# Resource monitoring for Black Sea Bass (*Centropristis striata*) at the Coastal Virginia Offshore Wind Commercial site

VIMS Marine Resource Report No. 2025-10

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2700 Cromwell Drive

Norfolk, VA 23509

Submitted by:

Reece Aponte, David Rudders, Sally Roman, Conor O'Meally, Andrew Scheld

Affiliation:

Virginia Institute of Marine Science

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## Executive Summary

The development of offshore wind capacity along the East Coast of the United States continues to progress with approximately 2,000 turbines planned coastwide over the next decade. In many instances, the construction and operation of turbines spatially overlaps with other ocean uses. Commercial and recreational fishing are two such activities that, in some cases, will interact with the development of offshore wind lease sites. While the impact on fishery resources and the fisheries supported by them is uncertain and likely variable across regions and species, this study provides a baseline characterization of potential impacts across the spatio-temporal scale associated with offshore wind development in Lease Area OCS-A 0483.

Located between 27 and 42 miles off the coast of Virginia Beach, VA, the Coastal Virginia Offshore Wind (CVOW) site occupies a lease site covering approximately 112,800 acres and at full build-out will contain 176 turbines, 3 substations, and transmission cabling. Historically, this area has supported both commercial and recreational Black Sea Bass (*Centropristis striata*) fisheries. Given the spatial overlap between the CVOW lease site and the traditional black sea bass fishery as well as this species' affinity for structured habitat, an investigation into the impact of lease site development is critical to the understanding of potential black sea bass fishery impacts by the CVOW site.

Dominion Energy worked with project Principal Investigators to develop and execute a survey, in alignment with the guidance for pre-construction monitoring included in the Responsible Offshore Science Alliance Offshore Wind Project Monitoring Framework and Guidelines (ROSA, 2021), as well as Dominion Energy's Fisheries Mitigation and Monitoring Plan (see Appendix V-2, Dominion Energy, 2023). Broadly, the survey endeavored to collect baseline information relevant to the black sea bass resource in the lease area and establish the foundation for potential post-construction fishery monitoring efforts to evaluate potential impacts on the resource in the CVOW lease area.

The survey domain included a region encompassed by the southeast corner of the lease area and was considered the experimental area. A control area, outside and directly south of the lease was also concurrently sampled. The spatial extent of the CVOW lease area, including lease subsections and planned turbine foundations, were included during the development of the study. Around each proposed turbine location, distance bands were created and utilized to collect catch data as a function of increasing distance from the proposed turbine locations following a before-after-gradient (BAG) design. In the lease area, distance bands associated with monopile positions were distributed at three intervals (inner: 28m-148m; intermediate: 148m-328m; and far: 328m-628m), while the control area was designed with 2 intervals (inner: 28m-148m; intermediate 148-328m). Survey trips were conducted monthly and collected catch data as well as biological samples from the deployed pots for each trip.

Pre-construction sampling of Black Sea Bass suggested no significant difference in catch rates between the lease and control areas. Catch rates between distance bands were also not significantly different. Reflecting the seasonality of resource abundance, catch per unit effort and catch at-length were significantly different across sampling events, with higher catch rates observed during periods of seasonal inshore-offshore migrations (e.g., spring and winter). Catch at-length showed a negative correlation with average bottom water temperature ($\rho = -0.14$, p-value $<0.001$), where larger individuals were caught during the colder winter months. Bycatch rates were not found to

be significantly different across the lease and control areas or distance bands. The most commonly identified bycatch species was Pinfish, *Lagodon rhomboides* (n = 145).

Estimated ages for Black Sea Bass ranged from 1 to 9 years with the predominant representation of age classes from 1 to 5 years old, with a mean age of 2 (SD = 0.98). Only one individual caught in November 2023 was estimated to be 9 years old. Stomach contents analysis revealed that decapod crabs were the dominant species group found in approximately 22% of the stomachs (n = 180), followed by teleost fishes, worms, and other crustaceans. Stomach weights differed seasonally, with higher weights in the winter and spring.

This study collected information on the Black Sea Bass resource and associated bycatch before lease build out utilizing a BAG design. This study reflects the state of the black sea bass resource in a subset of the lease area and adjacent control site prior to full build out of the lease site. In order to fully understand the impact of lease site development, this work represents the first phase of effort. Continuing data collection while honoring the initial experimental design would allow for a comparison of resource conditions before and after construction and support the evaluation of impacts upon Black Sea Bass population dynamics and relative abundance in the CVOW lease area.

## Introduction

The development of offshore wind capacity along the East Coast of the United States continues to progress with approximately 2,000 turbines planned coastwide over the next decade. In many instances, the construction and operation of turbines spatially overlaps with other ocean uses. Commercial and recreational fishing are two such activities that, in some cases, will interact with the development of offshore wind lease sites. While the impact on fishery resources is uncertain and likely variable across regions and species, this study provides a baseline characterization of potential impacts across the spatio-temporal scale associated with offshore wind development in Lease Area OCS-A 0483.

Located 27 to 42 miles off the coast of Virginia Beach, VA, the Coastal Virginia Offshore Wind (CVOW) site occupies a lease site of approximately 112,800 acres and will contain 176 turbines, 3 substations, and transport cabling. Water depth in the lease area ranges from 18 to 42m, and the seafloor is primarily comprised of sand. The project will provide up to 3,000 megawatts of power to Virginia and North Carolina, when fully operational.

Black Sea Bass (*Centropristis striata*) inhabit the US East Coast, from Maine to Florida, where they associate with structured habitat. Their maximum length is around 600mm, and they typically live from 8 to 12 years old. Sexual maturity is reached between 1 and 3 years of age, and Black Sea Bass are protogynous hermaphrodites, meaning most individuals start out as females and as they mature and grow, transition to males. In the Commonwealth of Virginia, the commercial black sea bass fishery operates year-round, while the recreational fishery operates from May 15$^{th}$ through July 15$^{th}$ and August 5$^{th}$ through December 31$^{st}$. The minimum landing size for the species commercially is 280mm and recreationally 330mm. Escape vents with a 63.5mm diameter opening are required when pot fishing, both commercially and recreationally.

In the US and Virginia, Black Sea Bass support productive commercial and recreational fisheries. In 2024 the US commercial landings totaled 4.7 million pounds and were valued at $12.5 million. The same year, US recreational landings totaled 6 million pounds. The Commonwealth of Virginia accounted for approximately 9% of the total US commercial landings in 2024, with 427,124 pounds landed, with an ex-vessel value of $959,709. Virginia also supports an extensive hook and line recreational fishery, accounting for approximately 2% of the US total in 2024, with 124,687 pounds landed (NOAA, 2022).

Investigations by Dominion Energy revealed that fishing effort for Black Sea Bass overlaps with the CVOW lease area. Given the high economic value of this species, Dominion Energy worked with project Principal Investigators with primary objective to develop and execute a survey to establish a baseline condition of the fishery and resource operating in and near the CVOW lease area. Two years of pre-construction and early construction data were collected to evaluate potential impacts on the Black Sea Bass resource and directed commercial fishery in the CVOW lease area. The survey was developed in alignment with the Responsible Offshore Science Alliance (ROSA) Offshore Wind Project Monitoring Framework and Guidelines (ROSA, 2021), as well as Dominion Energy's Fisheries Mitigation and Monitoring Plan (see Appendix V-2, Dominion Energy, 2023).

