GEAR TRIALS – REDUCTION OF WINTER FLOUNDER BYCATCH

Proof of Concept Program – Experimental Fishery Phase

Final project report to the Commercial Fisheries Research Foundation

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Project Team

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ABSTRACT

Cornell Cooperative Extension (CCE) conducted an at-sea experimental fishing component as part of the Gear Trials Program to expand on the knowledge and achievements made in the proof of concept and full proposal research done under the Challenge Grant Program for Conservation Engineering Projects. This portion of the work was approached as a Proof of Concept experimental fishery phase. The goal of this at-sea research component was to demonstrate the potential for two different conservation gear modifications to reduce winter flounder bycatch in the whiting small mesh trawl fishery in the Southern New England/Mid-Atlantic winter flounder stock area. The two gear types that were tested were the 12” drop chain sweep and the large mesh belly panel. Data was collected onboard two commercial fishing vessels that targeted whiting. Paired tows were conducted using either the large mesh belly panel or the 12” drop chain sweep as the experimental component and a standard small mesh trawl as the control.

In summary, neither the 12” drop chain sweep nor the large mesh belly panel experimental net proved to reduce the quantity of winter flounder bycatch by statistically significant levels. However, a winter flounder escapement of 25% in the drop chain net and 44% in the large mesh belly panel net was observed when all tows were combined. There was no significant difference in whiting or squid catch between the control net and either experimental net modified with the 12” drop chain sweep or the large mesh belly panel. Retention of whiting, the target species, was maintained using both experimental nets. Both experimental nets 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. The 12” drop chain net reduced miscellaneous flounder catch by 67.4%. The large mesh belly panel reduced miscellaneous flounder catch by 63%. When all flounders (including winter flounder) were pooled, there was a significant difference in the catch between the control net and net with the 12” drop chain sweep that yielded a 66.1% reduction in total flounders. The large mesh belly panel significantly reduced the catch of all combined flounders by 61.7%. When all demersal species were pooled, there was a highly significant difference between the control net and both experimental nets that yielded a 66.8% reduction in catch by the 12” drop chain treatment and a 65.5% reduction by the large mesh belly panel.

INTRODUCTION

Winter flounder in the Southern New England/Mid-Atlantic (SNE/MA) areas are often bycatch within the economically important small mesh fisheries. At the time of this project proposal, the most recent stock assessment (NEFMC, 2011) indicated that winter flounder stocks had been suffering severe decline in recent years. The SNE/MA winter flounder stock complex was overfished but overfishing was not occurring. The 2011 SAW 52 stock assessment of the SNE/MA stock complex of winter flounder includes fishery and research survey catch through 2010. The assessment indicated that during 1981-1993, fishing mortality (F ages 4-5) varied between 0.61 (1982) and 0.95 (1993) and then decreased to 0.47 by 1999. Fishing mortality then increased to 0.70 by 2001, and has since decreased to 0.051 in 2010, generally tracking the decrease in fishery catch. SSB decreased from 20,100 mt in 1982 to a record low of 3,900 mt in 1993, and then increased to 8,900 mt by 2000. Spawning stock biomass (SSB) has varied between 4,500-8,000 mt during 2001-2009, and was 7,076 mt in 2010. Recruitment at age 1 decreased nearly continuously from 71.6 million age-1 fish in 1981 (1980 year class) to 7.5 million fish in 2002 (2001 year class). Catch of 842 mt in 2011 is projected to provide median F2011 = 0.100 and median SSB2011 = 9,177 mt. Projections at F = 0.000 in 2012-2014 indicate less than a 1% chance that the stock will rebuild to spawning stock biomass maximum sustainable yield (SSBMSY) = 43,661 mt by 2014 as required by the Magnuson-Stevens Fishery Conservation and Management Act.

Most of the commercial landings of winter flounder from the SNE/MA stock complex have historically been taken from statistical areas 521 and 526 (east and south of Cape Cod, MA), 537 and 539 (south of Rhode Island), and 611-613 (Long Island Sound and south of Long Island). With the restrictions on Exclusive Economic Zone (EEZ) landings beginning in 2009, the percentage of landings from area 521 decreased from about 40% in 2007-2008 to about 20% in 2009; however, that percentage rebounded to 58% in 2010. In 2009 about 40% of the commercial landings were from areas 537 and 539 off Narragansett Bay, RI, and about 35% off the coasts of NY and NJ. In 2010 about 18% of the commercial landings were from areas 537 and 539 off Narragansett Bay, RI, and about 12% off the coasts of NY and NJ. The primary gear used in the commercial fishery is the otter trawl, which has accounted for an average of 98% of winter flounder landings since 1989. (NEFMC, 2011)

Avoidance of winter flounder during fishing activities is imperative at this time in order to reduce fishing mortality and assist rebuilding efforts. At the time of the proposed project, Amendment 16 to the Northeast Multispecies Fishery Management Plan (FMP) was implemented on May 1, 2010 and prohibited retention of winter flounder by federally permitted vessels throughout the SNE/MA winter flounder stock area. This area of prohibition extended from Massachusetts to North Carolina and affected many fisheries. The no-retention provision will likely increase winter flounder discard in the designated area. The no-retention provision has since been modified to allow a very restricted harvest. Therefore it is crucial to have available functional gear adaptations to avoid or reduce catching winter flounder, while minimizing the economic impacts on the small mesh fisheries.

Through this project, Cornell University Cooperative Extension Marine Program (CCE) in conjunction with the Commercial Fisheries Research Foundation (CFRF) implemented a program to perform additional testing on two conservation engineering gear types, the large mesh belly panel and the 12" drop chain sweep, and to assist the commercial fishing industry with utilizing these gear types. Both gear types are designed to reduce winter flounder bycatch in the southern New England stock area. A financial assistance component of the program assisted fishing vessel owners with acquiring this conservation gear technology. Fishermen were issued vouchers to be used towards obtaining either gear type at no cost. This research component extended previous research conducted under the proof of concept and full proposal phases of the CFRF sponsored Challenge Grant Program for Conservation Engineering Projects. This new project encompassed both qualitative observations reported by fishermen and quantitative analyses conducted by scientists onboard commercial fishing vessels. Further testing and evaluation of the avoidance gear large mesh belly panel developed through a 2010 SNECRI project and the avoidance gear 12" drop chain sweep with a 24" headrope adjustment was conducted. This testing would determine the potential for these types of gear to reduce winter flounder bycatch in the small mesh trawl fishery for whiting in the Southern New England (SNE) inshore winter flounder stock area. These avoidance gears were evaluated in paired sea trials over a total of 6 days of at- sea research fishing using 2 vessels representative of the active whiting fleet fishing inshore during the late summer and early fall. Each vessel fished for 6 days for a project total of 12 days at sea.

The large mesh belly panel avoidance gear adaptation was initially created and tested by CCE in 2010 for a SNECRI project in the small mesh fishery. The large mesh panel was made of 80cm (32") mesh 6mm poly webbing, 2 meshes deep X 16 meshes wide sewn into the standard 16cm (6") mesh of the belly. With the 'saw-toothing' of the 16cm mesh, this yields an effective opening of 3 full meshes deep, a total of about 8' of large mesh. The panel attaches five 16cm meshes (approximately 2.5') behind the footrope and goes from gore to gore (22 meshes wide or approximately 30'). Results of that study show that the use of the large mesh belly panel resulted in a statistically significant 88% reduction in winter flounder, and an 83% reduction in demersal species. Demersal species include 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 has been determined in the limited scope of that project that the large mesh belly panel is an effective avoidance gear adaptation that successfully reduces winter flounder bycatch and the bycatch of other demersals without significantly affecting squid catch.

Milliken and DeAlteris (2004) tested the effectiveness of 4 different large mesh panels positioned in the lower belly of a standard whiting trawl to reduce bycatch of various flatfish (including winter flounder) while not significantly reducing the whiting catch. One of the panels proved to be effective in reducing flatfish bycatch while not reducing the catch of whiting. They found that a large mesh panel constructed of 40.6-cm diamond shaped stretched mesh with orange-colored nylon twine 1.6 mm in diameter in the lower belly of the net resulted in a 73% reduction in flatfish catch with no effect on the catch of whiting. This study gives supporting evidence that a large mesh belly panel can be effective in the whiting fishery.

Data from a previously completed CFRF proof of concept study, assessing headrope length variability coupled with the use of a 12" drop chain sweep conducted by CCE in 2010, showed that across all adjustments of the headrope (6" – 36") there was no significant difference in winter flounder catch between the control (0 slack) and any headrope slack adjustments combined with the 12" drop chain sweep. However there was a significant difference between the control (0 slack) and all headrope adjustments (6" – 36") for squid, combined demersals and crustaceans (combined demersals for this study also included winter flounder). Catches of these species were reduced in the experimental net. A significant reduction in catch of demersal species was found in tows with the headrope lengthened. There was also a highly significant difference between control (0 slack) vs. experimental treatment in crustacean catch. The limited data set produced by that proof of concept project was not robust enough to draw definitive conclusions and an increased number of tows needed to be conducted to improve statistical strength.

As a continuation and addition to the Proof of Concept work discussed above, CCE completed a full evaluation of the 12" drop chain sweep combined with a single 24" headrope adjustment. The decision to increase the headrope length by 24" was based on the knowledge gained during the previously mentioned 2010 proof of concept project and the results of Jon Knight's (Superior Trawl) work in a flume tank evaluating the 12" drop chain sweep and associated headrope slack. The 24" headrope adjustment showed the most promise for bycatch reduction in the "combined demersals" category during CCE's proof of concept. In 2011 and 2012 CCE conducted 4 research trips and completed 98 paired tows comparing an experimental net outfitted with a 12" drop chain sweep and the headrope lengthened by 24" to a control net. Results of the study showed the experimental avoidance gear provided a statistically significant reduction in the bycatch of winter flounder as well as the bycatch of other demersal species. The 12" drop chain sweep showed an overall reduction of 78% in winter flounder catch compared to the control net. In addition, there was no statistically significant difference in squid catch between the control net and the modified experimental net.

All three of these demonstration projects have been well received by the commercial fishing industry. The statistically significant bycatch reduction achievements of the modified gear in the squid fishery have been recognized by industry and scientists, leaving them seeking more information on the performance of this technology in the small mesh whiting fishery.

STATEMENT OF RESEARCH QUESTION

Avoidance of winter flounder during commercial fishing activities is crucial at this time in order to reduce fishing mortality and assist rebuilding efforts of the SNE/MA winter flounder stock. The question addressed by this research is whether an avoidance gear adaptation, the large mesh belly panel or the 12" drop chain sweep, can successfully reduce winter flounder bycatch without reducing the harvest of the target species to levels below economic viability. While this approach was functionally and conceptually possible, it was necessary to determine, in practice, if either or both of the gear modifications would effectively reduce winter flounder bycatch in the small mesh, whiting fishery.

GOALS AND OBJECTIVES

To build upon the successes of CFRF's previous Conservation Engineering projects, CCE collected both quantitative and qualitative data that was necessary for the completion of this research phase in the ongoing effort to improve fishing practices and help fishermen fish more selectively.

The overall goal and objective of the Gear Trials Program Proof of Concept experimental fishery phase was to conduct a Proof of Concept at sea evaluation to determine the effectiveness of these gear types (large mesh belly panel and 12" drop chain sweep with a 24" headrope adjustment) at reducing winter flounder bycatch while at the same time not significantly reducing the catch of whiting or squid. This was accomplished by extending the research record previously established to now include information relative to the whiting fishery.

METHODOLOGY

The experimental design and methodology developed for the research portion of this project incorporated the use of existing gear and typical fishing practices to test the large mesh belly panel and 12" drop chain sweep (with a 24" headrope adjustment) in the commercial, small mesh whiting fishery. CCE tested for differences in the catch of both the target species (whiting) and the protected species of concern (winter flounder). CCE conducted the research fishing across the appropriate identified strata of time, depth, area, fishing vessel size and power, and fishing practices. Two vessels of similar size and horsepower (60'-70' vessels; 450-600 HP with identical fishing nets, doors, legs, ground cable) were chosen by the CFRF from a pool of applicants to work with CCE on the quantitative data collection portion of this phase of the project. The selected vessels were the F/V Lightning Bay and the F/V Excalibur both from Pt.

Judith, RI and both representative of the small mesh whiting trawl fleet. These vessels were specifically chartered to act as research platforms necessary for comparing the nets outfitted with the different experimental avoidance gears to a control net. The two participating captains (Jeff Wise and Phil Merris) have extensive experience fishing for whiting in the project areas and they worked willingly and supportively to accomplish all project goals. CCE, the vessel captains, and the CFRF Board of Directors cooperated to confirm that the study area at the time of the fieldwork was the best geographic location for testing the two types of gear. The geographic area was chosen based on confirmed empirical fisherman knowledge that winter flounder and whiting would likely both be present during the designated study time.

