SMALL MESH FISHERY BYCATCH REDUCTION IN THE SOUTHERN NEW ENGLAND/MID-ATLANTIC WINDOWPANE STOCK AREA

A Final Report to The Northeast Consortium and
The New England Fishery Management Council
Groundfish Research Program

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Emerson C. Hasbrouck, Principal Investigator and Project Leader
Cornell University Cooperative Extension of Suffolk County Marine Program
423 Griffing Avenue
Riverhead, NY 11901
(631) 727-7850 ext. 319
ech12@cornell.edu

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Abstract

Currently, bycatch of windowpane flounder in the northwestern Atlantic is a concern of fishery management. Exceeding the Annual Catch Limit (ACL) for windowpane could trigger Accountability Measures that restrict fishing activities. This project sought to enhance the opportunity for fishermen to avoid exceeding ACLs by validating the effectiveness of an innovative gear modification. Cornell University Cooperative Extension (CCE) tested and evaluated a large mesh belly panel for use as an avoidance gear to reduce windowpane flounder bycatch in small mesh fisheries in Southern New England. Statistical analysis of the data indicates that there was a highly significant difference in catch of windowpane flounder in the control net compared to the experimental net with the large mesh belly panel when analyzed in terms of both catch weights and in number of individual fish. The overall reduction in windowpane flounder catch weight due to the large mesh belly panel treatment was 48.04% compared to the control net. The reduction in catch based on numbers of fish is similar. For scup, statistical analysis indicates that there was a marginally significant difference in pounds caught and a highly significant difference in numbers of fish caught between the control and experimental nets. The overall reduction in scup catch weight due to the large mesh belly panel treatment was 26.14% compared to the control net. The reduction based on numbers of fish was 47.6%. This is actually a positive benefit of the panel as most of the loss in numbers of scup were of sub-legal size.

Introduction

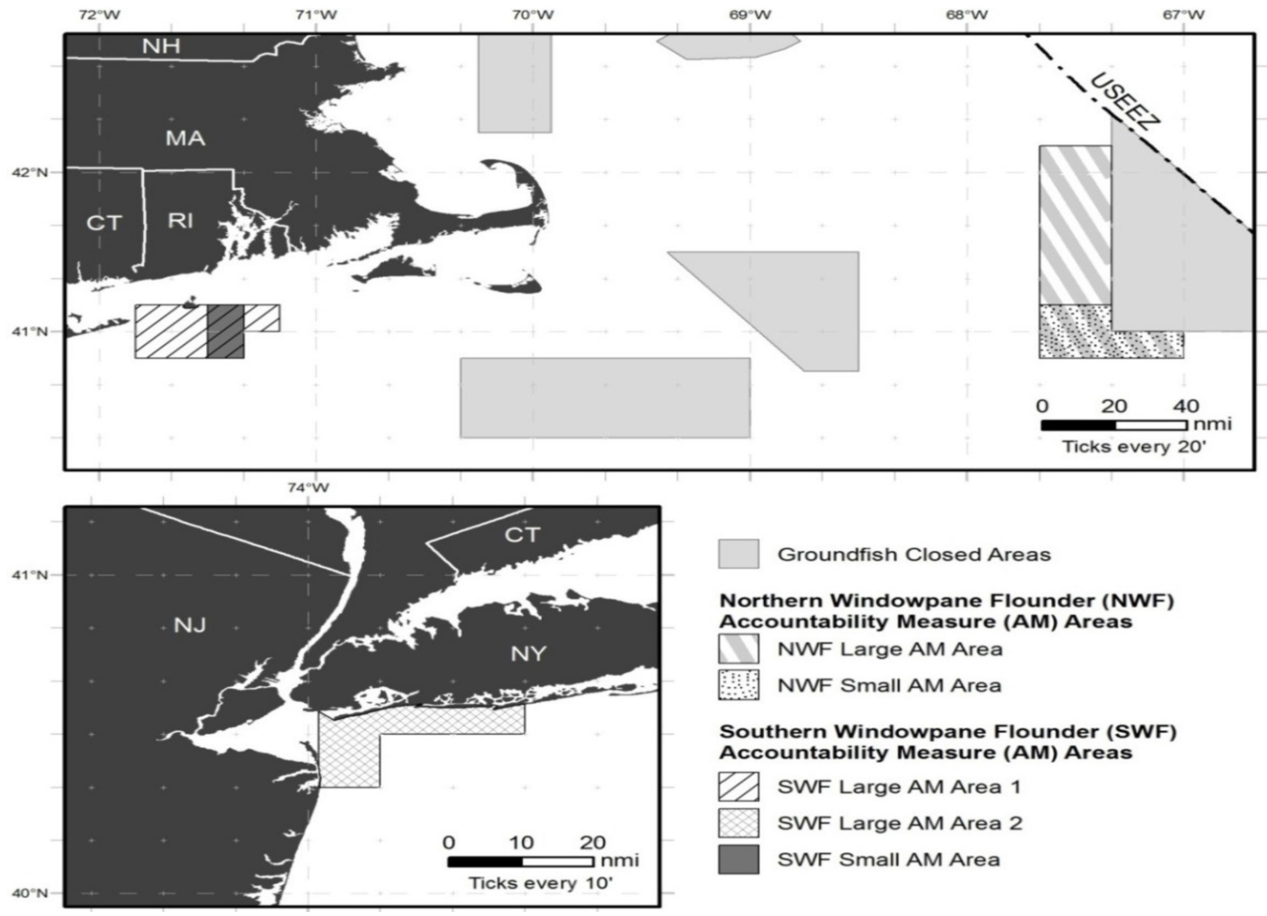
Background Information

Windowpane flounder are often a bycatch species in the economically significant small mesh trawl fisheries, including the scup fishery, in the Mid-Atlantic (MA) and Southern New England (SNE) areas. The groundfish fishery is also a contributor to the concern of windowpane bycatch. Accountability Measures (AMs) are management tools that are used to ensure catch limits are not exceeded or to make corrections for overages of a previous year's limits. Recently, AMs have been revised for the commercial groundfish fishery for both the southern and northern windowpane flounder stocks. If triggered by overages of the total Annual Catch Limit (ACL) for windowpane flounder, these new AMs could have a significant impact on the groundfish and other trawl fisheries.

In US waters, windowpane flounder are currently assessed as two stocks. These two stocks are the Gulf of Maine/Georges Bank (GOM-GB) or the northern stock and the Southern New England/Middle Atlantic (SNE-MA) or the southern stock. Windowpane flounder are managed under the New England Fishery Management Council's Northeast Multispecies Fishery

Management Plan (FMP). The northern windowpane stock at this time is considered overfished but overfishing is not occurring while the southern stock is not overfished and overfishing is not occurring. Neither windowpane flounder stock is allocated to groundfish sectors (i.e., non-allocated stocks), and possession is prohibited. Because the stocks are not allocated to sectors, the AMs apply to the entire commercial groundfish fishery (sector and common pool vessels combined), and sectors may not request an exemption from these AMs. For northern windowpane flounder, no other fishery receives an allocation of this stock. As a result, the commercial groundfish fishery is 100% accountable for any excesses in the overall northern windowpane annual catch limit (ACL), regardless of what fishery caused the overage (NMFS, 2015). For the 2013 fishing year and beyond, the scallop fishery and the "other" sub-components receive an allocation of southern windowpane flounder, and thus, the AMs for southern windowpane are only triggered for a fishery if it exceeds its sub-ACL, and the overall ACL is also exceeded (NEFMC, 2014). Simply put, if the total ACL for windowpane is exceeded by more than the management uncertainty buffer of 5%, the groundfish fishery AMs in place for both stocks would be triggered. The AMs are gear modification areas that require the use of approved selective trawl gear in defined areas to minimize the catch of flatfish (NMFS, 2015). Without the use of approved gear modifications, these areas would be closed to groundfish trawl fishing. Shown below (Figure 1) are the current northern and southern windowpane AM areas. The small AM area is implemented if the ACL overage is between 5% and 20%, and the large AM areas are implemented if the ACL overage is more than 20%. The application of these AM areas could have a significant negative impact on the groundfish fishery. The approved gear modifications are not favorable to catching and retaining groundfish. Additionally if the non-groundfish trawl fishery exceeds their ACL of southern windowpane all groundfish and non-groundfish vessels using trawl gear with mesh greater than or equal to 5 inches must use selective gear in the southern windowpane Large AM areas (NMFS, 2015)

Figure 1. Northern & southern windowpane flounder AM areas (NMFS, 2015)



Project Justification

The large mesh belly panel (LMBP) **i**s an avoidance gear adaptation that was initially adopted and tested by Cornell University Cooperative Extension (CCE) in 2010 for a Southern New England Cooperative Research Initiative (SNECRI) project in the small mesh squid fishery to reduce winter flounder bycatch. The large mesh panel in that study was an 80 cm (32 inch) mesh constructed from 6mm poly webbing. The belly panel was made from this 32 inch diamond mesh 3 meshes deep by 30 meshes wide and was sewn into the standard 16 cm (6 inch) mesh of the belly of a typical small mesh trawl. Results of that SNECRI study show that the use of the LMBP resulted in a statistically significant 88% reduction in winter flounder, and a statistically significant 83% reduction in demersal species (Hasbrouck, 2012). Demersal species included all flounders, skates, dogfish and sea robins. There was no statistically significant loss of squid in the experimental net compared to the control net. It was determined in the limited scope of that project that the LMBP is an effective avoidance gear adaptation that successfully reduces winter flounder bycatch and the bycatch of other demersals without significantly affecting the target catch. CCE has also tested the LMBP in two other projects for both winter flounder and yellowtail flounder bycatch reduction in the small mesh whiting and squid fisheries. Both of those projects have shown the large mesh panel to be successful at reducing flounder bycatch and maintaining the target species. When CCE evaluated the effectiveness of the LMBP at reducing flounder bycatch in the small mesh fishery on Southeast Georges Bank, a 72.3% reduction in yellowtail and a 50.9% reduction in windowpane flounder were documented with no loss of the target species (Hasbrouck, 2015a). When a similar study was conducted on Cultivator Shoals while targeting whiting, the LMBP effectively reduced yellowtail flounder by 80.7% and windowpane flounder by 59.3% (Hasbrouck, 2015b). These successful previous studies provided the basis of the current study.

The AMs in place for northern and southern windowpane flounder stocks in the groundfish fishery and other trawl fisheries are reactive AMs and were developed based on the characteristics of the fishery and stock assessment. During the 2012 fishing year, the ACLs for both windowpane flounder stocks were surpassed which caused the AMs to be triggered. The northern windowpane flounder catch limit was exceeded by 28%, and the southern windowpane flounder catch limit was exceeded by 36%. The total ACL for the southern windowpane stock during 2012 was 381mt. The scup fishery contributed 65.8mt of windowpane bycatch to the ACL. This equates to almost 17.5% of the total ACL. Accordingly, the need to reduce windowpane flounder bycatch in the SNE scup fishery as a means to reduce the overall windowpane bycatch and its effect on the ACL becomes obvious. It is for this reason that the scup fishery offered an ideal situation to continue testing the previous successes of the LMBP.

The next logical step was a more rigorous field-testing of the performance of the LMBP and the small mesh scup trawl fishery provided the opportunity. The project focused on determining the functional performance of the LMBP as an effective method to reduce windowpane flounder bycatch in the small mesh scup fishery. A successful effort would result in a reduction of bycatch while maintaining capture of the small mesh target species across a range of fishing strata variables. The additional testing of this avoidance gear adaptation produced a more robust and comprehensive assessment of the LMBP's performance across a wide range of variables while collecting quantitative information during the commercial pursuit of scup.

In keeping with the objectives of the Northeast Consortium and NEFMC Collaborative Research program, a cooperative/collaborative ground-truth testing was the principal pathway forward. This project fostered partnerships among scientists, fishermen, and management and supported commercial fishermen and vessels as active participants in a collaborative research scenario. The avoidance gear adaptation LMBP was compared against a control net during at-sea scientific fishing trips utilizing commercial vessels as research platforms. Windowpane bycatch and its affiliated AMs presented a unique opportunity for pre-emptive research into a foreseeable problem. This project allowed industry a firsthand opportunity to utilize their information, experience, and expertise to evaluate innovative fishing gear that avoids windowpane flounder. This approach relied on an industry developed methodology for bycatch reduction supported by scientific field work and data analysis.