## Methods

### *Survey Design*

Surveys were conducted onboard the Virginia Institute of Marine Science (VIMS) research vessels, the *R/V* Bay Eagle and the *R/V* Virginia. The *R/V* Bay Eagle was built in 1980 and acquired by VIMS in 1987. This vessel is 19.8m in length and has a draft of 2.4m. The *R/V* Virginia was built in 2018 by Meridien Maritime Reparation. The vessel is 28.3m in length and has a draft of 2.9m. Survey trips were completed monthly. The survey was conducted in the southeastern corner of the CVOW lease area (Figure 1). This subset of the lease area was chosen due to its habitat structure being representative of the entire lease area, with a range in depth of 18 to 42m, and a primarily sandy benthic seafloor. The area also provided an extended window of time to conduct the survey, given the longer duration of time free from construction disturbance. The spatial design of the CVOW lease area, including lease subsections and turbine foundations, was retained when creating the survey sampling design and proposed turbine spacing replicated when creating the control area, to allow for consistent sampling. Within the survey domain was a control area and a lease area. Utilizing a before-after-gradient method (BAG), circular distance bands were created around each turbine location. These bands will provide information to assess the relative effect of the CVOW development as a function of distance from the turbine structures (Methratta, 2020). Three distance bands were included around proposed turbine locations in the lease area, and two distance bands were included around the mimicked turbine locations in the control area. The inner band was positioned at 28m - 148m from the center of the turbine structure, the intermediate band was 148m - 328m from the turbine, and the far band was 328m - 628m from the turbine in the lease area. In the control area, the inner band was 28m - 148m and the intermediate band was 148m - 328m from the turbine. Distance bands were determined using a combination of structural information (i.e., monopile diameter and scour protection) and the responses (ecological, biological) exhibited by various species to these structures (i.e., reef and spillover effect) (McClanahan and Mangi, 2000; Degraer et al., 2020).

Sampling locations within a given distance band were randomly selected prior to each survey, utilizing R software and both the sf and lwgeom packages (R Core Team, 2023, Pebesma, 2018, Pebesma, 2023, Pebesma and Bivand, 2023). Six sampling locations were selected within the lease area and two within the control area for each survey leg. Locations were distributed evenly through distance bands, which avoided sites where future hard structures would be erected, such as turbine foundations and scour protection. This design ensured that future surveys remain statistically comparable to preconstruction data as sampling locations will not be displaced by hard structures.

Surveys were conducted monthly, depending on weather conditions. One vessel traveled to the CVOW survey area to deploy gear, the gear was allowed to soak for a minimum 48 hours, and the gear was retrieved after the 48-hour soak duration or when weather permitted. During each trip, 48 black sea bass pots were deployed; the dimensions of each pot were 1.0m x 0.53m x 0.38m. Eight strings were set within the survey area. Six strings were set in the lease area, and two strings were set in the control area. Each string had 6 pots spaced 19.8m apart along the main line. Three vented and three non-vented pots were on each string. Vents on the vented pots were 63.5mm in diameter. The order in which the vented and non-vented pots were assembled was randomized from string to string but kept consistent within a string throughout the entire survey period. At the start of a string, a pot was rigged with on-demand fishing gear (Figure 2). This gear included a Guardian Ropeless retrofit buoy system, which attached to the top of a pot and encapsulated a traditional vertical line with a buoy and hard float. This system worked in tandem with a Sub Sea Sonic acoustic release, that was tethered to the retrofit gear by a release line. The combination of this gear eliminated the need for vertical lines in the water column and reduced the chances of protected species entanglements. An Onset Hobo temperature logger was attached to each buoy pot and set to collect data every 10 minutes while deployed. Two Akaso EK7000 Action Cameras were attached to two buoy pots at random to record footage on fish behavior and habitat. At the end of each string of pots, an anchor was attached with approximately 76.2m of line.

On deployment days, strings were selected at random to be set at the previously determined sampling locations. As the first pot would leave the deck, the location was recorded on the Trap Timer application program designed for the Sub Sea Sonic acoustic releases. The location was also recorded when the final pot left the deck. Being that Trap Timer did not store data, latitude and longitude for each string was recorded on paper logs, to archive with string and catch data. On retrieval days, Trap Timer was used, along with a deck box and transducer, to send an acoustic release signal to release each buoy to float to the water surface. Each string was then hauled using a winch and pot hauler on deck. Catch from each pot was sorted by pot ID and deposited in fish totes to keep animals from pots within strings separate. All animals caught were identified to the lowest taxonomic level and enumerated. Total length in millimeters was determined using a traditional fish measuring board. Data on enumerated species and species length were recorded on paper logs. A maximum of 72 Black Sea Bass were kept from each survey for biological sampling.

Along with the fisheries independent surveys, fishery dependent data was to be collected on historic fishing efforts. Discussions took place with one known black sea bass fishermen, but with his plans of retirement approaching, we were unable to work with him on this survey. Historical fishing data was requested from the Virginia state fishery management agency, but the information is considered confidential so it could not be provided.

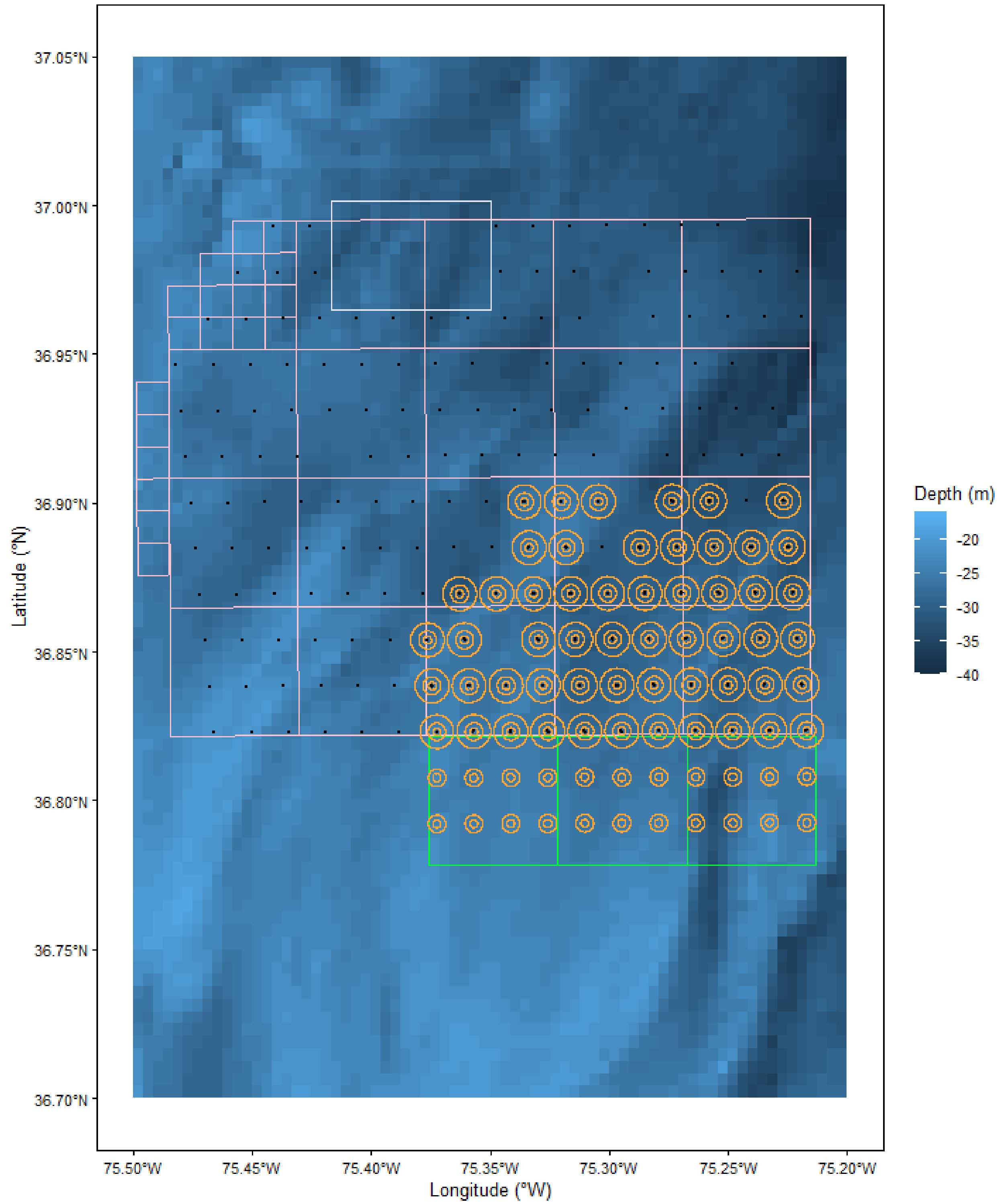


***Figure 1***. *Survey area offshore of Virginia Beach, VA, including the CVOW lease area (pink outline), control area (green outline), turbine locations (black points), distance bands (orange rings), and Triangle Wrecks (lavender outline), a frequented Black Sea Bass fishing location.*


