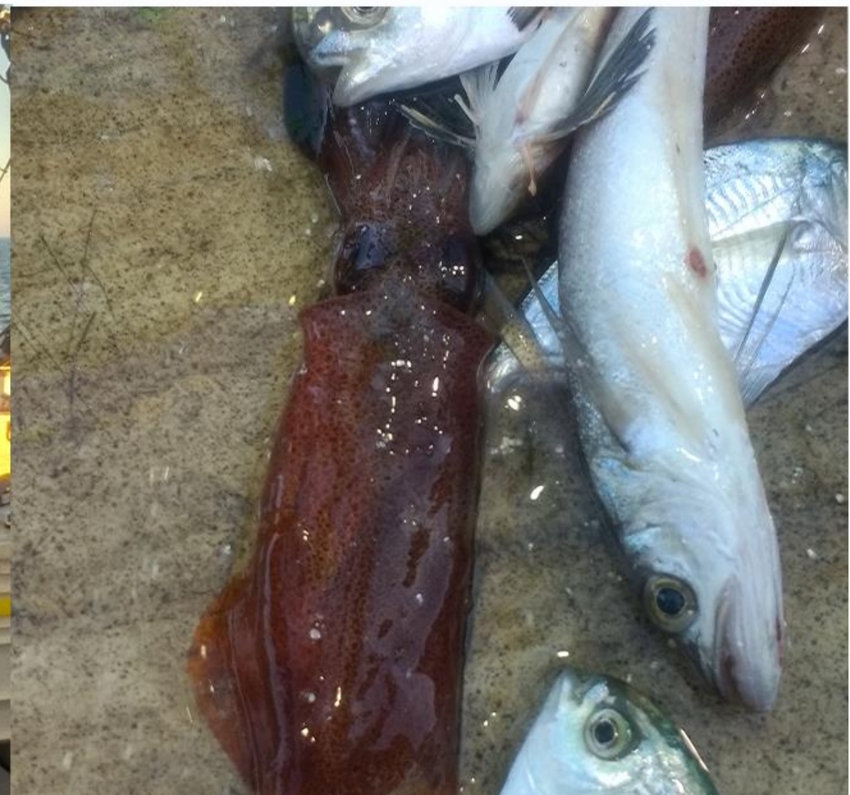
Vineyard Wind Demersal Trawl Survey



Quarterly Report

501 North Study Area

Fall 2020 (October - December)

VINEYARD WIND DEMERSAL TRAWL SURVEY

Fall 2020 Seasonal Report

501 North Study Area

December 2020

Prepared for Vineyard Wind, LLC

VINEYARD WIND

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Vineyard Wind Demersal Trawl Survey Fall 2020 Seasonal Report

501N Study Area

UMass Dartmouth

Progress Report #6

October 1 – December 31, 2020

Project title:	Vineyard Wind Demersal Trawl Survey Fall 2020 Seasonal Report – 501N Study Area

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SMAST-CE-REP-2020-094

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1. Introduction

In 2015, Vineyard Wind 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 developing the northern portion of Lease Area OCS-A 0501 and fisheries studies are being conducted in a 306 km^2 area referred to as the "501N Study Area," which is the focus of this report. Vineyard Wind is also conducting fisheries studies within the southern portion of Lease Area OCS-A 0501 (the "501S Study Area") and within Lease Area OCS-A 0522 (the "522 Study Area"); these studies are reported separately.[1]

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 will occur 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). The control site will be in the general vicinity with similar characteristics to the impact areas (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 have on the ecosystem within an ever-changing ocean.

The current monitoring plan incorporates multiple surveys utilizing a range of survey methods to assess different facets of the regional ecology. The trawl survey is one component of the overall

[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 501S Study Area is now located in the area designated as Lease Area OCS-A 0534 and referred to as the 501S Study Area in SMAST fisheries survey reports published prior to 2022.

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 bottom trawl survey is complemented by the drop camera survey and lobster trap survey, both are also carried out by SMAST.

The primary goal of this survey was to provide data related to fish abundance, distribution, and population structure in and around the 501N Study Area. The data will serve as a baseline to be used in a future analysis under the BACI framework. The reports for the previous five seasons of surveys – conducted from spring 2019 to summer 2020 – have been submitted to the sponsoring organization. This progress report documents survey methodology, survey effort, and data collected during the fall of 2020.

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 501S Study Area and the 522 Study Area).

2.1 Survey Design

The current survey is designed to provide baseline data on catch rates, population structure, and community structure for a future environmental assessment using the BACI framework as recommended by BOEM (BOEM, 2013). Tow locations within the 501N Study Area were selected using a systematic random sampling design. The 501N Study Area was modified from the 2019/2020 survey year due to boundary refinements of projects with Lease Area OCS-A 0501. The current 501N Study Area was increased from 249.3 km^2 to 306 km^2 by adding additional area to the southeastern corner. The current 501N Study Area was sub-divided into 20 sub-areas (each ~15.3 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 501N Study Area. The starting location within each sub-area was then randomly selected (Figure 2).

An area located to the east of the 501N 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 501N Study Area. The Control Area was modified from the 2019/2020 survey year. The Control Area was shifted north with an additional area added to the north of the 501N Study Area. The change was due to differences in depths and catch rates observed in the 2019/2020 survey data. The goal was to increase the similarity between the 501N Study Area and Control Area. Additionally, shifting effort to the north reduces the area located in the easterly adjacent Lease Area OCS-A 0520 as well as increases the overlap with the lobster and drop camera surveys. These changes increase the Control Area from 306 km^2 to 324 km^2. An additional 20 tows were completed in the Control Area (each ~16.2km^2). Tow locations were selected in the same manner as the 501N Study Area, using the systematic random sampling design.

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). The results indicated that 20 tows within the 501N Study Area and a similar number in the Control Area would allow for a 95% chance of detecting a 25% change in the population of the most abundant species (i.e., scup, butterfish, silver hake, and summer flounder). When distributing the survey effort, randomly selecting multiple tow locations across the 501N Study Area and Control Area accounts for spatial variations in fish populations. Alternatively, multiple tows could be sampled from a single tow track, which would assume that the tow track is representative of the larger ecosystem. The distributed approach, applied here, assumed that the catch characteristics across each area represent the ecosystem. Additionally, surveying each site seasonally accounts for temporal variations in fish populations. 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. 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 15.3 km^2 (4.5 square nautical miles [nmi^2]) in the 501N Study Area and one station per 16.2 km^2 (4.7 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 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 meters [m]) relative to the size of the net and consistent trawl geometry. These features make it a suitable net 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 501N Study Area. To ensure the retention of small individuals, a 1" mesh size knotless liner was used within a 12-centimeter (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 (i.e., 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. The F/V *Heather Lynn* is a commercial fishing vessel currently operating in the industry. Two trips to the survey area were made during which all planned tows were completed.

- Trip 1: November 6 - 12, 2020

- Trip 2: November 18 – 23, 2020

Surveys were alternated daily between the 501N 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 increasing the 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).

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. One of two sub-sampling strategies was employed during a tow: straight sub-sampling by weight or discard by count.

Straight sub-sampling by weight: When catch diversity was relatively low (five 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 made 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 employed during this survey.

Discard by count: The discard by count method was used when a large catch of large-bodied fish was caught. For this method, a sub-sample of the species (30 – 50 individuals) was collected to calculate a mean individual weight. The remaining individuals were counted and discarded. The aggregated weight for the species is the total number multiplied by the average individual weight. This method was employed to quantify the catch of spiny dogfish during large tows.

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 common 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 the 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 501N Study Area and Control Area (Figure 2, Table 1). Operational parameters were similar between these two survey areas (Table 2). Tow duration averaged 19.7 ± 1.3 minutes (mean ± one standard deviation) in the 501N Study Area and 20.2 ± 0.4 minutes in the Control Area. Tow distance averaged 0.9 ± 0.06 nautical miles (nmi) in the 501N Study Area giving an average tow speed of 2.9 ± 0.1 knots. Similarly, tow distance averaged 1.0 ± 0.04 nmi in the Control Area giving an average tow speed of 2.8 ± 0.1 knots.

The seafloor in both survey areas follows a northeast to southwest depth gradient with the shallowest tow along the northeast edge (~30 m). Depth increased to a maximum of 50 m along the southwestern boundary. Bottom water temperatures were relatively uniform throughout the survey areas. Bottom water temperatures averaged 14.5 ± 0.2°C (range: 14.2 – 14.8°C) in the 501N Study Area and 14.3 ± 0.4°C (range: 13.4 – 14.7°C) in the Control Area (Table 2).

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 33.2 ± 0.8 m (range: 32.1 – 34.6 m) for tows in the 501N Study Area and 32.5 ± 1.2 (range: 29.3 – 34.0 m) in the Control Area. Wing spread averaged 14.3 ± 0.5 m for tows in the 501N Study Area (range: 13.6 – 15.1 m) and 13.9 ± 0.6 m for tows in the Control Area (range: 12.5 – 14.6 m). All tows were within the acceptable tolerance limits for door spread and wing spread.

Headline height averaged 4.8 ± 0.2 m for tows in the 501N Study Area (range: 4.5 – 5.5 m) and 4.8 ± 0.2 m for tows in the Control Area (range: 4.4 – 5.3). All tows were within the acceptable tolerance limit except for one tow which was 0.1 m below the limit.

3.2 Catch Data

3.2.1 501N Study Area

In the 501N Study Area, a total of 29 species were caught over the duration of the survey (Table 3). Catch volume ranged from 150.2 kilograms per tow (kg/tow) to 2,354.3 kg/tow with an average of 529.5 kg/tow. The majority of the catch was primarily comprised of a small subset of the observed species. The five most abundant species (spiny dogfish, little skate, scup, silver hake, and butterfish) accounted for 87.7% of the total catch weight. Data collected from this area included the catch of both adults and juveniles of most species observed.

Spiny dogfish (*Squalus acanthias*) was the predominant species observed accounting for 35.6% of the total catch weight. Individuals ranged in length from 44 to 84 cm with a unimodal size distribution peaking at 68 cm (Figure 8). Spiny dogfish were observed in 19 of the 20 tows. Catch rates averaged 198.7 ± 96.8 kg/tow (mean ± Standard Error of the Mean [SEM], range: 0 – 1,766.3 kg/tow). Spiny dogfish were observed throughout the 501N Study Area with the highest catches observed in the southeastern corner (Figure 9).

Little skate (*Leucoraja erinacea*) was the second most abundant species observed accounting for 22.4% of the total catch weight. Individuals ranged in size length from 16 to 35 cm (disk width) with a unimodal size distribution consisting of a peak at 26 cm (Figure 10). Little skates were observed in all 20 tows. Catch rates averaged 114.8 ± 13.3 kg/tow (range: 30.1 – 231.6 kg/tow). Little skate were observed throughout the 501N Study Area (Figure 11).

Scup (*Stenotomus chysops*) was the third most abundant species accounting for 17.9% of the total catch weight. Individuals ranged in length from 7 to 32 cm with a narrow unimodal size distribution consisting of a peak at 24 cm (Figure 12). Scup were observed in all 20 tows at an average catch rate of 92.7 ± 18.1 kg/tow (range: 2.6 – 248.9 kg/tow). Scup were caught throughout the 501N Study Area (Figure 13).

Silver hake (*Merluccius bilinearis*), a commercially important species also commonly referred to as whiting, was the fourth most abundant species caught in the 501N Study Area. Individuals ranged in length from 10 to 50 cm. Silver hake had a narrow unimodal size distribution consisting of a peak at 24 cm (Figure 14). Silver hake were observed in all 20 tows at an average catch rate of 32.7 ± 6.9 kg/tow (range: 2.7 – 138.8 kg/tow). The catch of silver hake was distributed across the 501N Study Area (Figure 15).

Butterfish (*Peprilus triacanthus*) was the fifth most abundant species observed. Individuals ranged in length from 6 to 18 cm with a unimodal size distribution consisting of a peak at 8 cm (Figure 16). Butterfish were observed in all 20 tows at an average catch rate of 27.3 ± 3.9 kg/tow (range: 4.7 – 65.0 kg/tow). Butterfish were caught throughout the 501N Study Area (Figure 17).

Winter skate (*Leucoraja ocellata*) was commonly caught in the 501N Study Area. Individuals ranged in size from 26 to 51 cm (disk width; Figure 18). Winter skate were observed in 17 of the 20 tows at an average catch rate of 15.4 ± 3.5 kg/tow (range: 0 – 58.7 kg/tow). The catch of winter skate appeared to correlate with depth with higher catches were observed in the southern half of the 501N Study Area (Figure 19).

Atlantic longfin squid (*Dorytheuthis pealei*), is a commercially important species commonly referred to as loligo squid. Individuals ranged in length from 3 to 22 cm (mantle length) with a unimodal size distribution peaking at 8 cm (Figure 20). Atlantic longfin squid were observed in all 20 tows at an average catch rate of 14.0 ± 1.5 kg/tow (range: 2.7 – 29.4 kg/tow). Atlantic longfin squid were caught throughout the 501N Study Area with higher catches observed in the northern half of the 501N Study Area (Figure 21). No squid "mops" were observed during this survey.

Red hake (*Urophycis chuss*) was one of the dominant species in the 2019/2020 survey year. During this fall survey, the catch of red hake was common but at low abundances. Individuals ranged in length from 17 to 44 cm with a unimodal size distribution peaking between 24 and 26 cm (Figure 22). Red hake were observed in 19 of the 20 tows at an average catch rate of 11.1 ± 3.0 kg/tow (range: 0 – 58.2 kg/tow). Red hake were observed throughout the 501N Study Area with the highest catch associated with deeper tows to the south (Figure 23).

Northern sea robin (*Prionotus carolinus*) was observed in all 20 tows in the 501N Study Area. Individuals ranged in length from 7 to 33 cm with a majority of individuals between 19 and 30 cm (Figure 24). The average catch rate of northern sea robins was 5.9 ± 1.3 kg/tow (range: 1.1 – 21.6 kg/tow). Northern sea robins were caught throughout the 501N Study Area with higher catches observed in the southern half of the 501N Study Area (Figure 25).

Black sea bass (*Centropristis striata*) is a commercially important species commonly observed in the 501N Study Area. Black sea bass ranged in length from 11 to 44 cm with a unimodal size distribution peaking at 26 cm (Figure 26). Black sea bass were observed in all 20 tows at an average catch rate of 3.3 ± 0.3 kg/tow (range: 0.4 – 6.5 kg/tow). Black sea bass were caught throughout the 501N Study Area (Figure 27).

Windowpane flounder (*Scophtalmus aquosus*) is a federally regulated commercial flatfish species found in the 501N Study Area. Individuals ranged in length from 16 to 31 cm with a unimodal size distribution peaking at 21 cm (Figure 28). Windowpane flounder were observed in 19 of the 20 tows at an average catch rate of 3.1 ± 0.6 kg/tow (range: 0 – 8.4 kg/tow). Windowpane flounder were caught throughout the 501N Study Area with higher catches observed in the northern half of the 501N Study Area (Figure 29).

Winter flounder (*Pleuronectes americanus*) was another commercially important flatfish species commonly caught in the 501N Study Area. Individuals ranged in length from 21 to 47 cm with a wide size distribution (Figure 30). Winter flounder were observed in 19 of the 20 tows at an average catch rate of 2.9 ± 0.5 kg/tow (range: 0 – 7.7 kg/tow). Winter flounder were caught throughout the 501N Study Area (Figure 31).

Summer flounder (*Paralichthys dentatus*) is a commercially important flatfish species commonly referred to as fluke. Summer flounder were commonly caught in the 501N Study Area. Individuals ranged in length from 25 to 60 cm with a broad size distribution (Figure 32). Summer flounder were observed in 15 of the 20 tows at an average catch rate of 1.7 ± 0.4 kg/tow (range: 0 – 5.5 kg/tow). Summer flounder were caught throughout the 501N Study Area with the highest catches observed in the northern half of the 501N Study Area (Figure 33).

Fourspot flounder (*Paralichthys oblongus*) ranged in length from 13 to 39 cm with a unimodal size distribution peaking at 31 cm (Figure 34). Fourspot flounder were observed in 19 of the 20 tows at an average catch rate of 1.7 ± 0.3 kg/tow (range: 0 – 5.6 kg/tow). Fourspot flounder were caught throughout the 501N Study Area with the highest catches observed in the northern half of the 501N Study Area (Figure 35).

Less common recreational and commercial species observed included six monkfish (*Lophius americanus*, size range: 50 – 80 cm), 84 Atlantic sea scallops (*Placopecten* magellanicus), five weakfish (*Cynoscion regalis*, size range: 31 – 40 cm), two haddock (*Melanogrammus aeglefinus*, 22, 57 cm), one bluefish (*Pomotomus saltatrix*, 49 cm), and one American lobster (*Homarus americanus*).

3.2.2 Control Area

In the Control Area, a total of 32 species were caught over the duration of the survey (Table 3). Catch volume ranged from 42.8 kg/tow to 1,401.0 kg/tow with an average of 477.5 kg/tow. The majority of the catch was primarily comprised of a small subset of the observed species. The five most abundant species (little skate, scup, spiny dogfish, butterfish, and red hake) accounted for 86.3% of the total catch weight. Data collected from this area included the catch of both adults and juveniles of most species observed.

Little skate was the most abundant species observed in the Control Area accounting for 36.2% of the total catch weight. Individuals ranged in size from 10 to 33 cm (disk width) with a unimodal size distribution consisting of a peak between 24 and 26 cm (Figure 10). Little skates were observed in all 20 tows. Catch rates averaged 173.2 ± 27.2 kg/tow (range: 11.5 – 408.1 kg/tow). Little skate were observed throughout the Control Area (Figure 11).

Scup was the second most abundant species accounting for 19.5% of the total catch weight. Individuals ranged in length from 6 to 33 cm with a narrow unimodal size distribution consisting of a peak at 24 cm (Figure 12). Scup were observed in all 20 tows at an average catch rate of 93.6 ± 13.0 kg/tow (range: 0.6 – 215.3 kg/tow). Scup were caught throughout the Control Area (Figure 13).

Spiny dogfish was the third most abundant species observed in the Control Area accounting for 15.1% of the total catch weight. Individuals ranged in length from 24 to 85 cm with a unimodal distribution peaking at 68 cm (Figure 8). Dogfish were observed in 19 of the 20 tows. Catch rates averaged 71.7 ± 41.4 kg/tow (range: 0 – 831.1 kg/tow). The catch distribution of spiny dogfish appeared to follow the depth contour in the Control Area with low catches observed in shallow tows in the north and large catches associated with deeper tows along the southern boundary (Figure 9).

Silver hake was the fourth most abundant species caught in the Control Area. Individuals ranged in length from 8 to 45 cm. Silver hake had a narrow unimodal size distribution consisting of a peak at 23 cm (Figure 14). Silver hake were observed in all 20 tows at an average catch rate of 49.1 ± 10.2 kg/tow (range: 0.4 – 159.0 kg/tow). The catch of silver hake was distributed across the Control Area (Figure 15).

Butterfish was the fifth most abundant species observed. Individuals ranged in length from 4 to 22 cm with a unimodal size distribution consisting of a peak at 8 cm (Figure 16). Butterfish were observed in all 20 tows at an average catch rate of 24.6 ± 5.0 kg/tow (range: 2.9 – 110.3 kg/tow). Butterfish were caught throughout the Control Area (Figure 17).

Red hake was one of the dominant species in the 2019/2020 survey year. During this fall survey, the catch of red hake was common but at low abundances. Individuals ranged in length from 17 to 37 cm with a unimodal size distribution peaking at 27 cm (Figure 22). Red hake were observed in 19 of the 20 tows at an average catch rate of 18.6 ± 4.8 kg/tow (range: 0 – 83.8 kg/tow). Red hake were observed throughout the Control Area with higher catches associated with the southern half of the Control Area (Figure 23).

Winter skate was commonly caught in the Control Area. Individuals ranged in size from 20 to 69 cm (disk width; Figure 18). Winter skate were observed in 17 of the 20 tows at an average catch rate of 14.4 ± 3.3 kg/tow (range: 0 – 41.6 kg/tow). The catch of winter skate appeared to correlate with depth with higher catches were observed in the southern half of the Control Area (Figure 19).

Atlantic longfin squid ranged in length from 3 to 24 cm (mantle length) with a unimodal size distribution peaking at 5 cm (Figure 20). Atlantic longfin squid were observed in 19 of the 20 tows at an average catch rate of 9.2 ± 1.3 kg/tow (range: 0 – 19.5 kg/tow). Atlantic longfin squid were caught throughout the Control Area (Figure 21). No squid "mops" were observed during this survey.

Northern sea robins were observed in 18 of the 20 tows in the Control Area. Individuals ranged in length from 4 to 34 cm with a majority of individuals between 19 and 30 cm (Figure 24). The average catch rate of northern sea robins was 7.2 ± 1.8 kg/tow (range: 0 – 26.4 kg/tow). Northern sea robins were caught throughout the Control Area with higher catches observed in the southern half of the Control Area (Figure 25).

Windowpane flounder ranged in length from 16 to 33 cm with a unimodal size distribution peaking at 22 cm (Figure 28). Windowpane flounder were observed in 19 of the 20 tows at an average catch rate of 6.3 ± 1.8 kg/tow (range: 0 – 27.6 kg/tow). Windowpane flounder were caught throughout the Control Area with higher catches observed in the northern half of the Control Area (Figure 29).

Fourspot flounder was commonly caught in the Control Area. Individuals ranged in length from 16 to 41 cm with a unimodal size distribution peaking at 32 cm (Figure 34). Fourspot flounder were observed in 19 of the 20 tows at an average catch rate of 2.6 ± 0.7 kg/tow (range: 0 – 11.6 kg/tow). Fourspot flounder were caught throughout the Control Area with the highest catches observed in the northern half of the Control Area (Figure 35).

Summer flounder ranged in length from 29 to 63 cm with a broad size distribution (Figure 32). Summer flounder were observed in 18 of the 20 tows at an average catch rate of 2.3 ± 0.4 kg/tow (range: 0 – 6.6 kg/tow). Summer flounder were caught throughout the Control Area with the highest catches observed in the northern half of the Control Area (Figure 33).

Black sea bass ranged in length from 8 to 45 cm with a unimodal size distribution peaking at 26 cm (Figure 26). Black sea bass were observed in 18 of the 20 tows at an average catch rate of 0.8 ± 0.2 kg/tow (range: 0 – 2.3 kg/tow). Black sea bass were caught throughout the Control Area (Figure 27).

Winter flounder ranged in length from 21 to 40 cm with a wide size distribution (Figure 30). Winter flounder were observed in 11 of the 20 tows at an average catch rate of 0.7 ± 0.3 kg/tow (range: 0 – 4.1 kg/tow). The catch of winter flounder was primarily aggregated in the northern half of the Control Area (Figure 31).

Less common recreational and commercial species observed included nine monkfish (size range: 36 – 51 cm), 24 Atlantic sea scallops, five weakfish (size range: 24 – 42 cm), two American lobster, and one bluefish (22 cm).