Objectives and Scientific Hypotheses

By focusing on a small mesh fishery, in this case the small mesh scup fishery, CCE sought to better understand the specific reaction behavior of target and non-target species. The project approach relied heavily on industry developed ideas and methodologies aimed at bycatch reduction. The LMBP being tested needed to be easily retrofitted to pre-existing gear. It was equally important to all stake holders involved that avoidance gear adaptations do not drastically impact fishermen economically. A successful design would not reduce harvest of target species to levels below economic viability. Therefore, the project goal was to test the scientific hypothesis that windowpane flounder bycatch levels can be significantly reduced in the inshore scup fishery when a trawl net is outfitted with a LMBP. A second hypothesis to be tested is that the LMBP does not significantly reduce the catch of scup. These hypotheses were tested by evaluating the functional performance of the avoidance gear LMBP at reducing windowpane flounder bycatch retention while maintaining catch efficiency for the target species. This was conducted in the small mesh scup fishery within the Southern New England/Mid-Atlantic windowpane flounder stock area.

Objectives related to this goal were:

- Effectively reduce bycatch of windowpane flounder in order to help avoid or reduce the impact of triggering AMs for windowpane flounder
- To determine if a LMBP effectively reduces the catch of windowpane flounder in the small mesh scup fishery with existing gear and fishing practices.
- To demonstrate what the potential is for the conservation gear modification to reduce windowpane flounder bycatch in the small mesh trawl fishery for scup in the southern New England/Mid-Atlantic windowpane flounder stock area.
- To determine the statistical level of difference (if any) between the control and experimental nets for the targeted scup catch and for the windowpane flounder catch.
- To conduct paired trials to show significant difference levels (alpha 0.05) should a difference exist.
- To complete an applied experiment across a wide range of strata and conditions including: areas, depths, bottom type, and times reflective of the small mesh scup fishery.
- Validate these results for fishery managers and fishermen.

The objectives listed above respond directly to the stated project goal of delivering a gear solution for the bycatch avoidance of windowpane flounder.

Participants

The following project participants played key roles in project design and implementation:

CCE staff:
Emerson C. Hasbrouck, Principal Investigator and Project Leader (ech12@cornell.edu)
John Scotti
Tara Froehlich
Kristin Gerbino
Scott Curatolo-Wagemann
Joseph Costanzo
Jacqueline Wilson
Dan Kuehn
Chris Mazzeo
Contact for all CCE staff:
Cornell Cooperative Extension of Suffolk County Marine Program
423 Griffing Avenue
Riverhead, NY 11901
(631) 727-7850

Emerson Hasbrouck led the project and was responsible for management and execution of the study. Hasbrouck had primary responsibility for the design and implementation of the program, fiscal oversight, progress report writing, coordination with industry partners and preparation of the final report. He also assisted with statistical analysis. He directly supervised all CCE employees.

John Scotti was responsible for assistance with project design, coordination with industry partners and implementation.

Tara Froehlich, Kristin Gerbino, Scott Curatolo-Wagemann, Jacqueline Wilson and Joseph Costanzo were responsible for assistance with project design, coordination of vessels, project supervision, at-sea research trips, communications, outreach, data audit, and assistance with report writing.

Chris Mazzeo and Dan Kuehn were responsible for at-sea research trips, data entry, outreach, and assistance with reports.

Cornell Main Campus:
Dr. Patrick Sullivan, Professor and Department Chair
Department of Natural Resources
Cornell University
111B Fernow Hall
Ithaca, NY 14853
607-255-2822
pjs31@cornell.edu

Dr. Sullivan was responsible for project statistical analysis including determination of which statistics to use, development of R-script models, model runs and output

Industry Participants:

Vessel: Sea Breeze Too
Northeast Federal Fishery Permit: 150773
State Registration #: RI4367FT
Primary Owner/Corporation Name: Phillip Ruhle Jr - F/V Sea Breeze LLC
Captain on all trips: Jason Sawyer
Address:
28 Serenity Way
Wakefield, RI 02879
Phone: (401) 792-0188

Vessel: Elizabeth Katherine
Northeast Federal Fishery Permit: 151492
State Registration #: RI3973W
Primary Owner/Captain/ Corporation Name: Steve Arnold - Kingston Trawlers Inc
Address:
200 Blueberry Lane
West Kingston, RI 02892
Phone: (401) 639-6335

Vessel owners and captains were responsible for assisting with implementation of scientific design, gear and fishing vessel maintenance and handling, determination of fishing area and all on-board procedures relative to fishing gear deployment, retrieval and handling.

Jonathan Knight
Superior Trawl LLC
74 Table Rock Rd
Wakefield, RI 02879
Phone: (401) 782-1171

Jonathan Knight assisted in project design and was responsible for large mesh belly panel construction and installation for 2 experimental nets.

Methods

Research Design

The conceptual approaches and technical methods employed during this project were intended to test a LMBP in the commercial, small mesh scup fishery using existing gear and typical fishing practices. CCE tested for differences in both the target species (scup) catch and the bycatch of the species of concern (windowpane flounder). This project was intended to build upon the prior successes of the LMBP at reducing flounder bycatch as documented during three aforementioned CCE research projects (see Project Justification section for more details). Testing was completed across appropriately identified strata of time, depth, and area. Two vessels of similar size and horsepower with identical fishing nets, doors, legs, and ground cable were chosen to work with CCE during the quantitative data collection portion of the project. These vessels entered into direct Work Agreements and received compensation for their participation (charter fee). Both cooperating vessels were representative of the small mesh, scup trawl fleet. They were chartered and utilized as research platforms to contrast an experimental net to a control net during concurrent and comparative tows.

Two vessels from Montauk, NY were specifically identified in the original proposal to be the industry partners and fishing vessels for this project. During the concept and development phase of this project both vessel owners indicated that they both used the same net and doors. However it turns out that these two fishing vessels had different nets and doors. We were able to come up with another set of doors so that both pairs would be the same but the nets were too different to be easily modified to be exactly the same. Therefore this pair of identified vessels was not appropriate for this project. We then worked with our gear specialist partner and other fishing industry contacts to try to identify another vessel whose gear would match up to one of our original vessels. We could not come up with any viable matches from NY or RI. However we identified two appropriate vessels from RI to participate in the study. Both vessels were similar and they both had the same 3-bridal 4-seam box trawl typical of the scup fishery. The sweeps were the same on both nets. There were some minor twine differences in the front of the nets but they were corrected and made exactly the same when the large mesh belly panels were installed. We also rented a set of doors so that both vessels had the exact same doors.

The two vessels chosen to conduct the at-sea research were both fiberglass, A-frame, stern trawlers. Both vessels tow 72-inch Thyboron doors. Additional specifications of the two vessels are as follows:

F/V Sea Breeze Too	F/V Elizabeth & Katherine
55 feet in length	55 feet in length
65 gross tons	57 gross tons
450 horsepower	450 horsepower
Homeport – Point Judith, RI	Homeport – Point Judith, RI
Owner/Captain - Phil Rhule Jr.	Owner/Captain – Steve Arnold

Both vessels used an identical trawl net that was typical of the small mesh nets used in the scup fishery along the East Coast of the US. The nets used for this project were 286 x 16cm, 4-seam, 3-bridle standard otter trawls. The 286 x 16cm refers to the circumference of the fishing circle (286 meshes around of 16 cm mesh to form the circle) and nets of this size are appropriate for vessels with horsepower in the range of 400hp to 550hp. The net was constructed with 16cm (full mesh) webbing in the wings and jibs. The bunt and the 1st bottom belly were constructed from 12 cm mesh. The top square, top bellies, and the side panels were constructed from 8cm Dyneema webbing. The last belly section, top, and bottom were 6cm PE webbing. The codend was constructed of 5" regulation mesh used in the scup fishery. Flotation for this trawl was provided by 48 -8" floats mounted on the headrope. The sweep of the trawl was constructed of 2-3/8" and 3" rubber discs on wire rope. The sweep was comprised of three pieces totaling 2400cm or 78.72 feet in length. The headrope height was approximately 16 feet high. This net was then modified by Jon Knight of Superior Trawl to include the LMBP. This was accomplished in a similar manner to that of the SNECRI project described in the Project Justification section. The large mesh panel for this project was made from 5mm poly webbing and the mesh size was 80cm or approximately 32 inches knot-center to knot-center diamond mesh. The actual panel was 2 meshes deep and was sewn into the standard 12cm (5") mesh of the 1st bottom belly using a "saw-toothing" technique. Similar to the SNECRI project, this results in an effective area for fish escapement of 3 full 32 inch meshes, or an opening in the belly of the net that is approximately 8 feet deep from front to back. The LMBP attached approximately 1 foot (2.5 meshes/12cm) behind the footrope and extended widthwise across the entire belly of the net (from gore to gore) for 30 meshes of 32 inch diamond mesh.

The nets for each vessel were constructed with the LMBP in place so that each vessel would require only one net to complete the research fishing. The single net would serve as both the control and the experimental treatment. This was accomplished by installing or removing a 5 inch mesh cover from the LMBP. The captain and crew from each vessel would sew the 5 inch mesh cover over the LMBP to position the net in the control mode. This procedure took approximately 20 – 30 minutes to complete. When the net needed to be switched to the experimental design the lacing was simply cut and the 5 inch cover removed to expose the LMBP. This was a simple procedure and was completed in 5 – 10 minutes.

A net plan or schematic for each format (control and experimental) of the net described above has been supplied by Jon Knight of Superior Trawl and is included in the **Images** section at the end of this report.

Tow procedure during the research fishing had each vessel essentially fish as it would in a standard commercial fishing trip, with the exception that all tows were 1 hour in length. The standard control net was the one that the vessel would normally use in its standard commercial scup trip. As discussed previously, the two fishing vessels had identical nets. Each vessel had just one net that they made adjustments to in order to move from the control design to the experimental design. The two vessels towed the gear side by side with a maximum distance of $^{1}/_{2}$ mile between them through the designated study area while targeting scup and windowpane.

Each vessel had the experimental LMBP incorporated within the control net as described above, and followed an alternating testing pattern. One vessel used the net in the control arrangement while the other vessel used the net in the experimental arrangement. Comparison tows were completed as the vessels fished side by side using the protocol described below.

<u>Test Design</u> - Vessel 1 and Vessel 2 (towing side by side)

A= Control fishing net
B=Experimental net

Vessel 1		Vessel 2
A	Comparison tow	B
B	⟷	A
B		A
A		B

Tows were made oriented along slope. CCE used the coupled ABBA-BAAB protocol shown above during all research fishing. This alternating paired methodology was used to minimize any bias associated with the research fishing. The coupled ABBA-BAAB protocol had 1 vessel use the ABBA sequence and the other use the BAAB sequence. In addition to minimizing bias, this procedure ensured that every tow was completed as a paired comparison where one vessel fished a control net to which the other vessel's experimental net was compared. This method also reduced the number of net changes required thus maximizing at-sea time and offering the greatest number of completed paired tows. Also by using the ABBA protocol over the course of this project, variables such as type of sea bottom, depth, and time of day were randomized and thus stabilized the data relative to these variables. The coupled ABBA sequence was the best approach to use. In an effort to further reduce and randomize any bias associated with gear location the control net side was switched every tow regardless of which boat was towing it. In other words, the position or orientation of the control net to the experimental net alternated every tow. This procedure can best be explained by utilizing an imaginary line running parallel to the direction of tow and separating the vessels as they travel side by side and within one half-mile of each other. When a tow was completed the control net, regardless of which vessel it was on, would then be located on the other side of this imaginary line thus effectively switching sides before beginning the next tow. This research design maximized the quantitative data collection component of this program, made the most efficient use of the allotted time, and worked to reduce and randomize any bias associated with comparative studies.

Four scientific trips were necessary during this project to complete the 7 days of research fishing that were designated in the plan of work. The four trips were completed between October 6th, 2015 and October 22nd, 2015. The goal during each day of research fishing was a minimum of 6 comparative tows but if time allowed more would be done. On the 9th of October only 3 tows were completed due to the onset of unfavorable weather conditions. To compensate for this low number, one additional tow was completed during three of the subsequent days of research fishing. As a result, the project goal of 42 paired tows (84 total tows between the two boats) was achieved. In addition, the duration of all completed tows remained at the proposed one hour. The study vessels departed for all the trips from their home port of Point Judith, RI. Steaming time to and from the study area from the involved port was typically between three and five hours.

