Annual report to Ørsted Wind US

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2022 field activities pertaining to acoustic telemetry monitoring of highly migratory pelagic fishes (HMS) in Revolution Wind (OCS-A 0486), South Fork Wind (OCS-A 0517), Sunrise Wind (OCS-A 0487), and Bay State Wind (OCS-A 0500)

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Abbreviations:
BOEM: Bureau of Ocean Energy Management
HMS: highly migratory species
MACEC: Massachusetts Clean Energy Center
OCS: outer continental shelf
SNE: southern New England
WEA: Wind Energy Area

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Objectives

The objective of this project is to use passive acoustic telemetry to monitor the (presence) and persistence of highly migratory species (HMS) in Ørsted Wind lease areas in relation to offshore wind activities. Passive acoustic telemetry is a popular and powerful tool for studying the movement patterns and habitat use of marine fish over fine- and broad-scale spatial extents (e.g., Heupel et al., 2006; Kneebone et al., 2014abc; Bruce et al., 2019) and has been used previously to document baseline animal presence in wind energy areas (WEA) along the U.S. East Coast (e.g., Frisk et al., 2019; Haulsee et al., 2020; Secor et al., 2020; Gervelis and Kneebone, 2022). In 2022, our specific objectives were to:

(1) Work cooperatively with commercial fishermen to deploy and maintain an array of 32 acoustic receivers to monitor the presence and persistence of tagged HMS within Ørsted Wind lease areas,

(2) Use receiver 'detection' data to establish pre-turbine construction information on the presence, persistence, and habitat use of key HMS in Ørsted Wind lease areas, and

(3) Opportunistically monitor the presence and persistence of other acoustically-tagged marine species within the acoustic receiver array through cooperation with other project Principal Investigators (PIs) and regional acoustic telemetry data sharing programs.

Methods

Acoustic monitoring

To achieve our main objective of documenting HMS presence, persistence, and movements within the Ørsted Wind lease areas, VEMCO acoustic receivers (n = 32, INNOVASEA Systems Inc., Halifax, Nova Scotia, Canada) were deployed to continuously monitor for the presence of tagged HMS at specific locations during 2022 (Figure 1). Acoustic receiver deployment and maintenance occurred in cooperation with for-hire commercial fishing vessels. Details on the deployment location and duration of each receiver can be found in Table 1.

Thirty-two VEMCO VR2AR acoustic release receivers were deployed on the seafloor from roughly May/June to December in 2022. VR2AR receivers were rigged in a custom-designed pop-up mooring system (Mooring Systems, Inc., Bourne, MA) that could be reassembled and redeployed after being summoned to the surface (Figure 2). Individual VR2AR receiver locations were selected based on the desire to minimize potential interaction with commercial fishing gear, particularly mobile fishing gear, and maximize the coverage of the popular recreational fishing area. Receivers were downloaded and inspected at the end of the 2022 season.

Acoustic tagging

No tagging of HMS occurred in 2022. However, deployment of 50 acoustic transmitters will occur in summer 2023.

Data analysis

Raw acoustic detections downloaded from acoustic receivers were compiled into a database for analysis. Because acoustic transmitters have not yet been deployed for this project and no data sharing agreement has been finalized between other offshore wind developers who are funding similar studies, only detection data logged for acoustic transmitters deployed by a project funded by the Massachusetts Clean Energy Center (MACEC; Gervelis and Kneebone, 2022) were used for analyses. Due to high mobility of HMS and the relatively large distance between individual acoustic receivers, single detection events were considered valid and retained for analysis. Detection histories were created to visually demonstrate the presence of each individual and species over time and in relation to acoustic receiver stations. All analyses were performed in R (version 4.2.1; R Core Team, 2022), primarily with *tidyverse* packages (Wickham et al., 2019).

Results

Acoustic receiver deployments and maintenance

Twenty-nine of the thirty-two VR2AR acoustic receivers deployed were successfully recovered and downloaded in November 2022. Two receivers (Sunrise 10 and 13; Figure 1) were not present during the recovery trip and presumed lost, while one receiver (Sunrise 11; Figure 1) was confirmed present with sonar but could not be released remotely due to technical difficulties.

