Development of Monitoring Protocols and Guidance for Automated Radio Telemetry Studies at Offshore Wind Farms

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Development of Monitoring Protocols and Guidance for Automated Radio Telemetry Studies at Offshore Wind Farms

Final Report

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Abstract

This project developed standardized protocols for using coordinated automated radio telemetry to monitor birds and bats in offshore environments in the Atlantic region of North America in relation to planned offshore wind energy development. The project components include guidance on the technical specifications and operation of Motus stations on offshore structures; a study design tool; a simulation study estimating detection probability of avian taxa moving through arrays of Motus stations; a data framework to coordinate data dissemination; and a monitoring framework to inform offshore wind energy development activities. The products were developed with strong input stakeholders and draft protocols were field tested with industry partners on offshore wind turbines and monitoring buoys at several sites throughout the U.S. Atlantic.

Keywords

Automated radio telemetry, avian, bat, monitoring, Motus Wildlife Tracking System,

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Acronyms and Abbreviations

ASL	Above sea level
BC	Birds Canada
BOEM	Bureau of Ocean Energy Management
BRI	Biodiversity Research Institute
CAP	Civil Air Patrol
E-NGOs	Environmental Non-Governmental Organizations
GPS	Global Positioning System
IDIOMS	Online study design tool (Informing the Design and Implementation of Offshore Motus Systems)
MHz	megahertz
Motus	Motus Wildlife Tracking System
NYSERDA	New York State Energy Research and Development Authority
PAC	Project Advisory Committee
ROD	Record of Decision
RWSC	Regional Wildlife Science Collaborative for Offshore Wind
URI	University of Rhode Island
USFWS	United States Fish and Wildlife Service

Executive Summary

Automated radio telemetry systems use radio tags and receiver stations to collect movement data on many species of birds, bats, and insects. The Motus Wildlife Tracking System ("Motus" https://www.motus.org) is an international collaborative research network that uses cooperative automated radio telemetry to track tagged organisms on shared frequencies. While Motus is well-established for use in terrestrial systems, it has only recently begun to expand into marine environments including monitoring of ESA-listed bird and bat species for offshore wind assessments. The goal of this project was to develop standardized protocols for using coordinated automated radio telemetry to monitor birds and bats in offshore environments in the Atlantic region of North America in relation to planned offshore wind energy development. The project team from U.S. Fish and Wildlife Service (USFWS), Biodiversity Research Institute (BRI), University of Rhode Island (URI), and Birds Canada (BC) developed a series of interrelated products to guide and inform the deployment of automated radio telemetry technology in relation to offshore wind energy development in the U.S. Atlantic. The products were developed with strong input stakeholders and draft protocols were field tested with industry partners on offshore wind turbines and monitoring buoys at several sites throughout the U.S. Atlantic. Final products were released to the public in fall of 2022 and are available through the project website: https://motus.org/groups/atlantic-offshore-wind

1 Introduction

Automated radio telemetry systems consist of radio tags (small transmitters attached to aerofauna: birds, bats, or insects) and receiver stations (structures with mounted receivers with antennas that record signals from "tagged" organisms within the detection range). The Motus Wildlife Tracking System (see: https://www.motus.org) is an international collaborative research network that uses cooperative automated radio telemetry to track tagged organisms on shared frequencies (currently 166.380 megahertz [MHz] and 434 MHz in North America). Collaborators using Motus have collectively tagged tens of thousands of birds and bats and tracked their movements using an international network of automated radio telemetry stations. Motus also serves as a hub for data from thousands of receiving stations and tagged animals worldwide representing hundreds of species. A centralized database at the Birds Canada National Data Centre manages and disseminates data and metadata in a standardized format across all projects in the network.