***Figure 2.*** *Image of the Guardian Ropeless System and acoustic release (purple) attached to a black sea bass pot and set for deployment. The release line (yellow) runs through the net and wraps around the cam release (red) holding down the buoy line and float.*

### *Catch Data Analysis*

Catch data per pot (i.e., species, count, and length for Black Sea Bass) were merged with information on escape vent configuration (i.e., vented and ventless), soak time per string, and temperature per string (minimum, maximum, and average). The combined data were used to assess catch per unit effort (CPUE) and length distributions for Black Sea Bass across trips, experimental groups (i.e., lease and control areas), distance bands associated with monopile positions for strings set in the lease area (i.e., inner, intermediate, and far), and vent configuration. Catch per unit effort distributions for bycatch were assessed similarly, but data were pooled across all bycatch species.

Statistical tests were used to evaluate differences in catch rates and lengths across trips, experimental groups (i.e., lease and control), distance bands for strings set in the lease area (i.e., inner, intermediate, and far), and vent configuration. The data were first assessed for normality using Shapiro-Wilk tests (Shapiro and Wilk, 1965) and found to be non-normally distributed. Differences in central tendency for non-normally distributed data were assessed using the Mann-Whitney-Wilcoxon (Mann and Whitney, 1947; Wilcoxon, 1945) and Kruskal-Wallis rank sum tests (Kruskal and Wallis, 1952), where the latter was used when there were three or more independent groups. Additionally, Spearman's rank correlation coefficients (Spearman, 1904) between temperature and catch rates and lengths, and Mann-Whitney-Wilcoxon tests of catch rates within and outside of an intermediate temperature range of 10°-14°C were used to further understand potential drivers of differences in catch across sampling events. P-values for hypothesis tests less than or equal to an $\alpha$ of 0.05 were considered an indication of statistical significance. For hypothesis tests with statistically significant results, the value of the test statistic (W for Mann-

Whitney-Wilcoxon tests and $\chi2$ for Kruskal-Wallis rank sum tests), degrees of freedom (Kruskal-Wallis rank sum tests only), and p-value are reported.

Based on prior understanding of the fishery and life history of Black Sea Bass, we expected higher catch rates during the spring and fall, when bottom water temperatures were expected to be within an intermediate range. Additionally, the inclusion of escape vents on the gear would allow smaller individuals to escape the gear prior to gear retrieval, we expected lower catch rates of Black Sea Bass and bycatch as well as larger average sizes of Black Sea Bass in gear configured with escape vents. Finally, as sampling was occurring prior to construction of offshore wind energy infrastructure, we expected no difference in catch rates or the size distribution of catch among experimental groups (i.e., lease and control sites) or distance bands associated with monopile positions for strings set in the lease area (i.e., inner, intermediate, and far).

***Dissections***

Whole body specimens were retained for laboratory dissections from each of the 21 trips (n = 952). Specimens were kept frozen and thawed to room temperature before dissections began. Small, serrated knives were used to section the head of each Black Sea Bass just above the opercle. Once the interior of the head was exposed, the otoliths were located in two pockets just below the brain cavity. Otoliths were retrieved and cleaned for further analysis on black sea bass aging. Next, an incision was made along the ventral side of a fish from the vent to between the pectoral fins to access the gonads and stomach. Sex and maturity were determined by visual inspection of the gonad, following methods documented in Wuenschel et al. (2011). Stomachs were removed from the abdomen and kept frozen for further stomach content analyses.

***Aging***

Black Sea Bass ages were obtained from a subsample of the specimens retained from the 21 trips. Length bins and number of specimens were chosen based on data from McGovern (2002) and Pawson et al. (2007). The specimens selected for aging were distributed proportionally to the number of animals caught in each length bin, reflecting the black sea bass resource in the lease and control areas. The right otolith from each animal was used to determine age, unless the otolith was damaged or unable to be retrieved, in those cases the left otolith was used. Methods described by the Multispecies Research Group (MRG) at VIMS were followed when sectioning otoliths and counting annuli (VIMS, 2025c).

Black sea bass age and length data were used to construct an age-length key, showing the proportion of fish at each age within a given length interval. A bootstrapping process was used to estimate uncertainty in age proportions due to the sample size of aged fish. Sample sizes ranging from n = 50 to 400 aged fish were considered, where, for each of 1,000 bootstrap iterations, a sample of size n was drawn with replacement from the age data and used to construct age proportions by length bin. The standard deviation of age proportions across sample sizes was used to assess the effect of sample size on uncertainty in the age-length key. A simple multinomial logistic regression model was fit to age-length data and used to predict median age at the midpoint of length bins.

***Stomach Content***

Stomachs were analyzed using standard procedures for volumetric sampling by Hyslop (1980). Each stomach was weighed to the nearest 0.001g, and all contents were emptied onto a petri dish. The contents were viewed under a microscope and identified to the lowest taxonomic level. Prey items found were then weighed individually and recorded by species code and common name (VIMS 2025a, 2025b), along with the empty stomach weight.

The weight and prey composition of black sea bass stomachs were assessed. Prey were identified by species or species group and counted to determine relative prey frequency. The total weight of stomach contents was assessed by season (winter: December, January, February; spring: March, April, May; summer: June, July, August; fall: September, October, November), size (binned as above or below the median), and sex. Stomach content weights were assessed for normality using Shapiro-Wilk test and found to be non-normally distributed. Differences in the central tendency of the total weight of stomach contents by season, size, and sex were assessed using Mann-Whitney-Wilcoxon and Kruskal-Wallis rank sum tests. P-values for hypothesis tests less than or equal to an $\alpha$ of 0.05 were considered an indication of statistical significance. For hypothesis tests with statistically significant results, the value of the test statistic (W for Mann-Whitney-Wilcoxon tests and $\chi 2$ for Kruskal-Wallis rank sum tests), degrees of freedom (Kruskal-Wallis rank sum tests only), and p-value are reported.

## Results

### *Study Summary*

The Black sea bass survey began on July 17, 2023, and concluded on June 4, 2025. During this time period, 21 trips were completed, with 3 trips cancelled due to harsh weather conditions. During these trips, 164 strings were deployed in the lease (n = 122) and control areas (n = 42) (Figure 3). In total, 3,335 Black Sea Bass were caught, 2,332 were in the lease area (Table 1). Of those caught, 952 whole body specimens were analyzed for sex and maturity, 15 of which were determined as unknown (Table 2). In July 2023, there was one control location that was incorrectly plotted before departure; because of this the string was deployed outside of the control area (Figure 3). Data from this string was retained for analysis.

