore wind
PACM	Passive Acoustics Cetacean Map
PAM	Passive Acoustic Monitoring
PMEL	Pacific Marine Environmental Laboratory
POWERON	POWERON Initiative
PRD	Protected Resources Division
PWSC	Pacific Wildlife Science Collaborative
QA/QC	Quality Assurance/Quality Control
R&D	research and development
RFQ	request for proposal
RWSC	Regional Wildlife Science Collaborative
SCCOOS	Southern California Coastal Ocean Observing System
SWFSC	Southwest Fisheries Science Center
TEK	Traditional Ecological Knowledge
UAS	Unmanned Aerial Systems
UC	University of California
VTS	Vessel Traffic Service
WCODP	West Coast Ocean Data Portal
WEA	Wind Energy Area
WOW	Project Wildlife and Offshore Wind
WRAS	Whale Report Alert System

1 Workshop in Brief

1.1 Overview

In May 2024, the Bureau of Ocean Energy Management (BOEM) convened a two-day workshop in San Francisco entitled "Collaboratively Developing a Vision for a Pacific Passive Acoustic Monitoring (PAM) Network for Marine Mammals." Fifty-six (56) people attended the in-person workshop at the San Francisco Federal Building, with participants ranging from state and federal agencies and California Tribes to academic research institutions, offshore wind (OSW) development companies, and non-profit organizations. Attendees' expertise included effective Tribal engagement, OSW development, oceanography, marine mammal biology and behavior, marine acoustics, research, conservation, outreach, and advocacy. The workshop was facilitated by Patrick Field, Senior Mediator at the Consensus Building Institute (CBI).

The primary objectives of the workshop were to:

- Draw lessons on regional marine mammal monitoring via acoustics and collaboration framework from the East Coast experience.
- Review the PAM work to date on the West Coast for long-term ecosystem monitoring and identify key gaps and needs moving forward.
- Identify efficiencies and opportunities for collaboration to address key gaps and needs.
- Define potential steps to advance an inclusive, efficient, and effective U.S. West Coast PAM network partnership.

1.2 Key Takeaways

The workshop focused on leveraging current efforts and partnerships across the Pacific region to develop a comprehensive PAM network to monitor potential impacts of OSW development on marine mammals. Key concepts discussed included robust collaboration, coordination, data sharing, sustainability, efficacy, and technology integration. In summary, the workshop participants:

- Elicited lessons from the U.S. East Coast PAM network to inform expanding and enhancing the current U.S. West Coast PAM network to be more robust, collaborative, strategic, and efficient.
- Built shared understanding of current PAM activity along the U.S. West Coast, noting the extensive work done and being undertaken by the West Coast Ocean Sound Observation Network, and identified gaps where further information and monitoring effort is needed.
- Described the unique features of the U.S. West Coast and what resources would be needed to ensure a robust West Coast PAM network.
- Highlighted better practices for effective engagement of local Tribes and meaningful integration of Traditional Ecological Knowledge (TEK).
- Started to build a collective vision for a U.S. West Coast PAM network geared towards evaluating OSW impacts.

The group also defined potential specific, actionable steps for strategically growing the network, including:

Near Term (Years 1-3)

- Coordinate an effort to collate all existing PAM data sources and add them to West Coast Ocean Data Portal, develop the scientific questions related to OSW that can be addressed using PAM,

and design a research plan to address these questions and the research gaps identified in this report.
- Establish a catalyzing entity to support launching and establishing coordination activities in the short term and assist transition to the coordination entity.
- Establish a coordinating entity for the long-term support and management of the U.S. West Coast PAM network for OSW.
- Begin/increase engagement with Tribes now and continue to engage with Tribes as planning proceeds (especially Tribes in the Wind Energy Area [WEA] regions) to enhance their capacity to design and conduct monitoring.

Longer Term (Years 3+)

- Expand the West Coast Ocean Sound Observation Network's scope and infrastructure for OSW (data collection, technologies, funding mechanisms, staffing, data sharing, etc.).
- Refine and develop new robust analytical tools for data integration (e.g., machine learning and artificial intelligence) to process large datasets more efficiently.
- Formalize Tribal participation and positions for Tribal representatives (e.g., Memorandums of Agreement [MOAs] and subcommittees), where they are part of the planning and decision-making processes).
- Standardize data collection and protocols across network partners to support consistency and comparability across different studies and regions, leveraging or joining existing models like SanctSound, NMFS PAM Strategic Initiative, Ocean Sound Observation Network, SoundCoop, BioSound, etc.

2 Shared Learning and Understanding

2.1 Introduction

On May 21-22, 2024, BOEM convened an in-person workshop in San Francisco with a diverse group of subject matter experts ranging from state and federal government officials to Tribal members, marine scientists, policy analysts, marine mammal researchers, bioacousticians, and OSW developers. (Refer to **Appendix A** for the workshop agenda and **Appendix B** for workshop participants.)

Collectively, fifty-six attendees met to discuss and reflect on the following questions:

- What makes the U.S. West Coast unique compared to the U.S. East Coast?
- What does current PAM activity along the U.S. West Coast look like? Which areas have greater PAM activity, and where are there gaps in our understanding?
- What does current OSW activity off the U.S. West Coast look like? Are there plans to expand OSW efforts in the near future? If so, what would that look like?
- What do you envision for a well-coordinated, standardized West Coast PAM network that addresses the potential impacts of OSW development on marine mammals? What resources are needed to ensure the network is robust, successful, and all partners are meaningfully engaged?

Over the two days, workshop participants engaged in a variety of activities, including plenary presentations, breakout group discussions, individual reflection, and report backs.

The workshop was structured to allow participants to focus on relationship building as well as in-depth content discussion. Individuals also had the opportunity to participate in a sunset sailing trip on the evening of Day 1 of the workshop and a social hour at the end of Day 2 of the workshop.

2.2 Purpose and Intent of the Workshop

2.2.1 Welcome, Workshop Purpose, and Land Acknowledgment

Ingrid Biedron and Desray Reeb, BOEM, welcomed participants and highlighted the importance of partnerships in addressing environmental monitoring needs and noting significant changes in recent years. They emphasized that the U.S. West Coast PAM network workshop was about sharing information and fostering discussions, not reaching consensus.

Hillary Renick, BOEM Tribal Liaison Officer, led the land acknowledgment. She highlighted the historical and cultural significance of the workshop location, stressing the importance of recognizing the Tribal people and their ongoing engagement and contributions.

2.2.2 BOEM and NOAA Fisheries Roles / Perspectives for Utilizing PAM

Dr. Reeb provided an overview of BOEM's role and the regulatory framework governing OSW development, including the need for environmental assessments and Tribal collaborations. She walked through BOEM's role throughout the timeline of an OSW project's operations, from planning/analysis to decommissioning. She emphasized that a robust U.S. West Coast PAM network will require a multidisciplinary and collaborative approach to navigate the unique challenges of OSW development in the West Coast region. At a later point in the workshop, Dr. Reeb also shared an update on BOEM's Five-Year Renewable Energy Leasing Schedule.

Caroline Good, from the National Oceanic and Atmospheric Administration's National Marine Fisheries Service's (NOAA Fisheries) Office of Protected Resources (OPR), shared the role and importance of PAM in supporting NOAA Fisheries' work. She reviewed how NOAA Fisheries uses both archival and near-real-time PAM. From NOAA Fisheries' perspective, PAM will become an increasingly important tool for assessing and managing marine mammals. Potential PAM-related needs include technical guidance on performance, limitations, and applications; additional resources, including personnel, infrastructure, equipment, etc.; national and regional data-sharing repositories and public portals; and frameworks for partnerships.

2.3 Presentations | Context and East Coast PAM

2.3.1 PAM in the Context of a Multidisciplinary Monitoring Network

Several presenters shared context, activities, and status updates for the East Coast PAM network related to OSW.

