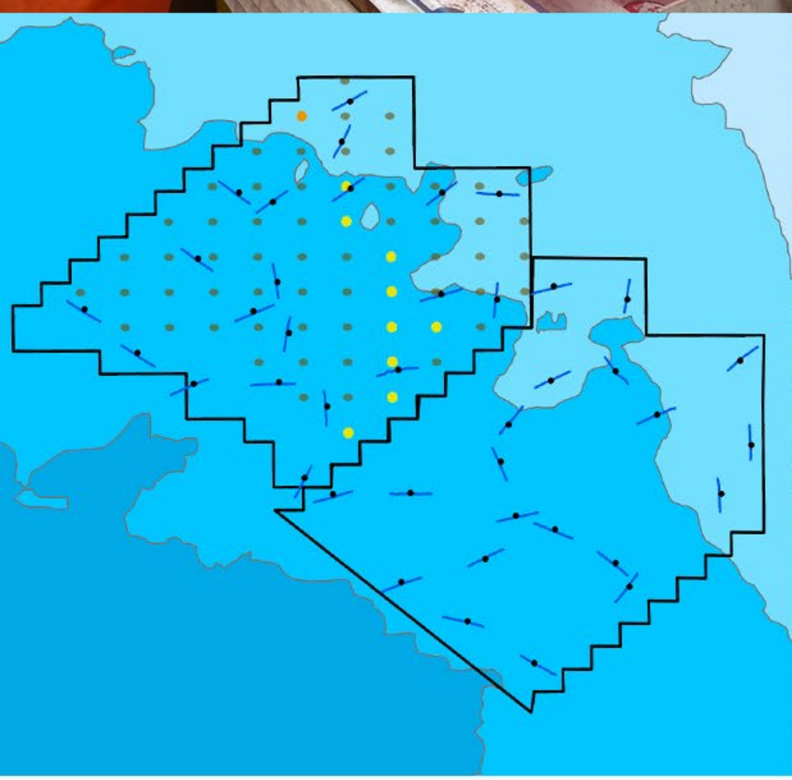
Vineyard Wind 1
Demersal Trawl Survey



Vineyard Wind 1 Study Area

Quarterly Report
Summer 2023 (July - September)

VINEYARD WIND 1 DEMERSAL TRAWL SURVEY

Summer 2023 Seasonal Report

Vineyard Wind 1 Study Area

September 2023

Prepared for Vineyard Wind 1 LLC

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Vineyard Wind 1 Demersal Trawl Survey Summer 2023 Seasonal Report

Vineyard Wind 1 Study Area

Progress Report #13

July 1 – September 30, 2023

Project title: Vineyard Wind 1 Demersal Trawl Survey Summer 2023 Seasonal Report – Vineyard Wind 1 Study Area

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Table of Contents

List of Tables

List of Figures

1. Introduction

In 2015, Vineyard Wind 1 LLC (Vineyard Wind) leased a 675 square kilometer (km^2) area for renewable energy development on the Outer Continental Shelf, Lease Area OCS-A 0501, which is located approximately 14 miles south of Martha's Vineyard off the south coast of Massachusetts. Vineyard Wind is conducting fisheries studies in a 306 km^2 area referred to as the "VW1 Study Area," which is the focus of this report. Fisheries studies were also conducted in Vineyard Wind shareholder company lease areas. This includes Lease Area OCS-A 0534 (the "534 Study Area") and Lease Area OCS-A 0522 (the "522 Study Area"); these studies were reported separately.[1]

The Bureau of Ocean Energy Management (BOEM) has statutory obligations under the National Environmental Policy Act to evaluate the environmental, social, and economic impacts of a potential project. Additionally, BOEM has statutory obligations under the Outer Continental Shelf Lands Act to ensure any on-lease activities "protect the environment, conserve natural resources, prevent interference with reasonable use of the U.S. Exclusive Economic Zone, and consider the use of the sea as a fishery."

To address the potential impacts, Vineyard Wind, in collaboration with the University of Massachusetts Dartmouth's School for Marine Science and Technology (SMAST), has developed a monitoring plan to assess the potential environmental impacts of the proposed development on marine fish and invertebrate communities. The impact of the development will be evaluated using the Before-After-Control-Impact (BACI) framework. This framework is commonly used to assess the environmental impact of an activity (i.e., wind farm development and operation). Under this framework, monitoring occurs prior to development (Before), and then during construction and operation (After). During these periods, changes in the ecosystem will be compared between the development site (Impact) and a control site (Control) to assess if there is any impact due to the development of wind farms. The control site will be in the general vicinity with similar characteristics to the study area (i.e., depth, habitat type, seabed characteristics, etc.). The goal of the monitoring plan is to assess the impact that wind farm construction and operation may have on the ecosystem within an ever-changing ocean.

[1] The Bureau of Ocean Energy Management (BOEM) segregated Lease Area OCS-A 0501 into two lease areas – OCS-A 0501 and OCS-A 0534 – in June 2021. The VW1 Study Area, which is located in the area designated as Lease Area OCS-A 0501, is referred to as the "501N Study Area" in SMAST fisheries survey reports compiled prior to the lease area segregation. Similarly, the 534 Study Area, which is designated as Lease Area OCS-A 0534, is referred to as the 501S Study Area in SMAST fisheries survey reports compiled prior to the lease area segregation.

The current monitoring plan incorporates multiple surveys utilizing a range of survey methods to assess different facets of the regional marine ecosystem. The trawl survey is one component of the overall survey plan. A demersal otter trawl, further referred to as a trawl, is a net that is towed behind a vessel along the seafloor and expanded horizontally by a pair of otter boards or trawl doors (Figure 1). Trawls tend to be relatively indiscriminate in the fish and invertebrates they collect; hence, bottom trawls are a generally accepted tool for assessing the biological communities along the seafloor and are widely used by institutions worldwide for ecosystem monitoring. Since they are actively towed behind a vessel, they are less biased by fish activity and behavior than passive fishing gear (i.e., gillnets, longlines, traps, etc.), which relies on animals moving to the gear. As such, state and federal fisheries management agencies heavily rely on trawl surveys to evaluate ecosystem changes and to assess the abundance of fishery resources. The current trawl survey closely emulates the Northeast Area Monitoring and Assessment Program (NEAMAP) survey protocol. In doing so, the goal was to ensure compatibility with other regional surveys, including the National Marine Fisheries Service annual spring and fall trawl surveys, the annual NEAMAP spring and fall trawl surveys, and state trawl surveys including the Massachusetts Division of Marine Fisheries trawl survey. The NEAMP survey protocol has also been adopted by trawl surveys conducted in other offshore wind development areas in the northeast US by other institutions. The bottom trawl survey is complemented by the drop camera survey and the lobster trap survey in the same area, also carried out by SMAST (reported separately).

The primary goal of this survey was to provide data related to fish abundance as represented by catch per unit effort (CPUE), distribution, and population structure in the VW1 Study Area and an adjacent area (Control Area). Offshore construction activities for the Vineyard Wind 1 project began in the spring of 2023. The data will serve to assess the impact that offshore construction activities have on fish communities. The reports for the first three years of pre-construction baseline monitoring from spring 2019 to summer 2022 have been submitted to the sponsoring organization. This progress report documents the survey methodology, survey effort, and data collected during the summer of 2023.

2. Methodology

The methodology for the survey was adapted from the Atlantic States Marine Fisheries Commission's NEAMAP nearshore trawl survey. Initiated in 2006, NEAMAP conducts annual spring and fall trawl surveys from Cape Hatteras to Cape Cod. The NEAMAP survey protocol has gone through extensive peer review and is currently implemented near Lease Area OCS-A 0501 using a commercial fishing vessel (Bonzek et al., 2008). The current NEAMAP protocol samples at a resolution of ~100 km^2, which is inadequate to provide scientific information related to potential changes on a smaller scale. Adapting existing methods with increased resolution (see Section 2.1) will enable the survey to fulfill the primary goal of evaluating the impact of wind farm development while improving the consistency between survey platforms. This should facilitate easier sharing and integration of the data with state and federal agencies and allow the data from this survey to be incorporated into existing datasets to enhance our understanding of the region's ecosystem dynamics. Additionally, the methodology is consistent with other ongoing surveys of nearby study areas (i.e., the 534 Study Area and 522 Study Area).

2.1 Survey Design

The current survey is designed to provide baseline data on catch rates, population structure, and community composition for a future environmental assessment using the BACI framework as recommended by BOEM (BOEM, 2013). Tow locations within the VW1 Study Area were selected using a spatially balanced sampling design. The current VW1 Study Area (total area: 265 km^2) was sub-divided into 20 sub-areas (each ~13.25 km^2), and one trawl tow was made in each of the 20 sub-areas. This was designed to ensure adequate spatial coverage throughout the VW1 Study Area. The starting location within each sub-area was randomly selected (Figure 2). Prior to the start of this survey, scour protection had been placed at all wind turbine locations. Scour protection consists of stone and rock material (~10 – 30 centimeter [cm] diameter) placed around a wind turbine's foundation to minimize the removal of seabed sediment by hydrodynamic forces from currents and/or waves. The scour protection consists of rock piles of ~50 meters (m) in diameter from the foundation, which makes the area untrawlable with demersal trawls. To address this, alternative tow locations were created for each sub-area. If the primary tow location was located within an area with scour protection, the alternative tow location was used. Additionally, tow directions were selected to avoid towing the trawl across the scour protection.

An area located to the east of the VW1 Study Area was established as a control region, further referred to as the Control Area. The selected region has similar depth contours, bottom types, and benthic habitats to the VW1 Study Area. The Control Area (total area: 269.5 km^2) was sub-divided into 20 sub-areas (each ~13.5 km^2). An additional 20 tows, one per sub-area, were completed in the Control Area. The tow locations were selected in the same manner as the VW1

Study Area, using the spatially balanced sampling design, except that no alternative tow locations were needed as there were no construction-related seabed obstructions in the area.

The selection of 20 tows in each area was based on a preliminary power analysis conducted using catch data from a scoping survey (Stokesbury and Lowery, 2018). This information was updated based on catch data from the 2019/2020 and 2020/2021 survey years (Rillahan and He, 2020, Rillahan and He, 2021). The results of the updated power analysis indicated that several species, including little skate (*Leucoraja erinacea*), Atlantic longfin squid (*Dorytheuthis pealei*), silver hake (*Merluccius bilinearis*), and fourspot flounder (*Paralichthys oblongus*), had relatively low variability and therefore a high probability of detecting small to moderate effects (i.e., ~25% change) under the current monitoring effort. Many other common species observed, including winter skate (*Leucoraja ocellata*), red hake (*Urophycis chuss*), windowpane flounder (*Scophtalmus aquosus*), monkfish (*Lophius americanus*), summer flounder (*Paralichthys dentatus*), scup (*Stenotomus chrysops*), yellowtail flounder (*Pleironectes ferrugineus*), winter flounder (*Pleuronectes americanus*), and butterfish (*Peprilus triacanthus*), had higher variability (Coefficient of variation [CV]: 1.5 – 2.3). For these species, the current monitoring effort would have a high probability of detecting moderate effects (i.e., 30 – 50% change). For species exhibiting strong seasonality and high variability (CV: 2.5 – 4), large effects (i.e., 50 – 75% change) can be detected with a high probability under the current monitoring plan. For all species collected during the surveys, the current monitoring plan has the statistical power to detect a complete disappearance from either the VW1 Study Area or Control Area (i.e., 100% change). The updated power analysis showed that increasing the survey effort would only result in small improvements in the detectability of change.

Accounting for spatial and temporal variations in fish assemblages reduces the assumptions of the population dynamics while increasing the power to detect changes due to the impacting activities. When distributing the survey effort, randomly selecting multiple tow locations across the VW1 Study Area and Control Area accounts for spatial variations in fish populations. The distributed approach, applied here, assumes that the catch characteristics across each survey area represent the ecosystem. Additionally, surveying each site seasonally accounts for temporal variations in fish populations. This methodology is commonly referred to in the scientific literature as the "beyond-BACI" approach (Underwood, 1991).

The survey will have a sampling density of one station per 13.25 km^2 (3.86 square nautical miles [nmi^2]) in the VW1 Study Area and one station per 13.5 km^2 (3.94 nmi^2) in the Control Area. As previously mentioned, the NEAMAP nearshore survey samples at a density of one station per ~100 km^2 (30 nmi^2).

2.2 Trawl Net

To ensure standardization and compatibility between these surveys and ongoing regional surveys, and to take advantage of the well-established survey protocol, the otter trawl used in this survey has an identical design to the trawl used for the NEAMAP surveys, including otter boards, ground cables, and sweeps. This trawl was designed by the Mid-Atlantic and New England Fisheries Management Council's Trawl Survey Advisory Panel, the predecessor of the Northeast Trawl Advisory Panel (NTAP). As a result, the net design has been accepted by management authorities, the scientific community, and the commercial fishing industry in the region.

The survey trawl is a three-bridle, four-seam bottom trawl (Figure 3). This net style allows for a high vertical opening (~5 m) relative to the size of the net and consistent trawl geometry. These features make it suitable to sample a wide diversity of species with varying life history characteristics (i.e., demersal, pelagic, benthic, etc.). To effectively capture benthic organisms, a "flat sweep" was used (Figure 4). A "flat sweep" contains tightly packed rubber disks and lead weights, which ensures close contact with the substrate and minimizes the escape of fish under the net. This is permissible due to the soft bottom (i.e., sand, mud) in the survey areas. To ensure the retention of small individuals, a 1" mesh size knotless liner was used within a 12-cm diamond mesh codend. Thyboron Type IV 66" trawl doors were used to horizontally open the net. The trawl doors were connected to the trawl by a series of steel wire bridles (see Figures 5 and 6 for a diagram of the trawl's rigging during the surveys). For a detailed description of the trawl design, see Bonzek et al. (2008).

2.3 Trawl Geometry and Acoustic Monitoring Equipment

To ensure standardization between tows, the net geometry was required to be within pre-specified tolerances (±10%) for each of the geometry metrics (door spread, wing spread, and headline height). These metrics were developed by the NTAP and are part of the operational criteria in the NEAMAP survey protocol. Headline height was targeted to be between 5.0 and 5.5 m with acceptable deviations between 4.5 and 6.1 m. Wing spread was targeted between 13.0

and 14.0 m (acceptable range: 11.7 – 15.4 m). Door spread was targeted between 32.0 and 33.0 m (acceptable range: 28.8 – 37.4 m).

The Simrad PX net mensuration system (Kongsberg Group, Kongsberg, Norway) was used to monitor the net geometry (Figure 1). Two sensors were placed in the doors, one in each, to measure the distance between the doors, referred to as door spread. Two sensors placed on the center wingends measured the horizontal spread of the net, commonly referred to as the wing spread. A sensor with a sonar transducer was placed on the top of the net (headrope) to measure the vertical net opening, referred to as headline height. The headline sensor also measured bottom water temperature. To ensure the net was on the bottom a sensor was placed behind the footrope in the belly of the net. That sensor was equipped with a tilt sensor which reported the angle of the net belly. An angle around 0° indicated the net was on the seafloor. A towed hydrophone was placed over the side of the vessel to receive the acoustic signals from the net sensors. A processing unit, located in the wheelhouse and running the TV80 software, was used to monitor and log the data during tows (Figure 7).

2.4 Survey Operations

The survey was conducted on the F/V *Heather Lynn*, an 84' stern trawler operating out of Point Judith, Rhode Island between August 14 and 19, 2023. The F/V *Heather Lynn* is a commercial fishing vessel currently operating in the industry. One trip to the survey areas was made during which all planned tows were completed. As previously mentioned, this survey occurred during the Vineyard Wind 1 project's construction phase. Prior to this survey, all the scour protection for the project's wind turbines had been deposited on the seafloor and the electrical service platform had been installed. Nine wind turbine foundations had been installed in Lease Area OCS-A 0501 using pile driving before this survey. No active pile-driving activities occurred during this survey.

Surveys were alternated daily between the VW1 Study Area and Control Area. Tows were only conducted during daylight hours. All tows started at least 30 minutes after sunrise and ended 30 minutes before sunset. This was intended to reduce the variability commonly observed during crepuscular periods. Tow duration was 20 minutes at a target tow speed of 3.0 knots (range: 2.8 – 3.2 knots). Timing of the tow duration was initiated when the wire drums were locked and ended at the beginning of the haulback (i.e., net retrieval). The trawl was towed behind the fishing vessel from steel wires, commonly referred to as trawl warp. The trawl warp ratio (trawl warp: seafloor depth) was set to ~4:1. This decision was based on the net geometry data obtained from the 2019 surveys indicating that the 4:1 ratio constrained the horizontal spreading of the net to provide the desired headline height.

In addition to monitoring the net geometry to ensure acceptable performance (as described in Section 2.3 above), the following environmental and operational data were collected:

- Cloud cover (i.e., clear, partly cloudy, overcast, fog, etc.)
- Wind speed (Beaufort scale)
- Wind direction
- Sea state (Douglas Sea Scale)
- Start and end position (Latitude and Longitude)
- Start and end depth
- Tow speed
- Bottom temperature

Tow paths and tow speed were continuously logged using the OpenCPN charting software (opencpn.org) running on a computer with a USB GPS unit (GlobalSat BU-353-S4).

A CTD sonde (RBR Concerto[3], RBR LTD, Ottawa, Canada) was deployed off the side of the vessel at the conclusion of each tow. The CTD sonde was lowered to the seafloor at a rate of ~30 cm per second. Upon hitting the seafloor, the sonde was immediately retrieved. The CTD sonde recorded water column profiles of conductivity/salinity, temperature, and pressure/depth at a sampling rate of 8 Hertz.

2.5 Catch Processing

The catch from each tow was sorted by species. Aggregated weight from each species was weighed on a motion-compensated scale (M1100, Marel Corp., Gardabaer, Iceland). Individual fish length (to the nearest centimeter) and weight (to the nearest gram) were collected. Length data were collected using a digital measuring board (DCS-5, Big Fin Scientific LLC, Austin, Texas) and individual weights were measured using a motion-compensated digital scale (M1100, Marel Corp., Gardabaer, Iceland). An Android tablet (Samsung Active Tab 2) running DCSLinkStream (Big Fin Scientific LLC, Austin, Texas) served as the data collection platform.

Efforts were made to process all animals; however, during large catches sub-sampling was used for some abundant species. Only one sub-sampling strategy was employed over the duration of the survey: straight sub-sampling by weight.

Straight sub-sampling by weight: When catch diversity was relatively low (5 to 10 species), straight sub-sampling was used. In this method, the catch was sorted by species. An aggregated species weight was measured and then a sub-sample (50 – 100 individuals) was collected for individual length and weight measurements. The ratio of the sub-sample weight to the total species weight was then used to extrapolate the length-frequency estimates. This was the predominant sub-sampling strategy.

Lengths were collected during every tow. Individual fish weights were collected during every tow for low abundance species (<20 individuals/tow) or during alternating tows for abundant species (>20 individuals/tow). The result from each tow was a measurement of aggregated weight, length-frequency curves, and length-weight curves for each species except crabs, lobsters, and some non-commercial species. For these species, aggregated weight and counts were collected. Any observation of squid eggs was documented. All survey data were uploaded and stored in a Microsoft Access database.

3. Results

3.1 Operational Data, Environmental Data, and Trawl Performance

Twenty tows were successfully completed in both the VW1 Study Area and the Control Area (Figure 2, Table 1). Operational parameters were similar between these two survey areas (Table 2). Tow durations averaged 20.1 ± 0.1 minutes (mean ± one standard deviation) in the VW1 Study Area and 20.1 ± 0.1 minutes in the Control Area. Tow distances averaged 0.97 ± 0.03 nautical miles (nmi) in the VW1 Study Area giving an average tow speed of 2.9 ± 0.1 knots. Similarly, tow distance averaged 0.95 ± 0.02 nmi in the Control Area giving an average tow speed of 2.9 ± 0.1 knots.

The trawl geometry data indicated that the trawl took about two to three minutes to open and stabilize. Once open, readings were stable throughout the duration of the tow. Door spread averaged 34.1 ± 1.3 m (range: 31.0 – 35.0 m) for tows in the VW1 Study Area and 34.8 ± 0.7 (range: 33.8 – 35.8 m) in the Control Area. Wing spread averaged 13.5 ± 0.3 m for tows in the VW1 Study Area (range: 12.8 – 14.3 m) and 13.3 ± 0.5 m for tows in the Control Area (range: 12.5

– 14.6 m). Headline height averaged 5.7 ± 0.1 m for tows in the VW1 Study Area (range: 5.5 – 6.0 m) and 5.7 ± 0.1 m for tows in the Control Area (range: 5.5 – 6.0 m). All tows were in the acceptable range for all trawl geometry parameters.