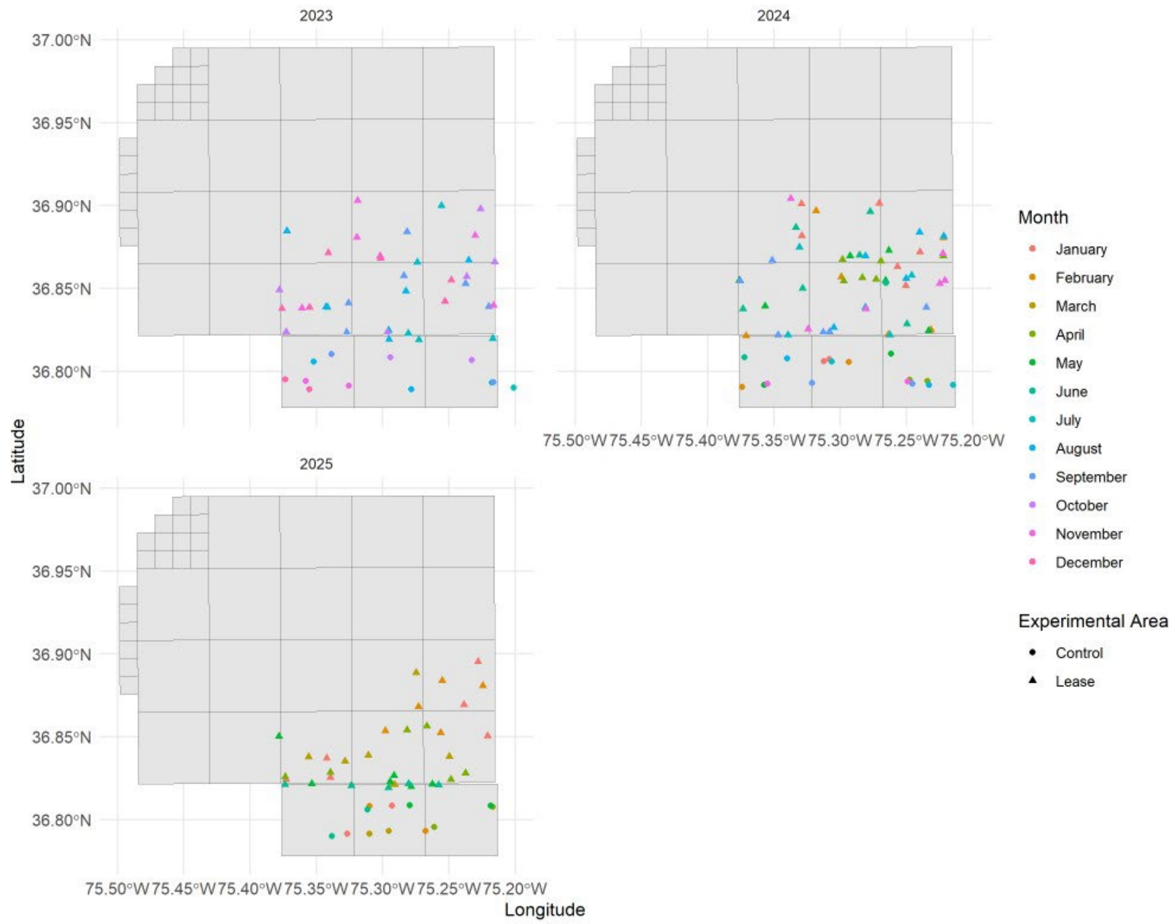


***Figure 3.*** *Maps of sample locations for each trip during each calendar year of the study. Locations are color coordinated by sample month. Lease locations are indicated by triangles and control locations are indicated by circles.*

***Table 1.*** *Total number of Black Sea Bass caught during each calendar year of the survey, separated by experimental area.*

| Year | Experimental Area | Total Caught |
|---|---|---|
| **2023** | Lease | 335 |
| | Control | 163 |
| **2024** | Lease | 984 |
| | Control | 224 |
| **2025** | Lease | 1,175 |
| | Control | 454 |

***Table 2.*** *Number of Black Sea Bass dissected, separated by sex and maturity stages.*

| Sex | Maturity | Count |
|---|---|---|
| **Female** | Mature | 2 |
| | Immature | 75 |
| | Developing | 204 |
| | Resting | 5 |
| | Ripe | 232 |
| | Spent | 30 |
| | Unknown | 7 |
| ***Total*** | | **555** |
| **Male** | Mature | 0 |
| | Immature | 33 |
| | Developing | 129 |
| | Resting | 1 |
| | Ripe | 208 |
| | Spent | 7 |
| | Unknown | 2 |
| ***Total*** | | **380** |
| **Transitioning** | | **2** |
| **Unknown** | | **15** |

### *Catch Data*

Observations of catch were recorded for 667 pots from 157 strings across 21 trips, including observations from 504 pots within the lease area (inner: n = 172; intermediate: n = 173; and far: n = 159) and 163 outside the lease area (Figure 3). Black Sea Bass was recorded in 541 pots, averaging 6.17 individuals per pot (sd = 7.20; median = 3). Pots with 0 catch were observed 309 times across all sampling events, with 219 occurrences in the lease area and 90 in the control area. Bycatch was recorded in 242 pots, averaging 2.32 individuals per pot (sd = 3.22; median = 1). Bycatch CPUE showed no statistical difference when compared to pots with zero Black Sea Bass ($W = 6965.5$, p-value = 0.602). However, pots with both Black Sea Bass and bycatch showed a positive correlation ($\rho = 0.23$, p-value = 0.006), while bycatch CPUE and black sea bass mean length had a negative correlation ($\rho = -0.33$, p-value $<0.001$).

Black Sea Bass CPUE and catch length were found to be statistically different across sampling events (CPUE: $\chi^2 = 237.28$, df = 20, p-value $< 0.001$; length: $\chi^2 = 472.45$, df = 20, p-value $< 0.001$), with higher catch rates primarily during the spring (Figure 4a) and larger individuals being caught during the winter (Figure 5a). Catch per unit effort was found to be weakly positively correlated with average bottom water temperature ($\rho = 0.11$, p-value = 0.01), and median values were significantly higher, approximately double, when bottom temperatures were 10°-14°C compared to temperatures outside this range ($W = 17{,}192$, p-value $< 0.001$). Catch length was found to be negatively correlated with average bottom water temperature ($\rho = -0.14$, p-value $<0.001$). Catch rates and lengths were not statistically different among experimental areas, and catch rates were not statistically different across distance bands (Figure 4b, c, Figure 5b); however, catch lengths were found to differ across distance bands ($\chi^2 = 13.03$, df = 2, p-value = 0.001; Figure 5c). Although significant differences in catch lengths across distance bands were detected, the effect size was small and indicated limited practical importance ($\eta 2 = 0.003$, indicating only 0.3% of the variance in catch length ranks was explained by distance bands). Pots including escape vents were found to have significantly lower catch rates ($W = 41{,}463$, p-value = 0.002) and caught significantly larger individuals ($W = 817{,}317$, p-value $< 0.001$), as expected (Figures 4d, 3d).

