FINAL REPORT

EVALUATION OF A TOPLESS BOTTOM TRAWL DESIGN WITH A 160 FOOT HEADROPE FOR FISH CAPTURE

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ABSTRACT

Previous work attempting to mitigate sea turtle interactions with a bottom trawl equipped with a turtle excluder device (TED) in the summer flounder fishery resulted in a significant loss of target species. A subsequent evaluation of a 109 ft headrope topless trawl in this fishery resulted in catch rates of the target species equivalent to a traditional trawl, but when that topless trawl was evaluated on its ability to reduce sea turtle capture rates, it proved ineffective. However, a modified 160 foot headrope topless trawl was successful at capturing less sea turtles. The goal of the project described herein was to evaluate the topless trawl design with a 160 foot headrope in terms of its ability to catch finfish. The purpose of this report is to present the methodology used, the data collected and a limited analysis of catch efficiency of the 160 foot headrope topless trawl design as compared to a traditional flounder trawl design. The results of this evaluation indicate that the 160 foot headrope topless trawl significantly reduced the catch of summer flounder and skates when compared to the traditional trawl. Two vessels carried out the evaluation, and the mean loss of catch by F/V Darana R was 51% for summer flounder and 48% for skates, the dominant bycatch. The mean loss of catch by the F/V Caitlin and Mairead was 74% for summer flounder, and 31% for skates. In general, the addition of floatation appeared to improve the catch retention, but there were an insufficient number of replicate trawls with the increased flotation to thoroughly evaluate this effect.

INTRODUCTION

Previous work attempting to mitigate sea turtle interactions with a bottom trawl equipped with a turtle excluder device (TED) in the summer flounder fishery resulted in a significant loss of target species (Lawson, DeAlteris and Parkins, 2007). As an alternative to a TED in the trawl, a topless trawl design was proposed in an effort to mitigate sea turtle interaction with the trawl net. In essence, the theory is that if the topless trawl is successful, sea turtles will not be captured in the trawl. From a trawl design perspective, the issue is providing sufficient setback of the headrope so that a sea turtle, once alarmed or stimulated by the sweep of the trawl, has sufficient time to swim upward and escape the trawl before the headrope passes overhead. By increasing the length of the headrope for a given footrope length, the time between passage of the footrope and passage of the headrope is increased, allowing more time for a sea turtle to escape.

In the summer of 2010 an evaluation of the catch performance of a topless trawl design was conducted in the summer flounder trawl fishery (DeAlteris and Parkins, 2011). The topless trawl design investigated in that study had a 106 foot headrope and an 80 foot footrope. That topless trawl design was compared to a trawl net with an identical fishing circle, but of traditional design with a 65 foot headrope and an 80 foot footrope. Both trawls had identical sweeps made of small rubber and lead discs (cookies). Based on the results of 80 comparative tows (40 pairs), it was determined that there was no statistical difference between the catch rates of bottom fishes in the traditional trawl vs. the topless trawl with a 106 foot footrope. The results of that study prompted a call from the fishing industry to further investigate the ability of the topless trawl to reduce sea turtle captures (DeAlteris 2010). In November of 2011, a test of the topless trawl design was completed off the Georgia coast using a paired tow experimental design. Unfortunately the 106 foot headrope was not effective at reducing sea turtle captures, but a 160 foot headrope was very effective, capturing only one sea turtle compared to 25 turtles captured in the control trawl (DeAlteris and Parkins 2012).

The primary goal of the project described in this report was to evaluate the topless trawl design with a 160 foot headrope in terms of its ability to catch finfish. The project was a collaborative effort between DeAlteris Associates Inc. (DAI), Cornell University Cooperative Extension (CUCE) and National Marine Fisheries Service, Northeast Fisheries Science Center (NMFS, NEFSC). CUCE had funds remaining from a previous project that were used to compensate the commercial fishing vessels for the charter time, and CUCE provided field sampling crew. DAI provided the lead field sampler, summarized and analyzed the data, and prepared this report. NMFS, NEFSC provided the funding, a single field crew member, underwater camera gear, and oversight of the field work. The purpose of this report is to present the methodology used, the data collected and a limited analysis of target species catch efficiency of the 160 foot headrope topless trawl design as compared to a traditional trawl design.

METHODS

Trawl designs

The traditional trawl and all the topless trawl designs evaluated were developed by a group of academics (DeAlteris and Parkins), trawl designers (Mary O'Rourke of Trawlworks, Narragansett, RI and Jon Knight of Superior Trawl, Narragansett, RI), fishermen (Capt Jim Ruhle), and NMFS personnel (Henry Milliken and Eric Matzen). The traditional trawl design is a composite of the most widely used flounder bottom trawl designs. The trawls were built by Trawlworks, but serviced by Jon Knight of Superior Trawl. Both trawls had 320 x 6 inch fishing circles, and had an 80 foot footrope. The experimental topless design had headrope length of 160 feet, while the control net had a traditional headrope length of 65 feet. Figures 1 and 2 illustrate the designs of the control and 160 foot topless trawl design trawls, respectively. The traditional and topless trawls were rigged with sweeps on travelers made of small rubber discs (cookies) with interspersed lead discs. Both the traditional and topless trawls were initially rigged with sixteen 8-inch plastic floats.

Field work

Comparative towing was conducted aboard the F/V Darana R and the F/V Caitlin and Mairead in the summer of 2012. These vessels are typical of the large class vessels in the summer flounder trawl fishing fleet. The first and second cruises were made aboard the F/V Darana R, home ported in Hampton, VA, and skippered by Capt Jimmy Ruhle. This vessel is 90 feet in length overall and powered by a 670 HP engine. The control and experimental nets were fished with 15 fathom bridles or legs, and 100 fathoms of ground cables. The third cruise was made aboard the F/V Caitlin and Mairead, home ported in Montauk, Long Island, and skippered by Capt. Dave Aripotch. This vessel is 65 feet in length overall and powered by a 600 HP engine. The control and experimental nets were fished with 10 fathom bridles or legs, and 60 fathoms of ground cables.

The vessel captain was directed to conduct fishing operations at locations of his choosing so as to duplicate conditions in the mid-Atlantic and southern New England trawl fishery and to maximize flounder catch. Most tows were conducted in daylight conditions from sunrise to sunset. An ABBA alternate, paired tow methodology (A=experimental and B=control) was utilized throughout the study to maximize efficiency in terms of time handling gear. All tows within a pair were identical with respect to location, duration, speed, etc. Most tows were 90 minutes in duration.

Data were recorded on standard NMFS Observer logs. The information recorded for each comparative tow included position, time, depth, temperature and weather, as well as detailed catch and length frequency data. In each tow, the catch was sorted into bushel baskets and weighed on a Marel motion-compensated, platform scale. In some circumstances sub-sampling occurred by taking average basket weights or extrapolating individual animal weights to estimate total skate or dogfish weights. Length data were collected on summer flounder and other species, as time and sampling priorities dictated. Notes including the condition of the released animals were made on protected species captured during the experiments.