4. Acknowledgments

We would like to thank the owner (Stephen Follett), captain (Kevin Jones), and crew (Mark Bolster, Andrew Follett, and Matt Manchester) of the F/V *Heather Lynn* for their help sorting, processing, and measuring the catch. Additionally, we would like to thank Mike Coute (SMAST), Keith Hankowsky (SMAST), and Altan Ernesti (A.I.S.) 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)	Trawl Warp (fm)
1	501N	11/7/20	Partly Cloudy	7-10	SW	0.5-1.25	6:57	N 41° 01.973	W 70° 34.736	24	7:17	N 41° 02.081	W 70° 35.661	24	95
2	501N	11/7/20	Clear	7-10	SW	0.5-1.25	8:16	N 41° 01.332	W 70° 35.363	25	8:38	N 41° 01.012	W 70° 36.691	25	100
3	501N	11/7/20	Clear	7-10	SW	0.5-1.25	9:30	N 40° 59.466	W 70° 33.521	27	9:45	N 41° 59.495	W 70° 32.530	26	100
4	501N	11/7/20	Clear	7-10	SW	0.5-1.25	10:59	N 41° 00.116	W 70° 31.509	26	11:19	N 41° 01.014	W 70° 31.329	25	100
5	501N	11/7/20	Clear	7-10	SW	0.5-1.25	12:37	N 40° 59.778	W 70° 30.502	25	12:57	N 40° 58.750	W 70° 30.549	25	95
6	501N	11/7/20	Clear	7-10	SW	0.5-1.25	13:42	N 40° 58.854	W 70° 29.955	24	14:02	N 40° 53.390	W 70° 30.867	25	100
7	501N	11/7/20	Clear	7-10	SW	0.5-1.25	14:46	N 40° 56.625	W 70° 30.071	25	15:06	N 40° 55.828	W 70° 30.701	26	100
8	501N	11/7/20	Clear	7-10	SW	0.5-1.25	16:07	N 40° 57.743	W 70° 29.978	25	16:27	N 40° 57.869	W 70° 28.746	24	95
9	Control	11/8/20	Clear	7-10	SW	0.5-1.25	6:25	N 40° 56.567	W 70° 25.912	24	6:45	N 40° 56.752	W 70° 27.115	25	95
10	Control	11/8/20	Clear	7-10	SW	0.5-1.25	7:49	N 40° 55.674	W 70° 26.377	25	8:09	N 40° 56.244	W 70° 27.375	25	95
11	Control	11/8/20	Clear	7-10	SW	0.5-1.25	9:18	N 40° 54.611	W 70° 25.176	25	9:38	N 40° 54.147	W 70° 26.274	26	100
12	Control	11/8/20	Clear	7-10	SW	0.5-1.25	10:53	N 40° 52.703	W 70° 25.098	27	11:13	N 40° 53.526	W 70° 24.434	25	100
13	Control	11/8/20	Clear	7-10	SW	0.5-1.25	12:22	N 40° 52.711	W 70° 23.177	25	12:42	N 40° 51.988	W 70° 22.284	26	100
14	Control	11/8/20	Clear	7-10	SW	0.5-1.25	13:37	N 40° 52.201	W 70° 22.196	26	13:57	N 40° 52.530	W 70° 21.060	25	100
15	Control	11/8/20	Clear	3-6	SW	0.5-1.25	14:55	N 40° 53.969	W 70° 21.214	24	15:15	N 40° 54.460	W 70° 22.199	24	95
16	Control	11/8/20	Clear	3-6	SW	0.5-1.25	15:51	N 40° 55.645	W 70° 22.528	23	16:11	N 40° 56.560	W 70° 22.679	24	95
17	Control	11/9/20	Clear	7-10	SW	0.5-1.25	6:30	N 40° 57.143	W 70° 20.799	23	6:50	N 40° 56.923	W 70° 21.961	23	95
18	Control	11/9/20	Clear	3-6	SW	0.33-0.5	7:53	N 40° 51.026	W 70° 19.128	22	8:13	N 40° 56.093	W 70° 19.412	22	95
19	Control	11/9/20	Clear	3-6	SW	0.33-0.5	9:20	N 40° 55.991	W 70° 18.791	22	9:40	N 40° 55.947	W 70° 17.546	22	95
20	Control	11/9/20	Clear	3-6	SW	0.33-0.5	10:28	N 40° 51.030	W 70° 17.856	21	10:49	N 40° 51.934	W 70° 18.418	22	95
21	Control	11/9/20	Clear	3-6	SW	0.33-0.5	11:47	N 40° 58.551	W 70° 18.390	22	12:07	N 40° 59.081	W 70° 17.309	21	95
22	Control	11/9/20	Clear	3-6	SW	0.33-0.5	13:07	N 41° 00.028	W 70° 16.945	20	13:27	N 41° 00.915	W 70° 16.774	19	75
23	Control	11/9/20	Clear	3-6	SW	0.33-0.5	14:24	N 41° 00.506	W 70° 19.977	21	14:44	N 41° 00.131	W 70° 21.123	21	95
24	Control	11/9/20	Clear	3-6	SW	0.33-0.5	15:21	N 41° 00.095	W 70° 21.224	21	15:41	N 40° 59.817	W 70° 22.293	21	95
25	501N	11/10/20	Mostly Cloudy	7-10	SW	0.5-1.25	6:31	N 41° 00.476	W 70° 23.434	22	6:51	N 41° 00.325	W 70° 24.654	22	95
26	501N	11/10/20	Partly Cloudy	7-10	SW	0.5-1.25	7:44	N 41° 00.583	W 70° 25.397	22	8:04	N 41° 00.730	W 70° 26.604	23	95
27	501N	11/10/20	Clear	7-10	SW	0.5-1.25	9:11	N 41° 01.016	W 70° 26.289	23	9:31	N 41° 01.006	W 70° 27.599	25	100
28	501N	11/10/20	Clear	7-10	SW	0.5-1.25	10:22	N 41° 01.619	W 70° 29.021	23	10:42	N 41° 01.570	W 70° 30.178	25	100
29	501N	11/10/20	Clear	11-15	SW	0.5-1.25	11:37	N 41° 02.755	W 70° 28.500	24	11:58	N 40° 03.121	W 70° 27.295	23	95
30	501N	11/10/20	Clear	11-15	SW	0.5-1.25	12:50	N 41° 04.794	W 70° 29.066	22	13:10	N 41° 05.192	W 70° 27.983	22	95
31	501N	11/10/20	Clear	11-15	SW	0.5-1.25	14:03	N 41° 05.841	W 70° 29.656	22	14:23	N 41° 06.063	W 70° 30.898	22	95
32	501N	11/10/20	Clear	11-15	SW	0.5-1.25	15:24	N 41° 04.794	W 70° 31.215	23	15:44	N 41° 03.707	W 70° 32.301	25	95
33	Control	11/11/20	Partly Cloudy	11-15	SW	0.5-1.25	6:36	N 41° 02.818	W 70° 15.461	17	6:56	N 41° 02.415	W 70° 16.614	18	75
34	Control	11/11/20	Clear	11-15	SW	0.5-1.25	7:30	N 41° 02.301	W 70° 14.487	20	7:50	N 41° 00.103	W 70° 20.663	21	95
35	Control	11/11/20	Clear	11-15	SW	0.5-1.25	8:38	N 41° 03.362	W 70° 20.481	21	8:58	N 41° 04.261	W 70° 20.159	21	95
36	Control	11/11/20	Clear	11-15	SW	0.5-1.25	9:44	N 41° 04.173	W 70° 19.689	19	10:04	N 41° 04.064	W 70° 20.941	20	75
37	501N	11/11/20	Mostly Cloudy	11-15	SW	0.5-1.25	10:47	N 41° 02.493	W 70° 21.469	21	11:07	N 41° 02.805	W 70° 22.676	21	95
38	501N	11/11/20	Mostly Cloudy	11-15	SW	0.5-1.25	11:56	N 41° 03.856	W 70° 25.546	23	12:16	N 41° 04.296	W 70° 26.637	22	95
39	501N	11/11/20	Overcast	11-15	SW	0.5-1.25	13:13	N 41° 05.521	W 70° 27.981	22	13:33	N 41° 06.355	W 70° 28.521	22	95
40	501N	11/11/20	Overcast	11-15	SW	0.5-1.25	14:18	N 41° 07.185	W 70° 27.781	21	14:38	N 41° 07.971	W 70° 28.894	21	95

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. (^oC)	Headline Height (m.)	Wing Spread (m.)	Spread Door (m.)
1	501N	18.5	1.00	3.2	24				
2	501N	17.8	0.86	2.9	25				
3	501N	15.3	0.77	3.0	27	14.6	4.8		33.4
4	501N	20.1	1.00	3.0	26	14.6	4.8	13.6	32.1
5	501N	20.9	1.00	2.9	25	14.7	5.5		33.2
6	501N	19.6	0.91	2.8	24	14.5	4.8	15.1	34.6
7	501N	20.4	0.95	2.8	25	14.8	4.5	14.3	34.3
8	501N	20.1	0.96	2.9	25	14.8	4.7	13.8	32.8
9	Control	20.1	0.94	2.8	24	14.6	4.9	13.5	31.8
10	Control	20.2	0.95	2.8	25		4.7	13.3	32.6
11	Control	19.7	0.98	3.0	25	14.7	4.4	14.2	34.0
12	Control	20.7	0.99	2.9	27		4.7	13.2	32.4
13	Control	20.2	1.01	3.0	25	14.7	4.6		33.9
14	Control	19.9	0.92	2.8	26	14.7	4.9	13.8	31.9
15	Control	19.5	0.95	2.9	24	14.7	5.0		33.3
16	Control	19.7	0.94	2.9	23	14.7	4.5	14.0	33.4
17	Control	19.9	0.93	2.8	23	14.2	4.9	13.1	31.5
18	Control	20.8	1.01	2.9	22	13.8	4.7	14.4	32.7
19	Control	20.0	0.96	2.9	22	13.5	4.4	14.4	33.8
20	Control	21.2	1.03	2.9	21	13.4	4.9	14.1	32.0
21	Control	20.5	0.99	2.9	22	13.9	4.7	14.2	32.6
22	Control	20.1	0.92	2.8	20	14.3	5.1	12.5	29.3
23	Control	20.0	0.95	2.9	21		4.7	14.1	33.5
24	Control	19.8	0.87	2.6	21	14.3	4.5	14.6	33.3
25	501N	20.3	0.95	2.8	22	14.4	4.5	15.0	33.7
26	501N	20.0	0.93	2.8	22	14.4	4.8	13.9	32.8
27	501N	20.5	1.00	2.9	23	14.5	4.7	14.1	33.7
28	501N	19.7	0.93	2.8	23	14.2	4.8	14.4	32.6
29	501N	21.1	1.00	2.8	24	14.5	4.5	14.1	34.3
30	501N	19.8	0.94	2.8	22	14.5	4.9	13.8	32.5
31	501N	20.2	0.92	2.7	22				
32	501N	20.4	0.93	2.7	23	14.5	4.6	14.9	34.5
33	Control	20.5	0.96	2.8	17	14.5	5.3	14.6	31.7
34	Control	20.3	0.93	2.8	20		4.7	14.0	32.0
35	Control	20.6	0.94	2.7	21	14.5	4.6	13.9	33.1
36	Control	20.0	0.96	2.9	19	14.4	5.1		30.5
37	501N	19.9	0.99	3.0	21	14.5	4.7	14.8	32.1
38	501N	20.1	0.95	2.8	23	14.5	4.7		32.3
39	501N	19.8	0.95	2.9	22	14.2	4.9		32.6
40	501N	19.9	0.91	2.7	21				33.1
Summary Statistics									
Control	Minimum	19.5	0.9	2.6	17.0	13.4	4.4	12.5	29.3
	Maximum	21.2	1.0	3.0	27.0	14.7	5.3	14.6	34.0
	Average	20.2	1.0	2.8	22.4	14.3	4.8	13.9	32.5
	St. Dev	0.4	0.04	0.1	2.5	0.4	0.2	0.6	1.2
501N	Minimum	15.3	0.8	2.7	21.0	14.2	4.5	13.6	32.1
	Maximum	21.1	1.0	3.2	27.0	14.8	5.5	15.1	34.6
	Average	19.7	0.9	2.9	23.5	14.5	4.8	14.3	33.2
	St. Dev.	1.3	0.06	0.1	1.7	0.2	0.2	0.5	0.8

Table 3: Total and average catch weights observed within the 501N Study Area.

Species Name	Scientific Name	Total Weight (Kg)	Catch/Tow (Kg)		% of Total Catch	Tows with Species Present
			Mean	SEM*		
Dogfish, Spiny	*Squalus acanthias*	3569.9	198.7	96.8	35.6	19
Skate, Little	*Leucoraja erinacea*	2246.6	114.8	13.3	22.4	20
Scup	*Stenotomus chrysops*	1799.5	92.7	18.1	17.9	20
Hake, Silver (Whiting)	*Merluccius bilinearis*	649.3	32.7	6.9	6.5	20
Butterfish	*Peprilus triacanthus*	536.7	27.3	3.9	5.3	20
Skate, Winter	*Leucoraja ocellata*	295.6	15.4	3.5	2.9	17
Squid, Atlantic Longfin	*Dorytheuthis pealei*	273.8	14.0	1.5	2.7	20
Hake, Red	*Urophycis chuss*	215.7	11.1	3.0	2.1	19
Northern Sea Robin	*Prionotus carolinus*	114.8	5.9	1.3	1.1	20
Black Sea bass	*Centropristis striata*	65.8	3.3	0.3	0.7	20
Flounder, Windowpane	*Scophtalmus aquosus*	62.6	3.1	0.6	0.6	19
Flounder, Winter	*Pleuronectes americanus*	56.0	2.9	0.5	0.6	19
Flounder, Summer (Fluke)	*Paralichthys dentatus*	34.9	1.7	0.4	0.3	15
Flounder, Fourspot	*Paralichthys oblongus*	33.2	1.7	0.3	0.3	19
Crab, Rock	*Cancer irroratus*	28.0	1.4	0.5	0.3	13
Monkfish	*Lophius americanus*	26.2	1.3	0.5	0.3	7
Sea Robin, Striped	*Prionotus evolans*	5.9	0.3	0.1	0.1	5
Hake, Spotted	*Urophycis regia*	5.5	0.3	0.1	0.1	6
Sea Scallop	*Placopecten magellanicus*	5.1	0.3	0.1	0.1	10
Skate, Barndoor	*Dipturus laevis*	2.9	0.1	0.0	0.0	10
Weakfish	*Cynoscion regalis*	2.3	0.1	0.1	0.0	4
Bluefish	*Pomatomus saltatrix*	1.9	0.1	0.1	0.0	1
Haddock	*Melanogrammus aeglefinus*	1.8	0.1	0.1	0.0	2
Flounder, Gulfstream	*Citharichthys arctifrons*	1.0	0.1	0.0	0.0	6
Cunner	*Tautogolabrus undulatus*	1.0	0.05	0.05	0.0	1
Lobster, American	*Homarus americanus*	0.5	0.02	0.02	0.0	1
Herring, Atlantic	*Clupea harengus*	0.3	0.02	0.01	0.0	3
Shad, American	*Alosa sapidissima*	0.1	0.00	0.00	0.0	1
Herring, Blueback	*Alosa aestivalis*	0.1	0.00	0.01	0.0	1
Total		10037.0				

*SEM is an acronym for Standard Error of the Mean

Table 4: Total and average catch weights observed within the Control Area.

Species Name	Scientific Name	Total Weight (Kg)	Catch/Tow (Kg)		% of Total Catch	Tows with Species Present
			Mean	SEM*		
Skate, Little	*Leucoraja erinacea*	3492.0	173.2	27.2	36.2	20
Scup	*Stenotomus chrysops*	1886.1	93.6	13.0	19.5	20
Dogfish, Spiny	*Squalus acanthias*	1460.0	71.7	41.4	15.1	19
Hake, Silver (Whiting)	*Merluccius bilinearis*	991.6	49.1	10.2	10.3	20
Butterfish	*Peprilus triacanthus*	497.2	24.6	5.0	5.2	20
Hake, Red	*Urophycis chuss*	377.6	18.6	4.8	3.9	19
Skate, Winter	*Leucoraja ocellata*	288.2	14.4	3.3	3.0	17
Squid, Atlantic Longfin	*Dorytheuthis pealei*	185.0	9.2	1.3	1.9	19
Northern Sea Robin	*Prionotus carolinus*	144.8	7.2	1.8	1.5	18
Flounder, Windowpane	*Scophtalmus aquosus*	129.6	6.3	1.8	1.3	19
Flounder, Fourspot	*Paralichthys oblongus*	53.4	2.6	0.7	0.6	19
Flounder, Summer (Fluke)	*Paralichthys dentatus*	46.3	2.3	0.4	0.5	18
Crab, Rock	*Cancer irroratus*	21.8	1.1	0.4	0.2	12
Black Sea bass	*Centropristis striata*	17.1	0.8	0.2	0.2	18
Monkfish	*Lophius americanus*	17.0	0.8	0.5	0.2	5
Flounder, Winter	*Pleuronectes americanus*	14.6	0.7	0.3	0.2	11
Alewife	*Alosa pseudoharengus*	8.7	0.4	0.2	0.1	7
Skate, Barndoor	*Dipturus laevis*	3.5	0.2	0.1	0.0	5
Hake, Spotted	*Urophycis regia*	2.7	0.1	0.1	0.0	4
Crab, Horseshoe	*Limulus polyphemus*	2.3	0.1	0.1	0.0	2
Weakfish	*Cynoscion regalis*	2.1	0.1	0.1	0.0	3
Sea Scallop	*Placopecten magellanicus*	1.9	0.1	0.1	0.0	5
Lobster, American	*Homarus americanus*	1.7	0.1	0.1	0.0	2
Sea Robin, Striped	*Prionotus evolans*	1.5	0.1	0.1	0.0	1
Ray, Cownose	*Rhinoptera bonasus*	1.1	0.1	0.1	0.0	1
Eel, Conger	*Conger oceanicus*	1.0	0.05	0.05	0.0	1
Shad, American	*Alosa sapidissima*	0.8	0.04	0.02	0.0	4
Dogfish, Smooth	*Mustelus canis*	0.5	0.02	0.02	0.0	2
Flounder, Gulfstream	*Citharichthys arctifrons*	0.4	0.02	0.01	0.0	4
Ocean Pout	*Zoarces americanus*	0.2	0.01	0.01	0.0	1
Herring, Atlantic	*Clupea harengus*	0.1	0.01	0.01	0.0	1
Bluefish	*Pomatomus saltatrix*	0.1	0.01	0.01	0.0	1
Total		9650.9				

*SEM is an acronym for Standard Error of the Mean

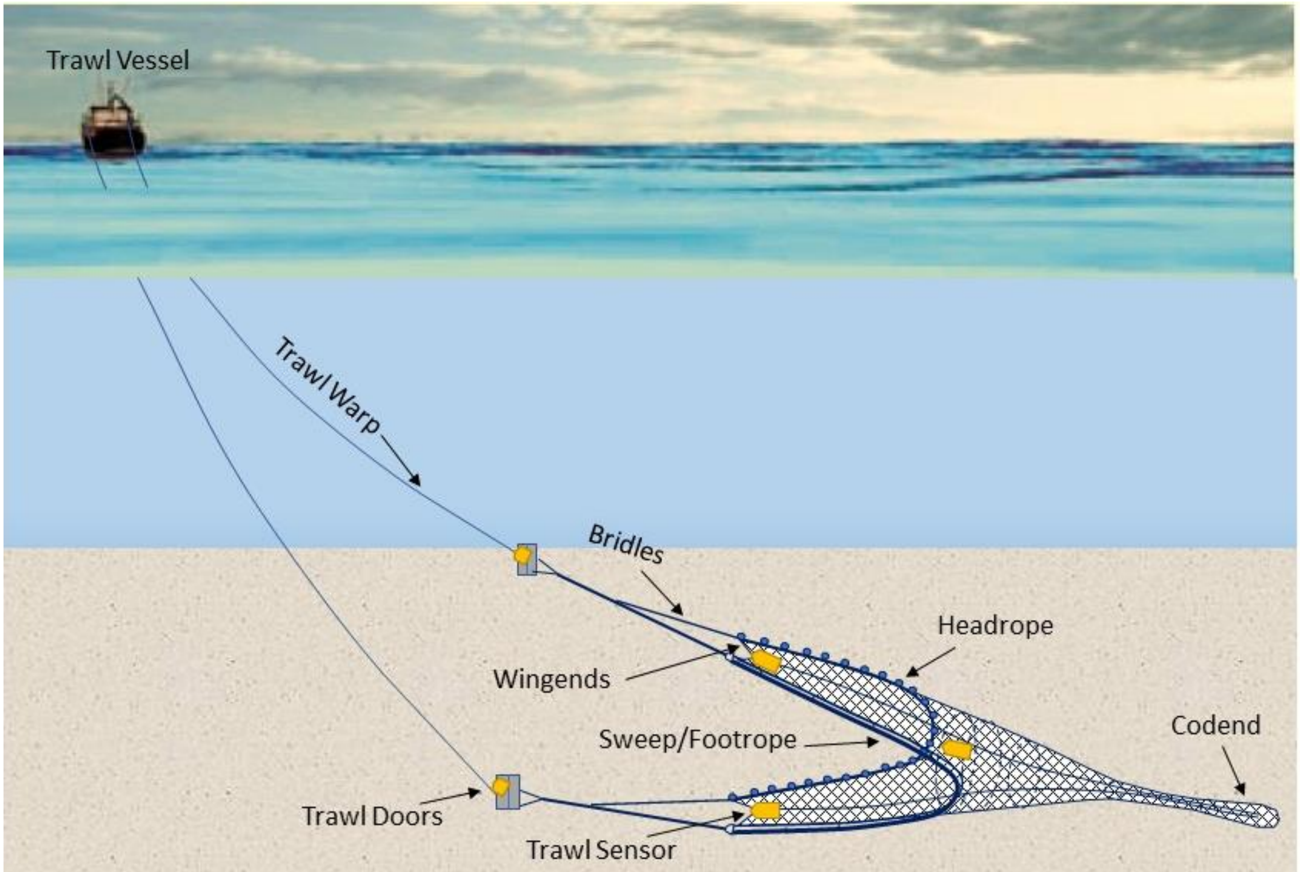


Figure 1: General schematic (not to scale) of a demersal otter trawl. Yellow rectangles indicate geometry sensors.