Tow procedure had each vessel essentially fish as it would in a standard commercial fishing trip, with the exception that all tows were 1 hour in duration. Each vessel was equipped with an identical net that was typical of the small mesh nets used in the commercial whiting fishery along the east coast of the United States – a four seam, three bridle box net. The two fishing vessels each had just one net that served as both the control and the experimental. This was accomplished by making adjustments to the single net in order to move from the standard control design to the experimental design. When a net was in the control mode, the sweep was attached to the traveler (hanging line/fishing line) by 2 chain links plus a shackle and there was an additional 4 links of chain left hanging from the shackle. Both vessels used this "2 links plus the shackle connected to the traveler with 4 hanging" as the control net design to provide consistency between vessels. While in control mode, both the headrope and the sweep were pulled in and fished on-even. The experimental 12" drop chain was assigned to the F/V Excalibur and remained with the boat for the entirety of the research fishing. The procedure the Excalibur followed to switch the net between the control and experimental arrangements was as follows: The drop chains in the control net were 2 chain links plus a shackle connected to the traveler with 4 chain links left hanging. This created a drop chain length of approximately 5". This was switched to the experimental design by undoing the shackle connected to the traveler and including the 4 chain links that were left hanging. The result was 6 links of chain connected to the traveler by a shackle which resulted in an overall drop chain length of 12". Further, the headrope was slacked out 12" on each side for a total adjustment/increase of 24". The sweep was also slacked back 12" on each side in order to drop the sweep back behind the fishing line. The F/V Lightning Bay was supplied with the experimental large mesh belly panel for all of the experimental fishing component. In this case, the experimental large mesh belly panel was sewn in place in the first bottom belly of the net. The procedure the Lightning Bay followed to switch the net between control and experimental formats was as follows: For this net to be in the control format a 5" mesh "patch" was sewn over the large mesh panel rendering the large openings unusable. For the experimental format the 5" mesh "patch" was unlaced and removed leaving the 32" mesh panel exposed and ready for testing. The 5" mesh was consistent with the unaltered surrounding mesh in that area of the net.

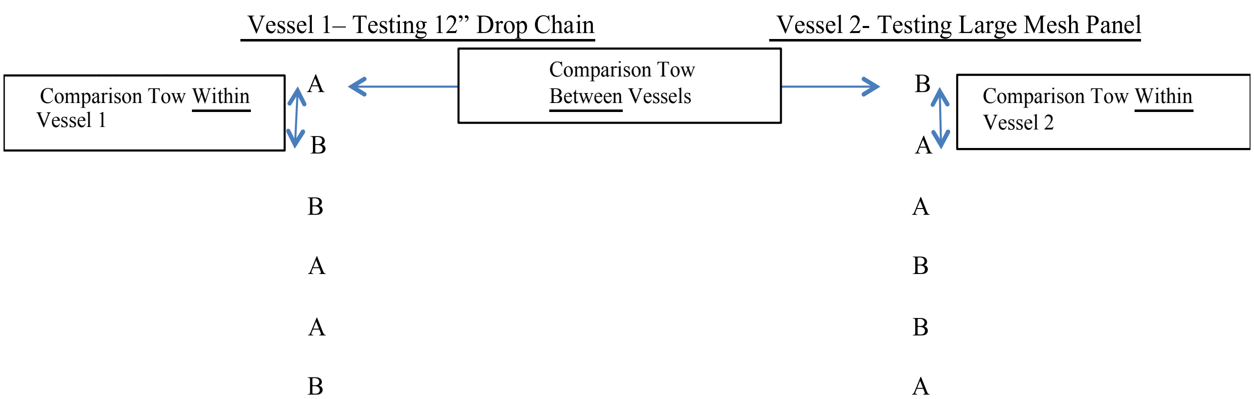
The two vessels towed the gear side by side in the designated study area while fishing for whiting. Again, each vessel had just one experimental gear type onboard either the 12” drop chain or the large mesh belly panel and it was incorporated into the control net as was described above. Comparison tows were accomplished because of the capability of each vessel to switch the single net onboard between the control format and the experimental format. This resulted in one vessel pulling the control net while the other vessel pulled its experimental net thus equaling a paired tow. Evaluation of the control and experimental nets was based primarily on differences in catch of winter flounder, whiting, and total catch across the paired tows. The weights for all other species were also collected and recorded for every tow.

CCE used the coupled ABBA-BAAB protocol for all the research fishing that occurred during this project. The ABBA – BAAB protocol is a comparative system by which a control net and experimental net are fished and compared using an alternating, paired methodology (DeAltaris and Castro, 1991). This system was used to reduce any bias that may occur (across an array of variables) when comparing the performance of two nets. This coupled ABBA-BAAB protocol had 1 vessel use the ABBA sequence while the other vessel used the BAAB sequence thus creating a paired tow. This ABBA – BAAB protocol with each vessel having only one of the experimental nets was recommended to be used by the CFRF Conservation Engineering Review Panel in order to try to accomplish more paired tows within the limited budget available for this project. A further depiction of this alternating, paired tow methodology follows:

ABBA – BAAB Protocol

Vessel 1 and Vessel 2 (towing side by side)

A = Control fishing net
B = Experimental fishing net



It was determined prior to the start of research fishing which vessel would begin with the net in the experimental format. Regardless of how many tows were completed at day’s end, the individual vessel continued to follow its predetermined sequence during each consecutive day of fishing. By using this procedure, the sequence is automatically reversed for each vessel on each successive day of fishing. In other words, the vessel that had the ABBA sequence on day 1 would follow The BAAB sequence on day 2. This worked to reduce any bias that could have resulted from time of day differences.

For Example:

A = experimental net B = control net

	DAY 1 – 6 TOWS	DAY 2 – 5 TOWS	DAY 3 – 6 TOWS
VESSEL 1	ABBA AB	BAAB B	ABBA AB
VESSEL 2	BAAB BA	ABBA A	BAAB BA

Also, by using the ABBA protocol over the same sea bottom, the variables of depth and temperature within each trip and over the course of the experiment were randomized. This randomization served to normalize the data relative to depth and temperature. This system also maximizes at-sea time by reducing the number of net changes thus allowing the greatest number of comparison tows to be completed. Finally, this methodology also created the possibility of comparing the experimental net to the control net within the same vessel thus equaling a paired tow. By comparing sequential tows of an individual vessel, an experimental/control paired tow could be established (see figure 1). This allowed an increase in the sample size or data set by combining the paired tows formed between the two vessels with those created by a single vessel. It was thought that this could increase statistical strength to the analysis of this otherwise limited Proof of Concept research.

At the time of planning the experiment, we chose this research design to maximize the quantitative data collection component of this program. We assumed that tows could be paired in two ways: 1. Paired by tow when the tows were occurring simultaneously with one vessel towing an experimental net and the other vessel towing a control net, and 2. Paired by vessel with the same vessel utilizing the experimental gear and control net consecutively.

Number of trips and tows

For the research portion of this project, a scientific trip was defined as one day at sea for 2 vessels and a paired tow between vessels described a tow consisting of one vessel pulling the control net and a corresponding experimental net pulled by the other vessel. Utilizing these definitions, CCE completed 6 scientific trips and 36 paired tows. A slight discrepancy arises when you look at the number of individual tows completed. This was due to mechanical failure prohibiting the F/V Excalibur to complete a tow causing the F/V Lightning Bay to complete the tow unaccompanied. As a result, instead of 72 individual tows or 36 paired tows, 73 individual tows were completed. These 73 individual tows can be separated into 36 tows completed with the control net and 37 tows completed with an experimental net. The 37 completed experimental tows can be broken down further into 18 tows completed with the belly panel net and 19 tows completed with the drop chain net.

Timing, Fishing Practice, and Area

The research fishing focused on a time period that coincided with the normal activities of the small mesh whiting fishery and would provide the highest likelihood of the co-occurrence of whiting and winter flounder. This operational plan was based on information from active fishermen, NEFSC trawl surveys, observer data, and landings reports. As was stated earlier in this report, the final decision as to where and when to fish was made jointly by fishermen, CFRF, and CCE. CCE's 6 research trips occurred in the summer and fall of 2013. The specific dates were July 16th, 17th, 18th, and 19th and October 14th and 15th, 2013.

Each vessel operated with a single net switching back and forth between the control mode and the individual experimental mode that was assigned to that vessel as described above. The nets, doors, legs and ground cables were identical with both vessels. The experimental and control nets were towed side by side with the vessels attempting to remain within a half-mile of each other. Tows were made oriented along slope. After haul-back, the vessels turned around and made the same tow in the opposite direction with the next net in the ABBA sequence. The towpath or track was moved or changed only if it was necessary due to changes in or movement of fish concentrations and this could occur only at the end of a tow-block sequence. One-hour tow durations were used during this study. This allowed CCE to maximize the number of tows conducted per day. One-hour tows are recognized by industry and managers alike as acceptable because they fall within the standard range of commercial tow durations (1-3 hours). Specific adjustments to fishing practices were discussed and agreed upon by project partners prior to the start of research fishing and were adhered to throughout the project. One shortened tow was conducted prior to actual research fishing for net mensuration purposes to ensure nets were fishing with similar geometries. Each vessel maintained an average tow speed of 3 knots and tow wire scope was kept in the range of 2.5 to 3.0 to 1 depending on depth, which is the accepted ratio range for inshore tows. The headrope for both the control net and the experimental net with the belly panel was set on even. The headrope on the experimental net with the 12" drop chain was lengthened by 24" (12" each side). This 24" extension was removed when it was necessary for the drop chain net to function as a control net. This was accomplished by adding or removing a 12" length of chain from the upper bridle on each side of the trawl net mouth. Also, the experimental 12" drop chain sweep was constructed in three pieces, the two wings and a center section, and it too was lengthened by 2 feet (one foot per side). This additional length is necessary to allow the 12" drop chains to function as they were designed. The reason for the extension is twofold. First, the increase in the sweep length allows the sweep to travel behind the hanging line causing the drop chains to extend to their full potential (12") and thus offering the greatest area for fish escapement between the sweep and hanging line. Second, by lengthening the sweep and allowing it to travel behind the hanging line, the mud cloud created by the sweep does not obscure the enlarged opening created by the experimental drop chains. This increased visibility offers fish the greatest opportunity for escapement. The two-foot extension in the sweep was removed when the net needed to be used as the control. This was accomplished in the exact same manner as the headrope extension except the 12” length of chain was added or removed from the lower bridle on each side of the net.

The study vessels departed from the commercial port of Point Judith, Rhode Island. All research fishing was conducted in a historically productive fishing site locally known as “The Dump”. The area earned the name due to its past as a munitions and debris dumping ground and is located approximately 30 miles south of Martha’s Vineyard, MA and roughly 50 miles south and east of Montauk Point, NY. The center of this area is generally viewed to be in the vicinity of latitude 40^0 44’N and longitude 70^0 52’W.

<u>On Board Catch Processing</u>

Our objective was the winter flounder catch specifically relative to quantifying differences in retention between a control net and each individual type of gear modification (12” drop chain or large mesh belly panel). As such, the total catch of winter flounder captured was accurately weighed for each and every tow in order to determine and quantify differences. Winter flounder were also sampled for length frequency. The goal was minimally 100 random length measurements per tow. If fewer individuals were caught, than all the specimens available were measured. Since we were looking at winter flounder bycatch in the targeted whiting fishery, the total weight of the whiting catch was also obtained by direct weighing for every tow. This was necessary to quantify and determine if the total whiting catch was positively or negatively influenced by the experimental modifications to the net. In addition, a length sample of whiting of at least 100 individuals was obtained. The total weight of all additional species in each tow was also collected either by direct weighing or by sub-sampling/ catch estimations. For sub-sampling, a random sample of either 3 totes or 5 baskets was immediately taken from the catch after it was released on deck. From this random sample, individual species were separated and weighed and catch estimations were calculated. Catch estimations were made using the Catch Estimation Worksheet from the NMFS Fisheries Observer Program. This procedure for catch estimations and all other onboard catch processing procedures followed standard NMFS survey methods and/or the NMFS At Sea Monitoring Program and the Observer Program Biological Sampling protocols as outlined in the NEFSC 2010 sampling manuals.

DATA ANALYSIS

Below is a quantitative evaluation and summary of the data analysis. Data were analyzed primarily to determine if a statistical difference exists in the catch of winter flounder and of whiting between the control net and each experimental net and to further quantify what the difference was. Analysis was based primarily on the paired tow difference in catch (control minus experimental). Analysis was conducted in weights. We also tested for difference in length frequencies between the nets. We further looked at the performance of the two experimental nets and the control net relative to squid, combined flounders (all flounders including winter flounder), miscellaneous flounders (all flounders except winter flounder), and combined demersal species. Combined demersal species includes all flounders, all skates, smooth and spiny dogfish, monkfish, and sea robins. The data generated from the paired tows was normally distributed; therefore the parametric t-test was an appropriate statistical model to use to analyze the data. We have also included the results of the Wilcoxon test as a nonparametric analysis. All statistics were at the $\alpha = .05$ level. Data from 18 paired tows are used for the large mesh belly panel comparison and data from 19 paired tows are used for the drop chain comparison. A vessel breakdown resulted in one less tow for the large mesh belly panel comparison.

The best analytical approach is to pair each treatment tow with its corresponding control tow in order to reduce the variability that occurs from place to place and time to time in the ocean environment. The pairing of the treatment and the control is the best way to reduce the between-sample variability due to ocean processes that are independent of the treatment effects. The research design suggested by the Conservation Engineering Review Committee (described above) was set up to provide this pairing and to increase the number of pairs that could be accomplished in each day of fishing. This would potentially allow the experimental of one boat to be compared to the control of the other boat during the same tow (paired by tow) as well as each boat comparing its own control to its own sequential replicate experimental tow (paired by boat).

However once we started the statistical analysis, we realized that this full complement of pairing was not statistically valid. In the paired by tow analysis it became obvious that the treatment was confounded with vessel and we could not separate out the gear effect from the vessel effect. This was because each vessel had its own experimental net that was not switched with the other experimental net during the experiment. Therefore we could not statistically determine if the differences in the catch between the control (on one boat) and the experimental (on the other boat) were due to differences in the fishing effect of each vessel or the fishing effect of the gear. If we had switched experimental nets between the vessels several times during the experiment, we would have been able to randomize for vessel effect. We tried to resolve this by conducting a statistical analysis of variance across all tows both paired by boat and paired by tow, but the need to do the pairing did not allow the ANOVA to be a valid approach.

