PART I

FINAL REPORT SUMMARY

1. Project Title: A Comparison of the Catch Efficiency of a NMFS Certified and a Northeast Modified Turtle Excluder Device (TED) in the southern New England And Mid-Atlantic Summer Flounder Trawl Fisheries
2. NOAA Award Number NA08NMF4720595
3. Project Team: Joseph DeAlteris and Christopher Parkins

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4. Project Period: 1 June 2009 to 31 May 2011, extended to 31 October 2011
5. Identification of Supporting Organizations: University of Rhode Island, FV Darana R and FV Excalibur
6. Total amount of sub-award: $39,875, with separate awards to the chartered fishing vessels
7. List of Equipment (>$5000) purchased: none
8. Summary of Tasks Scheduled:
    1. Construct two NMFS certified TEDs and rig in extension sections and two northeast modified TEDs and rig in extension sections.
    2. Conduct a minimum of 20 pairs of tows on board the FV Darana R and 20 pairs of tows on board the FV Excalibur comparing the NMFS certified flounder TED with the northeast modified TED.
    3. Collect catch data on each of these tows. Submit data reports after each field trip.
    4. Compare the catch data from the pairs of tows using the appropriate statistical methods, so as to evaluate the comparative catch efficiency of these TEDs for summer flounder, the target species, and for all other major species or species groups in the catch. Submit draft and final reports.
9. Summary of Tasks Accomplished: All the above tasks were completed on schedule.
10. Explanation of problems encountered: none.

11. Summary of Major Findings:

- The results of this study found essentially no difference between the catch performance of the NMFS certified flounder TED and the northeast modified TED for summer flounder, total catch, non-target bycatch, the skate complex, and the dogfish complex.
- It is believed that both TEDs suffer from clogging of the grate with larger fish, therefore expelling both water and catch out the opening of the TED extension section. The increased area of the sorting grate, and the decreased angle of attack did not improve fish retention. However the participating fishermen did consider the articulating TED an improvement over the rigid TED.

PART II

FINAL REPORT

A COMPARISON OF THE CATCH EFFICIENCY OF A NMFS CERTIFIED AND A NORTHEAST MODIFIED TURTLE EXCLUDER DEVICE (TED) IN THE SOUTHERN NEW ENGLAND AND MID-ATLANTIC SUMMER FLOUNDER TRAWL FISHERIES

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A Report to the

Commercial Fisheries Research Foundation

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ABSTRACT

This project was funded by the Commercial Fisheries Research Foundation and was conducted in 2009. It consisted of a field evaluation of the catch performance of the northeast modified Turtle Excluder Device (TED) with 15.2 cm (6 in) bar spacing compared to the NMFS certified flounder TED with a 10 cm (4 in) bar spacing. Previous testing of the NMFS certified flounder TED showed a 35% loss of summer flounder when compared to a net without a TED. Much of the loss was speculated to be attributed to the clogging of the TED with skates and rays. Unfortunately, the northeast modified TED did not significantly improve the catch retention of the target species as compared to the NMFS certified flounder TED. Therefore we conclude that the northeast modified TED would have a fish loss of about 35% as compared to a net with no TED

The summer flounder trawl fishery as conducted in the mid-Atlantic from the south shore of Long Island to the Virginia Capes is a high bycatch fishery. Summer flounder represents only a small portion of the catch (about 10% on average); while the major portion of the catch is skates, rays, and dogfish. These species were observed to clog both the NMFS certified TED and the northeast modified TED at catch rates greater than 1000 kg per 60-90 minute tow. The previous study also documented a loss of bycatch similar to the percentage of loss of summer flounder with the NMFS TED. This study found essentially no difference between the catch performance of the NMFS flounder TED and the northeast modified TED with large bar spacing for summer flounder, total catch, non-target bycatch, the skate complex and the dogfish complex. While small differences were observed between the catch rates of the FV Darana R and the FV Excalibur, none of these were statistically significant.