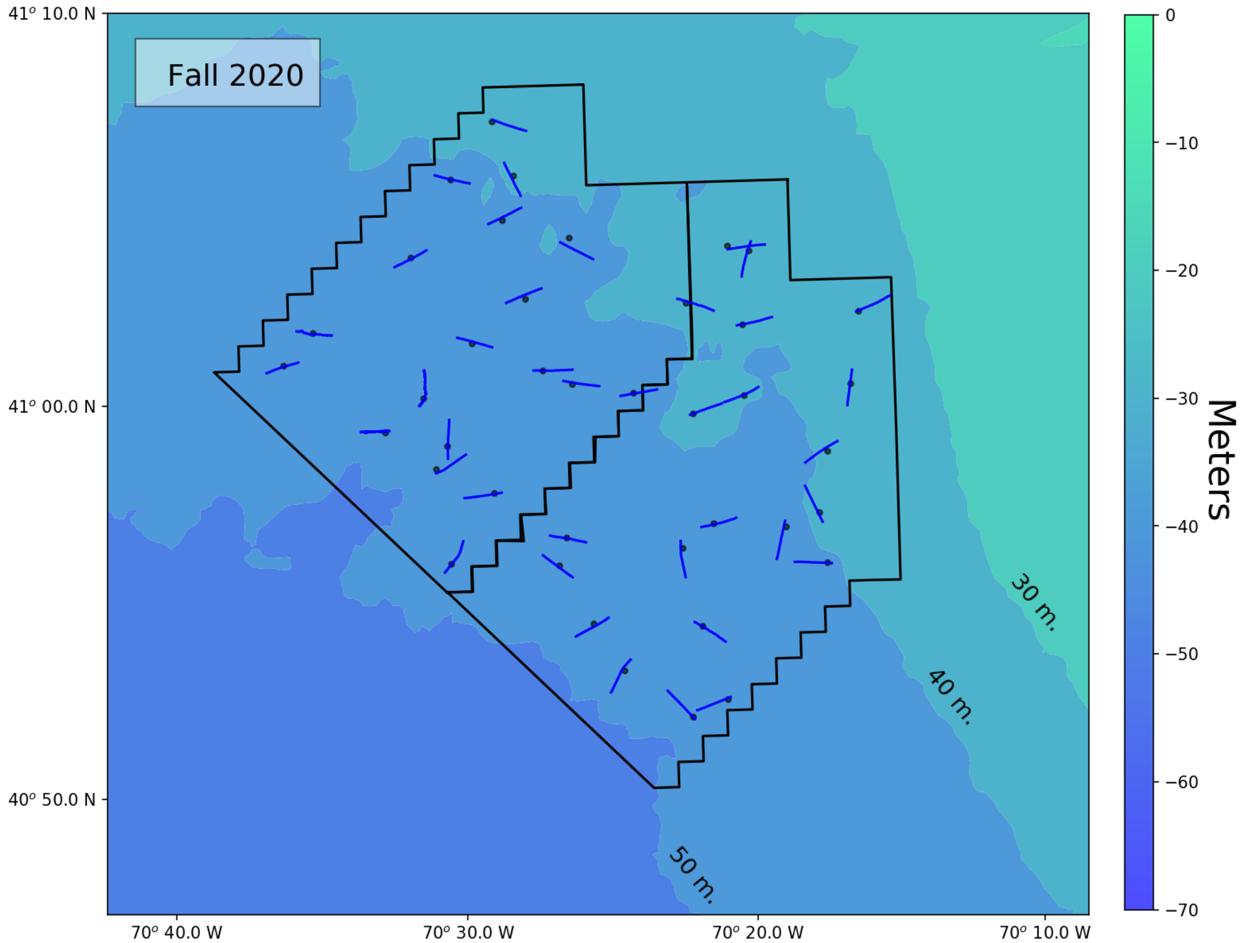


Figure 2: Tow locations (black dots) and trawl tracks (blue lines) from the 501N Study Area (left) and the Control Area (right).

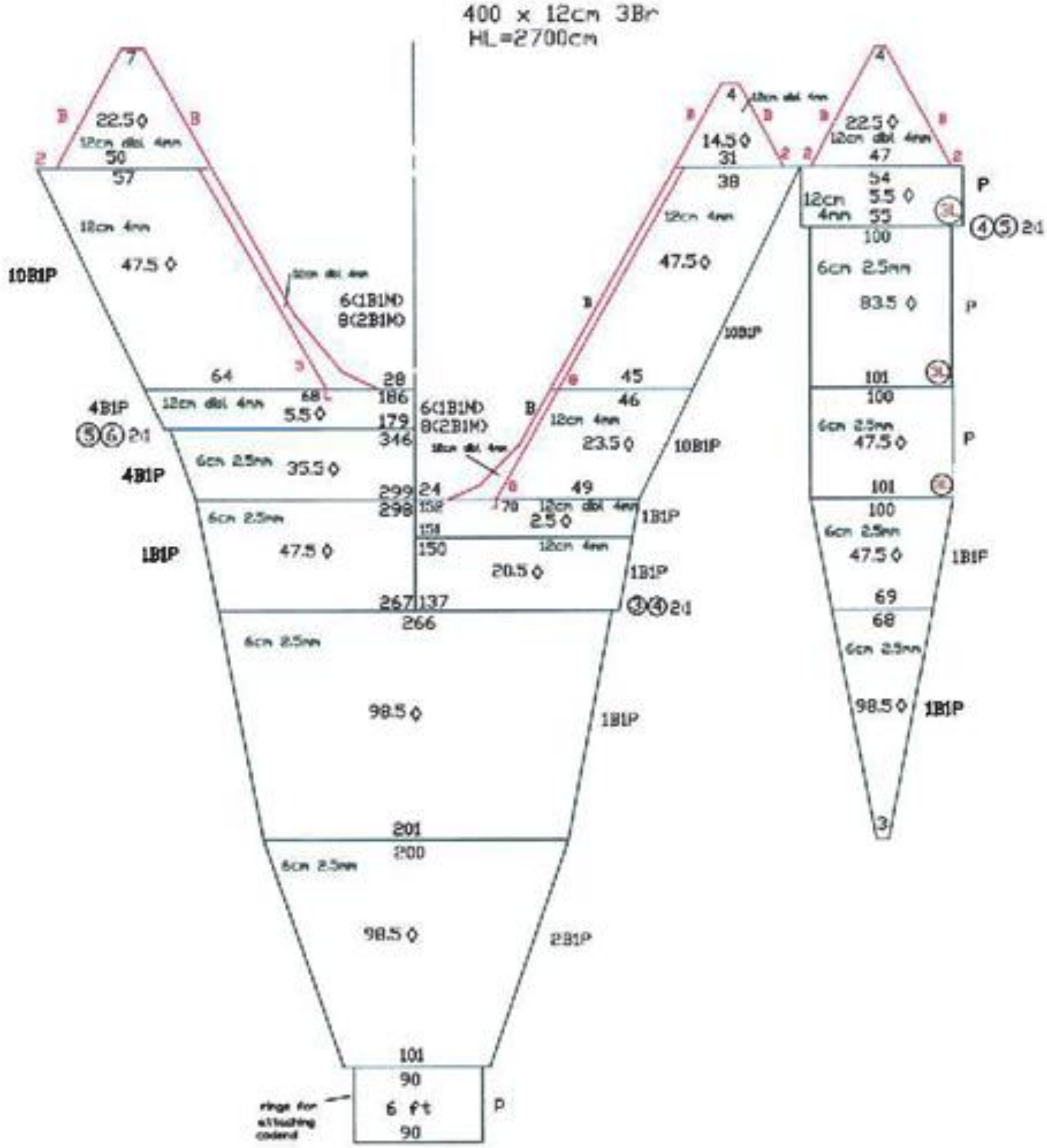


Figure 3: Schematic net plan for the NEAMAP trawl (Bonzek et al., 2008).

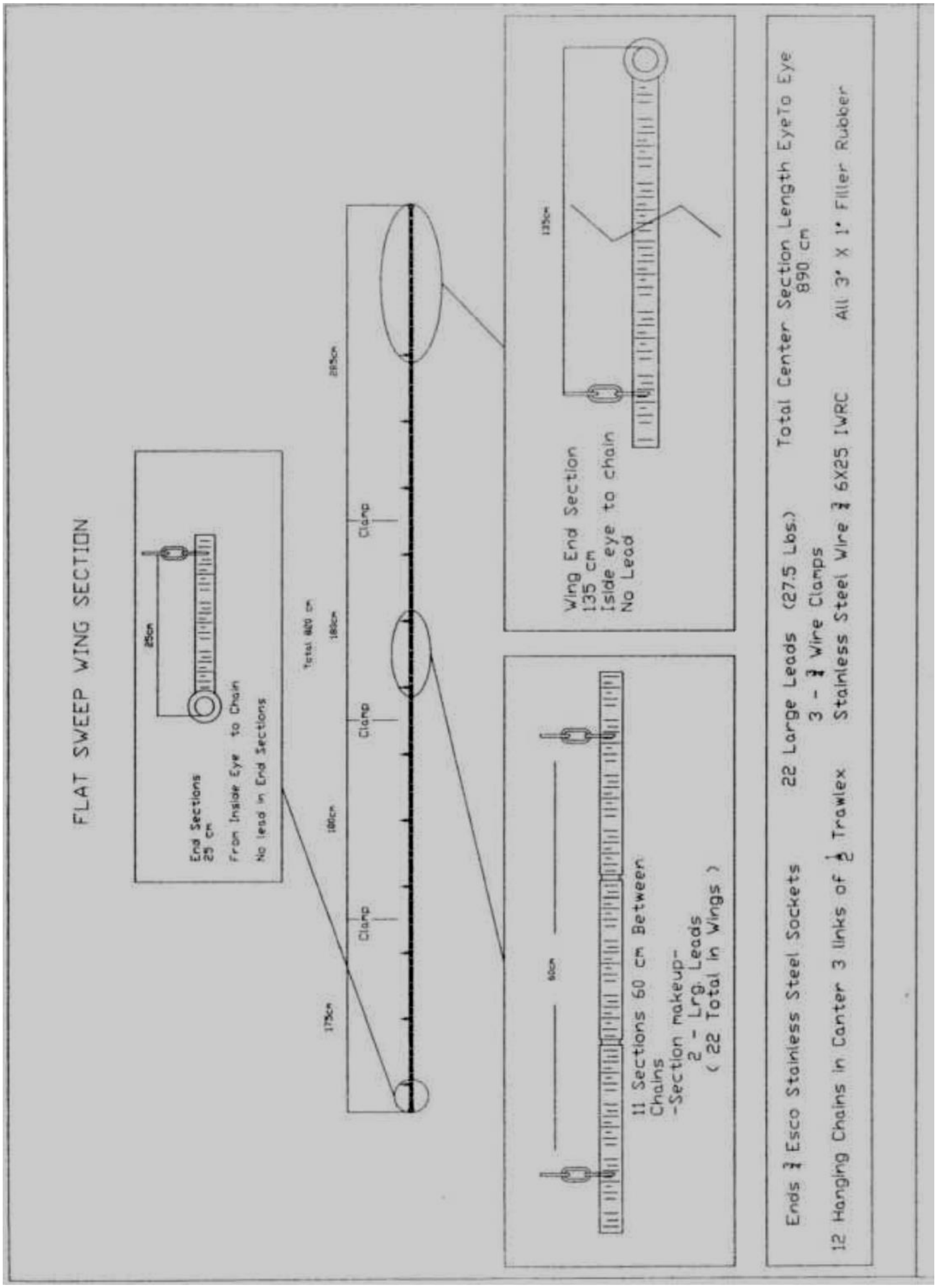


Figure 4: Sweep diagram for the survey trawl (Bonzek et al., 2008).

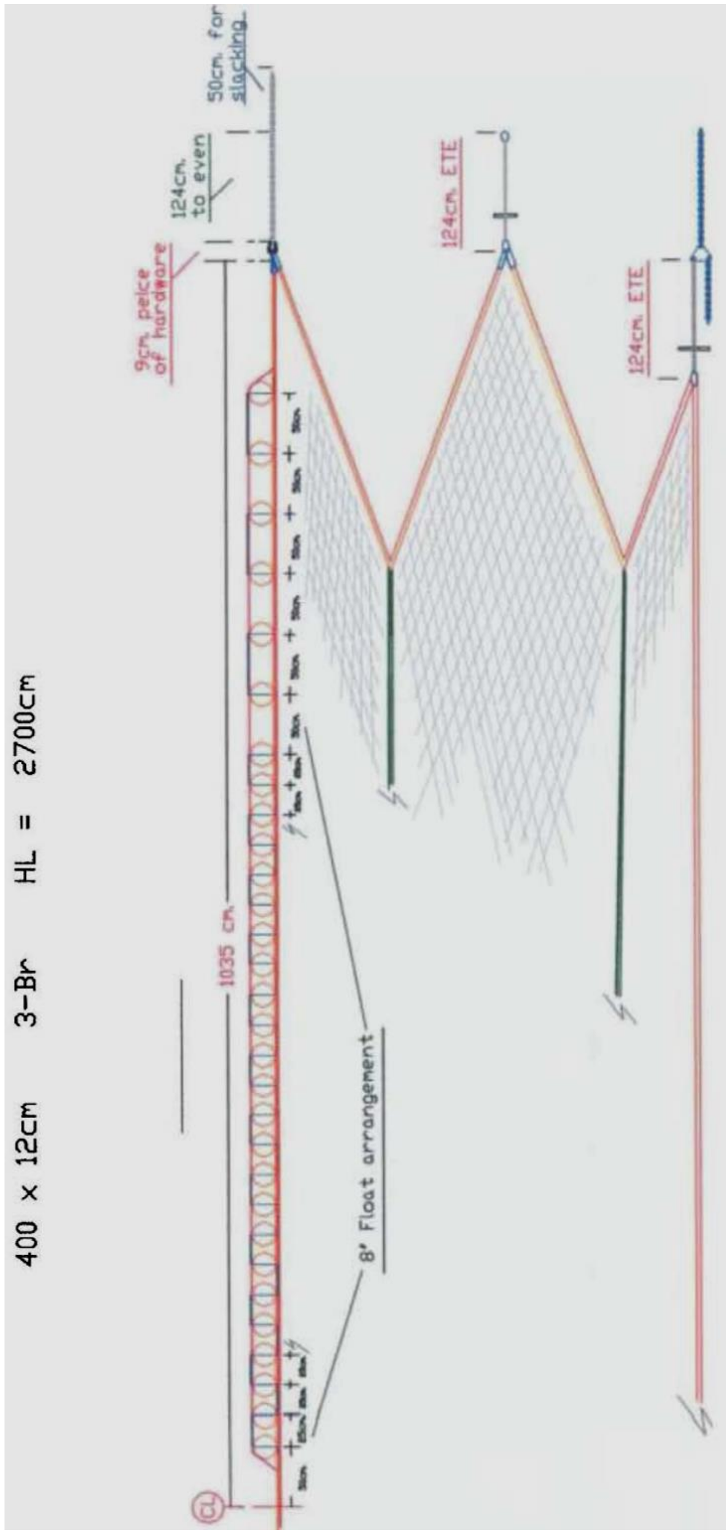


Figure 5: Headrope and rigging plan for the survey trawl (Bonzek et al., 2008).

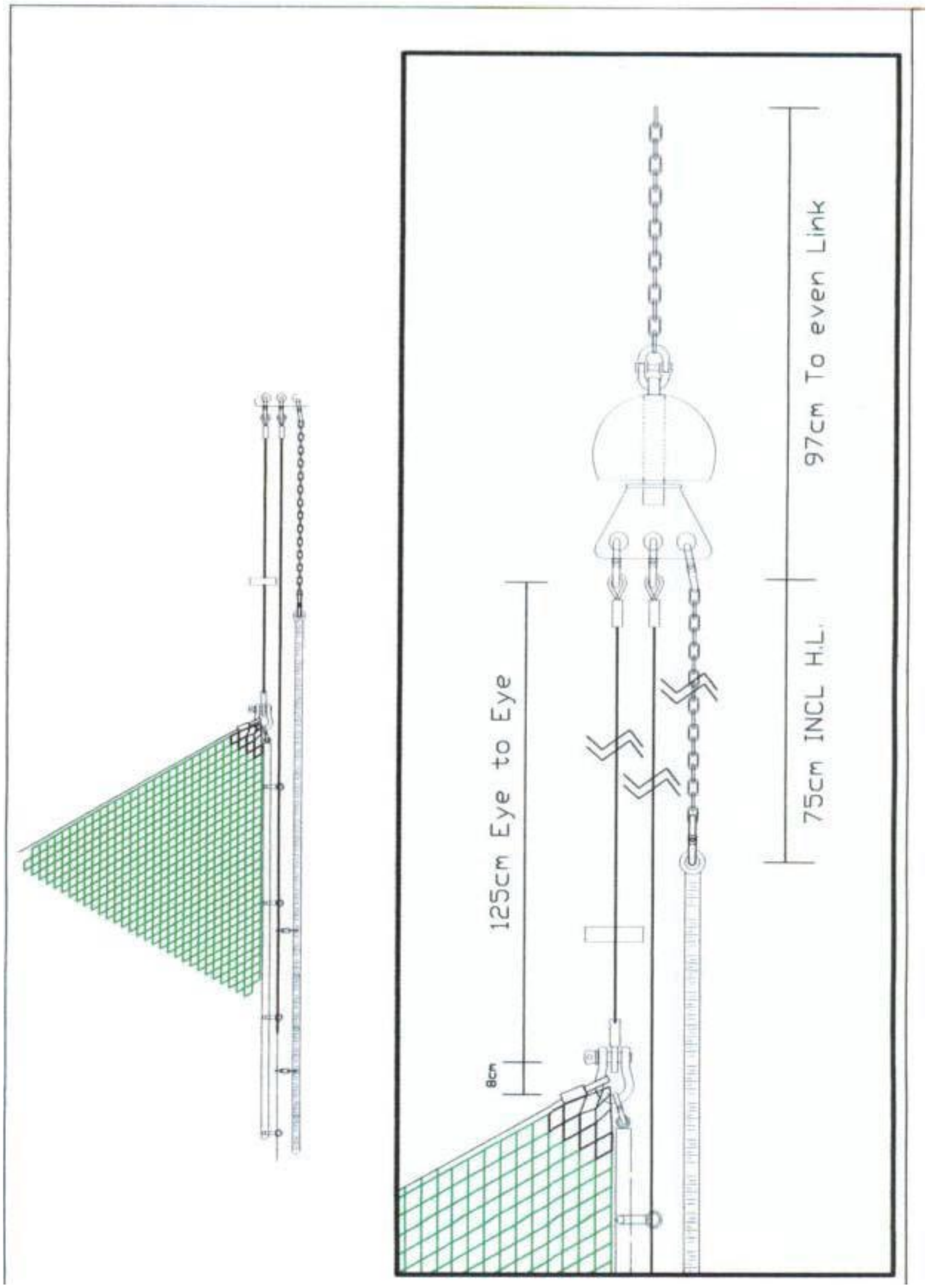


Figure 6: Lower wing and bobbin schematic for the survey trawl (Bonzek et al., 2008).

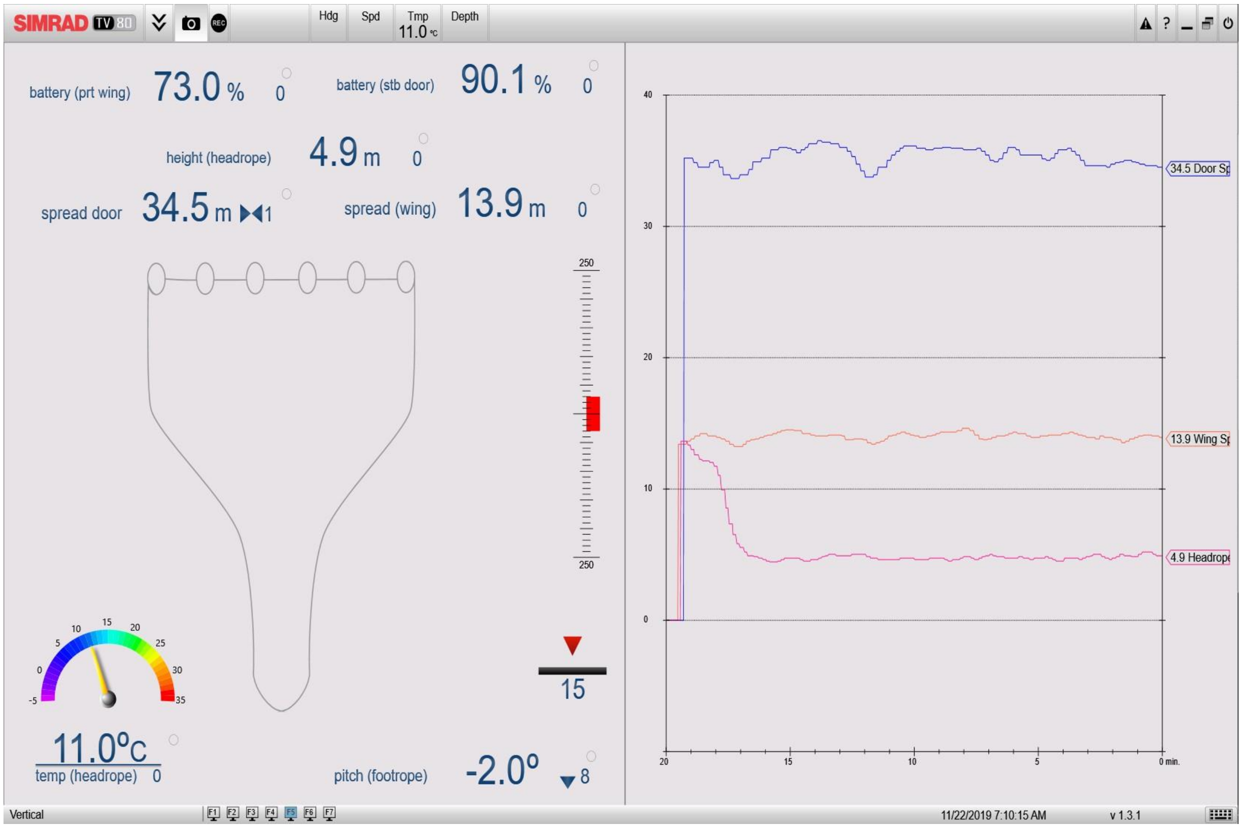
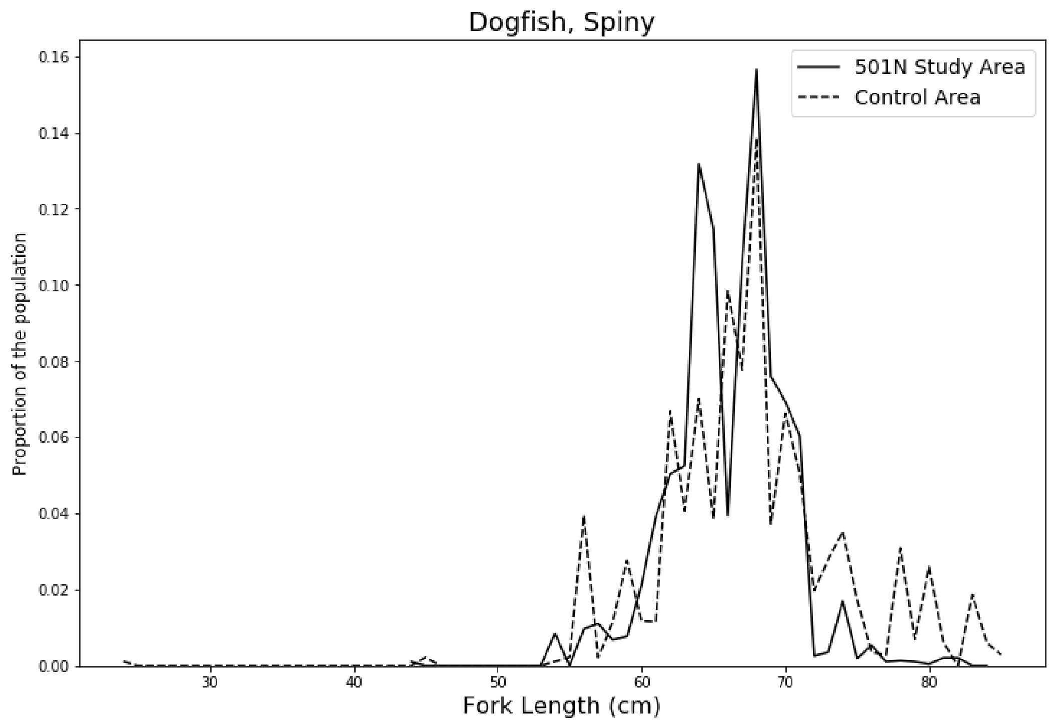


Figure 7: Screenshot of the SIMRAD TV80 software monitoring the trawl parameters.