2.3.1.1 PAM Regulatory Mitigation and Monitoring Atlantic Offshore Wind

A presentation by Nick Sisson, NOAA Fisheries Greater Atlantic Regional Fisheries Office (GARFO) Protected Resources Division (PRD) and Jaclyn Daly, NOAA OPR, reviewed the regulatory perspective and the application of PAM in mitigation and monitoring efforts for OSW projects along the U.S. East Coast. Mr. Sisson presented the regulatory framework under the Endangered Species Act (ESA) for Biological Assessments and resulting Biological Opinions that inform the development of mitigation measures. Articulating clear management needs can enhance the study design and utility of PAM data. PAM plays an essential role in collecting baseline pre-construction data to understand marine mammal

habitat usage and refine mitigation measures. PAM also supports monitoring mitigation zones during construction/operations to help trigger mitigation actions to reduce risks to marine mammals. It is therefore important to deploy PAM systems prior to the start of construction to understand ambient noise levels and soundscape, which are both important factors when assessing the effectiveness of the PAM systems used for mitigation. Mr. Sisson echoed Dr. Reeb and Dr. Good's recommendations for multidisciplinary and collaborative PAM planning and management. For enhancing PAM to inform mitigation and monitoring measures, Mr. Sisson shared the following considerations:

- Effectiveness of hardware/software for mitigation/monitoring goal (e.g., detector performance of species of interest, detection range relative to ambient and target sounds, and sampling rate relative to species of interests' activities)
- Technological systems (e.g., stationary vs. mobile, battery life, and communication capabilities)
- Mitigation zones and monitoring duration (e.g., distance to thresholds and species calling behavior)
- Data storage
- Criteria for assessing proposed systems

2.3.1.2 BOEM's Long-Term PAM Data Needs

Erica Staaterman, BOEM Center for Marine Acoustics (CMA), reviewed BOEM's long-term PAM data needs and lessons learned from the East Coast. While BOEM's overarching regulatory and scientific needs on the East Coast focused the PAM question on *baleen* whales, Dr. Staaterman suggested modifying the question for the West Coast, "Are there changes in the distribution of *soniferous* species as a result of OSW development?" Dr. Staaterman reviewed the monitoring requirements for East Coast OSW lessees, including conducting long-term monitoring of ambient noise, whale, and fish vocalizations pre-construction (one year) and post-construction (three to ten years) as part of the lessee's Construction and Operations Plan (COP). Instead of conducting PAM themselves, lessees can meet their COP requirement by providing funds to support this work through BOEM's Environmental Studies Program (the POWERON initiative). The POWERON team will conduct PAM in the lessee's area. POWERON takes on both the responsibility and the risk; however, benefits include ensuring standardized data collection, reducing lessee's costs, and optimizing regional data pooling.

Dr. Staaterman reviewed the U.S. East Coast PAM network project phases (including who is involved in which phase) and the potential deployment locations in the New York Bight. She noted that BOEM intends to invest in tetrahedral pressure sensors to go beyond simply detecting animal "presence" and detect bearing and location and deploy early to get data *between* lease areas (where lessee requirements do not apply). Dr. Staaterman emphasized the importance of collecting comprehensive baseline data before construction to understand the long-term impacts of OSW. She added that while many lessons from the East Coast are applicable, the West Coast will need to consider how to address major differences such as deeper waters and different species compositions.

2.3.1.3 Discussion

Takeaways from questions/comments from workshop participants related to Mr. Sisson, Ms. Daly, and Dr. Staaterman's presentations include:

- Interpretation of PAM data is somewhat dependent on the software/hardware used. No single algorithm universally exists for detecting and identifying all species. However, there are guidelines and methods to standardize the interpretation of data.
- The length of post-construction monitoring – three to ten years – was selected based on East Coast variables (e.g., decadal climatic variability). Three years is too short generally and may overrepresent conditions (e.g., heat waves). A longer time range allows for more accurate

projections, determining if any changes occurred (multivariate analysis), and then reassessing monitoring/management needs.
- Future efforts on the West Coast should aim to include Tribal Nations more comprehensively from the outset.
- It is uncertain who will be responsible for data processing. National Centers for Environmental Information (NCEI) will archive the data. The PAM portal is intended to be national.

2.3.2 PAM Deployment Technologies, Purpose, and Extent Along the East Coast

Sofie Van Parijs, NOAA Fisheries Northeast Fisheries Science Center (NEFSC), provided an overview of the PAM deployment technologies, purpose, and extent of the U.S. East Coast PAM network for OSW. She walked through several key considerations when using PAM and how these have been implemented for U.S. East Coast PAM:

- Species and sources of interest – e.g., marine mammals, fish, anthropogenic sounds, etc.
- PAM recording technologies – e.g., archival (bottom-mounted, acoustic tags, telemetry tags) and real-time (moored buoys, gliders, towed arrays, drop hydrophones, and drifting buoys)
- PAM system requirements – System requirements depend on information needs such as the target species' acoustic signatures (e.g., most baleen whales' acoustic energy is under 1 kHz), and their acoustic detection ranges (e.g., North Atlantic right whales are detected as far out as 10 km).
- PAM data collection design – As of May 2025, at least 200 PAM recorders were deployed along the East Coast, with data collection efforts growing exponentially through multi-agency collaboration. Three years of baseline passive acoustic recording were collected prior to pile driving. Eight species and one genus of cetacean were monitored specifically.
- Information that PAM data can provide – In the Atlantic, data showed vessel presence overlapping continuously with low-frequency cetaceans. However, the drivers for changes in species distribution could be the result of other factors (e.g., environmental) alongside anthropogenic impacts. A robust study design can help detect and understand abnormalities.
- Archiving and reporting PAM data – Dr. Van Parijs cautioned about realities like the overwhelming amount of data to process. She also noted the importance of processing and reporting PAM data in an accessible way. NEFSC has been working with partners to build the U.S. East Coast PAM's data processing capacity to create decision-support tools such as a Passive Acoustics Cetacean Map (PACM) web portal.

2.3.2.1 Discussion

- Developers receive many requests for raw data from a variety of sources. It would be helpful to better communicate to everyone the volume of data being considered here (many terabytes); it is a big technological and human resource investment.
- Consider convening several teams to help process the data. Part of this effort with Inflation Reduction Act (IRA) funding includes helping to streamline processing. Groups are also speaking with major tech companies to explore data storage on the cloud.
- Recordings are retained permanently as part of the public record. This might be sensitive for Tribal Nations and warrants further discussion.

2.3.3 Collaboration Across States, Federal Agencies, and Researchers on the East Coast

Emily Shumchenia, Director of the Regional Wildlife Science Collaborative for Offshore Wind (RWSC), shared the efforts and initiatives of the RWSC in organizing and coordinating research activities across states, federal agencies, and researchers as part of East Coast OSW development. The RWSC has played a major role in supporting the U.S. East Coast PAM network for OSW, particularly the RWSC Marine

Mammal Subcommittee, which leads regional PAM coordination discussions. This subcommittee prioritized the development of long-term/archival PAM data management practices (December 2022) and identified the research need, which led to a study to help optimize the placement of sensors (May 2023). The Marine Mammal Subcommittee also hosts meetings to review developers' PAM plans (as required by BOEM in Conditions of COP Approval).

Dr. Shumchenia shared several recent RWSC activities, including the results of a simulation study conducted by the RWSC Marine Mammal Subcommittee and funded by BOEM, which assessed the statistical power of a regional-scale PAM network to detect potential changes in the distribution or behavior of baleen whales due to wind farm construction and operation (Chudzinska and Thomas 2023). One of the major takeaways was that a T-shaped array had the highest statistical power to detect regional whale displacement from WEAs. Additionally, RWSC has been involved with and has supported other East Coast coordination activities to foster consistent data collection and management. The current status of RWSC U.S. East Coast PAM coordination activities includes:

- Suggested arrays configured to maximize the ability to detect displacement from WEAs broadly
- Standardized deployment data request – collected via form
- Subcommittee members committed to sharing exact coordinates of deployments on a public map (improve communication and minimize conflict with other ocean users)
- New maps/datasets will soon be launched with these changes

2.4 Panels | Lessons Learned and Guidance

2.4.1 East Coast PAM

Workshop facilitator Patrick Field moderated a panel of those involved with the U.S. East Coast PAM network to offer lessons learned that could inform the next steps in expanding and enhancing the U.S. West Coast PAM network. Workshop participants were also invited to ask questions of the panel. Panelists included:

- Laura Morse, Invenergy (OSW developer)
- Cynthia Pyć, RWE (OSW developer)
- Brandon Southall, Southall Environmental Associates, Inc.
- Erica Staaterman, BOEM CMA
- Jaclyn Daly, NOAA Fisheries OPR
- Caroline Good, NOAA Fisheries OPR
- Nick Sisson, NOAA Fisheries GARFO PRD
- Sofie Van Parijs, NOAA Fisheries NEFSC

Lessons learned and guidance for the U.S. West Coast PAM network are summarized below:

Planning, Timing, and Coordination:

- Dr. Van Parijs emphasized the need to keep initial monitoring plans simple and refine them as more information becomes available. The initial lack of clear guidance on PAM standards led to difficulties and scrambling to meet requirements. Future projects should ensure clear guidelines and specifications from the start, particularly for the West Coast, which will have different priorities.
- Dr. Staaterman encouraged mapping existing sensors early in the process to improve coordination and address data gaps more strategically and efficiently. Early placement and strategic positioning of sensors can lead to more effective data collection and better coverage of critical

areas. Mr. Sisson and Ms. Daly also suggested defining the planning areas for potential sensors (not just lease areas) to gather solid data early before permitting applications' environmental review.