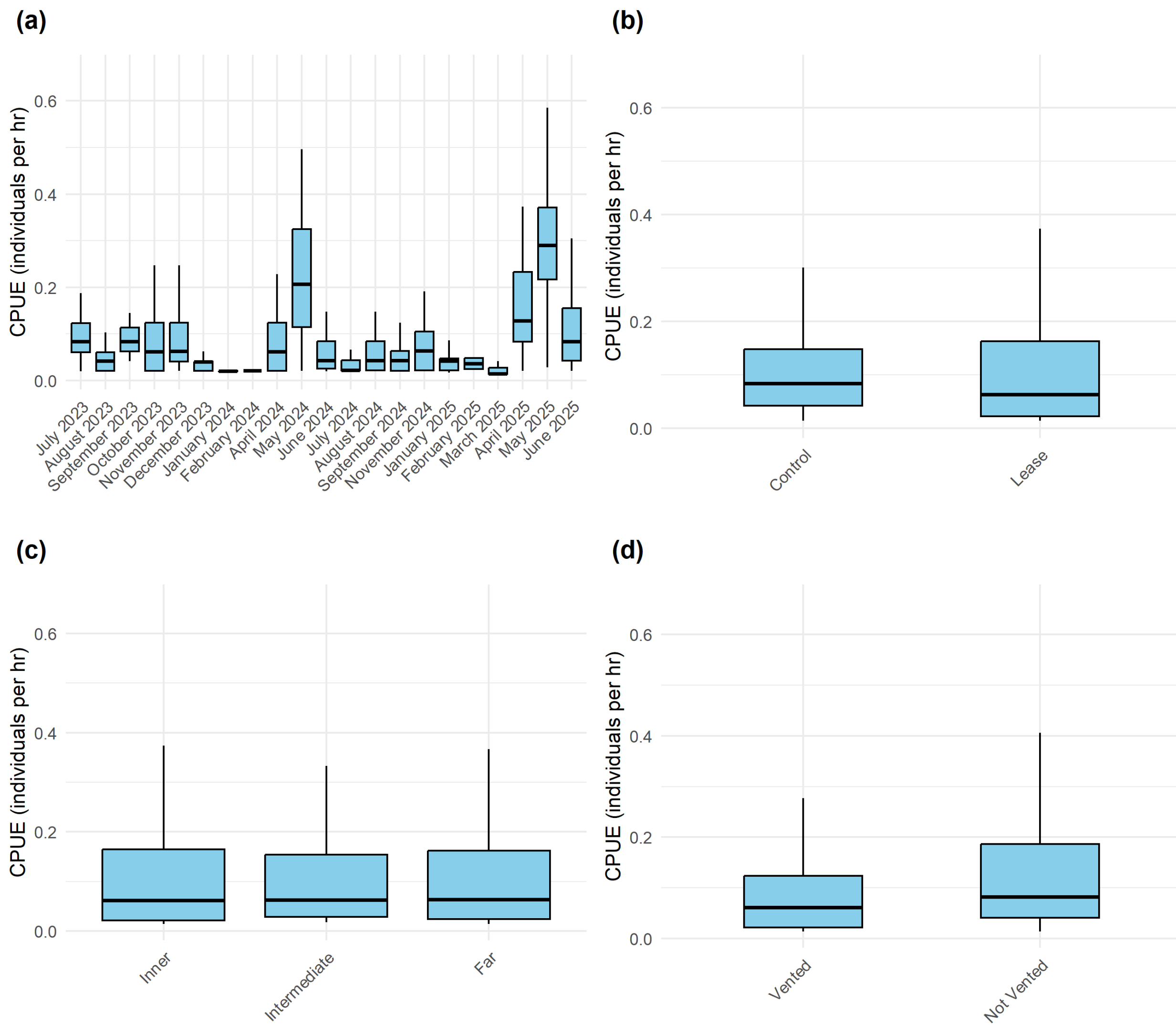


***Figure 3.*** *Boxplots of Black Sea Bass catch per unit effort (CPUE) shown by sampling event (panel a), experimental group (panel b), distance band for strings within the lease area (panel c), and vent configuration (panel d). Catch per unit effort was measured as individuals caught per hour soak time. Solid horizontal lines indicate medians, boxes cover the interquartile range, and whiskers extend to 1.5 times the interquartile range. Outliers were removed from plotting.*

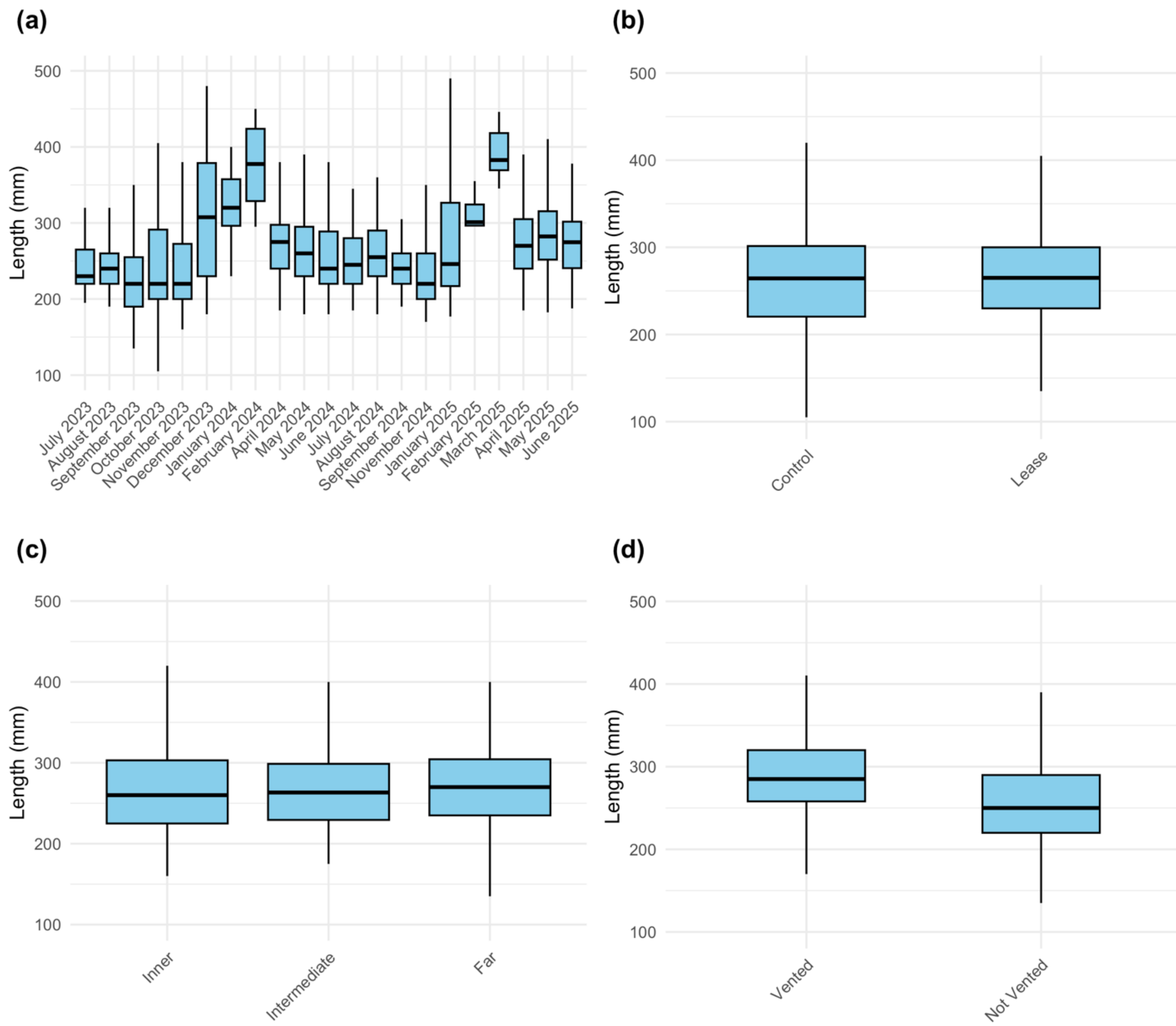


***Figure 4.*** *Boxplots of black sea bass catch lengths shown by sampling event (panel a), experimental group (panel b), distance band for strings within the lease area (panel c), and vent configuration (panel d). Solid horizontal lines indicate medians, boxes cover the interquartile range, and whiskers extend to 1.5 times the interquartile range. Outliers were removed from plotting.*

The most commonly identified bycatch species included: Pinfish (*Lagodon rhomboides*) (n = 145), Scup (*Stenotomus chrysops*) (n = 82), Cancer Crab (n = 110), and Spider Crab (*Macropodia rostrata*) (n = 60). Bycatch per unit effort was found to be statistically different across trips ($\chi^2 = 61.72$, df = 19, p-value < 0.001), with the highest bycatch rates during the fall (Figure 4a). Bycatch rates were not found to statistically differ across experimental groups, distance bands, or escape vent orientation (Figure 6b-d). Bycatch rates were positively correlated with average bottom water temperature ($\rho = 0.17$, p-value = 0.01).

