South Fork Fisheries Monitoring Plan
Acoustic Telemetry Monitoring Survey
2024 Annual Report

Reporting Period:
January 1, 2024 to December 31, 2024

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Summary

The Commercial Fisheries Research Foundation (CFRF) and local fishermen are conducting a two-year acoustic telemetry study within the South Fork Wind Farm (SFWF) and nearby undeveloped areas. This survey focuses on the introduction of artificial reef habitat by offshore wind turbine installation and operation. This direct change in the physical environment will likely impact the habits of species that typically reside in or migrate through these areas. Structure associated species may be drawn to the increase in structure within wind energy developments; however, the spatial extent to which they utilize the turbine foundations and how long individuals would stay in these areas is largely unknown. Fine scale positioning acoustic telemetry will provide precise spatial and temporal positions of individually tagged fish and crustaceans, allowing insight into how long and far away individuals stay around a turbine foundation. We have created and are monitoring fine scale positioning acoustic receiver arrays around a single turbine within the SFWF and in a reference control area. The reference area is in an area with a natural rocky reef habitat, which was present in the SFWF lease area prior to the wind farm's construction, providing potential insight into habitat use in SFWF before construction. Species of interest are tagged on the SFWF ventless trap survey trips and detected by other receivers placed around SFWF by external researchers, leveraging existing efforts to reduce costs and detect larger scale movement within and around the South Fork Wind Farm.

This report details the survey methods and summarizes the results from the first year of the survey conducted between January and December 2024. During this reporting period, the location of the two study areas was determined. Turbine AP08 within the SFWF is the center of the turbine reef array and the natural reef array is located in the western reference area of the SFWF ventless trap survey. The F/V Cailyn and Maren and the F/V Sweet Misery and all crew members met the Orsted HSE and marine inspection standards. Preliminary range testing was conducted within the SFWF, the two receiver arrays were deployed within the SFWF and control area, 67 acoustic tags were deployed across both receiver arrays on ventless trap survey trips, and half of the receivers in each array were hauled and data downloaded.

Introduction

The Commercial Fisheries Research Foundation, in partnership with local fishermen, is conducting fisheries monitoring surveys of the South Fork Wind Farm, which began in 2020. Due to the differences in selectivity of various gear types, five different surveys, each using a different gear type, are currently being conducted to collect information on the potential impacts of the SFWF project on fisheries resources in and around the lease area. These surveys are a beam trawl survey, ventless trap survey, fish pot survey, mechanical jigging survey, and acoustic telemetry monitoring survey. A gillnet survey was conducted in 2021 and 2022; however, it was terminated after two years of baseline data collection during the pre-construction phase of the SFWF. The acoustic telemetry monitoring survey serves as a partial redirection of effort from the terminated gillnet survey, and it aims to evaluate the spatial and temporal habitat use of fish and crustacean species in and around the SFWF. This report details the survey methods and summarizes the effort and results from the survey conducted between January and December 2024. Table 1 provides a complete project timeline.

Table 1. Adjusted timeline for the full survey period.

Timeline	Survey Period	Tasks
January – June 2024	Months 1 – 6	Order all required year 1 equipment and supplies, ensure all HSE and marine inspection standards are met, prepare all equipment, site selection for both receiver arrays, submit semi-annual progress report 1
July 2024	Month 7	Deploy range test receivers and transmitters, complete Innovasea Fathom software training
August 2024	Month 8	Review range test data and design full fine scale positioning receiver arrays
September – November 2024	Months 9 – 11	Deploy full receiver arrays, conduct preliminary positioning testing, train staff on crustacean and finfish tagging protocols, begin tag deployment on crustaceans and finfish, perform bi-monthly receiver data downloads, data management and auditing, tag crustaceans and finfish on ventless trap survey, exploration of detection history data
December 2024 – April 2025	Months 12 – 16	Perform bi-monthly receiver data downloads, complete Innovasea Fathom Position training, data management and auditing, exploration of detection history data, perform KDE, COA, and occupancy analysis, submit semi-annual progress report 2
May – November 2025	Months 17 – 23	Perform bi-monthly receiver data downloads, data management and auditing, tag finfish and crustaceans on ventless trap survey trips, exploration of detection history data, submit semi-annual progress report 3

December 2025 – April 2026	Months 24 – 28	Perform bi-monthly receiver data downloads, data management and auditing, exploration of detection history data, perform KDE, COA, and occupancy analysis, submit semi-annual progress report 4
May – July 2026	Months 29 – 31	Perform bi-monthly receiver data downloads, data management and auditing, tag finfish and crustaceans on ventless trap survey trips, exploration of detection history data, submit semi-annual progress report 5
August – December 2026	Months 32 – 36	Breakdown receiver arrays and store all equipment, data management and auditing, perform KDE, COA, and occupancy analysis, submit final report

Methods

This survey utilizes two fine scale positioning acoustic telemetry arrays. One array is deployed around turbine AP08 within the SFWF while the other is deployed in the SFWF ventless trap survey western reference control area outside any wind energy development area (Figures 1-3). The control area has habitat similar to the pre-construction habitat in the SFWF. This will allow for indirect comparisons of a turbine foundation reef to previously existing natural habitat and direct comparisons to a natural hard bottom. The exact locations of the study areas were determined with advisement from SFWF staff and partnering commercial fishermen from the SFWF fisheries monitoring surveys to avoid any conflict with the wind farm operation and fishing gear interaction. The two participating vessels from the former SFWF gillnet survey, F/V Cailyn and Maren and F/V Sweet Misery, are the partnering vessels for this acoustic telemetry monitoring study.