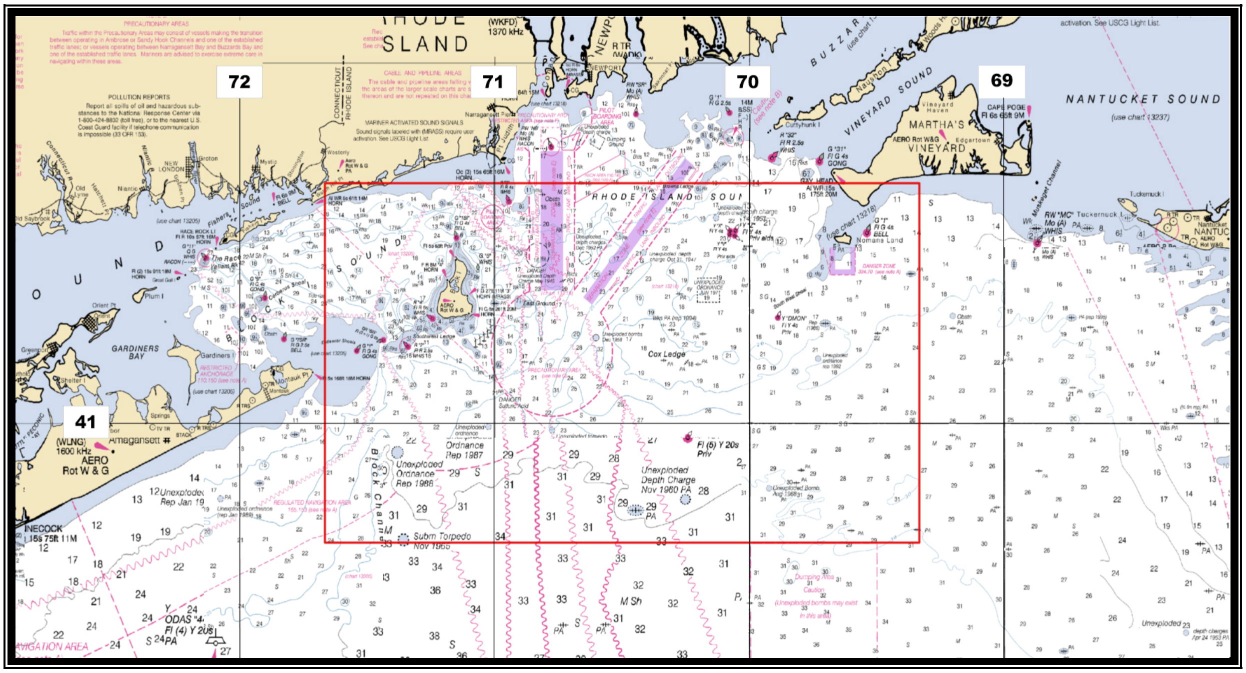
Study Area and Justification

The two participating captains had extensive experience fishing for scup in the project areas and worked cooperatively to accomplish all project goals. CCE worked with the vessel boat captains to confirm that the study area at the time of the fieldwork would be the best geographic location for testing the experimental gear. The geographic location was chosen based on confirmed empirical fisherman knowledge that windowpane flounder and scup would likely both be present in this area during the designated study time. This location can best be described as a rectangular region of Southern New England marine waters encompassing approximately 2000 square miles. It extends geographically from Point Judith, RI in the west to Martha’s Vineyard, MA in the east and extends south to include Rhode Island Sound and portions of the Atlantic Ocean. The corners of the project study area are roughly defined by the following latitude and longitude coordinates:

The northwest corner - 41°20’N and 71°50’W The northeast corner - 41°20’N and 70°40’W
The southwest corner - 40°50’N and 71°50’W The southeast corner - 40°50’N and 70°40’W

The study area described above is indicated in Figure 2 by a red, outlined rectangle on the nautical chart. All research tows completed during this project were conducted within this area. Specific tow locations within the study area were set at the discretion of the two captains based on fishing experience and probability of catching both species together.

Figure 2. Southern New England Project Area



Time is a critical factor in small mesh scup trawl fishery relative to the co-mingling of windowpane flounder and scup. The proposed experimental fishing was slated to occur between April and November 2015 and accordingly the project field activities were completed in October 2015. This time period coincided with the normal activities of the small mesh scup fishery and the highest likelihood for co-occurrences of scup and windowpane flounder. The specific testing time slot spanning the eight months mentioned above was determined with the advice of the fishing industry and by reviewing various data sources. These included the months of highest observed discards of windowpane flounder in the small mesh fisheries from the Northeast Fisheries Observer Program data, location of abundance of windowpane flounder according to NEFSC bottom trawl surveys, and scup landings by month. This project utilized a window of opportunity starting in the spring and running through the fall fishery. Both scup and windowpane flounder reside predominately inshore during these months. According to Figures 3 and 4 below from the NEFSC Autumn Bottom Trawl Survey, the abundance of both scup and windowpane coincides during the fall months (September-November) with a co-occurrence of these two species happening inshore south of Long Island to south of Nantucket. (NEFSC, 2013)

We applied to NMFS in June 2015 for permits needed for this project. Although we had anticipated starting at-sea work during the week of 9/21/15, delays at NMFS resulted in our permit not being issued until the end of the day on 9/28/2015. A series of coastal storms during that week and the following week delayed the start of at-sea activities. We finally got underway on October 6, 2015.

Due to permit and weather delays the fish had started to migrate offshore during this time. Everything went smoothly with both vessels and the project design without any issues or problems other than finding large concentrations of both the target species (scup) and the bycatch species (windowpane) together in the same place at the same time. We have conducted many of these types of studies and find that, despite what observer data may indicate, catching large concentrations of both target and bycatch species together can be illusive. As such we concentrated on windowpane catch (to verify large mesh belly panel performance) at the expense of larger catches of scup.

Figure 3. NEFSC 2013 Autumn Bottom Trawl Survey Data for Scup (Sept-Nov)

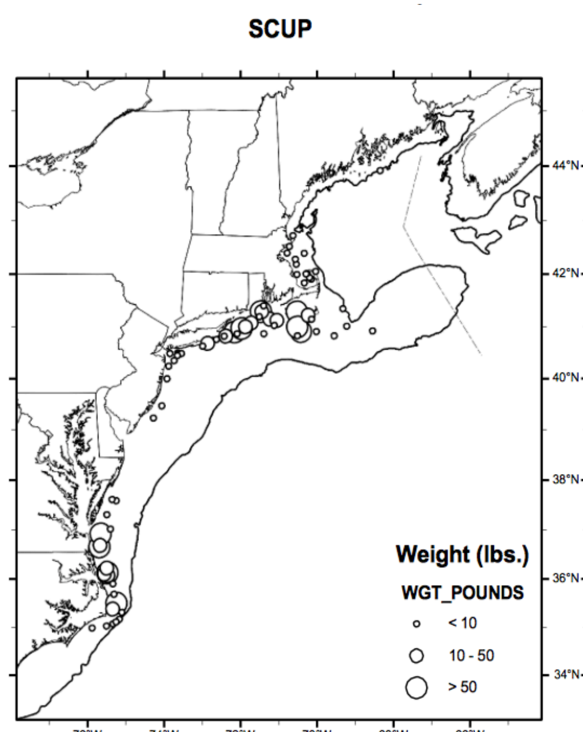
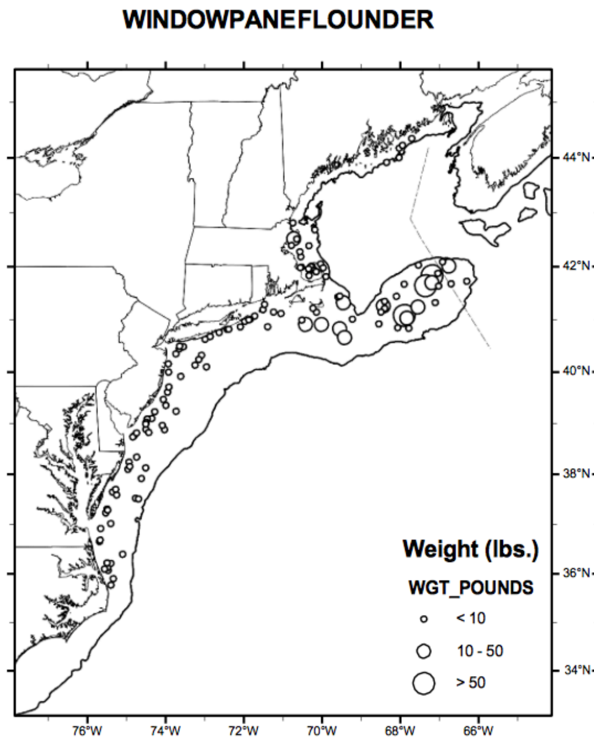


Figure 4. NEFSC 2013 Autumn Bottom Trawl Survey Data for Windowpane (Sept-Nov)



On Board Catch Processing

The onboard catch processing procedure followed standard NMFS survey methods as described below. Our objective was windowpane flounder catch relative to quantifying differences in the retention between the control and experimental nets. As such, total catch of windowpane flounder for each tow for each net was accurately weighed using a Marel m1100 motion compensating calibrated scale. Windowpane flounder were also sampled for length frequency, with the minimum goal of obtaining 100 random length measurements per tow. If fewer than 100 individuals were caught, all were measured. Since we also wanted to quantify if the catch of scup was influenced by the LMBP modification to the experimental net, the total scup catch for each net was also weighed (using the same Marel scale) for each tow. A length frequency sample of scup with at least 100 individuals or the total number of individuals caught was also obtained.

All research fishing combined resulted in the capture of 1,482 pounds of windowpane flounder. From that a total of 3,068 windowpane lengths were collected weighing 1,406 pounds. For windowpane flounder the project goal of 100 lengths per tow occurred 6 times and for all other tows all the windowpane flounder captured were measured. All research fishing combined resulted in the capture of 16,488 pounds of scup. A total of 8,083 scup were measured weighing

2,653 pounds. For scup, the project goal of 100 lengths per tow occurred 74 times and for all other tows all the scup captured were measured. The total weight of all additional species in each tow was also taken either by direct weighing or by catch estimations. Catch estimations were based on basket or tote counts. Catch estimations were made by separating individual species into baskets or totes. An average weight was determined by weighing a minimum of 3 baskets or totes. Next, a count of the number of baskets or totes was made for the particular species and this number was multiplied by the average weight. This number was recorded as the estimated total catch weight. This procedure for catch estimations, based on basket or tote counts, follows the NMFS At Sea Monitoring Program and the Observer Program Biological Sampling protocols as outlined in the NEFSC 2010 sampling manuals. The species specific data collected during this project can be obtained from the project database included in the **Data** section of this report.

Data

Project data was collected on a tow level basis. Data collected for each tow included trip number, tow number, vessel name, boat position (inside or outside of paired vessel), net (control or experimental), tow date, tow start and end time, time segment, latitude and longitude of tow start and end, water depth at tow start and end, tow speed, ground gear length, tow cable length, door spread at tow start and end, tow direction, statistical area, catch of each species (in lbs), and total catch.

Subsamples of the catch we taken during each tow for length frequency distribution analysis. For each tow, 100 individual length measurements were taken for scup and windowpane flounder. All fish were measured if there were less than 100 per tow. The subsample length frequencies were expanded to the entire catch to determine the length frequency distribution for the catch. For each tow, the total catch numbers at length were calculated as the subsample numbers at length multiplied by the species-specific ratio of catch weight to subsample weight. Catch numbers were calculated for each net as the sum of the expanded numbers at length per tow.

A variety of statistical tests were run on the data and the results are explained in the following section.

Results and Conclusions

Catch Comparisons

Windowpane Flounder

We tested the difference in windowpane flounder catch between the control net and the experimental net with the large mesh belly panel. Statistical analysis of the data was conducted to determine if the large mesh belly panel experimental net significantly affected retention of windowpane flounder relative to the standard control net. Figure 5 shows a box-plot distribution of the catches in the control and experimental nets (data are un-paired). Median and quartile catch distributions are noticeably different between the two nets. Figure 6 shows a histogram of the paired tow differences in catch (control minus experimental). Paired differences are largely positive indicating generally more windowpane flounder in the control net.

T- test results showed a highly significant difference in the catch weight between the control and experimental net ($t = 5.811$, $df = 41$, p-value <0.0001, mean of $x = 11.15238$ lbs). The experimental net significantly reduced the catch of windowpane flounder compared to the control net. The Wilcoxon test yielded similar results (p-value<0.0001).