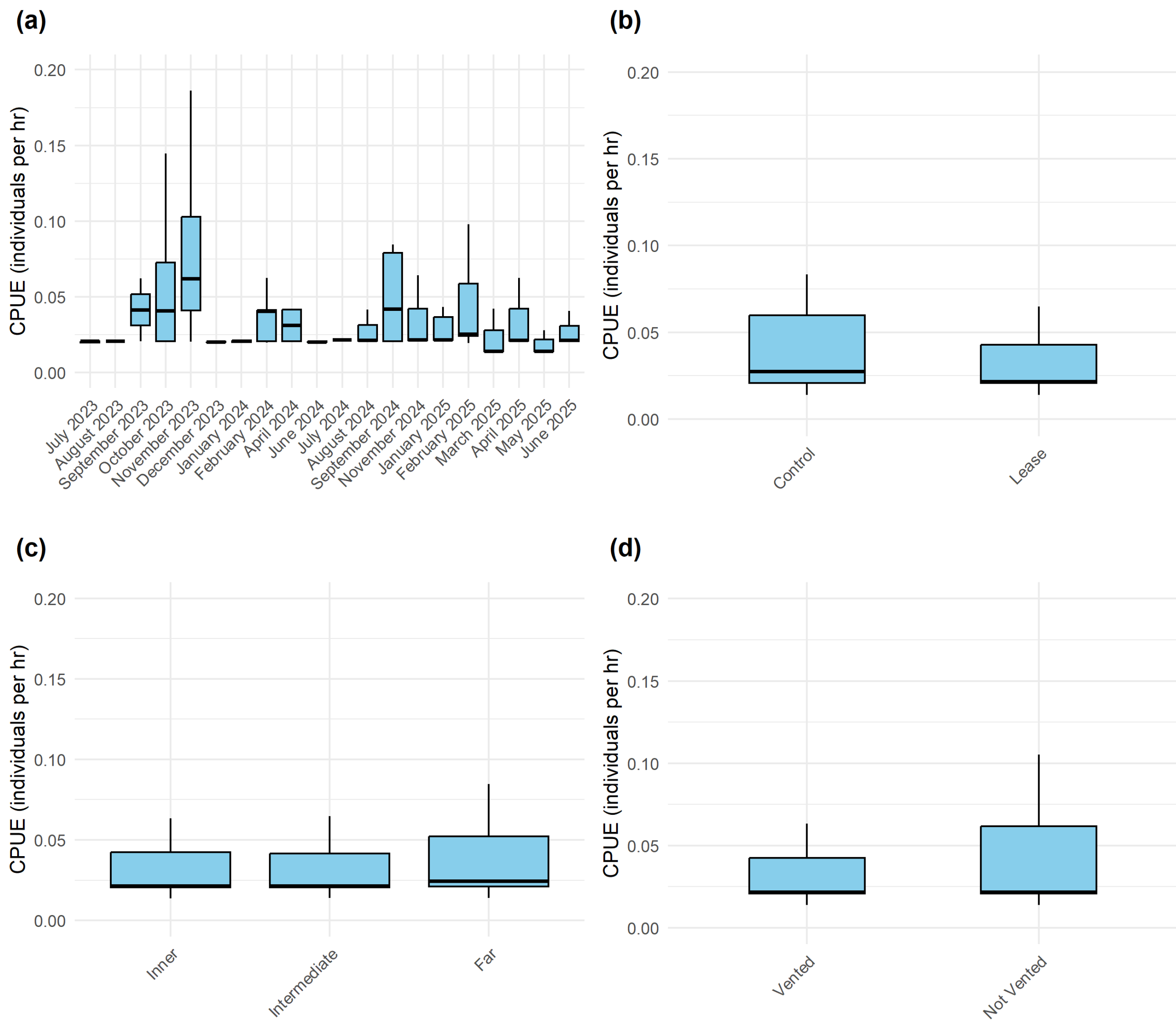


***Figure 5.*** *Boxplots of bycatch (non-target species) catch per unit effort (CPUE) shown by sampling event (panel a), experimental group (panel b), distance band for strings within the lease area (panel c), and vent configuration (panel d). Catch per unit effort was measured as individuals caught per hour soak time. Solid horizontal lines indicate medians, boxes cover the interquartile range, and whiskers extend to 1.5 times the interquartile range. Outliers were removed from plotting.*

### *Age Data*

Ages were determined for 180 individuals. Length bins below 200mm and equal to or above 400mm were collapsed into aggregate bins (< 200mm, ≥ 400mm) due to a small number of samples (Table 3). The distribution of lengths for aged fish was right skewed, with 74% of lengths being less than 300mm (Figure 7a). There was one 9 year old individual in the sample (Figure 7b). This observation was removed in subsequent calculations as there was a four-year gap between this observation and the next oldest age. Uncertainty in age probability estimates decreased as simulated sample sizes increased from 50 to 150 and then stabilized (Figure 7c). Fish 280mm and below were predicted to be age 2 on average, while fish 280mm to 380mm were predicted to be age 3 and fish greater than 380mm had a median predicted age of 4 (Figure 7d).

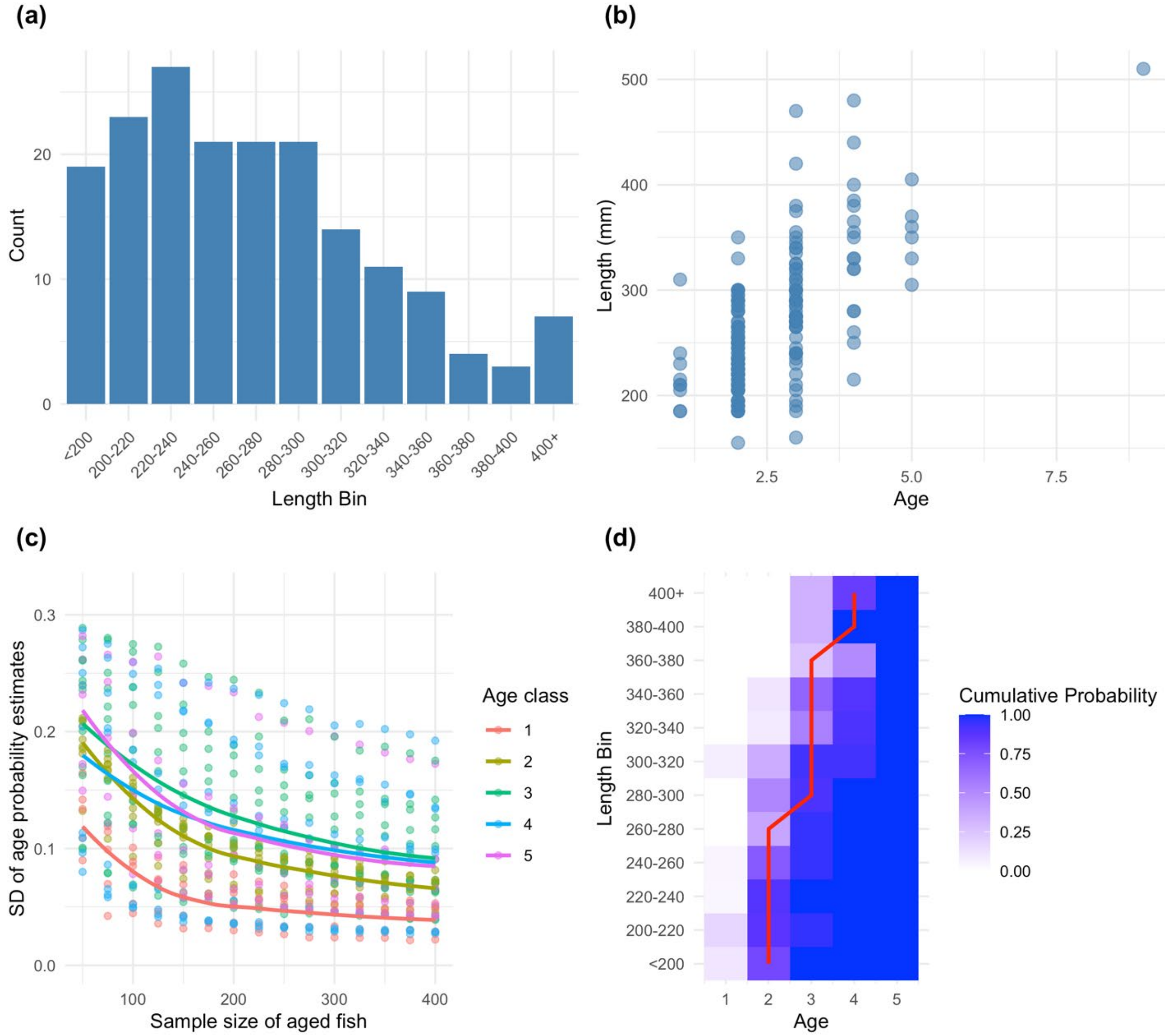


***Figure 7.*** *Age and length data and associated analyses, including: a histogram of lengths by bin (panel a), scatter plot of age and length data (panel b), age probability uncertainty estimates as a function of sample size (panel c), and cumulative probabilities of age given observed length (panel d). In panel d, the red line corresponds to median age predictions from a multinomial logistic regression model.*