The two fine scale positioning arrays each consist of 32 Innovasea VR2AR 69 kHz receivers. All receivers are deployed 2 m above the seafloor and utilize internal acoustic releases for all deployments and bi-monthly data downloads. Due to the relatively short distances between receivers and acoustic release deployments, there are no surface buoys marking their location. Paired with compatible Mooring Systems Inc. pop-up buoys, the acoustic releases maintain a connection with their mooring anchors during all bi-monthly data download trips to keep their deployment locations consistent and avoid leaving mooring anchors on the seafloor in the study areas. Biofouling is removed from receivers at each bi-monthly data download, and receivers will be deployed for two years.

This acoustic telemetry monitoring survey leverages efforts from the concurrent SFWF ventless trap survey to catch and tag structure associated species near the telemetry arrays in this study. We are deploying tags on target species of lobster, Jonah crab, rock crab, black sea bass, scup, tautog, cunner, and cod for this study; all of which are highly abundant structure associated species caught in the regular ventless trap survey effort or commercially or ecologically important in the South Fork Wind area. A total of 400 tags will be deployed over the course of the full study, with 200 deployed in each area. All tags are high power Innovasea V9 transmitters attached externally, and finfish with the ability to use the full water column around the turbine foundation will be tagged with depth sensor V9P transmitters to determine

their vertical distribution in the water column. Crustaceans will be tagged with base V9 tags, assuming they will consistently remain on the seafloor.

All tags have stepped programming with short intervals of 45-75 seconds between tag transmissions for 45 days after tagging, then longer transmission intervals of 5-6 minutes after the initial 45 days post-tagging. This stepped programming has two benefits. First, short transmission intervals immediately after tagging provide more data to determine any tagging associated mortality. The second benefit is due to the relatively small area monitored by the fine scale positioning arrays and the seasonal abundance of the target species in the greater SFWF area. Our target species have seasonal migration patterns into and out of the study area; thus, the probability that a tagged individual will remain in the receiver arrays will decrease over time. Short initial transmission intervals will provide more positioning data when the tagged animals are most likely within the receiver array areas. Longer transmission intervals after the initial 45-day post-tagging period will allow for sufficient battery life of all tags through the full study period if the animal remains in or returns to the study areas for extended periods of time while also giving adequate detection data to be used in all analyses.