While Motus is well-established for use in terrestrial systems, it has only recently begun to expand into marine environments. There is a recognized need for additional offshore tracking data for small-bodied animals of conservation and regulatory concern that cannot be tracked via more traditional methods, in order to understand their offshore movements and habitat use as well as potential exposure to offshore wind energy development. Offshore wind energy infrastructure can also provide stable platforms for Motus station deployment that have historically been lacking in many marine systems. The Bureau of Ocean Energy Management (BOEM) has included requirements for Motus monitoring for all commercial-scale offshore wind farms that have received a Record of Decision (ROD) to date, suggesting that this technology may become a central component of bird and bat monitoring at offshore wind energy facilities in the U.S. Therefore, the goal of this project was to develop standardized protocols for using coordinated automated radio telemetry to monitor birds and bats in offshore environments in the Atlantic region of North America in relation to planned offshore wind energy development. The project includes the following components, which can all be found on the Motus Wildlife Tracking website https://motus.org/groups/atlantic-offshore-wind

- A "Guidance Document" describing technological specifications and operation of Motus stations on offshore structures, in order to guide and standardize station deployment processes and obtain standardized, site-specific data on the movements of tagged animals through offshore wind project areas.

- An online "Study Design Tool," known as IDIOMS (Informing the Design and Implementation of Offshore Motus Systems), to help design, optimize, and assess coverage of wind energy project areas and adjacent waters from simulated arrays of Motus stations located on offshore structures.
- A "Simulation Study" that evaluates Motus design challenges and informs IDIOMS and monitoring recommendations (below) by estimating detection probability of select avian taxa moving through simulated arrays of Motus stations within wind energy project areas.
- A "Data Framework" within the Motus Wildlife Tracking System to facilitate coordination and dissemination of detection data, metadata, and summary reports from all tagged animals and Motus stations deployed for offshore wind energy applications in the Atlantic region of North America.
- A "Monitoring Framework" that contains guidance on applications of automated radio telemetry technology for monitoring birds and bats in offshore environments at site-specific to regional scales, including specifications of transmitters for deployments to inform offshore wind energy development activities.

The project was initiated in spring of 2020 and completed in the summer of 2022. Products were developed in coordination with stakeholders in a Project Advisory Committee (PAC) and through a series of stakeholder workshops. Final products are available through the project website: https://briwildlife.org/offshore-motus-guidance and through a dedicated page on www.motus.org. The products are intended to be living documents that are updated as new information and technology becomes available.

2 Stakeholder Engagement

Stakeholder engagement was conducted through a Project Advisory Committee (PAC) and through a series of stakeholder workshops that focused on each element of the project. Invitations to stakeholder workshops were sent to the PAC and a list of approximately 150 cross-sector stakeholders including offshore wind energy developers, environmental non-governmental organizations (e-NGOs), state and Federal entities, and researchers with tracking and automated radio telemetry expertise. At the onset of the project, outreach presentations were conducted on this work as webinars to engage potential stakeholders including, e-NGOs from "Avian Offshore Wind Dream Team" (September 10, 2020); state agency representatives from Atlantic Flyway Council Joint Environmental Issues Committee (September 15, 2020); and NYSERDA State of the Science meeting (November 19, 2020).

2.1 Project Advisory Committee

We developed a list of potential PAC members and invited them to an informational meeting on August 26, 2020. Approximately 40 participants attended with representation from government agencies, NGOs, and the offshore wind energy industry in the U.S. and Europe. Following the informational meeting, a total of 26 stakeholders joined the PAC (Table 1). The main role of the PAC was to provide a detailed review of the guidance document and associated appendices, field data sheets, and field reference manuals. Members of the PAC were also involved with field-testing draft protocols in the guidance document through deployment of Motus stations on wind turbines at Block Island Wind Farm (RI), Coastal Virginia Offshore Wind Pilot Project (VA), and on monitoring buoys at several lease areas offshore of Massachusetts, New York State, New Jersey, and Maryland. PAC members participated in a series of Stakeholder Workshops to review and develop content for the Motus Data Framework and Monitoring Framework. The PAC also participated in a workshop focused on the Study Design Tool and associated simulation study, and PAC members were asked to provide initial alpha-level testing of the Study Design Tool. Final beta-level testing of the Study Design Tool will be elicited from PAC members in the summer of 2022 to provide final comments and checks of the application prior to public release.