Depth sensors were attached to various areas of the topless trawl in an effort to understand why such a heavy loss of catch was observed. The information derived from these sensors is included in the description of the modifications. Note that the traditional and all topless trawl designs are considered bottom trawls, and the footrope is designed to tend the bottom. The reported headrope openings are distance off the bottom, except when specifically noted that the sensors were placed on the footrope, and the footrope height off the bottom is reported.

To better understand all the modifications, the data were divided and analyzed as particular sets and then combined for total analysis. The modifications are described in the order in which they were evaluated, and an explanation of each precedes the analyzed data.

Underwater video recording of the trawl and its performance was unsuccessfully attempted on several tows due to poor visibility. A NEFSC digital video camera was attached to the net in a variety of locations to document both fish escapement forward of the headrope and gear performance related to catch efficiency.

Data Analysis

Data were compiled using Microsoft Excel. Catch weights were compared using two-tailed, paired T-tests to compare the effect of the topless trawl design on summer flounder retention and bycatch reduction. In the bycatch analyses, the skate complex included little, winter, and clear nose skate species.

RESULTS

F/V Darana R

During two cruises in June 2012 aboard the F/V Darana R, a total of 24 paired tows (48 tows) were completed (Figure 3). The tow locations are listed in Table 1, and the configuration of the net and bridles and ground gear of each tow is listed in Table 2. The first cruise consisted of 8 successful paired tows (16 individual tows) during the period between 13 June 2012 and 17 June 2012. The second cruise consisted of 16 successful paired tows (32 individual tows) during the period of 26 June 2012 and 30 June 2012. The tow by tow weights of the catch of summer flounder and the skate complex are enumerated in Tables 3 and 4, respectively. Many modifications (Table 2) were made to the topless trawl during the second cruise in an attempt to improve its catch efficiency, and these are described in sequence.

No Modification (F/V Darana R)

A total of 13 paired tows were completed with no modifications to the topless trawl during the period of 13 June 2012 and 28 June 2012 aboard the F/V Darana R. Before any modifications were made to the topless trawl, sensors were attached to the upper (headrope) and lower (footrope) wings to obtain baseline observations. The average height of the wings over the period of the tow was determined to be 0.03 feet. The number of negative readings in the data suggested that the upper wing was actually laying outward and down onto the bottom. This was further confirmed by the presence of bottom sediment in the upper wing headrope. This most likely happened due to the lack of an upper section in the trawl. Without this section the net has no lift to support the wings and they fall backward against the flow of water. Headrope height was determined, without making any modifications to the net, by placing a sensor in the center of the headrope and in the center of the sweep. This was performed during tow no. 7 on 28 June 2012. The baseline reading for the center of the headrope was 2.76 feet. Note that the base configuration of the topless trawl was with 16, eight inch floats.

The average loss of summer flounder was 55%, and this was significantly different from 0 (p=0.008). The average loss of the skate complex was 55%, and this was significantly different from 0 (p=0.012).

Modification #1 and the Results (F/V Darana R)

In an attempt to lift the upper wing, 8 additional 8 inch floats were added. Four floats were attached to each wing in the headrope for a total of 24 floats on the headrope. During topless trawl tow nos. 4 and 5 on 27 June 2012, sensors were again put on the upper wing headrope and lower wing footrope. Also, during tow no. 5, 30 fathoms of ground gear were removed, for a total length of 70 fathoms, in an attempt to lighten the sweep. The readings were 1.86 feet for the upper wing headrope and 1.34 feet for the lower wing footrope. This indicates that the addition of the floats lifted the upper wing, resulting in an improvement in wing height, but also suggests that the footrope may have lifted off the bottom. With the floats remaining in the wing sections, the sensors were moved to the center of the headrope. For topless trawl tow nos. 3 and 6 on 28 June 2012, center headrope height readings were 2.95 and 2.44 feet respectively. The

average between these two readings is very close to the initial headrope height of 2.76. These readings indicate that the addition of floats on the wings increased the height of the wings while having little effect on the center headrope height.

Though an improvement in the height of the wings was observed, there was no improvement in the catch. For the ten tows (five pairs) using this configuration a significant loss (p=0.040) of 50% was observed for summer flounder. There was a 41% loss of the skate complex, but this was not significant (p=0.220).

Modification #2 and the Results (F/V Darana R)

During topless trawl tow no. 2 on 29 June 2012, four additional 8 inch floats were added to the center of the headrope, and the eight floats remained from Mod. #1 (four on each wing), for a total of 28 floats on the net. Seventy fathoms of ground wire remained from Mod. #1. The sensors were placed in the center of the headrope and the center of the sweep. The reading of headrope height during this tow was 4.54 feet.

Though an increase in the headrope height was observed, the loss of summer flounder was 52%, and the observed loss of skates in the single observed pair was 43%. Since the increased headrope height appeared to have no effect on the catch retention.

Modification #3 and the Results (F/V Darana R)

During topless trawl tow nos. 3 and 6 on 29 June 2012, the four floats at the center of the headrope were removed. Two groups of four floats (total 8) were attached to each wing end for a total of 32 floats on the headrope. The sensors were again placed in the center of the headrope and in the center of the sweep. The headrope height readings for these tows were 3.71 and 4.00 feet respectively.

A slight increase in the headrope height was observed with the addition of the floatation and ground wire but catch was not improved significantly. During these two pairs, the average loss of summer flounder was 35%, but this was not significantly different from 0 (p=0.251). The average loss of the skate complex was 47%, and this was significantly different from 0 (p=0.037).

Modification #4 and the Results (F/V Darana R)

During tow nos. 1 and 2 (a single pair) on 30 June 2012, all additional floats were removed, returning the trawl to the 16 float base configuration, and the upper wing was slacked 6 inches on each side while retaining the 100 fathoms of ground wire. Mod. #4 was an attempt to improve headrope height of the original configuration using only the addition of 6 inches of chain to lengthen the upper legs. The sensors were placed in the center of the headrope and the center of the sweep. The headrope height reading for this tow was 3.28 feet.

A slight increase in headrope height was observed, though it was minimal. A 47% loss of summer flounder and 55% loss of the skate complex were observed.

Modification #5 and the Results (F/V Darana R)

During topless trawl tow nos. 3 and 6 on June 30 2012, all additional floats remained off the headrope, and the 6 inch slack in the upper wings was removed from the topless trawl. The sensors were attached to the center of the headrope and the center of the sweep. The headrope height reading was 3.03 feet. No increase in the headrope height was observed with this modification. The average loss of summer flounder was 33%, and this was not significantly different from 0 (p=0.265) and the loss of the skate complex was 25%, and this was also not significantly different from 0 (p=0.119). The results of this comparison of the base configuration were not combined with the original data from the initial evaluation of the base configuration of the topless trawl because of the time difference between the initial trials and the later trials. It is however interesting to note that the loss of summer flounder and skate in the later trial was about half of the observed loss in the initial trial. Additionally, the loss in the later trial was not significantly different from 0, but this analysis is potentially subject to a Type 2 error due to the low sample size (n=2).