- Multiple panelists supported focusing PAM on two or so areas. Dr. Staaterman suggested first focusing on smaller areas with high detection capability (e.g., one lease area and vessel corridor) for a targeted power analysis and sample as much as possible to elicit more substantive and actionable data.
- Ms. Morse and Dr. Southall suggested connecting with the Navy to review its West Coast marine mammal research beforehand, as the Navy's early research/monitoring programs were structured to understand noise occurrence/exposure and response/consequence.
- Ms. Morse also noted the implications of faster-than-expected construction cycles, emphasizing the need to engage developers and regulatory bodies early to be well versed in the pace of development activities for more aligned coordination with monitoring deployment.
- Ms. Pyć emphasized the importance of identifying scientific questions *before* deploying equipment. West Coast developers have more time to plan, which allows for better consideration of similarities and differences in regional conditions. This aids in prioritizing scientific objectives and ensuring the right questions are addressed.

Data Collection for Target Species:

- Dr. Southall stressed the need to prioritize which species, areas, and times are most critical for monitoring. Different species have varying levels of data available, and strategic placement of sensors should reflect these priorities.
- Ms. Pyć pointed out the benefit of analyzing regional similarities and differences to tailor scientific questions and methodologies. For example, the East Coast had clear priority species (North Atlantic right whale); the West Coast will need to clearly identify the target species and PAM goals to tailor the PAM design appropriately.
- Ms. Daly highlighted that no single technology could address all monitoring needs. A combination of technologies is necessary to cover different species and environmental conditions effectively. Ms. Morse cited examples where multi-modal sensor platforms, combining archival and real-time data, have provided significant information for species of concern. These platforms should be considered for future monitoring efforts.

Technology and Methodology:

- Mr. Sisson discussed the balance between adopting new technologies and ensuring they can be effectively deployed. For example, gliders can provide valuable oceanographic data alongside PAM, but their deployment needs to be carefully planned.
- The panel discussed balancing technological advancements with deployment capabilities and utilizing multi-modal methods for more strategic and coordinated placement of sensors. For instance, if an area already has many stationary sensors, use gliders to explore if we can detect where deflected whales go and combine that information with environmental sampling.
- Panelists named several examples to glean lessons learned for deploying multiple sensors (e.g., Mark Baumgartner's research on the East Coast with sensors outside the lease areas, Canada's use of Venus and Neptune arrays, etc.). Dr. Staaterman encouraged engaging with oceanographers early (to ensure that PAM sensors do not conflict with oceanographic sensors).
- Dr. Van Parijs and Ms. Pyć emphasized the importance of considering cost and logistics when choosing technologies. For example, while gliders and multi-modal platforms offer significant benefits, their deployment must be feasible within budget constraints.

- Dr. Southall and Ms. Morse recommended looking at the Navy's long-standing research and monitoring programs on the West Coast. These programs offer valuable insights and methodologies that can inform future PAM strategies.
- Ms. Daly and Ms. Morse highlighted the need for solid data to inform environmental reviews and mitigation strategies. Timely and accurate data collection is crucial for understanding the impacts of OSW development on marine species and habitats.

Leveraging Partnerships

- Mr. Sisson and Ms. Morse discussed the ongoing efforts to standardize procedures while developing regional coordination. They emphasized the importance of having a single coordinating body like the RWSC and leveraging existing constructs like the U.S., Integrated Ocean Observing System (IOOS) regional associations and regional partnerships to streamline efforts.
- Ms. Pyć highlighted the need to identify sustainable funding sources from the outset and to include everyone who should be part of the conversation, like Tribal Nations, from the very beginning.
- Mr. Sisson and Ms. Morse discussed the role of the Coast Guard as a cooperating agency in the permitting process. Effective coordination with the Coast Guard can streamline the National Environmental Policy Act (NEPA) review and ensure smoother deployment of sensors.

Overall, the panelists underscored the need for early planning, clear communication, strategic sensor deployment, and leveraging existing partnerships and technologies to hit the ground running when enhancing a U.S. West Coast PAM network for OSW.

2.4.2 Tribal Engagement and Traditional Ecological Knowledge

Hillary Renick, BOEM Tribal Liaison Officer, opened the Tribal Engagement and Traditional Ecological Knowledge (TEK) panel with a brief presentation on the most recent national guidance on effective Tribal engagement, the 2022 White House Memorandum on Uniform Standards for Tribal Consultation.

Mr. Field then moderated a panel consisting of the following individuals:

- Hillary Renick, member of Pomo and Paiute Tribes, BOEM Tribal Liaison Officer
- Javier Silva, member of the Sherwood Valley Band of Pomo Indians
- Morning Star Gali, member of Pit River Tribe, Executive Director of Indigenous Justice

Together, the three panelists reflected on major questions, such as what the Pacific shoreline and coastal landscape means to them and what meaningful integration of Tribal knowledge and TEK into the PAM network looks like.

For context, panelists shared relevant historical and geographical context about their Tribes. In California, there are 109 federally recognized Tribes, while an estimated 55-75 Californian Native American Tribes are not currently federally recognized. Panelists recounted the history of discrimination and violence that their Tribes have endured; they emphasized that the impacts of historical injustices against Indigenous Peoples continue today, including through the criminalization of traditional practices. Panelists then highlighted the resilient efforts of Tribes to preserve indigenous knowledge, wisdom, and traditions for future generations.

Effective Engagement with Tribes

Panelists shared that to effectively engage Tribal communities, continuous relationships must be built with local Tribes who have the historical, landscape, and cultural knowledge. Panelists added that traditional practices, such as the art of storytelling, are valuable sources of knowledge and dissemination that should be recognized and respected by the PAM network.

Integrating TEK into PAM

The discussion on integrating TEK into the PAM network brought forward several key points:

- Effective Tribal consultation should be based on continuous relationship building rather than transactional interactions (communications that occur only when there is an explicit need without follow-up).
- Tribal knowledge and TEK cannot be separated from Tribes. To incorporate Tribal knowledge into decision making, Tribes themselves must be included in the decision-making process.
- There are significant differences between Tribal values and knowledge and the scientific and academic approaches typically used in environmental monitoring. For example, recording the sounds of the natural world can be viewed as extractive and may not align with the ways in which Tribes traditionally interact with and understand the ocean. More open and respectful dialogue is warranted where these deep-rooted differences in perspectives and values exist to better understand each other.

Better Practices for Tribal Engagement

The panel concluded with recommendations for better practices in engaging and deepening relationships with Tribes:

- Tribal engagement should center around the shared value of environmental justice.
- Efforts should avoid tokenism and transactionality, instead fostering ongoing and continuous relationships with Tribes.
- Engagement should involve a genuine willingness to learn and understand Tribal perspectives with humility.
- Tribes have limited resources and capacity to engage with federal, state, and stakeholder communities. Funding support is needed in the form of honoraria for participation in engagement, as well as to support internal capacity building and inter-Tribal coordination.
- At meetings where multiple Tribes are present, they should be provided with the time and space to discuss the topics at hand.
- More opportunities should be created for Tribal consultation on key issues affecting local Tribes (e.g., impacts of commercial salmon closures and abalone closures on marine mammals and other ocean resources; although Tribes have separate and sovereign rights to still harvest, they often face potential criminal charges regardless).
- By addressing these considerations, the integration of Tribal knowledge and perspectives can enhance the management and monitoring of marine mammal populations, ensuring that the PAM network is inclusive and respects the invaluable contributions of Tribal communities.

2.5 Presentations | What's Happening on the West Coast

2.5.1 Pacific Coast Deployment to Date

Laura Bliss, Coordinator of the West Coast Ocean Data Portal (WCODP), presented the WCODP – a marine planner visualization tool. The WCODP is designed to integrate with other ocean observation portals, offering near-real-time data and historical regional data. Dr. Bliss conducted a demonstration on

how to use the online tool, which includes functionalities such as base map selection, map scaling, and various data layer manipulations. The tool allows users to import their own layers, which can be kept private or shared with others. Dr. Bliss shared an example of the tool's utility and presented how West Coast PAM layers could be combined with wind planning areas to easily visualize and inform sensor deployment and marine spatial planning.

2.5.2 Rapid Review of What's Happening Along the West Coast

On both days of the workshop, several individuals shared brief presentations on activities along the West Coast:

2.5.2.1 Brandon Southall, Southall Environmental Associates / U.C. Santa Cruz

- On the East Coast, Project Wildlife and Offshore Wind (WOW) focuses on studying the impacts of OSW energy on marine mammals and other wildlife. The project involves many different partners, including the OSW industry, and uses complementary tools tuned to different taxa (e.g., fixed, archival PAM; real-time PAM; directional/localized PAM; tagging; biological sampling; environmental/prey sampling).
- A recent study on the acoustic ecology of blue whales in Monterey Bay utilized tagging and acoustic monitoring. Patterns indicated that blue whale distribution could be largely predictable based on oceanic conditions. Other animals, including birds, bats, and sea turtles, are part of the research project (integrating telemetry with real-time conditions).
- Dr. Southall also shared a study measuring the impact of military sonar on delphinid behavior and physiology that utilized a combination of methods, including Theodolite tracking and behavioral observations, unmanned aerial systems (UAS) photogrammetry, PAM, and biopsy sampling.