Therefore we used the paired by boat tows as the basis for the statistical analysis. This helped to resolve the variance but reduced the number of tow pairs that could be used for each experimental net.

WINTER FLOUNDER

First, statistical analysis of the data was conducted to determine if either the large mesh belly panel (Figure 1) or the 12" drop chain sweep experimental net (Figure 2) significantly effected retention of winter flounder relative to the standard control net.

The total catch weights of winter flounder for each tow were relatively low. Paired t-test results showed no significant difference between paired tows in terms of winter flounder catch for either experimental net. (Drop chain: t = 1.5154, df = 18, **p-value = 0.147,** mean of x = 3.715789; Large mesh belly panel: t = 1.4676, df = 17, **p-value = 0.1605,** mean of x 7.461111). The Wilcoxon nonparametric test showed similar results (Drop chain: **p-value=0.06105**; Large mesh belly panel: **p-value=0.1406).** These results were contradictory to CCE's previous studies on the 12" drop chain sweep and large mesh belly panel conducted with similar gear in the squid fishery. In the previous studies, the experimental nets were proven to significantly reduce the amount of winter flounder bycatch compared to the control net. It is likely that the very low and zero catches of winter flounder that occured in the current study coupled with the low number of paired tows produced the non-significant result. However we are still encouraged by the results of this study and suggest that conducting more tows in an area where winter flounder catches are higher might produce a result more consistant with our results in the squid fishery. As is shown below, both experimental gears significantly reduced the catch of all flounders and winter flounder are included with all flounders. Thus a more robust study may provide significant results for winter flounder.

Figure 1. Distribution of Paired Tow Differences for Winter Flounder (lbs) in the Large Mesh Belly Panel Net

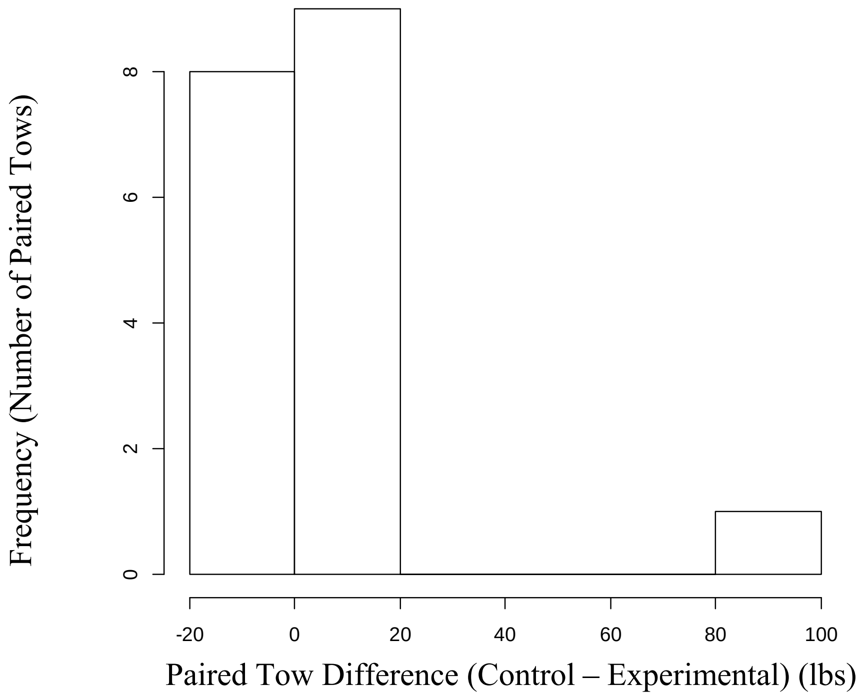
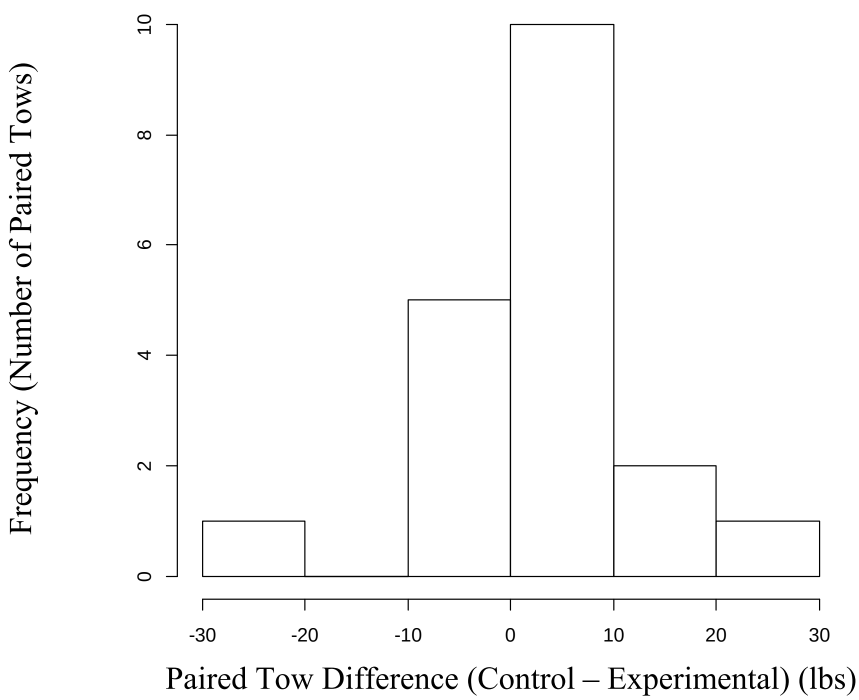


Figure 2. Distribution of Paired Tow Differences for Winter Flounder (lbs) in the 12” Drop Chain Sweep Experimental Net



In the figures below, the total weight of winter flounder caught by the large mesh belly panel (Figure 3) and the 12” drop chain sweep experimental net (Figure 4) are compared to the paired control net catch of winter flounder.

Figure 3. Total Catch Weight of Winter Flounder (lbs) in the Large Mesh Belly Panel Experimental Net and the Control Net for All Trips Combined

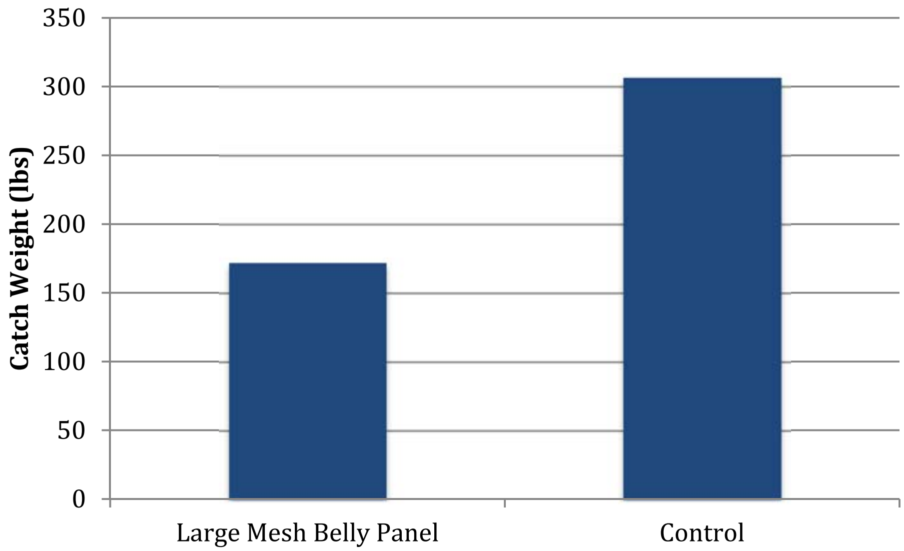
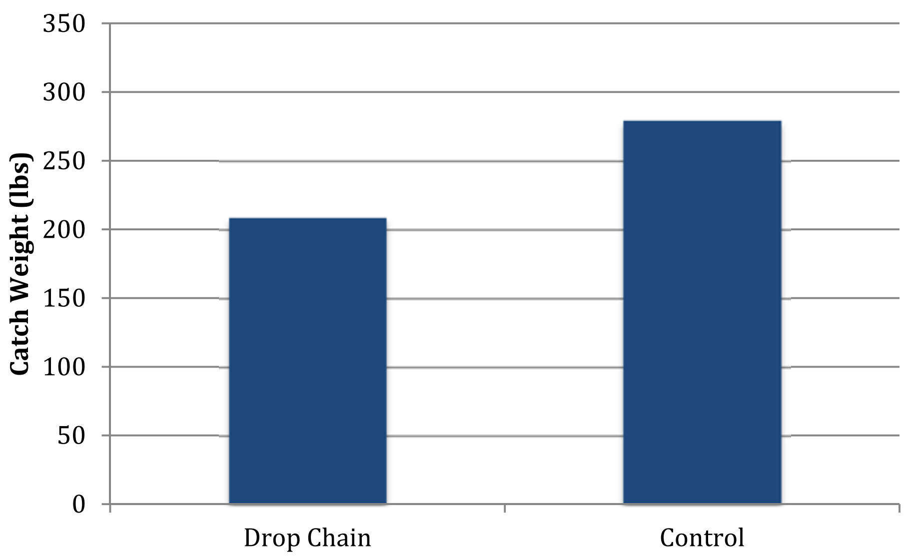


Figure 4. Total Catch Weight of Winter Flounder (lbs) in the 12” Drop Chain Sweep Experimental Net and the Control Net for All Trips Combined



Although the result is not statistically significant, there was a 25.3% reduction in winter flounder catch in the net fitted with the 12” drop chain sweep compared to the control net. For the large mesh belly panel net, there was a 44% reduction in winter flounder in the experimental net compared to the control net.

<u>WHITING</u>

Next, statistical analysis of the data was conducted to determine if either experimental net (large mesh belly panel (Figure 5) or the 12” drop chain sweep (Figure 6)) significantly affected retention of whiting relative to the standard control net.

A paired t-test showed no significant difference between paired tows in terms of whiting catch in pounds. Nether experimental net significantly reduced the catch of whiting compared to the control net. (Drop chain: t = 0.8952, df = 18, **p-value = 0.3825**, mean of x = 117.1; Large mesh belly panel: t = 1.8449, df = 17, **p-value = 0.08255**, mean of x = 223.7389). The Wilcoxon nonparametric test showed similar results (Drop chain: **p-value=0.3736**; Large mesh belly panel: **p-value=0.1187).**

Figure 5. Distribution of Paired Tow Differences for Whiting (lbs) in the Large Mesh Belly Panel Net

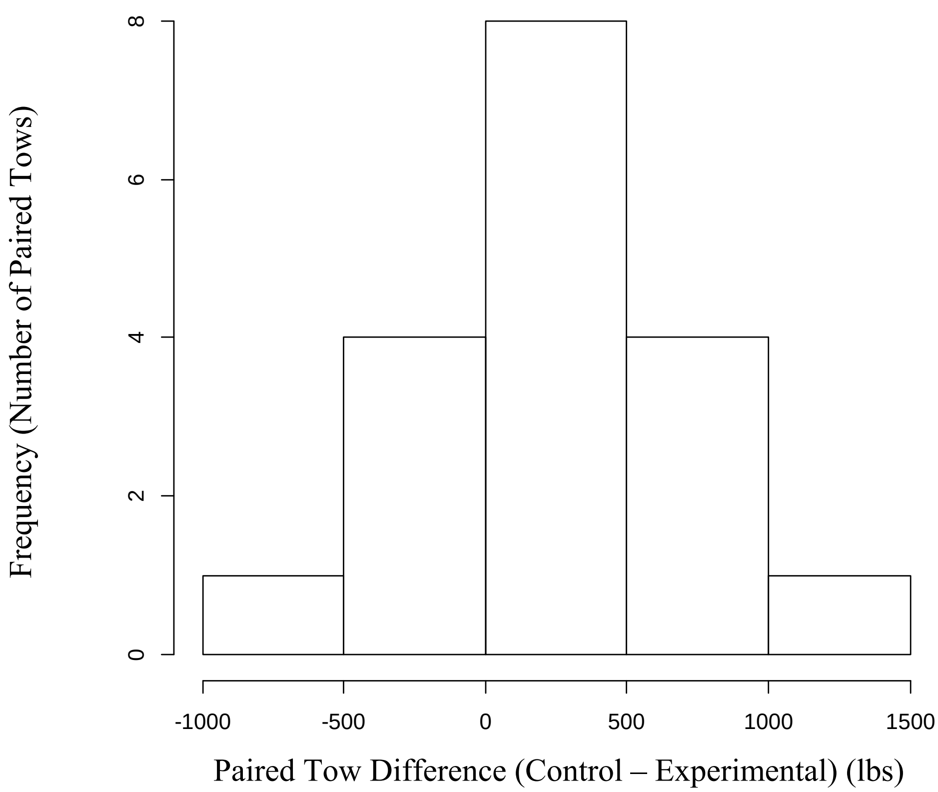
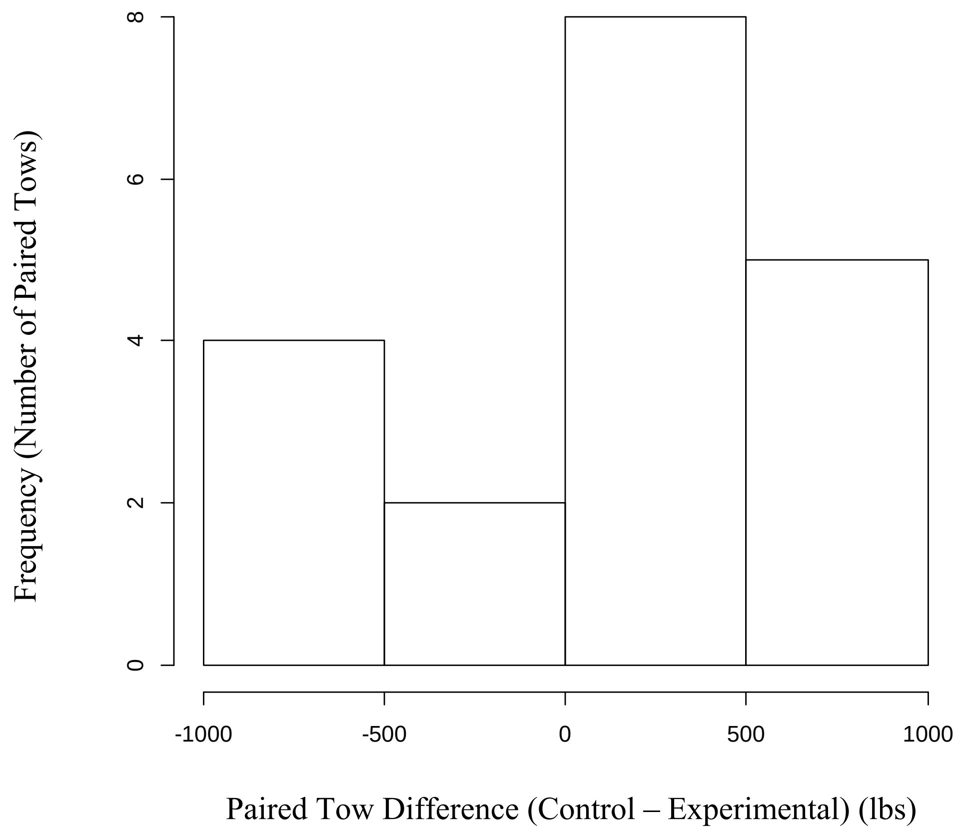