Figure 5. Boxplot Distribution of Windowpane Flounder Catch Weight in the Control and Experimental Net

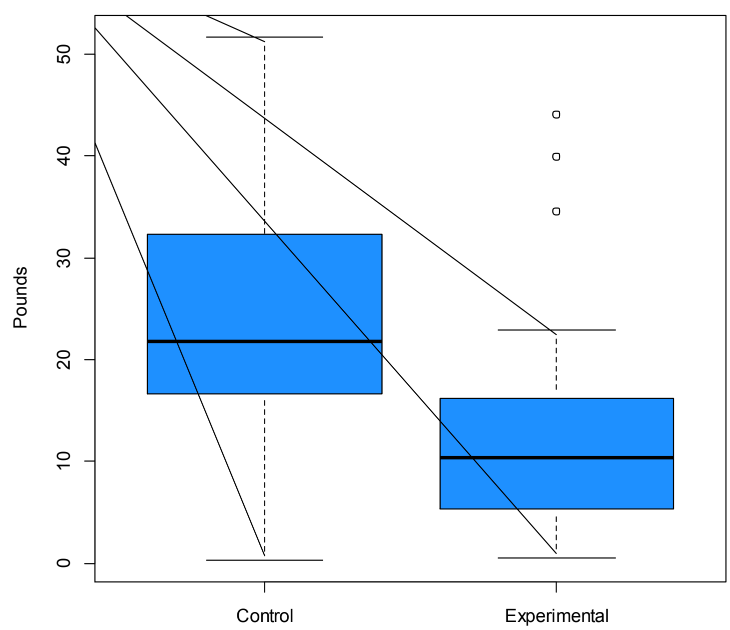
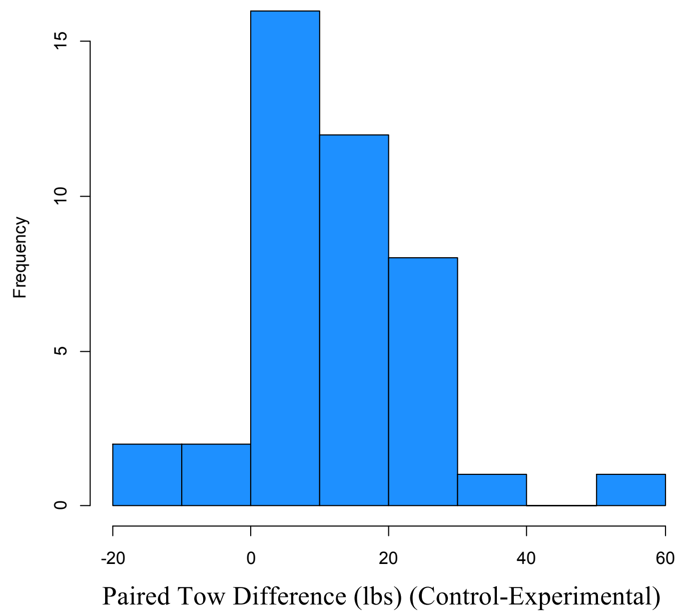
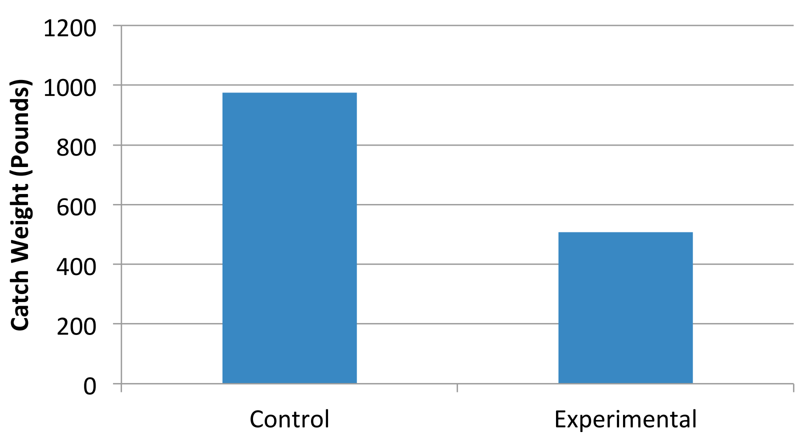


Figure 6. Distribution of Paired Tow Differences for Windowpane Flounder



In Figure 7, the total weight of windowpane flounder caught by the experimental net and caught by the control net, for all research tows combined, are compared.

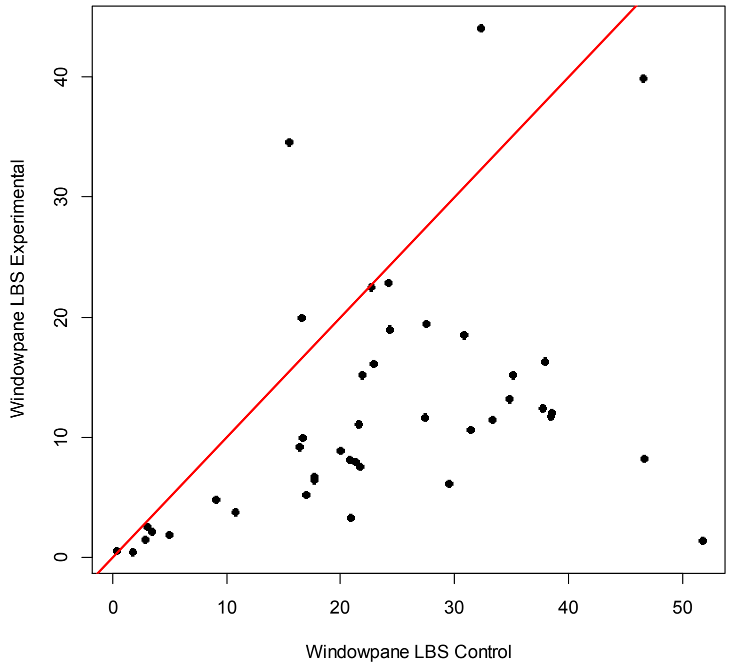
Figure 7. Total Catch Weight of Windowpane Flounder (lbs) in the Experimental and Control Nets for All Trips Combined



The overall reduction in windowpane flounder catch in the experimental net due to the large mesh belly panel treatment was 48.04% compared to the control net.

Figure 8 is a pairwise plot of the catches of windowpane flounder in the control net vs. experimental net. This figure shows the relationship and the differences between the pairs of tows. The diagonal red line is the calculated curve for equal catches in both nets. As can be seen, most data points fall to the right of the curve showing that for the range of distribution of catch weights per paired tow there are more windowpane in the control net for nearly all tows. Across the range of large catches and small catches only 3 tows are above the curve.

Figure 8. Catches of Windowpane Flounder in the Control Vs. Experimental Net



We tested the difference in windowpane flounder catch between the control net and the experimental net in terms of number of fish caught. The number of fish per tow was calculated by determining the average weight of an individual fish in the subsample and dividing the total windowpane catch (in pounds) by the average individual fish weight. Statistical analysis of the data was conducted to determine if the large mesh belly panel experimental net significantly affected retention of windowpane flounder by count relative to the standard control net. Figure 9 shows a box-plot distribution of the catches by number of fish in the control and experimental nets (data are unpaired). Median and quartile catch distributions are noticeably different between the two nets. Figure 10 shows a histogram of the paired tow differences in catch (control minus experimental). Paired differences are largely positive indicating generally a greater number of windowpane flounder in the control net.

T- test results showed a highly significant difference in the catch numbers between the control and experimental net ($t = 4.1612$, $df = 41$, p-value $=0.000158$, mean of $x = 24$). The experimental net significantly reduced the catch of windowpane flounder in numbers compared to the control net. The Wilcoxon test yielded similar results (p-value<0.0001).

Figure 9. Boxplot Distribution of Windowpane Flounder Catch By Number of Fish in the Control and Experimental Net

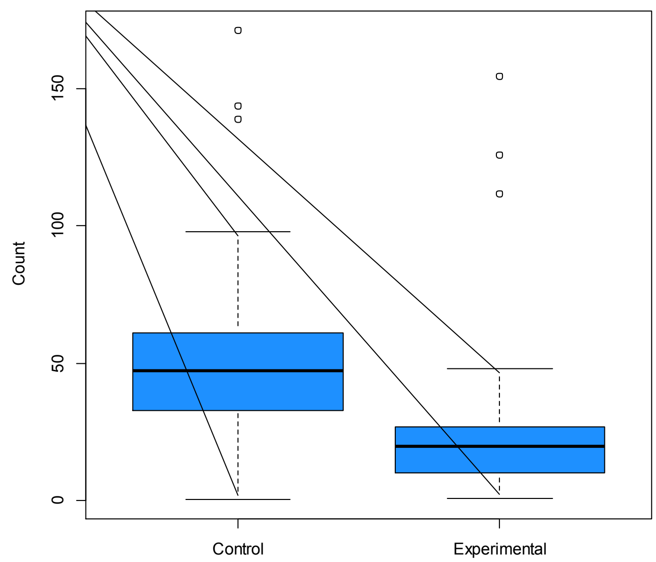
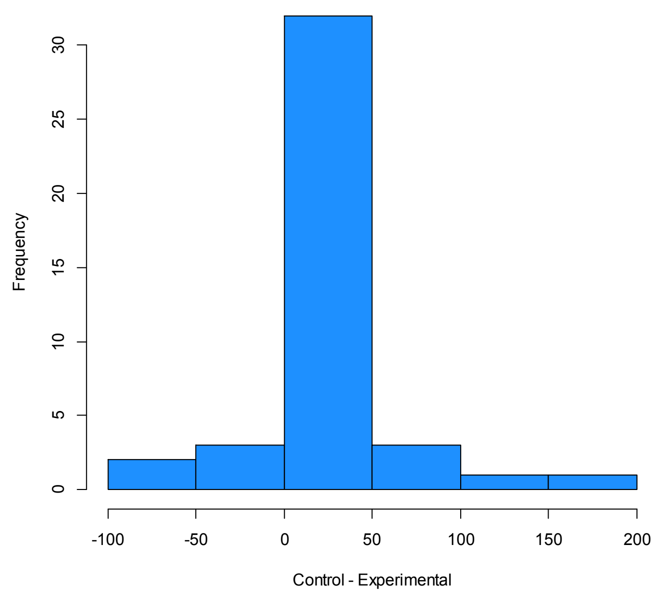
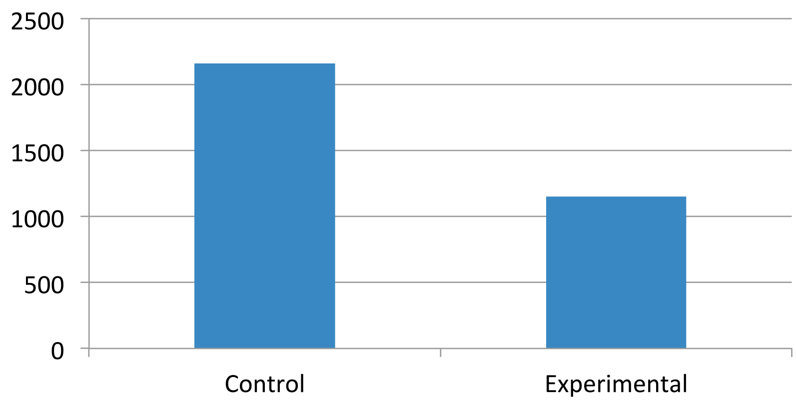


Figure 10. Distribution of Paired Tow Differences for Windowpane Flounder by Number of Fish



In Figure 11, the number of windowpane flounder caught by the experimental net and caught by the control net, for all research tows combined, are compared.

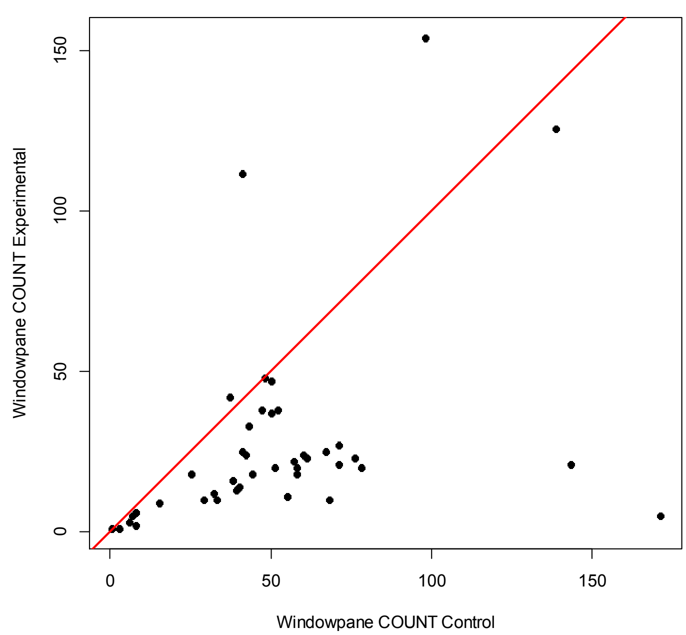
Figure 11. Total Catch in Numbers of Windowpane Flounder in the Experimental and Control Nets for All Trips Combined



The overall reduction in windowpane flounder catch in numbers of fish in the experimental net due to the large mesh belly panel treatment was 46.69% compared to the control net.

Figure 12 is a pair-wise plot of the catches of windowpane flounder by count in the control net vs. experimental net. This figure shows the relationship and the differences between the pairs of tows. The diagonal red line is the calculated curve for equal catches in both nets. As can be seen, most data points fall to the right of the curve showing that for the range of distribution of number of fish per paired tow there are a greater number of windowpane flounder in the control net for nearly all tows.