Presence of tagged HMS

Eight MACEC transmitters were detected by the Ørsted Wind receiver array, including blue sharks (n = 2), shortfin mako (n = 3), smooth hammerhead (n = 1), and bluefin tuna (n = 2) (Table 2). A total of 313 detections were recorded for these individuals. Blue sharks were detected between June 8 and September 14, shortfin mako between July 6 and November 4, smooth hammerhead between July 5 and July 15, and bluefin tuna between July 13 and September 19 (Figure 3). Tagged HMS were detected by 21 of 29 recovered receivers (Table 3; Figure 4). Over the course of the study, Sunrise 5 logged the most detections (n = 40), while Revolution 16 and Sunrise 12 detected the greatest number of individual fish (n = 4) (see Figure 1 for station locations). Overall, HMS presence at each station was variable (Table 3, Figure 4).

Other transmitter data collected

A total of 6,036 detections were recorded for 50 unique transmitters deployed on HMS by the other wind energy companies from May to November 2022. Such data will be included in future annual reports contingent upon the execution of a formal data sharing agreement between developers who are supporting HMS monitoring research. Additionally, a total of 14,095 detections were recorded for 285 unique transmitters deployed on animals not tagged by MACEC or the other wind energy companies from January to November 2022.

Discussion

Although no acoustic transmitters have been deployed for Ørsted Wind, detections of MACEC-tagged individuals revealed habitation of the lease areas by four species during warmer months (June to November). Conversely, no detections were recorded throughout the winter by the six receivers deployed since December 2021, indicating absence during cooler months. There is also evidence of at least some degree of fidelity to southern New England (SNE), as all (8) detected fish were tagged in previous years and migrated back to the area in 2022. These data preliminarily suggest that a range of HMS utilize this area of SNE seasonally and potentially on an interannual basis. However, the scope of our observations is extremely limited due to the scarcity of both detections and detected individuals, prohibiting the formation of any detailed conclusions regarding spatiotemporal patterns (i.e., timing of migration, residency time within the array, movements, etc.) until additional data are collected.

Currently, there is insufficient information to address the objectives of describing baseline presence, persistence, and movements of HMS in Ørsted Wind lease areas. We anticipate that this will change with the commencement of tagging in summer 2023, when we plan to deploy 50 acoustic transmitters. Ongoing MACEC monitoring in this region of the WEA has recently demonstrated that HMS broadly exploit these same lease areas during the period of time found in this report (Gervelis and Kneebone, 2022), and we expect to find similar patterns once tagging is underway and data are retrieved at the end of the upcoming 2023 field season. With multi-year battery lives on all transmitters, any returns from fish tagged in 2023, as well as MACEC-tagged fish from previous years, will continue to supplement detections from transmitters deployed in subsequent years. Additionally, the potential establishment of a unified data sharing agreement among all wind energy companies holding stakes in the WEA would immediately expand the dataset with no further effort required. The inclusion of all such data in 2022 would result in a 20-fold increase in the number of detections by the Ørsted Wind receiver array and allow for greater statistical ability to conduct analyses at the population level, rather than at the individual level. Efforts to establish a data sharing agreement has been in development since September 2021 and will continue until such an agreement is reached.

Deployment and retrieval of receivers were largely successful, indicating the overall efficacy of the current placement of stations throughout the Ørsted Wind lease areas. The fates of the two

missing receivers at Sunrise 10 and 13 are unknown and could have been due to a number of reasons but are most likely the result of interaction with mobile fishing gear. We will attempt to connect to the receiver at Sunrise 11 during upcoming receiver download trips (spring 2023) and will explore options for physical recovery if further attempts at remote release are unsuccessful (and the receiver is confirmed to still be on station by the vessel's sonar). If recovered, the existing receiver will be replaced to prevent similar technical issues from occurring in future deployments.

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Table 1 – Metadata for the 32 acoustic receivers that were deployed in the Ørsted Wind lease areas in 2022. Receivers at Sunrise 10 and 13 were lost during the field season, and the receiver at Sunrise 11 could not be retrieved at the time of hauling.