The seafloor in both areas follows a northeast-to-southwest depth gradient with the shallowest tow along the northeastern edge (~33 m). Depth increased to a maximum of 50 m along the southwestern boundary. Bottom water temperature followed the depth gradient with warmer temperatures observed in the shallow tows for the north (~13 – 15°C [55 – 59°F] at 18 – 22 fathoms [fm] [33 – 40 m]). Bottom water temperature was 11 – 12°C (52 – 54°F) during deeper tows in the southern half of the study areas (24 – 26 fm [44 – 48 m]). CTD data indicated that the surface water varied between 16 – 20°C [61 – 68°F]. In the VW1 Study Area, a gradual thermocline was apparent between 10 – 20 m [Figure 8]. The Control Area exhibited a strong thermocline in deeper tows with the water temperature dropping from 20 to 12°C between 10 – 20 meters water depth (Figure 9). Shallower tows exhibited a more gradual reduction in temperature throughout the water column.

3.2 Catch Data

3.2.1 VW1 Study Area

In the VW1 Study Area, a total of 26 species were caught over the duration of the survey (Table 3). Catch volume ranged from 27.3 to 1,468.6 kilograms per tow (kg/tow) with an average of 295.9 kg/tow. The majority of the catch was primarily comprised of a small subset of the observed species. The five most abundant species (butterfish, Atlantic longfin squid, little skate, silver hake, and red hake) accounted for 97.6% of the total catch weight. Data collected from this area included the catch of both adults and juveniles of most species observed.

Butterfish was the most abundant species, accounting for 63.9% of the total catch weight. Individuals ranged in length from 10 to 18 cm with a unimodal size distribution consisting of a peak at 13 cm (Figure 10). Butterfish were observed in all 20 tows at an average catch rate of 191.2 ± 82.3 kg/tow (mean ± Standard Error of the Mean [SEM], range: 0.8 – 1,390.5 kg/tow). Butterfish were caught throughout the VW1 Study Area with several large catches in the northwest corner of the VW1 Study Area (Figure 11).

Atlantic longfin squid is a commercially important species commonly referred to as loligo squid. Atlantic longfin squid was the second most abundant species, accounting for 12.8% of the total catch weight. Atlantic longfin squid ranged in length from 3 to 26 cm (mantle length) with a unimodal size distribution peaking at 12 cm (Figure 12). Atlantic longfin squid were observed in all 20 tows at an average catch rate of 36.9 ± 4.8 kg/tow (range: 6.4 – 94.2 kg/tow). Atlantic longfin squid were caught throughout the VW1 Study Area (Figure 13). No squid "mops" were observed during this survey.

Little skate was the third most abundant species observed, accounting for 11.1% of the total catch weight. Individuals ranged in size from 14 to 30 cm (disk width) with a unimodal size distribution consisting of a peak at 26 cm (Figure 14). Little skate were observed in 19 of the 20 tows with an average catch rate of 32.3 ± 7.4 kg/tow (range: 0 – 118.2 kg/tow). The catch of little skate appeared to follow the depth gradient with higher catches associated with shallower tows in the north half of the development area (Figure 15). Catch decreased in deeper tows in the southern half of the area.

Silver hake, a commercially important species also commonly referred to as whiting, was a frequently observed species in the VW1 Study Area. Silver hake was the fourth most abundant species, accounting for 6.5% of the total catch weight. Individuals ranged in length from 17 to 38 cm with a unimodal distribution consisting of a peak at 22 cm (Figure 16). Silver hake were observed in all 20 tows at an average catch rate of 18.9 ± 3.4 kg/tow (range: 2.2 – 47.1 kg/tow). Silver hake were observed throughout the VW1 Study Area (Figure 17).

Red hake was the fifth most abundant species observed, accounting for 3.4% of the total catch weight. Individuals ranged in length from 20 to 46 cm with a wide size distribution (Figure 18). Red hake were observed in 17 of the 20 tows. Catch rates averaged 9.7 ± 2.5 kg/tow (range: 0 – 35.6 kg/tow). Red hake were distributed throughout the VW1 Study Area with higher catches observed in the northern half of the development area (Figure 19).

Fourspot flounder was the most abundant flatfish in the VW1 Study Area. Fourspot flounder ranged in length from 23 to 37 cm with a unimodal size distribution peaking at 28 cm (Figure 20). Fourspot flounder were observed in 17 of the 20 tows at an average catch rate of 1.8 ± 0.6 kg/tow (range: 0 – 13.0 kg/tow). Fourspot flounder were caught throughout the VW1 Study Area (Figure 21).

Winter flounder is an important commercial flatfish species that was found in the VW1 Study Area. Individuals ranged in length from 20 to 32 cm (Figure 22). Winter flounder were observed in 13 of the 20 tows at an average catch rate of 0.4 ± 0.1 kg/tow (range: 0 – 1.5 kg/tow). Winter flounder were caught intermittently throughout the VW1 Study Area (Figure 23).

Windowpane flounder is a federally regulated commercial flatfish species found in the VW1 Study Area. Individuals ranged in length from 13 to 33 cm with a wide size distribution peaking at 15 cm (Figure 24). Windowpane flounder were observed in 15 of the 20 tows at an average catch rate of 0.2 ± 0.1 kg/tow (range: 0 – 1.1 kg/tow). The catch of windowpane flounder appeared to vary latitudinally with most of the catch observed along the northern boundary of the VW1 Study Area (Figure 25). No catch was observed along the southern boundary of the area.

Less common recreational and commercial species observed included seven individuals of yellowtail flounder (size: 22 – 25 cm), four individuals of Atlantic sea scallop (*Placopecten magellanicus*), and two individuals of American lobster (*Homarus americanus*).

One roughtail stingray (*Dasyatis cantroura*) was caught. The animal was estimated to be ~1.5 m long (disk width). Additionally, one thresher shark (*Alopias vulpinus*) was caught. The shark was estimated to be ~2 m long (fork length). Both animals were immediately returned to the sea and were observed to swim away.

3.2.2 Control Area

In the Control Area, a total of 27 species were caught over the duration of the survey (Table 4). Catch volume ranged from 48.1 to 561.0 kg/tow with an average of 66.1 kg/tow. The majority of the catch was primarily comprised of a small subset of the observed species. The five most abundant species (Atlantic longfin squid, silver hake, scup, butterfish, and little skate) accounted for 91.5% of the total catch weight. Data collected from this area included the catch of both adults and juveniles of most species observed.

Atlantic longfin squid was the most abundant species in the Control Area, accounting for 31.3% of the total catch weight. Atlantic longfin squid ranged in length from 4 to 31 cm (mantle length) with a unimodal size distribution peaking at 13 cm (Figure 12). Atlantic longfin squid were observed in all 20 tows at an average catch rate of 83.0 ± 12.5 kg/tow (range: 19.9 – 224.2 kg/tow).

The catch of Atlantic longfin squid was distributed throughout the Control Area (Figure 13). No squid “mops” were observed during this survey.

Silver hake was the second most abundant species in the Control Area, accounting for 24.7% of the total catch weight. Individuals ranged in length from 18 to 39 cm with a unimodal distribution consisting of a peak at 24 cm (Figure 16). Silver hake were observed in all 20 tows at an average catch rate of 65.9 ± 10.2 kg/tow (range: 3.7 – 165.1 kg/tow). Silver hake were observed throughout the Control Area (Figure 17).

Scup was the third most abundant species observed, accounting for 12.3% of the total catch weight. Individuals ranged in length from 20 to 31 cm with a unimodal size distribution consisting of a peak at 24 cm (Figure 26). Scup were only observed in seven of the 20 tows. Catch rates averaged 32.6 ± 12.8 kg/tow (range: 0 – 184.6 kg/tow). The catch of scup was limited to the northern edge of the Control Area (Figure 27).

Butterfish was the fourth most abundant species, accounting for 12.3% of the total catch weight. Individuals ranged in length from 11 to 18 cm with a unimodal size distribution consisting of a peak at 14 cm (Figure 10). Butterfish were observed in 17 of the 20 tows at an average catch rate of 32.9 ± 11.1 kg/tow (range: 0 – 156.7 kg/tow). Butterfish were caught throughout the Control Area (Figure 11).

Little skate was the fifth most abundant species observed, accounting for 10.9% of the total catch weight. Individuals ranged in size from 15 to 31 cm (disk width) with a unimodal size distribution consisting of a peak at 26 cm (Figure 14). Little skate were observed in all 20 tows with an average catch rate of 29.1 ± 9.2 kg/tow (range: 4.1 – 157.3 kg/tow). Similar to the VW1 Study Area, the catch of little skate appeared to follow the depth gradient with higher catches associated with shallower tows in the north half of the VW1 Study Area (Figure 15). Catch decreased in deeper tows in the southern half of the area.

Red hake were commonly observed in the Control Area. Individuals ranged in length from 18 to 40 cm with a unimodal size distribution consisting of a peak at 26 cm (Figure 18). Red hake were observed in all 20 tows. Catch rates averaged 12.7 ± 2.8 kg/tow (range: 0.2 – 44.4 kg/tow). Red hake were distributed throughout the Control Area (Figure 19).

Fourspot flounder was the most abundant flatfish in the Control Area. Fourspot flounder ranged in length from 18 to 42 cm with a unimodal size distribution peaking at 25 cm (Figure 20). Fourspot flounder were observed in 19 of the 20 tows at an average catch rate of 1.0 ± 0.2 kg/tow (range: 0 – 2.9 kg/tow). Fourspot flounder were caught throughout the Control Area (Figure 21).

Winter flounder is an important commercial flatfish species that was found in the Control Area. Individuals ranged in length from 20 to 33 cm (Figure 22). Winter flounder were observed in 11 of the 20 tows at an average catch rate of 0.9 ± 0.7 kg/tow (range: 0 – 14.1 kg/tow). Winter flounder were caught intermittently throughout the Control Area (Figure 23).

Shortfin squid (*Illex illecebrosus*) was commonly observed in the Control Area. Shortfin squid ranged in length from 11 to 19 cm (mantle length) with a unimodal size distribution peaking at 14 cm (Figure 28). Shortfin squid were observed in 14 of the 20 tows at an average catch rate of 0.6 ± 0.1 kg/tow (range: 0 – 2.0 kg/tow). The catch of shortfin squid was primarily observed in the southern half of the Control Area (Figure 29). No squid "mops" were observed during this survey.

Windowpane flounder is a federally regulated commercial flatfish species that was found in the Control Area. Individuals ranged in length from 13 to 30 cm with a wide size distribution peaking at 15 cm (Figure 24). Windowpane flounder were observed in eight of the 20 tows at an average catch rate of 0.2 ± 0.1 kg/tow (range: 0 – 1.0 kg/tow). The catch of windowpane flounder appeared to vary latitudinally with the catch solely observed in the northern half of the study area (Figure 25).

Less common recreational and commercial species observed included 10 individuals of yellowtail flounder (size: 21 – 26 cm), six individuals of Atlantic sea scallop, four individuals of American lobster, and one individual of summer flounder (size: 69 cm).

4. Acknowledgements

We would like to thank the owner (Paul Farnham), captain (Mike Decker), and crew (Alex Romero and Jeff Sanderlin) of the F/V *Heather Lynn* for their help in sorting, processing, and measuring the catch. Additionally, we would like to thank Keith Hankowsky and Drake Ssempijja in our Fish Behavior and Conservation Engineering lab for their help with data collection at sea.

5. References

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Table 1: Operational and environmental conditions for each survey tow.

Tow Number	Tow Area	Date	Sky Condition	Wind State (Knots)	Wind Direction	Sea State (m.)	Start Time	Start Latitude	Start Longitude	Start Depth (fm)	End Time	End Latitude	End Longitude	End Depth (fm)	Bottom Temp. (°C)	Trawl Warp (fm)
1	VW1	8/15/2023	Obscured	7-10	NE	0.5-1.25	6:58	N 41° 03.385	W 70° 32.633	25	7:18	N 41° 02.775	W 70° 31.718	24		100
2	VW1	8/15/2023	Overcast	11-15	NE	0.5-1.25	8:17	N 41° 01.872	W 70° 36.003	25	8:37	N 41° 01.299	W 70° 35.030	26	12.2	100
3	VW1	8/15/2023	Overcast	11-15	NE	0.5-1.25	9:22	N 41° 00.622	W 70° 34.392	25	9:42	N 41° 00.028	W 70° 33.394	27	11.8	100
4	VW1	8/15/2023	Overcast	16-20	NE	0.5-1.25	10:23	N 41° 01.351	W 70° 30.998	26	10:43	N 41° 01.077	W 70° 38.553	25	12.6	100
5	VW1	8/15/2023	Mostly Cloudy	11-15	N	0.5-1.25	11:16	N 41° 02.047	W 70° 29.745	24	11:36	N 41° 02.987	W 70° 29.916	24	13.1	100
6	VW1	8/15/2023	Partly Cloudy	11-15	W	0.5-1.25	12:14	N 41° 01.476	W 70° 29.385	23	12:34	N 41° 00.508	W 70° 29.549	25	12.8	100
7	VW1	8/15/2023	Partly Cloudy	11-15	W	0.5-1.25	13:20	N 40° 59.677	W 70° 31.829	26	13:40	N 40° 59.221	W 70° 32.909	26	11.9	100
8	VW1	8/15/2023	Overcast	11-15	W	0.5-1.25	14:19	N 40° 59.520	W 70° 30.515	26	14:39	N 40° 59.586	W 70° 29.215	25	12.8	100
9	VW1	8/15/2023	Overcast	11-15	W	0.5-1.25	15:11	N 40° 59.361	W 70° 28.345	24	15:31	N 40° 58.396	W 70° 28.265	24	12.6	100
10	VW1	8/15/2023	Mostly Cloudy	11-15	W	0.5-1.25	16:03	N 40° 57.232	W 70° 28.704	25	16:23	N 40° 56.342	W 70° 29.183	25	11.3	100
11	Control	8/15/2023	Overcast	11-15	W	0.5-1.25	16:49	N 40° 56.212	W 70° 28.624	26	17:09	N 40° 56.535	W 70° 27.483	24	11.3	100
12	Control	8/16/2023	Mostly Cloudy	7-10	E	0.5-1.25	6:52	N 40° 56.485	W 70° 26.328	25	7:12	N 40° 56.498	W 70° 25.125	24	11.8	100
13	Control	8/16/2023	Mostly Cloudy	7-10	E	0.5-1.25	7:55	N 40° 55.731	W 70° 23.141	24	8:15	N 40° 55.997	W 70° 21.943	24	12.1	100
14	Control	8/16/2023	Mostly Cloudy	7-10	E	0.5-1.25	8:51	N 40° 54.931	W 70° 22.987	24	9:11	N 40° 54.441	W 70° 24.004	25	11.9	100
15	Control	8/16/2023	Mostly Cloudy	7-10	E	0.5-1.25	9:48	N 40° 54.096	W 70° 25.424	26	10:08	N 40° 53.679	W 70° 26.570	27	11.0	100
16	Control	8/16/2023	Mostly Cloudy	7-10	E	0.5-1.25	10:43	N 40° 52.991	W 70° 24.145	27	11:03	N 40° 52.727	W 70° 23.534	26	11.2	100
17	Control	8/16/2023	Mostly Cloudy	7-10	E	0.5-1.25	11:45	N 40° 51.909	W 70° 22.400	26	12:05	N 40° 51.380	W 70° 21.369	26	11.6	100
18	Control	8/16/2023	Mostly Cloudy	7-10	E	0.5-1.25	12:40	N 40° 53.469	W 70° 19.612	24	13:00	N 40° 54.279	W 70° 18.975	24	12.4	100
19	Control	8/16/2023	Mostly Cloudy	7-10	E	0.5-1.25	13:44	N 40° 54.232	W 70° 19.274	24	14:04	N 40° 54.893	W 70° 20.168	23	12.4	100
20	Control	8/16/2023	Mostly Cloudy	7-10	E	0.5-1.25	14:43	N 40° 55.279	W 70° 20.934	24	15:03	N 40° 55.681	W 70° 22.049	23	12.3	100
21	Control	8/15/2023	Mostly Cloudy	3-6	E	0.5-1.25	15:47	N 40° 56.911	W 70° 22.895	24	16:07	N 40° 57.818	W 70° 23.323	24	13.5	100
22	Control	8/16/2023	Partly Cloudy	3-6	E	0.5-1.25	16:37	N 40° 58.218	W 70° 23.110	24	16:57	N 40° 58.008	W 70° 22.444	22	12.2	100
23	Control	8/16/2023	Partly Cloudy	3-6	E	0.5-1.25	17:31	N 40° 59.544	W 70° 22.064	21	17:51	N 41° 00.027	W 70° 21.041	21	12.6	95
24	VW1	8/17/2023	Overcast	7-10	E	0.5-1.25	6:51	N 40° 59.831	W 70° 26.779	23	7:11	N 41° 00.077	W 70° 25.577	22	12.0	100
25	VW1	8/17/2023	Overcast	7-10	E	0.5-1.25	7:57	N 41° 01.994	W 70° 25.470	23	8:17	N 41° 02.336	W 70° 24.287	22	12.1	100
26	VW1	8/17/2023	Mostly Cloudy	7-10	E	0.5-1.25	9:03	N 41° 04.732	W 70° 25.325	22	9:23	N 41° 05.386	W 70° 24.477	22	12.5	100
27	VW1	8/17/2023	Mostly Cloudy	7-10	E	0.5-1.25	10:08	N 41° 05.455	W 70° 27.243	22	10:28	N 41° 04.797	W 70° 28.155	22	11.9	100
28	VW1	8/17/2023	Mostly Cloudy	7-10	E	0.5-1.25	11:00	N 41° 05.065	W 70° 29.524	22	11:20	N 41° 04.450	W 70° 30.418	23	11.6	100
29	VW1	8/17/2023	Mostly Cloudy	7-10	E	0.5-1.25	12:10	N 41° 04.700	W 70° 30.631	23	12:30	N 41° 05.323	W 70° 31.551	23	11.6	100
30	VW1	8/17/2023	Overcast	7-10	E	0.5-1.25	13:21	N 41° 07.398	W 70° 28.168	21	13:41	N 41° 07.023	W 70° 27.187	21	12.6	95
31	VW1	8/17/2023	Overcast	7-10	E	0.5-1.25	14:17	N 41° 06.950	W 70° 27.669	21	14:37	N 41° 06.046	W 70° 28.144	21	11.9	95
32	VW1	8/17/2023	Rain	7-10	E	0.5-1.25	15:26	N 41° 05.079	W 70° 23.850	21	15:46	N 41° 05.026	W 70° 22.624	22	13.0	95
33	VW1	8/17/2023	Rain	7-10	E	0.5-1.25	16:26	N 41° 02.503	W 70° 23.230	21	16:46	N 41° 01.537	W 70° 23.325	21	12.5	95
34	Control	8/17/2023	Overcast	7-10	E	0.5-1.25	17:18	N 41° 02.208	W 70° 22.194	21	17:38	N 41° 02.517	W 70° 21.032	21	13.1	95
35	Control	8/18/2023	Mostly Cloudy	7-10	SW	0.5-1.25	6:51	N 40° 55.062	W 70° 16.537	21	7:11	N 40° 57.017	W 70° 16.619	20	13.9	95
36	Control	8/18/2023	Mostly Cloudy	7-10	SW	0.5-1.25	7:59	N 40° 57.580	W 70° 15.643	20	8:19	N 40° 58.550	W 70° 15.687	20	14.4	95
37	Control	8/18/2023	Overcast	11-15	SW	0.5-1.25	9:21	N 41° 00.784	W 70° 15.473	18	9:41	N 41° 00.105	W 70° 16.347	19	14.8	75
38	Control	8/18/2023	Overcast	11-15	SW	0.5-1.25	10:27	N 40° 59.008	W 70° 17.917	22	10:47	N 40° 58.549	W 70° 19.028	23	13.4	95
39	Control	8/18/2023	Mostly Cloudy	11-15	SW	0.5-1.25	11:27	N 40° 59.701	W 70° 19.326	21	11:47	N 41° 00.430	W 70° 20.006	21	13.3	100
40	Control	8/18/2023	Mostly Cloudy	16-20	SW	1.25-2.5	12:27	N 41° 01.720	W 70° 19.447	22	12:47	N 41° 02.659	W 70° 19.298	20	13.7	100

Table 2: Tow parameters for each survey tow.