Overall Summary of Results (F/V Darana R)

The topless trawl caused a substantial reduction in both the skate and summer flounder catch, irrespective of the modification. Though these results are not conclusive due to the small sample size of paired tows, they demonstrate that the topless trawl was not performing as expected. The overall average loss of summer flounder was 48%, and this was significantly different from 0 (p<0.001) using a two tailed paired t-test for the means when compared to the catch of the control. The skate complex included the following species: little skate, winter skate, and clearnose skate. An average reduction of 51% of skate catch was observed, and this was significantly different from 0 (p=0.001), using a two tailed paired t-test for the means when compared to the catch of the control.

Protected species interactions (F/V Darana R)

A total of 18 sturgeon were taken by the F/V Darana R during the study, 1 in the topless trawl net and 17 in the control trawl net. All were released alive. One loggerhead sea turtle was taken in the experimental net and released alive. Data on sturgeon taken during the fieldwork aboard the F/V Darana R are summarized in Table 5.

F/V Caitlin and Mairead

During the third cruise, which was aboard the F/V Caitlin and Mairead home ported in Montauk, Long Island, a total of 24 paired tows (48 tows) were successfully completed during the period 24-31 July 2012 (Figure 4). The tow locations are listed in Table 6, and the configuration the net and bridles and ground gear of each tow is listed in Table 7. The tow by tow weights of the catch of summer flounder and the skate complex are enumerated in Tables 8 and 9, respectively. Many modifications (Table 7) were made to the topless trawl during the third cruise in an attempt to improve its catch efficiency, and these are described in sequence.

No Modification (F/V Caitlin and Mairead)

Before any modifications were made to the topless trawl, sensors were attached to the upper (headrope) and lower (footrope) wings to get a baseline reading. One of the sensors had a software glitch, so the no readings were recorded.

A total of 4 pairs (8 tows) were completed with no modifications to the topless trawl during the period of 24 July 2012 and 25 July 2012 aboard the F/V Caitlin and Mairead. There was 80% loss of summer flounder, and this loss was significantly different from 0 (p=0.002). There was a 46% loss of the skate complex, but this was not significantly different from 0 (p = 0.270).

Modification #1 and the Result (F/V Caitlin and Mairead)

Six 8-inch floats were added, three to the headrope on each wing end. The total number of floats on the headrope for Mod. #1 was 22 (16+6). Even though sensors were used during this modification, software glitches prevented proper readings. Despite the assumed improvement in the height of the wings with the addition of the floatation, there was no improvement in the catch efficiency.

For the two pairs (four tows) using this configuration, there was a 52% loss of summer flounder, and this loss was not significantly different from 0 (p = 0.434). There was an 11% loss of the skate complex that also was not significantly different from 0 (p=0.717).

Modification #2 and the Result (F/V Caitlin and Mairead)

From tow no.1 on 26 July 2012 to tow no. 4 on 30 July 2012, two additional 8 inch floats were added to Mod. #1. One 8 inch float was added to the headrope on each wing end in an attempt to further lift the wings from the bottom and improve the catch. The total number of floats on the headrope for Mod. #2 was 24 (22+2). A total of 28 tows (14 pairs) were successfully completed in this configuration. New sensors arrived and were put on the upper wing headrope and lower wing footrope during tow 4 on 30 July 2012. This was used as the base reading for the wing ends during later modifications. The observed height between the upper and lower wing rigging lines was 1.58 feet.

The loss of summer flounder was 83% and this loss was significantly different from 0 (p<0.001). The loss of the skate complex was 49%, and this loss was also significantly different from 0 (p=0.026).

Modification #3 and the Result (F/V Caitlin and Mairead)

During topless trawl tow no. 5 on 30 July 2012, four 12 inch hard plastic trawl floats were added to Mod. #2, for a total of 24-8 inch float and 4-12 inch floats. The headrope for Mod 3 consisted of a total of 28 floats (24+4). The sensors were placed on the upper wing headrope and the lower wing footrope. The distance between the upper wing headrope and the lower wing footrope increased to 2.64 feet with the addition of the floats.

This modification resulted in 51% summer flounder catch loss and 26% skate catch loss. Due to the increased catch observed it was decided to add more flotation to the headrope in subsequent tows.

Modification #4 and the Result (F/V Caitlin and Mairead)

During topless trawl tows nos. 2, 3 and 6 (3 pairs) on 31 July 2012, 14 additional 8 inch floats were added throughout the headrope. Mod. #4 includes all additional floats from all previous modifications. This resulted in a total of 42 floats (38-8 inch floats plus 4- 12 inch). The sensors were placed on the upper wing headrope and lower wing footrope during tows 2 and 3, the wing height readings were 4.59 feet and 4.51 feet respectively. These data again suggest that the lower wing footrope is lifting off the bottom. The sensors were then moved to the center of the footrope and the center of the headrope in an effort to see the effect of all the additional flotation on the headrope. The reading from the sensors indicated a 9.58 headrope height. Based on the initial headrope reading of 4.54 feet from the F/V Darana R using four floats on each wing end, all this additional floatation resulted in an increase of 5 feet in the headrope height.

The loss of summer flounder was reduced to 22%, and this loss was not significantly different from 0 ($p = 0.366$). The loss of the skate complex was reduced to 36% and this loss was not significantly different from 0 ($p = 0.617$).

Overall Summary of the Results (F/V Caitlin and Mairead)

The topless trawl caused a significant reduction in the summer flounder catch. Though these results are not conclusive due to the small sample size of paired tows, they demonstrate that the topless trawl was not performing as expected.

The overall loss of summer flounder was 74%, and this loss was significantly different from 0 ($p < 0.001$) using a two tailed paired t-test for the means when compared to the catch of the control. The overall loss of the skate complex was 31% and this loss was not significantly different from 0 ($p=0.065$).

Protected species interactions (F/V Caitlin and Mairead)

No protected species were taken in the field work aboard the F/V Caitlin and Mairead.

DISCUSSION

The participants of the 2012 trawl workshop suggested that NMFS look at the feasibility of using a topless trawl to reduce sea turtle takes in the trawl fishery (DeAlteris 2010). This suggestion led to a collaboration of academics, industry fishermen and net builders, and NMFS staff who worked together to develop the topless trawl design and sampling protocols that made this project a success. The purpose of this report is to present the methodology used, the data collected, and some limited analysis of the evaluation of the target species catch efficiency of 160 foot headrope topless trawl design, as compared to a traditional founder bottom trawl design.

The base configuration of the 160 foot headrope topless trawl aboard the F/V Darana R was modified in an attempt to improve catch efficiency by adding additional flotation, changing the length of the ground wire, and adding setback or slack to the headrope. All attempts proved unsuccessful. Using all the information gathered from the sensors and the catch data a few conclusions can be made.

The floats on the wing, though successful in lifting the upper wing off the bottom, did not result in an increase in catch efficiency. In fact, it may be that the additional floatation lifted the footrope in the wing section off the bottom. The observed increases in headrope height, though small, did not result in an increase in catch efficiency.