Table 1. Project Advisory Committee for Offshore Motus Guidance

Name, affiliation (while participating in PAC), and sector group of Project Advisory Committee members.

Name	Affiliation	Sector
Alicia Mahon	Pacific Northwest National Lab	Government (US)
Andrew McGann	Cellular Tracking Technologies	Industry (Wildlife Tracking)
Brita Woeck	Orsted	Industry (OSW)
Carl Johnsen	OceanTech Services	Industry (Environmental Consultant)
Casey Halverson	Cellular Tracking Technologies	Industry (Wildlife Tracking)
David Bigger	BOEM	Government (US)
David LaPuma	Cellular Tracking Technologies	Industry (Wildlife Tracking)
Emily Argo	USFWS	Government (US)
Greg Forcey	Normandeau Associates	Industry (Environmental Consultant)
Jennifer Dupont	Equinor	Industry (OSW)
Jennifer Wehoff	OceanTech Services	Industry (Environmental Consultant)
Julia Wilmott	Normandeau Associates	Industry (Environmental Consultant)
Jurgen Weissenburger	Equinor	Industry (OSW)
Kim Peters	DNV-GL	Industry (Environmental Consultant)
Matt Robertson	Vineyard Wind	Industry (OSW)
Michelle Fogarty	Equinor	Industry (OSW)
Mike Vandentillart	Lotek Wireless	Industry (Wildlife Tracking)
Paul Phifer	Atlantic Shores	Industry (OSW)
Phil Taylor	Acadia University	University (Canada)
Ryan Reynolds	Siemens Gamesa	Industry (OSW)
Scott Lundin	Equinor	Industry (OSW)
Sjoerd Duijns	Bureau Waardenburg	Industry (OSW)
Tim White	BOEM	Government (US)
Todd Alleger	Northeast Motus Collaborative	NGO (US)
Todd Sumner	US Wind	Industry (OSW)
Wing Goodale	BRI	NGO (US)

2.2 Stakeholder Workshops

Four virtual workshops were conducted during 2021 and 2022 to obtain PAC and stakeholder input and engagement on the development of study products and to facilitate their implementation. The overarching goals of the workshops were to (1) introduce the study products; (2) obtain targeted stakeholder feedback in breakout groups to inform specific components of the products; (3) reflect on breakout group discussions with the broader group; and (4) invite participation in further development and review of the products. The guidance was also presented to the broader stakeholder community through an in-person workshop in conjunction with the State of the Science Workshop on Wildlife and Offshore Wind in Tarrytown, NY in July 2022. Materials from all stakeholder meetings, including agendas, presentations, and meeting summary reports, are posted on the project website: https://briwildlife.org/offshore-motus-guidance

The majority of these meetings were video recorded at participants' request, and in these cases the videos were posted on the project website.

2.2.1 Guidance Document

The first stakeholder workshop focused on Guidance for Deploying Automated Radio Telemetry Stations on Offshore Wind Turbines and Buoys. This workshop was held virtually on January 12, 2021 and was comprised of 80 participants. Workshop objectives included: (1) introducing draft components of the guidance document for setting up and operating receiving stations in offshore environments; (2) question and answer periods (Q&A) and group discussion; (3) breakout groups to obtain input on specific topics; and (4) identification of next steps. A summary report from the workshop and list of participants is available in Gulka et al. (2021a).

2.2.2 Online Study Design Tool

The second stakeholder workshop focused on the Online Study Design Tool. This workshop was held virtually on January 13, 2021 with 67 participants in attendance. The workshop was broadly divided into two sections, starting with an overview of the overall goals of the project and a discussion of the strengths and weaknesses of the technology involved. The second section detailed the goals of the Online Study Design Tool and included a demonstration of the tool. A summary report from the workshop and list of participants is available in Gulka et al. (2021b).