Tow Number	Tow Area	Tow Duration (min)	Tow Distance (nmi)	Tow Speed (knots)	Start Depth (fm)	Bottom Temp. (^0C)	Trawl Warp (fm)	Headline Height (m)	Wing Spread (m)	Spread Door (m)
1	VW1	20.0	0.93	2.8	25		100	5.5		
2	VW1	20.0	0.94	2.8	25	12.2	100	5.6	13.6	
3	VW1	20.0	0.97	2.9	25	11.8	100	5.7	13.5	35.1
4	VW1	20.4	0.98	2.9	26	12.6	100	5.6	13.7	
5	VW1	20.0	0.96	2.9	24	13.1	100	5.7	13.6	
6	VW1	19.9	0.99	3.0	23	12.8	100	5.7	13.7	
7	VW1	20.1	0.95	2.8	26	11.9	100	6.0	13.4	33.6
8	VW1	20.0	1.00	2.8	26	12.8	100	5.8	12.8	31.0
9	VW1	20.0	0.98	2.9	24	12.6	100	5.6	13.3	
10	VW1	20.0	0.98	2.9	25	11.3	100	5.8	13.3	34.6
11	Control	20.0	0.92	2.8	26	11.3	100	5.7		34.2
12	Control	20.0	0.98	2.9	25	11.8	100	5.6	14.6	35.8
13	Control	20.1	0.96	2.9	24	12.1	100	5.7	14.1	35.0
14	Control	20.0	0.92	2.8	24	11.9	100	5.7	13.2	34.9
15	Control	20.2	0.98	2.9	26	11.0	100	5.7	13.2	34.8
16	Control	20.0	0.95	2.8	27	11.2	100	5.8	13.3	35.4
17	Control	20.0	0.96	2.9	26	11.6	100	5.7		35.5
18	Control	20.1	0.95	2.8	24	12.4	100	5.5		35.6
19	Control	19.9	0.95	2.9	24	12.4	100	5.7	13.2	34.4
20	Control	20.1	0.97	2.9	24	12.3	100	5.9	13.1	33.4
21	Control	20.2	0.97	2.9	24	13.5	100	5.5	12.7	
22	Control	20.1	0.96	2.9	24	12.2	100	5.6	14.1	35.4
23	Control	20.2	0.92	2.7	21	12.6	95	5.8		33.9
24	VW1	20.0	1.03	3.1	23	12.0	100	5.7	13.5	35.5
25	VW1	20.1	0.98	2.9	23	12.1	100	5.6	13.3	
26	VW1	20.0	0.93	2.8	22	12.5	100	5.7	14.3	34.0
27	VW1	20.2	0.96	2.9	22	11.9	100	5.6	14.3	34.6
28	VW1	20.2	0.94	2.8	22	11.6	100	5.6	13.3	34.7
29	VW1	20.1	0.94	2.8	23	11.6	100	5.7	13.1	34.0
30	VW1	19.9	0.93	2.8	21	12.6	95	5.6	13.6	35.4
31	VW1	20.2	0.98	2.9	21	11.9	95	5.7	13.2	
32	VW1	20.0	0.95	2.9	21	13.0	95	5.5	13.5	
33	VW1	20.1	0.98	2.9	21	12.5	95	5.5	13.4	33.1
34	Control	20.1	0.94	2.8	21	13.1	95	5.6	13.0	34.3
35	Control	20.0	0.96	2.9	21	13.9	95	5.6	13.1	
36	Control	20.1	0.99	3.0	20	14.4	95	5.5	13.6	34.9
37	Control	20.0	0.95	2.9	18	14.8	75	6.0	12.5	
38	Control	20.3	0.97	2.9	22	13.4	95	5.7	13.1	
39	Control	19.8	0.92	2.8	21	13.3	100	5.6	13.3	
40	Control	20.4	0.95	2.8	22	13.7	100	5.5	13.2	34.1
Summary Statistics										
Control	Minimum	19.8	0.92	2.7	18.0	11.0	75.0	5.5	12.5	33.4
	Maximum	20.4	0.99	3.0	27.0	14.8	100.0	6.0	14.6	35.8
	Average	20.1	0.95	2.9	23.2	12.6	97.5	5.7	13.3	34.8
	St. Dev	0.1	0.02	0.1	2.4	1.1	5.7	0.1	0.5	0.7
VW1	Minimum	19.9	0.93	2.8	21.0	11.3	95.0	5.5	12.8	31.0
	Maximum	20.4	1.03	3.1	26.0	13.1	100.0	6.0	14.3	35.5
	Average	20.1	0.97	2.9	23.4	12.2	99.0	5.7	13.5	34.1
	St. Dev.	0.1	0.03	0.1	1.8	0.5	2.1	0.1	0.3	1.3

Table 3: Total and average catch weights from 20 tows within the VW1 Study Area.

Species Name	Scientific Name	Total Weight (kg)	Catch/Tow (kg)		% of Total Catch	Tows with Species Present
			Mean	SEM*		
Butterfish	*Peprilus triacanthus*	3555.6	191.2	82.3	63.9	20
Squid, Atlantic Longfin	*Dorytheuthis pealei*	711.1	36.9	4.8	12.8	20
Skate, Little	*Leucoraja erinacea*	618.2	32.3	7.4	11.1	19
Hake, Silver (Whiting)	*Merluccius bilinearis*	363.1	18.9	3.4	6.5	20
Hake, Red	*Urophycis chuss*	186.6	9.7	2.5	3.4	17
Hake, Spotted	*Urophycis regia*	55.2	2.9	0.9	1.0	14
Flounder, Fourspot	*Paralichthys oblongus*	34.2	1.8	0.6	0.6	17
Flounder, Winter	*Pleuronectes americanus*	7.3	0.4	0.1	0.1	13
Dogfish, Smooth	*Mustelus canis*	7.1	0.4	0.2	0.1	3
Dogfish, Spiny	*Squalus acanthias*	7.1	0.4	0.3	0.1	5
Flounder, Windowpane	*Scophtalmus aquosus*	3.9	0.2	0.1	0.1	15
Crab, Rock	*Cancer irroratus*	3.1	0.2	0.1	0.1	8
Mackeral, Atlantic	*Scomber scombrus*	1.9	0.1	0.05	0.03	4
Squid, Shortfin	*Illex illecebrosus*	1.8	0.1	0.1	0.03	4
Scup	*Stenotomus chrysops*	1.7	0.1	0.0	0.03	3
Skate, Barndoor	*Dipturus laevis*	1.5	0.1	0.1	0.03	2
Lobster, American	*Homarus americanus*	1.4	0.1	0.1	0.03	1
Flounder, Yellowtail	*Pleuronectes ferrugineus*	1.2	0.1	0.0	0.02	4
Shark, Thresher	*Alopias vulpinus*	1.0	0.1	0.1	0.02	1
Stingray, Roughtail	*Dasyatis centroura*	1.0	0.1	0.1	0.02	1
Flounder, Gulfstream	*Citharichthys arctifrons*	0.8	0.04	0.02	0.01	4
Sea Scallop, Atlantic	*Placopecten magellanicus*	0.7	0.04	0.02	0.01	3
Sculpin, Longhorn	*Myoxocephalus octodecimspinosus*	0.5	0.03	0.03	0.01	1
Ocean Pout	*Zoarces americanus*	0.3	0.02	0.02	0.01	1
Shad, American	*Alosa sapidissima*	0.2	0.01	0.01	0.004	2
Cusk	*Brosme brosme*	0.1	0.01	0.01	0.002	1
Total		5566.6				

*SEM - Standard Error of the Mean

Table 4: Total and average catch weights from 20 tows within the Control Area.

Species Name	Scientific Name	Total Weight (kg)	Catch/Tow (kg) Mean	Catch/Tow (kg) SEM*	% of Total Catch	Tows with Species Present
Squid, Atlantic Longfin	*Dorytheuthis pealei*	1566.7	83.0	12.5	31.3	20
Hake, Silver (Whiting)	*Merluccius bilinearis*	1235.1	65.9	10.2	24.7	20
Scup	*Stenotomus chrysops*	616.4	32.6	12.8	12.3	7
Butterfish	*Peprilus triacanthus*	613	32.9	11.1	12.3	17
Skate, Little	*Leucoraja erinacea*	545.3	29.1	9.2	10.9	20
Hake, Red	*Urophycis chuss*	237.1	12.7	2.8	4.7	20
Hake, Spotted	*Urophycis regia*	77.7	4.1	1.9	1.6	11
Sea Robin, Northern	*Prionotus carolinus*	23.4	1.3	0.6	0.5	6
Flounder, Fourspot	*Paralichthys oblongus*	18.4	1.0	0.2	0.4	19
Flounder, Winter	*Pleuronectes americanus*	18.2	0.9	0.7	0.4	11
Squid, Shortfin	*Illex illecebrosus*	12.1	0.6	0.1	0.2	14
Mackeral, Atlantic	*Scomber scombrus*	9.3	0.5	0.2	0.2	5
Skate, Barndoor	*Dipturus laevis*	5.4	0.3	0.1	0.1	9
Flounder, Summer (Fluke)	*Paralichthys dentatus*	4.6	0.2	0.2	0.1	1
Dogfish, Smooth	*Mustelus canis*	4.3	0.2	0.2	0.1	2
Crab, Rock	*Cancer irroratus*	4	0.2	0.1	0.1	8
Flounder, Windowpane	*Scophtalmus aquosus*	3.6	0.2	0.1	0.1	8
Flounder, Yellowtail	*Pleuronectes ferrugineus*	1.5	0.1	0.03	0.03	7
Lobster, American	*Homarus americanus*	1.1	0.1	0.03	0.02	4
Dogfish, Spiny	*Squalus acanthias*	1.0	0.1	0.04	0.02	2
Shad, American	*Alosa sapidissima*	0.6	0.03	0.02	0.01	4
Crab, Horseshoe	*Limulus polyphemus*	0.5	0.03	0.03	0.01	1
Sea Scallop, Atlantic	*Placopecten magellanicus*	0.5	0.03	0.01	0.01	5
Sea Robin, Striped	*Prionotus evolans*	0.5	0.03	0.03	0.01	1
Sculpin, Longhorn	*Myoxocephalus octodecimspinosus*	0.4	0.02	0.02	0.01	1
Ocean Pout	*Zoarces americanus*	0.3	0.02	0.02	0.01	1
Flounder, Gulfstream	*Citharichthys arctifrons*	0.2	0.01	0.01	0.004	2
Total		5001.2				

*SEM - Standard Error of the Mean

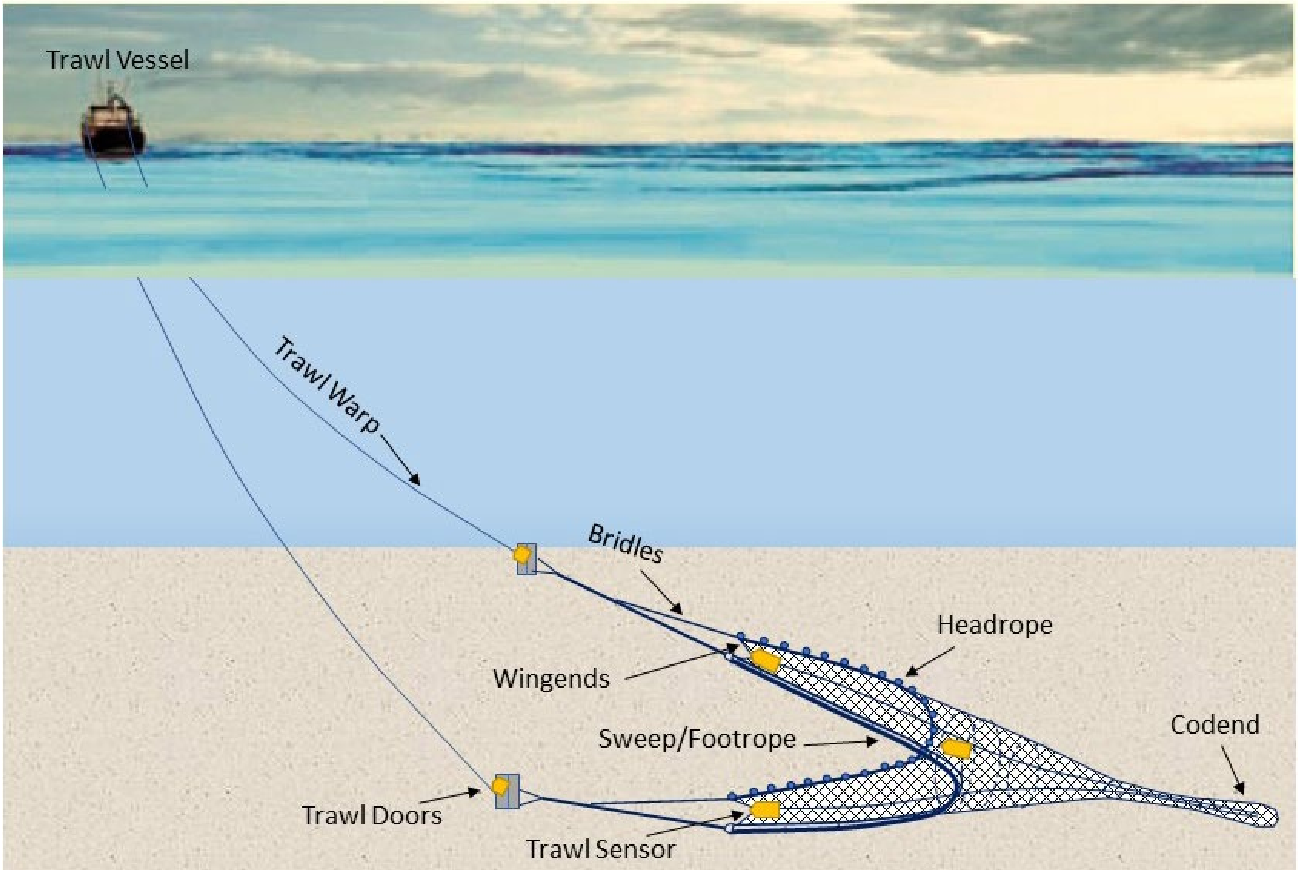


Figure 1: General schematic (not to scale) of a demersal otter trawl. Yellow rectangles indicate Simrad PX trawl geometry sensors.

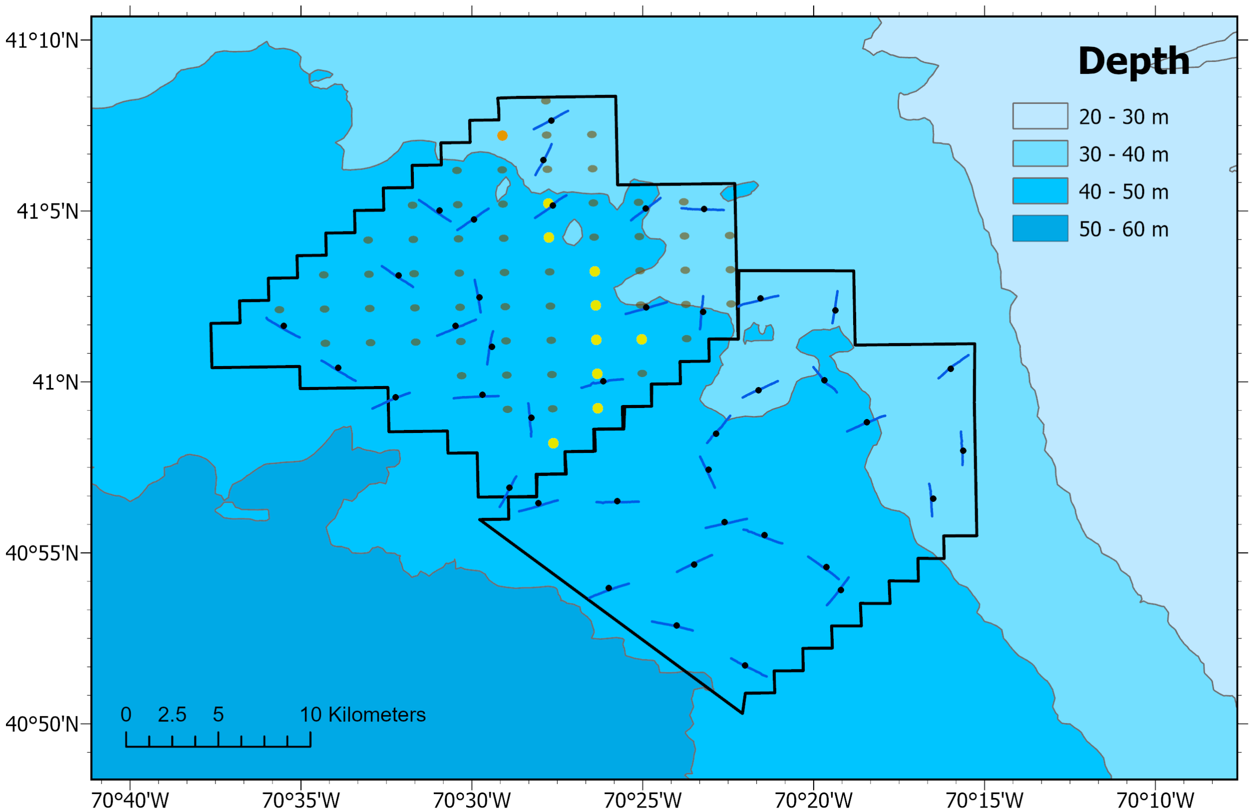


Figure 2: Tow locations (black dots) and trawl tracks (blue lines) from the VW1 Study Area (left) and the Control Area (right). Prior to the start of the survey, scour protection (gray dots) had been installed in all wind turbine locations. The electrical service platform (orange dot) in addition to select wind turbine foundations (yellow dots) had been installed.

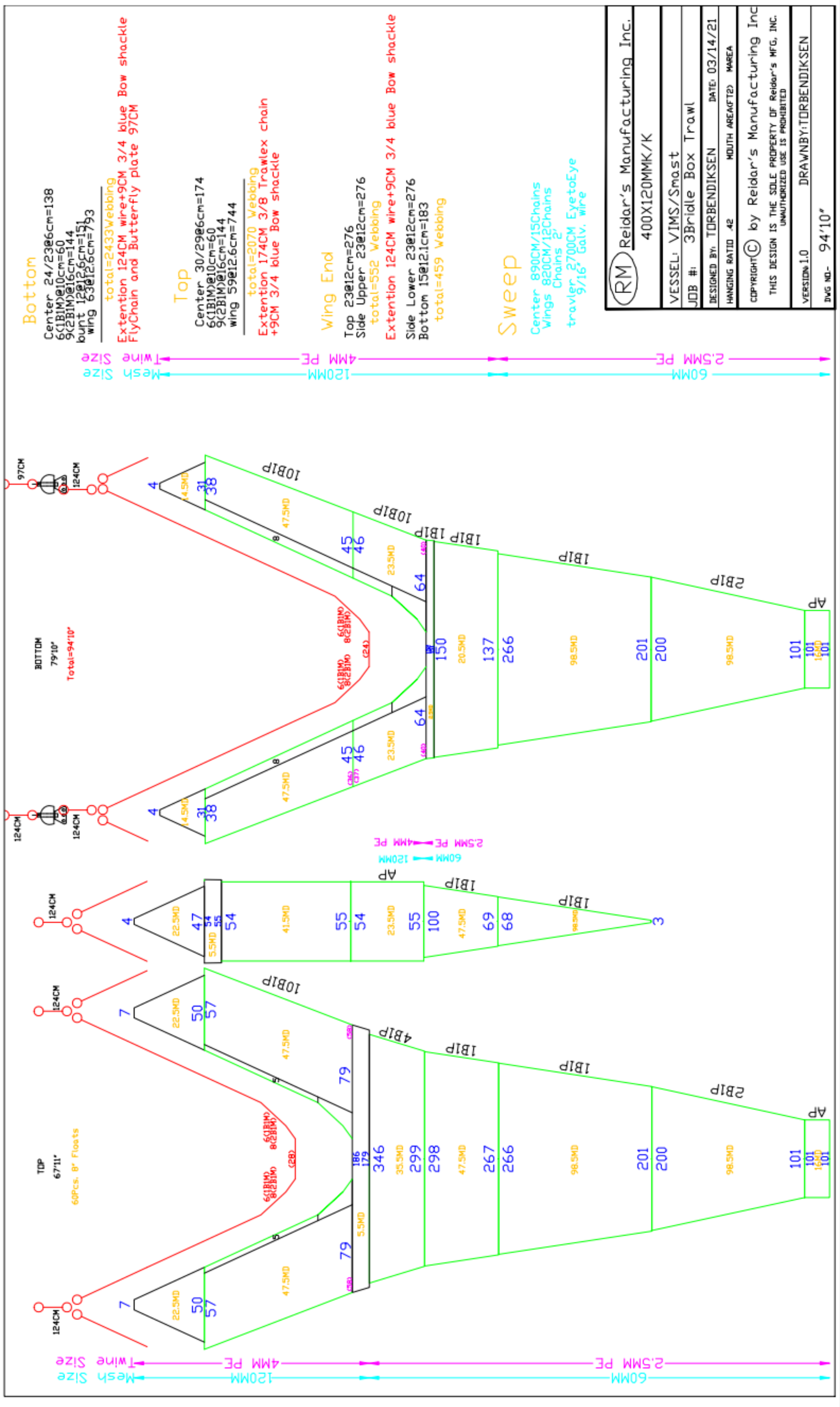


Figure 3: Schematic net plan for the NEAMAP trawl (Courtesy of Reidar's Manufacturing Inc.).