Figure 6. Distribution of Paired Tow Differences for Whiting (lbs) in the 12” Drop Chain Sweep Experimental Net



In the following figures the total weight of whiting caught by the large mesh belly panel (Figure 7) and the 12” drop chain sweep experimental net (Figure 8) are compared to the paired control net catch of whiting.

Figure 7. Total Catch Weight of Whiting (lbs) in the Large Mesh Belly Panel Experimental Net and the Control Net for All Trips Combined

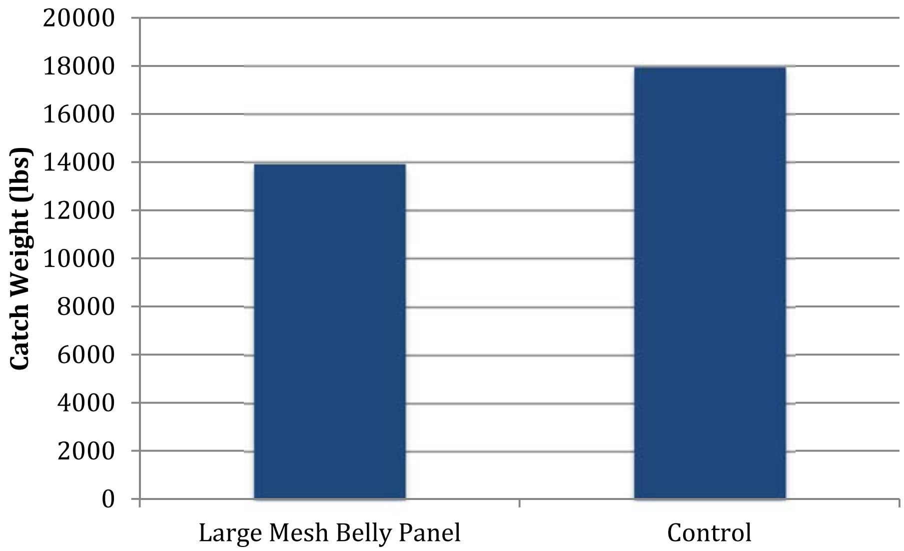
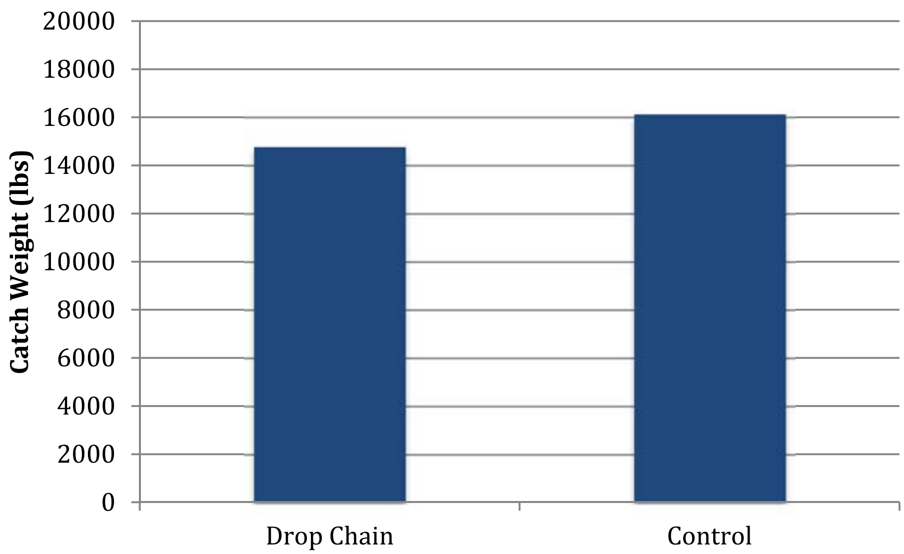


Figure 8. Total Catch Weight of Whiting (lbs) in the 12" Drop Chain Sweep Experimental Net and the Control Net for All Trips Combined



According to Figures 7 and 8, a larger quantity of whiting was retained by the control net; however, the result is not statistically significant.

SQUID

Next, statistical analysis of the data was conducted to determine if either the large mesh belly panel experimental net (Figure 9) or the 12" drop chain sweep experimental net (Figure 10) significantly affected retention of longfin squid relative to the standard control net.

Neither experimental net significantly reduced the catch of squid compared to the control net. (Drop chain: t = 0.705, df = 18, **p-value = 0.4898,** mean of x = 22.81053; Large mesh belly panel: t = -0.8031, df = 17, **p-value = 0.433**, mean of x -20.62778). The Wilcoxon nonparametric test showed similar results (Drop chain: **p-value=0.2101**; Large mesh belly panel: **p-value=0.2837).**

Figure 9. Distribution of Paired Tow Differences for Squid (lbs) in the Large Mesh Belly Panel Net

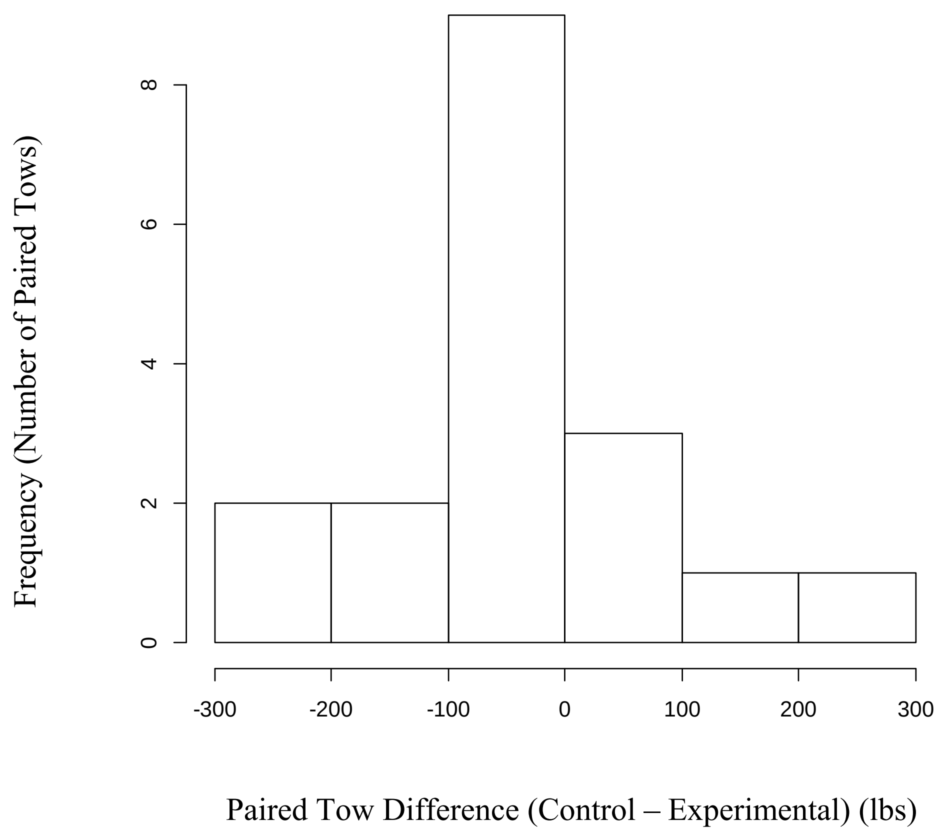
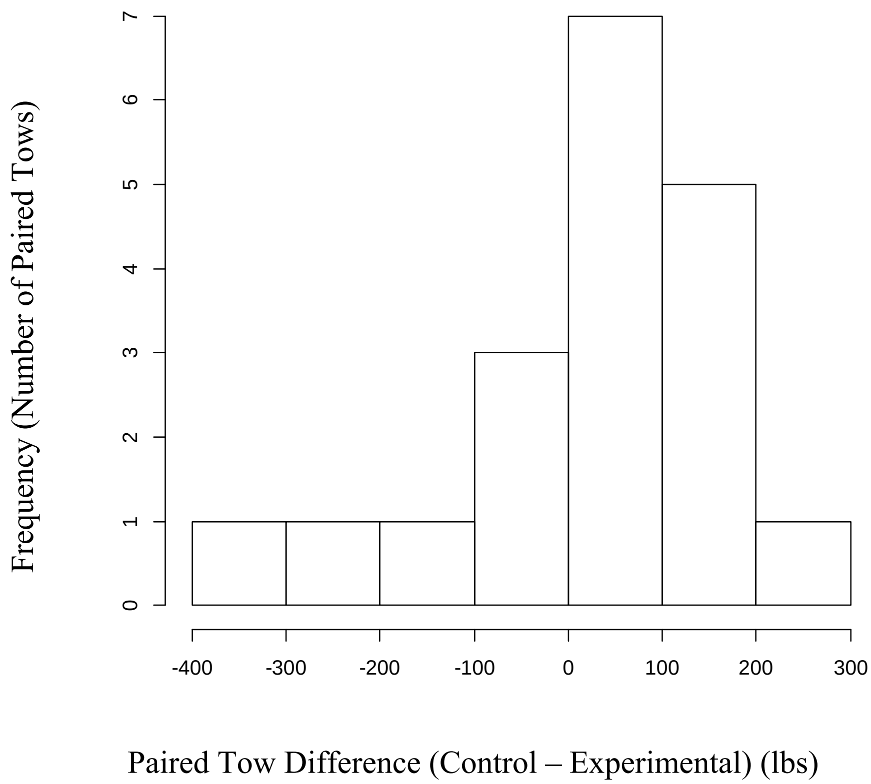


Figure 10. Distribution of Paired Tow Differences for Squid (lbs) in the 12" Drop Chain Sweep Experimental Net



In the following figures the total weight of squid caught by the large mesh belly panel (Figure 11) and the 12" drop chain sweep experimental net (Figure 12) are compared to the paired control net catch of squid.