On board the F/V Caitlin and Mairead, the smaller and lighter doors and shorter bridles did not appear to have any positive effect on the catch efficiency of the net. With the addition of 12 floats (eight 8 inch and four 12 inch floats) there was still a significant and substantial loss of target catch. It was not until fourteen 8-inch floats and four 12 inch floats were added (42 floats in all) that catch efficiency appeared to improve. In general, the addition of floatation improved the catch retention, but there was an insufficient number of replicate trawls to evaluate this.

ACKNOWLEDGMENTS

As noted previously this project would not have been possible without the cooperation and participation of many individuals: Henry Milliken, Heather Haas and Eric Matzen of the NMFS Northeast Fisheries Science Center, Captain Jim Ruhle and Captain Dave Aripotch , Jon Knight of Superior Trawl and Mary O'Rourke of Trawlworks.

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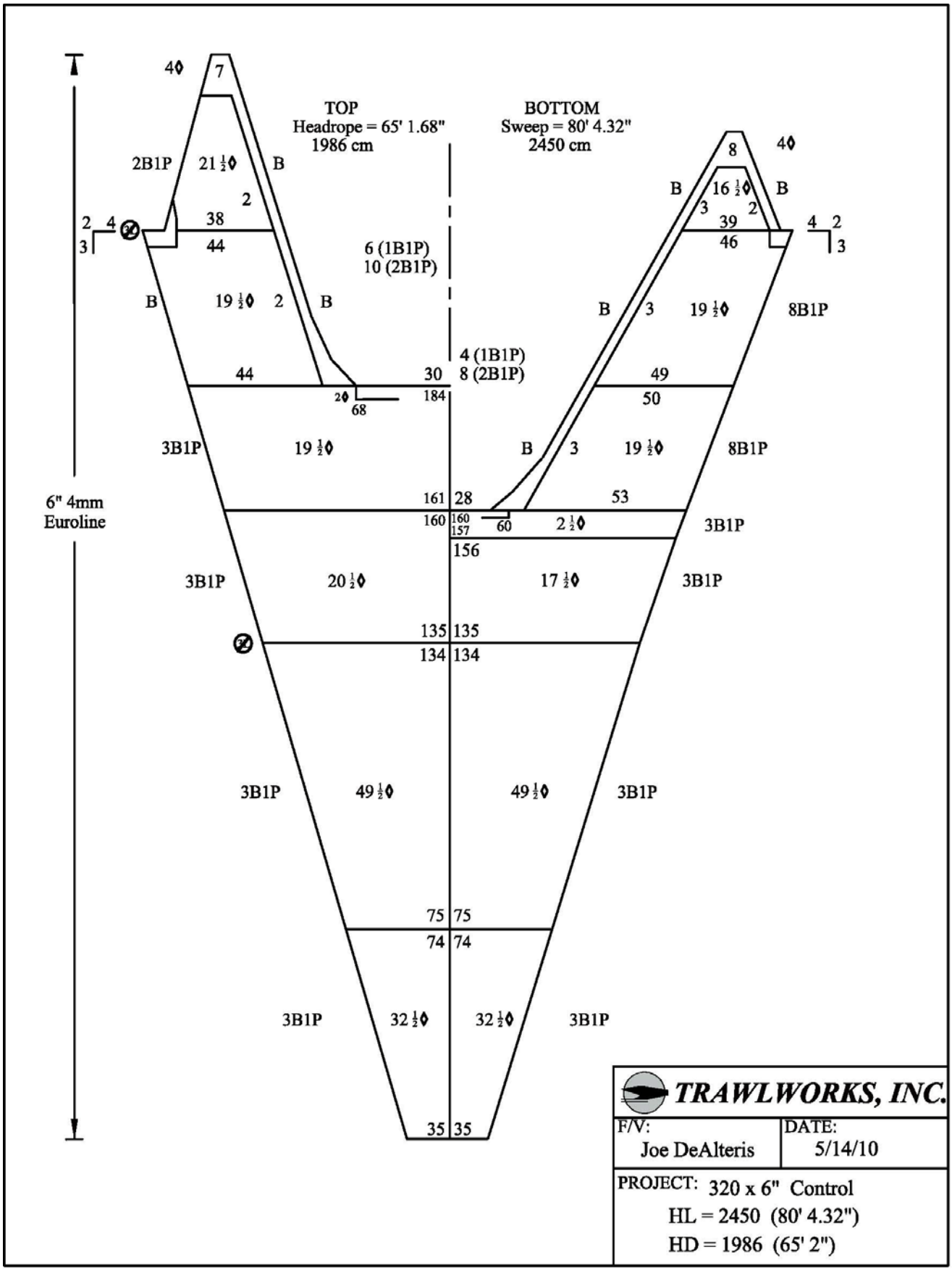

Figure 1. Schematic of 360x6” control or traditional trawl with a 65 foot headrope used in this study.