Station	Latitude	Longitude	Depth (m)	Receiver type	Date deployed	Date downloaded	Days deployed
Revolution 1	41.28	-71.13	38	VR2AR	5/14/22	11/14/22	184
Revolution 2	41.22	-71.15	35	VR2AR	5/14/22	11/14/22	184
Revolution 3	41.21	-71.12	36	VR2AR	5/14/22	11/14/22	184
Revolution 4	41.21	-71.07	34	VR2AR	5/14/22	11/14/22	184
Revolution 5	41.20	-71.20	39	VR2AR	5/14/22	11/14/22	184
Revolution 6	41.19	-71.15	37	VR2AR	5/14/22	11/14/22	184
Revolution 7	41.16	-71.24	40	VR2AR	12/8/21; 5/14/22	5/14/22; 11/15/22	342
Revolution 8	41.16	-71.17	38	VR2AR	12/8/21	11/15/22	342
Revolution 9	41.16	-71.12	35	VR2AR	5/14/22	11/15/22	185
Revolution 10	41.11	-71.25	35	VR2AR	12/8/21	11/15/22	342
Revolution 11	41.10	-71.20	34	VR2AR	5/14/22	11/15/22	185
Revolution 12	41.16	-71.00	33	VR2AR	5/14/22	11/14/22	184
Revolution 13	41.12	-71.04	33	VR2AR	5/14/22	11/14/22	184
Revolution 14	41.13	-70.97	30	VR2AR	5/14/22	11/14/22	184
Revolution 15	41.12	-70.89	36	VR2AR	5/14/22	11/14/22	184
Revolution 16	41.08	-71.02	35	VR2AR	12/8/21	11/14/22	341
Revolution 17	41.09	-70.96	36	VR2AR	5/14/22	11/14/22	184
South Fork 1	41.07	-71.11	34	VR2AR	12/8/21; 5/14/22	5/14/22; 11/14/22	341
South Fork 2	41.09	-71.09	33	VR2AR	12/8/21; 5/14/22	5/14/22; 11/14/22	341
Sunrise 1	40.96	-71.26	52	VR2AR	6/1/22	11/14/22	166
Sunrise 2	40.98	-71.18	52	VR2AR	6/1/22	11/14/22	166
Sunrise 3	40.97	-71.13	49	VR2AR	6/1/22	11/14/22	166
Sunrise 4	41.00	-71.00	46	VR2AR	6/1/22	11/15/22	167
Sunrise 5	41.01	-70.94	44	VR2AR	6/1/22	11/15/22	167
Sunrise 6	40.99	-70.91	49	VR2AR	6/1/22	11/15/22	167
Sunrise 7	41.00	-70.87	47	VR2AR	6/1/22	11/15/22	167
Sunrise 8	41.00	-70.82	48	VR2AR	6/1/22	11/15/22	167
Sunrise 9	40.94	-70.96	50	VR2AR	6/1/22	11/15/22	167
Sunrise 10	40.93	-70.91	54	VR2AR	6/1/22	-	-
Sunrise 11	40.89	-71.01	58	VR2AR	6/1/22	-	-
Sunrise 12	40.91	-70.91	51	VR2AR	6/1/22	11/15/22	167
Sunrise 13	40.90	-70.85	54	VR2AR	6/1/22	-	-

Table 2 – Metadata from eight highly migratory species (HMS) tagged for the Massachusetts Clean Energy Center in previous years that were detected during 2022. FL = fork length

Species	# Detected	Sex			Size	Tag placement	
		Male	Female	Unknown	FL (cm)	External	Internal
Blue shark	2	2	0	-	183 - 190	2	0
Bluefin tuna	2	-	-	2	69 - 83	0	2
Shortfin mako	3	1	1	1	137 - 137	3	0
Smooth hammerhead	1	0	1	-	183	1	0

Table 3 – Summary of the number of detections (Dtx) and unique transmitters (Tx) observed at each receiver station by species during the 2022 season. Receivers at Sunrise 10 and 13 were lost during the field season, and the receiver at Sunrise 11 could not be retrieved at the time of hauling. Refer to Figure 1 for the location of each station.