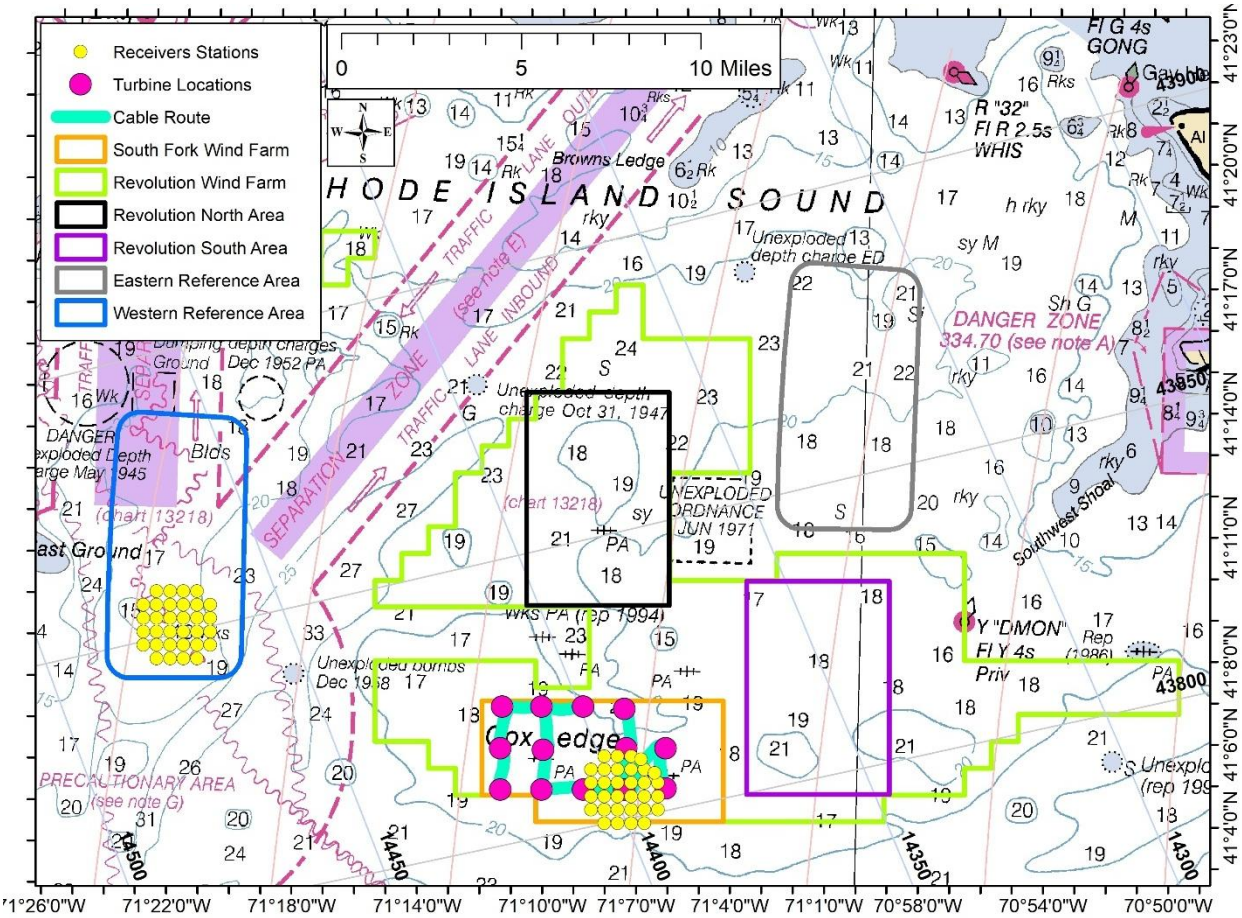

Figure 1. Map of both receiver array locations within the SFWF and ventless trap survey western control area.

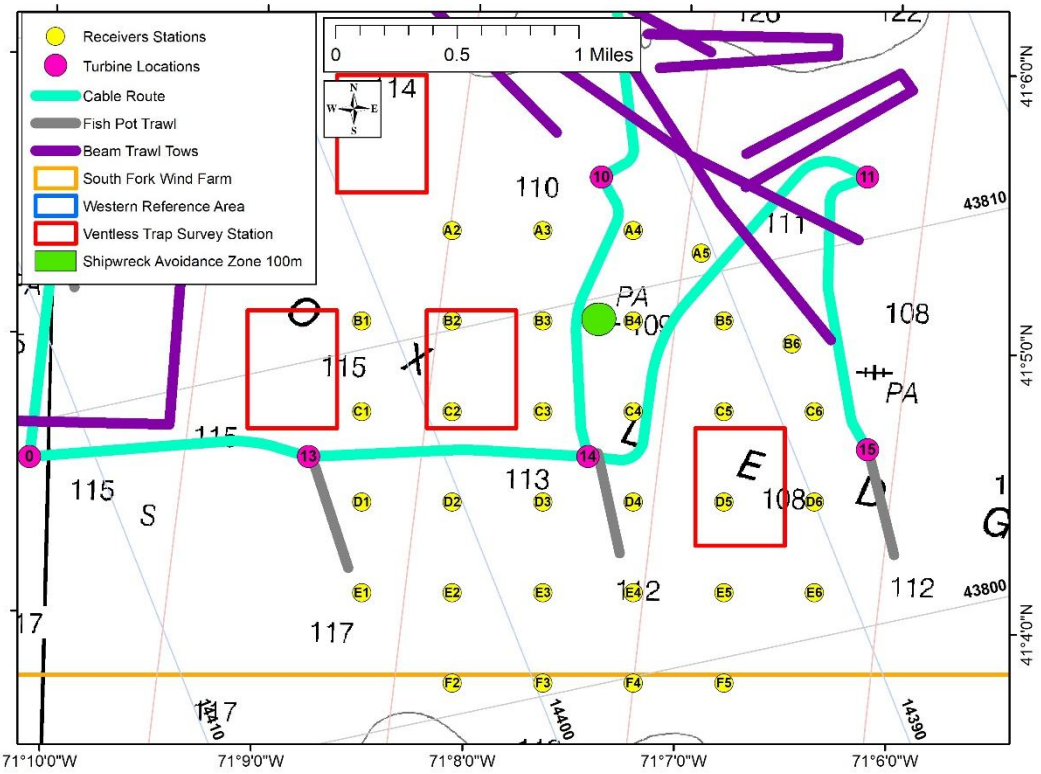

Figure 2. Map of the SFWF receiver array and four 2024 ventless trap survey stations (503, 507, 508, and 509) where acoustic tags were deployed.