2.2.3 Offshore Motus Data Framework

The third stakeholder workshop focused on the Offshore Motus Data Framework. This workshop was held virtually on November 29, 2021 and was comprised of 72 participants. Workshop objectives included (1) introducing the Offshore Motus Data Framework document; (2) obtaining initial feedback from stakeholders on the Motus Wildlife Tracking System's Atlantic Offshore Wind Group and data explorer portal, including a draft online tool for exploration of Motus summary data and draft designs for static and dynamic reporting; and (3) discussing opportunities for further engagement with development of the framework. A summary report from the workshop and list of participants is available in Jenkins et al. (2021).

2.2.4 Monitoring Framework

The fourth stakeholder meeting focused on the Offshore Motus Monitoring Framework. This workshop was held virtually on June 8, 2022 and was comprised of 40 participants. Workshop objectives included (1) introducing the Offshore Motus Monitoring Framework; (2) discussing ideas for tag deployment strategies; (3) obtaining initial feedback from stakeholders on the framework; and (4) discussing opportunities for further stakeholder engagement. A summary report from the workshop and list of participants is available in Gulka et al. (2022).

2.2.5 Workshops to Disseminate Project Results

Project collaborators led a workshop in conjunction with the NYSERDA State of the Science Workshop on Wildlife and Offshore Wind on 26 July, 2022 (Tarrytown, NY), titled "Operating and Calibrating Offshore Motus Stations" (P. Loring and E. Carlson).

2.3 Presentations

There have been three conference presentations conducted on various aspects of the project to date (June 2022):

- Adams, E. K. Williams, A. Gilbert, E. Carlson, D. Gobeille, S. Mackenzie, P. Loring. 2022. Integrating Motus Tracking into Aerofauna Monitoring at Offshore Wind Projects. Oral presentation at Conference on Wind Energy and Wildlife Impacts, Apr. 2022 (Egmond aan Zee, the Netherlands).
- Williams, K, K. McClellan Press, J. Gulka, G. Lampman, P. Loring. 2020. Regional Collaboration to Identify Research Needs and Develop Conservation Guidance for Offshore Wind Development. Poster Presentation at the North American Ornithological Conference, Aug. 2020 (virtual).
- Williams, K, K. McClellan Press, J. Gulka, G. Lampman, P. Loring, E. Jenkins. 2020. Understanding the effects of offshore wind energy development in the U.S. on birds and bats: Identifying key research needs, mitigation measures, and conservation guidance. Oral presentation at the Wind Wildlife Research Meeting, Dec. 2020 (virtual).

Project co-leads led a symposium at the NYSERDA State of the Science Workshop on Wildlife and Offshore Wind in July 2022 (Tarrytown, NY), titled "Collaborative animal movement studies to improve conservation outcomes." The symposium discussed current efforts and next steps for coordination and analysis of wildlife telemetry data for offshore wind energy research, monitoring, and assessments in

the Atlantic. Using birds as a case study, symposium speakers focused on coordinated automated radio telemetry (Motus) and satellite telemetry (e.g., Argos and GPS). The symposium included the following presentations relating to this project, which are available at https://www.nyetwg.com/2022-workshop:

- Development of a coordinated offshore Motus network for monitoring birds and bats at site specific to regional scales (P. Loring).
- Evaluating the impact of offshore Motus study design choices on the presence and movements of birds in marine environments (E. Adams).
- A framework to determine optimal sample sizes and transmitter distribution for individual tracking studies (J. Lamb, The Nature Conservancy).

3 Study Components and Products

In addition to the stakeholder engagement efforts described above, this study included five interrelated components to inform the use of Motus to monitor offshore wind energy developments. The study components and associated product(s) are described below.

3.1 Guidance for Deploying Motus Stations on Offshore Wind Turbines and Buoys

The "Guidance Document for Deploying Motus Stations on Offshore Wind Turbines and Buoys" (Guidance Document) describes technical specifications for the deployment and operation of Motus automated radio telemetry stations on offshore structures (e.g., offshore wind turbines and buoys) to obtain site-specific data on the movements of tagged animals (birds, bats, and insects) through offshore wind project areas. The Guidance Document and supplementary materials describe responsibilities and actions of station operators to set up, calibrate, maintain, and report data from offshore Motus stations.