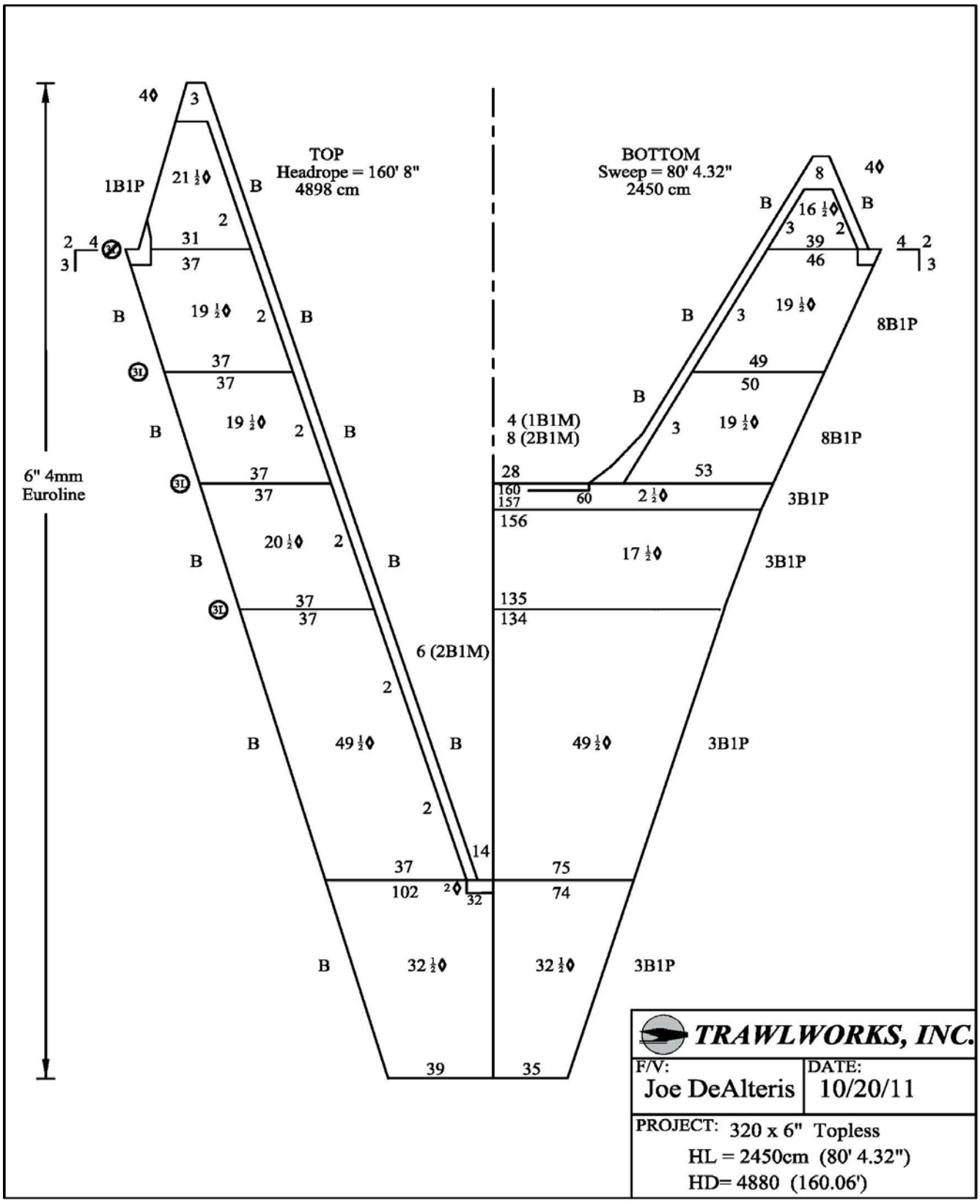

Figure 2. Schematic of 320 x 6 inch topless trawl with 160 foot headrope used in this study.

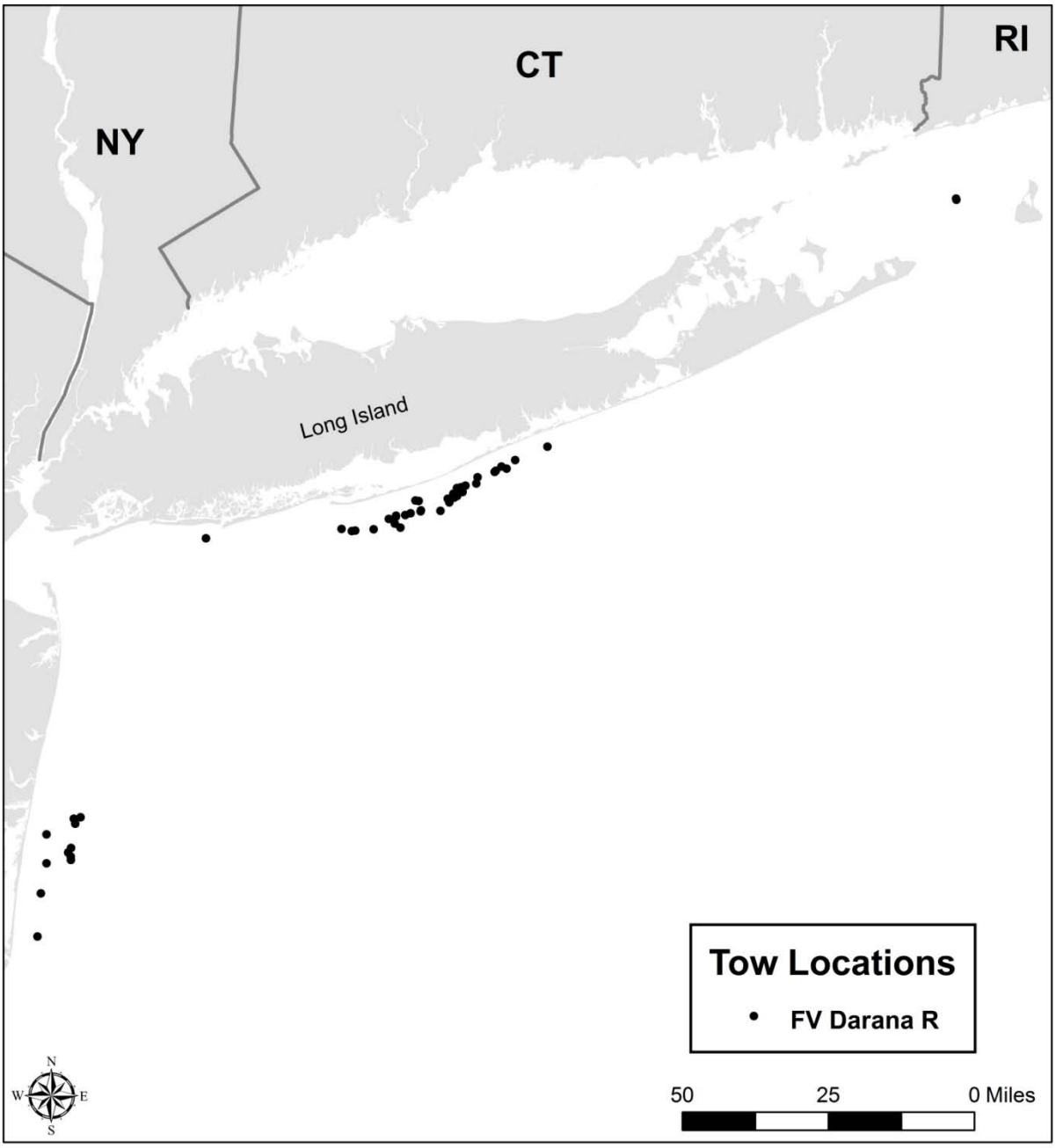

Figure 3. Chart showing tows locations conducted in this study aboard the F/V Darana R.