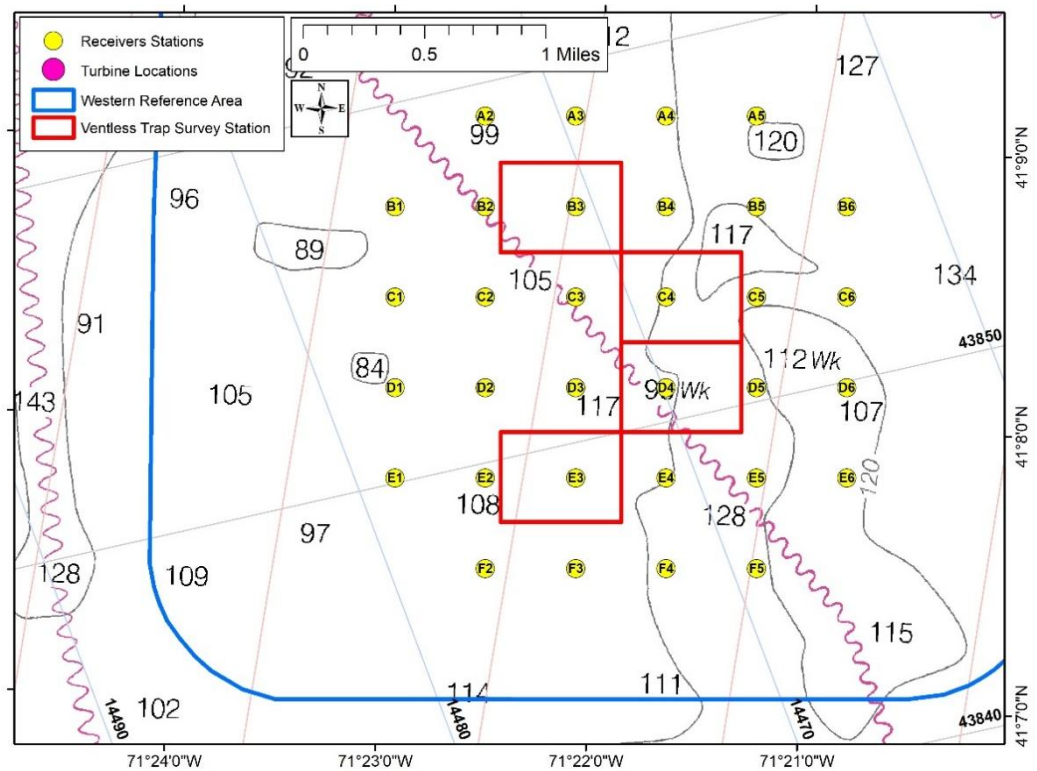

Figure 3. Map of the control area receiver array and four 2024 ventless trap survey stations

(517, 518, 519, and 520) where acoustic tags were deployed.

The research staff aboard the SFWF ventless trap survey trips are trained on acoustic tagging protocols for all target species. Acoustic tags are only deployed at the stations near the receiver arrays (Figures 2 and 3), and all tagged individuals are biologically sampled following traditional ventless trap survey protocols prior to tagging. All crustacean tags are deployed by cleaning and lightly sanding the carapace, allowing the carapace time to dry, and attaching the acoustic tag to the carapace with a marine grade super glue (Collie et al. 2019). Crustaceans are also tagged with uniquely numbered Floy FD-94 T-Bar Anchor Tags at the rear of the carapace. All finfish are tagged externally with uniquely numbered Floy FT-4 Lock On Tags behind the dorsal fin. All animals are tagged and returned to the water as quickly as possible, and only animals in good condition are tagged (hard shells and no shell disease for crustaceans, and no barotrauma or signs of injury for finfish). All crustacean tags are deployed after the summer molt to reduce the probability of tags being shed with a molt, and finfish tags are deployed throughout the ventless trap survey season of May – November. All finfish and crustacean Floy tags have the CFRF phone number printed on them to promote reporting and returns of the acoustic tags if commercial or recreational fishermen catch tagged individuals.

Prior to the two full arrays deployment, ten receivers and four range test tags were deployed for approximately one month at the turbine array location to determine on-site detection range and efficiency with concurrent background turbine operation noise. The full receiver array spacing was determined based on this preliminary range testing, and fine scale array positioning tests were also conducted to validate receiver spacing and positioning capabilities once the two full arrays were deployed.

Acoustic telemetry efforts with Innovasea receivers already underway by many other organizations around the SFWF area will also provide greater spatial monitoring of tagged individuals outside of our study areas, even if they leave the fine scale positioning arrays. Pending continuation of these studies, we will continue monitoring our tagged animals at a broader scale even if they leave our survey areas through data sharing networks such as the Atlantic Cooperative Telemetry Network, Mid-Atlantic Acoustic Telemetry Observation System, and Animal Telemetry Network - Integrated Ocean Observing System.

All data is processed by CFRF staff using Innovasea Vue and Fathom software. Innovasea will provide an initial training with the Fathom software to process the raw receiver detections into the precise latitude and longitude positions within the two fine scale receiver arrays. Innovasea will also conduct the initial array calibration after the first two months of deployment to determine the overall array performance and ensure the receiver spacing is adequate for precise location estimation.

Data is analyzed through kernel density estimation (KDE) for each species' occupancy and spatial use of the two individual study areas. Centers of activity (COA) are also calculated at the individual and species levels. Occupancy will be determined based on overall residency times spent in the survey areas, not by the number of detections or precise location estimates of individual tags. Comparisons for each of these individual types of analysis is made between the turbine reef and the natural reef areas. Comparisons are also made between years within the two individual study areas themselves. We are also using directional movement rates within the turbine reef area across cable routes to investigate any avoidance or attraction behavior of

tagged individuals in relation to power cables. Detections and data from external studies' transmitters is also shared and utilized for similar analysis where appropriate in coordination and collaboration with the original researchers through networks including the Atlantic Cooperative Telemetry Network, Mid-Atlantic Acoustic Telemetry Observation System, and Animal Telemetry Network - Integrated Ocean Observing System.