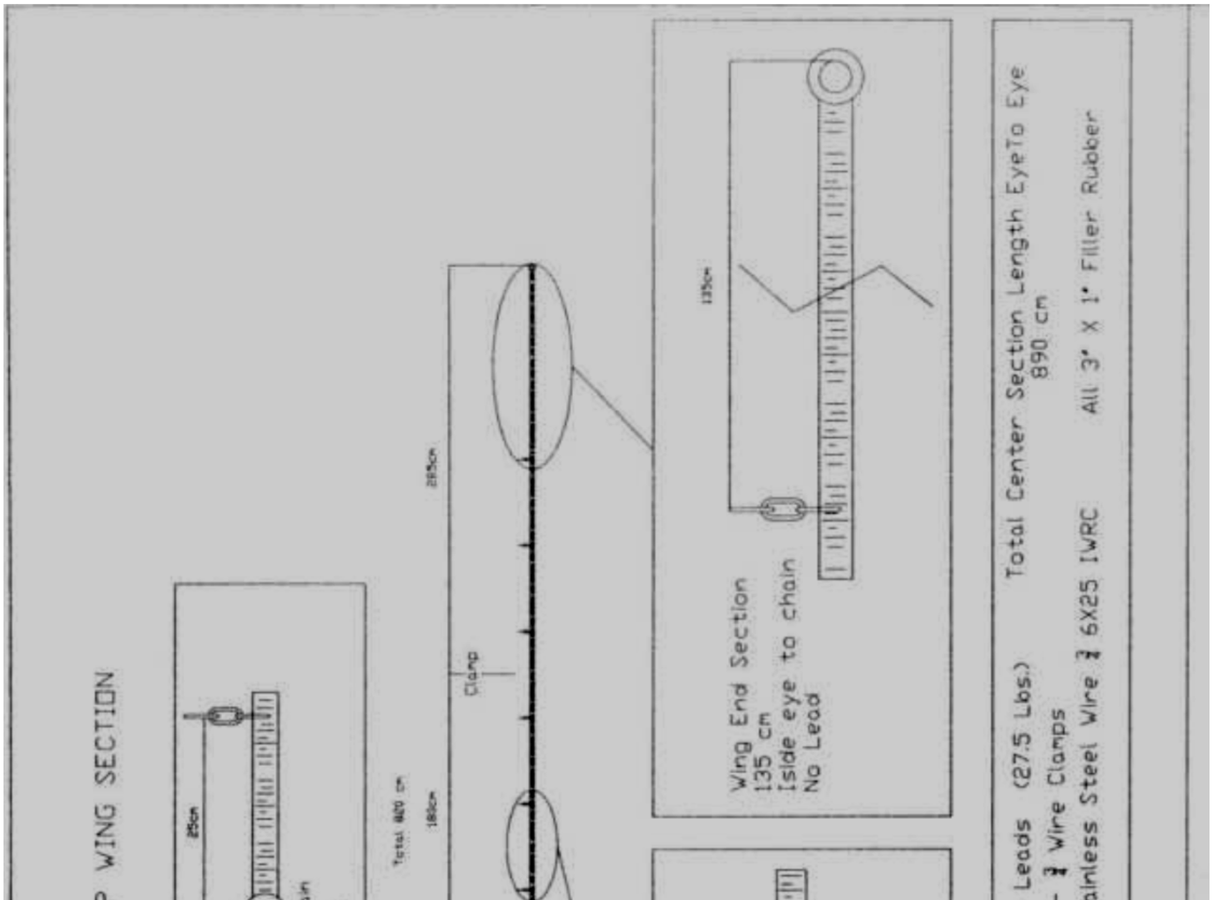


Figure 4: Sweep diagram for the survey trawl (Bonzek et al., 2008).

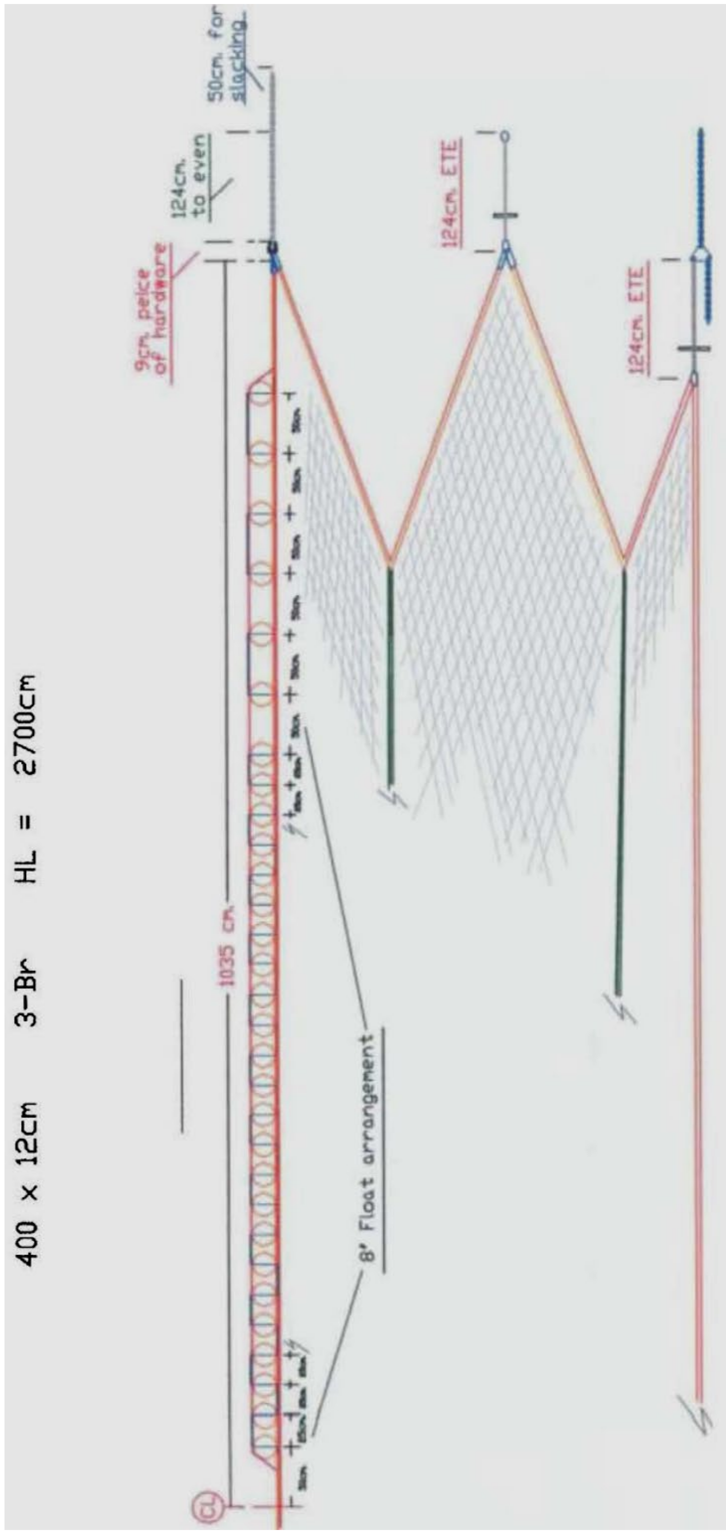


Figure 5: Headrope and rigging plan for the survey trawl (Bonzek et al., 2008).

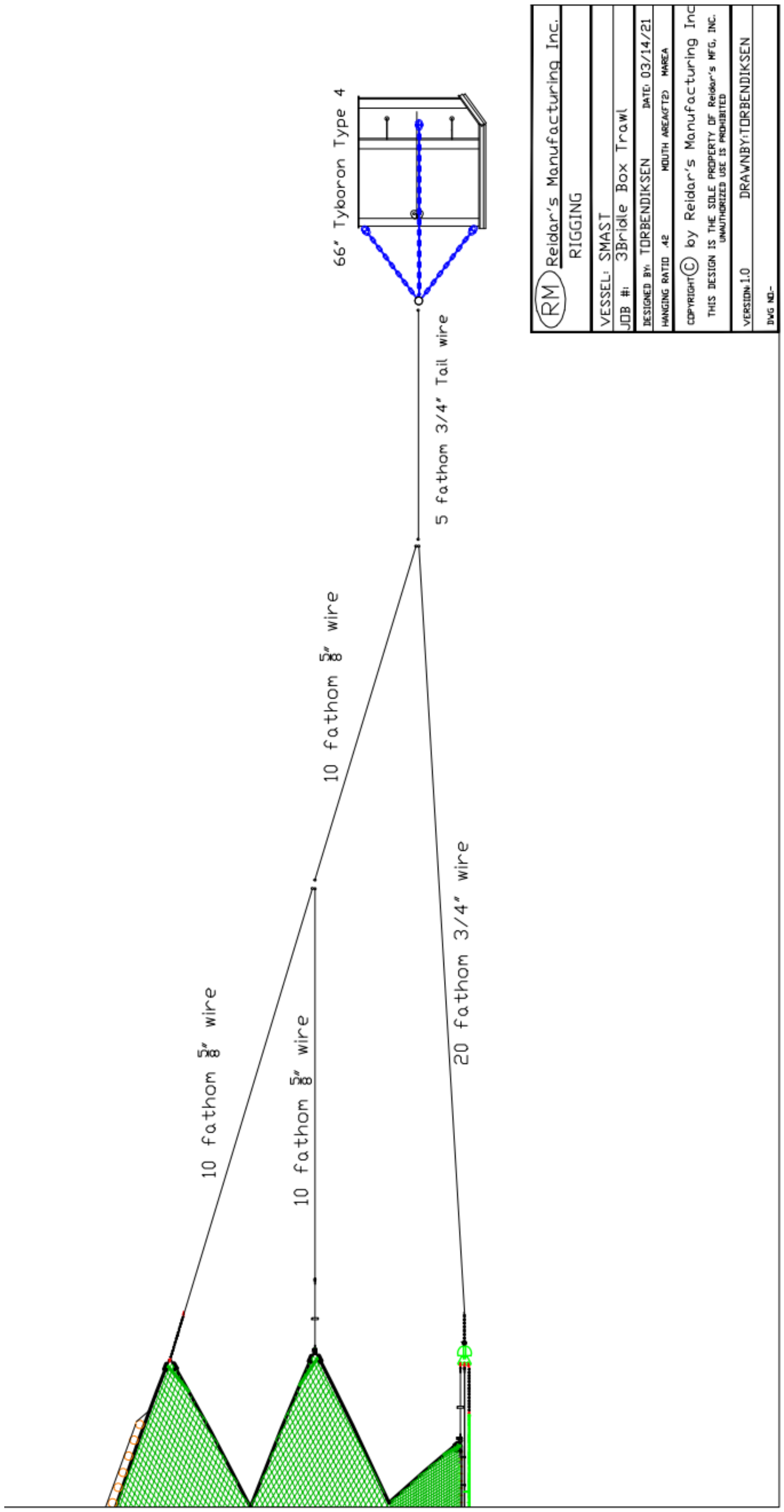


Figure 6: Bridle and door rigging schematic for the survey trawl (Courtesy of Reidar's Manufacturing Inc.).

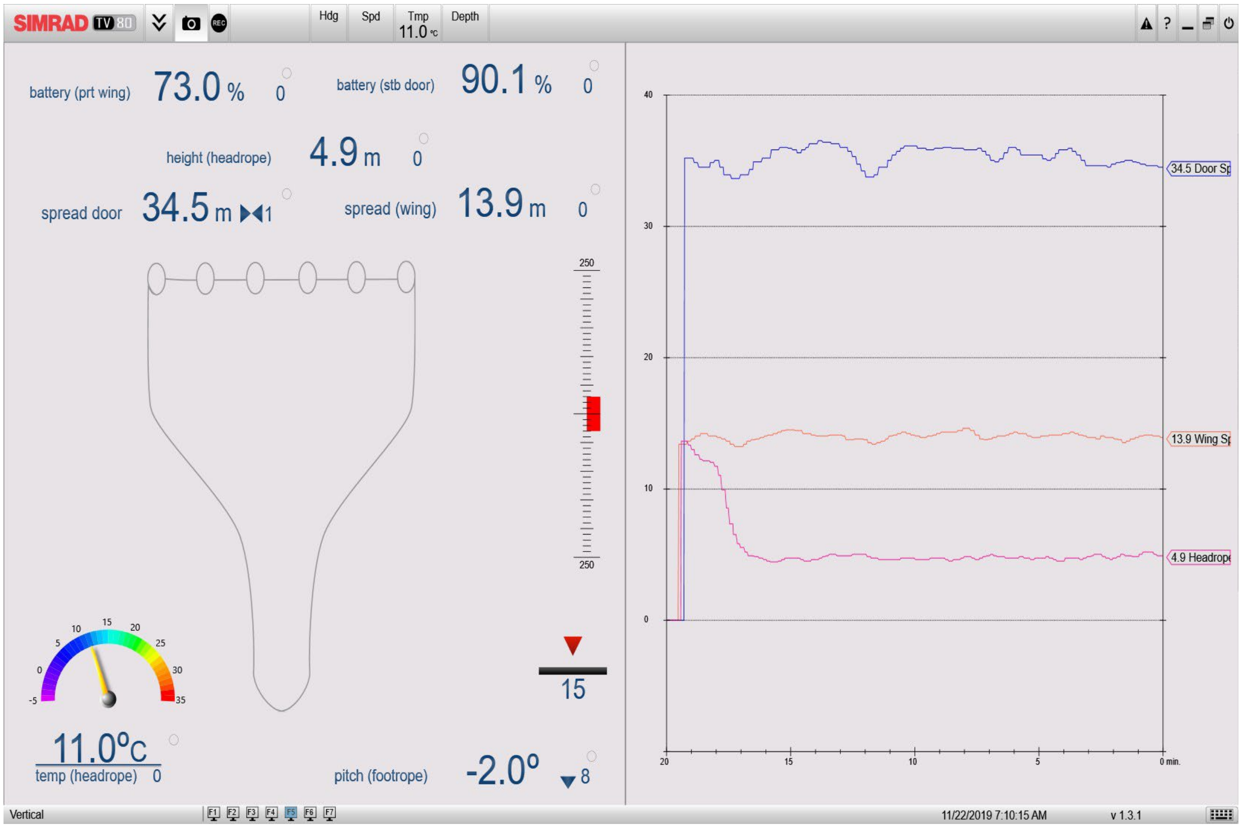


Figure 7: Screenshot of the SIMRAD TV80 software monitoring the trawl parameters.

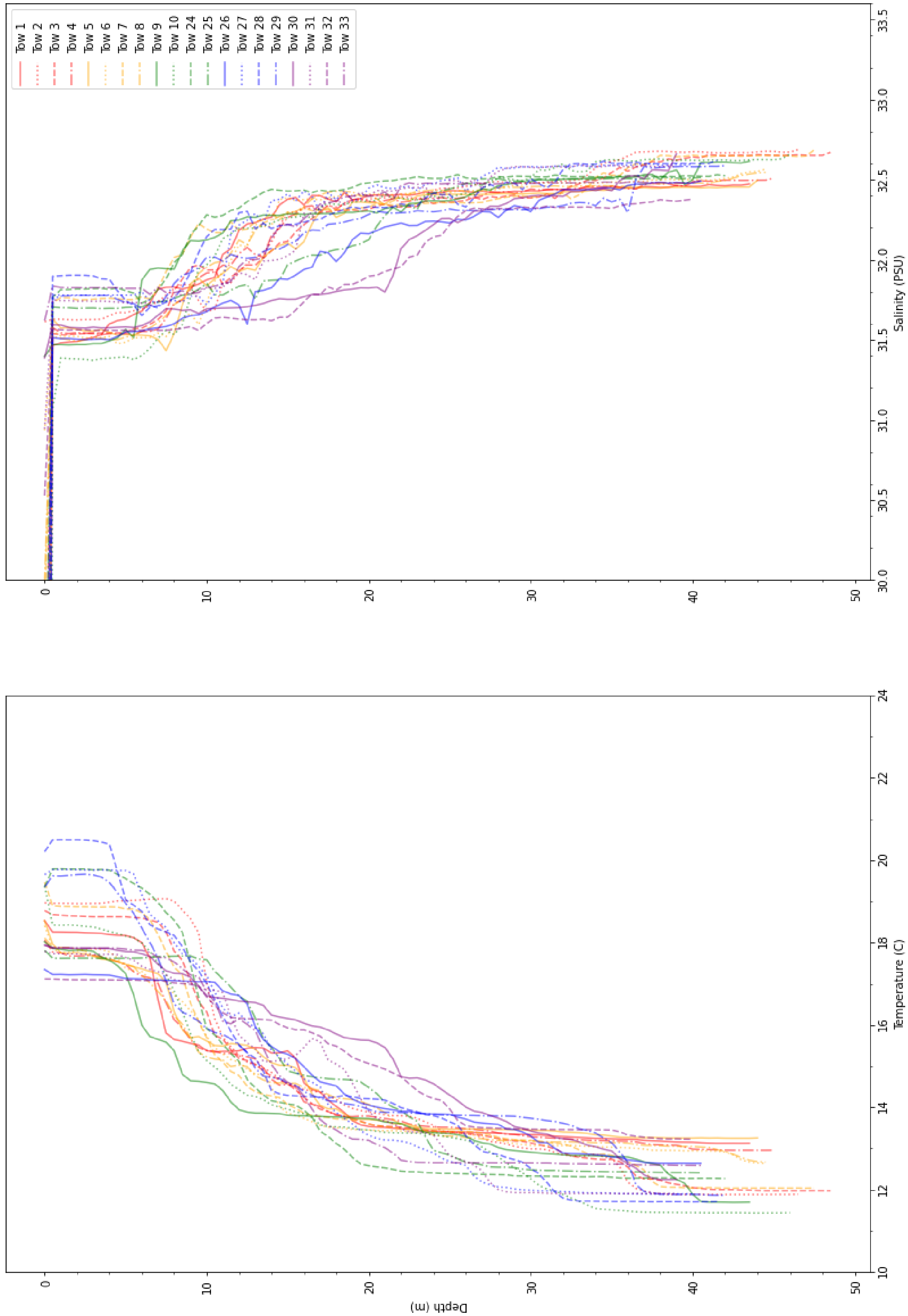


Figure 8: CTD sonde downcast profiles from the VW1 Study Area.