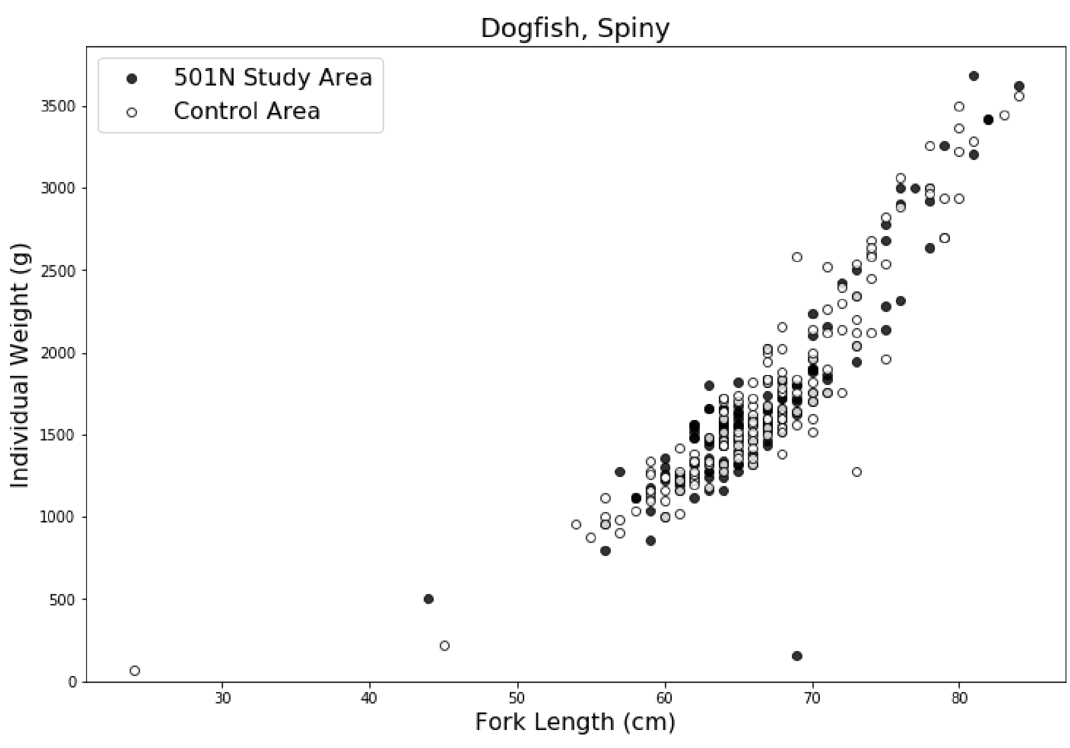


Figure 8: Population structure of spiny dogfish in the 501N Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

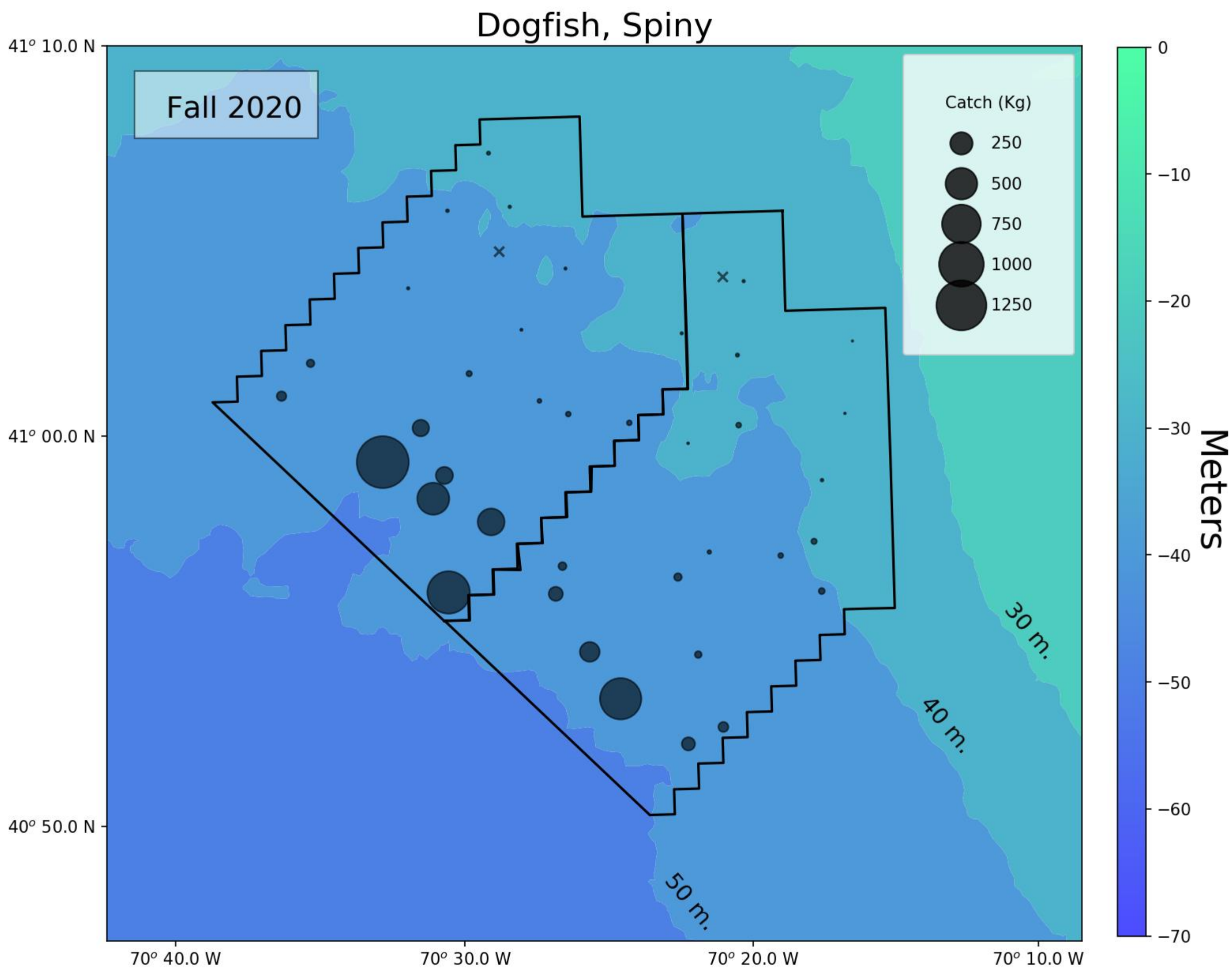
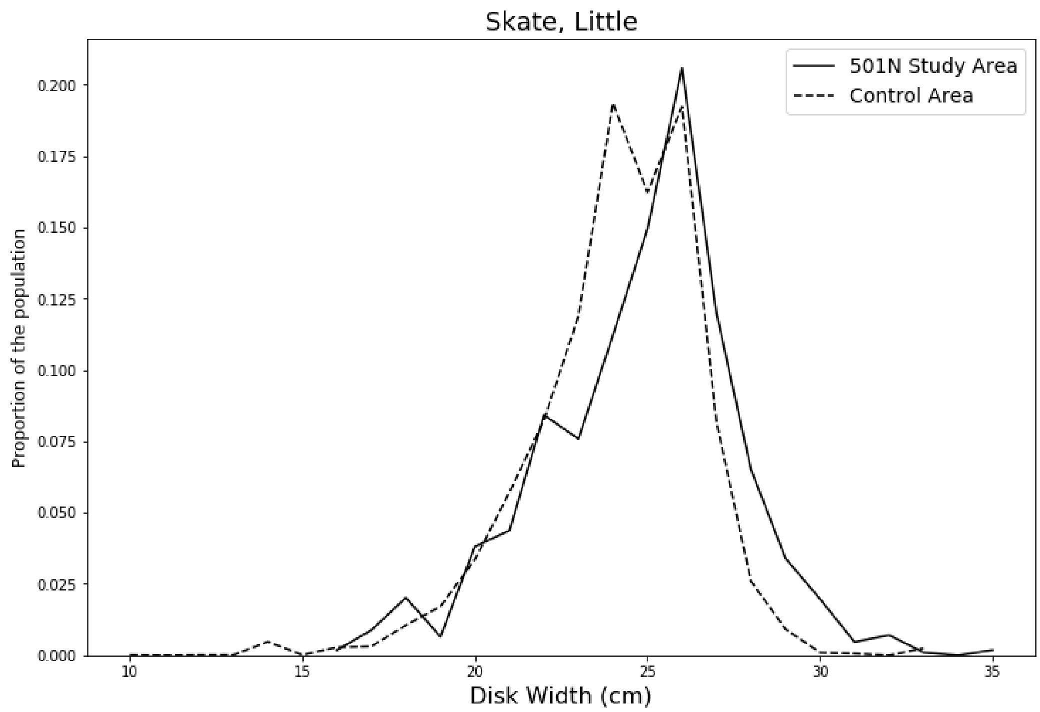


Figure 9: Distribution of the catch of spiny dogfish in the 501N Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.



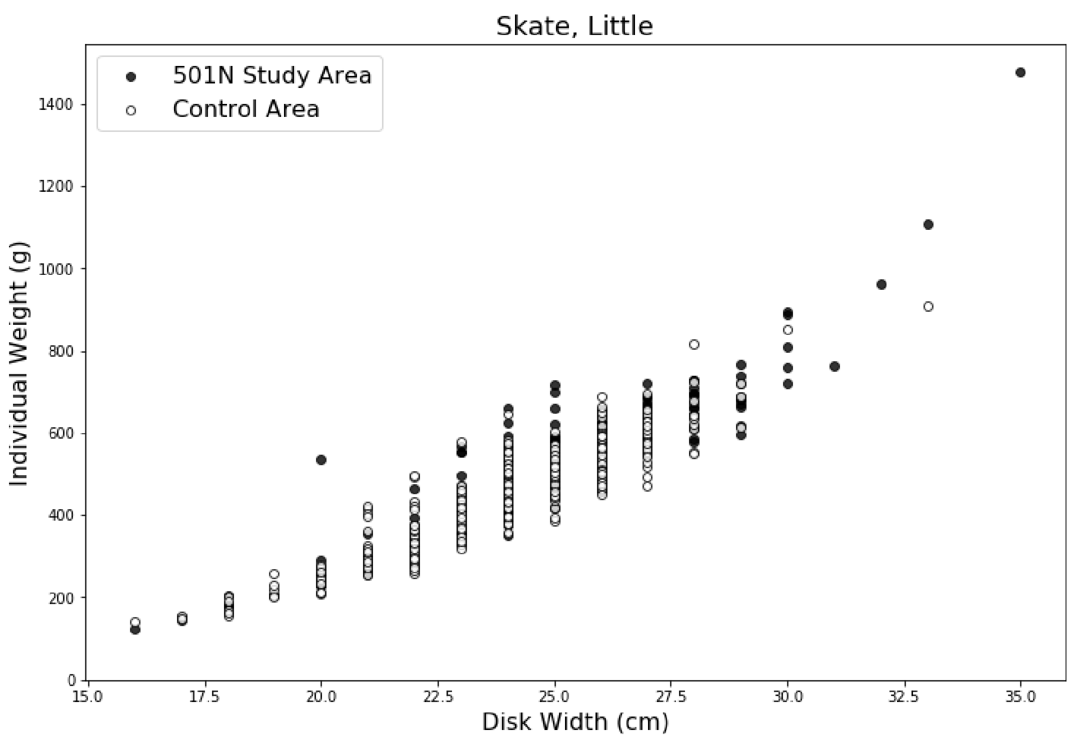


Figure 10: Population structure of little skate in the 501N Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

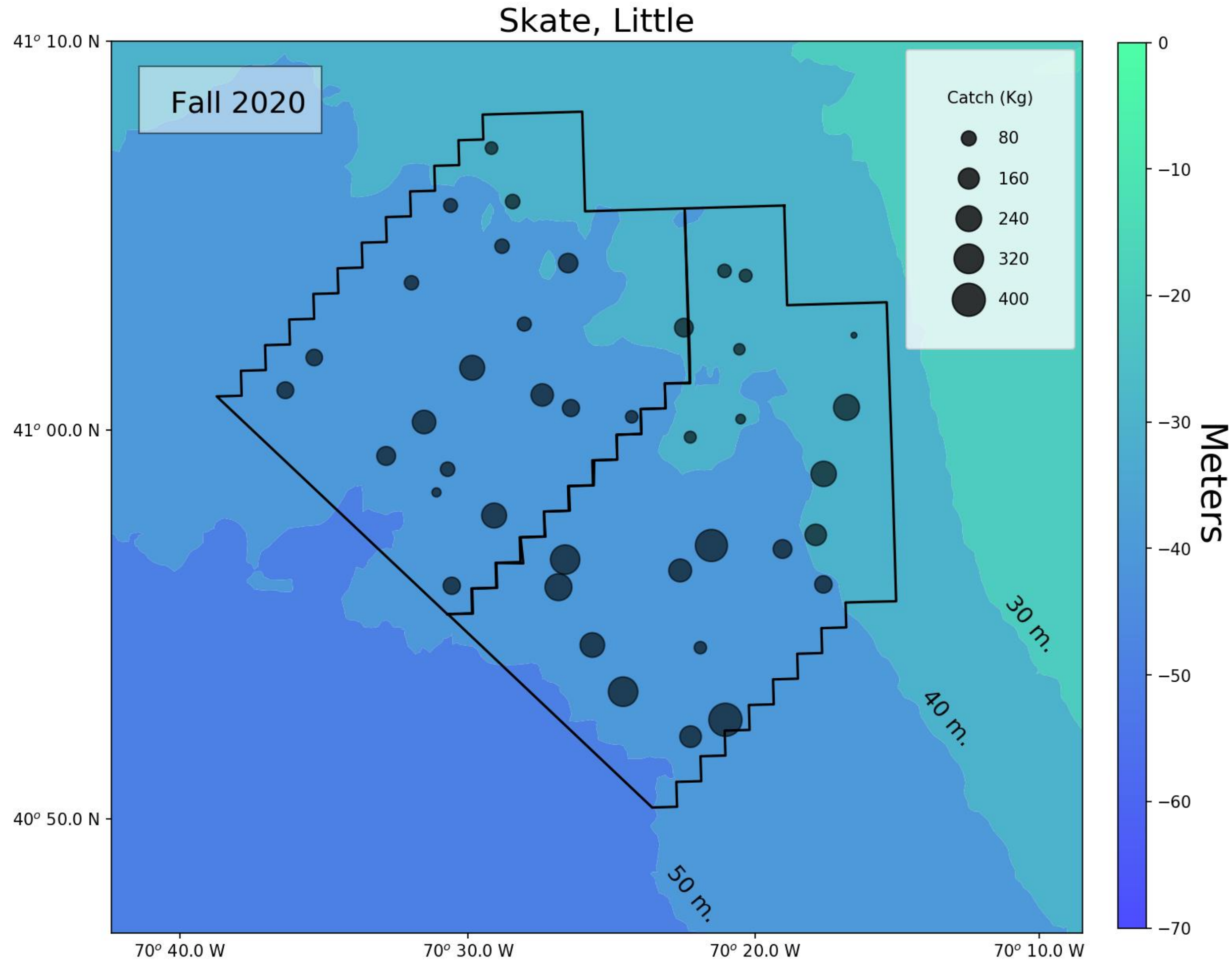
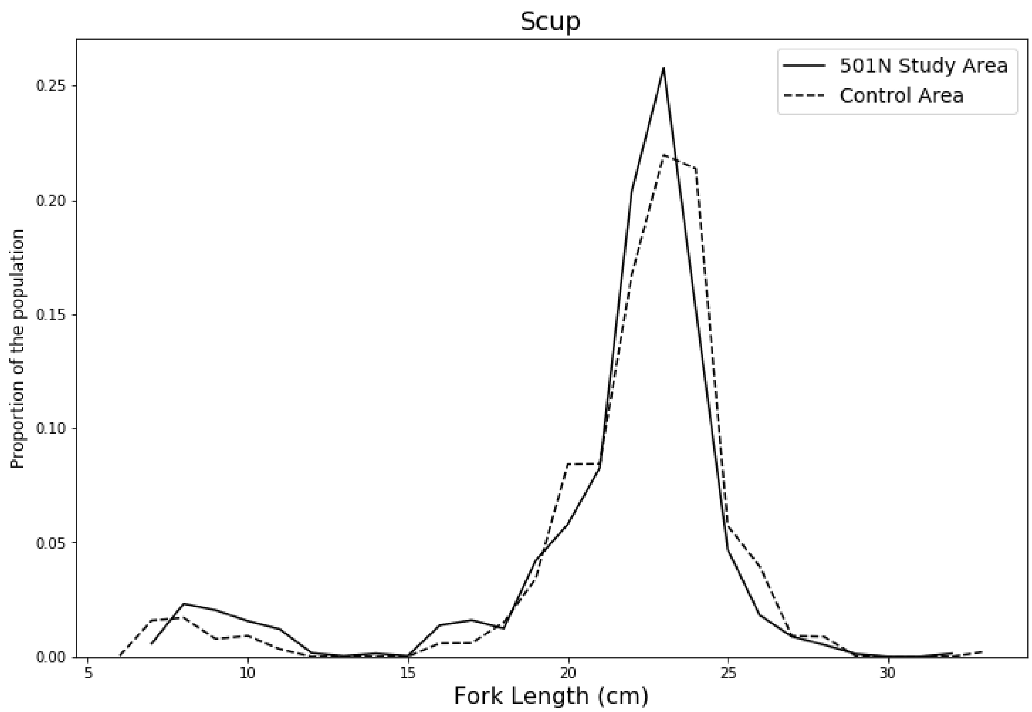


Figure 11: Distribution of the catch of little skate in the 501N Study Area (left) and Control Area (right).



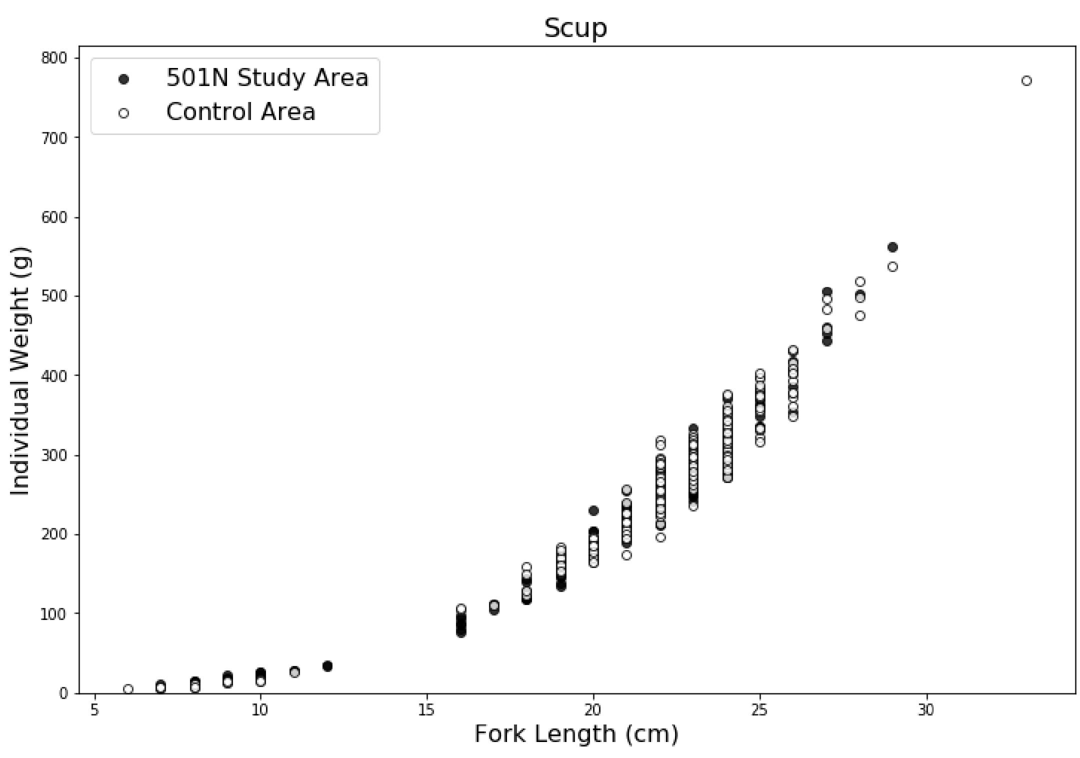


Figure 12: Population structure of scup in the 501N Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

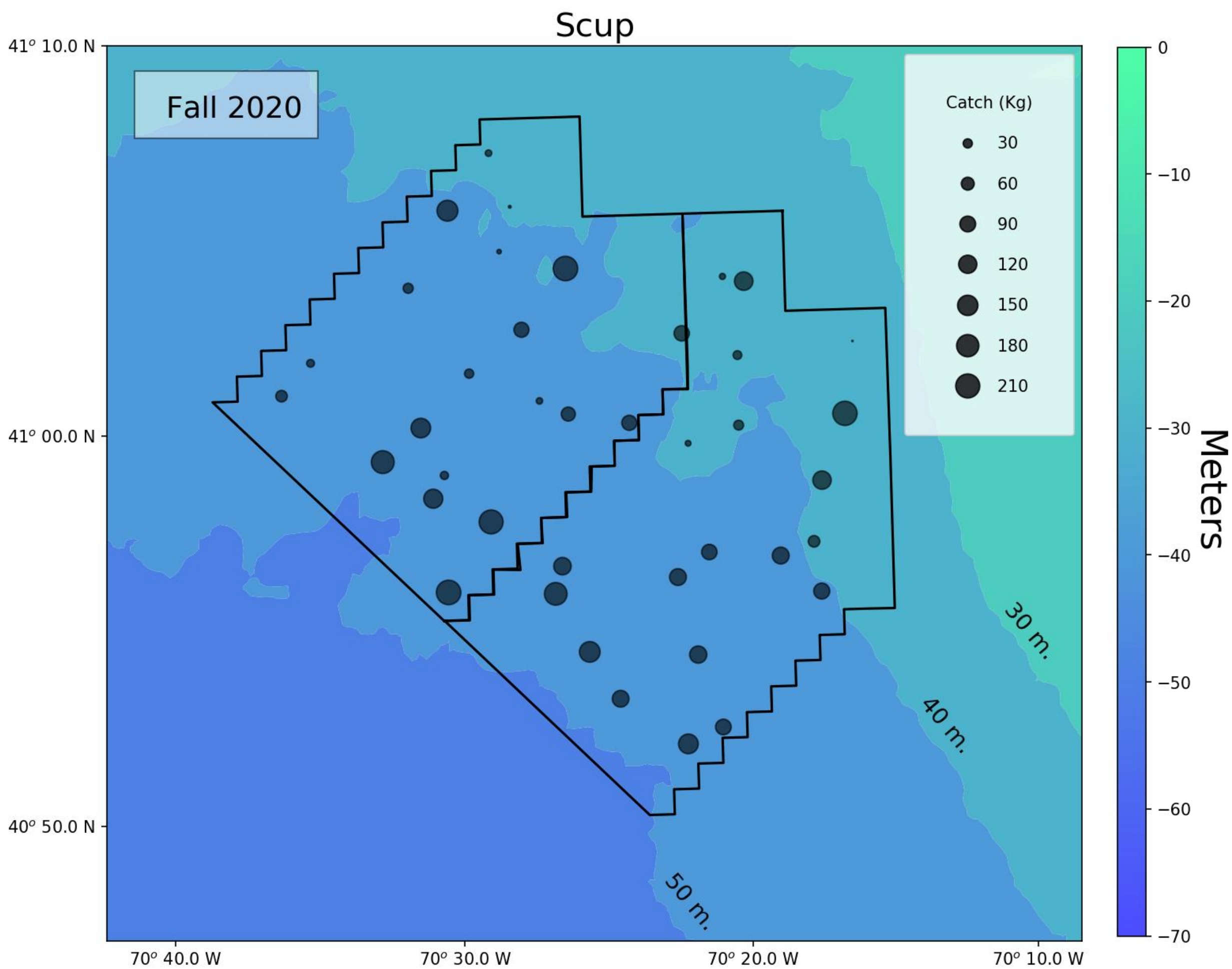
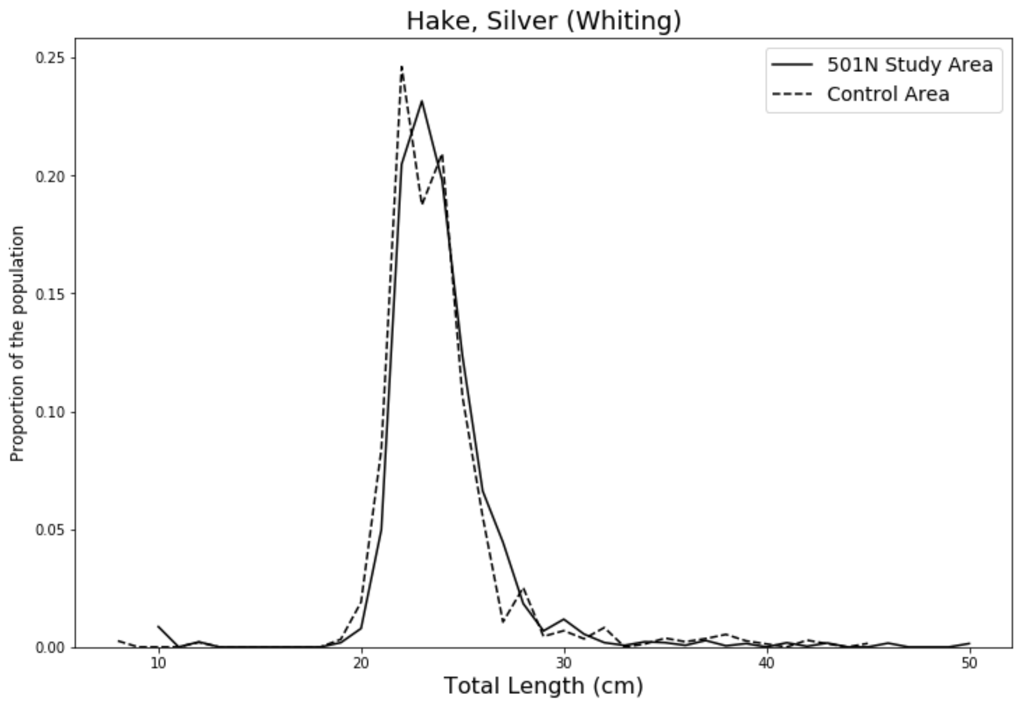


Figure 13: Distribution of the catch of scup in the 501N Study Area (left) and Control Area (right).



