Collaborative Whale Detection Technology Evaluation Virtual Workshop Series

SESSION 3 | NOVEMBER 19, 2024

RWSC
Regional Wildlife Science Collaborative for Offshore Wind

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Collaborative Technology Workshop Series

Workshop Session 3: Summary of Findings and Next Steps for Evaluating Real-Time Marine Mammal Monitoring Tools and Technologies

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Executive Summary

A collaborative virtual workshop series was hosted by the RWSC, the Marine Technology Society (MTS), and the Consensus Building Institute (CBI), in partnership with the Pacific Northwest National Laboratory (PNNL) and National Renewable Energy Laboratory (NREL), with support from the U.S. Department of Energy (DOE) and contributions from NOAA Fisheries, the Bureau of Ocean Energy Management (BOEM), and Turn Forward to identify models, technologies, and information from other sectors, research areas, and potential partners in support of whale conservation and responsible offshore wind development.

The objective of the series was to assess the state of the science regarding technologies, tools, and methods for monitoring baleen whales in full-visibility, low-, and no-light conditions specifically during sound-producing offshore wind construction activities. PNNL and NREL led the development of the technical workshop materials and outputs, with input from DOE, NOAA, and BOEM. RWSC, MTS, and CBI provided the forum, workshop facilitation, and developed workshop proceedings for each session that captured participant input and discussion.

The third and final session of the Collaborative Technology Workshop Series was held virtually on November 19, 2024. This report summarizes discussions and key takeaways from this final session. The objectives for this session were to:

- Review PNNL and NREL's draft report "Evaluating Tools and Technologies for Monitoring Marine Mammals during Offshore Wind Construction Activities".
- Understand the U.S. Department of Energy's timeline for report finalization and release.
- Learn from NOAA and BOEM about their work related to technology evaluation and how this report supports their ongoing work in this area.

Materials from this session including an agenda and draft products produced by PNNL and NREL can be found here: http://bit.ly/3Ot5PEI

Below are the key takeaways from the workshop:

- PNNL and NREL are finalizing a report "Evaluating Tools and Technologies for Monitoring Marine Mammals during Offshore Wind Construction Activities" which includes a three-phased approach to inform the deployment of technologies that can detect, monitor, and avoid negative interactions between marine mammals and offshore wind turbine construction. The report identifies three performance metrics that can be used to assess the efficacy of different technologies: detection capability, detection distance, and variation in performance relative to environmental/biological conditions.
- Given the challenges of measuring technology performance and the lack of standardization among existing validation studies, a standardized framework is needed to evaluate monitoring technologies in the context of their intended application for offshore wind. PNNL and NREL developed an example assessment framework that includes field characterization of each individual sensor in relevant environmental conditions and model simulations to assess the overall ability of an array of sensors to detect whales.
- The National Labs' report may serve as a useful tool for helping to standardize technology evaluations and provides a possible framework for consistent evaluation.
- Given the dependence on innovation to drive improvement in monitoring technologies, trade associations, forums like RWSC, and data-sharing agreements are essential to balance private innovation with industry-wide progress.

- Agencies strive to balance public transparency and the protection of proprietary business confidential information.
- BOEM is open to partnering with industry and leveraging their statutory authority to help address gaps in evaluation, particularly for emerging technologies like infrared camera systems.
- This is the last workshop session in the series. The National Labs' report will be finalized and published in January 2025.

Acknowledgements

The Collaborative Technology Workshop Series was conceived through a collaboration between the Regional Wildlife Science Collaborative (RWSC), the Marine Technology Society (MTS), American Clean Power (ACP), Turn Forward, several environmental nonprofits, the U.S. Department of Energy (DOE), the Pacific Northwest National Laboratory (PNNL), and the National Renewable Energy Laboratory (NREL). The organizers are grateful for the facilitation provided by Patrick Field from the Consensus Building Institute (CBI). The organizers would also like to thank the following panelists for participating in the discussion: Kyle Baker, BOEM; Jaclyn Daly-Fuchs, NOAA Fisheries; Casey Corrado Kirsch, MITRE.