Figure 12. Catches of Windowpane Flounder in Numbers in the Control Vs. Experimental Net



Scup

We tested the difference in scup catch weights between the control net and the experimental net with the large mesh belly panel. Statistical analysis of the data was conducted to determine if the large mesh belly panel experimental net significantly affected retention of scup relative to the standard control net. Figure 13 shows a box-plot distribution of the scup catches in the control and experimental nets (data are un-paired). Median and lower quartiles are similar but upper quartiles are different between the two nets. A greater quantity of scup was caught in the control net. Figure 14 shows a histogram of the paired tow differences in catch (control minus experimental). Paired differences center around zero but are more positive indicating generally more scup in the control net.

T- test results showed a marginally significant difference in the catch weight between the control and experimental net ($t = 2.5846$, $df = 41$, p-value = 0.01341, mean of x = 59.02381 lbs).
The experimental net did affect retention of scup compared to the control net according to the t-test. The Wilcoxon test returned a similar result (p=0.001521).

Figure 13. Boxplot Distribution of Scup Catch Weight in the Control and Experimental Net

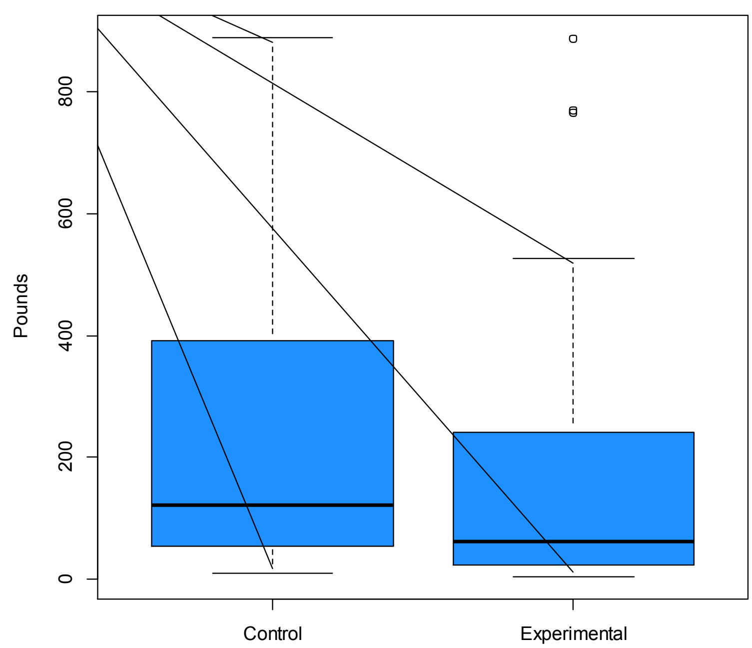
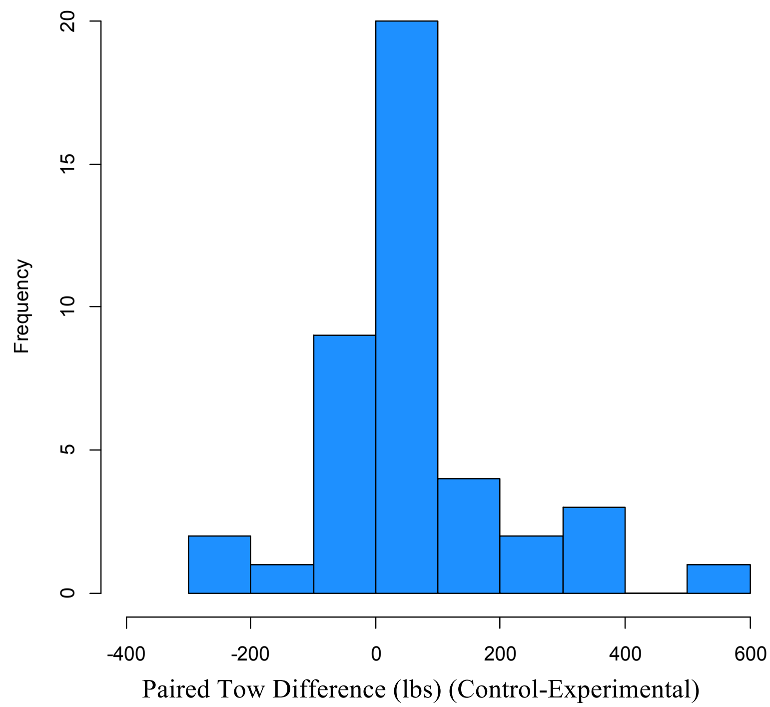
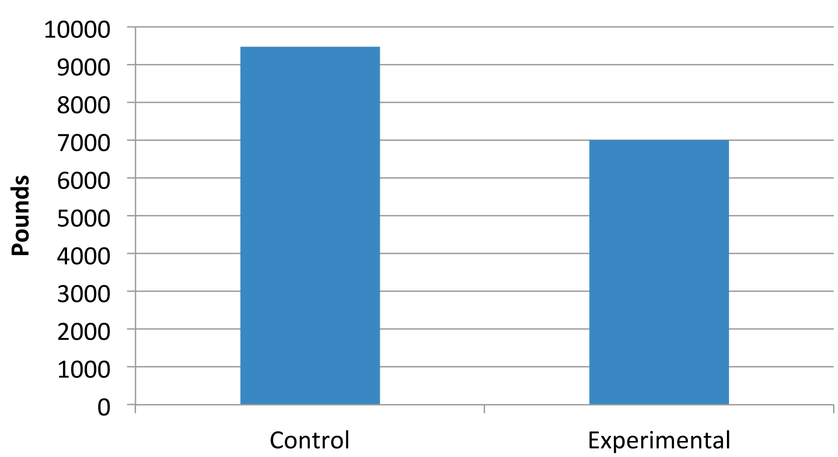


Figure 14. Distribution of Paired Tow Differences for Scup



In Figure 15, the total weight of scup caught by the experimental net and caught by the control net, for all research tows combined, are compared.

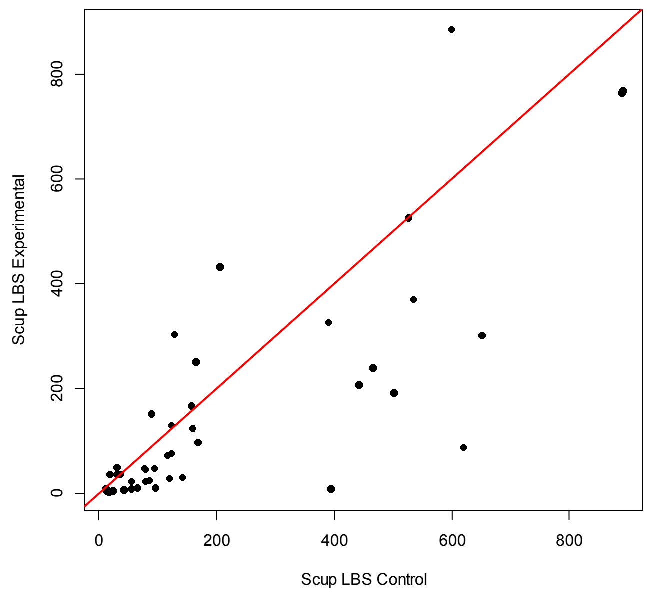
Figure 15. Total Catch Weight of Scup (lbs) in the Experimental and Control Nets for All Trips Combined



The overall reduction in scup catch weight in the experimental net due to the large mesh belly panel treatment was 26.14% compared to the control net.

Figure 16 is a pair-wise plot of the catches of scup by weight in the control net vs. experimental net. This figure shows the relationship and the differences between the pairs of tows. The diagonal red line is the calculated curve for equal catches in both nets. There is a wide distribution of points both above and below the curve. However a lot of the points fall in the lower left of the plot indicating many tows with small (<200lbs) scup catches with more fish in the control net.

Figure 16. Catches of Scup in the Control Vs. Experimental Net



We tested the difference in scup catch between the control net and the experimental net in terms of number of fish caught. Statistical analysis of the data was conducted to determine if the large mesh belly panel experimental net significantly affected retention of scup by number of individual fish relative to the standard control net. Figure 17 shows a box-plot distribution of the catches by number of fish in the control and experimental nets (data are unpaired). Median and quartile catch distributions are noticeably different between the two nets. Figure 18 shows a histogram of the paired tow differences in catch (control minus experimental). Paired differences are largely positive indicating generally a greater number of scup in the control net.

T- test results showed a highly significant difference in the catch numbers between the control and experimental net ($t = 4.3903$, $df = 41$, p-value <0.0001, mean of $x = 381$). The experimental net significantly reduced the catch of scup in numbers of fish compared to the control net. The Wilcoxon test yielded similar results (p-value <0.0001).

Figure 17. Boxplot Distribution of Scup Catch By Number in the Control and Experimental Nets

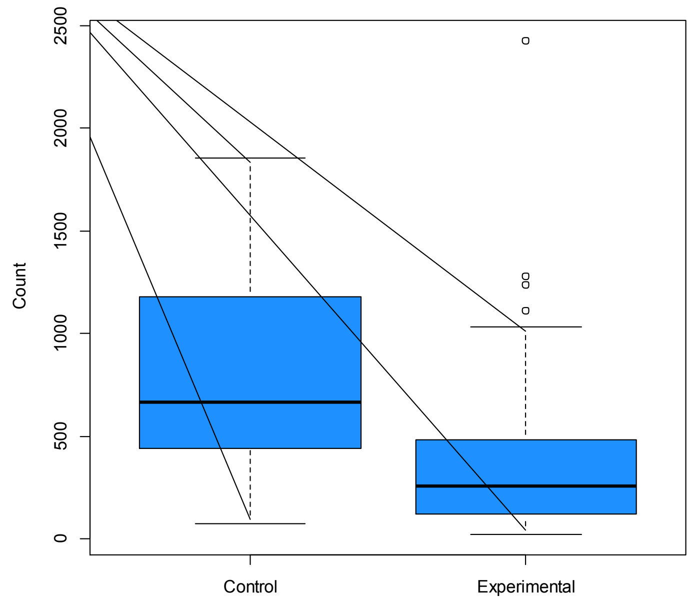
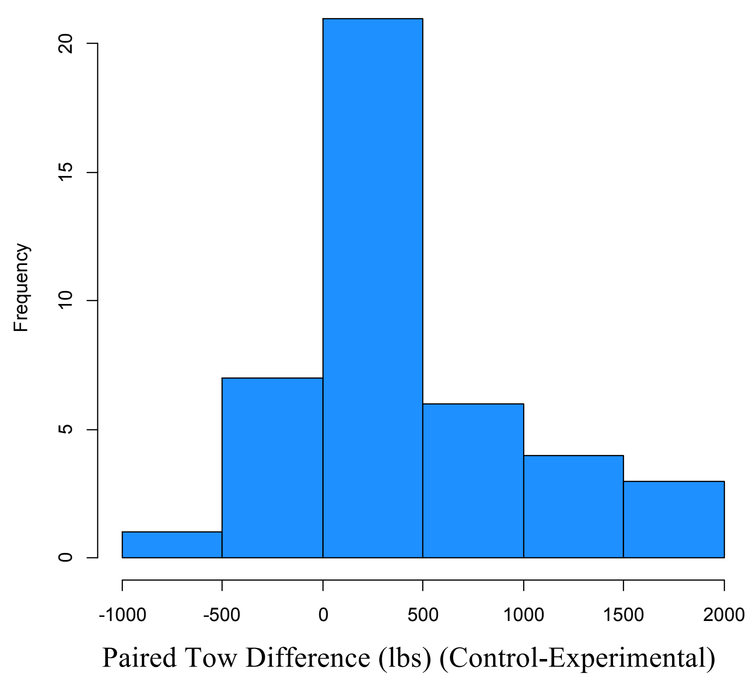
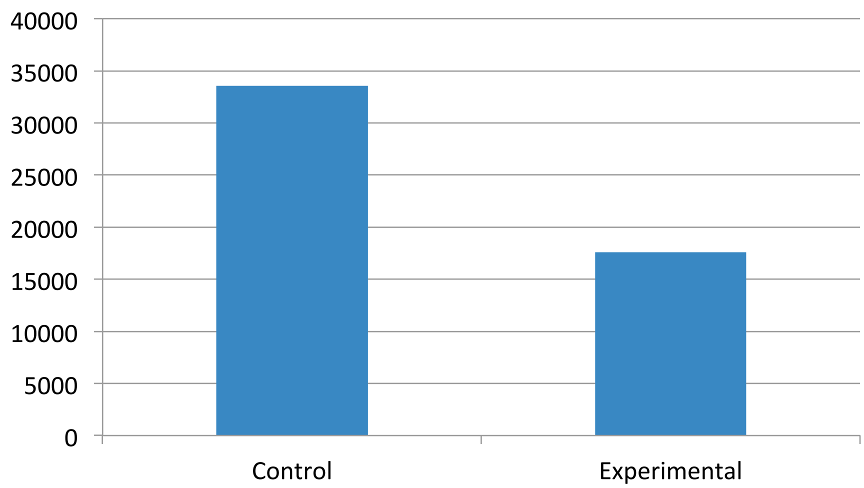


Figure 18. Distribution of Paired Tow Differences for Scup by Count



In Figure 19, the number of scup caught by the experimental net and caught by the control net, for all research tows combined, are compared.