2.5.2.2 Anu Kumar, U.S. Navy Living Marine Resources Program

- The Navy utilizes a multifaceted approach to marine species monitoring and conservation of living marine resources, particularly marine mammals. Mr. Kumar highlighted ongoing efforts to expand data collection on species occurrence and the application of acoustic-based density estimation techniques.
- Key projects that relate to the PAM workshop include the demonstration and validation of passive acoustic density estimation of right whales; Bryde's whale cue rate/kinematics; Cetacean Caller-ID (CETACID): validating approaches for identifying focal communication signals using acoustic recording tags; and PAM access network: advancing data management and cyberinfrastructure solutions for a big data problem.

2.5.2.3 Lindsey Peavey Reeves, National Marine Sanctuary Foundation / NOAA Office of National Marine Sanctuaries

- As part of the workshop's goal to identify and leverage existing networks, Dr. Peavey Reeves presented several initiatives collaborating to feed data into a long-standing Ocean Sound Observation Network (OSON) across the U.S. West Coast. Partners follow a standardized framework to generate products and tools such as QA/QC data archives, baseline time series of sound monitoring, and soundscapes (characterization, variability, biologics, before-after control-impact [BACI] studies). This integrated West Coast array offers long-term time series and standardized data in a centralized and accessible hub that can support management applications.
- For California, she noted that there is a planned OSON site in the Humboldt WEA (funded by the Central & Northern California Ocean Observing System [CeNCOOS]) and several active sites in the Morro Bay region (with a proposed site in the Morro Bay WEA funded by the U.S. Navy).
- Sound receivers can be deployed in waters of variable depth (19 m to over 1000 m depth).

2.5.2.4 Simone Baumann-Pickering, Scripps Institution of Oceanography / U.C. San Diego

- Scripps has been involved with several long-term PAM networks off California, Washington, and the Gulf of Mexico, with data spanning four months to approximately 20 years. Low-frequency sensors have been used since the 1990s, and high-frequency sensors were deployed in the early 2000s.
- This information helps analyze marine mammal presence trends (e.g., can develop 3D space utilization) and if/how other factors like prey presence or climate may be affecting their presence.
- Many existing moorings are in Navy-focused locations; some are in and near the wind energy lease areas (CADEMO pilot project, Morro Bay, Humboldt).

2.5.2.5 Tetyana Margolina, Naval Postgraduate School

- The Naval Postgraduate School has been collaborating with several partners to use integrated approaches to characterize ocean soundscapes in the Monterey Bay area. The collaborative PAM effort involves:
    - Long-term monitoring at mooring stations (SanctSound and historic) to track long-term variability, trends, and connections
    - Developing high-endurance PAM-capability gliders with onboard processing and real-time reporting
    - Acoustic propagation modeling to estimate receivers' listening spaces for data interpretation

2.5.2.6 Samara Haver, Oregon State University Cooperative Institute for Marine Ecosystem and Resource Studies / NOAA Pacific Marine Environmental Laboratory

- The NOAA Pacific Marine Environmental Laboratory (PMEL) acoustics group uses long-term records of underwater sound to assess the impact of human activities and climate change on marine animals and ecosystems.
- The group also works on the development of novel passive-acoustic recording technologies and analysis tools in partnership with NOAA and extra-agency stakeholders (e.g., renewable energy, blue economy, and ecosystem climate change impacts).

2.5.2.7 William Oestreich, Monterey Bay Aquarium Research Institute (MBARI)

- Three MBARI collaborative passive acoustic projects exploring whale behavior and ecology and anthropogenic noise include:
    - Omnidirectional cabled PAM in Monterey Bay (2015-present).
    - MBARI collaboration with Naval Postgraduate School to use cabled acoustic vector sensing in Monterey Bay (continuously May 2019-May 2022).
    - Further south in the Morro Bay area and the proposed Chumash Heritage National Marine Sanctuary, MBARI collaborated with NOAA SanctSound using archival omnidirectional PAM systems (continuously April/June 2022-present).

2.5.2.8 Angela Szesciorka, Oregon State University

- Dr. Szesciorka shared a map of different PAM systems in various parts of the Pacific, including:
    - Drifting Acoustic Spar Buoy Recorders (DASBRs) used near the Marianas archipelago for beaked whales and other baleen whales

- High-Frequency Acoustic Recording Packages (HARPs) used off the coast of southern California
- DASBRs and sound traps (ST600s) off the coast of Oregon
- Autonomous Underwater Recorders for Acoustic Listening- Model 2 (AURAL-M2s) used off the coast of northern Alaska for North Pacific right whales
- ST600s deployed between Canada and Greenland

2.5.2.9 Margaret Woodridge, U.S. Coast Guard

- In early 2024, the U.S. Coast Guard launched the Cetacean Desk, a 4-year pilot program within the Puget Sound Vessel Traffic Service (VTS) to address vessel traffic impacts on these endangered and threatened animals.
- It is a voluntary program that provides situational awareness on nearby whales to pre-vetted commercial mariners by encouraging reporting sightings via the Cetacean Desk platform and using the Whale Report Alert System (WRAS) program to inform transits.
- Future work includes incorporating additional whale detection technologies like hydrophones and thermal cameras and improving how alerts reach mariners.

2.5.2.10 Henry Ruhl, MBARI / CeNCOOS / Synchro

- Synchro aims to bridge the gap between R&D innovation and widespread adoption of ocean technology by providing a testbed to synchronize and evolve technology for industry, ocean science, and conservation.
- Dr. Ruhl noted the work of CeNCOOS, the Southern California Coastal Ocean Observing System (SCCOOS), and the Northwest Association of Networked Ocean Observing Systems (NANOOS). These regional associations make up the West Coast Ocean Observing systems and collectively promote a healthy and prosperous coastal ocean powered by information solutions. CeNCOOS is a key collaborator of and contributor towards the Synchro initiative.
- Synchro plans to conduct a two-year pilot study evaluating technology for OSW industry baseline and impact assessment.

2.5.2.11 Kathi George, The Marine Mammal Center

- The Whale Safe program is a proactive initiative in Santa Barbara and San Francisco designed to minimize the negative impact of human activities on marine mammals, particularly whales. Whale Safe identifies and tracks ship data and whale presence in real time with the goal of preventing fatal ship collisions with whales.
- Whale Safe focuses on detecting blue, fin, and humpback whales. Whale Safe uses acoustic detection, visual observations, and blue whale habitat model data to calculate Whale Presence Ratings.
- Whale Safe was established in Santa Barbara in 2019 and San Francisco in 2022. Cooperation with NOAA's Vessel Speed Reduction program is currently higher in the San Francisco Region.

2.5.2.12 Shannon Rankin, NMFS Southwest Fisheries Science Center (SWFSC)

- NMFS is developing a Pacific-wide PAM Glider Research to Operations plan to augment ship surveys. Key efforts include deploying PAM-equipped gliders in large-scale surveys (partnering with OSU), building operational capacity, conducting a "glider rodeo" to test instrumentation, plankton to whale surveys, and producing a national strategy roadmap for sharing glider assets.
- The program will run through mid-2026. The group plans to test several types of gliders. They are still in the planning phase, and Ms. Rankin invited feedback or suggestions.

2.5.2.13 Anne Simonis, San Francisco State University

- The BOEM-funded ADRIFT in the California Current project involved deploying drifting buoys to collect acoustic recordings, and since 2020, has been focusing on collecting seasonal observations of marine mammals and soundscapes in California and Oregon WEAs. These drifter observations contribute to beaked whale density estimation, species habitat models, and sound propagation models.
- Collecting the acoustic data requires substantial effort, and the project has expanded its capacity by engaging a broad array of partners, including other researchers, managers, and local whale-watching and fishing captains.
- In central California, they have developed a successful model that combines multiple research tasks (deploy/recover buoys, service seafloor moorings, conduct visual surveys, and accommodate other data collection/experiments wherever possible). These are done as day trips, allowing the group to broaden their engagement to invite others (e.g., young students, artists, journalists, politicians, elders, spiritual leaders, etc.). Dr. Simonis emphasized bringing in these diverse perspectives to help scientific progress thrive.

3 Gaps and Opportunities for a West Coast PAM Network

In facilitated, small breakout groups, workshop participants identified and explored gaps and opportunities for establishing a PAM network on the U.S. West Coast to monitor potential impacts of OSW development on marine mammals by answering the following questions:

- What is different about the West Coast?
- What are the questions we can answer given the current actions and efforts? What questions can we answer by building a more robust network?
- Which species should be of focus?
- How do we engage Tribes and integrate TEK?
- How do we actively incorporate outreach and engagement opportunities?