Specific objectives of the Guidance Document:

- Provide detailed technical specifications for deployment of coordinated Motus stations on offshore structures for pre- and post-construction monitoring.
- Provide information necessary for developers and engineers to determine the optimal configuration of equipment for stations on different types of structures, including wind turbines and buoys.
- Identify best practices for configuring stations on offshore structures to optimize system durability, detection range, and data quality.
- Provide guidance on station operation, assessment, and maintenance, including minimum equipment checks, calibration surveys, and maintenance activities.
- Specify minimum data processing and delivery standards for station metadata, calibration surveys, and tag detection data.

3.1.1 Pilot Efforts at Block Island Wind Farm

Development of the Guidance Document was informed by pilot efforts at Block Island and Rhode Island in coordination with the Block Island Wind Farm and the University of Rhode Island. In May 2021, two tracking stations on Block Island were set up to collect calibration data for modeling detection range and antenna beam patterns for 434 MHz Motus stations and develop a standardized workflow for data processing/management for the 434 MHz stations. In July 2021, Orsted set up a tracking station on Turbine #1 at Block Island Wind Farm using draft equipment specifications and

protocols from the Guidance Document. In August 2021, two boat-based surveys were conducted at Block Island Wind Farm to collect calibration data from the three Motus stations by flying a Motus tag attached to a kite flown behind a boat at altitudes ranging from 0 to 128 meters (m) above sea level (ASL). In September 2021, three calibration flights were conducted in cooperation with Rhode Island Civil Air Patrol (CAP) to attach test tags to fixed-wing airplanes flying up to 1,220 m ASL. Multiple calibration methods at different altitudes were required to inform three-dimensional estimates of station detection range, including the variety of altitudes at which migratory flights can occur for focal avian species. Unprocessed global positioning system (GPS) data and tag detection data from these surveys are located on GitHub: https://github.com/erikvcarlson/BIWF_Calibration_Data/tree/v.1.0.0

Data from the calibration surveys at Block Island were used to developed models of 434 MHz antenna radiation patterns that were incorporated into the Study Design Tool and Simulation Study. These models and associated methods are described in Carlson et al. (*in prep*).

3.1.2 Station Calibration Tool

To simplify the calibration data workflow and standardize reporting of results between offshore Motus stations, a calibration data analysis tool was developed that serves three primary functions: survey planning, data analysis, and automated reporting. The survey planning functions can be used to generate standardized transect lines for targeted calibration surveys and provides a standardized metadata sheet for use in the field. The data analysis and reporting functions use input data from calibration surveys to report signal strength versus radial distance of detection data and generates summary statistics including the number of detections per antenna and the detections range of each antenna. Visit https://birdsdev.uri.edu for access to the tool.

3.2 Study Design Tool and Simulation Study

Biodiversity Research Institute developed a free online tool: Informing the Design and Implementation of Offshore Motus Systems (IDIOMS). The goal of IDIOMS is to help users optimize site-specific study designs at offshore wind energy facilities, including the number and locations of receiving stations necessary to cover a given offshore wind energy project area relative to factors such as the project size and configuration, key species, and questions of interest, and specific Motus technology used (e.g., 166.380 MHz versus 434 MHz). Users can create hypothetical wind farms or upload their own shapefiles with wind farm specific data (study area and turbine locations) and use the tool to help determine optimized numbers and placement of Motus stations or assess the approximate coverage of

Motus stations *post hoc* following real-world deployment. Users can also download outputs in a variety of file types to use in further mapping and analysis (e.g., R data files, shapefiles, csv). Results from the tool are summarized in automated reports that contain key information on study design that offshore Motus monitoring studies should include as standardized elements in post-construction monitoring plans. Input on the design of the tool and early testing was provided by a range of offshore wind-wildlife stakeholders to help ensure its robustness and utility. A partial list of these contributors is included in Gulka et al. (2021b). The online tool and user manual are available at https://briloon.shinyapps.io/IDIOMS