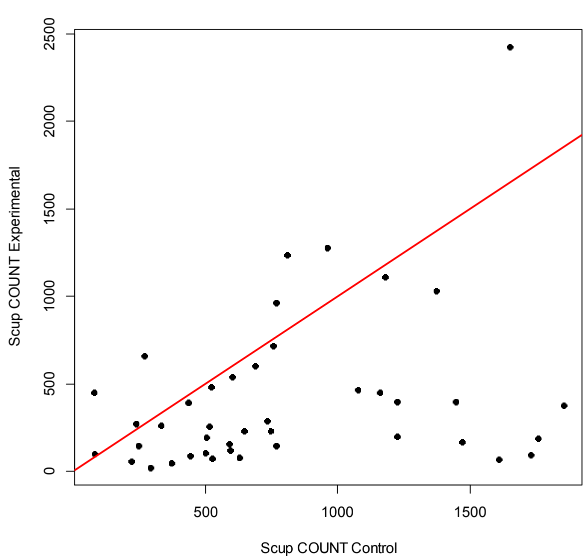
Figure 19. Total Catch in Numbers of Scup (lbs) in the Experimental and Control Nets for All Trips Combined



The overall reduction in scup catch in numbers of fish in the experimental net due to the large mesh belly panel treatment was 47.60% compared to the control net.

Figure 20 is a pair-wise plot of the catches of scup by count in the control net vs. experimental net. This figure shows the relationship and the differences between the pairs of tows. The diagonal red line is the calculated curve for equal catches in both nets. As can be seen, a greater number of data points fall to the right of the curve showing that for the range of distribution of catch weights per paired tow there are generally a greater number of scup in the control net.

Figure 20. Catches of Scup in Numbers in the Control Vs. Experimental Net



Catch Summary

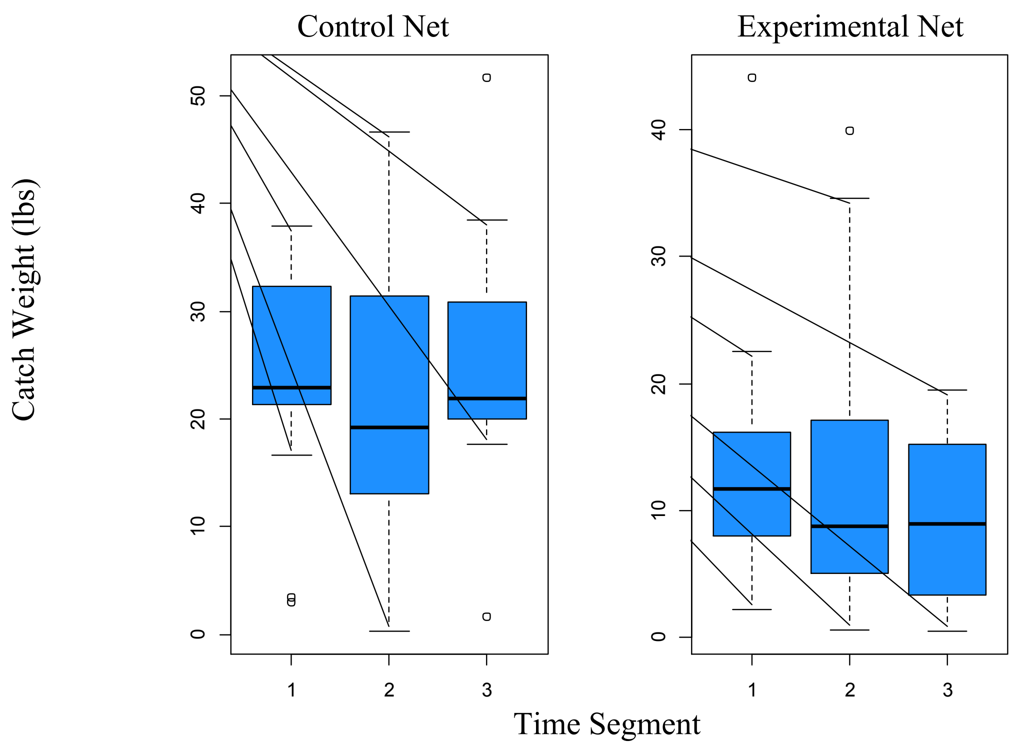
In summary, statistical analysis indicates that there was a highly significant difference in catch of windowpane flounder in the control net compared to the experimental net with the large mesh belly panel when analyzed in terms of both catch weights and in number of individual fish. The overall reduction in windowpane flounder catch weight due to the large mesh belly panel treatment was 48.04% compared to the control net. The reduction in catch based on numbers of fish is similar. For scup, statistical analysis indicates that there was a marginally significant difference in pounds of catch and a highly significant difference in numbers of fish caught between the control and experimental nets. The overall reduction in scup catch weight due to the large mesh belly panel treatment was 26.14% compared to the control net. The reduction based on numbers of fish was 47.6%. However this may actually be a positive benefit of the large mesh belly panel as most of the loss in terms of numbers of fish were of sub-legal size. See additional discussion under length frequency.

Time of Day

We tested to determine if there were any differences in the catches of windowpane flounder and scup between the control and experimental nets based on the time of day the tow was conducted. We therefore divided the fishing period into three time segments to determine if time of day affected the catch of scup and windowpane flounder. The three time segments were as follows – 1) 05:00 – 10:00; 2) 10:00- 15:00; 3) 15:00 – 20:00. No tows were conducted between 20:00 and 05:00.

Experimental fishing occurred across all three time segments. Although the experiment was not designed to specifically test for time of day catch differences, the data were analyzed to test for differences since escapement through the large mesh belly panel may have been influenced by light. The time-of-day paired tow differences are analyzed below (Figures 21 and 22).

Figure 21. Boxplot Distributions of Windowpane Flounder Catch Weights in The Control and Experimental Nets During Three Times Segments

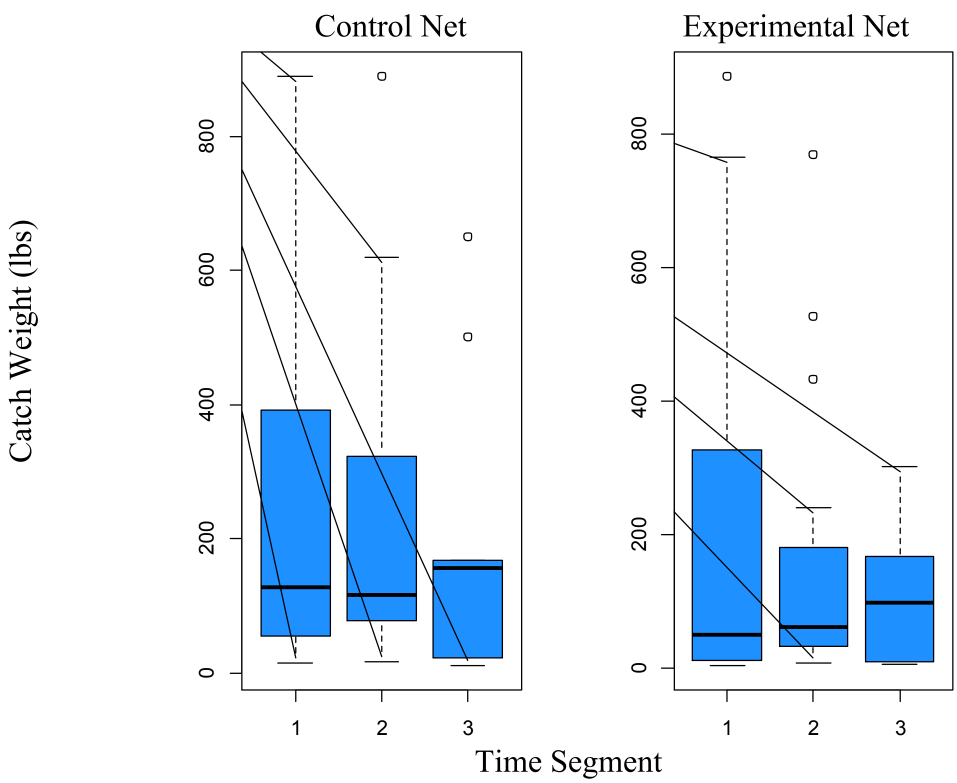


There is greater variation in the catches of windowpane flounder in the middle time segment most likely due to the fact that the most tows occurred during this time segment. We ran a two-way ANOVA to test for significance of two main effect independent variables: Net; (control or experimental) and time segment. The catch of windowpane flounder in pounds is the dependent variable. P-value results are as follows:

	Windowpane lbs.
Net	**< 0.0001**
Time Segment	**0.664**

Net is highly significant and correlates with the t-test results described above. Time segment is not significant for windowpane flounder catches.

Figure 22. Boxplot Distributions of Scup Catch Weights in The Control and Experimental Nets During Three Times Segments



For scup there is greater variation in catches during the first time segment. Also, the median scup catch was highest (but only slightly so) during the third time segment. This correlates with scup fishermen's knowledge that the "sundown tow" usually produces good catches of scup. We ran a two-way ANOVA on scup catches to test for significance of two main effect independent variables: net (control or experimental) and time segment. The catch of scup in pounds is the dependent variable. P-value results are as follows:

	Scup lbs.
Net	**0.247**
Time Segment	**0.152**

Time segment is not significant for scup catches. However in the ANOVA net is also not significant which is a different result than returned by the t-test above. The non-significant result for net in the ANOVA has less power than the T-test and Wilcoxon results above. Since the catches of scup among all tows has a very high variance, the significances of the difference in catch for each tow pair is reduced. The ANOVA is not a paired-tow statistic.

Total Catch

We graphically presented the data to determine the effect of total catch of all species on the difference in windowpane flounder and scup catch per tow. Figures 23 and 24 are pair-wise plots of the difference in windowpane flounder and scup catch (control net catch minus experimental net catch) vs. total catch weight of all species per tow. The horizontal line at zero represents equal catch in the control and in the experimental nets. Points above the line represent greater catches in the control net. The curve is the calculated best fit of the data.

Figure 23. Difference in Windowpane Flounder Catch Weight (Control – Experimental) Vs. Total Catch Weight of All Species Per Tow

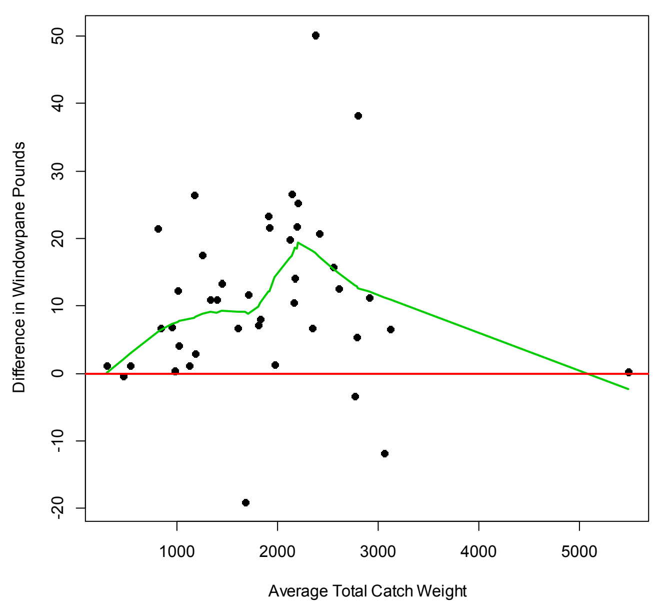
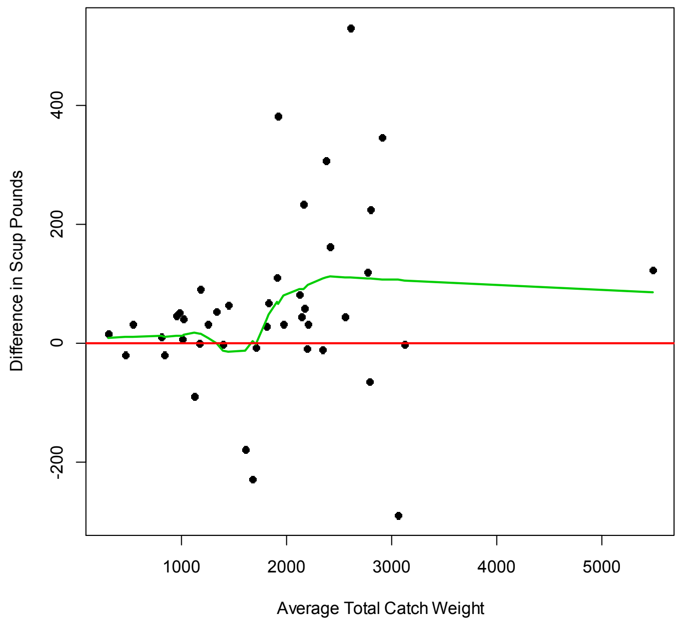


Figure 23 shows that the difference in windowpane catch (control minus experimental) trends up as total catch weight goes up. This indicates that the large mesh belly panel is more effective at releasing windowpane flounder as total catch goes up. A single outlier with a total catch greater that 5,000 lbs pulls the plot downward towards the end.