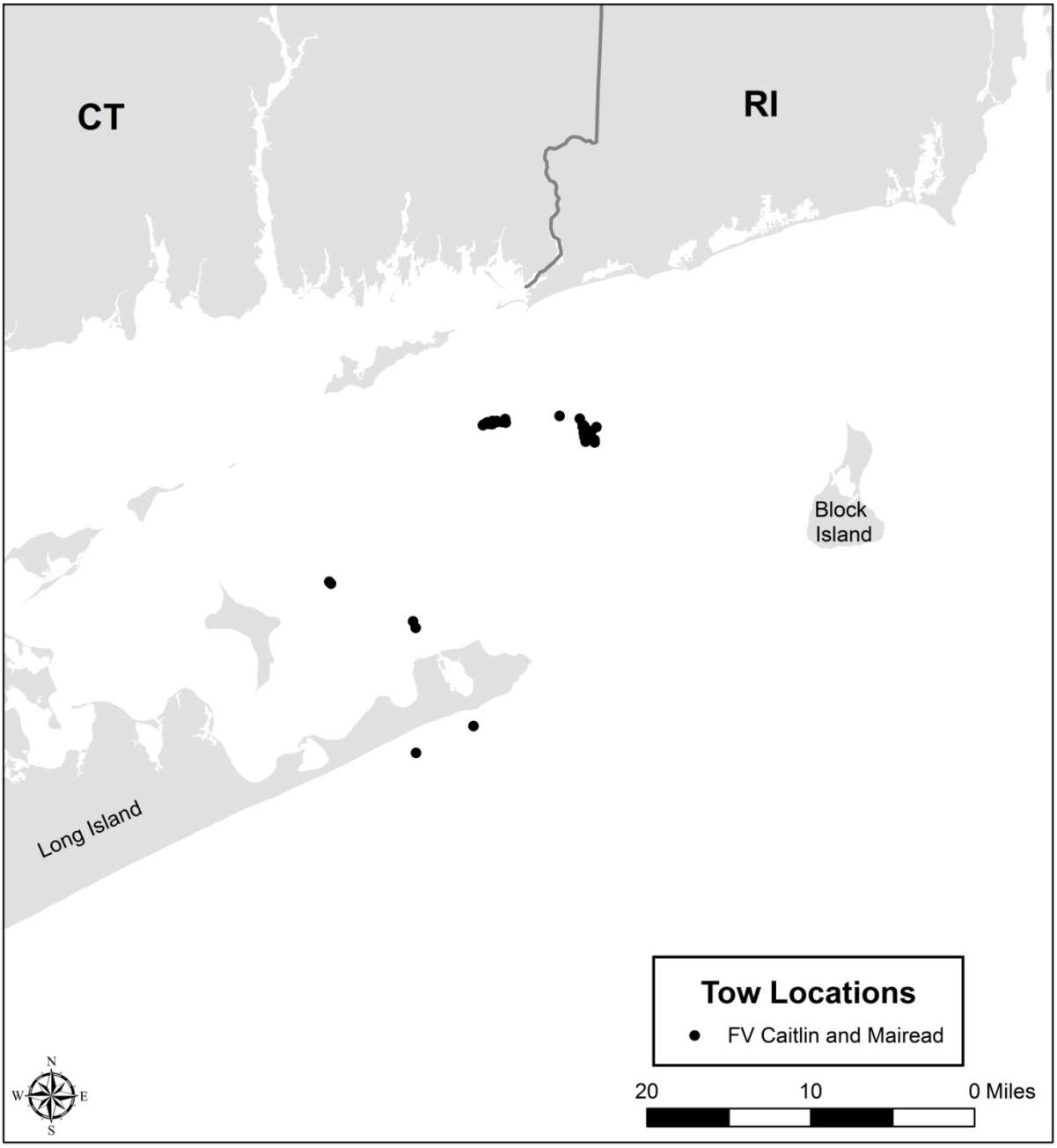

Figure 4. Chart showing tows locations conducted in this study aboard the F/V Caitlin and Mairead.

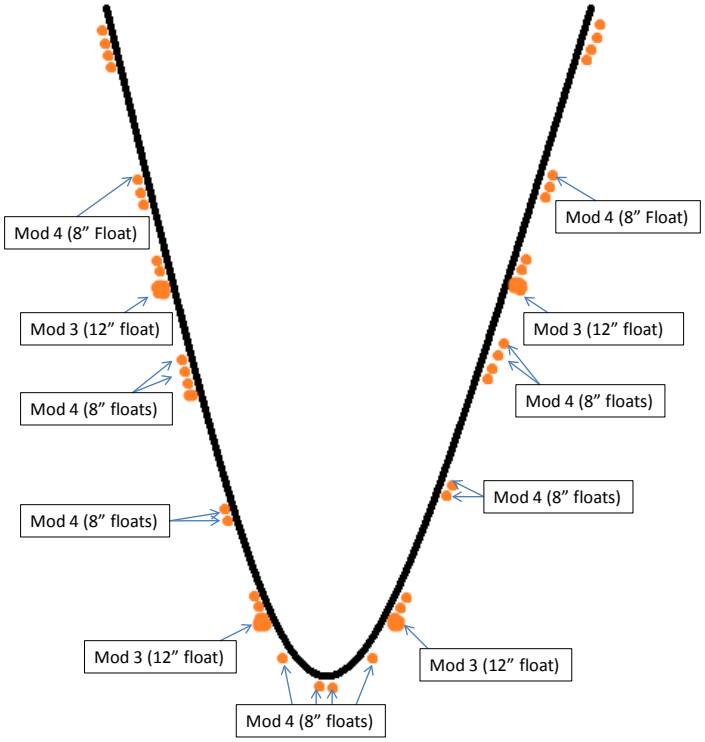

Figure 5: Topless trawl headrope diagram with locations of the floats for modifications 3 and 4 on the F/V Caitlin and Mairead. At the conclusion of the project the headrope consisted of a total of 42 floats (38- 8 inch and 4- 12 inch). The base configuration of 16 floats included four 8 inch floats at each wing end, and two sets of two 8 inch floats on each side of the central portions of the headrope. Note that this diagram is not to scale.

Table 1. Tow locations aboard the F/V Darana R showing the start and end locations of all tows in Latitude and Longitude expressed as degrees and thousandths of a degree.

		Start		End	
Date	Tow #	Lat	Long	Lat	Long
6/13/2012	1	40.610	-73.033	40.657	-72.947
6/13/2012	2	40.657	-72.971	40.607	-73.056
6/13/2012	3	40.654	-72.982	40.691	-72.893
6/13/2012	4	40.685	-72.896	40.648	-72.997
6/14/2012	1	40.730	-72.768	40.698	-72.875
6/14/2012	2	40.693	-72.882	40.727	-72.791
6/15/2012	1	41.193	-71.757	41.218	-71.680
6/15/2012	2	41.191	-71.756	41.226	-71.675
6/16/2012	1	40.661	-72.944	40.693	-72.864
6/16/2012	2	40.689	-72.869	40.654	-72.958
6/16/2012	3	40.645	-72.978	40.605	-73.085
6/16/2012	4	40.609	-73.082	40.647	-72.981
6/16/2012	5	40.673	-72.941	40.707	-72.847
6/16/2012	6	40.705	-72.848	40.666	-72.949
6/17/2012	1	40.572	-73.252	40.585	-73.151
6/17/2012	2	40.586	-73.146	40.571	-73.263
6/26/2012	1	39.807	-74.030	39.889	-74.019
6/26/2012	2	39.889	-74.022	39.807	-74.030
6/26/2012	3	39.945	-74.007	40.002	-74.007
6/26/2012	4	40.000	-74.008	39.941	-74.007
6/26/2012	5	39.974	-73.947	40.038	-73.921
6/26/2012	6	40.020	-73.936	39.956	-73.953
6/27/2012	1	39.952	-73.947	40.035	-73.938
6/27/2012	2	40.033	-73.923	39.955	-73.956
6/27/2012	3	39.966	-73.954	40.032	-73.937
6/27/2012	4	40.030	-73.940	39.958	-73.959
6/27/2012	5	40.030	-73.940	39.958	-73.952
6/27/2012	6	39.958	-73.947	40.029	-73.927

Table 1. Continued: Tow locations aboard the F/V Darana R showing the start and end locations of all tows in Latitude and Longitude expressed as degrees and thousandths of a degree.