As part of this effort, a simulation study was conducted to assess the study design trade-offs for offshore deployment of 434 MHz Motus stations when tracking two representative taxa (migrating shorebirds and wintering seabirds). This three-stage approach simulated: (1) offshore wind turbines where Motus stations are deployed, (2) movement patterns for shorebirds and seabirds, based on tracking data from Piping Plovers and Common Terns, and (3) detections of tagged animals, in which calibration data from Motus stations was combined with the simulated tracks. Scenarios varied the number of Motus stations, focal taxon, animals' flight height, and the signal detection threshold for tags to be picked up by receivers, in order to assess the number of stations needed to provide adequate numbers of detections under various circumstances. Results from this simulation study are incorporated into the IDIOMS study design tool and are detailed in a forthcoming manuscript that evaluates detection rates of focal species relative to different configurations of offshore Motus stations within a wind project area (Adams et al. *in prep*).

3.3 Data Framework

The "Offshore Motus Data Framework" (Motus Data Framework) was developed to coordinate, archive, and serve tag detection data, station data, standardized metadata, and summary reports in support of offshore wind energy research, assessments, and monitoring activities. The overall goal of the Motus Data Framework is to develop an Atlantic Offshore Wind Group within the Motus Wildlife Tracking System's online database to coordinate information among projects collecting data for offshore wind applications in the Atlantic region of North America.

Specific objectives of the Motus Data Framework:

- Facilitate access, storage, and standardization of Motus data relevant to offshore wind energy applications.
- Establish minimum standards and centralized data management for various types of data within the Atlantic Offshore Wind Group, including station metadata, calibration data, tag metadata, tag detection data, station health data and station maintenance data.

- Develop a user-friendly online interface for data exploration and dynamic information summaries.
- Implement a process for automated report generation to provide standardized, transparent, and timely information for offshore wind energy applications.
- Coordinate timely access to detailed detection data and metadata across projects for use in offshore wind energy research, assessments, and monitoring activities.

Development of the Motus Data Framework and the Atlantic Offshore Wind Group occurred concurrently with a major update to the entire Motus database, including new Explore Data tools and functionality released publicly in Fall 2022. The online interface, data summaries, and automated reporting tools are currently in beta version. Further development and implementation of the Motus Data Framework will continue in coordination with the Regional Wildlife Science Collaborative for Offshore Wind's (RWSC) Bird and Bat Subcommittee using the Explore Data tools.

3.4 Monitoring Framework

The "Monitoring Framework for Automated Radio Telemetry at Offshore Wind Projects in the U.S. Atlantic" (Monitoring Framework) draws from multiple other products produced during this project (above) to provide a comprehensive overview of using Motus to track birds and bats offshore and to inform research, monitoring, and assessments of offshore wind energy projects in the Atlantic region of North America. In addition to describing a process to optimize coverage of Motus stations for site-specific and regional-scale science needs for offshore wind, the Monitoring Framework also recommends coordinated, strategic tag deployment efforts to best inform population-level inferences as well as develops standard workflows and tools to facilitate timely, efficient, and consistent data collection, analysis, and delivery using the best available science.

Specific objectives of the Monitoring Framework:

- Standardize methods for site-specific monitoring and reporting.
- Coordinate methods and information across sites for regional-scale analyses.
- Develop centralized tag deployment strategies to facilitate population-level inferences from individual-based tracking data.
- Identify standardized data analysis methods to address high-priority information needs.
- Facilitate regional coordination opportunities to maximize resources.
- Recommend high-priority future actions identified during framework development, including improved workflows, analysis tools, and integration with other avian and bat monitoring technologies.

The monitoring framework is intended to provide a roadmap for using the various products and tools to design and implement offshore Motus studies at site specific and regional scales. The monitoring framework was developed by project co-leads with input from stakeholders during the May 2022 workshop (Gulka et al. 2022) and invited reviewers from the USFWS, BOEM, and the RWSC. The RWSC Bird and Bat Subcommittee intends to build from the Monitoring Framework to develop a regional tagging strategy for incorporation into a broader RWSC science plan during 2022–2023.