Major Tasks Completed in the Reporting Period

During the January – June 2024 reporting period, the location of the two study areas was determined with input from SFWF staff and fishermen participating in the SFWF fisheries monitoring surveys. Turbine AP08 within the SFWF is the center of the turbine reef array (Figure 2), and the natural reef array is located in the western reference area of the SFWF ventless trap survey (Figure 3). Both the F/V Cailyn and Maren and the F/V Sweet Misery also participated in the SFWF mechanical jigging survey, and through that survey, both vessels and all crew met Orsted HSE and marine inspection standards.

During the reporting period of July – December 2024, range testing was conducted within the SFWF, the two receiver arrays were deployed within the SFWF and control area, 67 acoustic tags were deployed across both receiver arrays on ventless trap survey trips, and half of the receivers in each array were hauled and data downloaded.

Range Test: July 2024

A set of ten receivers and four reference tags were deployed around turbine AP08 for preliminary range testing from 7/2/2024 to 7/31/2024 (Figure 4). Locations of the receivers and reference tags were designed to test detection efficiency at varying distances under three different conditions: no direct interference of a turbine, complete interference of a turbine, and adjacent interference of a turbine. Two test tags were deployed at the receiver closest to the turbine location at different depths in the water column; however, the test tag deployed higher in the water column was damaged during the deployment and did not provide any data. As a result, all three functional test tags were deployed 0.5 m above the seafloor during the range testing to closely simulate expected tag depths when on animals. Drifts with reference tags deployed 0.5 m and 20 m off the bottom were also conducted during the range testing. All range test reference tags were V9P high power tags to replicate tags used on animals for this survey, and pressure sensors confirmed tag depths during all testing.

With the relatively small area of range testing and the high number of reference tags and receiver sync tags in the area, overall detection efficiency was low, with a maximum detection percentage of 30-40% due to the high occurrence of transmission interference between multiple tags sending simultaneous transmissions (Figure 5). However, this detection percentage was fairly consistent out to a tag-receiver distance of 600 m. Upon range test data review and insight from Innovasea, this 600 m distance was used as the receiver spacing when designing the two full fixed receiver arrays.