		Start		End	
Date	Tow #	Lat	Long	Lat	Long
6/28/2012	1	40.602	-73.120	40.642	-73.003
6/28/2012	2	40.653	-72.992	40.609	-73.084
6/28/2012	3	40.635	-72.998	40.683	-72.901
6/28/2012	4	40.683	-72.899	40.642	-73.001
6/28/2012	5	40.642	-73.001	40.602	-73.101
6/28/2012	6	40.611	-73.081	40.645	-72.968
6/28/2012	7	40.633	-73.015	40.631	-73.096
6/28/2012	8	40.628	-73.087	40.638	-72.992
6/29/2012	1	40.576	-73.278	40.597	-73.160
6/29/2012	2	40.601	-73.143	40.567	-73.233
6/29/2012	3	40.599	-73.143	40.613	-73.034
6/29/2012	4	40.626	-73.011	40.601	-73.112
6/29/2012	5	40.605	-73.107	40.625	-72.991
6/29/2012	6	40.558	-73.613	40.621	-73.046
6/30/2012	1	40.595	-73.160	40.570	-73.257
6/30/2012	2	40.573	-73.244	40.599	-73.143
6/30/2012	3	40.629	-73.095	40.635	-72.998
6/30/2012	4	40.638	-72.992	40.628	-73.101
6/30/2012	5	40.578	-73.132	40.569	-73.237
6/30/2012	6	40.575	-73.198	40.601	-73.124

Table 2. Configuration of the experimental topless trawl by tow number aboard the F/V Darana R

Date	Tow #	Mod. #	Grd. Wire (fa)	Bridles (fa)	Floats 8”	HR slack (ft)
13-Jun-2012	2	None	100	15	16	0
13-Jun-2012	3	None	100	15	16	0
14-Jun-2012	2	None	100	15	16	0
15-Jun-2012	2	None	100	15	16	0
16-Jun-2012	2	None	100	15	16	0
16-Jun-2012	3	None	100	15	16	0
16-Jun-2012	6	None	100	15	16	0
17-Jun-2012	1	None	100	15	16	0
26-Jun-2012	2	None	100	15	16	0
26-Jun-2012	3	None	100	15	16	0
26-Jun-2012	6	None	100	15	16	0
27-Jun-2012	1	None	100	15	16	0
28-Jun-2012	7	None	100	15	16	0
27-Jun-2012	4	1	100	15	24	0
27-Jun-2012	5	1	70	15	24	0
27-Jun-2012	2	1	70	15	24	0
28-Jun-2012	3	1	100	15	24	0
28-Jun-2012	6	1	100	15	24	0
29-Jun-2012	2	2	100	15	28	0
29-Jun-2012	3	3	100	15	32	0
29-Jun-2012	6	3	100	15	32	0
30-Jun-2012	2	4	100	15	16	0.5
30-Jun-2012	3	5	100	15	16	0
30-Jun-2012	6	5	100	15	16	0

Table 3. Catch weights in pounds for summer flounder on all tows aboard the F/V Darana R.

Date	Tow #	Topless	Tow #	Control
13-Jun-2012	2	163.7	1	381.3
13-Jun-2012	3	157.4	4	174.1
14-Jun-2012	2	64.4	1	96.35
15-Jun-2012	2	28.1	1	136.1
16-Jun-2012	2	69.9	1	186.4
16-Jun-2012	3	27.4	4	60.2
16-Jun-2012	6	76.4	5	126.2
17-Jun-2012	1	62.9	2	84.7
26-Jun-2012	2	79.6	1	94.9
26-Jun-2012	3	117.6	4	134.8
26-Jun-2012	6	100.7	5	377.8
27-Jun-2012	1	178.7	2	343.2
27-Jun-2012	4	227.3	3	400.7
27-Jun-2012	5	172.1	6	577.4
28-Jun-2012	2	235.5	1	410.7
28-Jun-2012	3	252.6	4	395.8
28-Jun-2012	6	206.8	5	357.3
28-Jun-2012	7	123.7	8	594.1
29-Jun-2012	2	135.5	1	280.3
29-Jun-2012	3	338.1	4	407.6
29-Jun-2012	6	107.5	5	276.4
30-Jun-2012	2	158.4	1	297
30-Jun-2012	3	282.8	4	351.2
30-Jun-2012	6	226	5	402.9

Table 4. Catch weight in pounds for the skate complex on all tows aboard the F/V Darana R.

Date	Tow #	Topless	Tow #	Control
13-Jun-2012	2	1234.06	1	3090.26
13-Jun-2012	3	3031.286	4	3848.4
14-Jun-2012	2	4939.62	1	9577.22
15-Jun-2012	2	686.7	1	1352.32
16-Jun-2012	2	2112.24	1	3232.28
16-Jun-2012	3	801.32	4	1438.92
16-Jun-2012	6	3045.84	5	4280.64
17-Jun-2012	1	1477.82	2	1774.22
26-Jun-2012	2	2759.46	1	10490.73
26-Jun-2012	3	1962.72	4	11159.2
26-Jun-2012	6	3699.84	5	3507.66
27-Jun-2012	1	2781.45	2	11275.11
27-Jun-2012	4	5691.6	3	7300.5
27-Jun-2012	5	5342.96	6	11985.6
28-Jun-2012	2	573.2	1	1655.64
28-Jun-2012	3	1849.26	4	2196.48
28-Jun-2012	6	467.6	5	1000.27
28-Jun-2012	7	743.5	8	825.6
29-Jun-2012	2	659.4	1	1161.9
29-Jun-2012	3	1293.7	4	2130.8
29-Jun-2012	6	466	5	1210.4
30-Jun-2012	2	587.6	1	1298.6
30-Jun-2012	3	1444.1	4	2083.5
30-Jun-2012	6	1851	5	2286.5

Table 5. Summary of sturgeon taken in this study aboard the F/V Darana R.

Date	Tow #	Topless	Lengths (in)	Tow #	Control	Lengths (in)
13-Jun-2012	2	0		1	0	
13-Jun-2012	3	0		4	10	52,57,52,30,51,59,62,51,65,56
14-Jun-2012	2	1	52	1	2	43,39
15-Jun-2012	2	0		1	0	
16-Jun-2012	2	0		1	0	
16-Jun-2012	3	0		4	0	
16-Jun-2012	6	0		5	5	38,28,38,52,56

Table 6.Tow locations aboard the F/V Caitlin and Mairead showing the start and end locations of all tows in Latitude and Longitude expressed as degrees and thousandths of a degree.