3.1 Differences Between East Coast and West Coast

During a sticky-note exercise, workshop participants identified several variables that a U.S. West Coast PAM network for OSW would need to consider, given unique differences from the U.S. East Coast PAM network (Table 1). These variables were summarized into the following topics:

- **Depth and unique topography**. A shorter continental shelf to deep waters (with complex topography like canyons and sea mounts) creates a larger and more complex acoustic space to study.
- **Oceanographic conditions.** Marine mammal behavior and distribution will be different due to the West Coast's unique offshore oceanographic conditions. Upwelling dynamics are shaped by the steeper continental slope and canyons closer to the coastline. Other related oceanographic conditions like temperature gradients (and mixing) and seasonal changes also affect marine mammal distribution and behavior.
- **Species composition.** There are different marine mammal species, including more deep-diving species like beaked whales and more resident species. PAM systems will need to be tailored to target species' acoustic signatures.
- **Tribal engagement**. There are more and diverse Tribal Nations along the West Coast who should be engaged early on. Invest in these long-term relationships and partnerships.

- **Offshore wind**. Timing-wise, OSW development is still in its relatively early stages on the West Coast. Participants saw this as a major opportunity to develop a more strategic and robust PAM network with the additional time that the East Coast did not have. Spatially, the network of Marine Protected Areas (MPAs) on the West Coast limits OSW development, and the current set of lease areas is widely separated geographically (a separate power analysis by region would be useful).

Table 1. Sticky-note exercise: Unique features related to PAM on the West Coast. The table below captures key ways workshop participants described how PAM on the West Coast is unique, ranging from topography and oceanographic conditions to coordinating resources and investing in Tribal engagement.

Features of the West Coast	Funding	Deep Water	Fishing	Ocean Habitats and Ecosystem Diversity	Sanctuaries	PAM Data & Monitoring	Tribal Engagement	Coordination	Communication
Only 3 states to coordinate (but very large)	State mandates to fund PAM (or lack of thereof)	Deep(er) water x 9	Coordination of the fishing community	Diversity of ocean. conditions and interplay of scales --> diversity of habitats and variable x5	Many/extensive natural sanctuaries x2	20+ monitoring sites	Many tribes with interest and investment	Lots of existing coordinating already	Communication can be less direct
There are more MPAs on the West Coast that will break up lease areas	Presumably, no IRA money [to fund PAM]	Deep water scale, locations, and distance x9 (e.g., near the coast, distance to port, deeper continental shelf)		Ecosystem management approach is more developed in state laws	Oregon marine reserves (state vs. federal marine protected areas	Lots of current effort	Tribal engagement and collaboration started and needs more resources and effort	Coordinate research sharing with species team	
Less populated port cities compared to east access		Deep water and some different species and issues to tackle		Long dynamic coastline with microhabitats and sharp gradients in species composition		Lots of background/baseline date in Southern CA, but little in NorCal x2		Vessel coordination "team" - coordinates use	
Port access disparities along U.S. West Coast		Deep ocean with challenging winter field conditions		CA current and seasonal upwelling		Open sources analytics share methods openly		List of regional stakeholders to join	
Floating turbines		Deep water WEA site(s)				PAM network is fairly extensive			
		Depth challenges will need different PAM solutions x2				Long-term surveys (e.g., CalCOFI) that involves PAM			
		Bathymetry and deep bathymetry x2				More of mobile PAM platforms			

3.2 Existing Knowledge and Resources

Workshop participants observed there are already substantial amounts of data, experiences, and resources to utilize for enhancing the West Coast PAM network for OSW:

- **Baseline data and species distribution for several species**. Extensive surveys and long-term data collection (visual surveys, NOAA surveys, California Cooperative Oceanic Fisheries Investigations [CalCOFI] surveys, long-term data archives, etc.) exist for us to have an adequate understanding of which species are present on the West Coast. Additionally, there are also rough models that help us broadly predict species' distribution along the West Coast.
- **PAM technology and tools.** Strategically using multiple PAM technologies and platforms will be crucial for a robust PAM network to capture the diversity of marine mammal presence and behavior. Lessons learned from the U.S. East Coast PAM network will help inform monitoring study designs and approaches.
- **Well-covered regions.** Southern California is relatively well covered, whereas certain areas, such as the Lost Coast and Mendocino, have significant data gaps. The Humboldt lease area is also data-poor in terms of marine mammal information.
- **Species of focus**. Overall, participants agreed both mysticetes and odontocetes should be monitored. Frequently mentioned target species for PAM included small odontocetes that are difficult to detect acoustically (e.g., beaked whales), other deep divers (e.g., sperm whales and Risso's dolphin), and offshore baleen whales (e.g., humpback, blue/fin, gray, and North Pacific right whales).
- **Partnerships and Collaborative Initiatives**. Working with other local and regional partners, such as academic/research institutions, marine sanctuaries, local communities, Tribes, aquariums, etc., can leverage existing resources, expertise, and personnel to enhance coverage during critical periods and in underserved areas. Many robust, collaborative partnerships already exist and should be leveraged.

3.3 Gaps/Challenges and Opportunities

Participants caveated that while there are many existing sources of information and resources to leverage, many are not readily accessible to contribute to a robust and effective OSW-focused West Coast PAM network. With a more robust PAM network that integrates these resources, we could have a deeper insight into covariates – oceanographic influences, inshore/offshore trends, behavioral responses, sound-source contributions, long-term population trends, etc.

Sharing Information and Resources

- **Inventory of what we know and have.** Participants expressed a strong need to have a better understanding of relevant data products (e.g., coverage, frequency range, analyses, etc.) and resources (e.g., equipment) to nimbly leverage for a West Coast PAM network. Several individuals cautioned against investing too much time and effort in this exercise at the cost of missing opportunistic situations to collect more data, with clear benefits.
- **Data sharing.** Data sharing has been a struggle for the East Coast. Standardized/comparable data collection methods and open data sharing should be part of the OSW-focused West Coast PAM network's development early on. Multiple participants expressed interest in continuing to build and use the WCODP tool that Dr. Bliss shared. Passive Acoustics Cetacean Map (PACM) plans to eventually extend beyond the Atlantic.

Multi-modal Technologies and Approaches Needed

- **Technological capabilities/limitations (currently)**. PAM should not be the only tool to assess the impacts of OSW activities on marine mammals. Participants identified what tools may be most appropriate for which purposes or under which conditions:
    - Bottom-mounted recorders – Are useful for long-term monitoring at specific sites to derive long-term patterns; however, cannot produce real-time data to trigger immediate management actions and cover a limited spatial area. Also, retrieval can be challenging (especially in deep waters).
    - Gliders – Although expensive, would help reach areas that are difficult to access.
    - Stationary moored buoys – Offer real-time, consistent data from stationary locations (like bottom-mounted recorders); additionally, they can be equipped with other sensors. However, they can have high maintenance costs compared to bottom-mounted recorders.
    - Drifting buoys – Can cover broad spatial areas; however, they have a short deployment duration and are subject to drift (e.g., potentially creating spatial data gaps).
    - Towed arrays – Are useful for covering extensive areas along with other surveys with real-time data but are dependent on vessel logistics (availability/speed/path). They are also limited by vessel noise to detect more high-frequency species and not baleen whales.
    - Omnidirectional hydrophones – Can detect sounds over a wide range in real time; however, very large data sets mean that substantial data processing could be required (continuous monitoring and data analysis needed).
- An ideal robust monitoring network would strategically leverage the capabilities of these various technologies, considering their limitations, costs, and other factors (e.g., probability and timelines for overcoming limitations), to produce an effective multi-modal study design.

Addressing Data Gaps

1. **Lack of coverage in WEAs.** Often these areas, such as the Mendocino coast, are difficult to access or are far away from key facilities (e.g., marine laboratories). Participants signaled this could be an opportunity to more actively collaborate with local Tribes and enhance their capacity to design and conduct monitoring.
2. **Seasonal gaps.** Winter storms often make field work challenging and create seasonal data gaps. There is a need for basic distribution models that capture what species are present for each month of the year. Consider partnering with local or regional entities like marine sanctuaries that can nimbly seize upon time-sensitive opportunities (e.g., good weather conditions).
3. **Biological data gaps.** Participants identified additional factors to study to complement the PAM network (e.g., kelp and other habitats, fisheries, etc.). There was also interest in using PAM to detect prey species.

PAM Deployment

- Find opportunities for PAM deployment by coordinating with OSW lessees' plans to deploy meteorological buoys.
- Participants emphasized working closely with developers and the local communities to expand and enhance the OSW infrastructure and coordinating efforts in alignment with PAM and other key monitoring efforts.