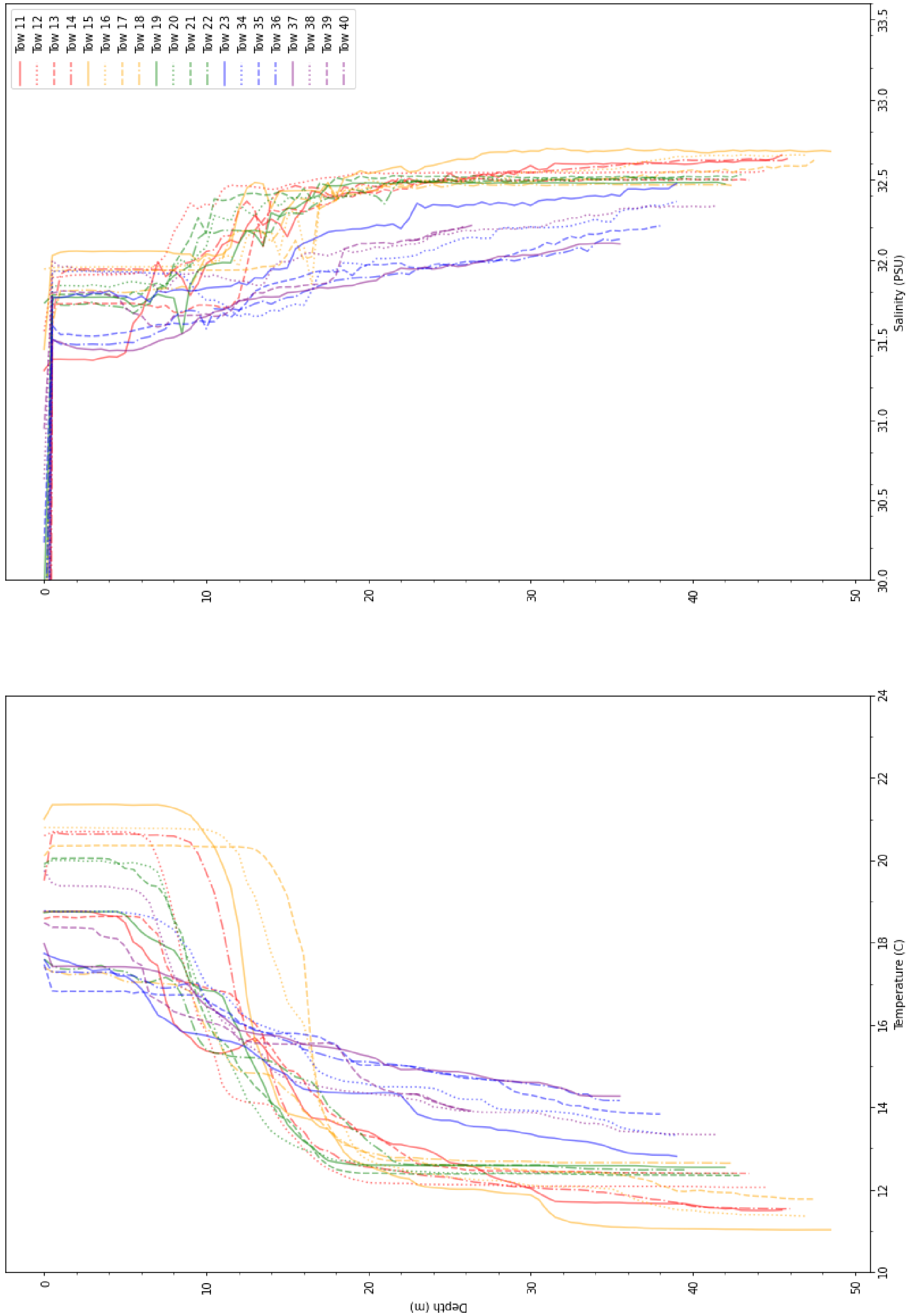
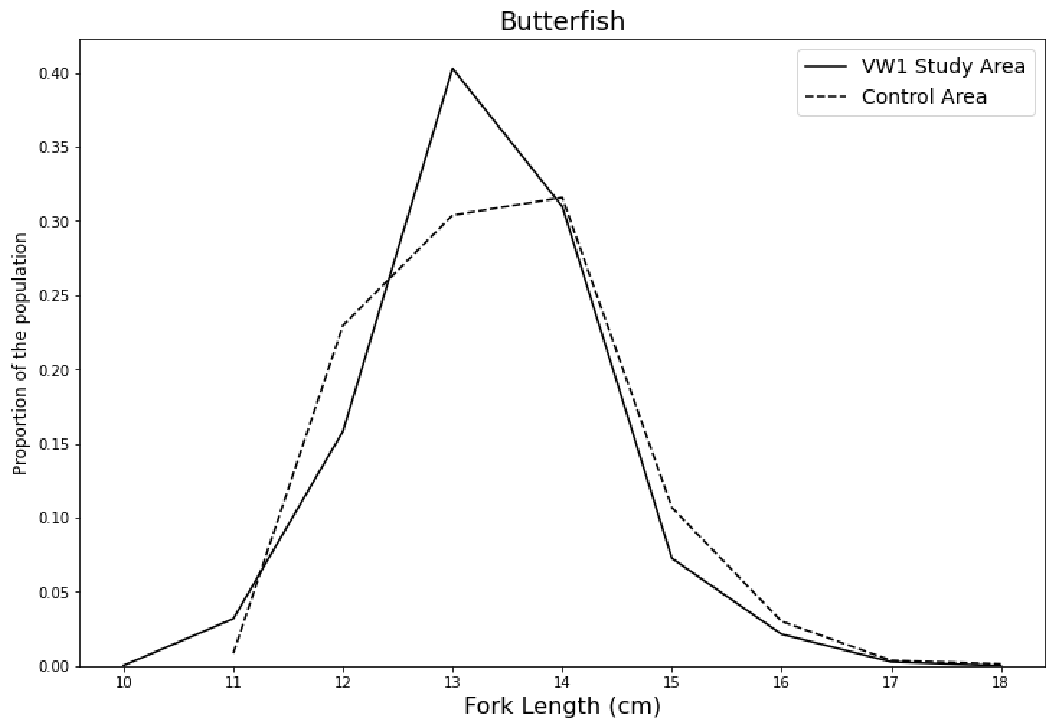


Figure 9: CTD sonde downcast profiles from the Control Area.



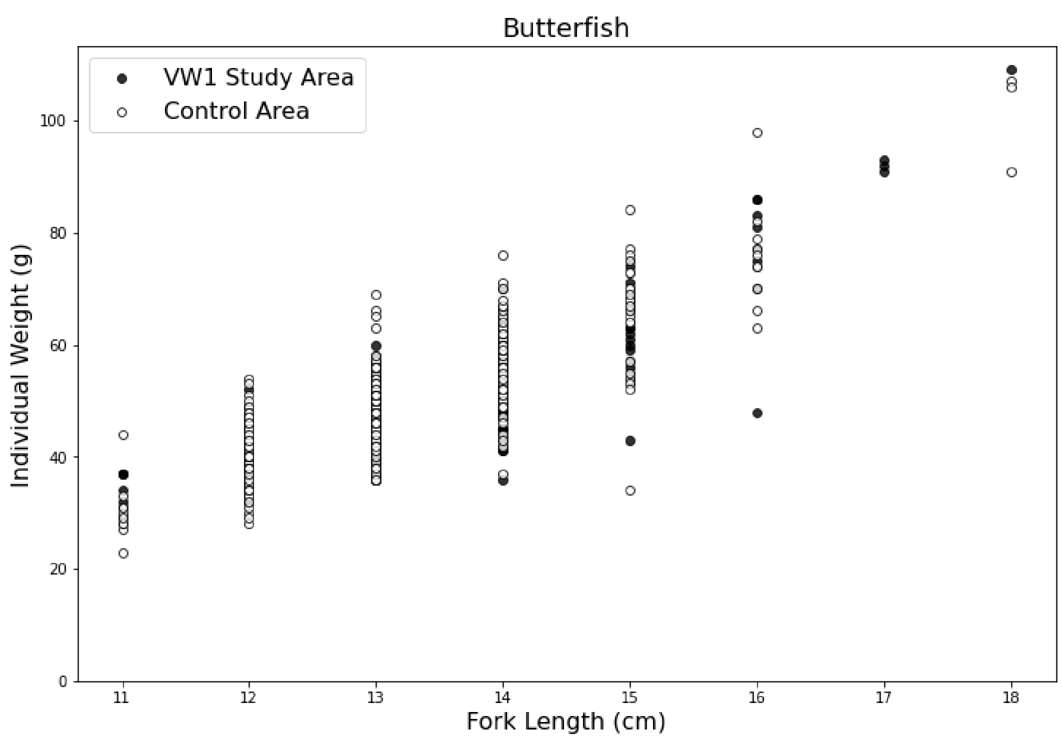


Figure 10: Population structure of butterfish in the VW1 Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

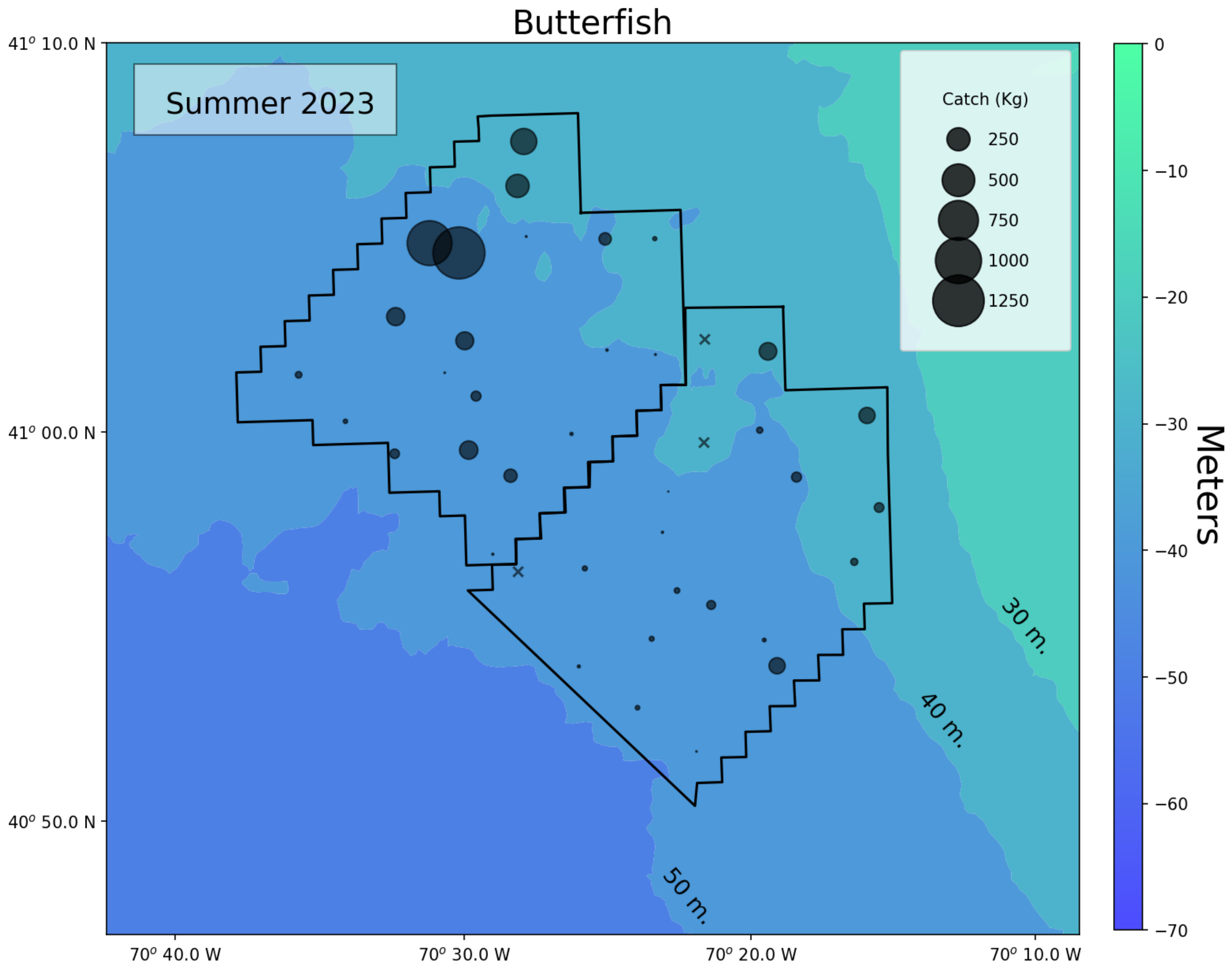


Figure 11: Distribution of the catch of butterfish in the VW1 Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.

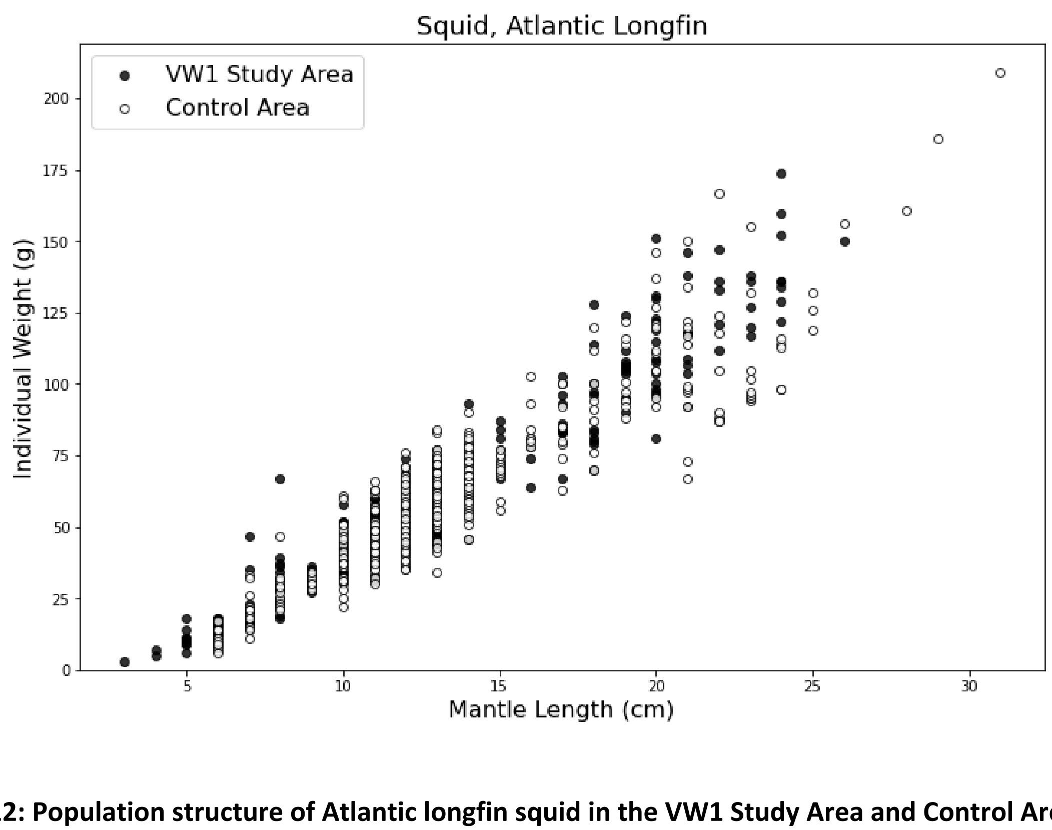


Figure 12: Population structure of Atlantic longfin squid in the VW1 Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

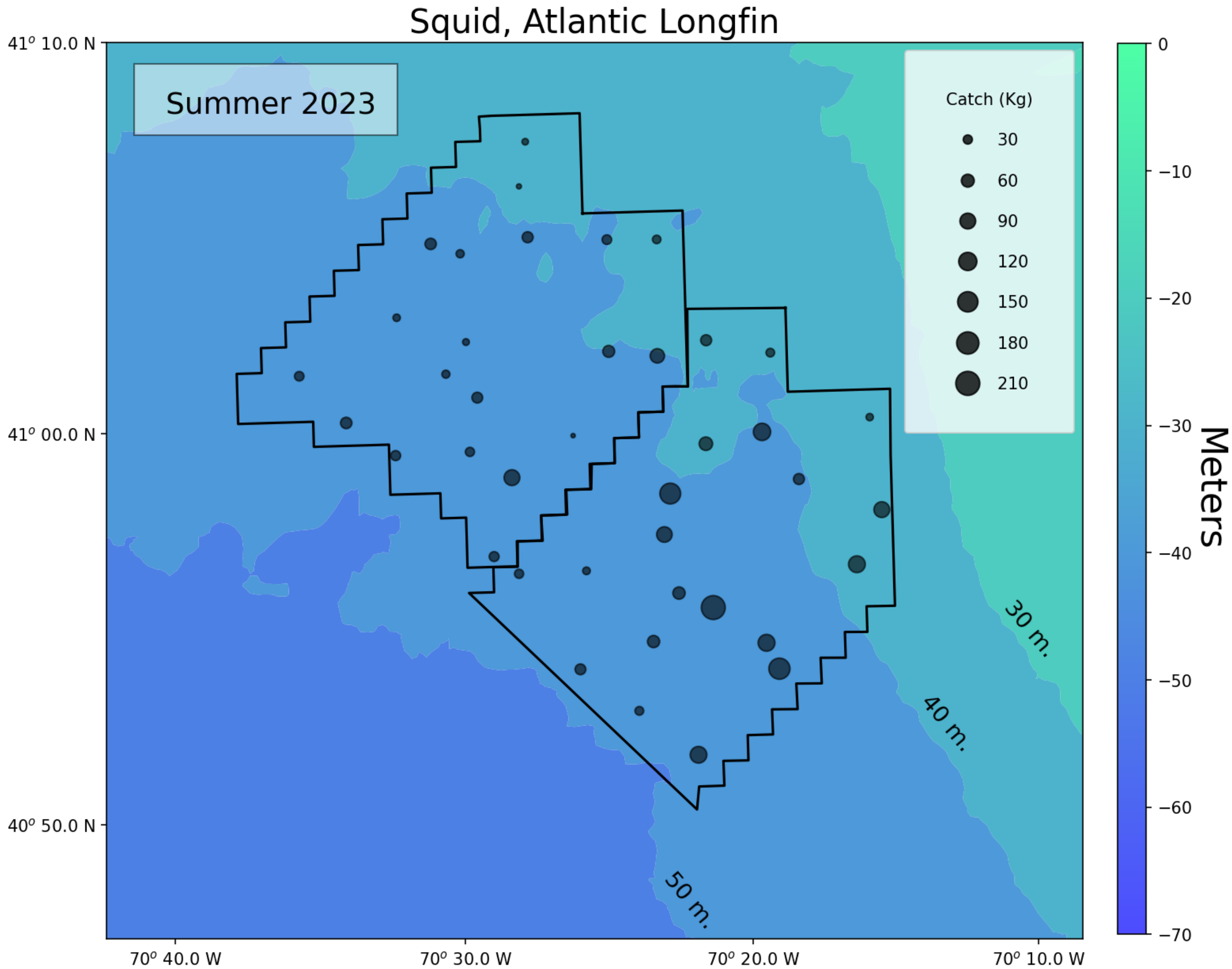
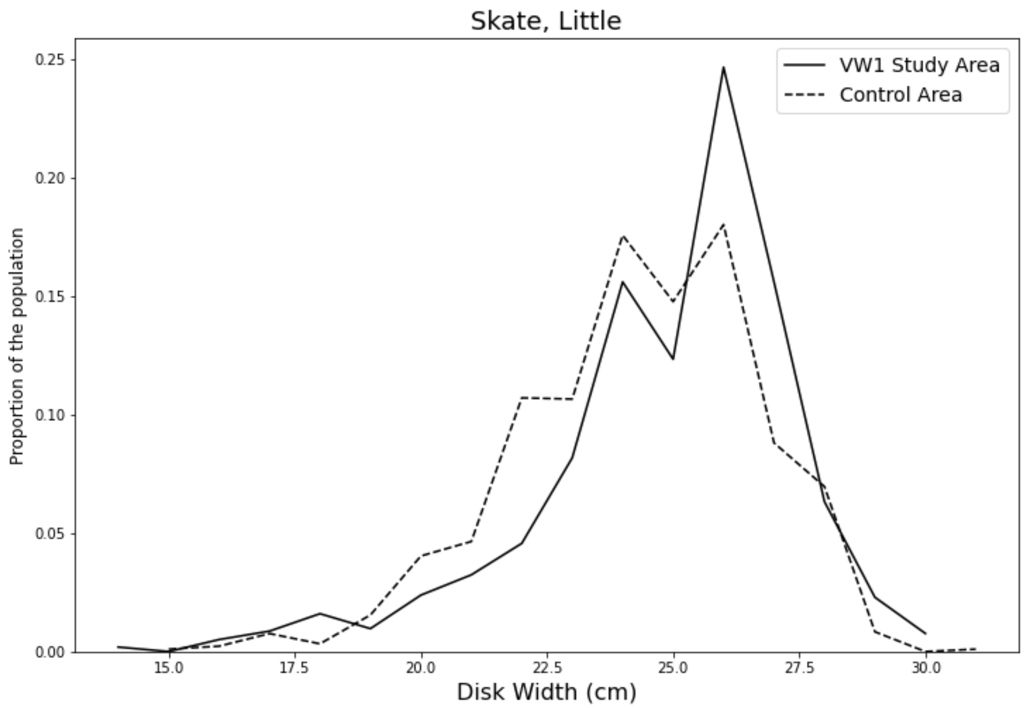


Figure 13: Distribution of the catch of Atlantic longfin squid in the VW1 Study Area (left) and Control Area (right).