INTRODUCTION

The National Marine Fisheries Service (NMFS) published an Advance Notice of Proposed Rulemaking (ANPR) in February 2007 regarding their intent to reduce the mortality of sea turtles that interact with trawl fisheries in the Mid-Atlantic and southern New England regions. NMFS has documented interactions between sea turtles and the summer flounder trawl fishery, the scallop trawl fishery, the whelk trawl fishery, the squid, mackerel, butterfish and scup trawl fisheries, and other trawl fisheries. NMFS has required the use of a Turtle Excluder Device (TED) in the summer flounder trawl fishery in the mid-Atlantic south of Cape Charles, VA during particular times of the year. On 18 October 2008 Tanya Dobrzynski of NMFS Headquarters made a presentation to the Mid-Atlantic Fishery Management Council indicating that the agency is moving forward with plans to require TEDs in all trawl fisheries north of the existing TED line that extends east from Cape Henry, VA. Based on documented interactions in southern New England and the mid-Atlantic, it is likely that the proposed regulations will include the area south of a line extending due east from Cape Cod to the edge of the Exclusive Economic Zone (EEZ) for a 4-6 month period of each year. Finally, in 2009 NMFS conducted scoping hearings in ports from VA to MA soliciting comments on proposed regulations to mitigate sea turtle interactions with northeast and mid-Atlantic trawl fisheries.

In January, 2007, Dr. DeAlteris was contracted by NMFS to conduct a workshop with fishing industry, and non-Governmental Organizations (NGOs) participants to discuss bycatch reduction technologies (BRTs) to reduce sea turtle interactions in southern New England and mid-Atlantic trawl fisheries. The participants at this workshop stressed the need for further work to develop a modified TED with better target catch retention in the summer flounder and scallop trawl fisheries (DeAlteris and others 2007).. The Northeast Regional Office (NERO) has also identified these two fisheries as their top two priorities. The proposed project addresses improved catch retention testing in the summer flounder trawl fishery. In 2007 Dr. DeAlteris was contracted by NMFS to conduct some preliminary research, and that study demonstrated that there was 35% loss of summer flounder (*Paralichthys dentatus*), the target catch, but that there

was no difference in the size distribution of retained summer flounder when a certified[1] NMFS flounder TED was used in the summer flounder trawl fishery (Lawson, DeAlteris and Parkins, 2007). Dr. DeAlteris chartered the FV Daranar R, and worked collaboratively on this research with Captain Jim Ruhle, the owner and operator of the vessel. Underwater video and direct on-deck visual observations of the trawl TED extension on haul-back suggested that clogging of the TED by bycatch of skates and rays was a probable cause for the loss of flounder. In 2008, Dr. DeAlteris, Captain Ruhle, Charles Taylor (NMFS, SEFSC) and Henry Milliken (NMFS, NEFSC) designed and conducted evaluations of the physical performance of various alternative flounder TED designs in the flume tank at Memorial University in St. John's, Newfoundland. That effort resulted in a northeast modified TED design that incorporated a flexible joint to allow for the TED to go on a net reel, flat bars versus pipe on the interior, a 50% larger size to increase filtration capacity, a lower operational angle of attack to reduce the impingement of skates and rays, and horizontal bars in the lower portion to facilitate the passage of flounder and vertical bars in the upper portion to assist in the ejection of sea turtles. The field tested design had bar spacing in the upper section that is larger [15.2 cm (6 in)] than the presently mandated 10 cm (4 in) spacing and this was chosen to help mitigate the loss of the targeted catch.