Target Species

- **Prioritizing species.** Ideally, all species of interest would be monitored; however, participants acknowledged limitations like cost would require prioritizing PAM target species. Endangered species will be monitored as part of permit requirements. If there are non-listed species of

interest, several participants encouraged prioritizing species that might have the greatest risk of adverse effects from OSW operations.
- **Sentinel species.** Participants also suggested identifying sentinel species to get a broad sense of impacts (migratory vs. resident species).

Understanding Impacts

- **Cause/effect challenge.** Displacement will be challenging to tie to the source (e.g., climate change affecting prey availability vs. OSW activities). Potential pathways include:
    - Increase effectiveness of predictive models (e.g., track data across shallow and deep waters).
    - Track changes in wildlife distribution and migratory patterns.
- **Holistic perspective.** Rather than just focusing on select species, also foster place-based approaches where possible.

Tribal Partnerships and Other Engagement and Outreach at Multiple Scales

- **Tribal engagement.** Determine what process/structure would work well for the local Tribes (e.g., steering committee, formal agreements [MOAs], caucuses, etc.).
- **Cross-sector, expansive networks.** Leveraging the knowledge and resources of a large network of cross-sector national/international partners can help address large-scale and/or complex questions and help overcome historically prohibitive impasses (e.g., utilizing expensive but promising technologies, navigating complex regulations, etc.). Examples of networks include RWSC, IOOS and regional observing systems, and Synchro.
- **Tailored local-level engagement.** Conversely, focused, and tailored engagement with local entities (local fishing communities, Tribes, whale watching/ecotourism operators, schools, etc.) leverages the local expertise and more timely/nimble response (e.g., help deploy and recover PAM equipment when weather conditions are good). Plus, meaningful engagement in these local areas invests in long-term capacity and relationship building, which are crucial for long-term monitoring, management, socio-economic health, etc.
- **General outreach.** Working with diverse partners will also assist with general outreach and foster accurate messaging before misinformation undermines our shared goals and efforts.

Funding and Sustainability

- **Financial stability.** Build a risk-management strategy for funding sources to prevent interruption when sources protract due to changes in leadership/administration priorities, etc.

4 Potential Next Steps for Advancing West Coast PAM

4.1 Vision and Principles for a Robust West Coast PAM Network for Offshore Wind

Participants envisioned what a successful OSW-focused U.S. West Coast PAM network would look like in five years. It likely would have made significant progress with the following:

- **Answering key questions** related to understanding marine mammal species, distribution, and behavior and better understanding interactions with OSW operations.
- **Covering a broader geographic scope** including control/reference areas and difficult-to-reach regions where there are key data gaps.

- **Focusing on priority species,** including endangered species (and making progress on gathering data on other acoustically detectable species) and sentinel species (to understand broader impacts).
- **Meaningfully engaging Tribes** to collaborate with them through all stages of the process, integrating TEK, and establishing long-term collaborative relationships.
- **Establishing/maintaining a diverse collaborative structure and process** that efficiently collects comparable data from a diverse set of data sources and contributors.

This PAM network would embody the following principles (Table 2):

- **Inclusivity** – incorporating diverse knowledge and perspectives (Tribal engagement in particular)
- **Collaboration** – fostering collaboration across various entities and interested parties
- **Accessibility of information** – emphasizing early data sharing and standardization and making information readily available
- **Robust science** – basing decisions on robust scientific research
- **Responsible stewardship** – advancing management actions to avoid, prevent, minimize, or mitigate negative impacts on marine life
- **Financial resilience** – planning and implementing funding strategies that manage risk and ensure financial sustainability

Table 2. Sticky-note exercise: Principles of a robust PAM network for offshore wind on the U.S. West Coast. This table lists key principles workshop participants identified in five areas that are needed to create a robust offshore wind-focused PAM network on the West Coast - inclusivity, collaboration, data sharing, science-based, and responsible stewardship.

Inclusivity	Collaboration	Data-Sharing	Responsible stewardship	Based on robust science/pre-existing work
Inclusion of first peoples	Collaborative and communication	Easily accessible transparent info-sharing network	Responsible stewardship of marine resources	Driven by evidence-based
Think beyond human timelines	Open communication between parties and frank communication between parties to ensure understanding	Open data that is shareable	Best intentions at all steps	Not re-inventing the wheel, building on existing technology and methods
Human perspective is not the only one	Transparency and communication	Open sharing of data	Ensure mitigation occurs to negate harmful impacts and all voices are represented in the interpretation for this	Consider existing scientific knowledge and resources available to study the species of interest
Driven by community values	Collaborative decision-making	Clear standards, data analysis, public access	Vision towards answering ultimate questions about consequences to animals and what that means to populations	Ongoing data analysis,
Inclusive of diverse persepctives, concerns, needs	Collaborative	Maximize collaboration/activities for data collection		Scientifically founded

Inclusive, respectful collaborations	realistic, collaborative plan			Marine mammal ecology/behavior
Tribes are part of decisions about experimental design/deployment strategy	Clear trusted funded, effective leadership and coordination across west coast states, industry, Tribes, agencies, regulators			Understand baselines and support assessment of impacts
Involvement of public (Tribes, people not on the coast, etc.)	Multi-disciplinary collaboration			Utilize existing resources and build off lessons from the east coast
Overarching collaborative strategy or structures	Multi-disciplinary studies including TEK, PAM, oceanographic and prey			Continue to shape and understand who is doing what
Coordination and consistency	Integrate with other science			Question is well-defined
Continuous engagement with stakeholders				

4.2 Work Plan

4.2.1 Key Leading Roles

Participants identified two new roles essential for launching and sustaining a U.S. West Coast PAM network for OSW – a temporary catalyst to launch the formation of this network in the near term and a coordinating entity for long-term coordination and support.

4.2.1.1 Catalyst/Broker (Temporary, Near Term)

Participants observed that it will take time for the coordinating entity to be identified, form, and become fully functional and operate efficiently (see below). Therefore, the group saw a need for a near-term, temporary catalyst who would broker key initial steps. For example, the New York State Energy Research and Development Authority (NYSERDA) had a similar role in jumpstarting a regional collaboration to monitor the potential impacts of OSW energy. Participants suggested identifying potential NYSERDA correlates in the West (e.g., California Ocean Protection Council) and tracking potential initial funding sources (e.g., California Assembly Bill 80).

The catalyst/broker would initiate, accelerate, and facilitate the establishment and growth of the U.S. West Coast PAM network for OSW. While the coordinating entity focuses on long-term operation and sustainability, the broker drives the initial momentum and sets the foundation:

- Initial strategic planning and tailored engagement (e.g., early Tribal engagement planning and relationship building, other partner/stakeholder identification and engagement, etc.)
- Early awareness and advocacy (e.g., raise general and local awareness of the importance of PAM related to marine mammals [and other soniferous species] and OSW)
- Inventory/audit existing data and resources
- Study effort to collate data sources as well as identify data/resource gaps, who should be engaged to collaborate, and pertinent research questions. This study would feed into a power analysis,

identification of priority areas that need baseline soundscapes, master science plan development, infrastructure/governance needs, etc.

4.2.1.2 Coordinating Entity (Long Term)

Throughout the workshop, participants identified a strong need for an entity to lead coordination and support the long-term sustainability of a U.S. West Coast PAM network for OSW. The East Coast-focused RWSC was named as an example to model. While many participants broadly agreed that the RWSC illustrated successful collaborative support and coordination that substantially advanced the U.S. East Coast PAM network, several indicated that there should be a separate entity focused on the West Coast region.

The group envisioned two potential options: 1) form a West Coast-focused subcomponent of RWSC or 2) create a new steering committee for a West Coast RWSC-equivalent entity. A subset of the existing RWSC would leverage the existing infrastructure and experience; however, this approach risks spreading personnel and priorities too thinly. Conversely, establishing two distinct entities helps maintain the RWSC's goals and efficacy with the East Coast while also ensuring that the West Coast's needs are a priority.

The coordinating entity should have the following criteria:

- **Financially nimble** – capable of fundraising/pooling and distributing funds effectively.
- **Responsive, fleet-footed** – has established workflows and agility to respond to needs and move forward quickly.
- **Trusted and facilitative** – operates in a manner that demonstrates it serves the shared goals and interests of all network partners. A diverse steering committee (which is accountable to the network's partners) should be formed to make decisions like prioritizing research funding.
- **Science and issue expertise** – has a strong background in science and a deep understanding of the relevant issues to guide research priorities.
- **Collaborative (cross boundary)** – works efficiently and effectively across multiple states and with diverse, cross-sector, and jurisdictional groups.
- **Early networking and relationship-building** – invests in fostering interest and buy-in, especially among local grassroots entities.