Figure 11. Total Catch Weight of Squid (lbs) in the Large Mesh Belly Panel Experimental Net and the Control Net for All Trips Combined

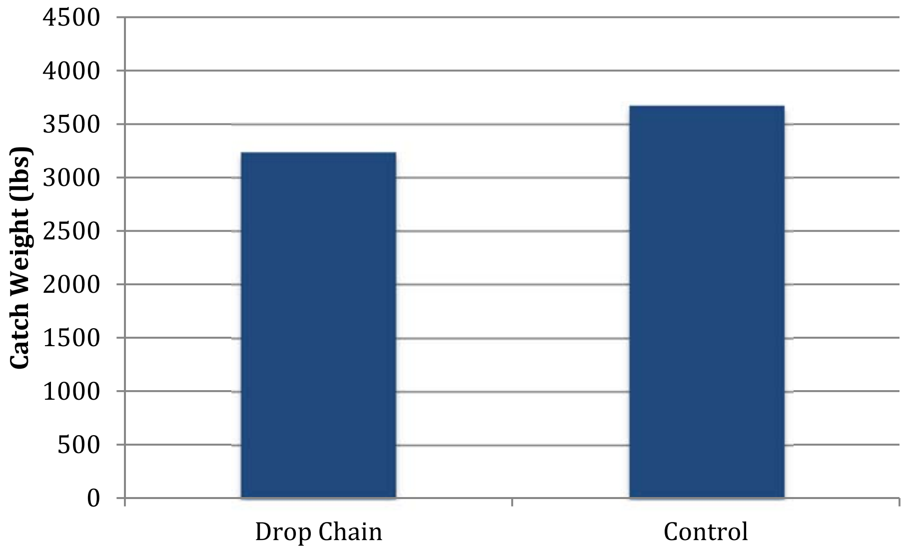
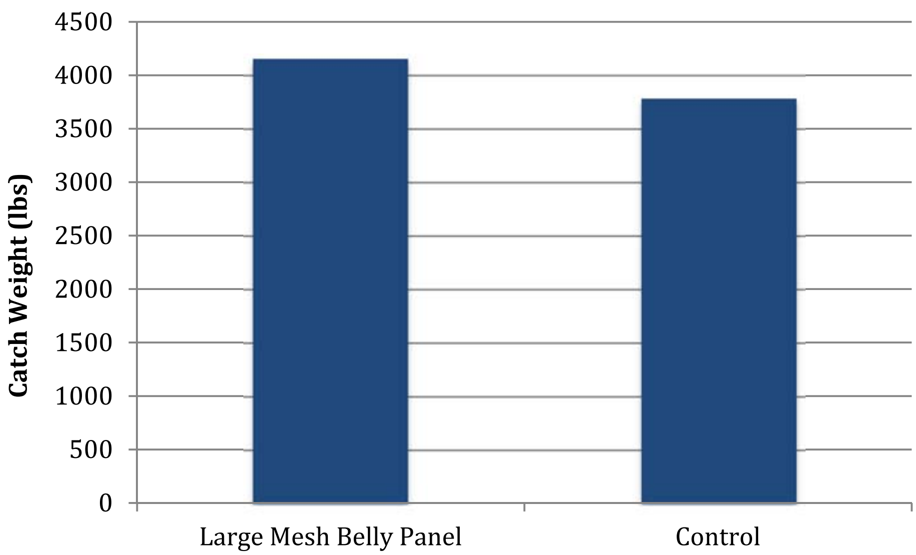


Figure 12. Total Catch Weight of Squid (lbs) in the Large Mesh Belly Panel Experimental Net and the Control Net for All Trips Combined



Although the result was not statistically significant, a larger quantity of squid was retained by the large mesh belly panel compared to the control net. When compared to the experimental net with the 12” drop chain sweep, a larger quantity of squid was retained by the control net but the difference was not significant.

MISCELLANEOUS FLOUNDER

Next, the effect of the both the large mesh belly panel (Figure 13) and the 12" drop chain sweep (Figure 14) on the catch of miscellaneous flounders was analysed. Miscellaneous flounders includes yellowtail flounder, summer flounder, fourspot flounder, gulfstream flounder, witch flounder, and grey sole. Miscellaneous flounder does not include winter flounder.

The paired t-test results for miscellaneous flounder catch weights between the control net and both experimental nets showed a significant difference. Both experimental nets caught significantly less flounders. (Drop chain: t = 4.6064, df = 18, **p-value = 0.0002191**, mean of x = 304.2789; Large mesh belly panel: t = 4.514, df = 17**, p-value = 0.0003064,** mean of x = 150.4222). The Wilcoxon nonparametric test showed similar results (Drop chain: **p-value = <0.0001;** Large mesh belly panel: **p-value=0.0001907).**

Figure 13. Distribution of Paired Tow Differences for Miscellaneous Flounder (lbs) in the Large Mesh Belly Panel Net

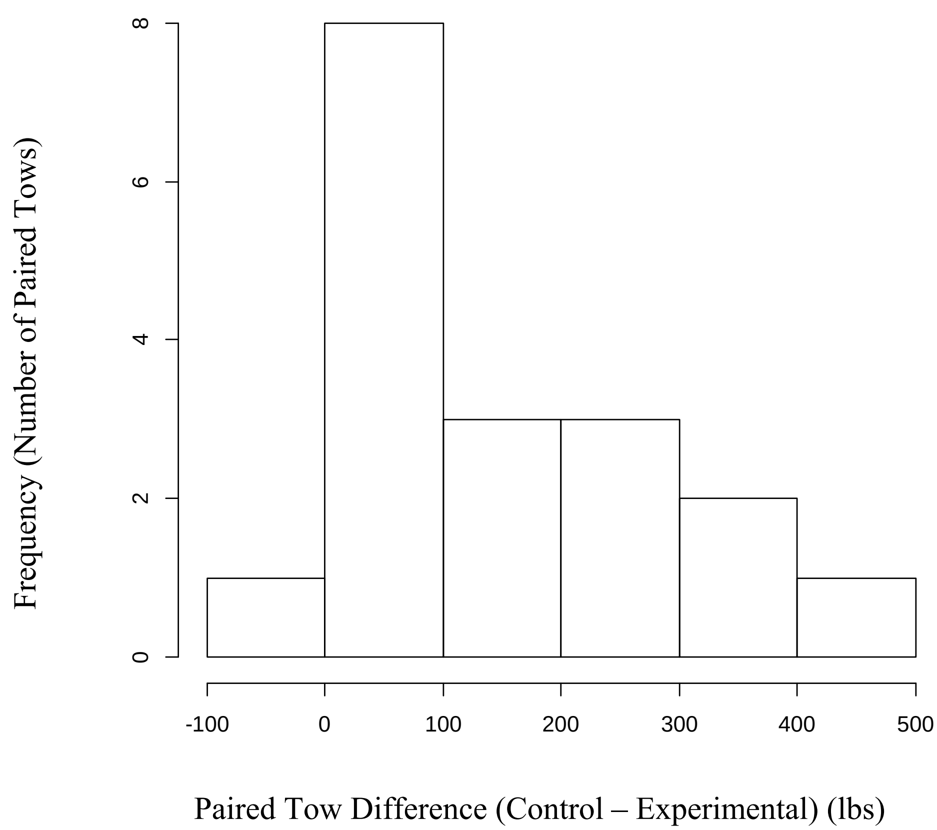
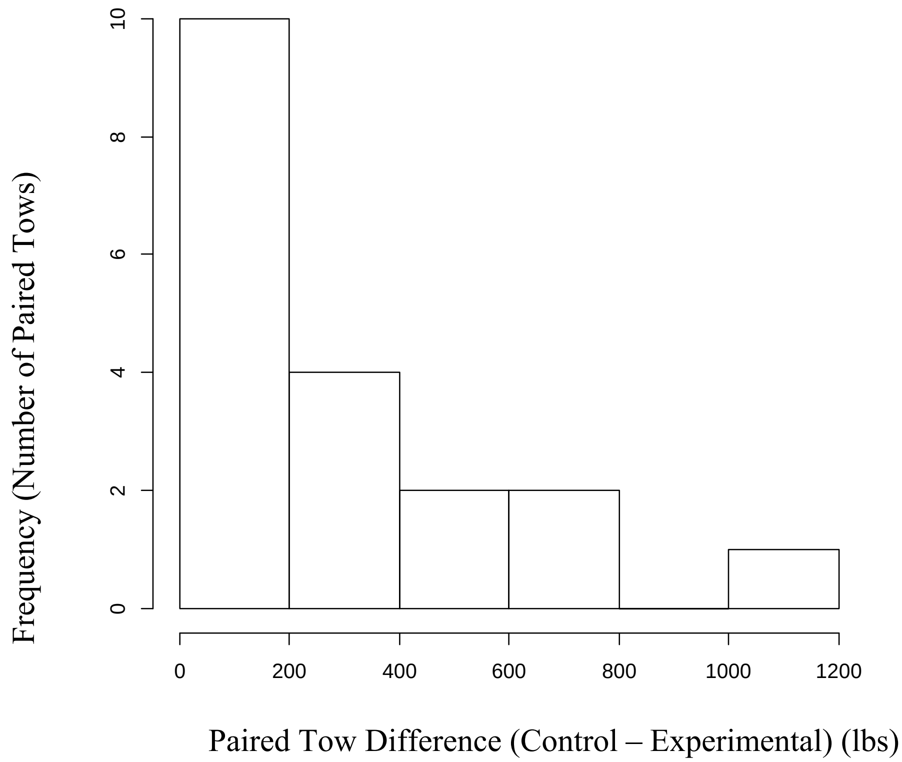


Figure 14. Distribution of Paired Tow Differences for Miscellaneous Flounder (lbs) in the 12" Drop Chain Sweep Experimental Net



In the following figures the total weight of miscellaneous flounder caught by the large mesh belly panel (Figure 15) and the 12" drop chain sweep experimental net (Figure 16) are compared to the paired control net catch of miscellaneous flounder.

Figure 15. Total Catch Weight of Miscellaneous Flounder (lbs) in the Large Mesh Belly Panel Experimental Net and the Control Net for All Trips Combined

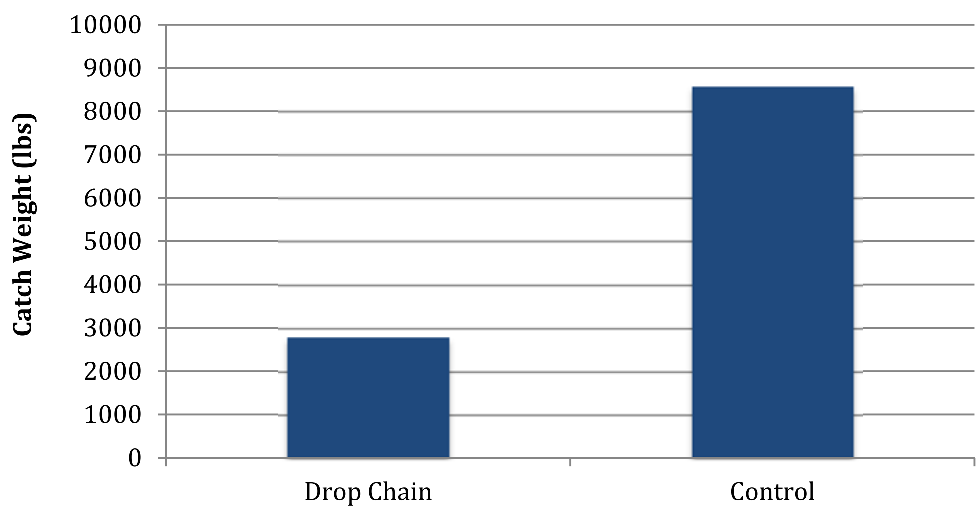
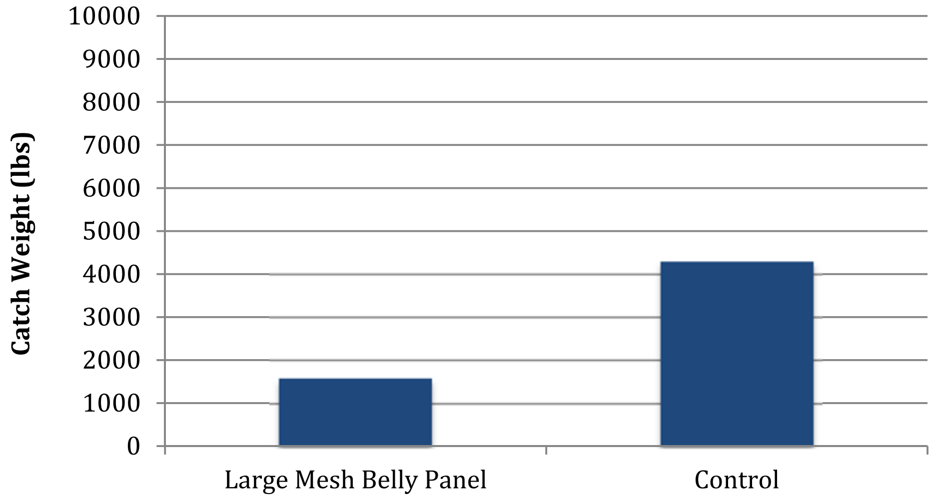


Figure 16. Total Catch Weight of Miscellaneous Flounder (lbs) in the 12" Drop Chain Sweep Experimental Net and the Control Net for All Trips Combined



When miscellaneous flounder species were pooled, there was a 67.4% reduction in miscellaneous flounder catch in the net fitted with the 12" drop chain sweep compared to the control net. For the large mesh belly panel net, there was a 63% reduction in miscellaneous flounder in the experimental net compared to the control net when all paired tows were combined. Results are significant.

ALL FLOUNDERS

Next, the effect of both the large mesh belly panel (Figure 17) and 12" drop chain sweep (Figure 18) on the catch of all flounders combined was analysed. All flounders includes flounder species mentioned above as miscellaneous flounders, as well as winter flounder.

The paired t-test results showed a significant difference in the catch of all flounder combined in the control net compared to the net with the 12" drop chain sweep ($t = 2.4069$, $df = 18$, **p-value = 0.00025**, mean of $x = 307.94$). The net with the 12" drop chain sweep caught significantly less flounders. The paired t-test results also showed a significant difference in the catch of all flounder in the control net compared to the net with the large mesh belly panel ($t = 1.2917$, $df = 17$, **p-value = 0.00035**, mean of x 157.88). The Wilcoxon nonparametric test showed similar results.