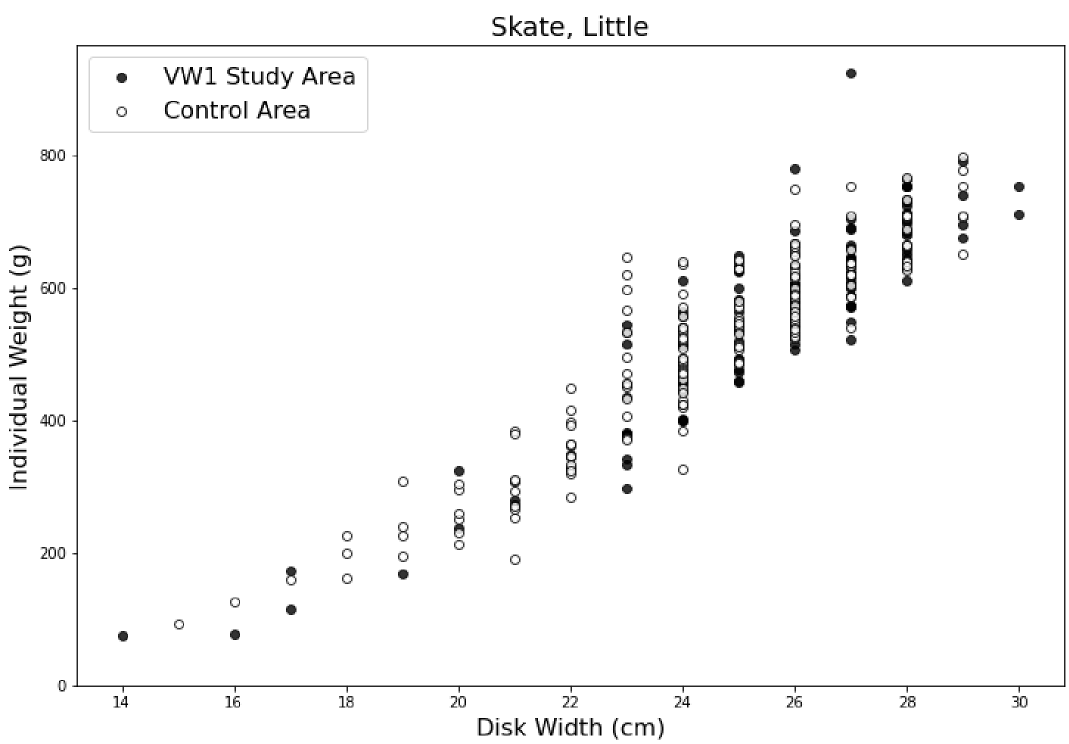


Figure 14: Population structure of little skate in the VW1 Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

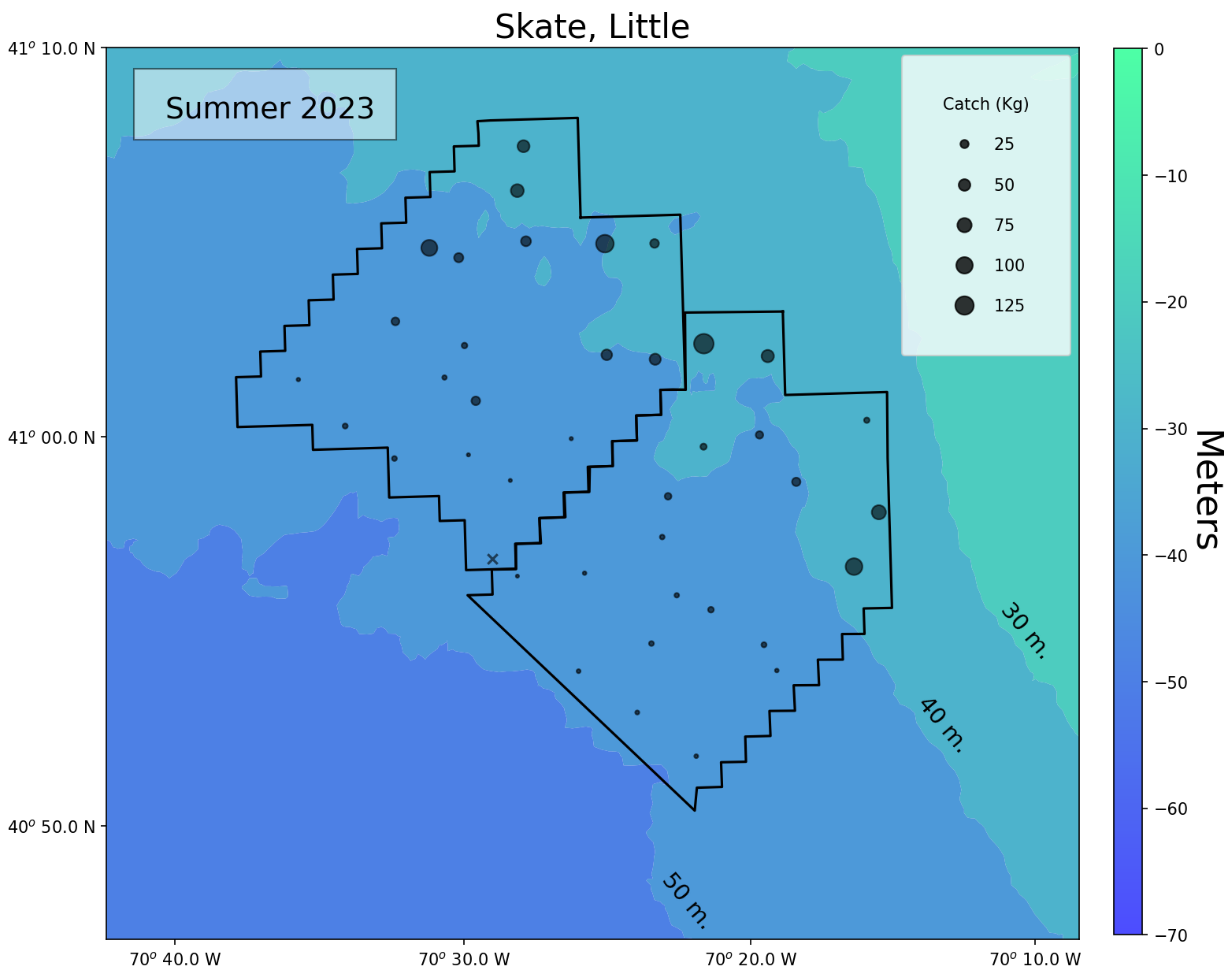


Figure 15: Distribution of the catch of little skate in the VW1 Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.

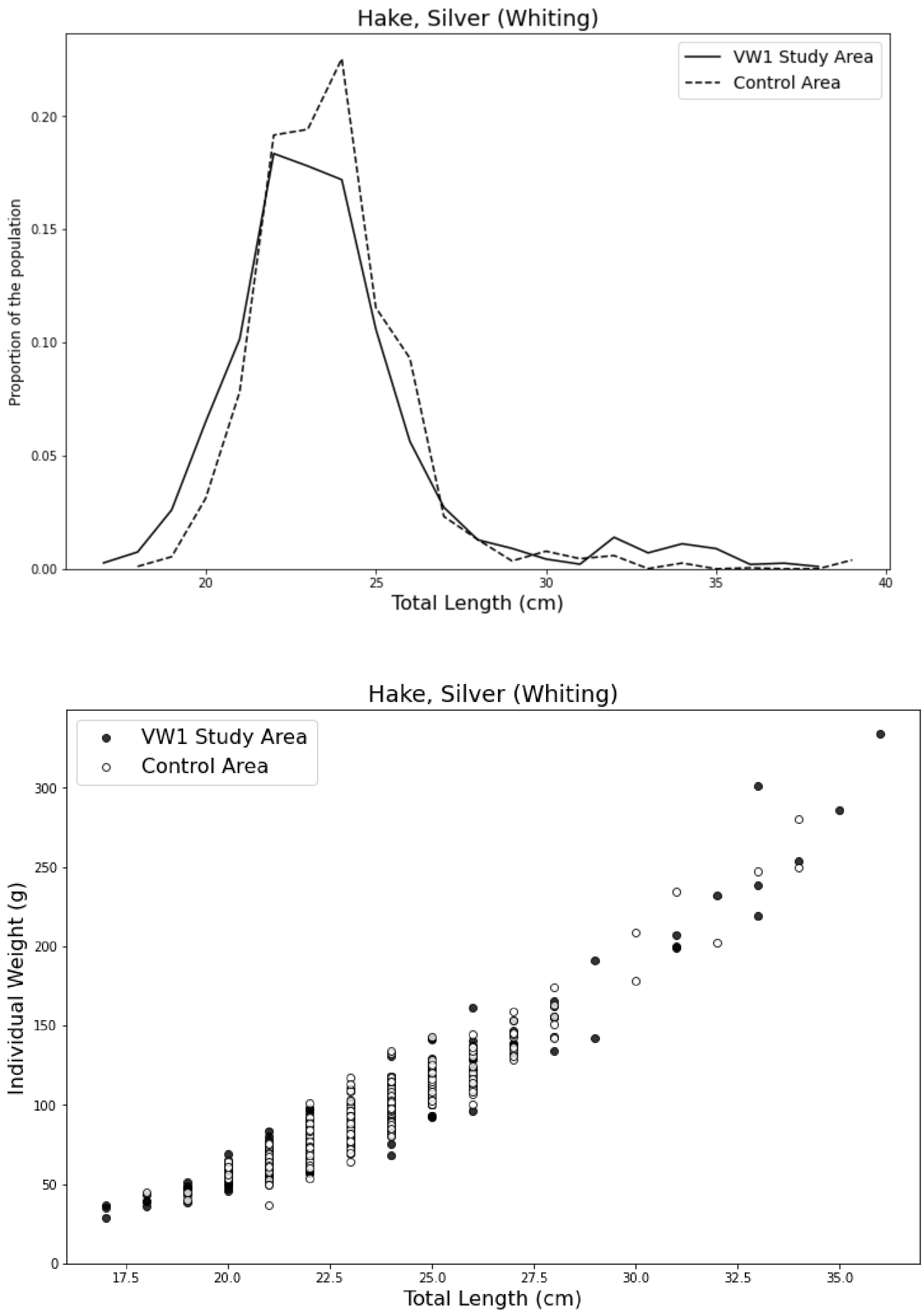


Figure 16: Population structure of silver hake in the VW1 Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

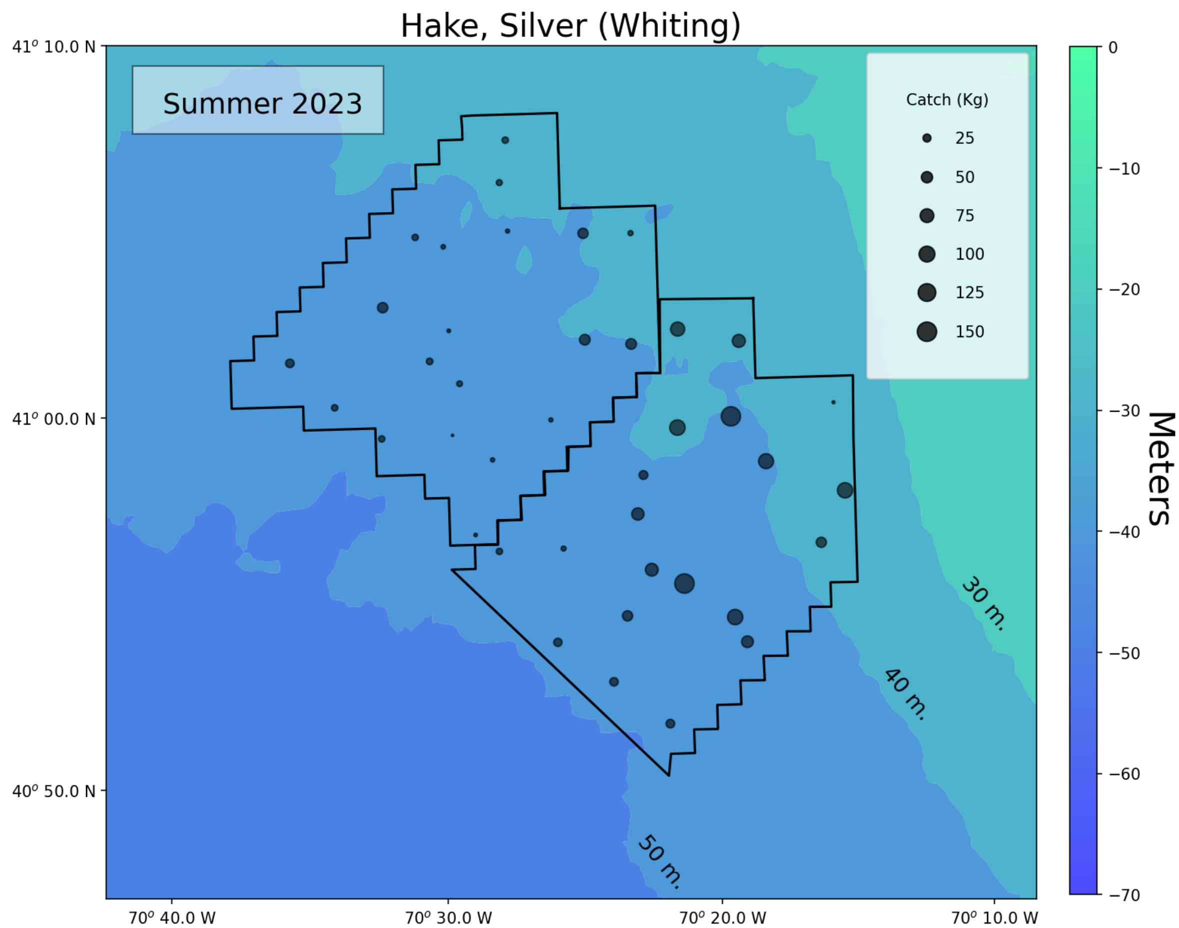


Figure 17: Distribution of the catch of silver hake in the VW1 Study Area (left) and Control Area (right).

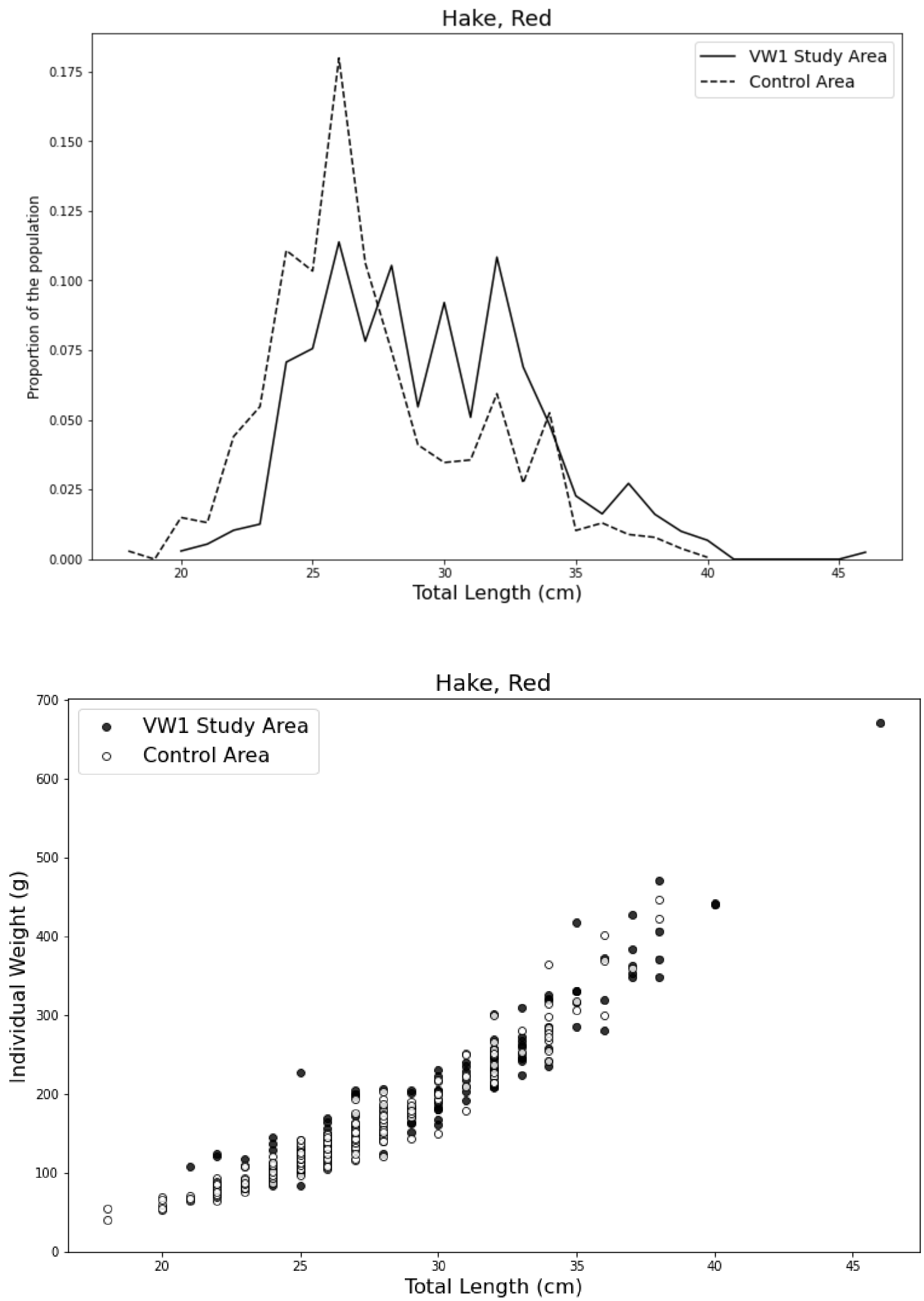


Figure 18: Population structure of red hake in the VW1 Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

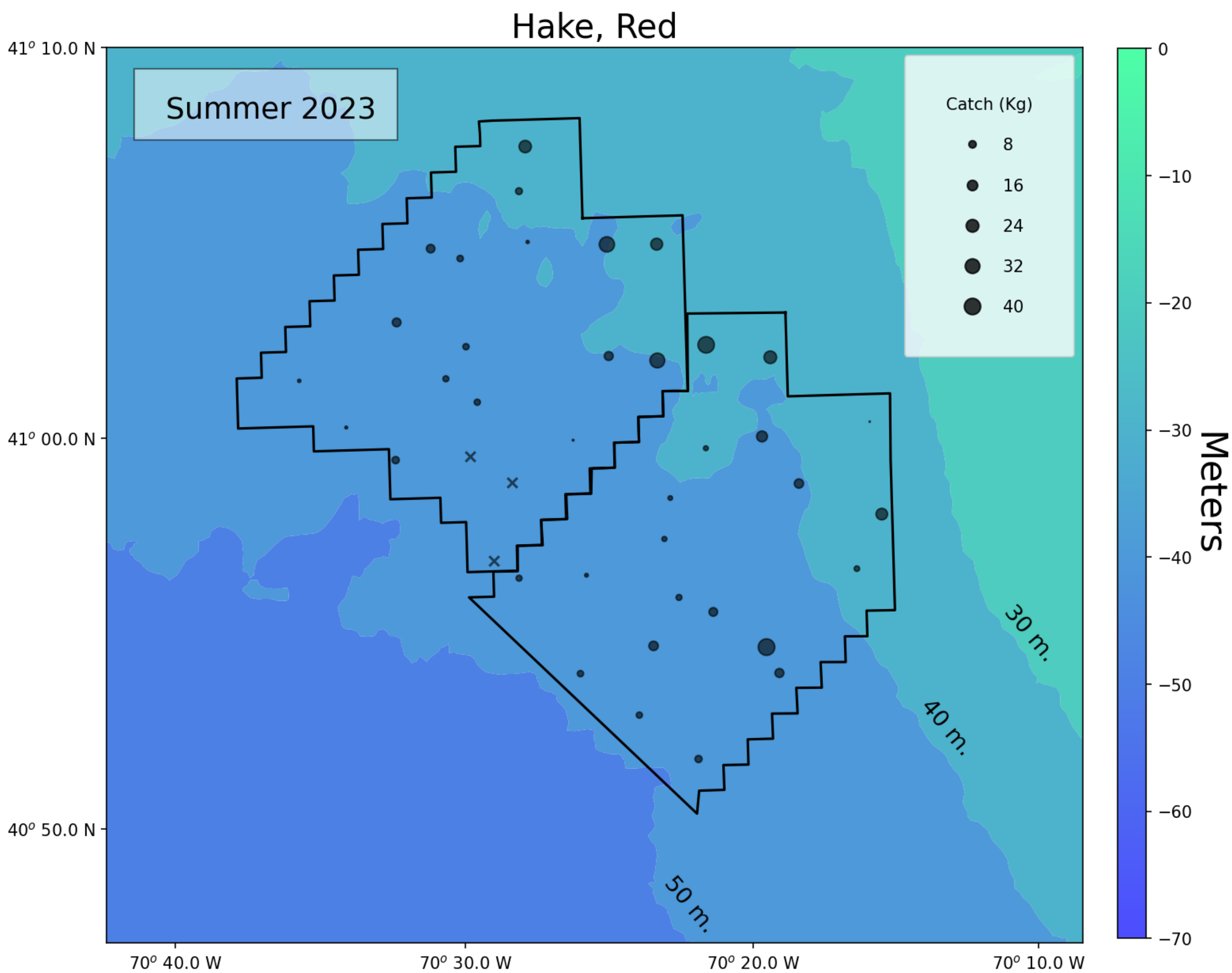


Figure 19: Distribution of the catch of red hake in the VW1 Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.