4.2.2 Partnerships, Engagement, and Outreach

Workshop participants frequently underscored the importance of early and meaningful engagement with Tribes, other potential key partners, and the broader communities. Participants offered several considerations to inform near-term priorities and approaches, many of which were considered crucial for establishing long-term, productive relationships.

4.2.2.1 Engaging Tribes

Workshop participants identified specific actions that would support better-tailored and more meaningful engagement with Tribes:

- Transform Tribal engagement from a secondary, add-on task to an essential and mandatory integration component throughout the process. To do this meaningfully and well, take sufficient time to consult with social scientists to develop strategic outreach and engagement plans (consider focusing on the current WEAs: Morro Bay and Humboldt in California and Brookings and Coos Bay in Oregon).

- Help enhance the Tribal Marine Stewards Network (e.g., part of the coordinating entity's steering committee and/or have a dedicated liaison).
- Government agencies like BOEM should conduct a cultural landscape study to get a better understanding of Tribal interests, viewpoints, needs, engagement interests, etc.
- Explore how particular Tribes or Tribal groups would like to be engaged (short term and long term) and gauge needs/interests in tailored capacity building (e.g., trained protected species observers).
- Consider what internal capacity building is needed (e.g., additional dedicated staff, time, training, etc.) and find ways to fund it.

4.2.2.2 Other Potential Partners and Outreach

- In the near term, engage local communities near existing WEAs (proactively foster grassroots relationships).
- To address the substantial shift in perceptions and trust towards government and academic institutions, leverage and support entities that are still trusted, such as local aquariums.

4.2.3 PAM Deployment

Participants provided specific steps and considerations for deploying PAM strategically and effectively for the U.S. West Coast PAM network for OSW.

- Conduct an assessment to affirm the monitoring research question(s), especially related to OSW operations, and identify other monitoring needs, target species, focus areas, etc.
- Engage other research networks that share comparable approaches/methods and additional key partners early (local communities in the WEA region, Tribes, developers, agencies, etc.).
- Design general monitoring plans (PAM and other monitoring) that consider and align with permitting and OSW construction.
    - Near-term opportunity: who can deploy PAM easily (meteorological buoys by developers); other areas by agencies or research institutions. Focus on northern areas where there are data gaps (San Francisco to Humboldt) outside of the WEAs and areas where future potential WEAs (due to suitable wind energy potential) might be.
- Choose appropriate PAM technology that meets data collection standards and is appropriate for environmental conditions.
- Build capacity and train key partners who will help with monitoring (e.g., Tribes and local communities).
- Develop detailed deployment plans, including logistics, timelines, and personnel.
- Deploy devices and begin data collection (develop contingencies for unpredictable weather/sea conditions, technical issues, etc.).
    - One mooring at each WEA (Humboldt, Morro Bay, Brookings, and Coos Bay).
    - Deep-water mooring with broadband capabilities; attach oceanographic equipment as appropriate (e.g., Acoustic Doppler Current Profilers [ADCPs]).
- Conduct regular maintenance of equipment (leveraging local partners).

4.2.4 Potential Work Plan

The following potential work plan integrates the workshop discussion. Please note the work plan was only partly discussed during the workshop and then further fleshed out by the planning team afterward. This plan is intended to serve as a starting point for planning discussions.

4.2.4.1 Key Activities

Table 3. Proposed work plan activities by year for enhancing a U.S. West Coast PAM network for offshore wind.

Year 1	Years 2-3	Years 3-5+
Identify a catalyst/broker and form an interim steering committee to guide the initial steps for West Coast PAM network development.	Establish data collection and processing standards and protocols.	Expand the West Coast Ocean Sound Observation Network's scope and infrastructure for OSW (data collection, technologies, funding mechanisms, staffing, data sharing, etc.).
Coordinate an effort to collate all existing PAM data sources and add them to West Coast Ocean Data Portal, develop the scientific questions related to OSW that can be addressed using PAM, and design a research plan to address these questions and the research gaps identified in this report.	Deploy initial monitoring equipment in strategic locations (particularly for baseline data in data gap areas).	Collect and analyze data (especially baseline data). Refine and develop new robust analytical tools for data integration (e.g., machine learning and artificial intelligence) to process large datasets more efficiently. Review analyzed data to reassess the network; inform mitigation/management decisions.
Conduct a power analysis to inform the deployment strategy of PAM technology.	Build the capacity of participating entities, especially local partners and Tribes, to design and conduct monitoring.	Review analyzed data to reassess the network; inform mitigation/management decisions.
Engage relevant partners (Tribes, researchers, developers, government agencies, non-governmental organizations [NGOs], etc.).	Continue to conduct outreach and engagement.	Continue to build capacity and conduct outreach and engagement.
Secure initial funding to support network development (particularly for planning and pilot studies).		Formalize Tribal participation and positions for Tribal representatives (e.g., MOAs and subcommittees), where they are part of the planning and decision-making processes).
Establish a West Coast coordinating entity (e.g., Pacific Wildlife Science Collaborative [PWSC]) for long-term support and management of the West Coast PAM network for OSW.		Standardize data collection and protocols across the network partners to support consistency and comparability across different studies and regions, leveraging or joining existing models like SanctSound, NMFS PAM Strategic Initiative, Ocean Sound Observation Network, SoundCoop, BioSound, etc.
Develop outreach and engagement plans (tailored to specific groups as well as broad outreach).		

4.2.4.2 Near-Term Timeline to Create the Coordinating Entity – Pacific Wildlife Science Collaborative (PWSC)

The following outlines specific potential steps for the first year toward forming a U.S. West Coast PAM network for OSW in the form of a Pacific Wildlife Science Collaborative (PWSC). Refer to Figure 1 for a summarized timeline graphic of these steps.

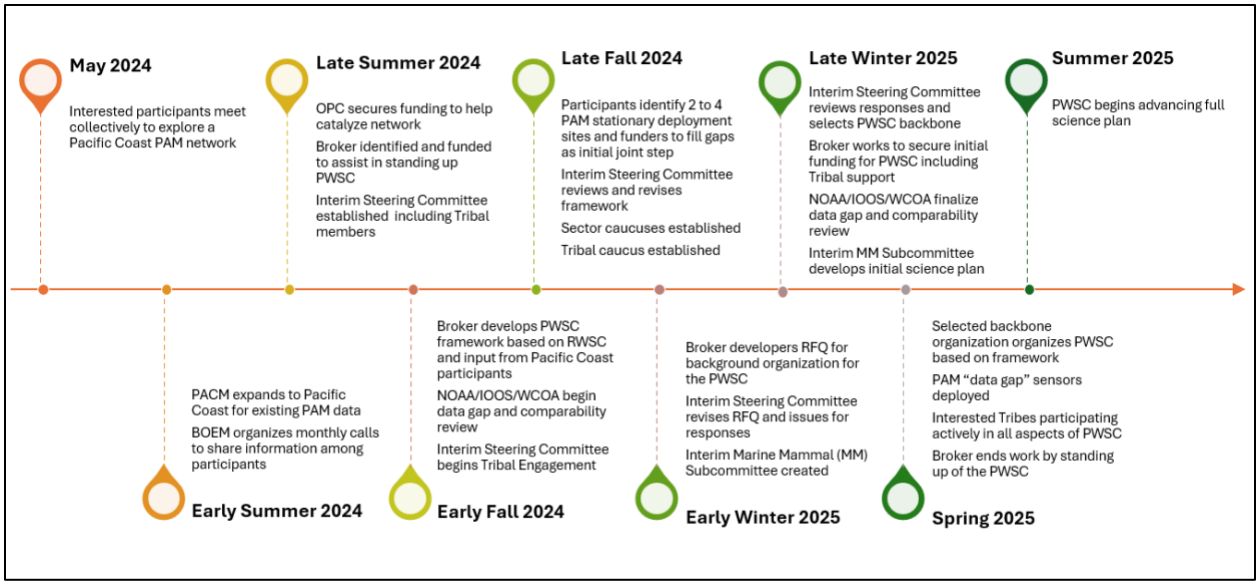

Figure 1. Potential near-term timeline to create a U.S. Pacific Wildlife Science Collaborative (PWSC). The figure is a timeline that lists potential steps for forming the OSW-focused U.S. West Coast PAM network between Spring 2024 and Spring 2025, beginning with gathering interested participants to expanding PAM deployment and establishing a sustainable funding framework for the PWSC.

5 Next Steps

Overall, the group expressed appreciation for the progress made and the efforts to foster communication among participants. They emphasized the importance of maintaining momentum and suggested several actions.

Workshop organizers will compile the takeaways and ideas from the discussions and hold virtual meetings to keep participants connected and explore ways to catalyze specific actions. The outputs from these discussions are intended to serve as guidance rather than formal decisions.