Opening and Welcome

Presenters: Joy Page, Department of Energy, and Emily Shumchenia, Ph.D, Regional Wildlife Science Collaborative for Offshore Wind

The workshop opened with a welcome from Joy Page, DOE, and Emily Shumchenia, Ph.D, RWSC, who provided reminders about the background, context, and purpose of the Collaborative Technology Workshop Series. Bringing together various stakeholders including agencies, eNGOs, and industry players, this series has aimed to gather technical insights on monitoring baleen whales during sound-producing offshore wind construction activities. Key objectives included developing a shared understanding of relevant technologies, discussing their applicability and limitations, and informing the production of a technical report by PNNL and NREL.

Following each workshop session, RWSC-MTS produced proceedings summarizing key themes and feedback. PNNL and NREL have been developing a technical report that assesses the state of the science regarding technologies, tools, and methods for monitoring baleen whales specifically during sound-producing offshore wind construction activities. Key milestones in this process included:

- April 18, 2024: First workshop held to present project scope.
- June 26, 2024: Second workshop held to present initial frameworks and obtain participant feedback.
- September 2024: PNNL and NREL produced a report draft, informed by subject matter experts and workshop participants.
- September – November 2024: PNNL and NREL conducted a peer review on the draft report and revised the draft according to expert input.
- November 19, 2024: PNNL and NREL presented findings of final draft report and solicited final feedback from subject matter experts and participants.
- January 2025: PNNL and NREL will finalize the technical report and post publicly.

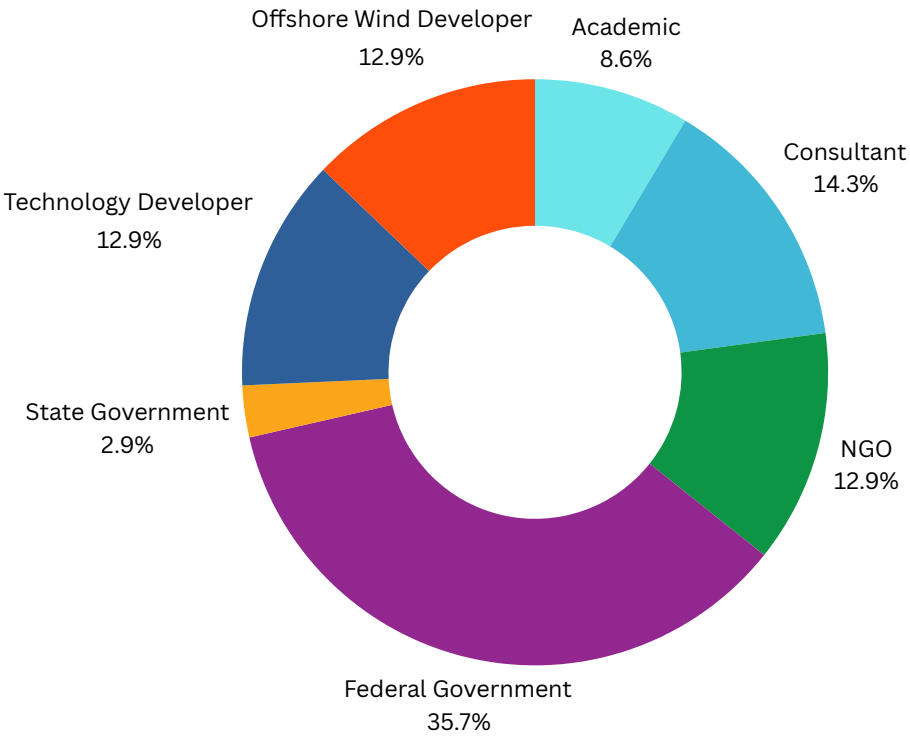
The workshop attracted significant interest, with over 200 registrations and nearly 150 attendees spanning various sectors and locations.