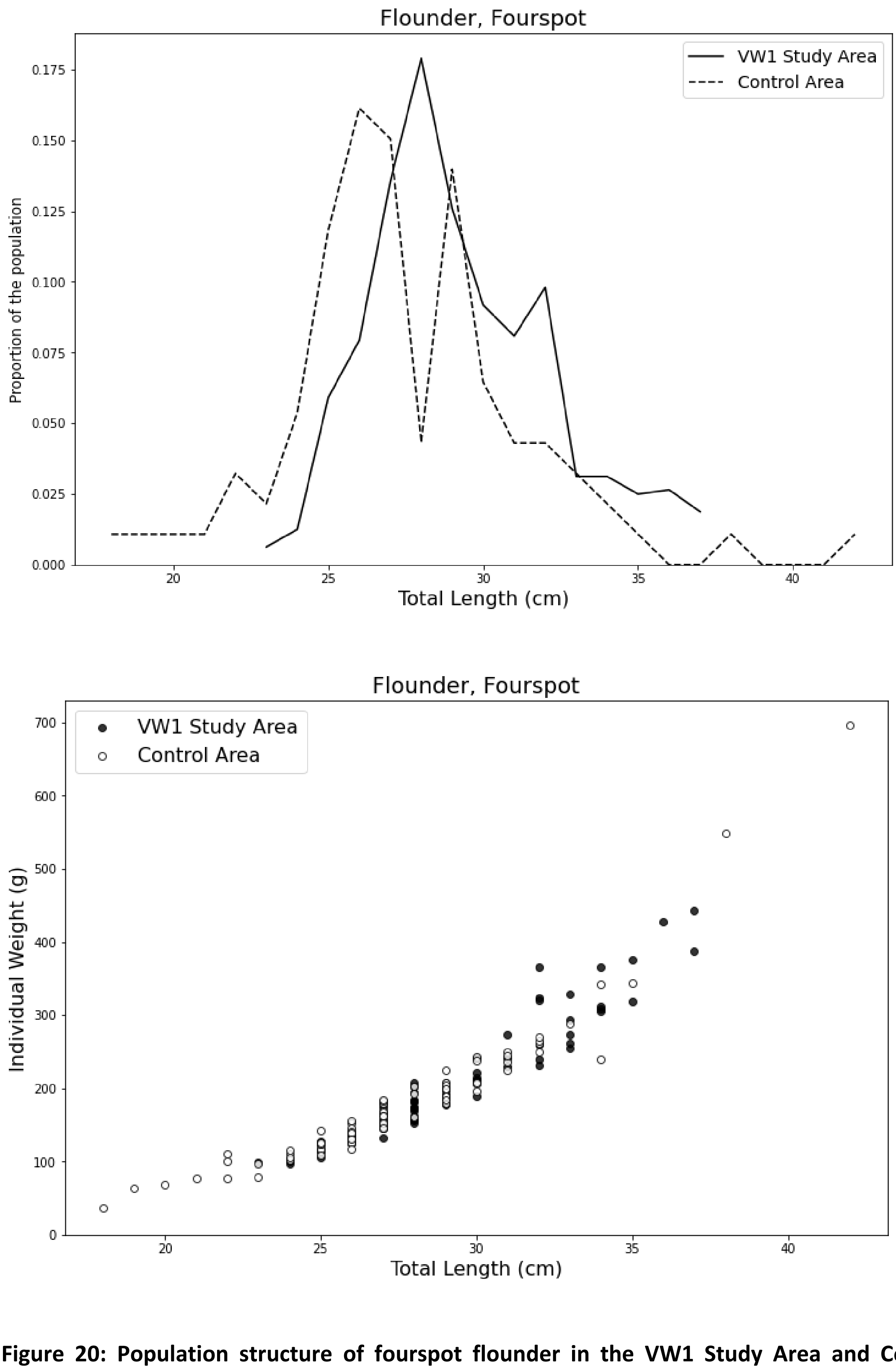


Figure 20: Population structure of fourspot flounder in the VW1 Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

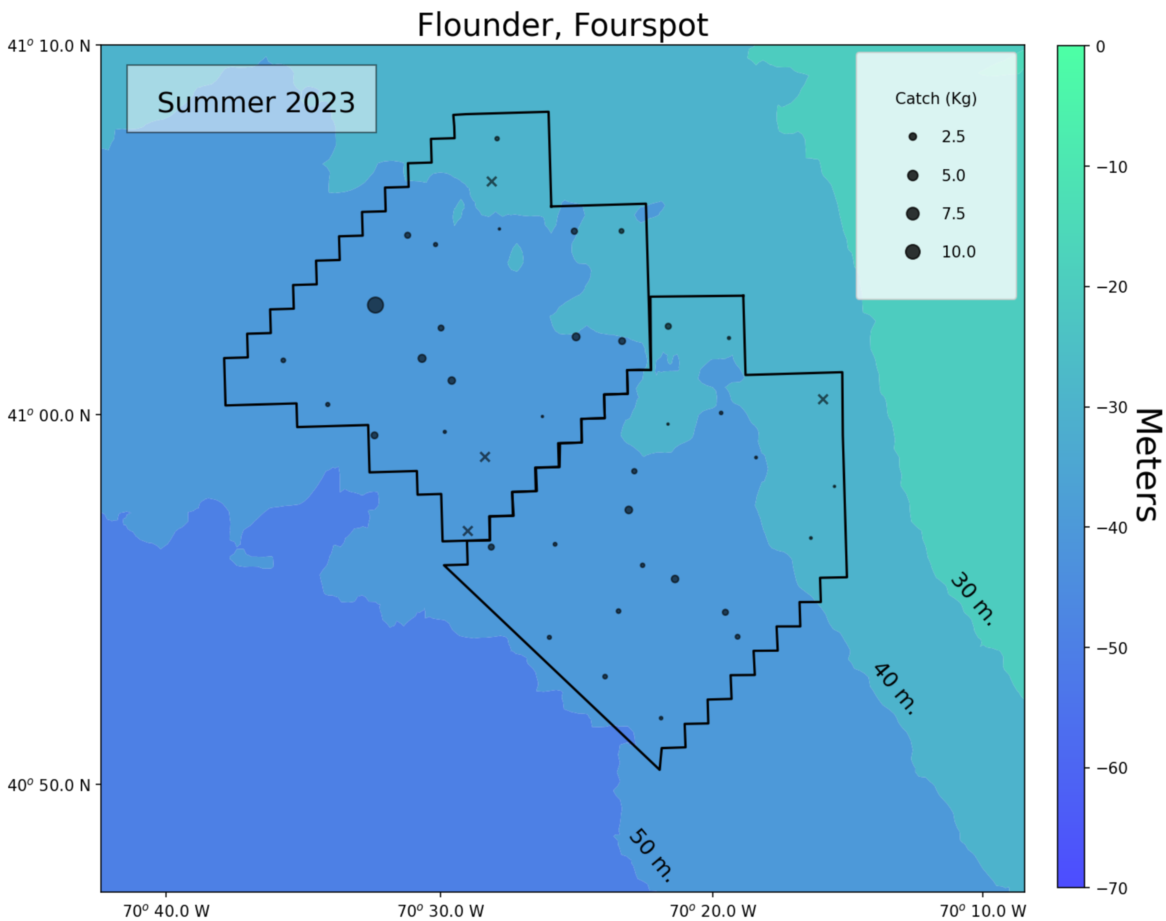
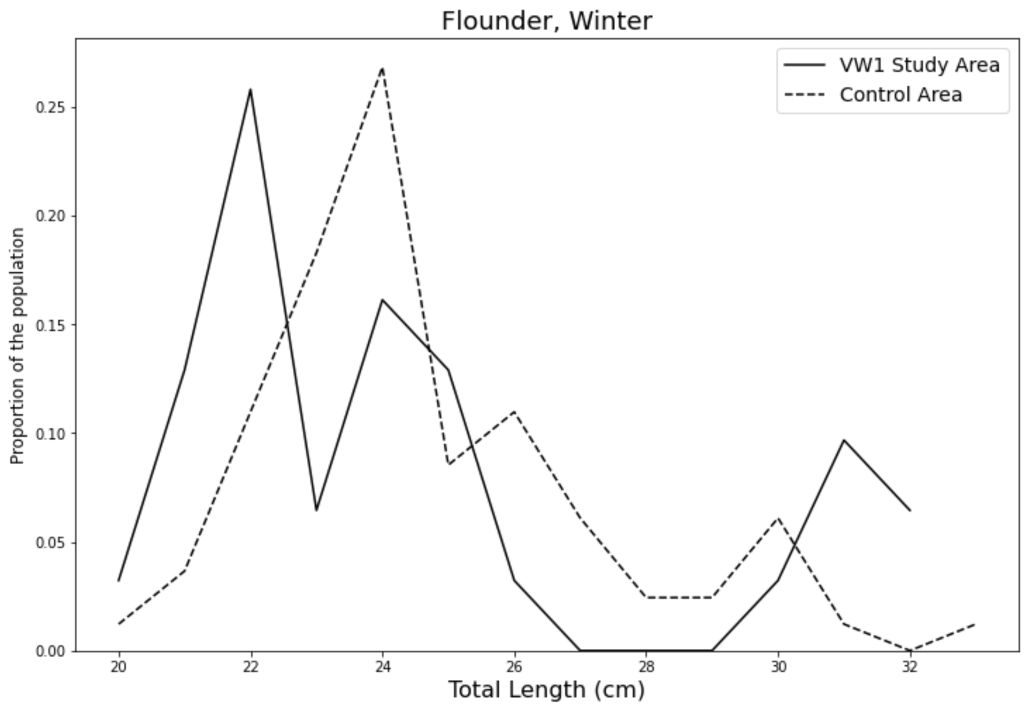


Figure 21: Distribution of the catch of fourspot flounder in the VW1 Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.



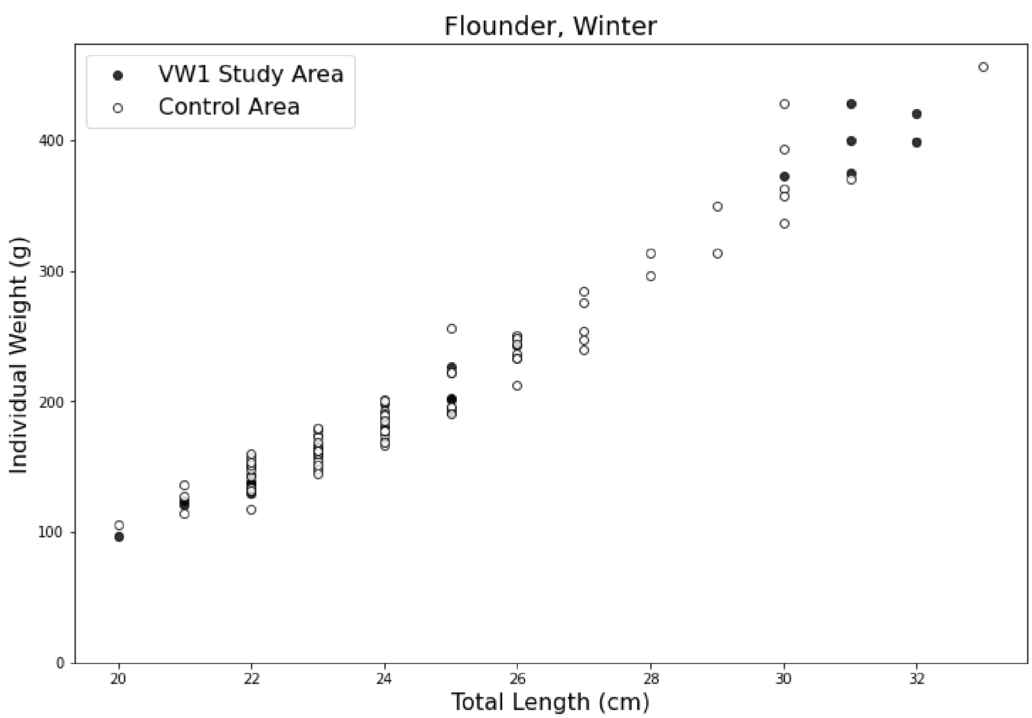


Figure 22: Population structure of winter flounder in the VW1 Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

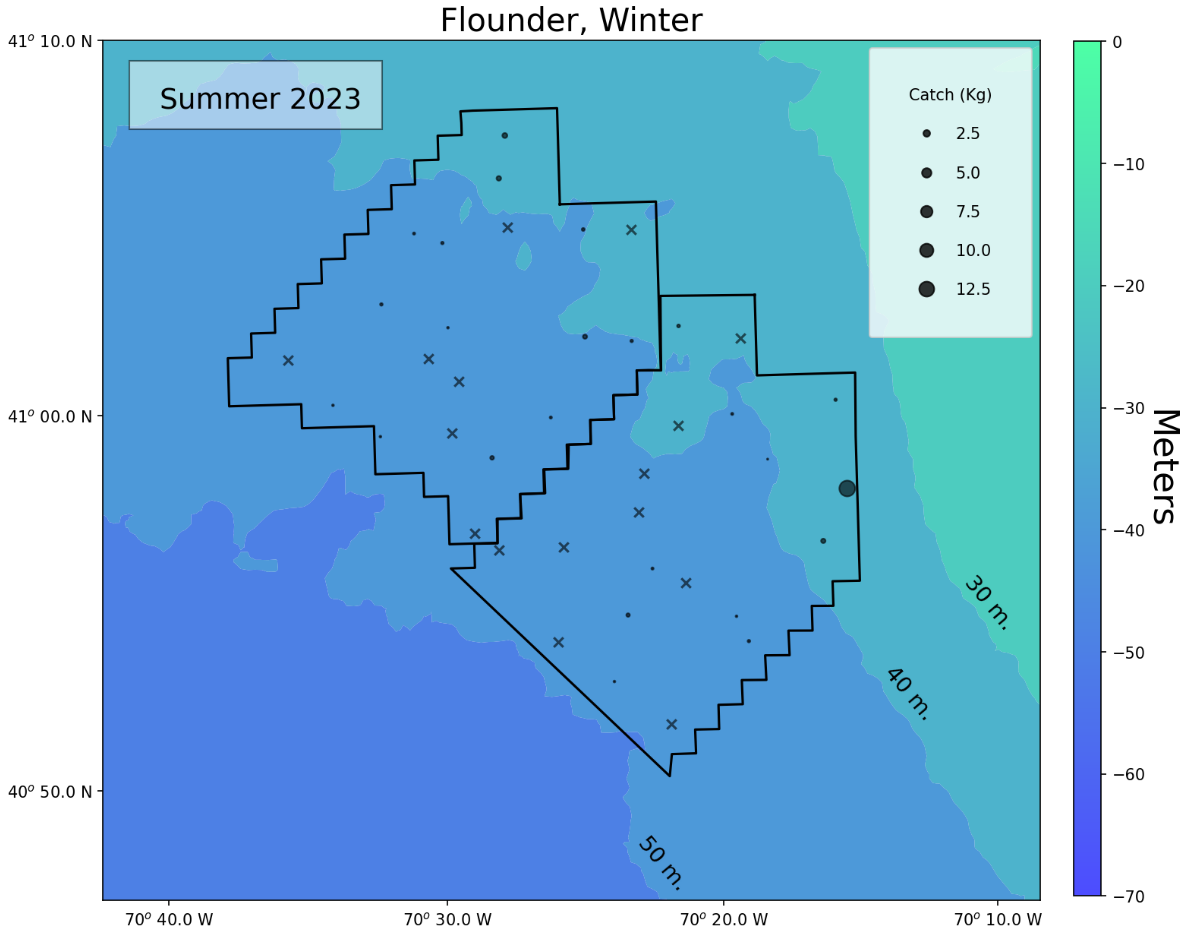
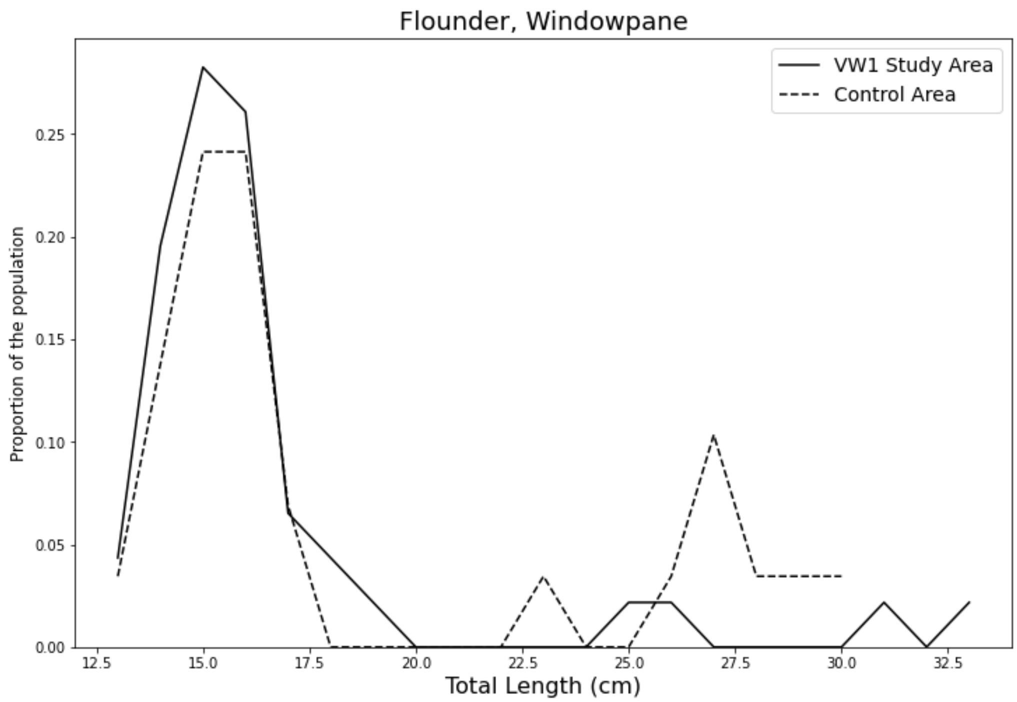


Figure 23: Distribution of the catch of winter flounder in the VW1 Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.