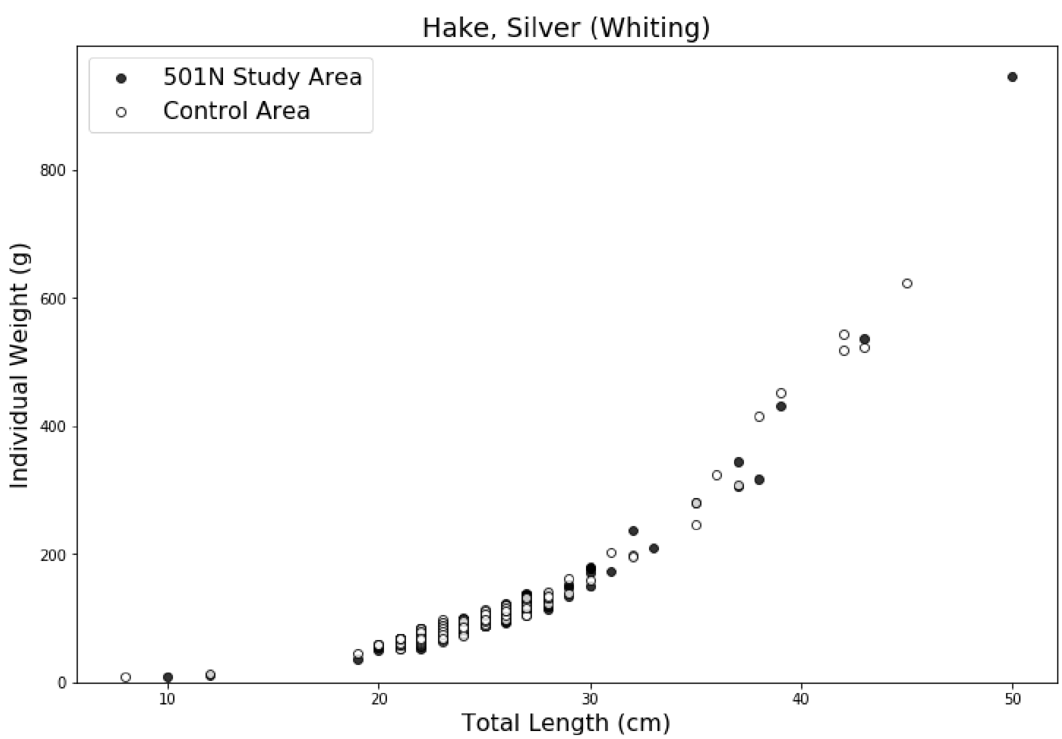


Figure 14: Population structure of silver hake in the 501N Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

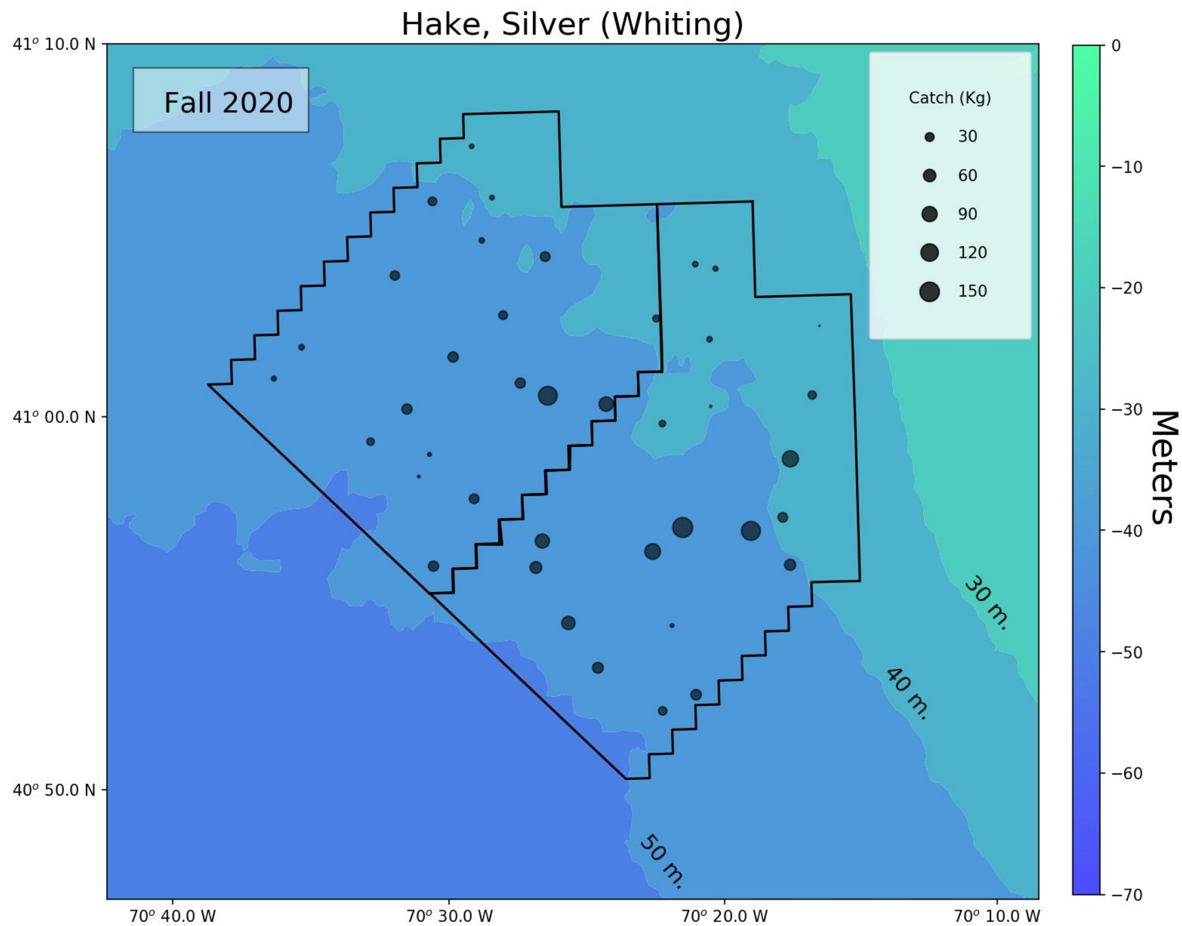
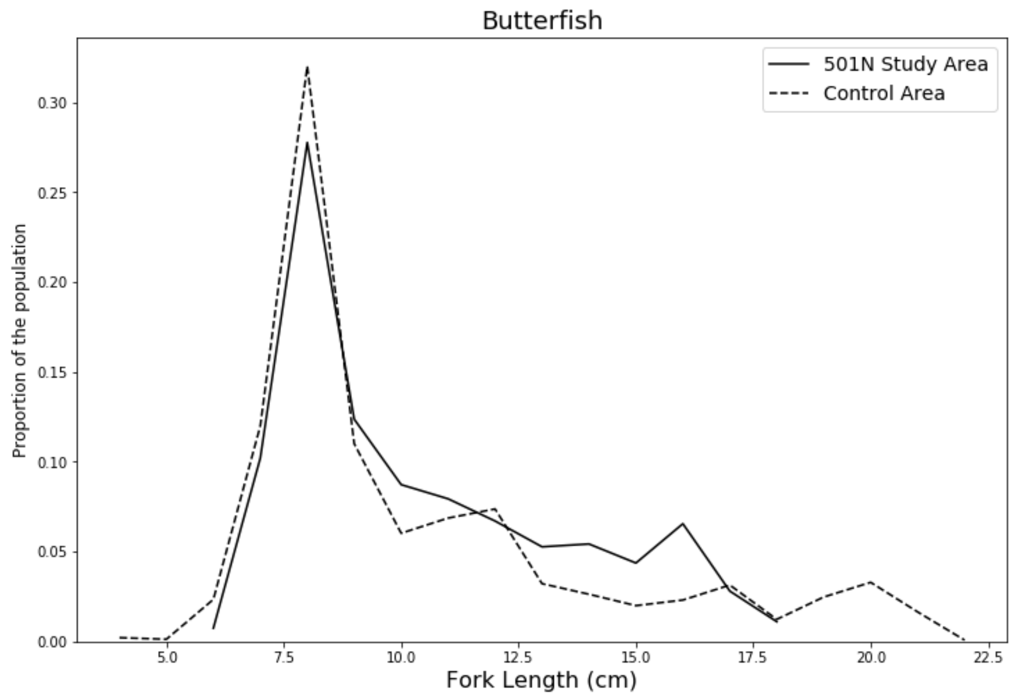


Figure 15: Distribution of the catch of silver hake in the 501N Study Area (left) and Control Area (right).



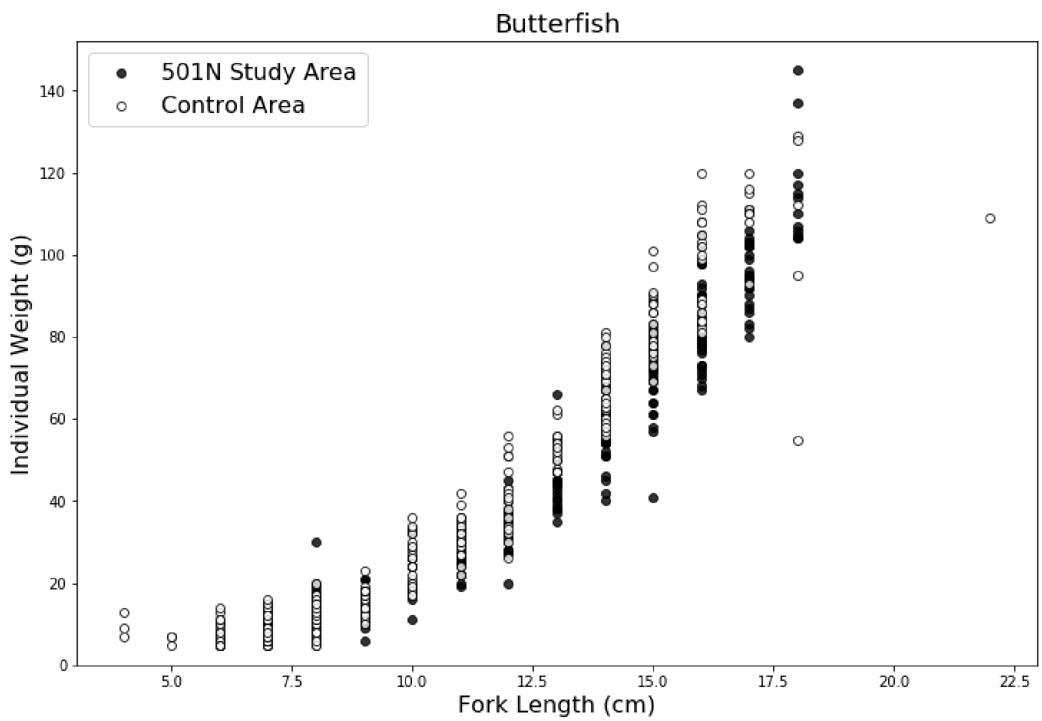


Figure 16: Population structure of butterfish in the 501N Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

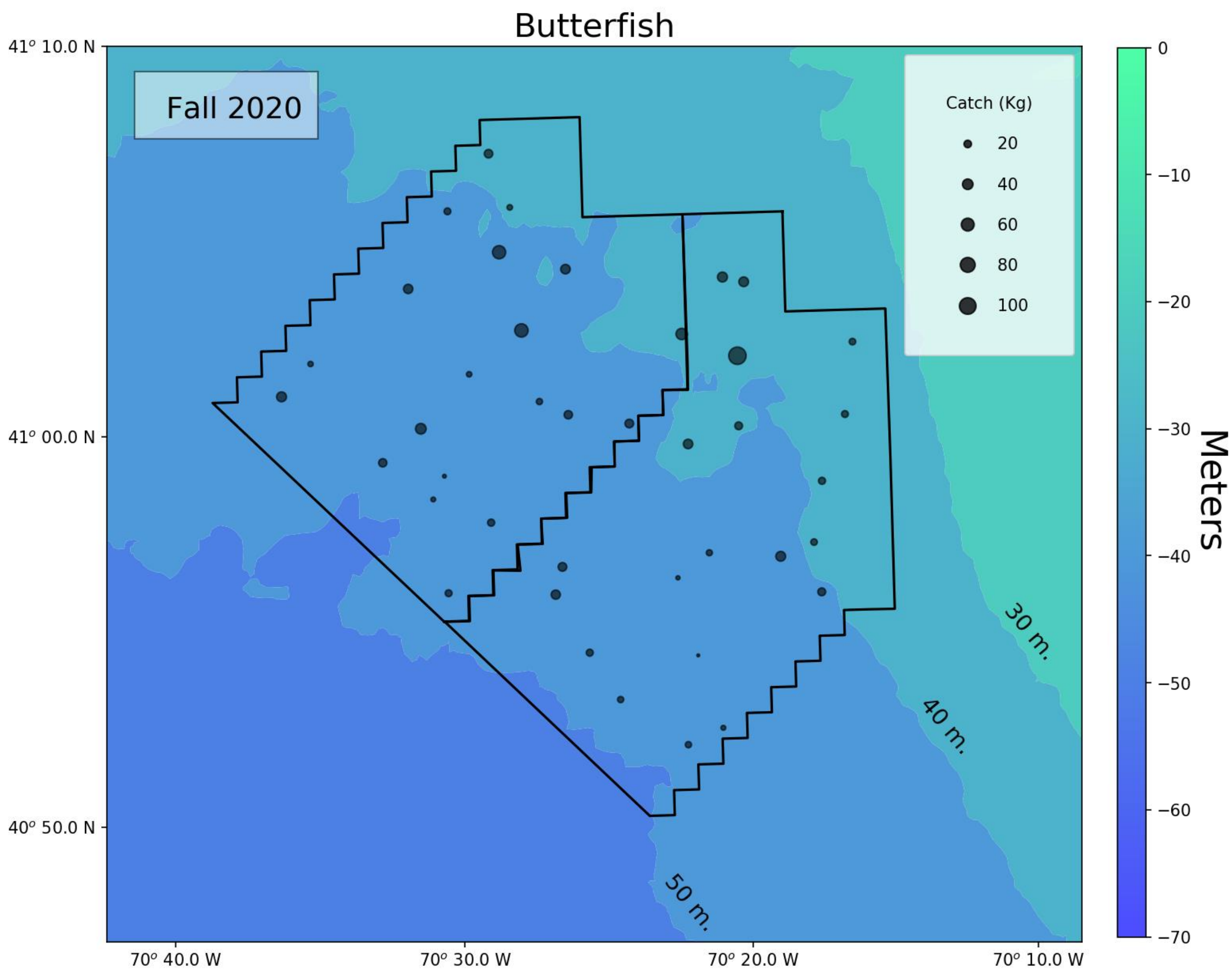
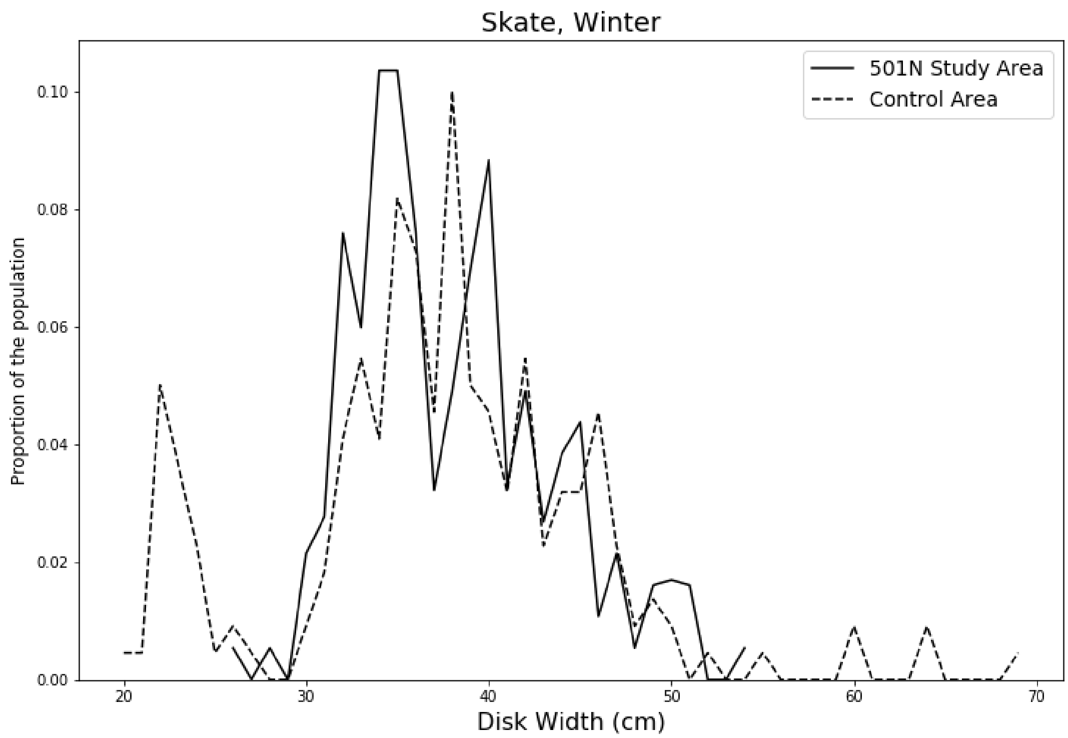


Figure 17: Distribution of the catch of butterfish in the 501N Study Area (left) and Control Area (right).