Figure 24. Difference in Scup Catch Weight (Control – Experimental) Vs. Total Catch Weight of All Species Per Tow



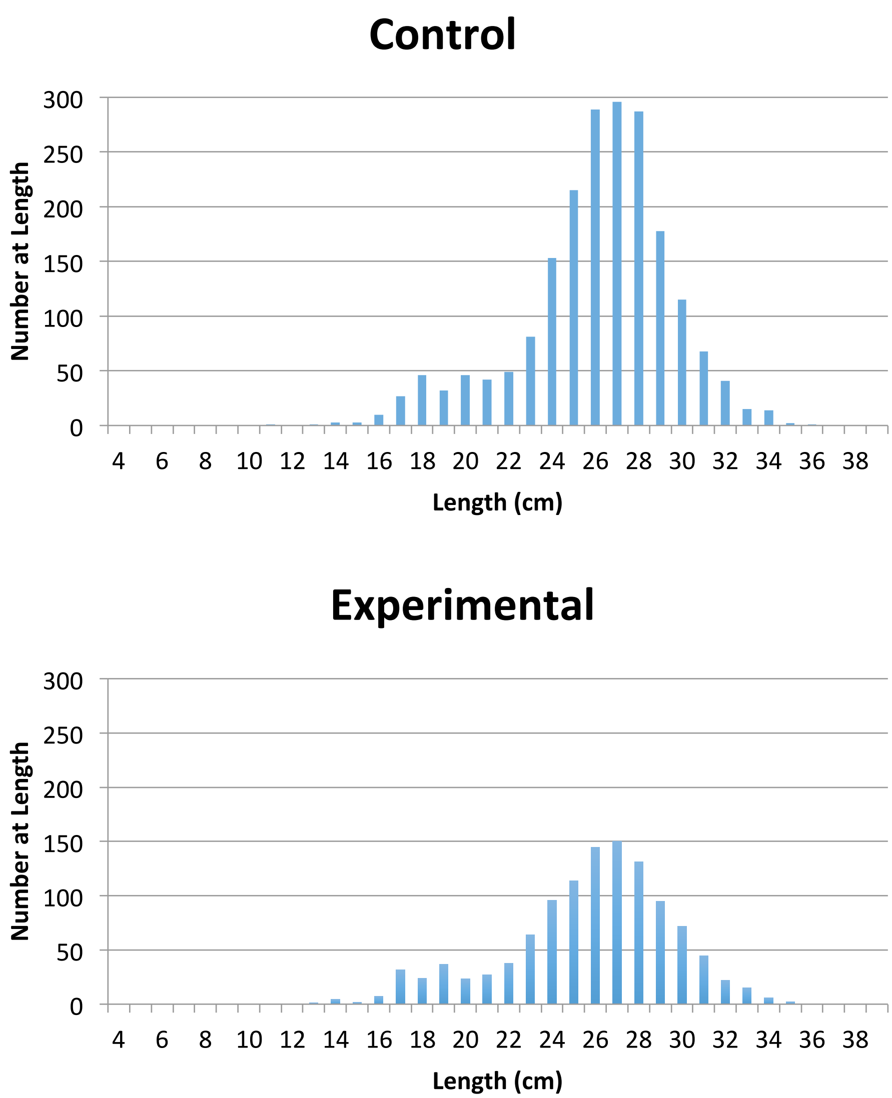
In Figure 24, when total catch weight of all species is plotted against the difference in scup catch weights between control and experimental nets, the resulting curve is horizontal at lower total catches. As total catch increases the difference in scup catch between control and experimental nets is clustered around zero until total catch weights reach approximately 2,000 lbs. At catch weights above approximately 2,000 lbs, the difference in scup catch between the control net and experimental net increases slightly. This indicates that with larger catches, more scup may be escaping from the panel. Again, there is a single outlier of total catch greater than 5000 lbs that pulls the plot back toward zero.

Length Frequency

Length measurements were collected from a subsample of the windowpane flounder and the scup catches. The subsample length frequencies were then expanded to the entire catch to determine the length frequency distribution for the catch. For each tow, the total catch numbers at length were calculated as the subsample numbers at length multiplied by the species-specific ratio of catch weight to subsample weight. Catch numbers were calculated for each net as the sum of the expanded numbers at length per tow. This method follows Hendrickson (2011) to expand the length frequency of a subsample to the entire catch.

In Figure 25 the length frequency distribution of windowpane flounder is compared between the control and experimental nets.

Figure 25. Windowpane Flounder Length Frequency Distribution in the Control Net (top) and Experimental Net (bottom)



In Figure 25, the peak of the windowpane flounder length distribution occurs in both nets at 27 cm. In the control net, there were 296 fish at 27 cm. In the experimental net, there were 150 fish at 27 cm. This is a 49.3% reduction in fish of this size as a result of the large mesh belly panel. A drastic reduction occurs at nearly all of the size intervals.

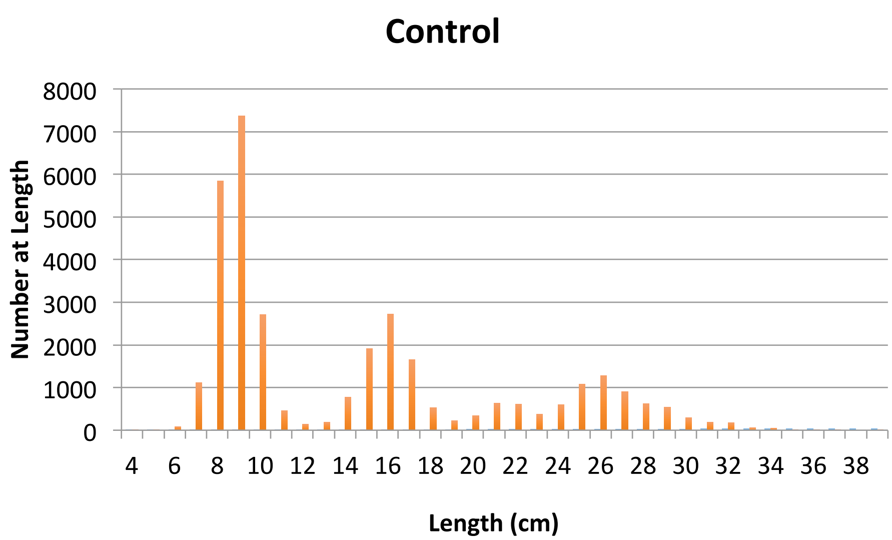
The mean length of windowpane flounder in the control net was 26.11 cm. The mean length of windowpane flounder in the experimental net was 25.99 cm. The mean length of windowpane flounder in the control net was 0.12 cm larger than the mean length in the experimental net. This is not a large size difference. The large mesh belly panel is reducing the catch of all sizes of windowpane flounder.

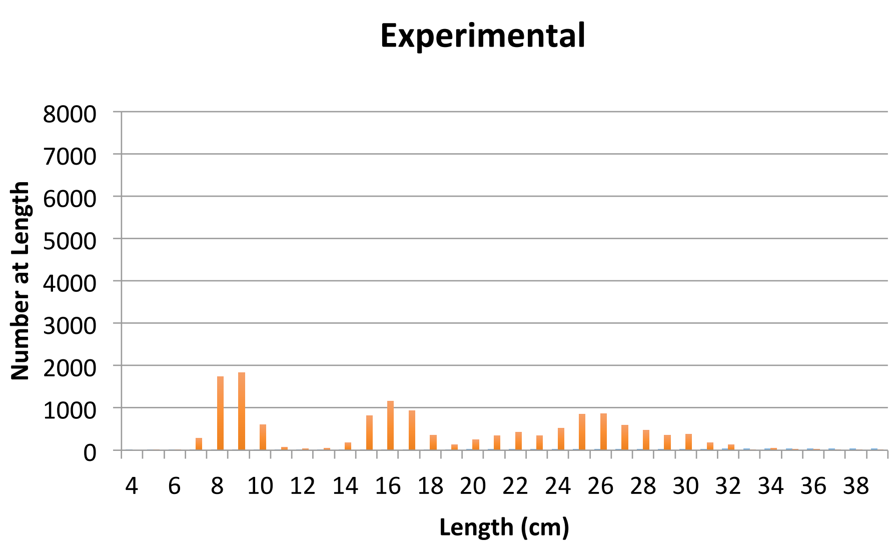
It is important to note that the scup lengths that were collected for this project were fork lengths. The commercially legal size for scup is 9 inches (22.9 cm) measured in total length. The following conversion was used to determine that a 22.9 cm (9") total length equates to a 20.2 cm fork length based on proven ASMFC conversion calculations (John Maniscalco, personal communication).

$$\text{Total Length} = 1.1337 \times \text{Fork length (in mm)} - 0.3842$$

In Figure 26 the length frequency distribution for scup is compared between the control and experimental nets.

Figure 26. Scup Length Frequency (fork length) Distribution Fork Length in the Control Net (top) and Experimental Net (bottom)





According to Figure 26, there are three peaks in the length frequency distribution which occur in both nets at 9 cm, 16 cm and 26 cm. The highest peak is at 9 cm in the control net. There are 7,374 fish at 9 cm in the control net. In the experimental net, the number of fish at 9 cm is 1,836. This is a 75% reduction in fish of this size. This reduction is the most dramatic, but substantial reductions at other sizes can be observed based on this figure. As determined above, the commercial legal size of scup is 20.2 cm (fork length). Based on this figure, it is obvious that the experimental net is reducing the catch of undersized, sublegal scup. A total of 25,761 sub-legal sized fish less than or equal to 19cm (fork length) were caught in the control net. A total of 8,211 fish less than or equal to 19cm were caught in the experimental net. This is a reduction of 68% of sub-legal sized fish as a result of the experimental net.

The mean length of scup in the control net was calculated to be14.54 cm. The mean length of scup in the experimental net was calculated to be 16.29 cm. The mean length of scup in the experimental net was 1.75 cm larger than the mean length in the control net indicating that large mesh belly panel is allowing for escapement of smaller fish and retaining larger fish. The reduction in undersized, sublegal scup observed in the experimental net is beneficial to the industry and to the scup resource.

The median and quartile fork lengths were calculated for scup and windowpane flounder in both the control and experimental nets (Figure 27).

Figure 27. Fork Length of Scup and total length of Windowpane Flounder in the Control and Experimental Nets at the 25, 50 and 75 percentiles

	25 percentile	50 percentile (Median)	75 percentile
Scup Control Net	9 cm	10 cm	18 cm
Scup Experimental Net	9 cm	17 cm	25 cm
Windowpane Control Net	25 cm	27 cm	28 cm
Windowpane Experimental Net	24 cm	26 cm	28 cm

According to Figure 27, the most dramatic result of the large mesh belly panel relative to length frequencies is the reduction of smaller sized scup at the 50^{th} and 75^{th} percentiles when compared to the control net. Again, a legal sized scup is 20 cm (fork length). The experimental net is avoiding the capture of at least 68% of sublegal sized scup. Although there was a significant reduction in scup overall as discussed in the beginning of the data analysis section of this report, this significant reduction appears to be in undersized, sublegal fish. This correlates well with information from the fishing industry. Industry partners indicate that scup tend to stratify by size within a school, with small fish at the bottom and increasingly larger scup with distance from the bottom with the largest at the top of the school. Also smaller scup likely tire quicker than larger scup and may then fall back into the net sooner while also being close to the bottom of the net. These two issues can explain the release of small scup through the large mesh belly panel. For windowpane flounder, there is only a slight difference in the size of fish captured by the control and experimental nets. The large mesh belly panel is reducing the windowpane flounder catch across all size intervals.