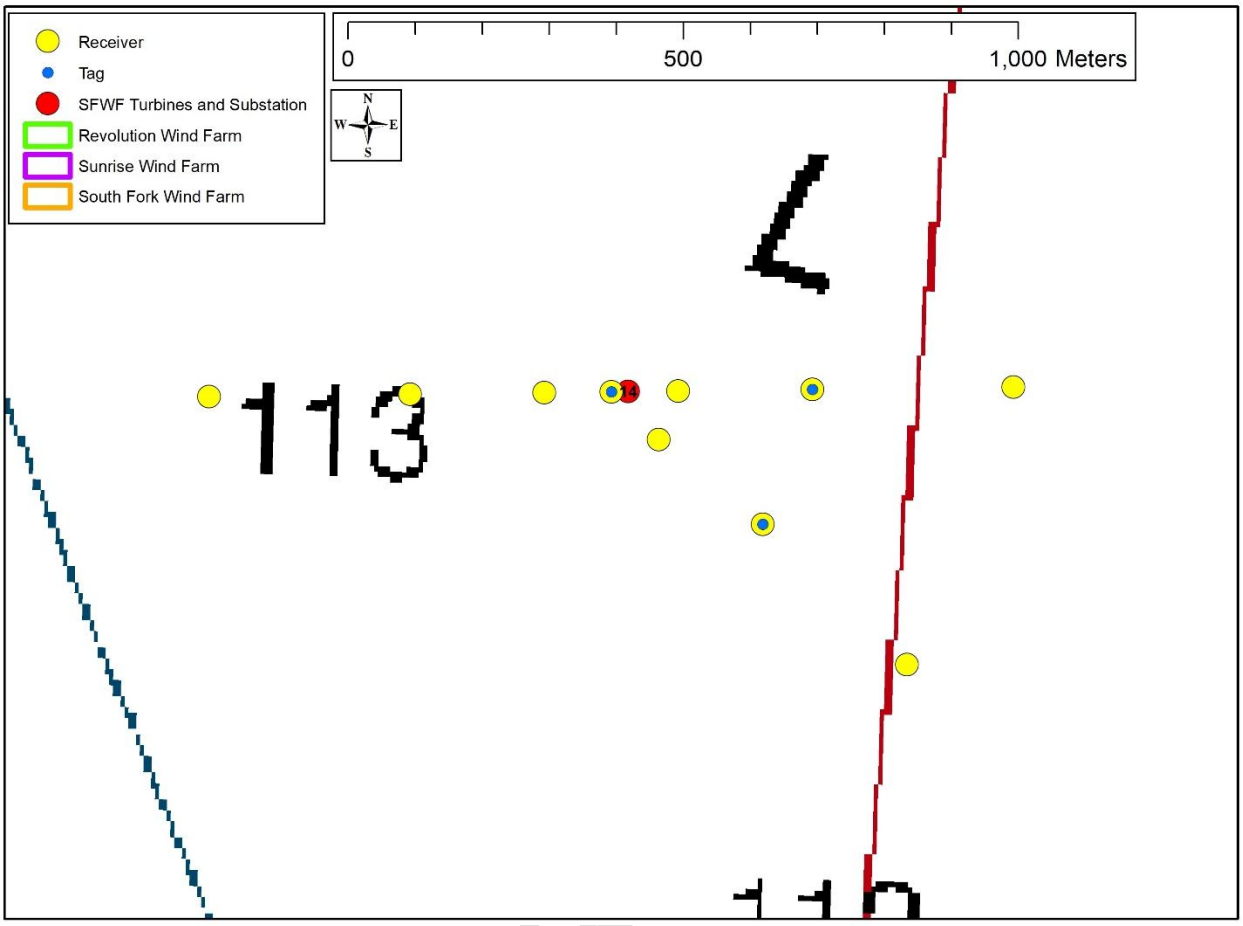

Figure 4. Range test receiver and reference tag locations around turbine AP08 within the SFWF.

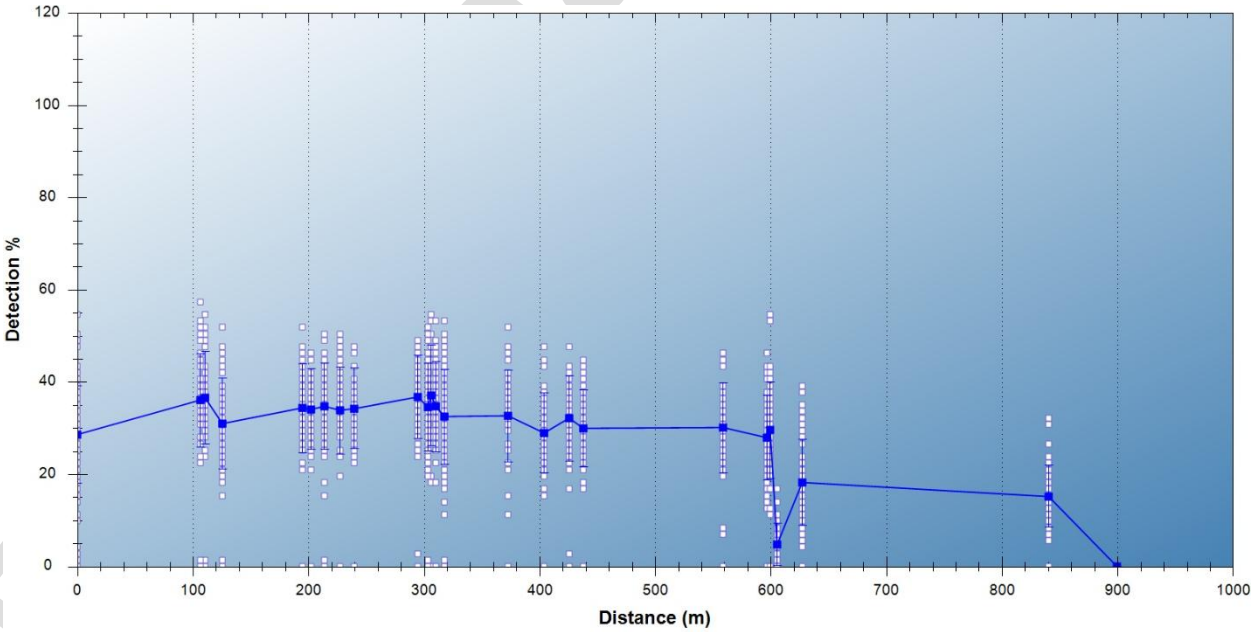

Figure 5. The range test results show the detection percentage of all expected tag transmissions at varying test tag distances.

Fine Scale Positioning Array Deployments: September – December 2024

Both fine scale positioning receiver arrays consisting of 32 receivers each were deployed following the range testing data review. The array within the SFWF around turbine AP08 was deployed on 9/30/2024, and the western control area array was deployed on 10/4/2024. Following the full array deployments, tags were deployed in both areas during the October and November ventless trap survey trips at the stations mentioned previously (Figures 2 and 3). A total of 67 tags have been deployed on six species (Table 2), and tagging will continue with the resumption of the SFWF ventless trap survey in May 2025. The receiver download trips were completed on 11/27/2024 for the South Fork array and 12/2/2024 for the control area array.

Table 2. Tags deployed by species and array area during the October and November 2024 ventless trap survey trips.