Station	Blue shark		Bluefin tuna		Shortfin mako		Smooth hammerhead		Total	
	Dtx	Tx	Dtx	Tx	Dtx	Tx	Dtx	Tx	Dtx	Tx
Revolution 1	0	0	0	0	0	0	0	0	0	0
Revolution 2	0	0	0	0	0	0	0	0	0	0
Revolution 3	0	0	0	0	2	1	0	0	2	1
Revolution 4	0	0	0	0	0	0	0	0	0	0
Revolution 5	0	0	0	0	0	0	0	0	0	0
Revolution 6	0	0	0	0	0	0	0	0	0	0
Revolution 7	0	0	0	0	10	1	0	0	10	1
Revolution 8	0	0	0	0	0	0	0	0	0	0
Revolution 9	0	0	0	0	0	0	0	0	0	0
Revolution 10	0	0	0	0	9	2	0	0	9	2
Revolution 11	0	0	0	0	13	1	0	0	13	1
Revolution 12	0	0	0	0	21	2	0	0	21	2
Revolution 13	0	0	0	0	10	2	0	0	10	2
Revolution 14	0	0	0	0	6	1	0	0	6	1
Revolution 15	5	1	0	0	9	1	0	0	14	2
Revolution 16	0	0	9	1	24	3	0	0	33	4
Revolution 17	0	0	0	0	13	1	0	0	13	1
South Fork 1	0	0	0	0	7	1	0	0	7	1
South Fork 2	0	0	0	0	4	1	0	0	4	1
Sunrise 1	0	0	0	0	0	0	0	0	0	0
Sunrise 2	9	1	1	1	11	1	0	0	21	3
Sunrise 3	0	0	3	1	16	2	0	0	19	3
Sunrise 4	6	1	0	0	20	1	0	0	26	2
Sunrise 5	0	0	0	0	40	3	0	0	40	3
Sunrise 6	0	0	0	0	4	1	0	0	4	1
Sunrise 7	0	0	0	0	25	1	2	1	27	2
Sunrise 8	4	1	3	1	0	0	0	0	7	2
Sunrise 9	0	0	0	0	17	1	0	0	17	1
Sunrise 10	-	-	-	-	-	-	-	-	-	-
Sunrise 11	-	-	-	-	-	-	-	-	-	-
Sunrise 12	4	2	0	0	2	1	4	1	10	4
Sunrise 13	-	-	-	-	-	-	-	-	-	-
Total	28	2	16	2	263	3	6	1	313	8