4 Summary of Key Recommendations

Strategically deployed offshore Motus stations can be used to collect site-specific presence and movement data from individually tracked birds and bats at offshore wind energy project areas. The broader network of Motus stations provides information on larger-scale migratory patterns and movements among wind energy project areas across the U.S. Atlantic region. Results from this guidance development effort will facilitate consistency, transparency, and efficiency of Motus studies and help to address specific avian and bat monitoring needs during multiple phases of offshore wind energy development (site characterization, construction, operations, and decommissioning) using the best available science. Specific recommendations for station deployment methods, study design, tag deployment approaches, data sharing, and other aspects of Motus tracking are included in each of the above-mentioned products.

Key recommendations are summarized below:

- We recommend that offshore wind project proponents support the following: deployment and calibration of receiving stations on offshore buoys and wind turbines within their wind project areas; support of ongoing data fees and maintenance of nearby priority coastal stations; contribute to centralized funding for tagging efforts for species of interest; and follow established guidelines for full transparency of all data through the Motus portal.
- Offshore wind turbine stations should be deployed during the construction phase of the wind facility and operated through the lifetime of the project to help address priorities for consistent, long-term monitoring data.
- All Motus station data, tag data, and metadata should be provided as non-proprietary information so that data is available for use and assessments at regional scales. Regional assessments are necessary for use of best available science when studying migratory species at scales that are ecologically meaningful.
- To standardize detection coverage of offshore stations, we recommend that all offshore stations are configured for dual frequency monitoring and operate following specific guidance in the Guidance Document and IDIOMS study design tool.
- To standardize detection probability of tags, we recommend that tagging studies focused on offshore wind monitoring use power regulated tags programmed to standardized transmit rate of five seconds where possible.
- Coordinated tagging efforts are necessary to maximize population level inferences from individually tagged animals, to minimize animal safety and welfare risks by reducing the number of individuals subjected to tagging activities, and to most effectively leverage time, funding, and other resources for monitoring efforts.

5 References

Adams, E.A., A. Gilbert, K.A. Williams, E.V. Carlson, D. Gobeille, S. MacKenzie, P.H. Loring, R. Deluca. *In prep.* Study design guidance for tracking aerofauna using 434 MHz automated radio telemetry Motus network in the offshore environment.

Carlson, E.V., D. Gobeille, R. Deluca, P.H. Loring. *In prep.* Numerical approximation methods for antenna radiation patterns for Motus Wildlife Tracking Systems.

Carlson, Erik. (2022). Calibration Data for Block Island Wind Farm MOTUS Stations (v.1.0.0). Zenodo. https://doi.org/10.5281/zenodo.6654363

Gulka, J., E. Adams, A. Gilbert, P. Loring, and K.A. Williams. 2021a. Stakeholder Workshop: Guidance Document for Deploying Automated Radio Telemetry Stations on Offshore Wind Turbines and Buoys. Report for New York Energy Research and Development Authority. 10 pp. Available at https://briwildlife.org/offshore-motus-guidance

Gulka, J., E. Adams, A. Gilbert, E. Jenkins, P. Loring, and K.A. Williams. 2021b. Stakeholder Workshop: Online Study Design Tool for Informing Offshore Deployment of Automated Radio Telemetry Stations. Report for New York Energy Research and Development Authority. 11 pp. Available at https://briwildlife.org/offshore-motus-guidance

Gulka, J., K.A. Williams., and P. Loring. 2022. Stakeholder Workshop: Offshore Motus Monitoring Framework. Report for New York Energy Research and Development Authority. 11 pp. Available at https://briwildlife.org/offshore-motus-guidance

Jenkins, E., K.A. Williams., P. Loring., S. Mackenzie., and L. Berrigan. 2021. Stakeholder Workshop: Framework for Offshore Motus Data. Report for New York Energy Research and Development Authority. 10 pp. Available at https://briwildlife.org/offshore-motus-guidance

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