Participant Overview

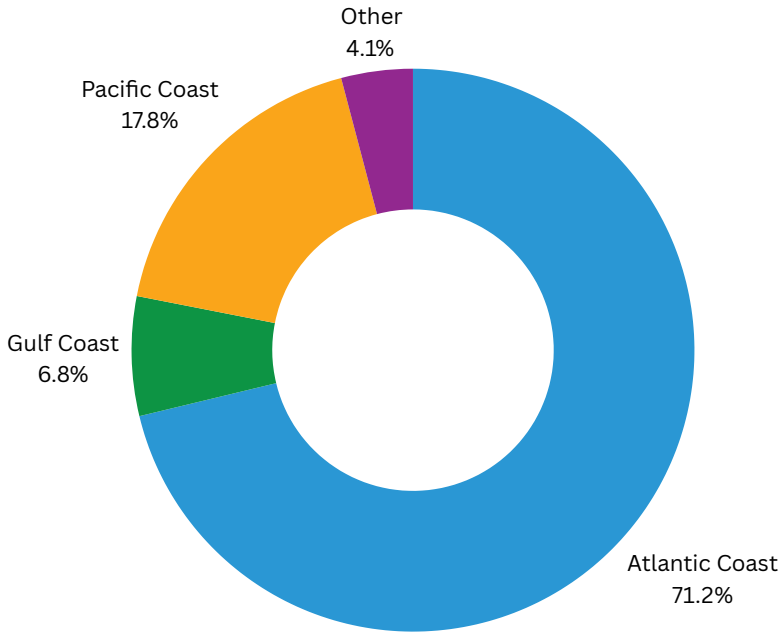
222 Persons Registered

143 Persons Attended

Participants by Sector



Location of Participants



Review PNNL and NREL's Draft Report: "Evaluating Tools and Technologies for Monitoring Marine Mammals during Offshore Wind Construction Activities"

Presenter: Mark Severy, P.E., Pacific Northwest National Laboratory

Key Takeaways

- The PNNL and NREL report will outline standardized documentation for validating detection technologies aimed at monitoring baleen whales during offshore wind construction activities.
- The final PNNL and NREL report will focus on potential performance metrics without endorsing specific products or operational performance thresholds.
- The PNNL and NREL report will highlight the significance of emerging technologies in multi-modal monitoring systems. The PNNL and NREL have developed a Zotero Library that includes all the publicly available references used to develop the report.
- The draft final report will be completed by the end of September 2024.

Mark Severy, PNNL, presented an overview of PNNL and NREL's draft report "Evaluating Tools and Technologies for Monitoring Marine Mammals during Offshore Wind Construction Activities". The slides for this presentation can be found in Appendix B. This work assesses the state of the science regarding technologies, tools, and methods for monitoring baleen whales around offshore wind construction activities and leverages the contributions of many subject matter experts from different sectors (e.g., academia, industry, government agencies). This effort is intended to have practical outcomes that can inform the deployment of technologies that can detect, monitor, and mitigate negative interactions between marine mammals and offshore wind turbine construction. This project was conducted in three parts: Technology Performance Metrics, Evaluating Technology Performance, and Technology Validation and Research & Development (R&D) Needs.

1. *Technology Performance Metrics*

PNNL and NREL identified potential performance metrics that can be used to assess the efficacy of different technologies. Standardized metrics need to be established to characterize technology performance in real world conditions. Standards and metrics can be used to compare different monitoring technologies, tools, and approaches and to provide context for technology performance results in different environments. Three categories of performance metrics were identified:

- **Detection capability:** This category of metrics seeks to characterize how well a sensor's readings match real-world conditions. Examples include precision (ratio of true positives to total positives), recall (ratio of true positives to all actual whale occurrences), and probability of missed mitigation (ratio of false positives in the shutdown zone to total positives in mitigation zone).

- **Detection distance:** This category relates to how far a sensor can reliably detect the feature of interest. An example metric is "reliable detection range", which is the distance at which the number of detections starts to decrease.
- **Variation in performance relative to biological and environmental conditions** (animal behavior, weather, sea conditions, etc.): This category of metrics seeks to understand how the sensor's performance varies when conditions are not ideal (e.g., low visibility for optical methods, high ambient noise for acoustic methods, animal behaviors that make them difficult to detect).

To use performance metrics to predict the success of implementing mitigation measures in an operational setting, practitioners should collect data directly in the field on each sensor and/or array. If complex field tests of arrays are untenable due to time, logistical, and permitting constraints, we suggest that data from the individual sensor field characterizations be used to describe the performance of each component in a proposed array as part of a simulated model.