***Table 3.*** *Sample sizes of aged Black Sea Bass, by length bin.*

| Length Bins (mm) | Sample Size |
|---|---|
| <200 | 19 |
| 200-220 | 23 |
| 220-240 | 27 |
| 240-260 | 21 |
| 260-280 | 21 |
| 280-300 | 21 |
| 300-320 | 14 |
| 320-340 | 11 |
| 340-360 | 9 |
| 360-380 | 4 |
| 380-400 | 3 |
| 400+ | 7 |

***Stomach Contents Analysis***

Stomach contents from 180 specimens were analyzed. Of these, material was identified in 90 stomachs (50%) and included 130 items. Of the 130 items, 50 (38%) were rock, sand, shell, or unidentified materials. Of the remaining items, cancer crab was found to be dominant, followed by fish, worms, and other crustaceans including amphipods, isopods, and shrimp (Figure 8a). Stomach contents had an average weight of 1.45g (sd = 2.81), with weights found to differ by season ($\chi^2 = 8.72$, df = 3, p-value = 0.03) and be higher during the winter and spring compared to the summer and fall (Figure 8b). Stomach content weights were found to be higher for larger individuals, though the difference was not statistically significant at a 5% $\alpha$ level (Figure 8c). Stomach content weights were similar between females and males (Figure 8d).

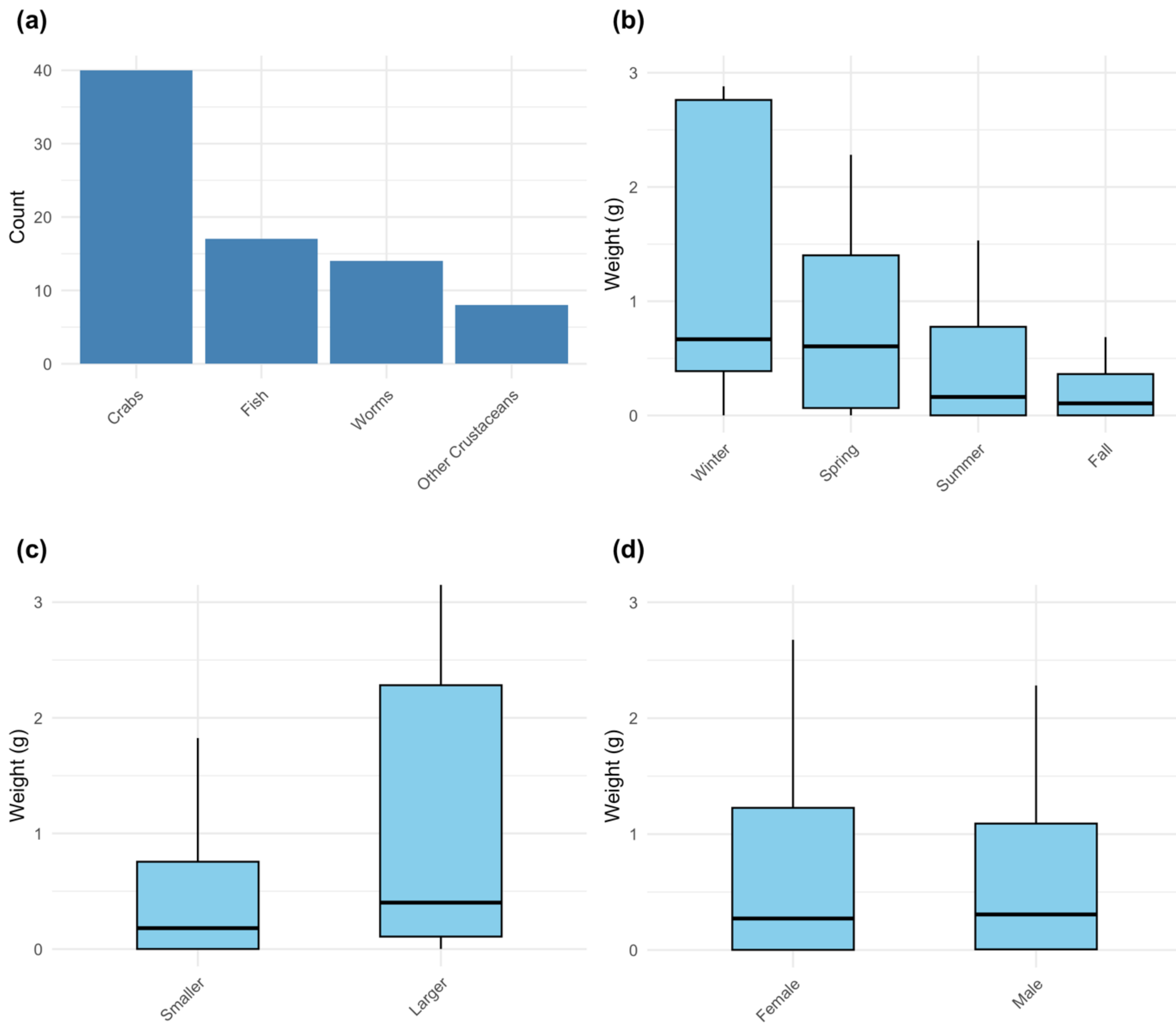


***Figure 8.*** *Analysis of stomach contents, including counts by prey category (panel a) and weights by season (panel b), size (panel c), and sex (panel d). For seasons, winter included December, January, and February, spring included March, April, and May, summer included June, July, and August, and fall included September, October, and November. For size, smaller included below the median length (260mm) and larger included equal to or above the median length.*

### *Video Footage*

Video cameras were deployed on 12 pots on 9 trips and recorded 16 hours 8 minutes and 24 seconds worth of footage. The most commonly identified species observed were Black Sea Bass (n = 30) and Sea Robin (*Prionotus carolinus*) (n = 30) (Table 3). One Smooth Butterfly Ray (*Gymnura micrura*) was observed, as well as five unknown fish species. Other invertebrate species included Hermit Crabs (*Pagurus spp.*) (n = 13) and Rock or Jonah Crabs (*Cancer spp.*) (n= 3). The majority of Black Sea Bass were observed in October 2023 (n = 29). The majority of Sea Robin were observed in September 2024 (n = 18), September 2023 (n = 7), and May 2025 (n = 5). Video footage was also intended to provide abundance estimates of Black Sea Bass and habitat classification, but the quality and duration of videos collected were not suitable for this analysis.

Of the months cameras were deployed, August 2024 and January 2025 had zero visibility due to a lack of light source. The remaining deployments had poor footage quality, or the camera angle did not show the bottom habitat. From the footage where bottom habitat was identified it was classified as a sandy bottom habitat.