Figure 17. Distribution of Paired Tow Differences for All Flounders (lbs) in the Large Mesh Belly Panel Net

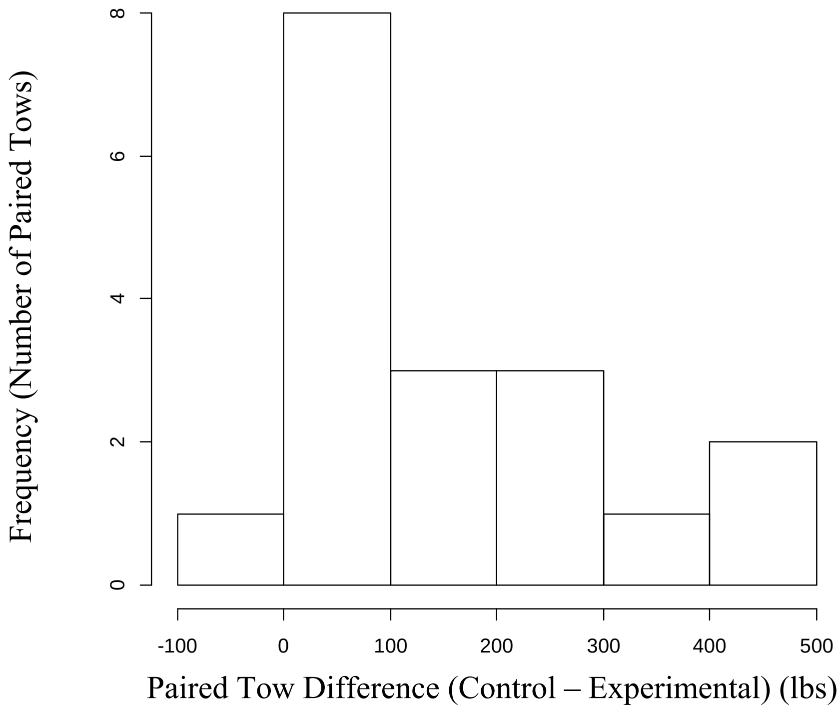
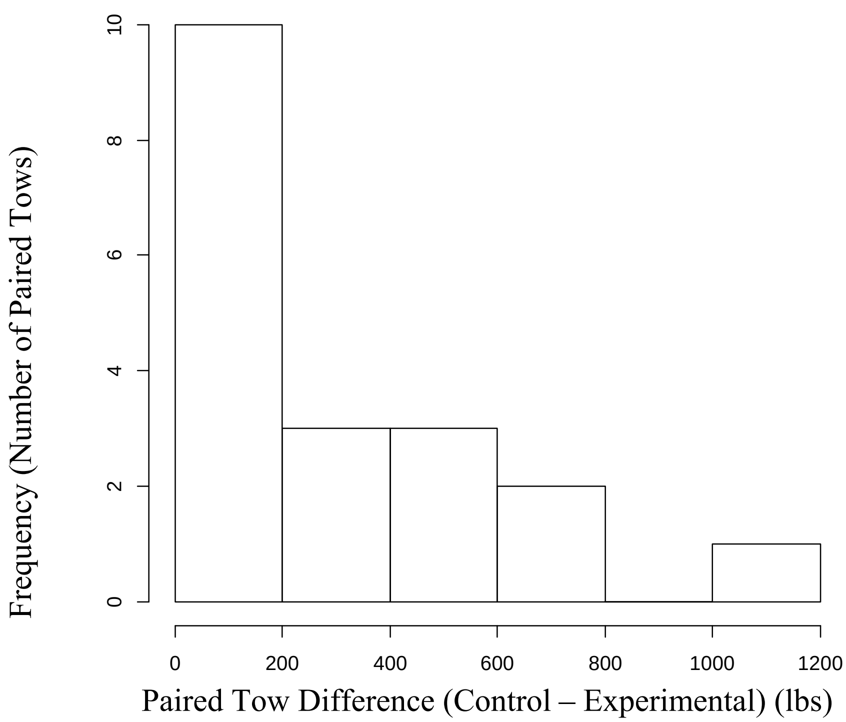


Figure 18. Distribution of Paired Tow Differences for All Flounders (lbs) in the 12" Drop Chain Sweep Experimental Net



In the figures below, the total weight of all flounders caught by the large mesh belly panel (Figure 19) and the 12" drop chain sweep experimental net (Figure 20) are compared to the paired control net catch of all flounders.

Figure 19. Total Catch Weight of All Flounders Combined (lbs) in the Large Mesh Belly Panel Experimental Net and the Control Net for All Trips Combined

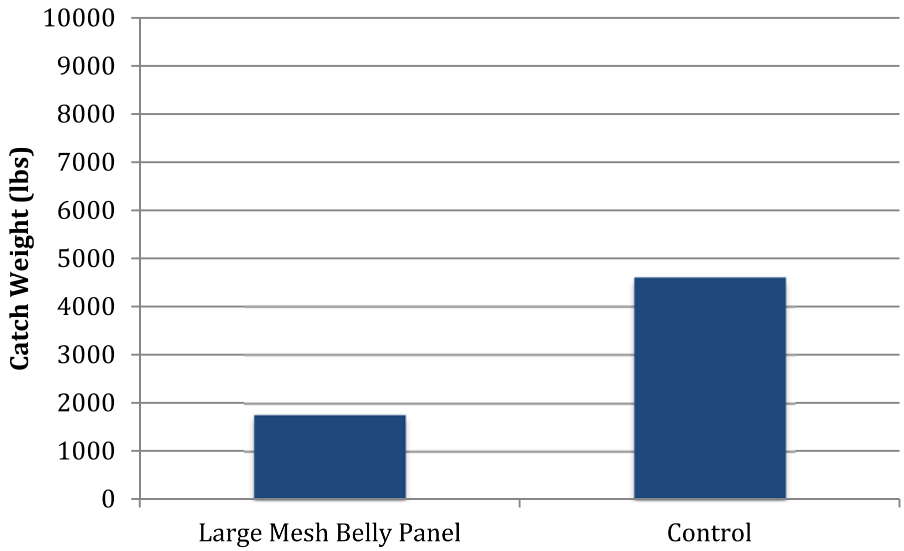
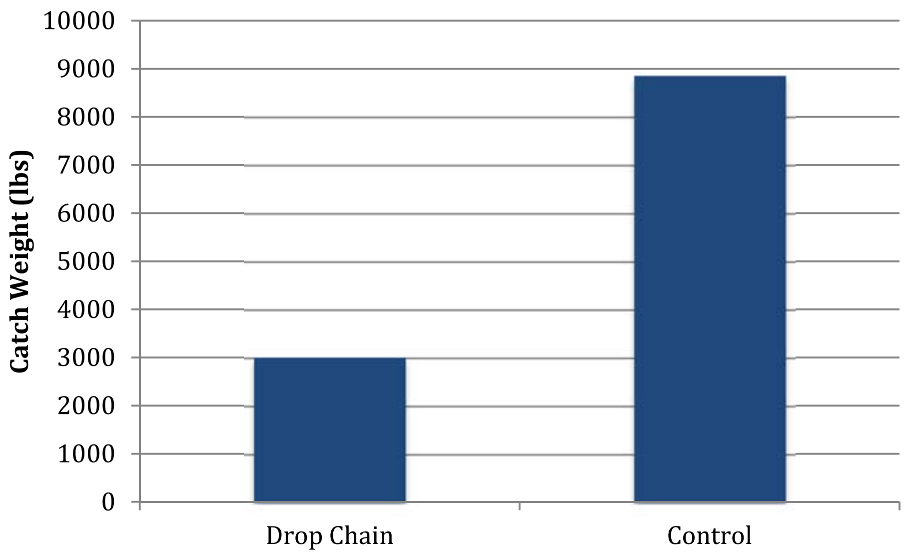


Figure 20. Total Catch Weight of All Flounders Combined (lbs) in the 12" Drop Chain Sweep Experimental Net and the Control Net for All Trips Combined



When all flounder species were pooled, there was a 66% reduction in total flounder catch in the net fitted with the 12” drop chain sweep compared to the control net. There was a 61.7% reduction in total flounders caught when all paired tows were combined for the large mesh belly panel. These results are consistent with the results for miscellaneous flounders. These results also provide encouragement that winter flounder can be effectively, and possibly significantly, reduced by these gear modifications. A more robust study would provide further information on winter flounder results.

<u>COMBINED DEMERSALS</u>

Next, the data was analyzed to determine if a statistical difference exists in the catch of combined demersals in the large mesh belly panel net (Figure 21) and 12” drop chain sweep net (Figure 22) compared to the control net. Combined demersal species include all flounders, all skates, dogfish, monkfish and sea robins.

The paired t- test results for the catch of combined demersals showed a highly significant difference between the control net and both experimental nets (Drop chain: t = 5.6106, df = 18**, p-value = <0.0001**, mean of x = 814.0842 ; Large mesh belly panel: t = 6.0928, df = 17**, p-value = <0.0001**, mean of x = 480.9611). Both experimental nets caught fewer combined demersals. The nonparametric Wilcoxon signed rank test also returned a significant result for combined demersals catch weight differences between the control and experimental nets (Drop chain: **p-value=<0.0001**; Large mesh belly panel: **p-value=<0.0001).**

Figure 21. Distribution of Paired Tow Differences for Combined Demersals (lbs) in the Large Mesh Belly Panel Net

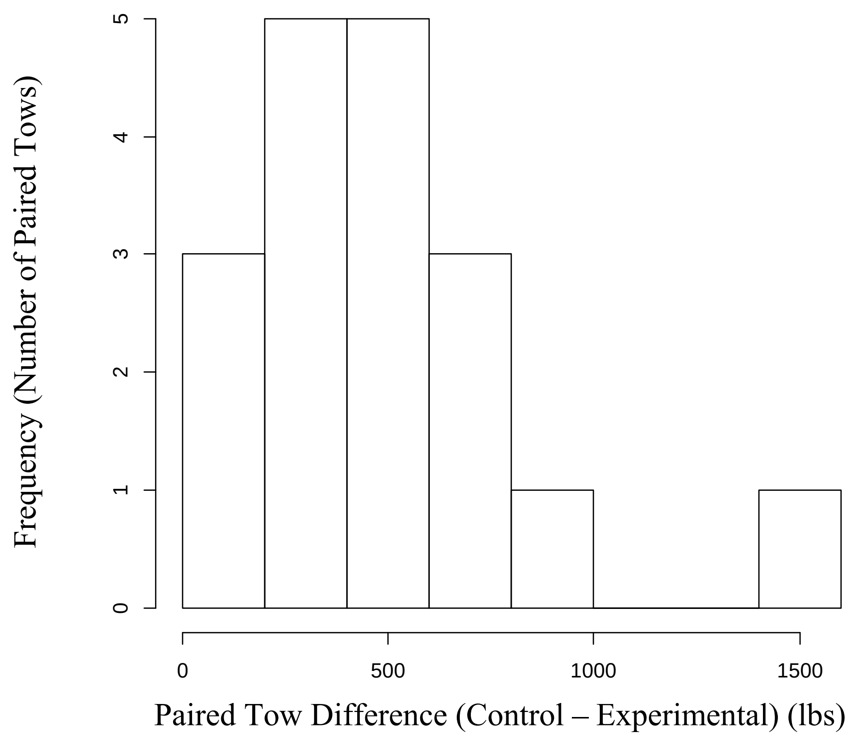
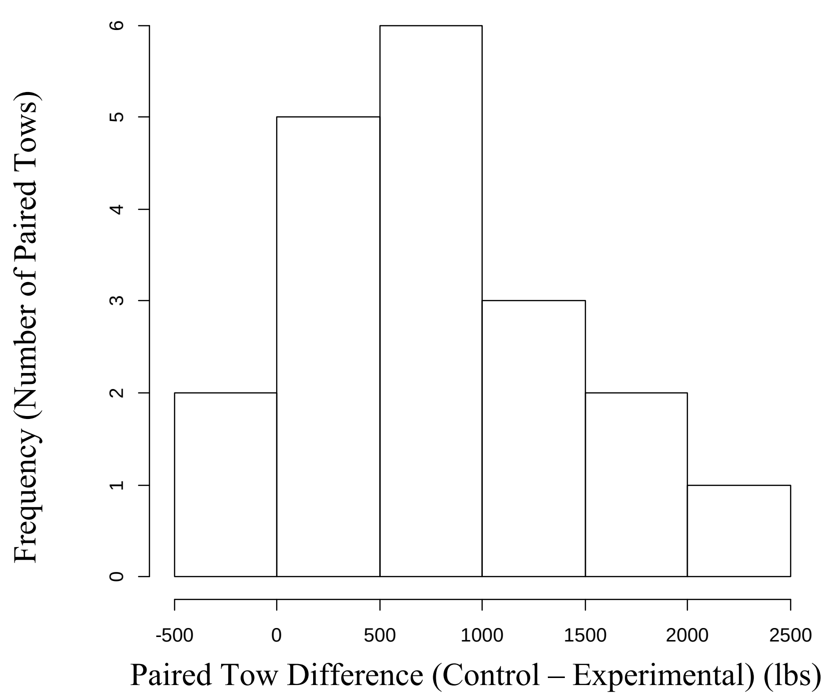


Figure 22. Distribution of Paired Tow Differences for Combined Demersals (lbs) in the 12" Drop Chain Sweep Experimental Net



In the figures below, the total weight of combined demersals caught by the large mesh belly panel (Figure 23) and the 12" drop chain sweep experimental net (Figure 24) are compared to the paired control net catch of combined demersals.