		Start		End	
Date	Tow #	Lat	Long	Lat	Long
7/24/2012	1	41.231	-71.886	41.212	-71.803
7/24/2012	2	41.218	-71.807	41.231	-71.887
7/24/2012	3	41.231	-71.894	41.219	-71.807
7/24/2012	4	41.221	-71.808	41.229	-71.899
7/24/2012	5	41.230	-71.892	41.216	-71.806
7/24/2012	6	41.219	-71.806	41.230	-71.887
7/25/2012	1	41.098	-71.960	41.119	-72.031
7/25/2012	2	41.125	-72.034	41.095	-71.961
7/25/2012	3	41.094	-71.957	41.118	-72.032
7/25/2012	4	41.124	-72.032	41.098	-71.963
7/25/2012	5	41.029	-71.906	41.005	-71.966
7/25/2012	6	41.011	-71.957	41.032	-71.895
7/26/2012	1	41.231	-71.886	41.213	-71.799
7/26/2012	2	41.219	-71.801	41.229	-71.887
7/26/2012	3	41.230	-71.878	41.233	-71.810
7/26/2012	4	41.233	-71.812	41.226	-71.880
7/26/2012	5	41.231	-71.881	41.223	-71.806
7/26/2012	6	41.228	-71.810	41.228	-71.894
7/27/2012	1	41.228	-71.810	41.219	-71.801
7/27/2012	2	41.219	-71.801	41.229	-71.895
7/27/2012	3	41.233	-71.878	41.214	-71.796
7/27/2012	4	41.217	-71.799	41.231	-71.886
7/27/2012	5	41.230	-71.888	41.217	-71.798
7/27/2012	6	41.223	-71.808	41.227	-71.903
7/28/2012	1	41.230	-71.890	41.216	-71.800
7/28/2012	2	41.219	-71.803	41.231	-71.889
7/28/2012	3	41.231	-71.887	41.217	-71.795
7/28/2012	4	41.219	-71.799	41.228	-71.899
7/28/2012	5	41.230	-71.892	41.223	-71.800
7/28/2012	6	41.229	-71.810	41.226	-71.904

Table 6. Continued: Tow locations aboard the F/V Caitlin and Mairead showing the start and end locations of all tows in Latitude and Longitude expressed as degrees and thousandths of a degree.

		Start		End	
Date	Tow #	Lat	Long	Lat	Long
7/29/2012	1	41.229	-71.898	41.220	-71.804
7/29/2012	2	41.223	-71.803	41.230	-71.891
7/29/2012	3	41.232	-71.890	41.221	-71.795
7/29/2012	4	41.226	-71.806	41.229	-71.899
7/29/2012	5	41.229	-71.890	41.220	-71.797
7/29/2012	6	41.224	-71.805	41.224	-71.906
7/30/2012	1	41.229	-71.898	41.226	-71.803
7/30/2012	2	41.227	-71.808	41.230	-71.897
7/30/2012	3	41.230	-71.891	41.225	-71.795
7/30/2012	4	41.227	-71.798	41.230	-71.891
7/30/2012	5	41.230	-71.895	41.235	-71.823
7/30/2012	6	41.235	-71.830	41.229	-71.900
7/31/2012	1	41.230	-71.894	41.223	-71.808
7/31/2012	2	41.224	-71.809	41.228	-71.903
7/31/2012	3	41.229	-71.897	41.223	-71.805
7/31/2012	4	41.228	-71.809	41.229	-71.899
7/31/2012	5	41.231	-71.893	41.222	-71.799
7/31/2012	6	41.224	-71.802	41.227	-71.900

Table 7. Configuration of the experimental topless trawl by tow number aboard the F/V Caitlin and Mairead. No slack was added to the headrope during this testing.

Date	Tow #	Mod. #	Grd. Wire (fa)	Bridle (fa)	Floats 8"	Floats 12"
24-Jul-12	2	None	60	10	16	
24-Jul-12	3	None	60	10	16	
24-Jul-12	5	None	60	10	16	
25-Jul-12	1	None	60	10	16	
25-Jul-12	4	1	60	10	22	
25-Jul-12	5	1	60	10	22	
26-Jul-12	2	2	60	10	24	
26-Jul-12	3	2	60	10	24	
26-Jul-12	6	2	60	10	24	
27-Jul-12	1	2	60	10	24	
27-Jul-12	4	2	60	10	24	
27-Jul-12	5	2	60	10	24	
28-Jul-12	2	2	60	10	24	
28-Jul-12	3	2	60	10	24	
28-Jul-12	6	2	60	10	24	
29-Jul-12	2	2	60	10	24	
29-Jul-12	3	2	60	10	24	
29-Jul-12	6	2	60	10	24	
30-Jul-12	1	2	60	10	24	
30-Jul-12	4	2	60	10	24	
30-Jul-12	5	3	60	10	24	4
31-Jul-12	2	4	60	10	38	4
31-Jul-12	3	4	60	10	38	4
31-Jul-12	6	4	60	10	38	4

Table 8. Catch weights in pounds for summer flounder aboard the F/V Caitlin and Mairead.

Date	Tow #	Topless	Tow #	Control
24-Jul-12	2	143.8	1	532.1
24-Jul-12	3	60.2	4	442.35
24-Jul-12	5	80	6	322.3
25-Jul-12	1	57	2	365.23
25-Jul-12	4	50.8	3	160.8
25-Jul-12	5	61.2	6	72.5
26-Jul-12	2	55	1	492.5
26-Jul-12	3	17.8	4	184.55
26-Jul-12	6	35.2	5	232.8
27-Jul-12	1	115.1	2	512.4
27-Jul-12	4	41.2	3	319.7
27-Jul-12	5	38.74	6	196.3
28-Jul-12	2	29.9	1	439.6
28-Jul-12	3	62.4	4	305.5
28-Jul-12	6	112.6	5	241.5
29-Jul-12	2	58.45	1	400.4
29-Jul-12	3	146.1	4	317.54
29-Jul-12	6	82.55	5	373.64
30-Jul-12	1	23.4	2	522.9
30-Jul-12	4	38.5	3	429.2
30-Jul-12	5	87.3	6	175.5
31-Jul-12	2	287.1	1	275.8
31-Jul-12	3	153.2	4	317.6
31-Jul-12	6	229.8	5	260.6

Table 9. Catch weight in pounds for the skate complex aboard the F/V Caitlin and Mairead.

Date	Tow #	Topless	Tow #	Control
24-Jul-12	2	1657.74	1	2565.34
24-Jul-12	3	768.4	4	3353.8
24-Jul-12	5	1421.7	6	1067.69
25-Jul-12	1	174.9	2	444
25-Jul-12	4	266.4	3	235.7
25-Jul-12	5	227.4	6	313.9
26-Jul-12	2	402.2	1	1151.04
26-Jul-12	3	265	4	498.7
26-Jul-12	6	197.3	5	619
27-Jul-12	1	792.1	2	505.15
27-Jul-12	4	540	3	693.4
27-Jul-12	5	173.1	6	793.8
28-Jul-12	2	239.9	1	743.02
28-Jul-12	3	842	4	836.2
28-Jul-12	6	463	5	552.5
29-Jul-12	2	339.5	1	688.95
29-Jul-12	3	1186.9	4	623.95
29-Jul-12	6	497.45	5	486.7
30-Jul-12	1	248.15	2	1273.8
30-Jul-12	4	351.9	3	1230.1
30-Jul-12	5	447.5	6	601.5
31-Jul-12	2	2209.2	1	787
31-Jul-12	3	751.53	4	787.5
31-Jul-12	6	790.7	5	1196.9