***Table 4.*** *Fish and invertebrate species observed for each sampling event where cameras were deployed. If no fish or invertebrates were observed, species and count are labeled as NA.*

| Trip | Cameras Deployed | Species | Count |
|---|---|---|---|
| **Sep-23** | 1 | Northern Sea Robin | 7 |
| **Oct-23** | 2 | Black Bea Bass | 29 |
| | | Hermit Crab | 6 |
| | | Unknown fish | 3 |
| **Aug-24** | 1 | NA | NA |
| **Sep-24** | 2 | Northern Sea Robin | 18 |
| | | Hermit Crab | 7 |
| | | Cancer spp. | 2 |
| **Jan-25** | 2 | Unknown fish | 1 |
| **Feb-25** | 1 | Black Sea Bass | 1 |
| | | Cancer spp. | 1 |
| | | Unknown fish | 1 |
| **Mar-25** | 1 | Smooth Butterfly Ray | 1 |
| **Apr-25** | 1 | NA | NA |
| **May-25** | 1 | Northern Sea Robin | 5 |

## Discussion

The survey data were collected to establish baseline information on the black sea bass resource in and around the CVOW lease area. A seasonal increase in the Black Sea Bass population was observed during the spring and another minor peak in the fall (Figure 4a). This pattern follows the typical Black Sea Bass migration documented in the Mid-Atlantic region. Musick and Mercer

(1977) investigated this occurrence and gathered data from 1967 – 1971, finding evidence that in the Mid-Atlantic Bight Black Sea Bass would overwinter at depths of 73m – 165m, but during the summer there was a higher catch rate of Black Sea Bass at depths less than 37m. During the spring and fall, Black Sea Bass were found to be actively migrating across the continental shelf, which leads to the seasonal increase in population (Moser and Shepherd, 2008). Similarly, there was a seasonal trend in the length distribution of Black Sea Bass, where larger individuals were caught during winter months and smaller individuals in the summer months. This may indicate that smaller individuals were moving to shallower waters to overwinter, while larger individuals remained in deeper offshore waters for longer periods (Musick and Mercer, 1977, Moser and Shepherd, 2008).

Results indicated that Black Sea Bass length was significantly different across distance bands. When investigating further the average length found at each distance band was inner = 260mm (sd = 54.87), intermediate = 263mm (sd = 52.95), and far = 270mm (sd = 49.30), although these were determined statistically different, the averages are relatively close in comparison. This is reflected in Figure 5c, where the corresponding boxplots seem to show relatively similar results in the length distribution between distance bands, although the resulting p-value was 0.001. At the conclusion of this survey, there were no monopiles present at sampling locations, which should result in no significant difference between distance band and black sea bass length. This trend should be investigated following post-construction to assess for any changes, with the addition of hard structure and its impact on population dynamics in and around the CVOW lease area. Pots equipped with escape vents functioned as expected by retaining larger individuals and facilitating escapement of smaller individuals. This resulted with the largest individual being caught in a vented pot at a length of 540mm and the smallest individual caught in a non-vented pot at a length of 105mm. Overall, CPUE was comparable across the lease and control areas, along with the distance bands. This indicated that the survey design was successful in creating a repeatable study for future work, where distance bands can be used to determine if there are changes in the black sea bass resource as a function of distance from turbine locations, and the control area selection was appropriate in comparison to the lease area.

Black Sea Bass observed in this study were comprised of 1 to 5 year old individuals, with one fish found to be 9 years old. This distribution appears consistent with reporting from the Northeast Area Monitoring and Assessment Program (NEAMAP), which samples approximately 24km west of the CVOW lease area. In samples collected from 2013 – 2016, eight individuals were documented as 9 years or older (n = 4,264 total aged individuals) (Bonzek et al., 2016). The NEAMAP data also indicated higher catch rates among individuals aged 2 to 5 years, similar to the age distribution found in the lease and control areas. This study found a wide length distribution for both ages 2 and 3, although compared to NEAMAP these distributions are relatively small. The NEAMAP results show a larger length distribution, ranging approximately 260mm for both 2-year and 3-year age groups. This study found 2-year olds to have a 180mm distribution and 3-year olds to have a 100mm distribution. The length distributions resulting from this survey do fall into the same ranges as the NEAMAP results but could vary in range due to the difference in each studies sample size, as well as gear selectivity. With both studies using different fishing methods, there is a likelihood that the size selectivity of each gear type varies, leading to a difference in length distribution.

Approximately 50% of the stomachs analyzed contained identifiable prey items, which is lower in comparison to work done by MRG. The MRG coordinates surveys in a number of tributaries around the Chesapeake Bay and near shore along the Mid-Atlantic and Black Sea Bass is a common species observed during their work. Stomach analyses performed by MRG found 8-9% of black sea bass stomachs were identified as empty (VIMS 2025a, 2025b). This discrepancy could be due to either the sampling methods or the storage process of black sea bass stomachs for this survey. During the surveys conducted by MRG, a net is trawled along the bottom for 20 minutes and catch is sorted and processed aboard the vessel. Immediately following MRG dissects specimens in the onboard wet lab, placing stomachs in normalin to halt the digestion process and preserve stomach contents. The methods for this study include soaking pots for at least 48 hours and keeping specimens on ice until returning to the VIMS lab, potentially allowing the digestion process to continue during soak time, transit, and until specimens were fully frozen, allowing stomach contents to further break down. A majority of specimens fell into the category of unidentified material, rock, sand, and shell, with crabs being the highest identifiable species by count (n = 40). This finding is consistent with the MRG results. Their research found that 11% of black sea bass stomachs contained unidentified material, and out of the 10 most frequent prey items found in Black Sea Bass, 6 fell into a crab related category (Ralph et al., 2022). When compared to historical data, although this study did not find a great number of specimens, the range of specimens seems to indicate that these Black Sea Bass are generalized carnivores. Sedberry (1988) studied stomach contents of Black Sea Bass and came to a similar conclusion, finding a range of specimens from a variety of motile invertebrates to a number of fish species and crustaceans. Sedberry (1988) also found that habitat and animal size were greatly influential on stomach contents. Where specimens recorded were almost exclusively found in the study area and the volume of contents increased with black sea bass length. Looking toward the future, stomach contents could provide information on prey species present in the lease area and any resulting dietary changes post-construction. Methods to better preserve stomach contents will be investigated for future post-construction efforts.

Video footage captured in the survey area was able to identify multiple instances of Black Sea Bass and other species active near survey gear, confirming presence of the species of interest as well as other species in the lease and control areas. Continuing data collection during a post-construction survey could allow for a comparison of species presence in the survey area. In future work, higher quality cameras with longer lasting batteries would be preferred to allow for additional data collection.

Upon completing these surveys, there were additional lessons learned from survey operations. Sample locations could have been monitored more closely, thus preventing any deviations from the survey plan. Future survey efforts will incorporate navigational software independent of the vessel to provide additional spatial accuracy. Data analysis will also include omitting strings that are set out of the survey area. The use of ropeless gear also represented an opportunity to gain experience with a new technology for both the vessel crew and scientific staff. In the first year of the survey, five buoy pots did not release properly, causing the crew to grapple for the strings to retrieve them. The captain and crew were careful to deploy a specially made grapnel, which was designed with multiple hooks facing different directions, which would ensnare the line. This interruption in the fieldwork triggered a number of issues including an increased risk of handling heavy pots partially by hand, and added time to trips when this occurred. Though we tried to avoid adding time to trips, we made sure to grapple for any string that could risk a vertical line in the water column. Additional experience gained during subsequent trips, increased the comfort with setup, deployment, and retrieval of strings resulting in a more seamless process. The process remained consistent through the duration of the study and will likely be incorporated into any post-construction survey efforts.

**Outreach**

As an outreach component to this study a number of posters and presentations were given at various conferences. The list of participants and the work presented are as follows:

- Poster **-** Evaluating the Effectiveness of Escape Vents in the Black Sea Bass (*Centropristis striata*) Trap Fishery, Presenter: Conor O'Meally, American Fisheries Society – Tidewater Chapter, Beaufort, North Carolina, 13 Mar 2025
- Poster **-** Survey Design and Methods for the Fishery Characterization and Monitoring of the Black Sea Bass (*Centropristis striata*) and Whelk (*Busycon spp.*) Resources at the Coastal Virginia Offshore Wind (CVOW) Development Site, Presenter: Reece Aponte, American Fisheries Society – Tidewater Chapter, Beaufort, North Carolina, 13 Mar 2025
- Presentation **-** Fisheries Characterization within the Coastal Virginia Offshore Wind (CVOW) Development Site, Presenter: Reece Aponte, American Fisheries Society, San Antonio, Texas, 13 Aug 2025
- Presentation **-** Ropeless Gear in the Coastal Virginia Offshore Wind Surveys, Presenter: Conor O'Meally, American Fisheries Society, San Antonio, Texas, 13 Aug 2025

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