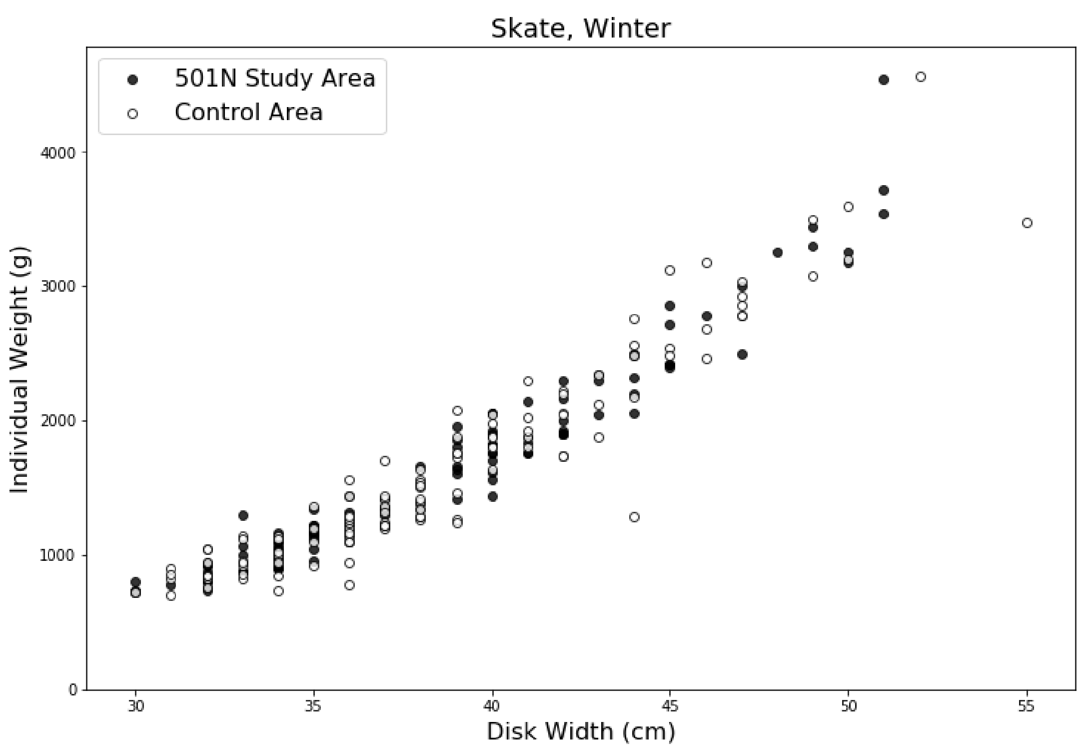


Figure 18: Population structure of winter skate in the 501N Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

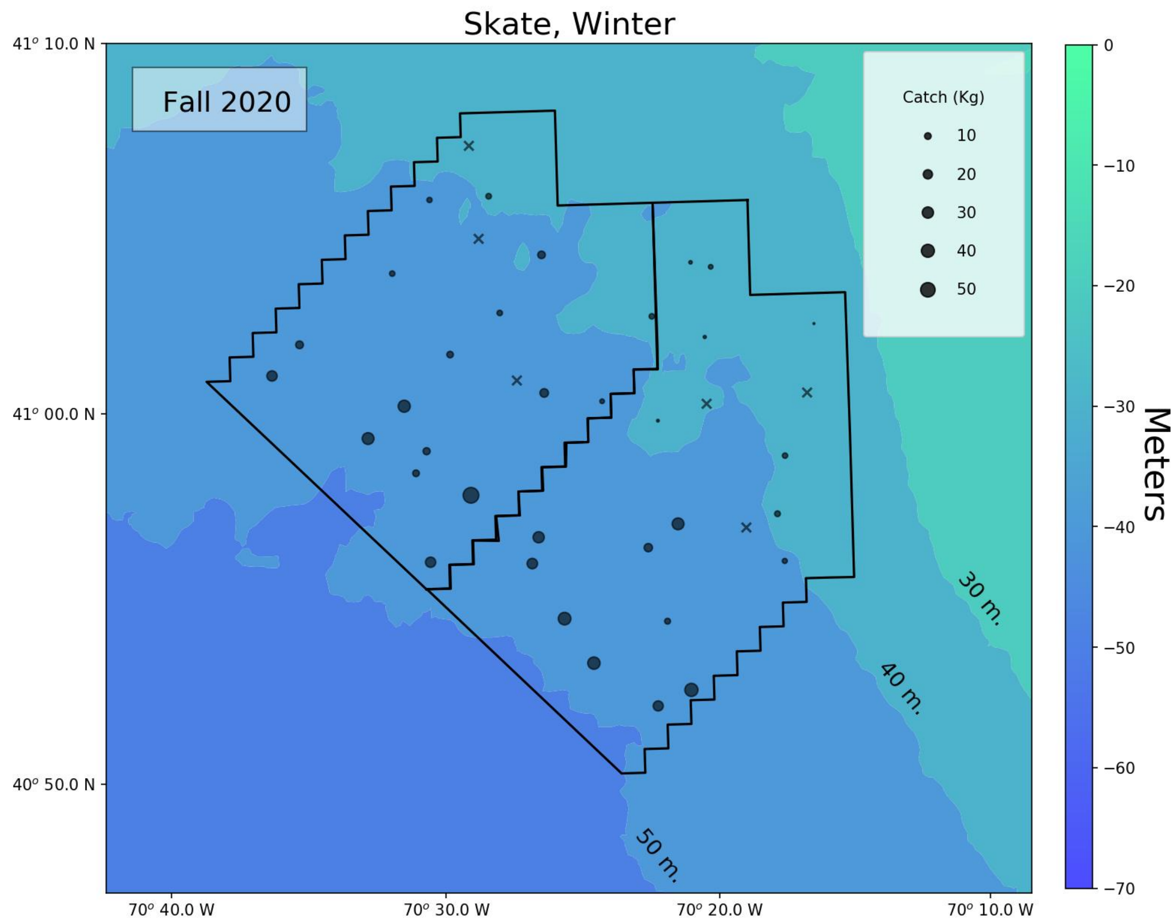
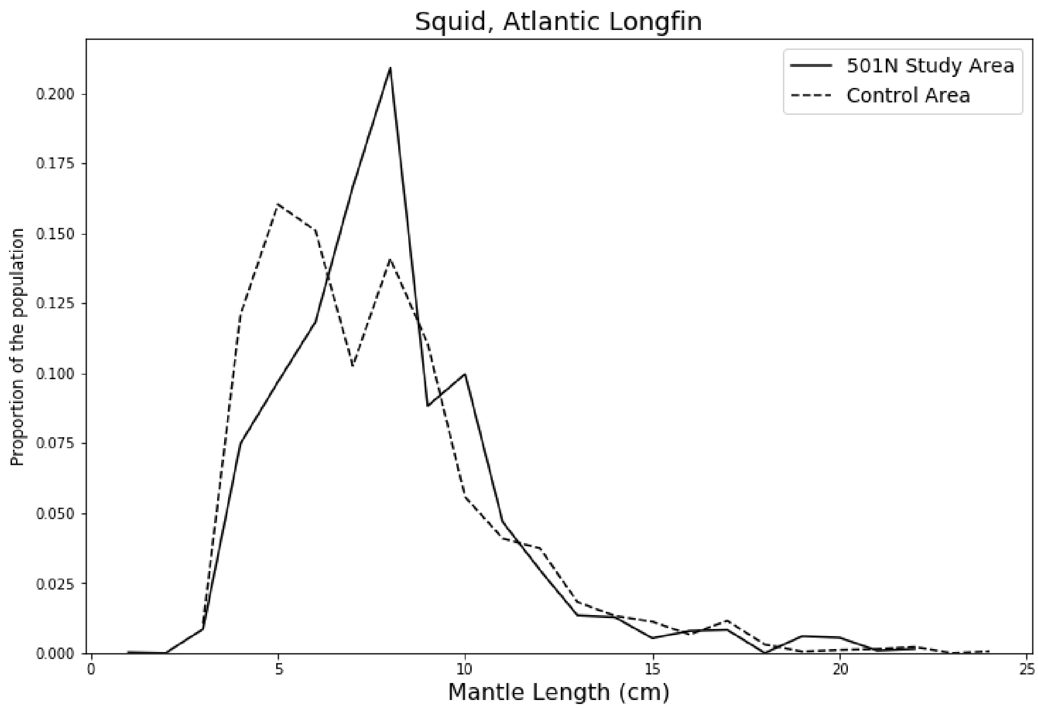


Figure 19: Distribution of the catch of winter skate in the 501N Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.



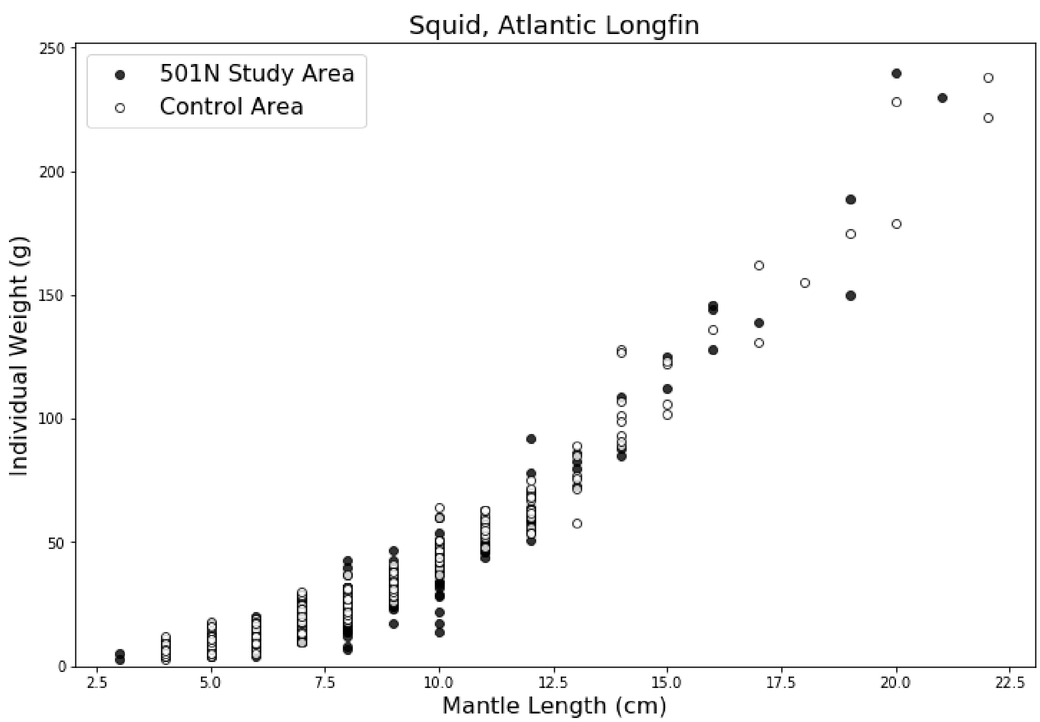


Figure 20: Population structure of Atlantic longfin squid in the 501N Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

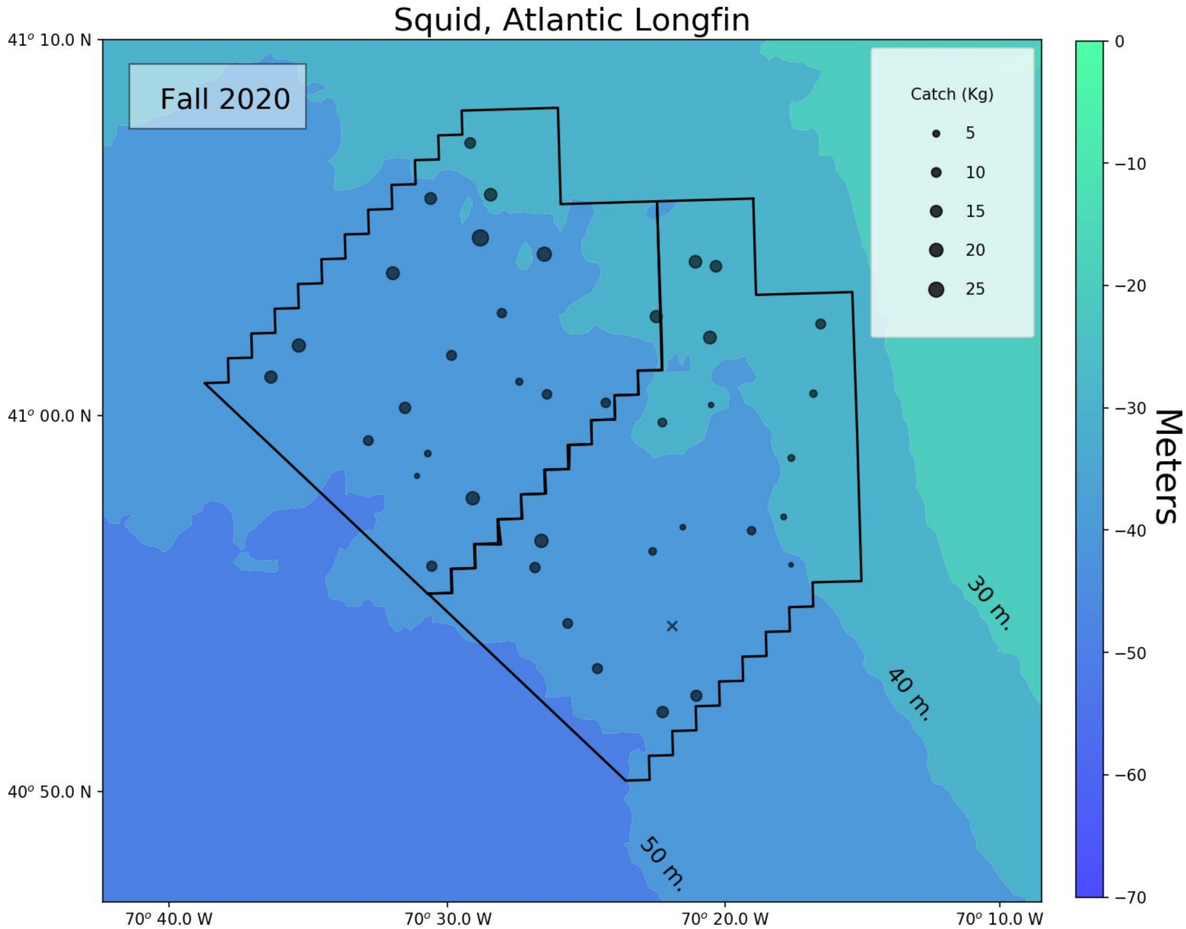
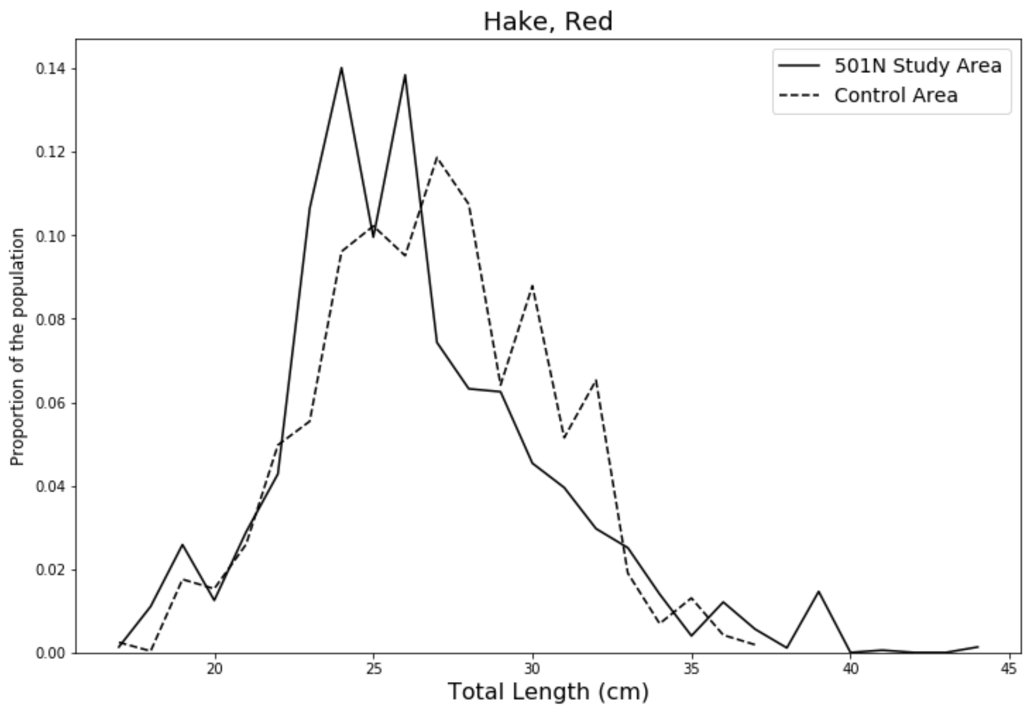


Figure 21: Distribution of the catch of Atlantic longfin squid in the 501N Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.



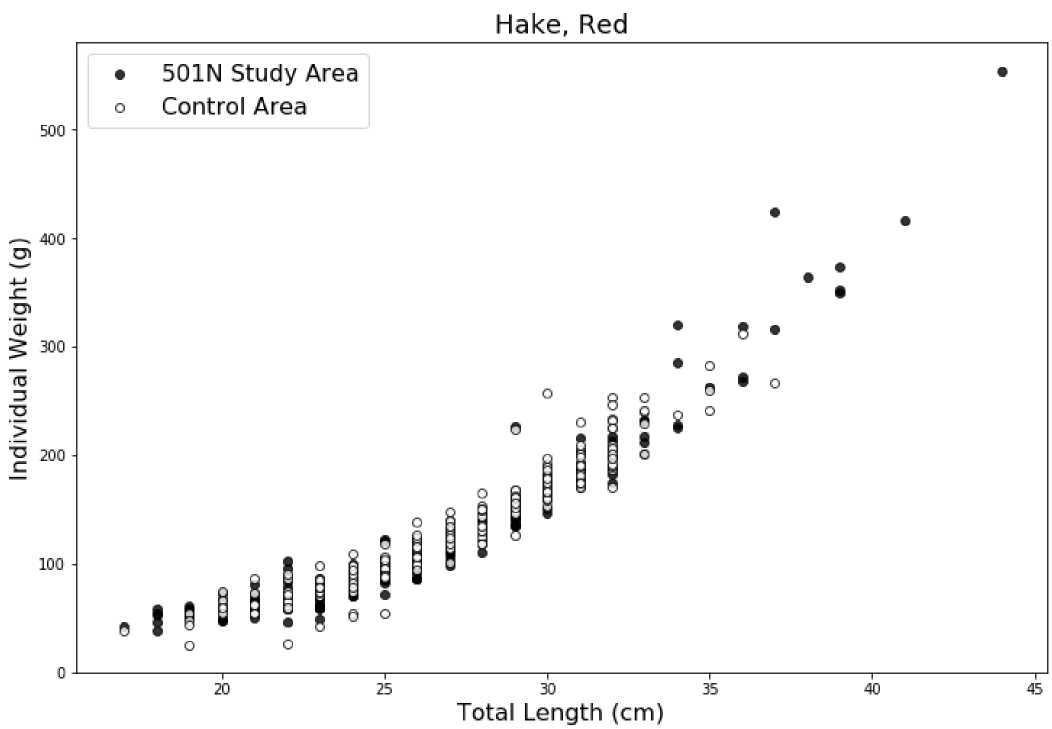


Figure 22: Population structure of red hake in the 501N Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

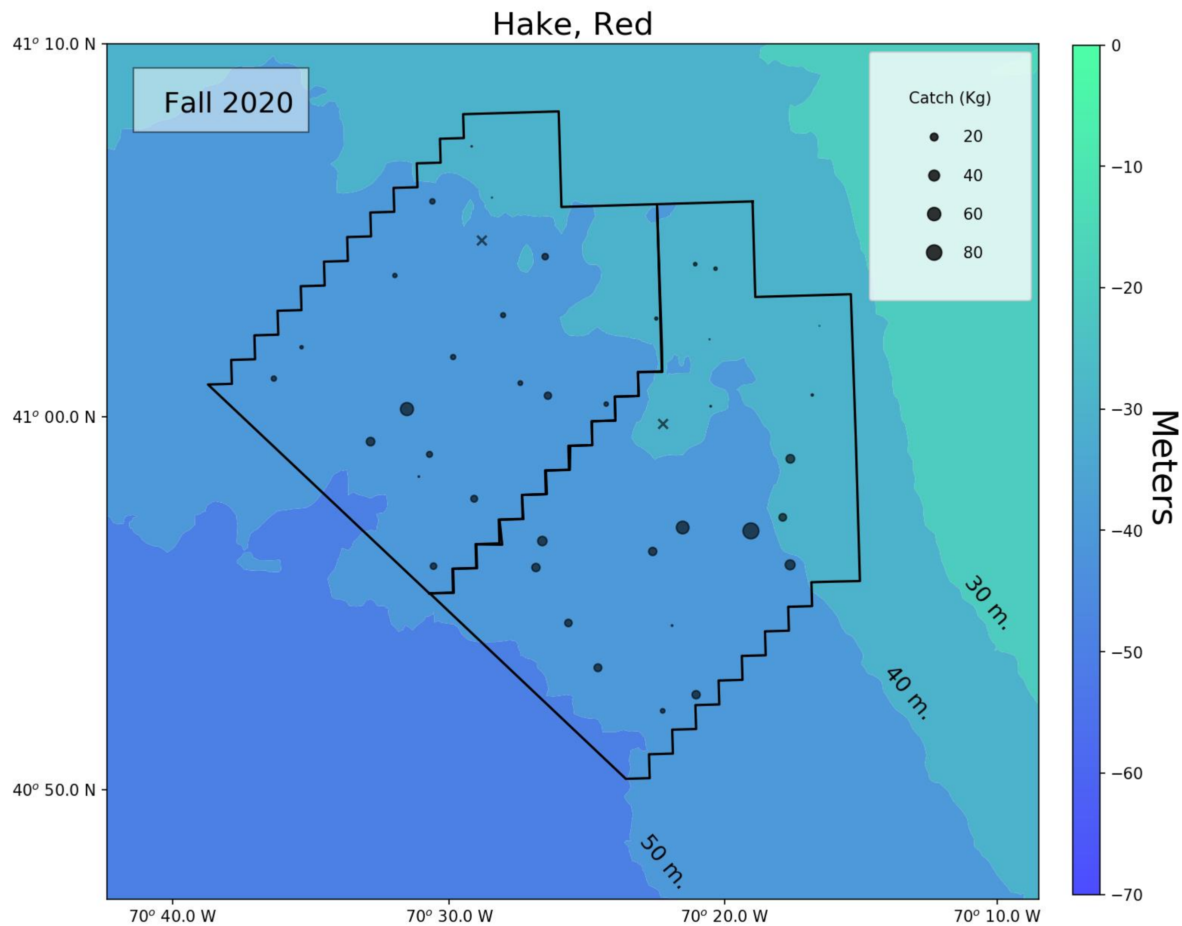
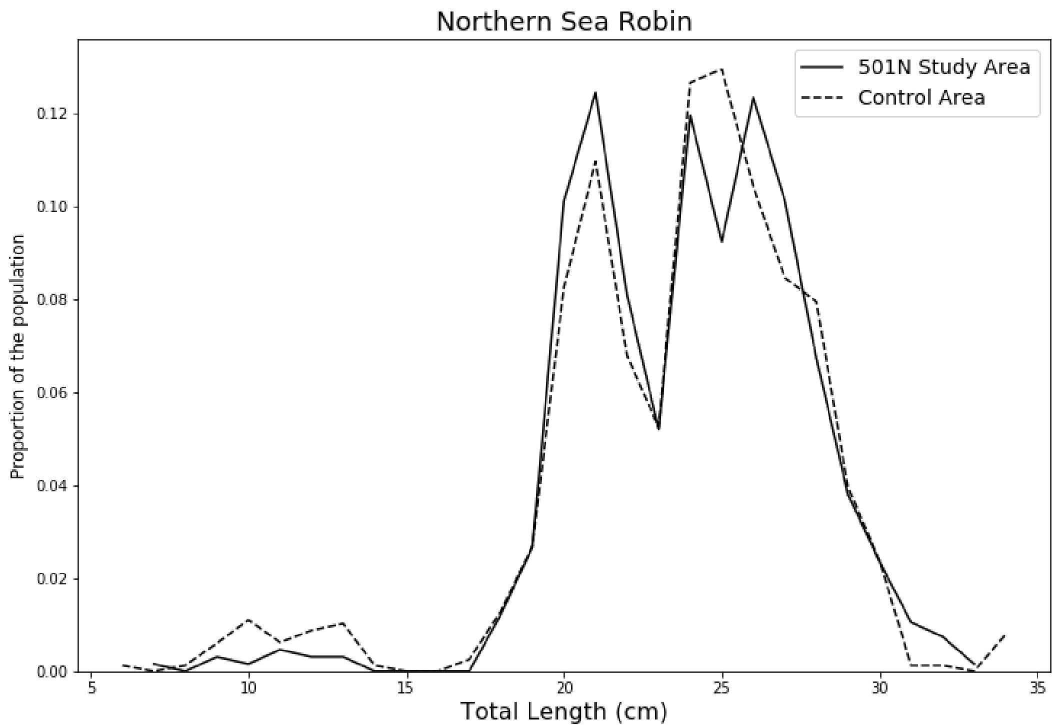


Figure 23: Distribution of the catch of red hake in the 501N Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.