2. *Evaluating Technology Performance*

This phase of the project evaluated current technology performance based on existing/recent technology use and observation. PNNL and NREL summarized efficacy studies, real-world applications, and validation to date for a subset of existing tools and technologies that have the attributes to monitor the presence of baleen whales to inform offshore wind construction activities. The technologies that they focused on were passive acoustic monitoring, infrared cameras, and visible light cameras. These technologies were selected for their detection ability and information delivery timelines. Key findings from this analysis include:

- Technology performance varied with system design and local conditions.
- Consistent metrics for performance have not been used across different studies because each study has different research objectives.
- There is no perfect baseline for comparison; the performance of individual technologies has been evaluated by comparison to itself or comparison to another system
- When compared to another type of monitoring technology, detections agree within <10-50% because of availability bias (i.e., detecting different cues that may not be present congruently - such as a whale not vocalizing for detection via passive acoustics when surfacing and being detected via camera, or a whale does not break the surface to be visible when calls are detected via passive acoustics), and perception/detection bias.
- False negative detection rates are only known relative to another system, i.e., evaluating the true performance of a system would require knowing the presence of all whales or acoustic cues within the detection zone.
- It is also important to keep in mind the accurate estimation of false positives. High false positive rates risk inefficiencies by suggesting implementation of mitigation requirements that are unnecessary.
- Using multiple technologies concurrently improves the overall probability of detection – especially for pairings of visual/infrared and passive acoustic systems which each rely on different animal cues and are deployed in different components of the system (air vs. water).

3. *Technology Validation and R&D Needs*

From the evaluation in Phase II, PNNL and NREL concluded that technologies have demonstrated the functionality to perform the intended task of detecting baleen whales during offshore wind construction, but that additional work is needed to characterize the performance level of specific sensor and array designs. PNNL and NREL next identified recommendations for research and development within a proposed 3-phase roadmap for evaluating technology performance (System Design, Pre-Test Assessment, and Field Characterization and Modeling). The draft roadmap for technology validation can be found here.

The R&D needs identified by PNNL and NREL include:

1. Consider if or how the technology assessment framework could be applied to inform operational decisions.
2. Apply lessons learned from military and oil and gas contexts wherever possible.
3. Support R&D for technology developers to apply the assessment framework.
4. Support the development of a field testing site.
5. Support the development of modeling tools and data sets that can be used to characterize the performance of a multi-modal array.

Summary of Q&A

Questions and discussions from workshop participants included:

- A participant asked what combination of multi-modal systems was most effective. PNNL and NREL noted that it depends on the conditions, but passive acoustic monitoring (PAM) and infrared (IR) are used together most frequently and seem to have a promising path forward. The scope of this project did not look at eliminating technologies, so the use of multi-modal systems to replace observers was not explored.
- Attendees highlighted the need for consistent evaluation of PAM systems using standardized whale call source levels for each species (e.g., every study should use a 165 dB source level for a North Atlantic right whale upcall) as there is a range of published source levels for various species. Because practitioners have used different whale call sound source level references, it is difficult to compare and evaluate system performance. Having a standard sound level for each species call could help alleviate that problem. This guidance should include an expert panel review.
- Another attendee asked if there was consideration regarding how the sensors were deployed (e.g. fixed vs mobile). PNNL and NREL referenced literature relevant to various deployment platforms.
- One attendee asked if this project looked at toothed whales. The scope of this project is focused on baleen whales and does not include toothed whales.

Feedback Form

PNNL and NREL requested feedback on the work presented via an online form. Participants were given time to fill out this feedback form during this workshop session. The feedback form opened on November 15, 2024, and closed on November 26, 2024. 9 individuals provided feedback via the form. Participant feedback included:

- Participants noted that the findings in this study help to establish a common understanding of the currently available monitoring technologies and tradeoffs associated with different

categories of technologies which is a good starting point for developing a monitoring strategy.
- Participants would like to see guidance on how to handle data gaps and how these findings will be translated to the general public.
- Near-term needs for R&D identified by participants include testing sensors under various conditions and steering innovation to address known weaknesses in current technologies (e.g., passive acoustics is less useful when whales don't vocalize, as with mom/calf pairs).

This feedback will be incorporated in the final report that will be published in January 2025.

Panel Discussion: NOAA and BOEM Technology Evaluation

Moderator: Pat Field, Consensus Building Institute
Panelists: Kyle Baker, BOEM; Jaclyn Daly-Fuchs, NOAA Fisheries; and Casey Corrado Kirsch, MITRE

Key Takeaways

- The National Labs' report provides a foundational framework for standardizing technology evaluations, providing a foundational framework.
- Trade associations, forums like RWSC, and data-sharing agreements are essential to balance private innovation with industry-wide progress.
- Agencies strive to balance public transparency and the protection of proprietary information without compromising competitive edges.
- BOEM is open to partnering with industry and leveraging their regulatory role to address gaps in evaluation, particularly for emerging technologies.