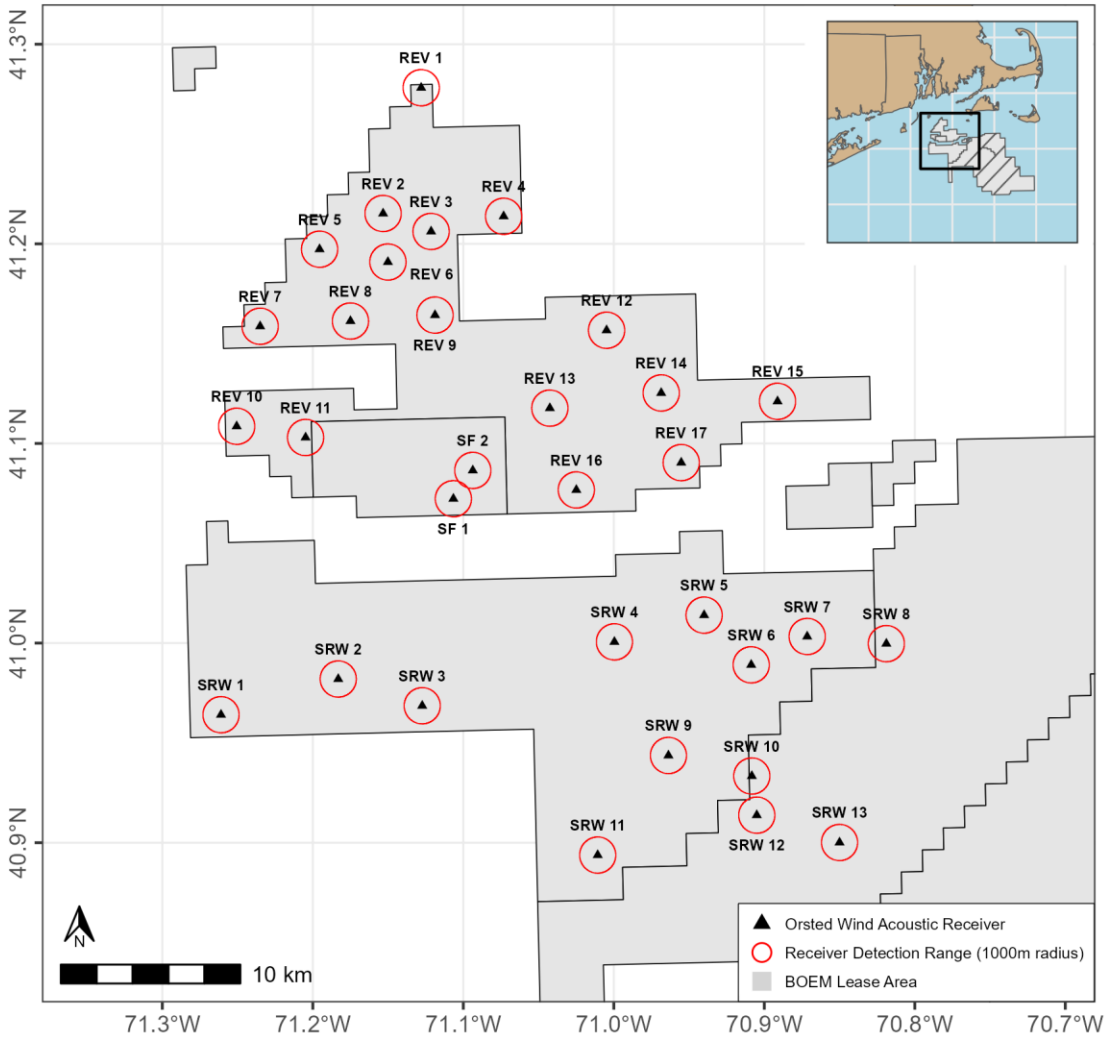

Figure 1 – Map showing the locations of the 32 acoustic receiver stations in the Ørsted Wind lease areas in 2022. Receivers at SRW 10 and 13 were lost during the field season, and the receiver at SRW 11 could not be retrieved at the time of hauling. REV = Revolution Wind, SF = South Fork Wind, SRW = Sunrise Wind

Figure 2 – Mooring configuration used to deploy VEMCO VR2AR acoustic receivers.

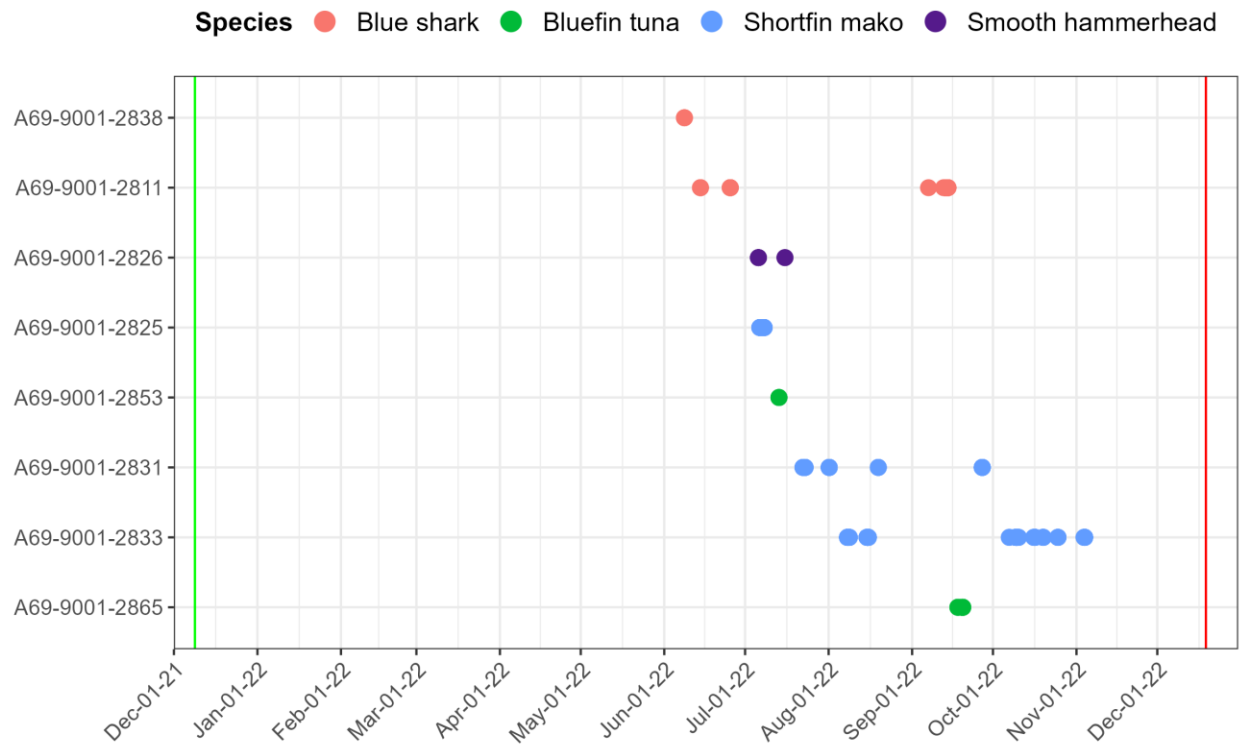

Figure 3 – Detection histories for eight individuals tagged for the Massachusetts Clean Energy Center in previous years that were monitored within Ørsted Wind lease areas in 2022. Each dot represents a detection on one of the acoustic receivers. The green vertical line represents the earliest time any receivers were deployed, and the red vertical line represents the latest time all receivers were downloaded. Six receivers were deployed in December 2021, while all other receivers were deployed in May/June 2022.