In the summer of 2008 summer Dr. DeAlteris, Captain Ruhle and Henry Milliken participated in the NMFS, SEFSC small turtle certification of the northeast modified TED design using the larger leatherback turtle opening in Panama City, Florida. The northeast modified TED was certified for small turtle exclusion when 10 cm (4 in) bar spacing was used. This report describes the results of a project that compared the ability of the northeast modified TED with larger bar spacing (to retain the targeted summer flounder) compared to the NMFS flounder TED that was used in the 2007 summer flounder TED evaluation. The proposal for this project indicated that the northeast modified TED would be compared to a trawl with no TED installed, but based on a request from the NMFS NEFSC Protected Species Branch, the project protocol was modified from a comparison of a trawl with the northeast modified TED to a trawl with no TED (control), to a comparison of a trawl with the northeast modified TED to a trawl with the NMFS flounder TED that was evaluated in 2007. The rationale for this change in protocol was

[1] Certified means that the TED has been tested and passed a NMFS approved test that demonstrates that the TED is successful at expelling turtles from a bottom trawl net 97% of the time.

that a comparison between the northeast modified TED and the old NMFS flounder TED would be more statistically robust by directly comparing them rather than comparing each to a trawl with no TED. This change in the project experimental design was approved by the Commercial Fisheries Research Foundation prior to the start of the project.

METHODS

Gear

The TEDs used in this experiment were a NMFS certified flounder TED and a northeast modified TED that had increased [15.2 cm (6 in)] bar spacing in the upper section. Extensions were easily swapped using rings and lines that ran the circumference of the extension. The TEDs were evaluated using traditional groundfish trawls commonly used by fishermen targeting summer flounder. On the FV Darana R, the headrope measured 17.0 m (55 ft), and the 21.7 m (70 ft) sweep was constructed of 1 row of 1.3 cm (1/2 in) chain attached to a 5.1 cm (2.0 in) cookie sweep. The net was constructed of 15.2 cm (6.0 in) mesh polyethylene webbing with a 14 cm (5.5 in) mesh double-twine polyethylene codend. The trawl doors were 600 kg (1323 lb), and the same door were used for all tows during the evaluation on board the FV Darana R. The net was rigged with 28.6 m (15 fathom) bridles and 143 m (75 fathom) of ground gear. On the FV Excalibur, the headrope measured 24.8 m (78 ft) and the sweep was 31.2 m (98 ft). The net was constructed of 16 cm (6.5 in) polyethylene webbing, with a 14 cm (5.5 in) mesh double-twine polyethylene codend. The trawl doors were 900 kg (1900 lb) and the same doors were used for all tows during the evaluation on the FV Excalibur. The net was rigged with 38.2 m (20 fathom) bridles and 114.6 m (60 fathom) of ground gear.

The NMFS certified flounder TED used in this study was constructed of aluminum pipe (inner bars were 4.5 cm (1.4 in) in outside diameter). The dimensions were 81.3 cm (32 in) in width and 129.5 cm (51 in) in height (Figure 1). The bar spacing of the grid was 10.2 cm (4 in), except for the two large openings 36.8 x 25.4 cm (14.5 x 10 in) along the bottom. The TED grid was installed in an 8.9 cm x 4 mm (3.5 x ⅛ in), braided, double-twine, polyethylene extension, 20 meshes in depth at an angle of approximately 45^{o}. The TED extension was installed in a top opening configuration between the body of the trawl and the codend with two 20 cm (8 in) hard plastic floats installed on each side of the grid. The TED opening was an approved one mesh cut

leaving an escape hole with a stretched measurement of 91.4 cm (36 in) wide and 40.6 cm (16 in) in height, covered by a flap constructed of 3.8 cm (1.5 in) polyethylene webbing. This opening was in excess of the 88.9 cm (35 in) and 30.5 cm (12 in) stretched measurement requirements for this fishery.