Species	Transmitter	South Fork	West	Total
Black Sea Bass	V9P	17	5	**22**
Cunner	V9P	2	0	**2**
Jonah Crab	V9	8	3	**11**
Lobster	V9	14	4	**18**
Rock Crab	V9	5	2	**7**
Scup	V9P	2	5	**7**
Total		**48**	**19**	**67**

Figures 6-8 provide a brief overview of the detection data collected to date. Data for all SFWF stations consists of the date range 9/30/2024 – 11/27/2024 and data for all west control area stations consists of the date range 10/4/2024 – 12/2/2024. For both arrays, only the southern half of the receivers have been downloaded (stations in rows D, E, and F for both arrays, Figures 2 and 3). Out of 67 tags deployed, 54 were detected on the first data downloads for each receiver array. Because only the southern half of the receivers in each array have been downloaded to date, we expect to have detection data from the remaining 13 tags on the northern half of the receivers in each array upon their first download, which will take place in early 2025.

Innovasea will provide CFRF staff with a training session on the Fathom Position software in January 2025. This program transforms the raw detection data into fine-scale positioning data. Following this training, we will begin a more detailed spatial analysis of the data. This training will utilize our own data from this survey and verify appropriate receiver spacing for the fine scale positioning arrays. If needed, receiver spacing and station locations will be adjusted on the next receiver download trips planned for early 2025.

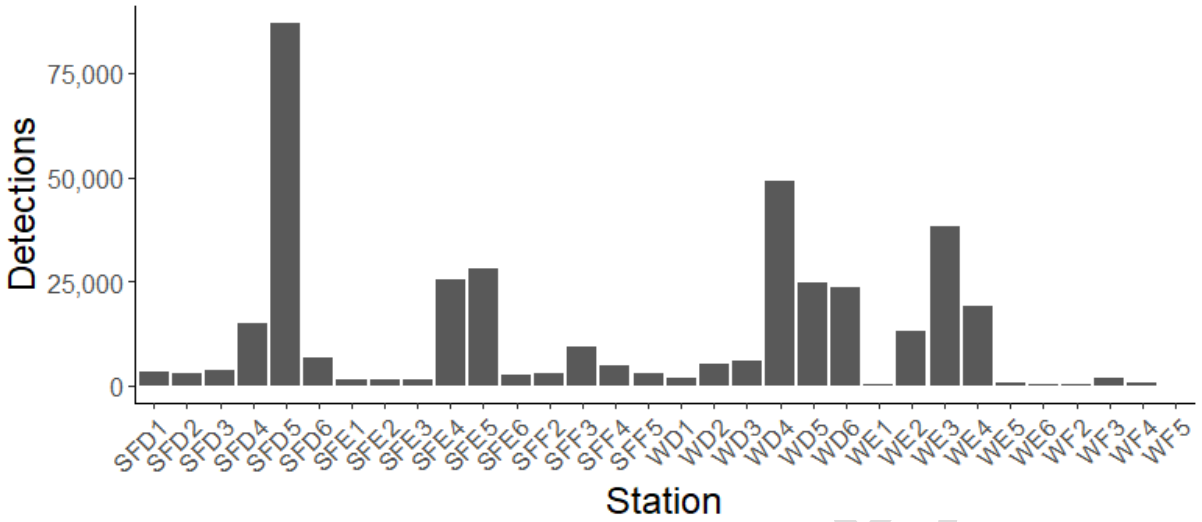

Figure 6. Total number of detections at all stations during this reporting period from CFRF deployed tags. Only the southern 16 of 32 total stations in each array were downloaded during the reporting period. Receiver stations with the highest number of detections correspond with locations of ventless trap survey stations used for tag deployments (Figures 2 and 3).

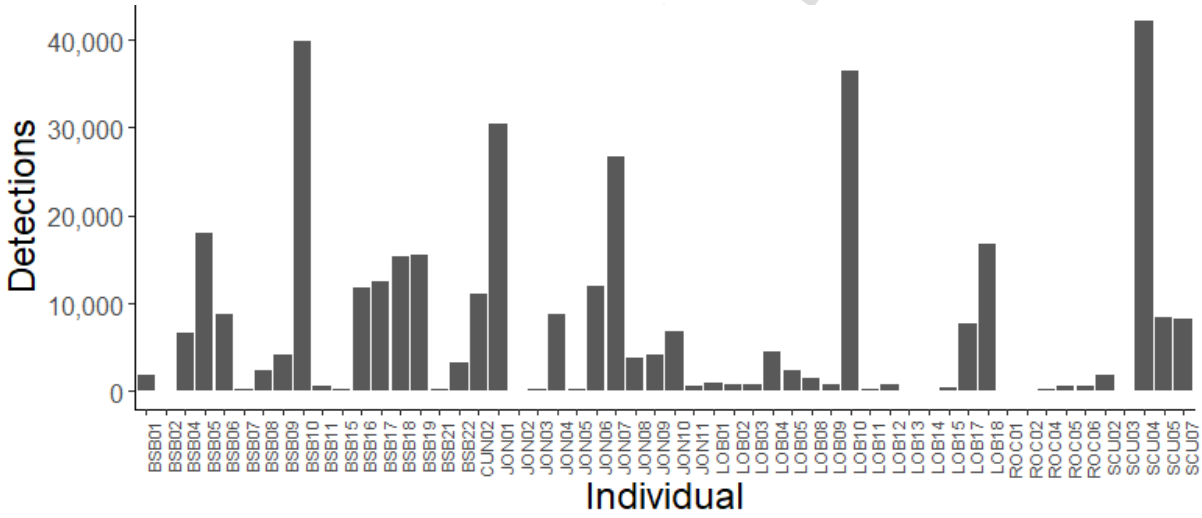

Figure 7. Total number of detections per tagged individual during this reporting period from CFRF deployed tags. Species abbreviations are as follows: BSB = black sea bass, CUN = cunner, JON = Jonah crab, LOB = lobster, ROC = rock crab, SCU = scup.