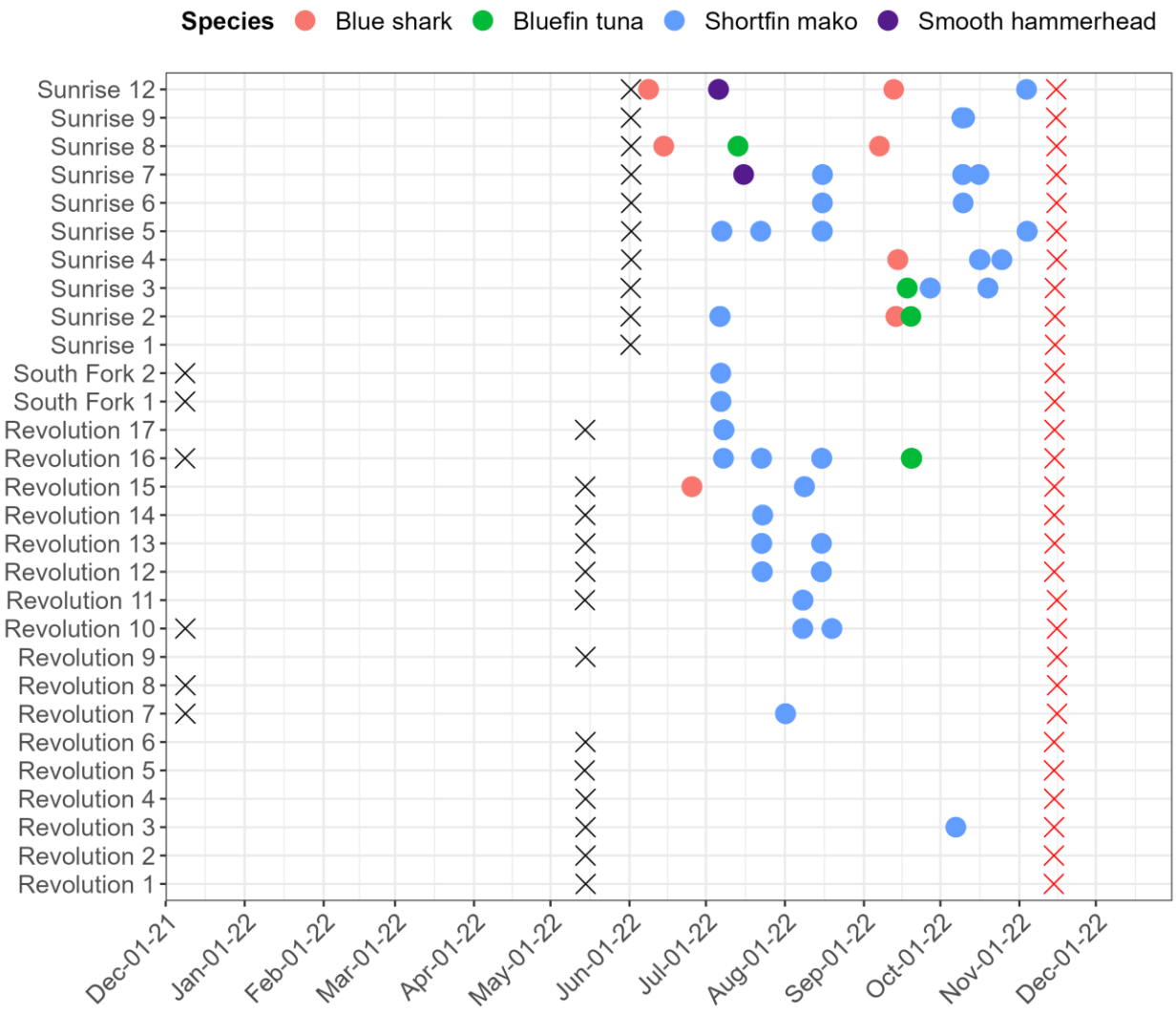

Figure 4 – Detection histories of each species on each receiver station deployed in Ørsted Wind lease areas in 2022. Colored circles indicate when that species was observed at a given station. Black 'Xs' represent the time when the receiver was deployed, and red 'Xs' represent the time it was last downloaded. Receivers at Sunrise 10 and 13 were lost during the field season, and the receiver at Sunrise 11 could not be retrieved at the time of hauling. Additionally, receivers at Revolution 7, South Fork 1, and South Fork 2 were hauled in June for maintenance and then immediately redeployed.