The workshop concluded with a panel that provided insights into NOAA and BOEM's technology evaluation activities for offshore wind planning, permitting, and decision-making. The discussion focused on current efforts to implement technology evaluation frameworks, challenges in balancing confidentiality and transparency, and opportunities to advance industry standards and collaboration.

The panelists included:
- Kyle Baker, BOEM
- Jaclyn Daly-Fuchs, NOAA Fisheries
- Casey Corrado Kirsch, MITRE

Common themes from the discussion with the panel included:

Activities each agency/group is doing with respect to technology evaluation and what they see as next steps following this workshop series and National Labs' report finalization:

Agencies and collaborators are engaged in various efforts to advance technology evaluation for offshore wind development.

BOEM is the lead permitting agency for offshore wind and integrates environmental, technological, and regulatory reviews. BOEM has clearer standards for Protected Species Observers (PSOs) and passive acoustic monitoring (PAM) but acknowledges gaps for technologies like infrared camera systems. Although BOEM does not conduct research and development, it is open to partnering with the industry on studies to validate and test new technologies.

NOAA is actively addressing vessel strike reduction with initiatives like a multi-million investment through the National Fish and Wildlife Foundation (NFWF) to develop tech-based tools that alert vessels about the presence of whales. NOAA is also working with MITRE to further explore technologies for applications including vessel strike risk reduction and offshore wind monitoring. The National Labs' report addresses the desire for standardization, providing a toolkit to evaluate technologies consistently. For BOEM, the report lays the groundwork for a common understanding among stakeholders for assessing mitigation effectiveness and reliability. NOAA sees the report as a possible framework to evaluate and review plans submitted by developers.

While this report is not formal guidance for agencies, it serves as a key resource leading the path forward. MITRE, a not-for-profit organization supporting U.S. government agencies, will build on the National Labs' report by offering more detailed best practices, testing protocols, and data evaluation methods.

Balancing innovation with proprietary and confidential business information:

The pace of innovation requires a shift toward greater data transparency and information sharing. Currently, most technology discussions occur on a project-by-project basis between developers and their contractors, limiting cross-industry learning. Trade associations like American Clean Power (ACP) can foster collaboration, helping to establish best practices and promote open communication. Forums like the RWSC and initiatives to create testbeds or communities of practice offer additional opportunities to bridge the gap between private innovation and broader industry needs.

Agencies operate within varying frameworks of transparency and confidentiality. The Marine Mammal Protection Act (MMPA) requires transparency. The BOEM permitting process has to protect confidential business information. BOEM and NOAA and through their contractor MITRE respect confidentiality while counting on collaborative research agreements to balance information sharing with proprietary concerns. These agreements allow agencies to honor business confidential information (BCI) while fostering broader collaboration by scrubbing data, aggregating data across sources without attribution, and obscuring identifying parameters. Developers must identify and justify what qualifies as BCI. NOAA prioritizes transparency for data like whale locations, which are shared to prevent vessel strikes. BOEM also upholds confidentiality agreements while ensuring critical information is available to evaluate mitigation effectiveness.

Agencies recognize the tension between transparency and protecting competitive advantages for developers. Agencies emphasize the need to share sufficient information to ensure effectiveness without penalizing innovation leaders. Collaborative research agreements and other mechanisms can help bridge the gap between transparency and confidentiality.

Conclusions and Next Steps

The workshop closed with Emily Shumchenia, RWSC Director, thanking participants and giving a brief overview of the next steps. This workshop proceeding will be posted on the RWSC website. This is the final workshop session in this series, but the report "Evaluating Tools and Technologies for Monitoring Marine Mammals During Offshore Wind Construction Activities" presented in the workshop will be finalized and published publicly by DOE in January 2025. Participants were reminded that they could provide feedback on this work via the online form until November 27, 2024.

The RWSC-MTS Joint Committee will continue to meet in 2025 to discuss and advance goals related to technology evaluation and implementation as described in the Technology chapter of the RWSC Science Plan that were first described in late 2023. The details for those virtual meetings are posted to both the RWSC and MTS websites, and all are invited to participate.

Appendices

- Appendix A: Workshop Attendees
- Appendix B: Presenter Slides