The northeast modified TED was also constructed of aluminum, and overall was 123 cm (48 in) wide and 183 cm (72 in) long. It was designed and constructed in two sections that hinge or articulate (Figure 2). The lower section has three 25.4 x 36 cm (10 x 14 in) windows at the base, with horizontally oriented 3.8 x 1.2 cm (1.5 x 0.5 in) flat bars above. The upper section has vertically oriented 3.8 x 1.2 cm (1.5 x 0.5 in) flat bars. The spacing of the bars is variable, in the lower sections the bars were 10-12.7 cm (4-5 in) apart, and in the upper section the bars were initially 15.2 cm (6 in) apart in the TED evaluated in this study. The TED with the increased bar spacing did not pass the small turtle certification until the spacing was reduced to 10 cm (4 in) in Florida, and that design passed the small turtle test. This later design, which has smaller bar spacing than what was tested, is shown in Figure 2. The TED grid was installed in an 8.9 cm x 4 mm (3.5 x ⅛ in), braided, double-twine, polyethylene extension, 30 meshes in depth at an angle of approximately 30^{o}. The TED extension was installed in a top opening configuration between the body of the trawl and the codend with two 20 cm (8 in) hard plastic floats installed on each side of the grid. The TED opening was V-shaped with an escape hole with a measurement of 91.4 cm (36 in) wide at the TED frame and 40.6 cm (16 in) in height, covered by a double flap constructed of 3.8 cm (1.5 in) polyethylene webbing. This opening was in excess of the 88.9 cm (35 in) and 30.5 cm (12 in) stretched measurement requirements for this fishery.

Field Work

Comparative towing was conducted aboard the FV Darana R, home ported in Hampton VA, and the FV Excalibur, home ported in Point Judith RI. These vessels are 25–30 m in length and are typical of the large class vessels in the summer flounder trawl fishing fleet. The vessel captain was directed to conduct fishing operations at locations of his choosing so as to duplicate conditions in the mid-Atlantic trawl fishery and to maximize flounder catch. All towing was conducted daylight conditions from sunrise to sunset. An ABBA 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. All tows were 90 minutes in duration form the time the winches were locked after setting the gear, to the time the winches were engages on haul-back.

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, average basket weights or another sub-sampling procedure had to be used to estimate skate or dogfish total weights. Length data were collected on summer flounder and other species, as time and sampling priorities allowed. Random selection of baskets was used when sub-sampling was required.

Underwater video recording of the trawl and the performance of the TED was attempted on several tows. A Sony DCR-HC32 digital video camera mounted in an underwater housing was attached to the net in a variety of locations to document fish escapement out of the TED opening, fish behavior at the grid, the orientation of the TED during trawling, and other gear aspects related to catch efficiency.

Data Analysis

Data were compiled and entered into Microsoft Excel. Catch weights were compared using two-tailed, paired T-tests to compare the effect of the tow TED designs on summer flounder retention and bycatch reduction. In the bycatch analyses, the results were divided into catches of dogfish complex (smooth and spiny dogfish) and the skate complex (little, winter and clearnose). Although not all sub-sets of the data met all the assumptions of a parametric statistical test, by invoking the Central Limit Theorem, the paired T-test was considered to be sufficiently robust, so as to provide reliable analyses in this study. A Kolmogorov-Smirnov (K-S) test was used to detect significant shifts in the size frequency distributions summer flounder catch of the two different TEDs (Sokal and Rohlf 1981). A significance level of $\alpha=0.05$ was used for all

statistical tests. The p values reported are for a two-tailed T-test, since we examined the question about the relative catch rates of one TED design versus another TED design.

RESULTS

Field Work

The first phase of field work for this project commenced on 22 June 2009 aboard the FV Darana R departing from Hampton VA. The vessel spent 11 days at sea and accomplished 22 pairs or 44 tows. Using a waiver for trip limits that was provided from the Virginia Marine Resources Commission, about 10,000 pounds of summer flounder were captured and sold, and the revenue used to defray the cost of the vessel charter and the research overall. The second phase of field work was conducted aboard the FV Excalibur commencing on 9 July 2009 fishing from Pt Judith RI. The vessel spent 11 days at sea and accomplished 19 pairs or 38 tows. Using a waiver for trip limits that was provided from the RI Department of Environmental Management, about 10,000 pounds of summer flounder were captured and sold, and the revenue used to defray the cost of the vessel charter and the research overall.