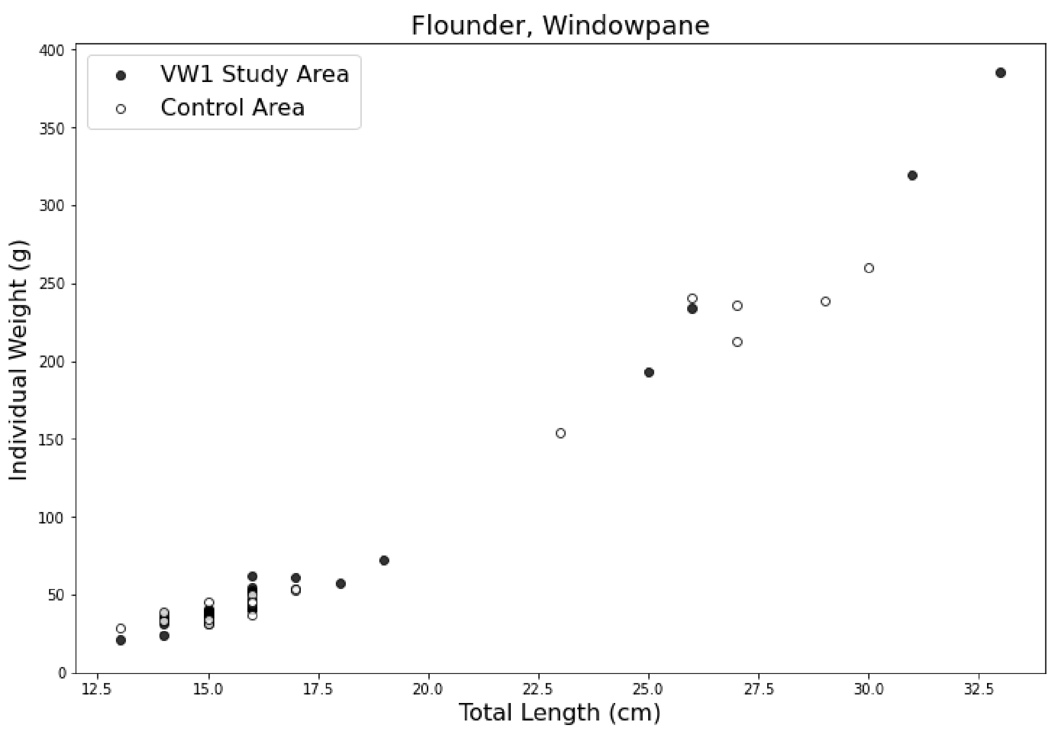


Figure 24: Population structure of windowpane flounder in the VW1 Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

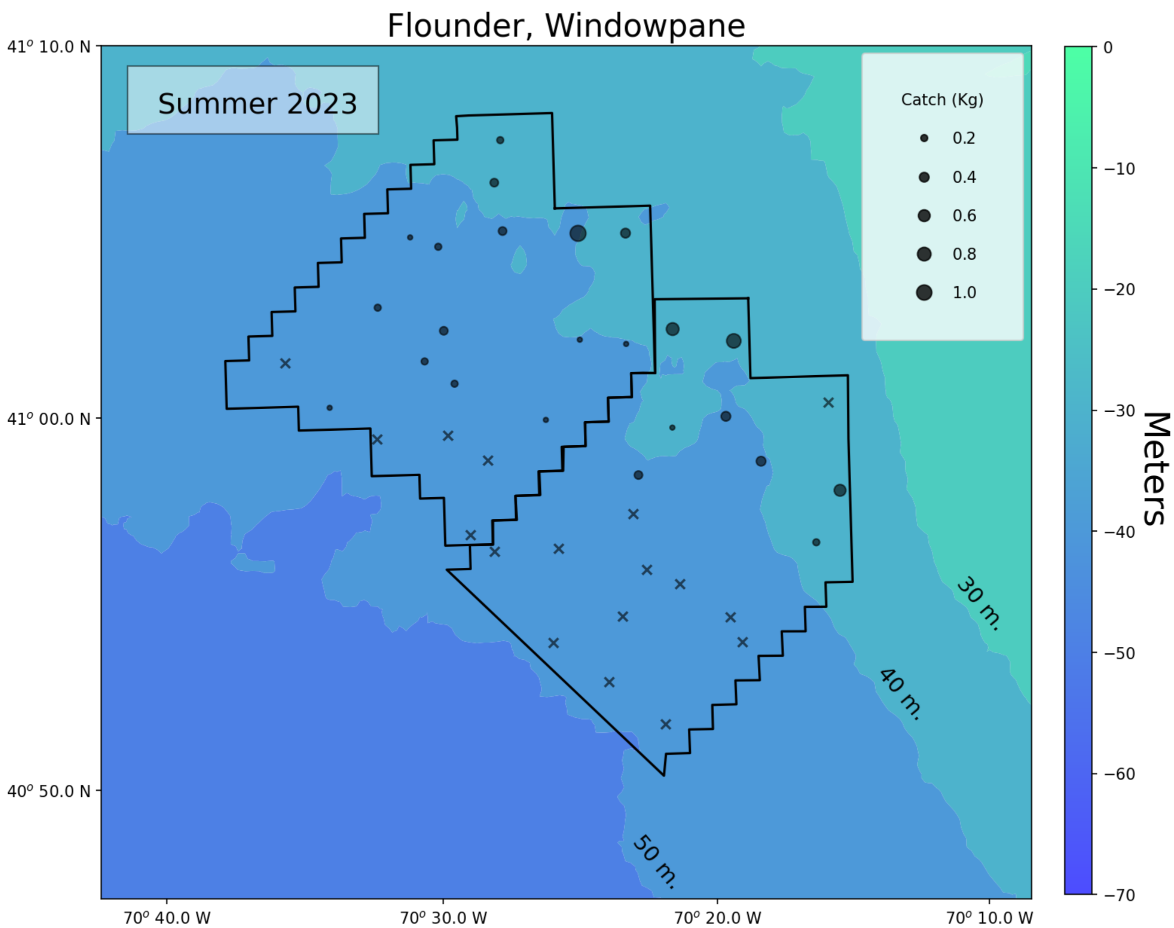
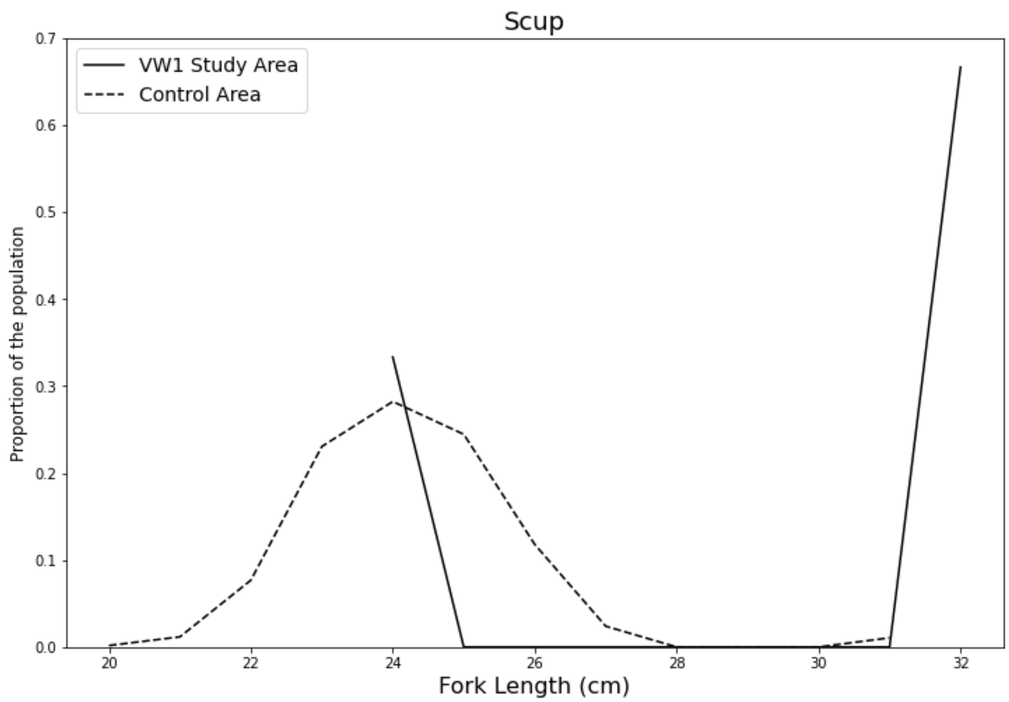


Figure 25: Distribution of the catch of windowpane flounder in the VW1 Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.



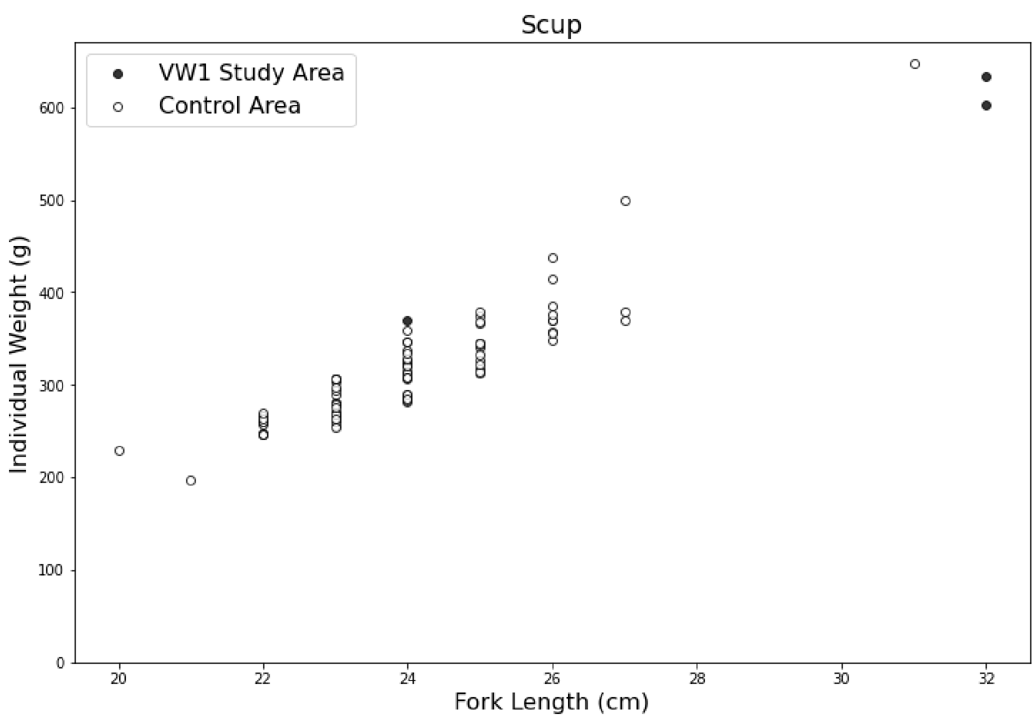


Figure 26: Population structure of scup in the VW1 Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

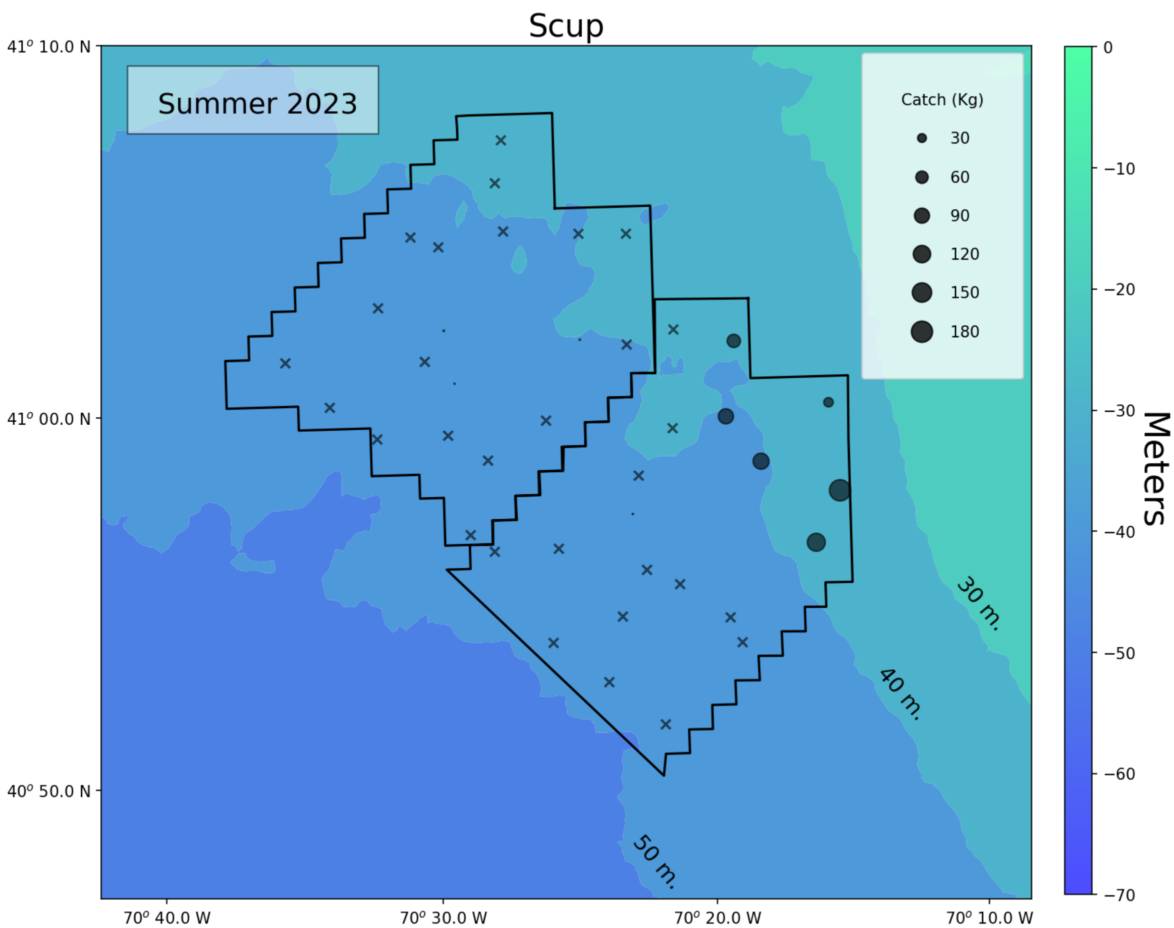
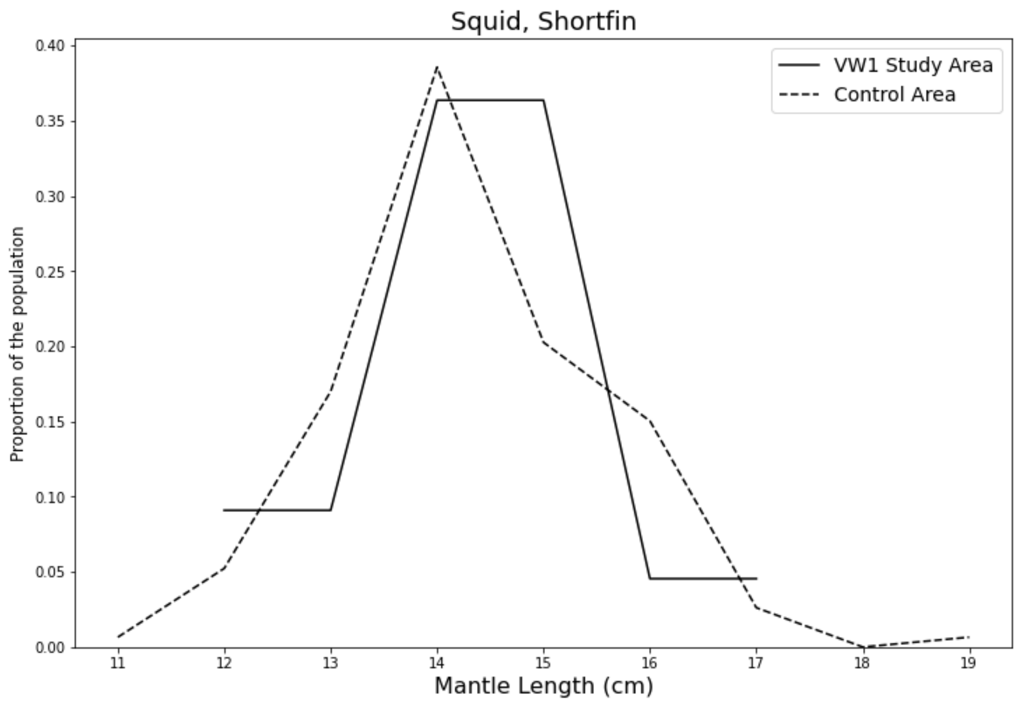


Figure 27: Distribution of the catch of scup in the VW1 Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.



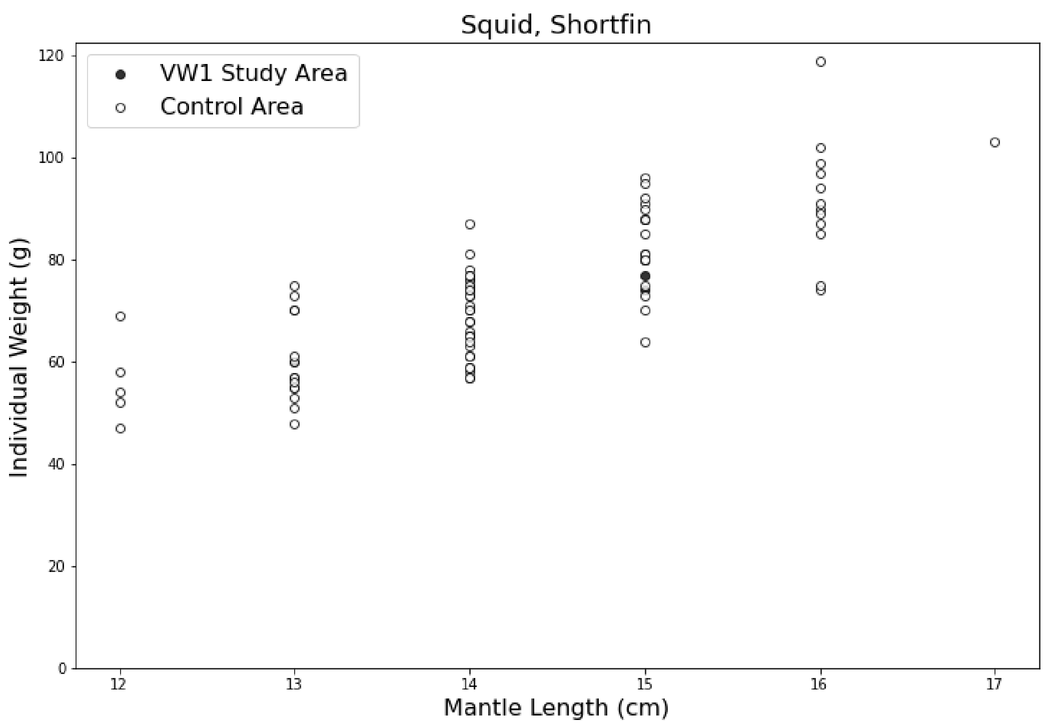


Figure 28: Population structure of shortfin squid in the VW1 Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

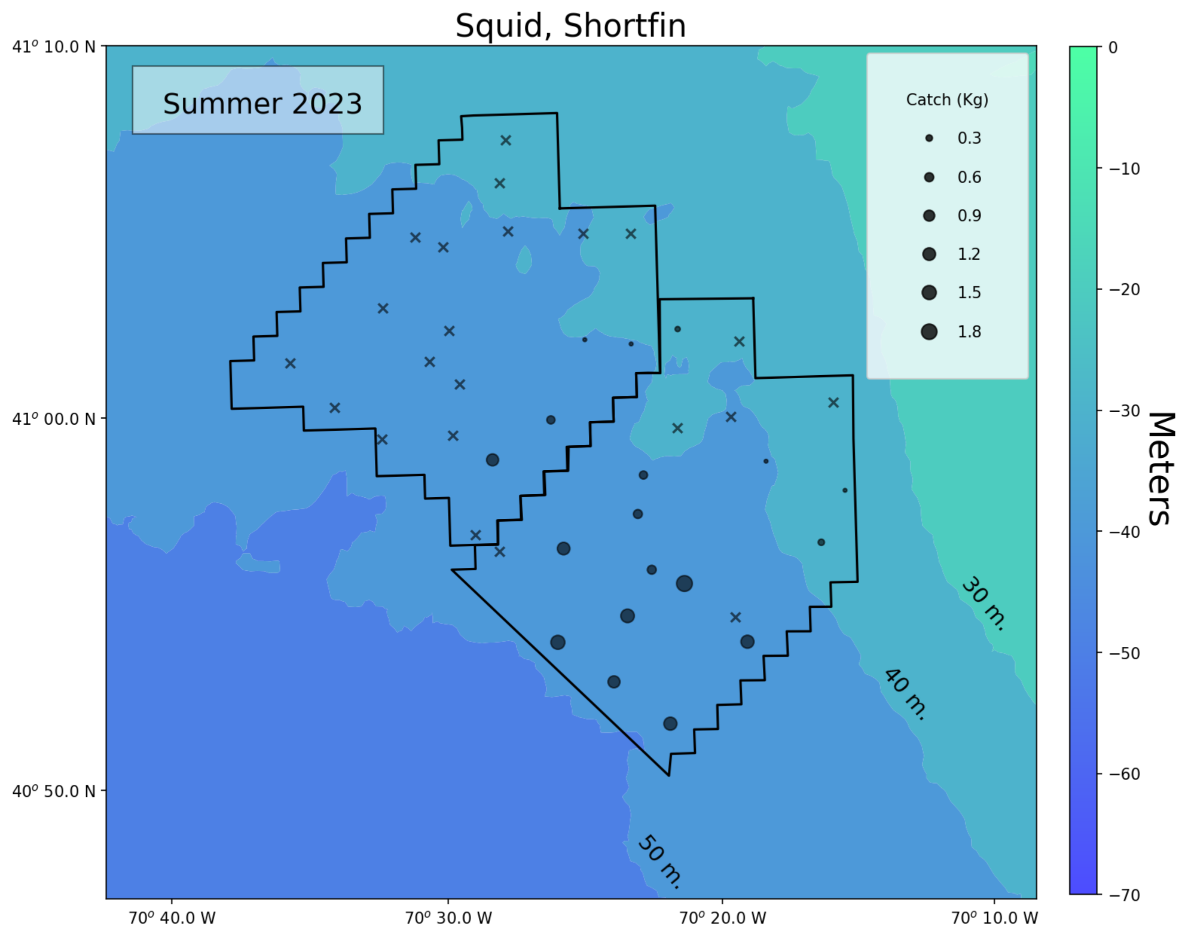


Figure 29: Distribution of the catch of shortfin squid in the VW1 Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.