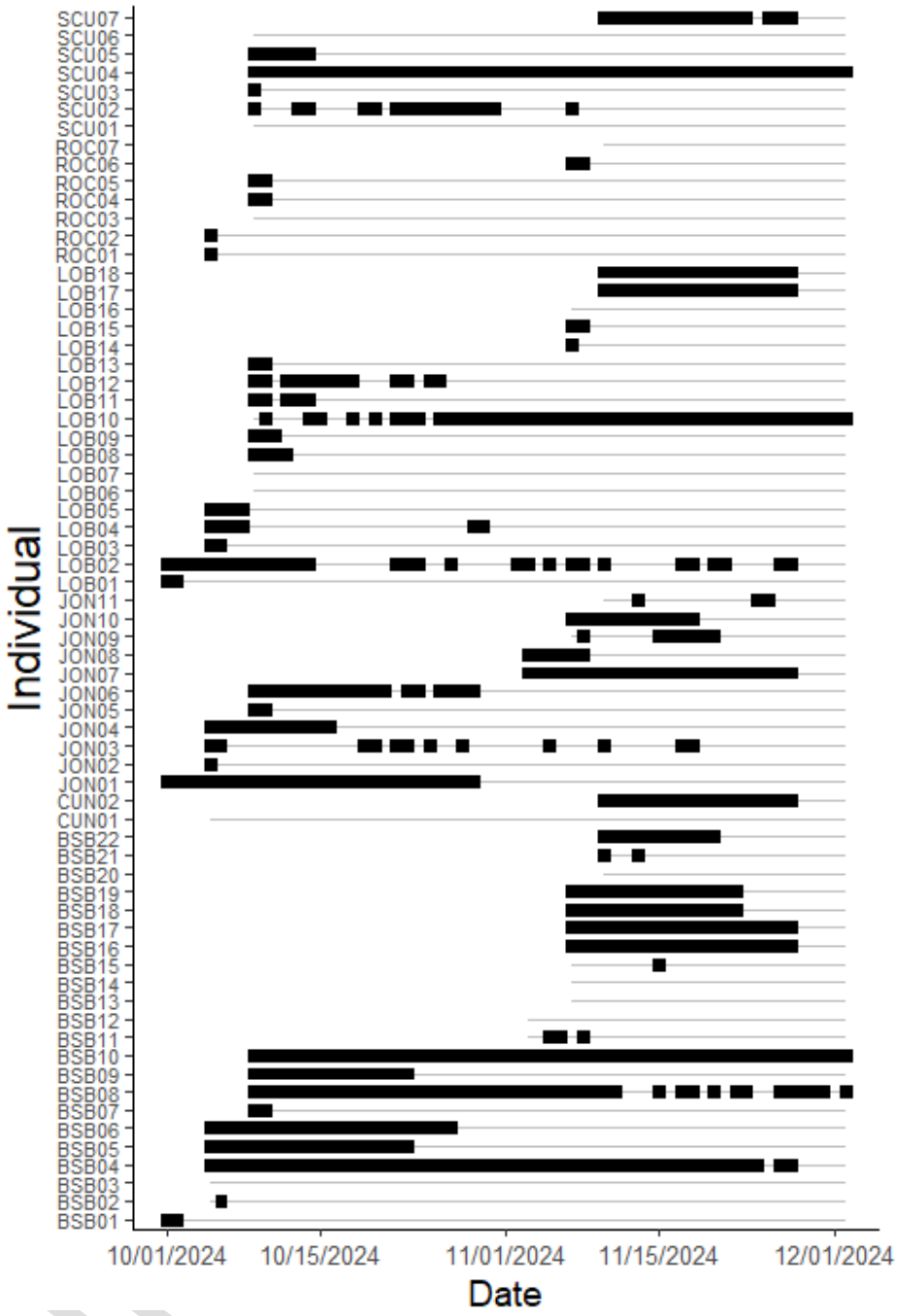

Figure 8. Temporal detection histories for all CFRF tagged individuals deployed to date. Grey lines are potential detection periods after tagging date. Black fill are periods of detection for each individual. Species abbreviations are as follows: BSB = black sea bass, CUN = cunner, JON = Jonah crab, LOB = lobster, ROC = rock crab, SCU = scup.

Outreach

The CFRF maintains a project website at www.cfrfoundation.org/sfwf-acoustic-monitoring which gives a general survey description. This survey was also highlighted in our June 2024 newsletter.