A total of 43 successful comparative paired tows (86 total tows) were completed over 20 sampling days using a trawl equipped with either the NMFS certified flounder TED or the northeast modified TED. Approximately 10% of the tows were east of the Delmarva Peninsula, and the other 90% of the tows were south of Long Island and Cape Cod (Table 1 and Figure 3).

The NMFS flounder TED was observed to be clogged more often during haul-back (Figure 4a) as compared the northeast modified TED (Figure 4b). The northeast modified TED was able to be rolled on to the net reel, but both TEDs sustained damage during the field work (Figures 5a and 5b). Both TEDs showed a small curvature due to either the weight of the catch that clogged on the grid, or as a result of being placed on the net reel. Both Captains Ruhle and Hovanesian noted that the northeast modified TED was easier to handle on board as it can go on a net reel, and that it appeared to be more rugged overall.

Several attempts were made to collect video data on TED tows during the middle daylight hours. Cameras were positioned on top of the net looking at the escape opening, in the net looking at the TED grid, and forward in the net looking back down towards the sweep. Due to the amount of suspended sediments produced during trawling in sand and mud bottoms, visibility was extremely limited and the vast majority of data was uninformative.

Data Analysis

The catch weight per tow data for the paired tows of the two fishing vessels are presented in Tables 2-6 for total catch weight, summer flounder catch weight, non-target or bycatch weight, skate complex weight and dogfish complex weight, respectively. The results of the statistical analyses are summarized in Table 7. Two groups of bycatch were dominant throughout the study and based on past experience were most likely to contribute to clogging of the TED grid. Skates and rays (Rajiformes and Myliobatiformes) were caught on every tow, and were subsequently treated as one complex. Smooth dogfish (*Mustelus canis*) and spiny dogfish (*Squalus acanthias*) were combined into a dogfish complex, but dogfish did not occur in every tow.

The mean total catch weight per tow for the 23 paired tows conducted aboard the FV Darana R was 883 kg for the NMFS flounder TED trawl and 961 kg for the northeast modified TED trawl. The catch ratio of the modified TED to the NMFS flounder TED was 1.09. The results of the T-test indicate no significant difference between the catch performance of the two TEDs ($p=0.079$). The mean total catch weight per tow for the 19 paired tows conducted aboard the FV Excalibur was 1398 kg for the NMFS flounder TED trawl and 1449 kg for the northeast modified TED trawl. The catch ratio of the modified TED to the NMFS flounder TED was 0.99. The results of the T-test indicate no significant difference between the catch performance of the two TEDs ($p=0.682$). The mean total catch weight per tow for the combined 42 paired tows conducted aboard both vessels was 1116 kg for the NMFS flounder TED trawl and 1182 kg for the northeast modified TED trawl. The catch ratio of the modified TED to the NMFS flounder TED was 1.06. The results of the T-test indicate no significant difference between the catch performance of the two TEDs ($p=0.272$).

The mean summer flounder catch weight per tow for the 23 paired tows conducted aboard the FV Darana R was 149 kg for the NMFS flounder TED trawl and 138 kg for the northeast modified TED trawl. The catch ratio of the modified TED to the NMFS flounder TED was 0.99. The results of the T-test indicate no significant difference between the catch performance of the two TEDs (p=0.927). The mean summer flounder catch weight per tow for the 19 paired tows conducted aboard the FV Excalibur was 122 kg for the NMFS flounder TED trawl and 158 kg for the northeast modified TED trawl. The catch ratio of the northeast modified TED to the NMFS flounder TED was 1.30. The results of the T-test indicate no significant difference between the catch performance of the two TEDs (p=0.165). The mean summer flounder catch weight per tow for the combined 42 paired tows conducted aboard both vessels was 131 kg for the NMFS flounder TED trawl and 147 kg for the northeast modified TED trawl. The catch ratio of the northeast modified TED to the NMFS flounder TED was 1.12. The results of the T-test indicate no significant difference between the catch performance of the two TEDs (p=0.210).