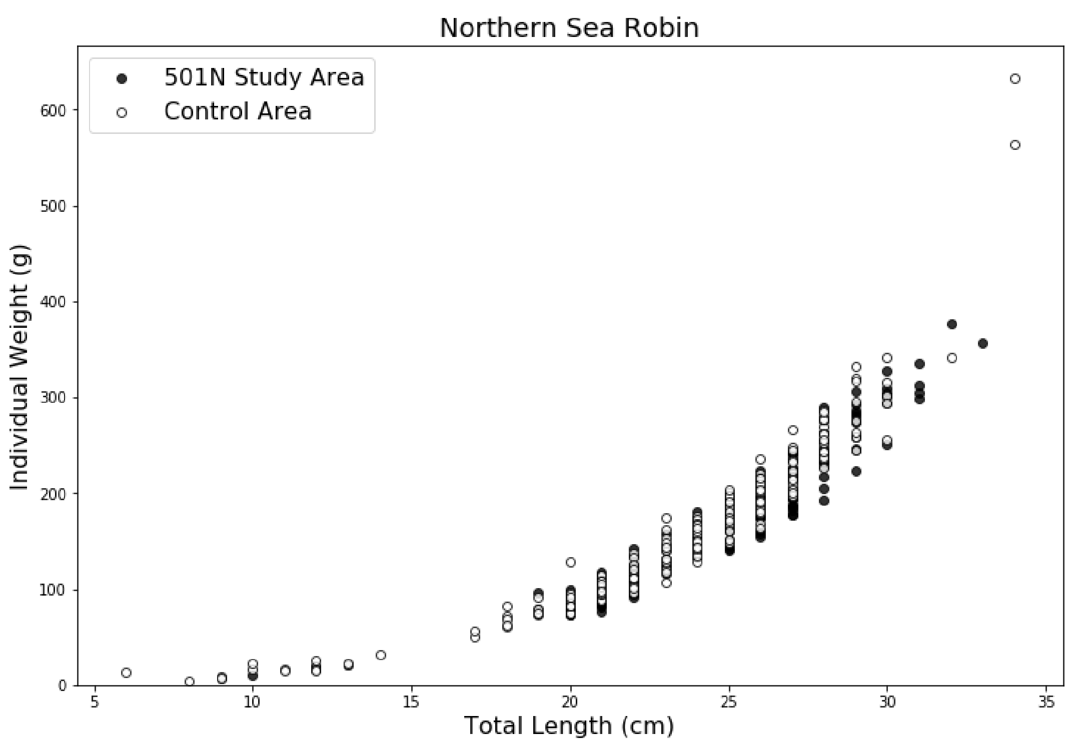


Figure 24: Population structure of northern sea robin in the 501N Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

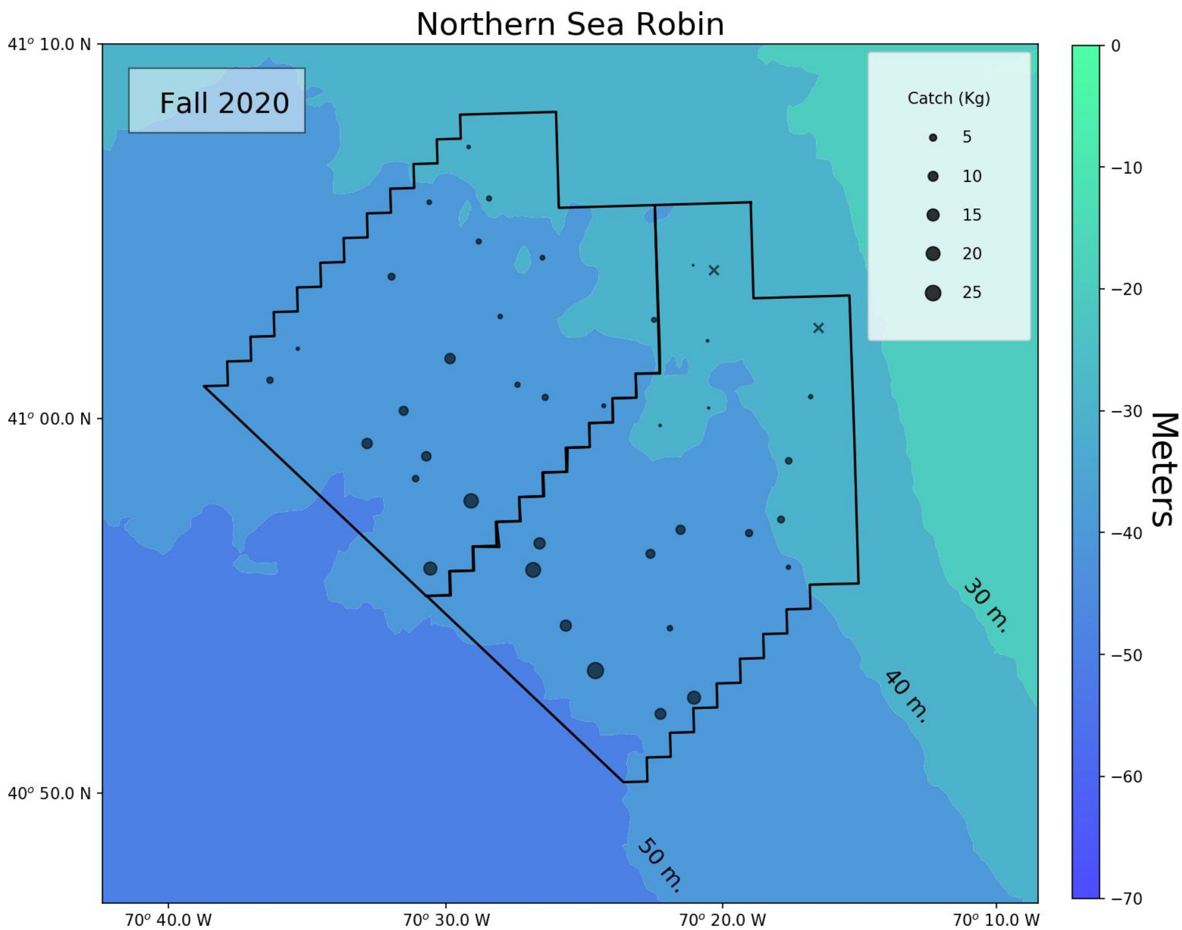


Figure 25: Distribution of the catch of northern sea robin in the 501N Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.

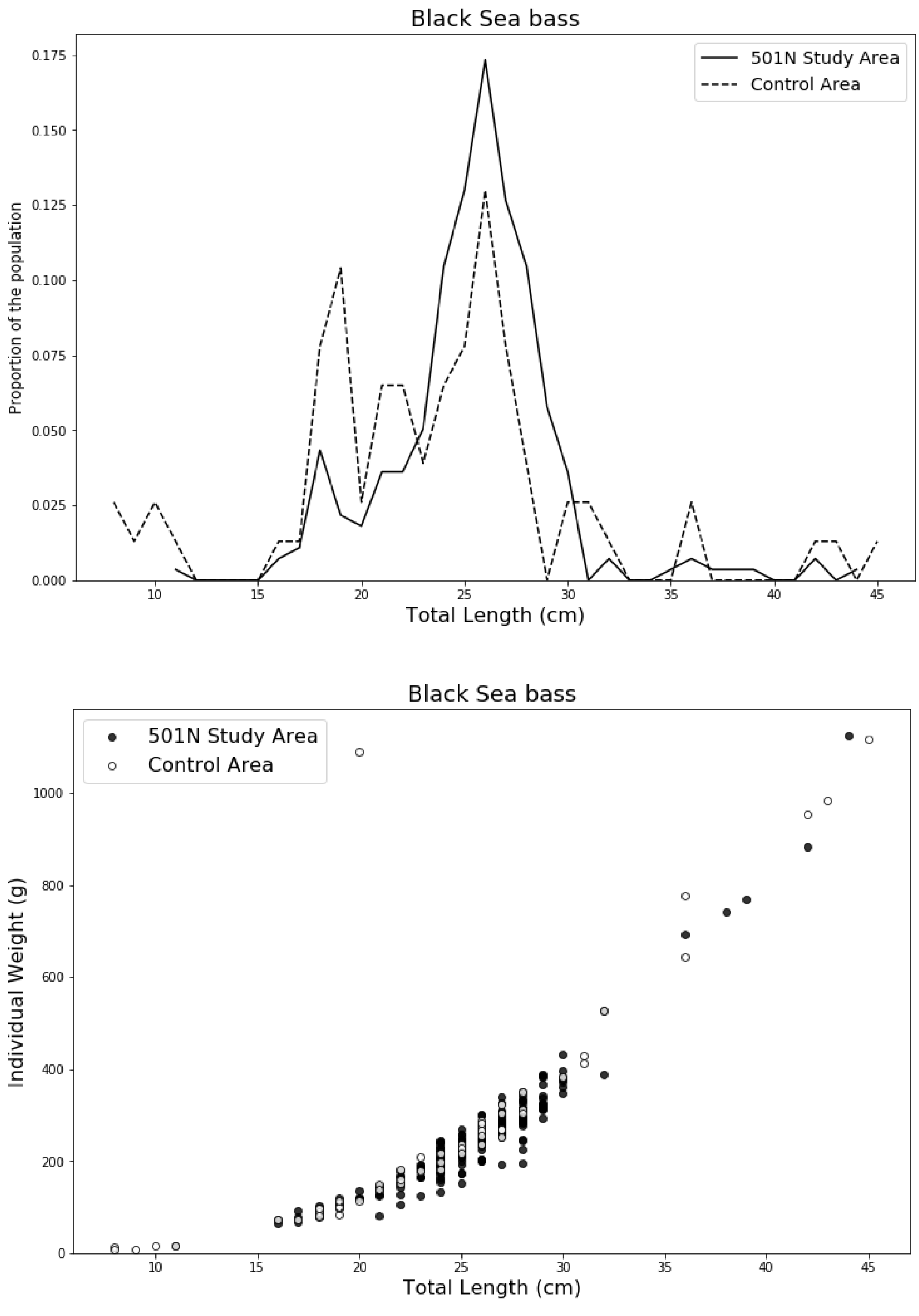


Figure 26: Population structure of black sea bass in the 501N Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

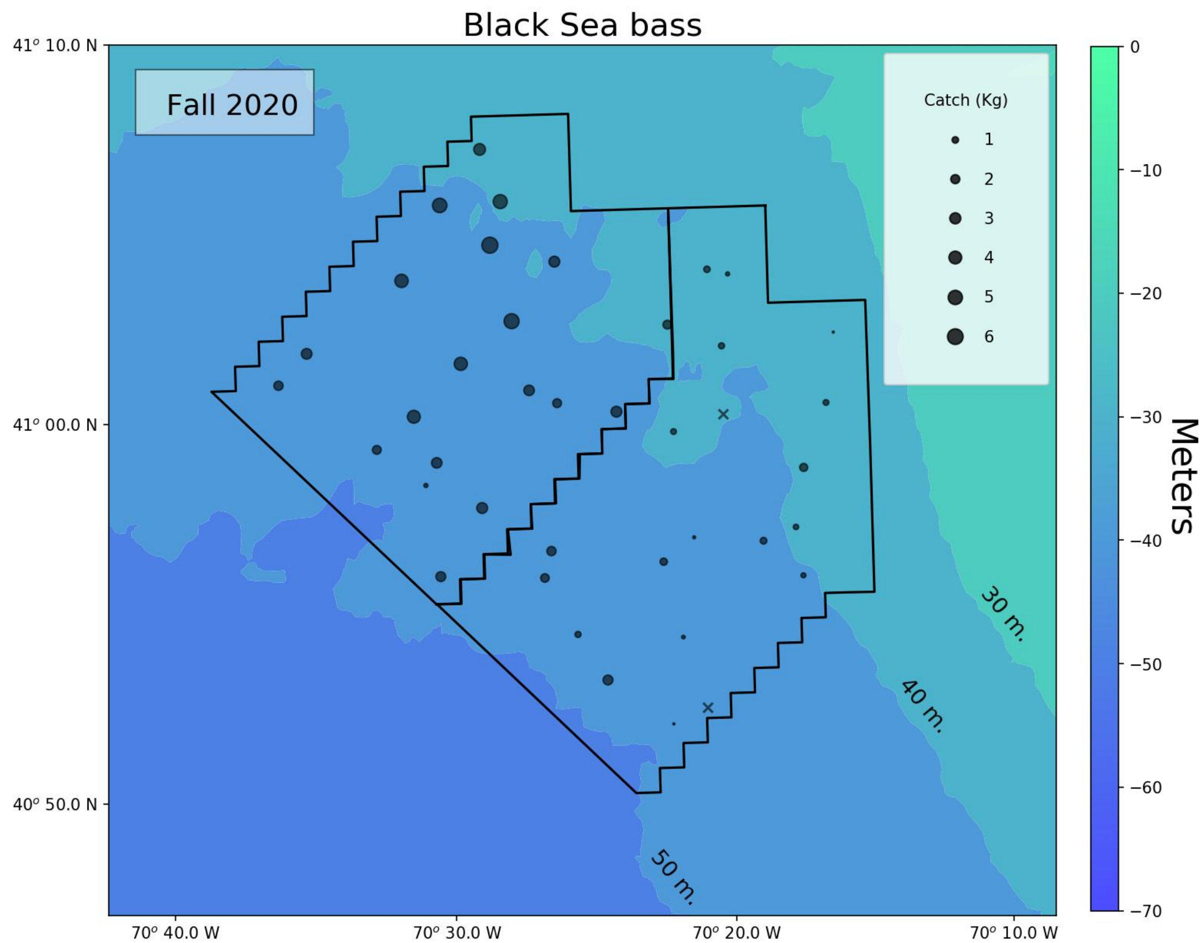
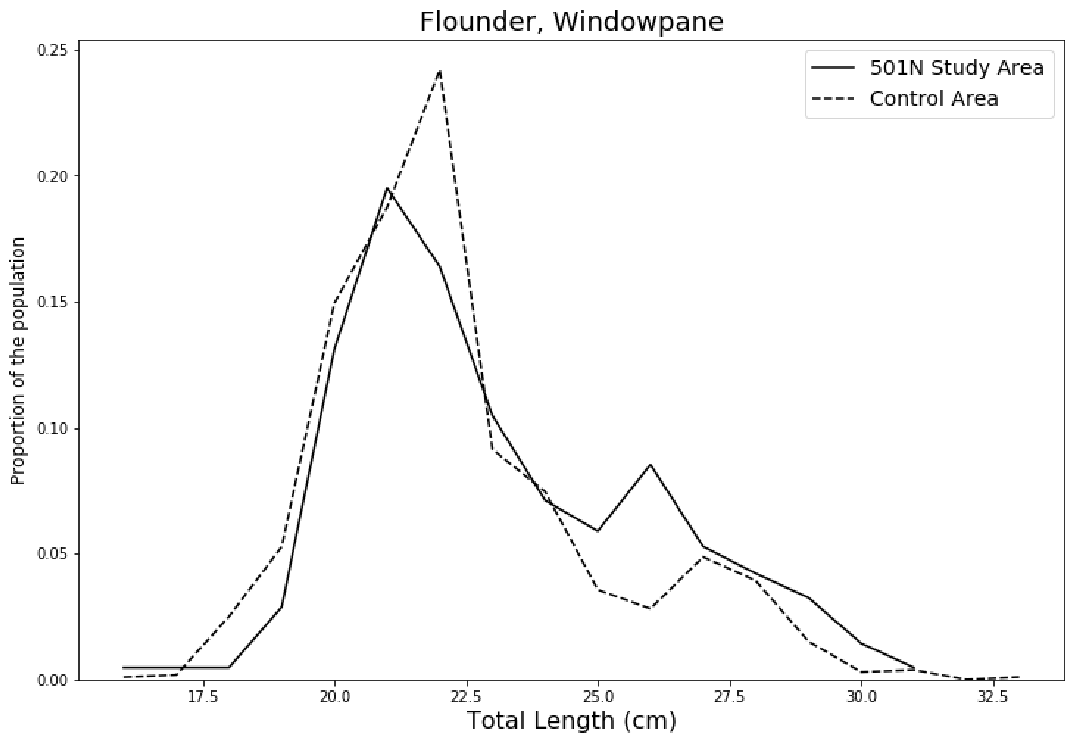


Figure 27: Distribution of the catch of black sea bass in the 501N Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.



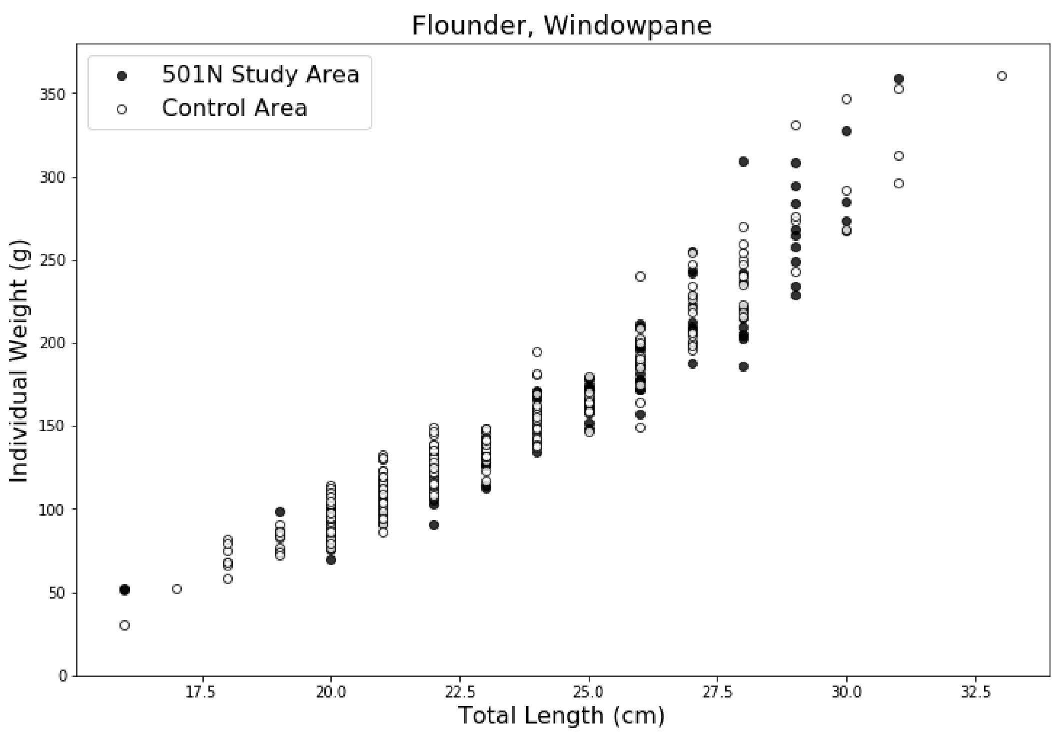


Figure 28: Population structure of windowpane flounder in the 501N Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

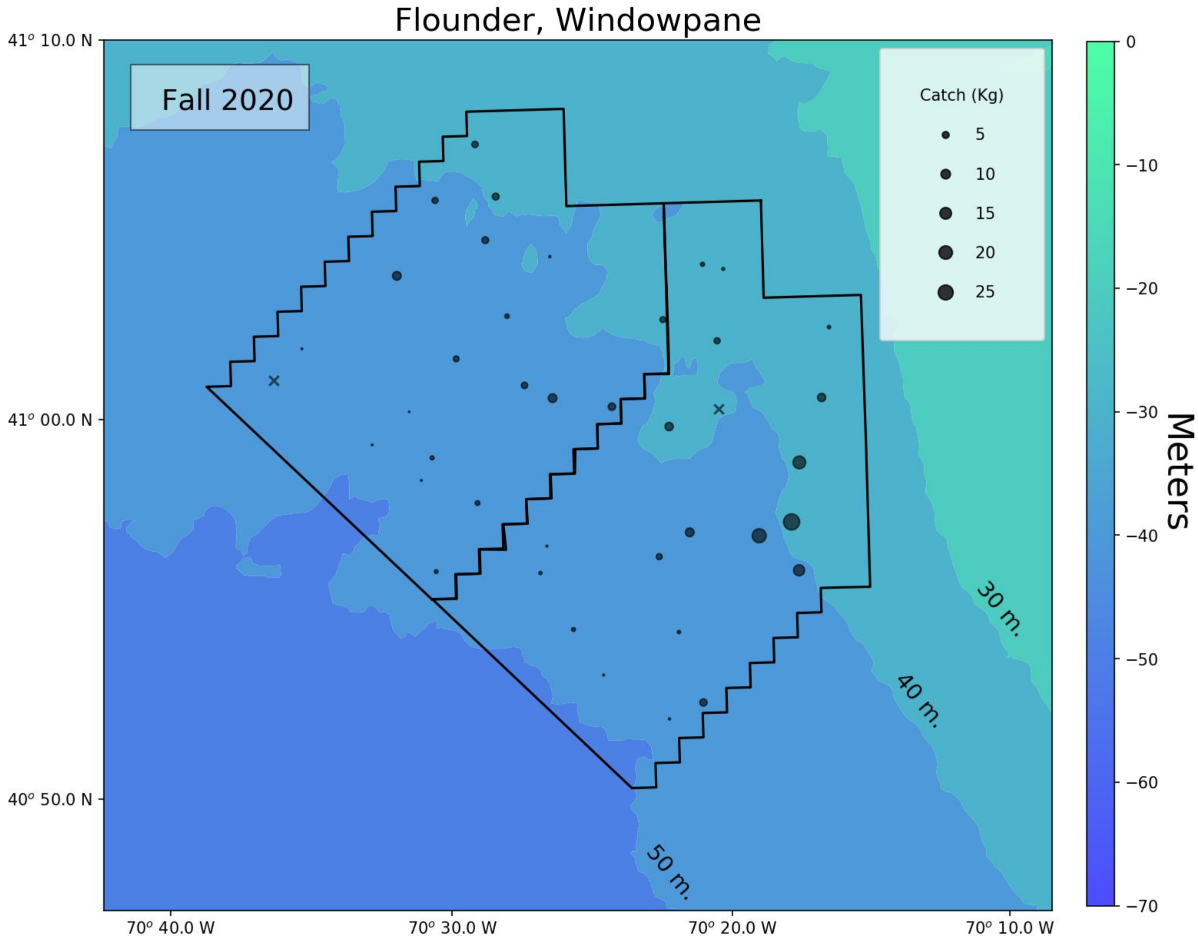


Figure 29: Distribution of the catch of windowpane flounder in the 501N Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.