Figure 23. Total Catch Weight of Combined Demersals (lbs) in the Large Mesh Belly Panel Experimental Net and the Control Net for All Trips Combined

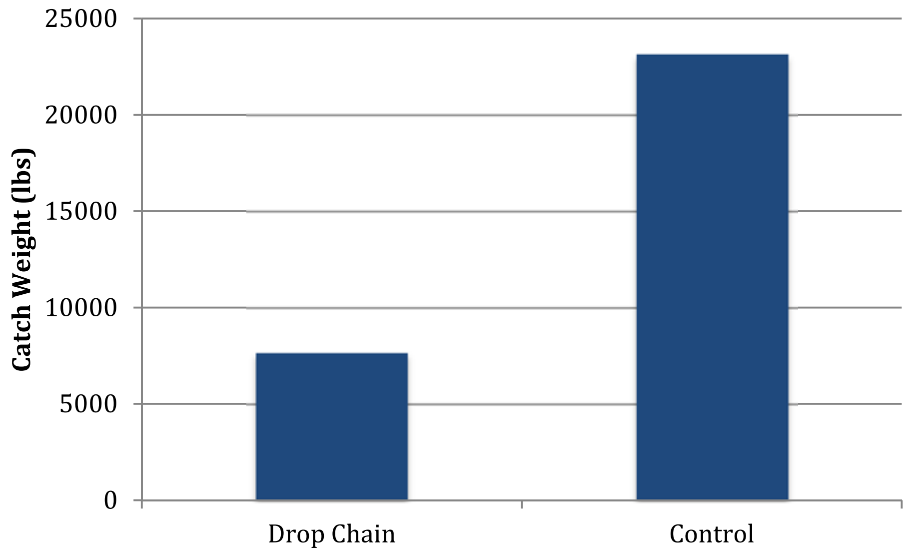
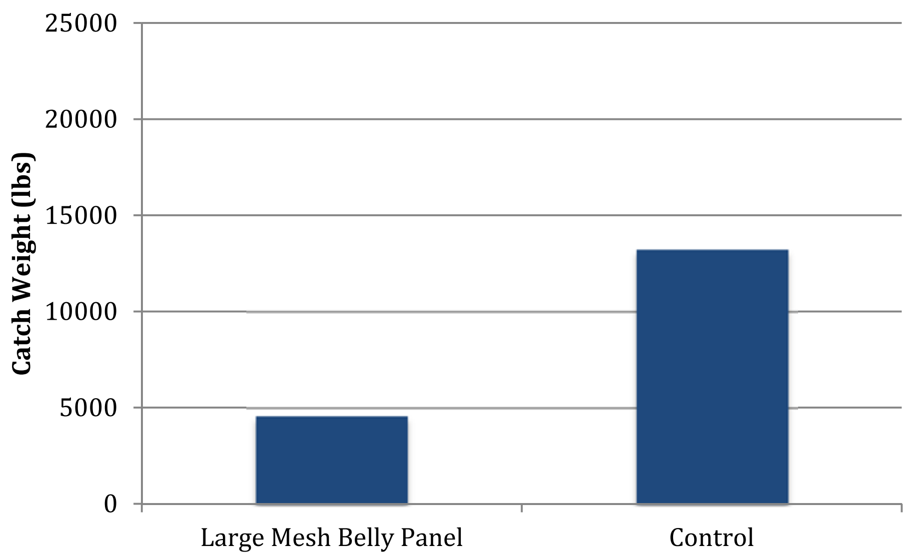


Figure 24. Total Catch Weight of Combined Demersals (lbs) in the 12" Drop Chain Sweep Experimental Net and the Control Net for All Trips Combined



When all demersal species were pooled for this comparison, the 12” drop chain sweep experimental net allowed for a 66.8% escapement rate of all combined demersal species (Figure 23). The large mesh belly panel experimental net allowed for a 65.5% escapement rate of all combined demersals (Figure 24). For both experimental gears, this reduction in the capture of combined demersal species is statistically significant.

The results of all statistical tests by species and species grouping for both experimental gears are combined in Table 1 below.

Table 1. Results of T-Test and Wilcoxon Test on Catch Difference by Species for Both Experimental Gears NS = Not Significant, S = Significant

Species	Gear	T-Test Results
Winter flounder	12” Drop Chain	P=0.1470 (NS)
	Large Mesh Belly Panel	P=0.1605 (NS)
Whiting	12” Drop Chain	P=0.3825 (NS)
	Large Mesh Belly Panel	P=0.0825 (NS)
Squid	12” Drop Chain	P=0.4898 (NS)
	Large Mesh Belly Panel	P=0.4330 (NS)
Miscellaneous flounder (excludes winter flounder)	12” Drop Chain	P=0.0002 (S)
	Large Mesh Belly Panel	P=0.0003 (S)
All flounders (includes winter flounder)	12” Drop Chain	P=0.00025 (S)
	Large Mesh Belly Panel	P=0.00035 (S)
Combined demersals	12” Drop Chain	P=<0.0001 (S)
	Large Mesh Belly Panel	P=<0.0001 (S)

For all comparisons, the Wilcoxon test yielded results similar to the t-test results.

TIME OF DAY

Next we tested to see if there were any differences in the whiting catch based on the time of day the tow was conducted. Tows were conducted during the day and night. For analysis purposes we divided the fishing period into four time segments to determine if time of day affected the catch of whiting. The four time segments were as follows: 1) 05:00 – 10:00; 2) 10:00- 15:00; 3) 15:00 – 20:00; 4) after 20:00.

We performed an ANOVA with whiting catch in pounds for all control and experimental nets as the dependent variable and time segment as the main effect. The results are given in Table 2.

Table 2. Results of ANOVA on Whiting Catch

	Whiting Catch (Pounds)
Time Segment	P=0.00888 Significant

We next conducted a Tukey analysis on the results of the ANOVA to see how the whiting catch during each time segment was different from the other time segments. Results are in Table 3. Time segment 4 (tows made at night) is significantly different from time segment 2 (tows made from mid-morning to mid-afternoon), and marginally significantly different from time segment 1 (morning tows), but not different from time segment 3. The rest of the segments are all similar to each other.

Table 3 – Tukey Results for Time Segment Comparison of Whiting Catch
NS=Not Significant, S=Significant

Time Segment Comparison	**P-Value**
2 – 1	0.5344 NS
3 – 1	0.9999 NS
4 – 1	0.0529 Marginal
3 – 2	0.6674 NS
4 – 2	0.0039 S
4 – 3	0.1031 NS

We then looked at the mean whiting catch weights for each time segment (Table 4). Time segment 2 had the lowest mean catch weight while time segment 4 had the largest mean catch weight of whiting. This confirms what fishermen already know: in this fishing area, at this time of year, you will catch more whiting at night than you will in the middle of the day. Further the larger catch at night is statistically significant from the smaller catch during the middle of the day. However, these differences by time segment have no effect on the overall analysis of species escapement afforded by the experimental gear because all of those comparisons are based on the fact that we are analyzing by paired tows and all pairs occurred within the same time segment.

Table 4 - Mean Catch Weights of Whiting by Time Segment

	Time Segment			
	1	2	3	4
Mean Weight (Lbs)	877.88	716.43	883.05	1332.69

LENGTH FREQUENCY

Next, we looked at the effect of both experimental nets and the control nets on the length frequency distribution of winter flounder (Figure 25) and of whiting (Figure 26).

ANOVAs were conducted to determine if any of the nets caused a significant difference in the mean lengths of winter flounder (Table 5) and of whiting (Table 6). Mean length was the dependent variable. Gear was the main effect. A separate ANOVA was conducted for each species.

Table 5. ANOVA on Mean Length of Winter Flounder with Gear

	Mean Length of Winter Flounder (cm)
Gear	P= 0.411 Not Significant

Gear was not significant for winter flounder so there was no size selectivity caused by either of the experimental nets. A boxplot of winter flounder length frequencies for each net type is shown in Figure 25.

Figure 25. Boxplot of Winter Flounder Length Frequencies (cm) For Each Net Type

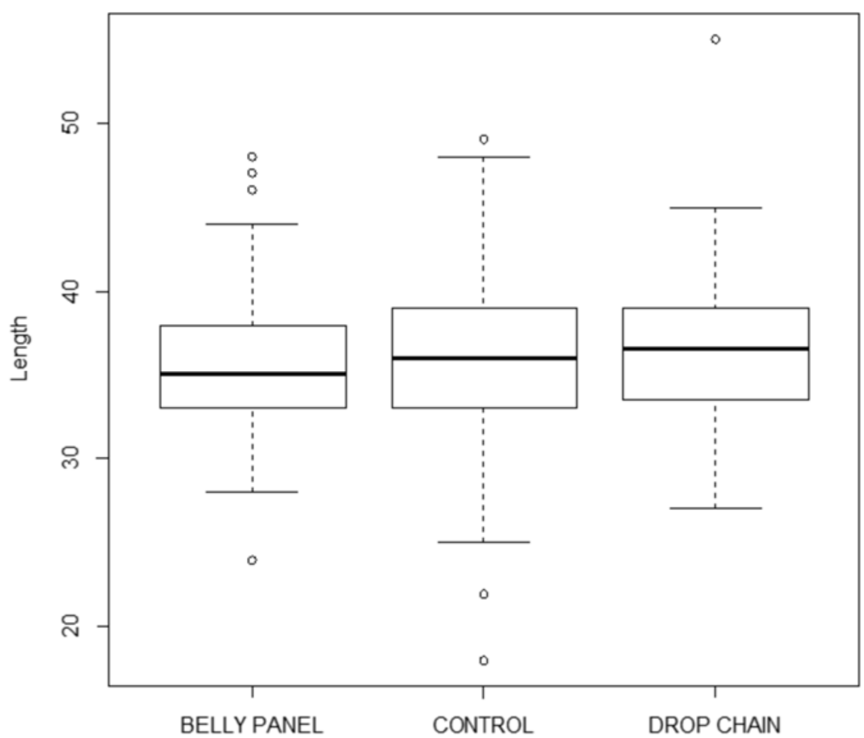


Table 6. ANOVA on Mean Length of Whiting with Gear

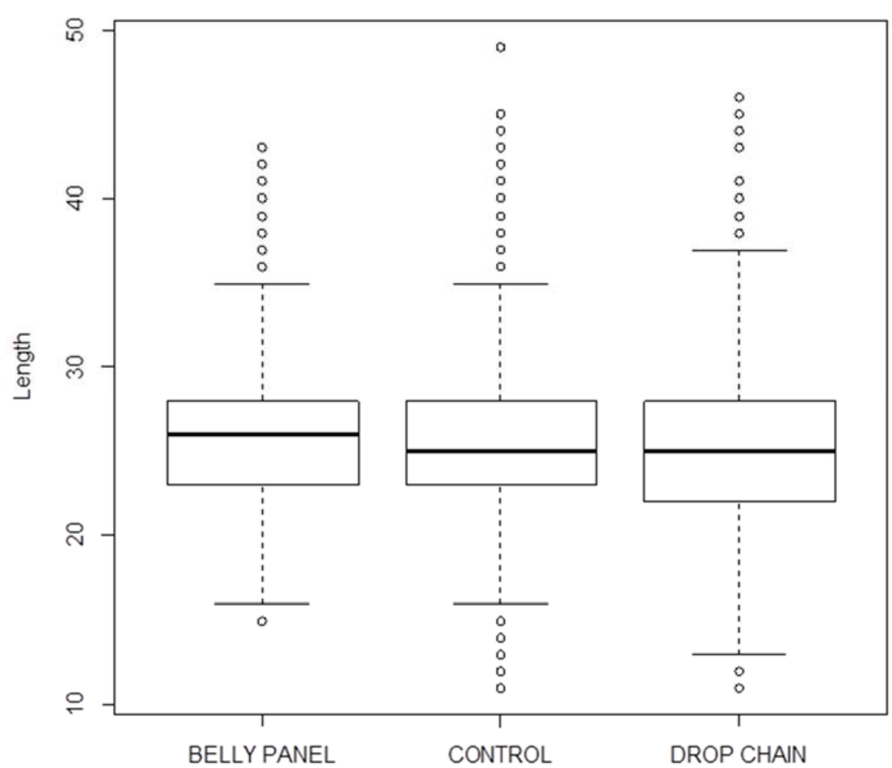
	Mean Length of Whiting (cm)
Gear	P= < 0.0001 Significant

For whiting there was a significant result for the effect of gear on length frequency. We then conducted a Tukey analysis on the results of the ANOVA to see which nets were significantly different from the others for whiting length frequency. Results are in Table 7. The belly panel net is significantly different from both the drop chain net and the control net. There was no significant difference in size distribution between the drop chain net and the control net. A boxplot of whiting length frequencies for each net type is shown in Figure 26.

Table 7. Tukey Results for Net Comparison On Whiting Length Frequency

Net Comparison	P-Value
Control – Belly panel	< .0001 Significant
Drop chain – Belly panel	< .0001 Significant
Drop chain – Control	0.09 Not significant

Figure 26. Boxplot of Whiting Length Frequencies (cm) For Each Net Type



The mean lengths of winter flounder and whiting for each experimental net and the control are shown in Table 8 below.

Table 8. Mean Lengths of Winter Flounder and Whiting for Each Gear

	Mean Lengths (cm)	
Gear	**Whiting**	**Winter Flounder**
Large Mesh Belly Panel	25.82	35.79
Drop Chain	24.98	36.5
Control	25.23	36.18

The mean size of whiting is larger in the belly panel net and the belly panel caught fewer smaller size whiting. So it seems that even though there is no significant difference in whiting catch in pounds between the belly panel and control (see t-test analysis above) there is a significant difference in size. The belly panel may allow for greater escapement of small whiting. The largest winter flounder were caught in the net with the 12" drop chain sweep and the smallest were caught in the net with the large mesh belly panel. Smaller winter flounder may have increased ability to avoid capture in the net with the 12" drop chain sweep but the difference is not significant.