Summary

In summary, statistical analysis indicates that there was a significant difference in catch of both windowpane flounder and scup in the control net compared to the experimental net with the large mesh belly panel when analyzed in terms of catch weights and in number of individual fish. The overall reduction in windowpane flounder catch weight due to the large mesh belly panel treatment was 48.04% compared to the control net. The overall reduction in scup catch weight due to the large mesh belly panel treatment was 26.14% compared to the control net. When the analysis was conducted on number of fish, the overall reduction in number of windowpane flounder due to the large mesh belly panel treatment was 46.7% compared to the control net. The overall reduction in number of scup due to the large mesh belly panel treatment was 47.6% compared to the control net. Since the goal of the project was to utilize the large mesh belly panel to reduce windowpane flounder catch while retaining the catch of the target species (scup), the gear did not seem to be accomplishing both goals simultaneously. Initially, the fact that scup was significantly reduced was discouraging. However, once length frequency distribution data was analyzed, it was determined that the reduction in scup was attributed to the reduction of small, sublegal sized fish which would be discarded anyhow. The significant reduction in scup caused by avoiding these unmarketable fish may actually be an improvement over currently utilized gear. This reduction will benefit the industry by decreasing time spent processing and sorting the catch on deck as well as benefit the scup resource by decreasing the amount of scup discards. Coupled with the effectiveness of the large mesh belly panel at reducing windowpane flounder catch, the gear seems promising as a bycatch avoidance strategy benefitting both fish and fishermen.

All data has been submitted to the Northeast Consortium Fisheries and Ocean Database.

Partnerships

There is great value in cooperative research that partners commercial fishermen and scientists. This project was a true collaboration between industry and science from proposal conception to final results. CCE and industry participants communicated and coordinated on all aspects of project implementation. By expanding industry and science partnerships a pro-active course of action can be taken to address windowpane flounder bycatch issues using conservation gear technology.

Windowpane flounder is a species with a high level of interest to both fishermen and scientists. Both stocks of windowpane flounder are strictly managed and carefully monitored. Developing and testing a gear modification that will reduce windowpane flounder bycatch is of extreme importance and benefit to the industry and science. This project's members included both communities working in synergy to evaluate a gear modification concept that can be easily implemented by management and practical in function and construction for the commercial fishing industry.

Having an industry-tested design promotes widespread involvement and interest among fishermen and scientists. CCE has already proven success in reducing flatfish bycatch using the large mesh belly panel in the squid and whiting fisheries. Evaluating this gear type in the scup fishery expands its value and usefulness to another fleet of vessels. CCE's outreach for this project will include management and industry to facilitate industry participation and management adoption.

Impacts and Applications

This project has direct impacts on windowpane flounder bycatch reduction and the commercial fishing fleet impacted by the regulations put into effect to reduce bycatch of this species. We have verified the success of the large mesh belly panel as a conservation gear-engineering solution for reducing windowpane flounder bycatch by a statistically significant level. Although a significant reduction in the target species (scup) was observed in this project, the reduction in scup catch was determined to be comprised of predominantly sub-legal sized fish. Based on these positive results, we will encourage the small mesh fleet to adopt this gear in order to further reduce the bycatch levels of windowpane flounder. The lessening of bycatch encounters of windowpane flounders will be reflected in the NMFS observer program data tracking for vessels adopting the gear and can be used to further evaluate the effectiveness of the project. A reduction in windowpane flounder bycatch can reduce the probability of triggering Accountability Measures in the groundfish and other trawl fisheries and the harmful effects the AMs can cause to these valuable fisheries. By adopting and utilizing the large mesh belly panel, there can be increased fishing opportunities for a fleet that might otherwise be restricted once the bycatch of windowpane flounder causes unwanted fishery restrictions.

This project has resulted in the formation and expansion of partnerships between commercial fishermen and scientists. Enabling fishermen to participate in cooperative research results in the development of improved bycatch reduction solutions. Through this project, we have brought fishermen's information, experience, and expertise into the scientific framework needed for fisheries management. By using commercial fishing vessels as research platforms we have produced tools that are industry-tested, acceptable and more readily adopted as a bycatch solutions.

This project has provided timely, accurate and credible data to be used for science based management strategies that protect and rebuild fisheries resources while minimizing impacts to fishing communities. Through collaborative efforts with the industry we are helping to achieve both the sustainability of the fishery resources important to Southern New England and the sustainability of the livelihoods and economic well-being of the harvesters and coastal communities that depend on these resources.

In Fishing Year 2015 (May 1, 2015 to April 30, 2016), Northern and Southern windowpane flounder ACLs have been exceeded by more than 20%. This overage has triggered the implemenation of Accountability Measures which go into effect on May 1, 2017. Use of selective gear types designed to avoid flounder must be used in the large and small AM areas (See Figure 1). Based on the results of this project, CCE would recommend that the large mesh belly panel be considered in management as an additional approved selective gear type utilized to reduce windowpane bycatch in designated areas when AMs are triggered. Based on two of our previous studies, we are currently working with NMFS to approve the large mesh belly panel as an additional gear type in the small mesh squid and whiting fisheries to reduce yellowtail and windowpane bycatch if AMs are triggered based on sub-ACLS for those small mesh fisheries.

Related Projects

CCE has completed several research projects evaluating the effectiveness of a LMBP at reducing the bycatch of other flounder species. The positive results from these projects can perhaps be described as a means for leveraging this project's research. Based on these prior projects' results, the probability of achieving a positive outcome was good. Therefore we would be using the LMBP to its maximum advantage by including an additional flounder species empirically proven to be reduced by the belly panel. CCE's list of LMBP research projects includes:

1. A METHOD TO REDUCE WINTER FLOUNDER RETENTION THROUGH THE USE OF AVOIDANCE GEAR ADAPTATIONS IN THE SMALL MESH TRAWL FISHERY WITHIN THE SOUTHERN NEW ENGLAND/MID-ATLANTIC WINTER FLOUNDER STOCK AREA – This project was funded through the Commercial Fisheries Research Foundation and research was completed in 2010. CCE tested a LMBP in the longfin squid fishery to reduce the bycatch of winter flounder. The experimental LMBP was proven to be

functionally effective in significantly reducing the quantity of winter flounder bycatch as well as other demersal species.

2. GEAR TRIALS – REDUCTION OF WINTER FLOUNDER BYCATCH – This project was funded through the Commercial Fisheries Research Foundation and research was completed in 2013. A portion of this project was dedicated to testing the LMBP in the whiting fishery to reduce winter flounder bycatch. The experimental LMBP proved to be functionally effective in significantly reducing the quantity of miscellaneous flounder (all flounders excluding winter flounder) and all combined flounder (including winter flounder) bycatch.
3. EVALUATION OF THE LARGE MESH BELLY PANEL IN SMALL MESH FISHERIES AS A METHOD TO REDUCE YELLOWTAIL FLOUNDER BYCATCH ON SOUTHEAST GEORGES BANK - This project was funded through NOAA and research was completed in January of 2014. CCE evaluated the effectiveness of the LMBP at reducing the bycatch of yellowtail flounder as well as windowpane flounder in deep water while targeting squid and whiting. During this project, the LMBP was shown to significantly reduce the bycatch of both flounder species.
4. EVALUATION OF THE LARGE MESH BELLY PANEL IN SMALL MESH FISHERIES AS A METHOD TO REDUCE YELLOWTAIL FLOUNDER BYCATCH ON CULTIVATOR SHOALS - This project was funded through NOAA and research was completed in August of 2014. CCE tested a LMBP in the small mesh Georges Bank/Cultivator Shoals fisheries to reduce the bycatch of yellowtail flounder as well as windowpane flounder. During this project, the LMBP was shown to significantly reduce the bycatch of both flounder species.

Presentations

At this time, CCE has made no presentations related to this project. However, if requested, we would be happy to provide presentations on project results for the Research Steering Committee, other NEFMC Committees and the NEFMC.

Student Participation

This project and associated research did not incorporate student participation.

Published Reports and Papers

Currently, CCE has not published or submitted any papers or reports or newsletters relative to this project other than those required by the Northeast Consortium. A summary of this project and the results are included on CCE's "Squid Trawl Network" website for public access (www.squidtrawlnetwork.com) and on CCE of Suffolk County's Marine Program website at http://ccesuffolk.org/marine/fisheries/bycatch-reducation-projects/large-mesh-belly-panel-windowpane-bycatch-reduction-in-scup-fishery.

Future Research

Since the Northern and Southern windowpane flounder ACLs have been exceeded by more than 20% in FY 2015 and this overage has triggered the implementation of Accountability Measures requiring the use of selective gear types designed to avoid flounder in the large and small AM areas, CCE would recommend that the large mesh belly panel be considered in management as an additional approved selective gear type utilized to reduce windowpane bycatch in designated areas when AMs are triggered. In order to have this gear certified for use in the designated large and small AM areas, more tows may need to be conducted to further verify the effectiveness of the large mesh belly panel in additional areas and during other times of the year.

Literature Cited

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Images

Photo 1. Large mesh belly panel at Superior Trawl

Photo 2. Captain Steve Arnold installing large mesh belly panel into net on F/V Elizabeth Katherine

Photo 3. Hauling back the net

Photo 4. Fishing Vessel Sea Breeze Too

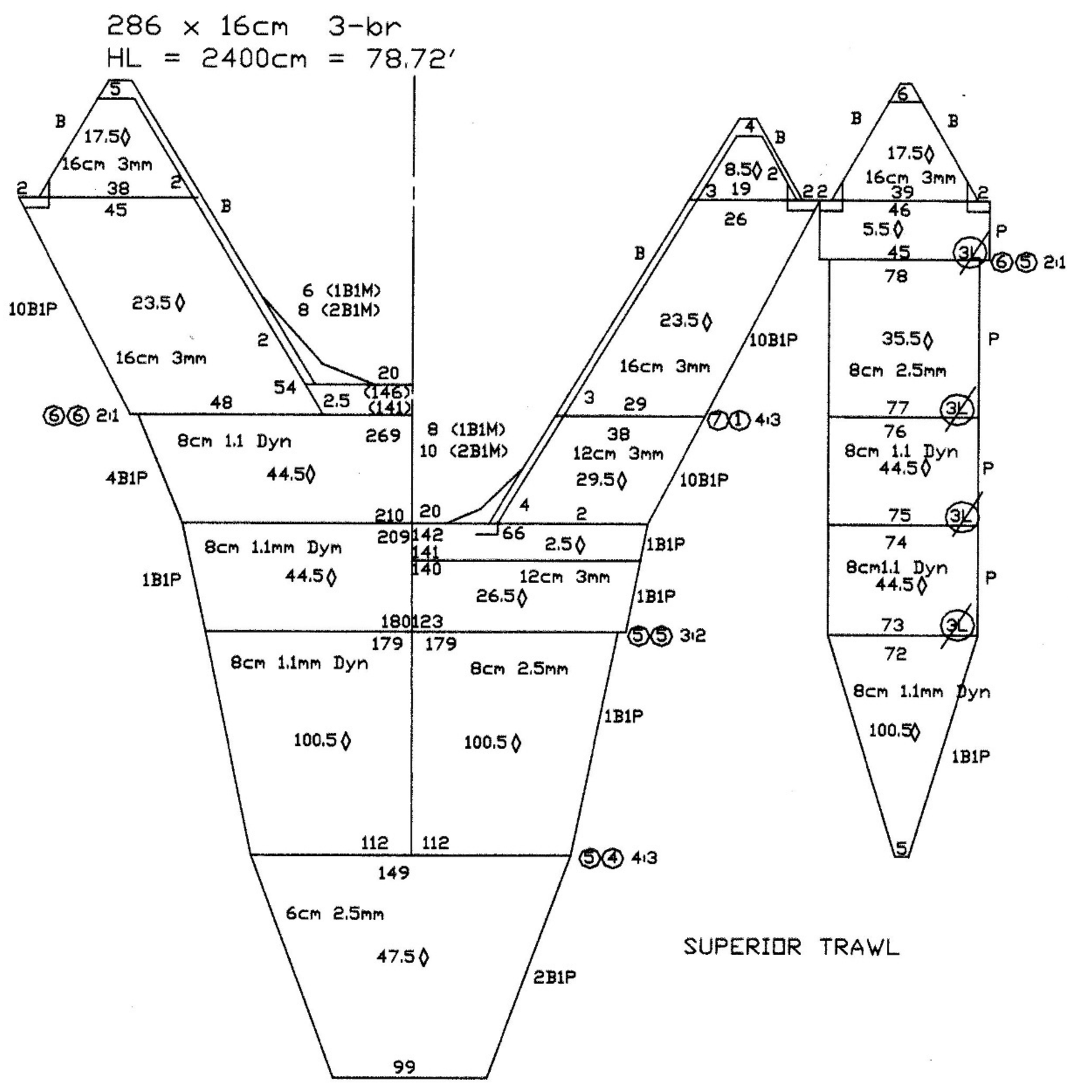
Photo 5. CCE Fisheries Technician Dan Kuehn processing the catch

Photo 6. Dumping the catch on deck

Photo 7. Crew member aboard F/V Sea Breeze Too sewing cover over large mesh belly panel in the experimental net

Photo 8. Removing cover from large mesh belly panel in the experimental net aboard F/V Sea Breeze Too

Net Plan (Schematic) – Control Net



Net Plan (Schematic) – Experimental Net