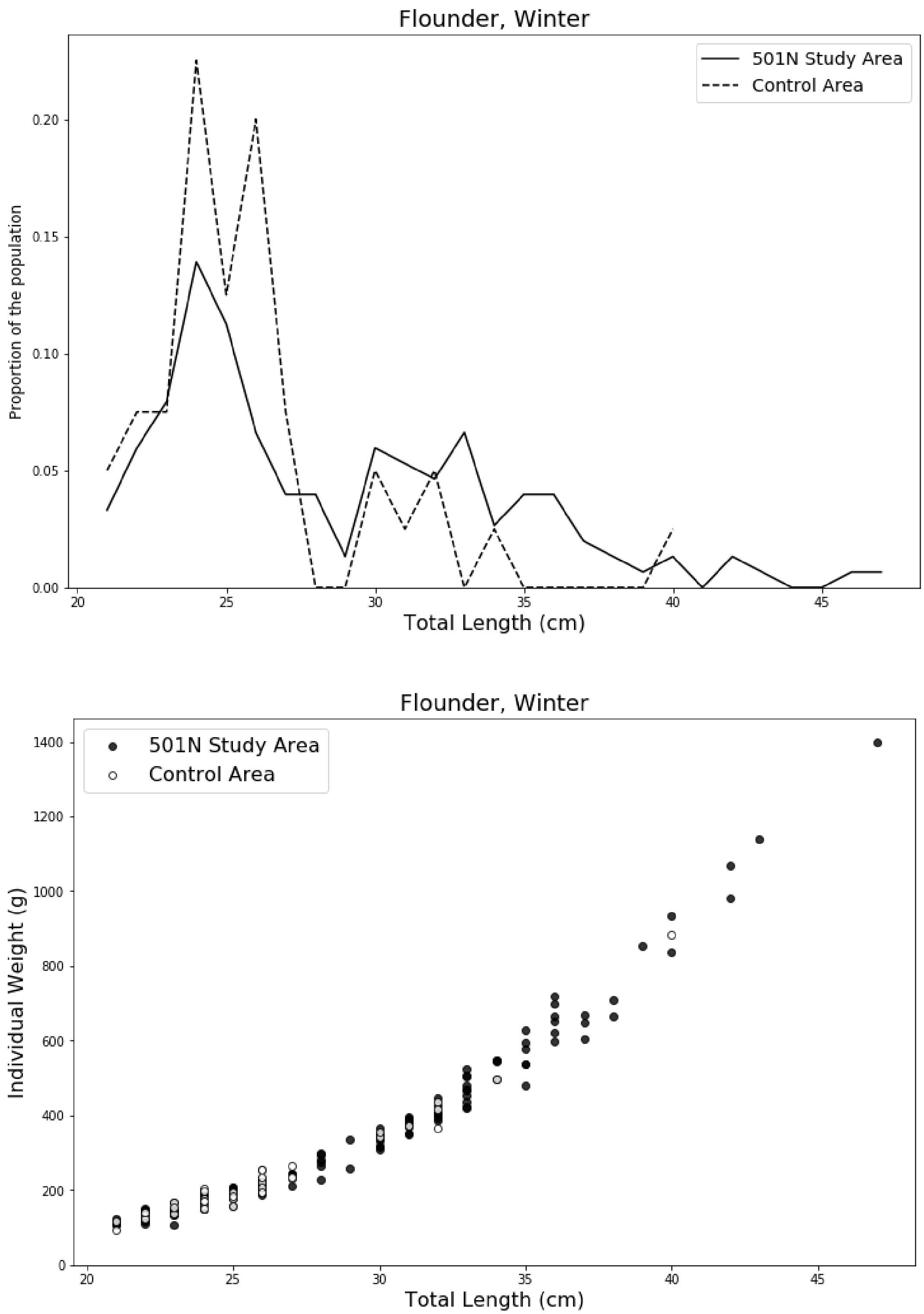


Figure 30: Population structure of winter flounder in the 501N Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

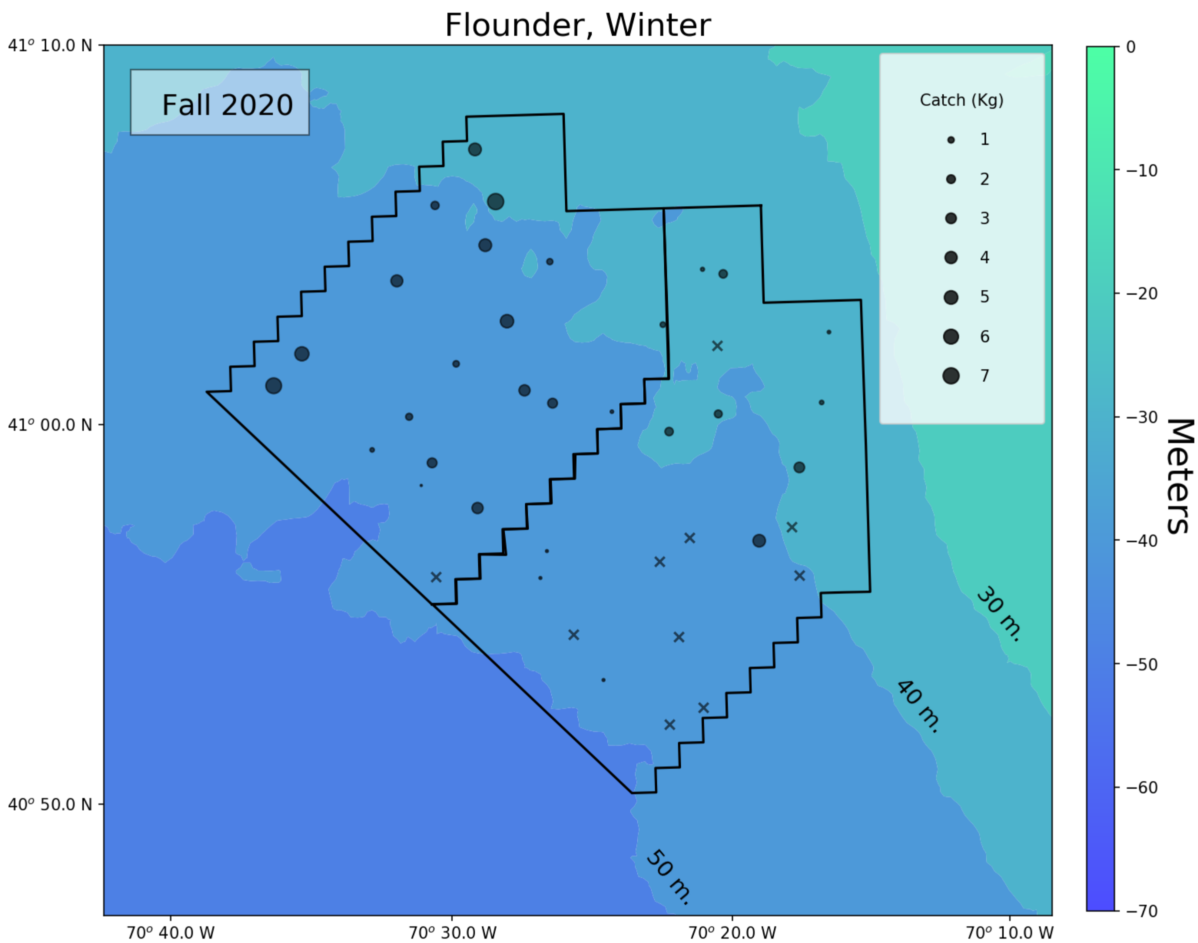
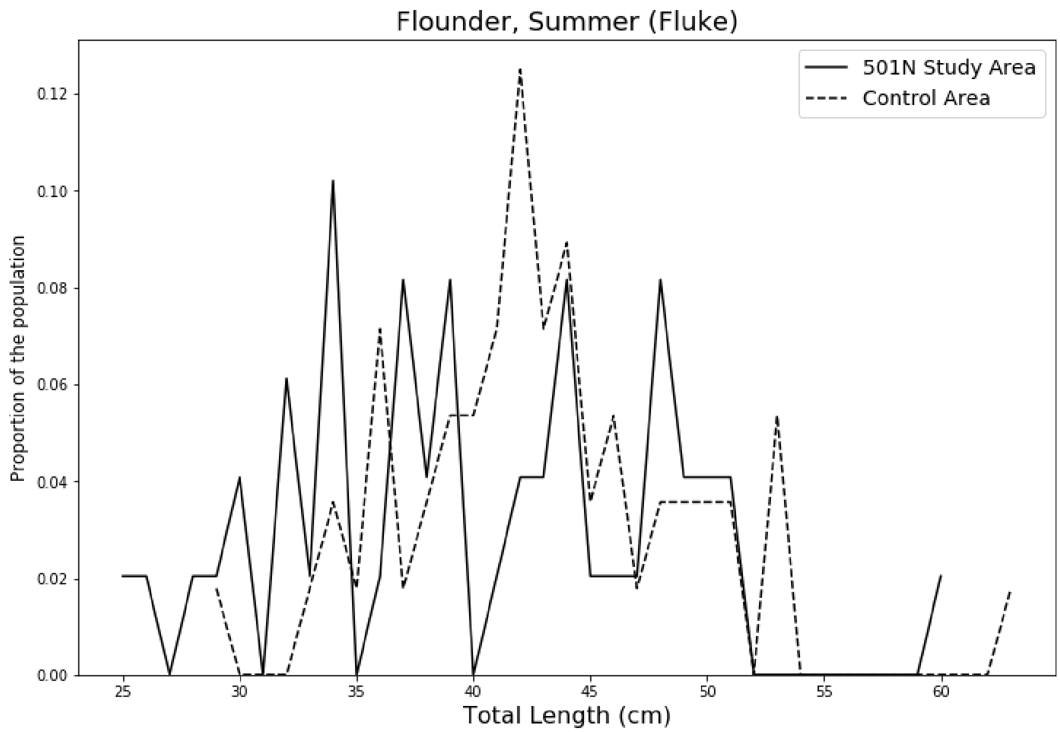


Figure 31: Distribution of the catch of winter flounder in the 501N Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.



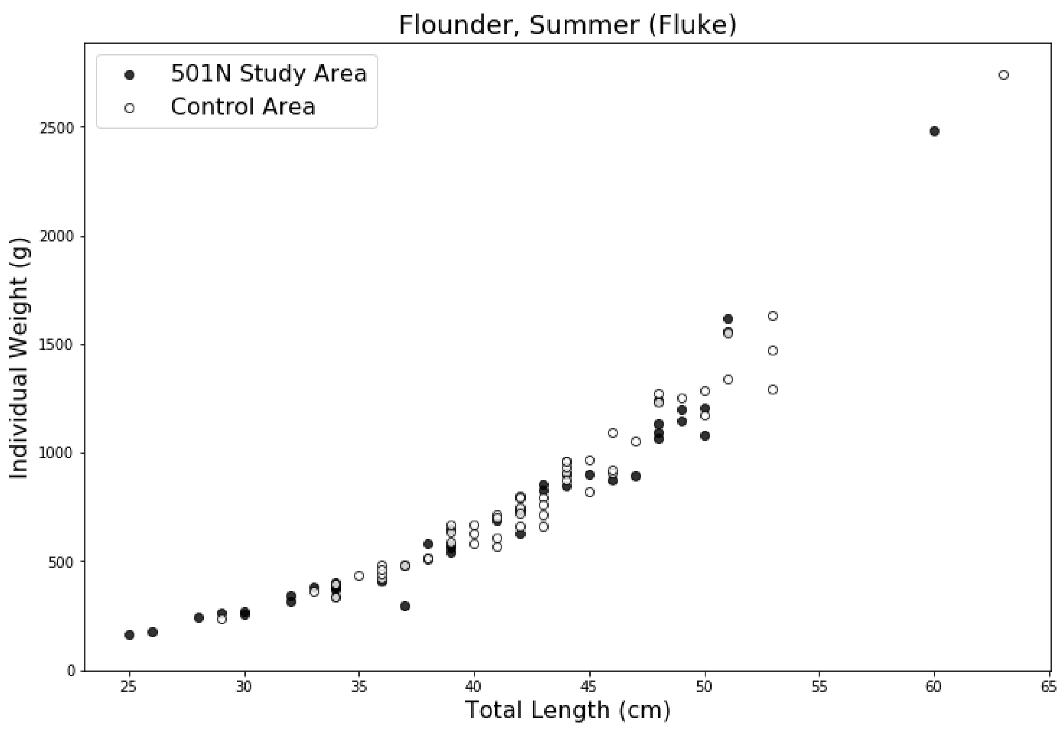


Figure 32: Population structure of summer flounder in the 501N Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

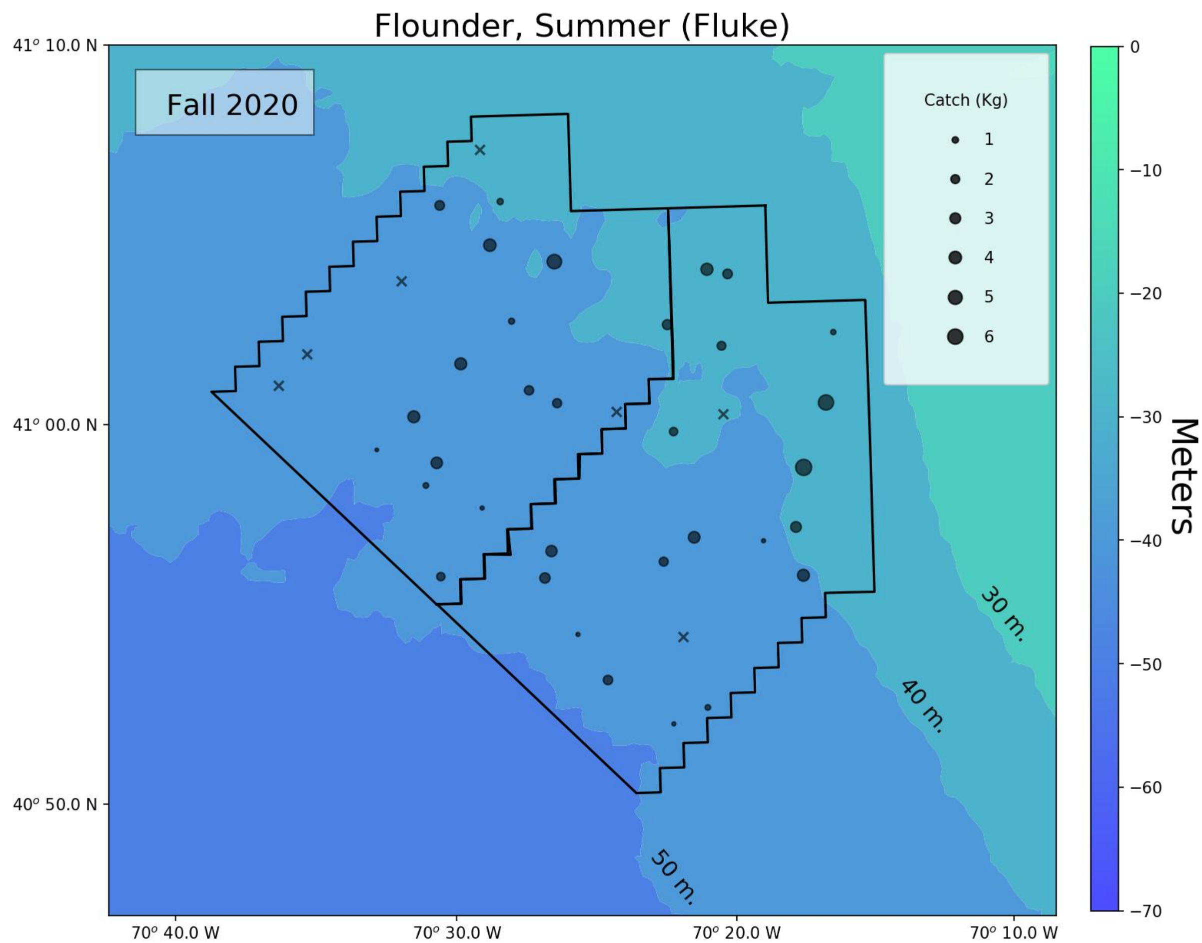
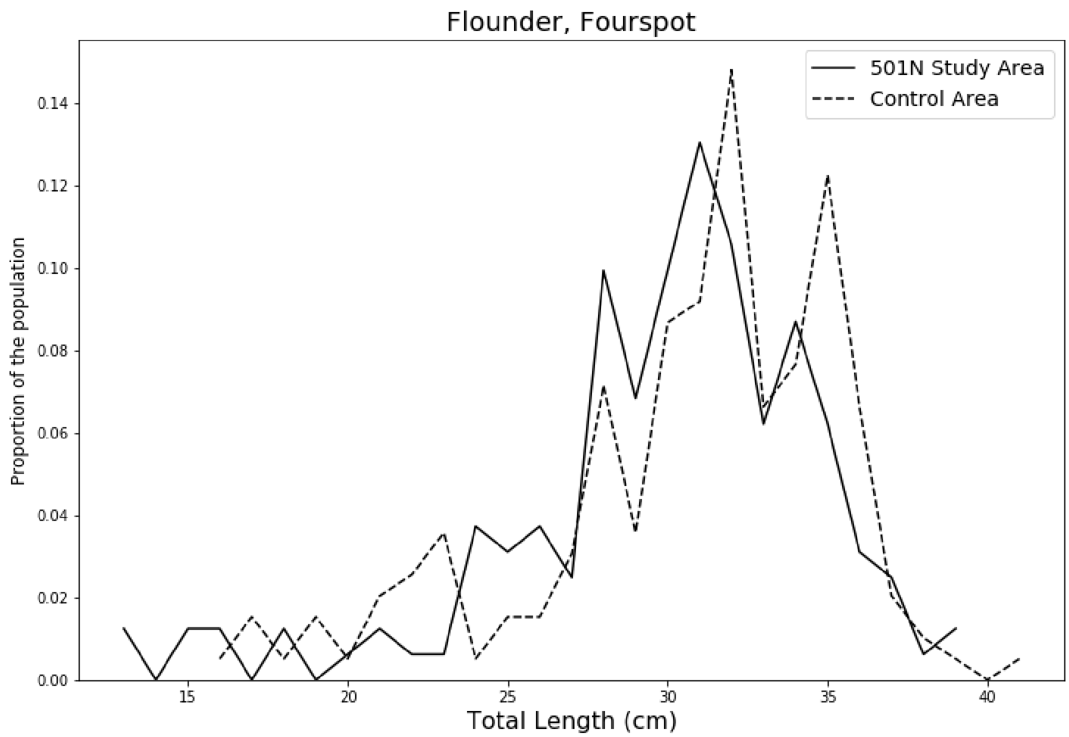


Figure 33: Distribution of the catch of summer flounder in the 501N Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.



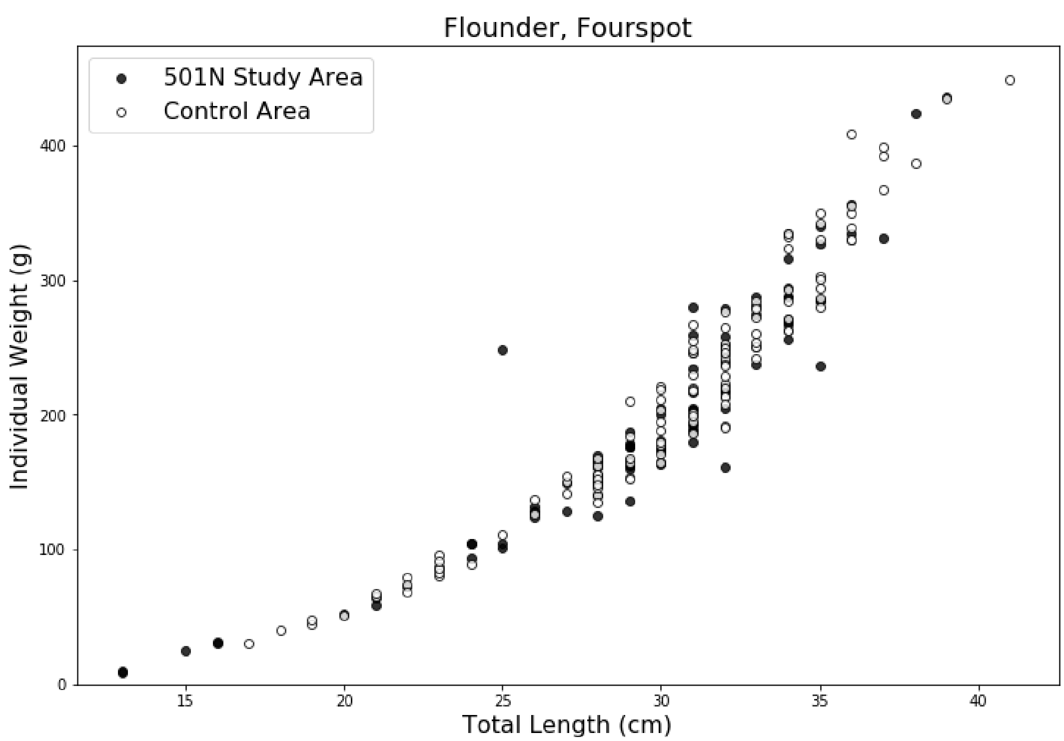


Figure 34: Population structure of fourspot flounder in the 501N Study Area and Control Area as determined by the length-frequency data (top) and length-weight relationships (bottom).

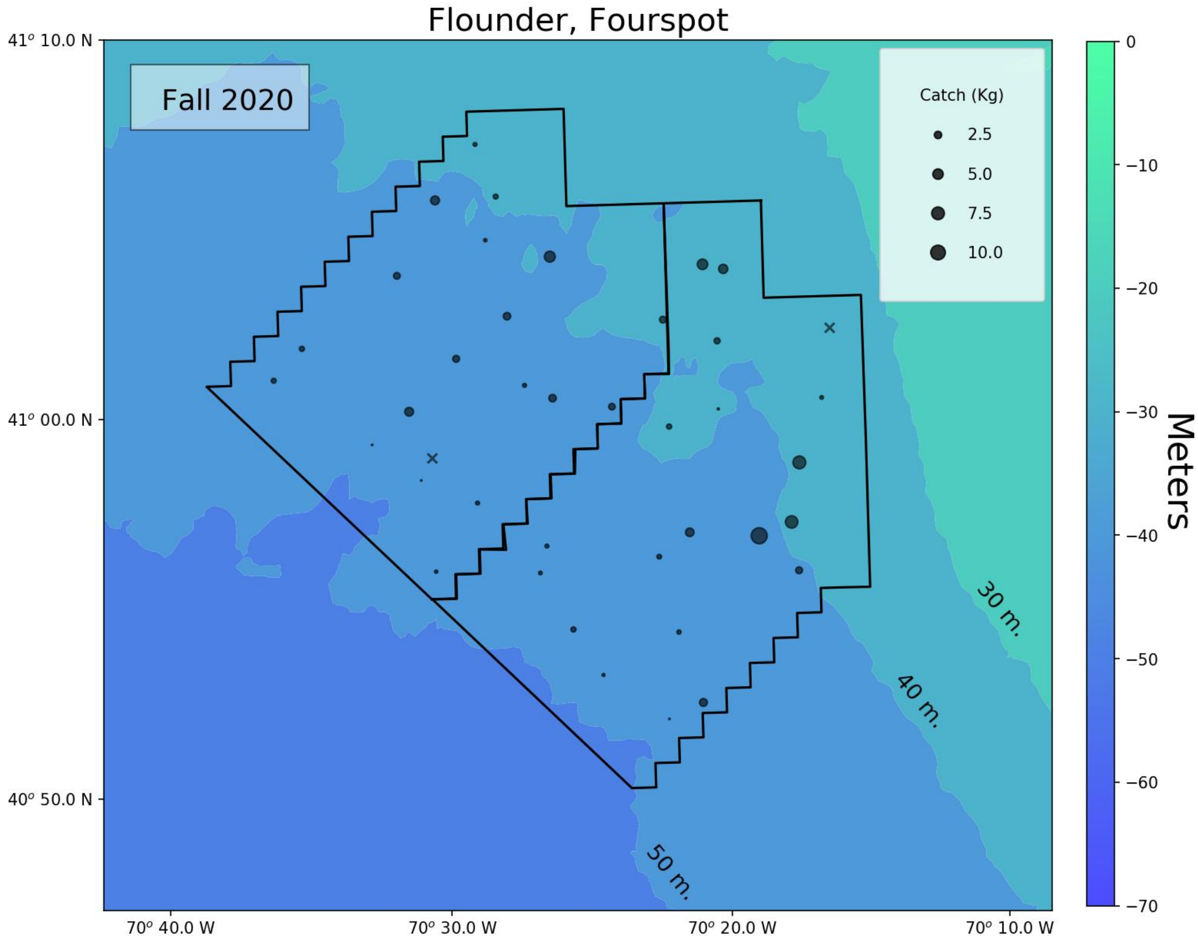


Figure 35: Distribution of the catch of fourspot flounder in the 501N Study Area (left) and Control Area (right). Tows with zero catch are denoted with an x.