DISCUSSION

For this project we looked mainly at the difference in winter flounder catches and in whiting catches of the two experimental nets (large mesh belly panel and 12" drop chain sweep) compared to the control net. We also looked at the difference in catch of squid, miscellaneous flounders (excluding winter flounder), all flounders (including winter flounder), and combined demersals between the experimental nets and the control net. For the large mesh belly panel, paired t-test results showed no significant difference in the catch weights of winter flounder or of whiting. The large mesh belly panel does not significantly reduce the whiting or winter flounder catch. Although the result was not significant, there was a 44% reduction in winter flounder catch in the net with the large mesh belly panel compared to the control net when all 18 paired tows were combined. Paired t-test results also showed a non-significant result for the catch differences of squid in the net with the large mesh belly panel compared to the control net. Paired t-test results showed a significant difference for miscellaneous flounders, all flounders combined, and combined demersals in the net with the large mesh belly panel compared to the control net. The experimental net with the large mesh belly caught significantly less miscellaneous flounders (excluding winter flounder), combined flounders (including winter flounder) and combined demersals than the control net. The nonparametric Wilcoxon signed rank test produced the same results for all tests. The large mesh belly panel experimental net reduced miscellaneous flounders by 63%, reduced total flounders by 61.7% and reduced combined demersals by 65.5%.

For the 12" drop chain sweep, paired t-test results showed no significant difference in the catch weights of winter flounder or of whiting. The 12" drop chain sweep does not significantly reduce whiting or winter flounder catch. Although the result was not significant, there was a 25.3% reduction in winter flounder catch in the net with the 12" drop chain sweep compared to the control net when all 19 paired tows were combined. Paired t-test results also showed a non-significant result for the catch difference of squid in the experimental net compared to the control net. Paired t-test results showed a significant difference for miscellaneous flounders, all combined flounders and combined demersals. The nonparametric Wilcoxon signed rank test produced the same results. The experimental net with the 12" drop chain sweep caught significantly less miscellaneous flounders, combined flounders and combined demersals than the control net. The 12" drop chain experimental net reduced miscellaneous flounders by 67.4%, reduced total flounders by 66.1% and reduced combined demersals by 66.8%.

Neither experimental net caused any significant reduction in the catch of the target species of whiting and squid. This met the goal of these gears not reducing the catch of the target species. However the primary goal of significantly reducing winter flounder catch was not accomplished. However we are still encouraged by the results of this study.

Results of the statistical analysis of the current project differ from results of the previous projects examining winter flounder bycatch reduction using both the large mesh belly panel and the 12" drop chain sweep in the longfin squid fishery. In previous projects, statistical analysis indicated that both experimental gears significantly reduced winter flounder bycatch. It is possible that the lack of statistical significance for winter flounder catch difference in the current project is being influenced by low sample size and low or zero catches of winter flounder. Both experimental gears tested for this project significantly reduce bycatch of miscellaneous flounders, demersal species and combined flounders while retaining the target species of whiting and squid making these gear types practical solutions to the overall bycatch problem in the small mesh fisheries.

SUMMARY OF CONCLUSIONS

- Neither the 12" drop chain sweep or large mesh belly panel experimental net has proven to significantly reduce the quantity of winter flounder bycatch by statistically significant levels. However, a winter flounder escapement of 25% in the drop chain net and 44% in the large mesh belly panel net was observed when all tows were combined.
- There was no significant difference in whiting or squid catch between the control net and either experimental net modified with the 12" drop chain sweep or the large mesh belly panel. Retention of these target species was maintained using both experimental nets.

- Both experimental nets proved to be functionally effective in significantly reducing the quantity of miscellaneous flounder (all flounders excluding winter flounder) bycatch. The 12" drop chain net reduced miscellaneous flounder catch by 67.4%. The large mesh belly panel reduced miscellaneous flounder catch by 63%.
- When all flounders (including winter flounder) were pooled, there was a significant difference in the catch between the control net and net with the 12" drop chain sweep that yielded a 66.1% reduction in total flounders. The large mesh belly panel significantly reduced the catch of all combined flounders by 61.7%.
- When all demersal species were pooled, there was a highly significant difference between the control and both experimental nets that yielded a 66.8% reduction in catch by the 12" drop chain treatment and a 65.5% reduction by the large mesh belly panel.
- Given the above results we are still encouraged that these two gear modifications can be successful in reducing winter flounder bycatch since they are successful in reducing the catch of all flounders and all demersals. A more robust study (more tows where there are higher concentrations of winter flounder) will provide greater statistical strength to this study.

OUTREACH

The outreach component of this program is a significant element linked to the project's success. CCE's mission is to enable people to improve their lives and communities through partnerships that put experience and research knowledge to work. Through this opportunity afforded by CFRF, CCE has fostered its strong industry relationships to support and advance the tools used for conservation gear technology within commercial fisheries. Outreach associated directly with the research component that has been conducted by CCE includes the following:

- CCE staff members have and will continue to conduct outreach by engaging industry members (including fishermen, dealers, and dockworkers) in discussions regarding this program and the associated research while they are in the field.
- CCE completed a Gear Trials Program newsletter on behalf of CFRF in early September 2013. The finalized newsletter was printed and mailed to industry members and is still available in electronic format on the CFRF, CCE, and Squid Trawl Network websites. Printed newsletters were also distributed to any interested parties when CCE staff is in the field. This newsletter did contain a small section regarding the research work that had been completed at that time.
- CCE gave a presentation to fishermen at the RSA Auction on February 5, 2014 that was held at CCE's office in Riverhead, NY. The presentation included a segment detailing the specifics of the Gear Trials Program including the research component.
- The results of this project linked with previous results for the large mesh belly panel and drop chain projects are being used to encourage fishermen to enroll in the Gear Trials Program and to use these gears to reduce bycatch.

In addition to the activities completed and those continuing to occur, CCE has committed to also do the following:

- CCE will focus outreach and education efforts at the end of the program to share observations, present an overview of the data collected, explain the analysis of the data, and offer a summary of the final results. This will be done for the research component as well as the financial/ technology transfer component.
- Results of the project will be provided and presented to NMFS, MAFMC, NEFMC, ASMFC, and state agencies at regional council meetings as requested.
- Presentations of the final program findings will also be offered at CFRF workshops and to commercial fishing group meetings and other entities interested in the results.

PROBLEMS ENCOUNTERED

Commercial fisheries research is always an uncertain enterprise. Performing research aboard commercial fishing vessels with experimental gear and scientific equipment offers many opportunities for problems to arise. The research portion of this project overall went very well. The issues that did arise and should be noted were as follows:

- Scheduling research trips was challenging due to the availability of the cooperating vessels.
- The occasional loss of door spread readings throughout the course of the project. Door spread sensors are prone to be erratic in their performance and such was the case during this project.
- Winter flounder catches were relatively small. Despite the historical co-occurrence of winter flounder and whiting in the area fished, the numbers we encountered were unfortunately lower than we had hoped for and likely affected the statistical power of the results.
- Underwater Video Recording – CCE had written into the submitted proposal for this project that "videotape recordings would be made during as many tows as possible and where conditions permit". This component of the research proved impossible because of the conflicting availabilities of the cooperating fishing vessels and the necessary video technician and equipment supplied by the NEFSC. Also, based on CCE staff observations, the water clarity and sea bottom (soft, mud) conditions would have made visibility difficult.
- The F/V Excalibur experienced complete mechanical failure and needed assistance via a tow to return to port for repairs during one of our research trips. Once the vessel was repaired, CCE staff returned to sea with captain and crew and completed the unfinished research fishing.

- Unfortunately the field design suggested for this project did not stand up to statistical rigor. We therefore had only half of the paired tows that we had hoped for. This coupled with low winter flounder catches likely affected the statistical power of the results.

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CFRF COMMERCIAL FISHERIES RESEARCH FOUNDATION

http://cfrfoundation.org/

GEAR TRIALS PROGRAM

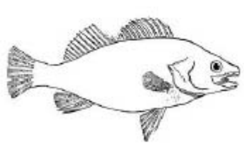
September 2013 Volume 1, Issue 1

CFRF and the Gear Trials Program

The Commercial Fisheries Research Foundation (CFRF) is a non-profit, private organization that was founded in 2004 by a group of commercial fishermen. The fundamental goal of the CFRF is to create practical solutions to the issues faced by commercial fishermen in southern New England.

The CFRF's Board of Directors is filled entirely by commercial fishermen and individuals who work in industries that support commercial fishing. The Foundation's mission is to establish quality relationships between fishermen, managers, and scientists through collaborative research projects. These projects allow fishermen and scientists to work together to alter current gear designs or develop new ones to fish more selectively which ultimately culminates in better management decisions.

The Gear Trials Program was established and sponsored by the CFRF. The Program addresses two experimental gear types, the large mesh belly panel and the 12" drop chain sweep. Both were designed to reduce winter flounder bycatch in the southern New England stock area within the small mesh trawl fisheries. Through this project, CFRF with Cornell University Cooperative Extension Marine Program (CCE) acting as a facilitator, implemented a program to assist the commercial fishing industry with obtaining and implementing these two conservation engineering gear modifications. The program will also continue to test the performance of the two gear modifications. The financial support component of the program assists fishing vessel owners with acquiring this conservation gear technology. The research component will extend the work conducted previously in the squid fishery into the small mesh whiting fishery to continue to evaluate the performance of the two gear types.



The Large Mesh Belly Panel and 12" Drop Chain Sweep

The large mesh belly panel was initially tested by CCE in 2010 for a Southern New England Collaborative Research Initiative (SNECRI) project which was funded by CFRF. Results of the study showed that the use of the belly panel resulted in an 88% reduction in winter flounder, and an 83% reduction in combined demersal species (all flounders, skates, dogfish and sea robins) while showing no statistically significant loss of squid. Similarly, the experimental 12" drop chain sweep was proven to be functionally effective through testing conducted by CCE in 2011/2012 and funded by CFRF. During this project, the 12" drop chain sweep resulted in a 78% reduction in winter flounder bycatch and a 76% reduction in combined demersal species bycatch with no significant loss of squid.

Both of these demonstration projects were well received by the commercial fishing industry. The significant bycatch reduction achieved by each of the modified gear types in the squid fishery has been recognized mutually by industry and scientists prompting them to now seek more information on the performance of this technology in the small mesh whiting fishery.

The overall goals and objectives of the two components of the Gear Trials Program are the following:

- To coordinate and assist industry with acquiring the new gear technology (large mesh belly panel and/or 12"drop chain sweep) through a financial assistance program for fishing vessel owners.
- Continue to evaluate the effectiveness of these two gear types at reducing winter flounder bycatch, as well as the bycatch of other demersal species, by conducting at sea research during the whiting fishery.
- Establish an outreach program that will monitor and record fishermen's observations and comments about the performance of these two gear types and effectively relay this information back to fishing industry members. The outreach program will also distribute the results of the continued testing of the new gear in the whiting fishery when the research is completed.

Outcomes (as of September 16, 2013)

At the start of the program efforts focused on identifying qualified participants and informing them of the unique opportunity that was being offered by the CFRF. Qualifications included home port (NY, CT, MA, RI, DE, NJ, VA) and vessel trip reports (current VTR's indicating the use of an otter trawl with 3" mesh or smaller landing whiting, squid, or scup in NMFS statistical areas 537, 538, 539, 611, 612, or 613). Eligible participants received voucher applications for one or both of the new gear types from CFRF that could be redeemed at Superior Trawl or Reidar's Manufacturing, Inc.

To date:

• 44 completed applications have been received from the combined states of NY, CT, MA, and RI.

• From all the completed applications, 41 vouchers were issued for the 12" drop chain sweep and 39 vouchers were issued for the large mesh belly panel.

• 31 participants have already received their new gear accounting for 27 drop chain sweeps and 26 belly panels.

Fishermen have begun using the new gear and CCE has started to receive feedback on the performance of the new gear types. The gear has been used by fishermen targeting primarily squid, whiting, and scup. Opinions of these gear modifications are predominantly positive.

To date:

• 18 responses have been received by CCE in the form of a brief survey (10 questions) regarding the fishermen's opinions.

• The surveys are from March, April, May, and June of 2013.

• 16 surveys were received relative to the use of the 12" drop chain sweep and 2 surveys were received commenting on the combined use of the 12" drop chains and the large mesh belly panel.

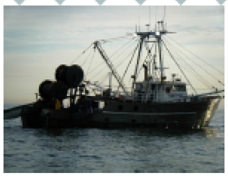
• All 18 surveys indicated a positive reduction in bycatch with estimates ranging from a 20% reduction to a 90% reduction.

• 15 of the 18 surveys stated there was no reduction in retention of the target species while the 3 remaining surveys indicated an estimated 20% reduction in the target species.

Continued Research

During mid-July of 2013 four days of research fishing evaluating the performance of the two gear types were conducted while targeting whiting. Two additional days of fishing still remain and then the accumulated data will be organized and analyzed to evaluate the effectiveness of the two gear types as a means of winter flounder bycatch reduction in the targeted small mesh whiting fishery. Once completed, the results will be available to all interested parties. Future research may be directed at the effectiveness of these gear types in reducing the bycatch of other flounders as well.

Cornell Cooperative Extension
of Suffolk County



For More Information:

If you are interested in participating in the Program there is funding still available. Please contact Jane Dickinson at:

jdickinson@cfrfoundation.org

Commercial Fisheries Research Foundation go to:

www.cfrfoundation.org

Gear Trials Program go to:

www.geartrials.org

Cornell University Cooperative Extension Marine Program go to:

www.ccesuffolk.org/marine-2/

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