Several participants expressed strong interest in follow-up dialogue, specifically asking when the next discussion might be. Participants suggested that future discussions be more multidisciplinary, incorporating strategies beyond PAM to better understand the potential impacts of OSW operations on marine mammals. Additionally, they recommended organizing an event dedicated solely to the science of understanding co-variates affecting marine mammals, such as the NYSERDA State of the Science meetings.

BOEM and NOAA staff thanked participants for their exceptional hard work in outlining specific steps for developing a robust U.S. West Coast PAM network for OSW that aims to foster more thoughtful and informed decision making that considers diverse needs and perspectives.

6 References

Bureau of Ocean Energy Management [BOEM]. 2024. BOEM renewable energy leasing schedule update handout. Washington DC: Bureau of Ocean Energy Management; [accessed 2024 May 22]. https://www.boem.gov/sites/default/files/documents/renewable-energy/RELS%20Information%20Sheet%20Handout%20v3.pdf.

Chudzinska M, Thomas L. 2023 (CREEM, St Andrews, UK). Power analysis for optimal design of a passive acoustic monitoring network in the Atlantic Ocean. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. 85 p. Report No.: OCS Study BOEM 2023-041. https://espis.boem.gov/final%20reports/BOEM_2023-041.pdf.

National Oceanic and Atmospheric Administration National Marine Fisheries Service [NOAA Fisheries]. 2024. ADRIFT in the California Current. Silver Spring (MD): National Oceanic and Atmospheric Administration; [accessed 2024 May 22]. https://www.fisheries.noaa.gov/west-coast/science-data/adrift-california-current.

Synchro. 2024. Offshore wind pilot study. San Francisco (CA): Ocean Sync; [accessed 2024 May 22]. https://oceansynchro.io/offshore-wind-pilot-study/.

West Coast Ocean Data Portal. 2024. West Coast Ocean Data Portal. Portland (OR): West Coast Ocean Alliance; [accessed 2024 May 22]. https://portal.westcoastoceans.org/.

Whale Safe. 2024. Whale Safe. Santa Barbara (CA): Benioff Ocean Science Laboratory; [accessed 2024 May 22]. https://whalesafe.com/.

White House. 2022. Memorandum on uniform standards for Tribal consultation. Washington (DC): The White House, Office of the President; [accessed 2024 May 22]. https://www.whitehouse.gov/briefing-room/presidential-actions/2022/11/30/memorandum-on-uniform-standards-for-tribal-consultation/.

Appendix A: Workshop Agenda

PACIFIC PAM WORKSHOP AGENDA

Vision: Partnering to meet marine life and environmental monitoring needs using Passive Acoustic Monitoring in the Pacific, with a focus on marine mammals

Objectives of the Workshop:

- Draw lessons on regional marine mammal monitoring from the East Coast experience.
- Review the PAM work to date on the West Coast for long-term ecosystems monitoring and identify key gaps and needs moving forward.
- Identify efficiencies and opportunities for collaboration to address key gaps and needs.
- Define potential steps to advance an inclusive, efficient, and effective West Coast PAM Network Partnership.

DAY 1 MORNING

8:30	Welcome
8:35	Land Acknowledgement
8:40	Introductions (at small tables)
8:55	Agenda and Rules of the Sea for the Workshop

Part 1: Shared Learning and Understanding

9:00	Purpose and Intent of the Workshop
9:15	East Coast PAM management requirements and how recommendations were developed for Offshore Wind
9:45	Building an East Coast PAM Network - Data Products, Uses, and Management
10:00	Organizing Collaboration across states, federal agencies, Tribes, and researchers, Emily Shumchenia, RWSC (pre-recorded 30) with questions
10:30	Break
10:45	Small Group Discussion at Tables

11:00 Facilitated discussion with Panel of Presenters and Others

12:00 Lunch (provided on-site)

DAY 1 AFTERNOON

1:00 Panel: Meaningful partnerships, TEK integration and PAM

2:00 Break

2:15 Rapid Review of What's Happening on the West Coast

3:20 Overview of Deployment to Date

3:30 Break

Part 2: Identifying Gaps and Opportunities for a robust PAM network on the West Coast

3:45 Small group discussions

4:45 Small groups return for closing day with logistics, preview of day 2

5:00 Adjourn

5:30 Arrive at Dock for Vessel (**Pier 40**, by Giants Stadium, NOT near Pier 39) (89 King Street)

DAY 2 MORNING

9:00 Summary Day 1/Overview of Day 2

9:15 Continuation of Part 2 Discussion + Report out from Day 1 Breakout Groups and full group Reflections

Part 3: Identify potential steps to advance an inclusive, efficient, and effective West Coast PAM Network Partnership.

10:00 Small group discussions: *Our vision for 5 years*

10:45 Break

11:00 Small Groups report Back and full group discussion of commonalities and differences

12:00 Lunch (provided on-site); Facilitators/Notetakers prepare summary slides

DAY 2 AFTERNOON

1:00	Facilitator shares summary synthesis across groups for a shared five year "vision"; participants react
1:15	Small groups: *Our Plan*: where to from here in the next year; the next 3 years
2:00	Break and Mingling
2:30	Report Backs
3:45	Closing Reflections
4:00	Thanks and Adjourn – Planning Team Close

Appendix B: Workshop Attendance

The following individuals attended one or both days of the workshop:

Name	Affiliation
Kristen Ampela	HDR
Simone Baumann-Pickering	Scripps Institution of Oceanography / UC San Diego
Catherine Berchock	NOAA Fisheries Alaska Fisheries Science Center
Ingrid Biedron	BOEM Pacific Region
Laura Bliss	West Coast Ocean Data Portal
Erin Boydston	BOEM Pacific Region
Nicole Cristales	The Marine Mammal Center
Jaclyn Daly	NOAA Fisheries Office of Protected Resources
Elizabeth Diaz	Ocean Winds
Rikki Eriksen	California Marine Sanctuary Foundation
Norely Faz	The Marine Mammal Center
Patrick Field	CBI
Selene Fregosi	NOAA Fisheries Pacific Islands Fisheries Science Center
Bruce Gali	Pit River Tribe
Loyen Redhawk Gali	Pit River Tribe
Morning Star Gali	Pit River Tribe
Kathi George	The Marine Mammal Center
Dawn Goley	Cal Poly Humboldt
Abreanna Gomes	Kashia Band of Pomo Indians
Caroline Good	NOAA Fisheries Office of Protected Resources
Helen Haile	Kashia Band of Pomo Indians
Samara Haver	OSU Cooperative Institute for Marine Ecosystem and Resources Studies/NOAA PMEL
Tyler Helble	Naval Information Warfare Center Pacific
Stephanie Horii	CBI
Alice Kojima	BOEM Pacific Region
Anu Kumar	U.S. Navy Living Marine Resources Program
Tetyana Margolina	Naval Postgraduate School
Elizabeth Marsjanik	Vineyard Offshore
Megan McKenna	University of Colorado Boulder/NOAA-NCEI
Deeqa Mohamed	CBI
Laura Morse	Invenergy
Laura Nagy	Vineyard Offshore
Will Oestreich	Monterey Bay Aquarium Research Institute
Julia O'Hern	The Marine Mammal Center
Lindsey Peavey Reeves	National Marine Sanctuary Foundation / NOAA Office of National Marine Sanctuaries
Cynthia Pyć	RWE
Shannon Rankin	NOAA Fisheries Southwest Fisheries Science Center
Desray Reeb	BOEM Office of Renewable Energy Programs

Name	Affiliation
Hillary Renick	Pomo/Paiute
William Robinson	U.S. Coast Guard
Pilar Rodriguez	The Marine Mammal Center
Henry Ruhl	Monterey Bay Aquarium Research Institute/CeNCOOS/Synchro
Leonard Seabolt	
Mandy Shoemaker	U.S. Navy Living Marine Resources Program
Javier Silva	Sherwood Valley Band of Pomo - Noyo - Yokayo
Anne Simonis	San Francisco State University
Nick Sisson	NOAA Fisheries GARFO Protected Resources Division
Brandon Southall	Southall Environmental Associates; UC Santa Cruz
Erica Staaterman	BOEM Center for Marine Acoustics
Angela Szesciorka	Oregon State University
Sinead Tally	CBI
Patrick Tennant	Equinor
Rebecca Van Hoeck	NOAA Fisheries Northeast Fisheries Science Center
Sofie Van Parijs	NOAA Fisheries Northeast Fisheries Science Center
Amy Wolfrum	Monterey Bay Aquarium
Jason Wood	SMRU Consulting
Margaret Woodbridge	U.S. Coast Guard
Silvia Yanez	Ocean Winds/Golden State Wind
Susan Zaleski	BOEM Pacific Region

U.S. Department of the Interior (DOI)
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, mineral, and geological resources in an environmentally and economically responsible way.