The mean non-target catch weight per tow for the 23 paired tows conducted aboard the FV Darana R was 774 kg for the NMFS flounder TED trawl and 824 kg for the northeast modified TED trawl. The catch ratio of the northeast modified TED to the NMFS flounder TED was 1.11. The results of the T-test indicate no significant difference between the catch performance of the two TEDs (p=0.056). The mean non target catch weight per tow for the 19 paired tows conducted aboard the FV Excalibur was 1272 kg for the NMFS flounder TED trawl and 1292 kg for the northeast modified TED trawl. The catch ratio of the northeast modified TED to the NMFS flounder TED was 1.03. The results of the T-test indicate no significant difference between the catch performance of the two TEDs (p=0.869). The mean non-target catch weight per tow for the combined 42 paired tows conducted aboard both vessels was 983 kg for the NMFS flounder TED trawl and 1035 kg for the northeast modified TED trawl. The catch ratio of the northeast modified TED to the NMFS flounder TED was 1.05. The results of the T-test indicate no significant difference between the catch performance of the two TEDs (p=0.363).

The mean skate complex catch weight per tow for the 23 paired tows conducted aboard the FV Darana R was 595 kg for the NMFS flounder TED trawl and 623 kg for the northeast modified

TED trawl. The catch ratio of the northeast modified TED to the NMFS flounder TED was 1.05. The results of the T-test indicate no significant difference between the catch performance of the two TEDs (p=0.499). The mean skate complex catch weight per tow for the 19 paired tows conducted aboard the FV Excalibur was 872 kg for the NMFS flounder TED trawl and 894 kg for the northeast modified TED trawl. The catch ratio of the northeast modified TED to the NMFS flounder TED was 1.03. The results of the T-test indicate no significant difference between the catch performance of the two TEDs (p=0.701). The mean skate complex catch weight per tow for the combined 42 paired tows conducted aboard both vessels was 872 kg for the NMFS flounder TED trawl and 894 kg for the northeast modified TED trawl. The catch ratio of the northeast modified TED to the NMFS flounder TED was 1.03. The results of the T-test indicate no significant difference between the catch performance of the two TEDs (p=0.701).

The mean dogfish catch weight per tow for the 23 paired tows conducted aboard the FV Darana R was 75 kg for the NMFS flounder TED trawl and 110 kg for the northeast modified TED trawl. The catch ratio of the northeast modified TED to the NMFS flounder TED was 1.46. The results of the T-test indicate no significant difference between the catch performance of the two TEDs (p=0.184). The mean dogfish complex catch weight per tow for the 19 paired tows conducted aboard the FV Excalibur was 15 kg for the NMFS flounder TED trawl and 14 kg for the northeast modified TED trawl. The catch ratio of the northeast modified TED to the NMFS flounder TED was 0.93. The results of the T-test indicate no significant difference between the catch performance of the two TEDs (p=0.783). The mean dogfish complex catch weight per tow for the combined 42 paired tows conducted aboard both vessels was 48 kg for the NMFS flounder TED trawl and 66 kg for the northeast modified TED trawl. The catch ratio of the northeast modified TED to the NMFS flounder TED was 1.39. The results of the T-test indicate no significant difference between the catch performance of the two TEDs (p=0.194).

The performance of a TED was also evaluated with regard to effect of the grid design on the length distribution of the catch for the target species, and species with a similar geometric morphology to the target species. In this study, more than 10,000 summer flounder were measured for total length. Length frequency distributions for both NMFS flounder TED and northeast modified TED caught summer flounder from all paired tows are depicted in Figure 6.

The shapes of the two distributions are nearly identical. A K-S test indicated no statistically significant difference between the two distributions.

DISCUSSION

The results of this study were an important step in our search for a sea turtle bycatch reduction device that will reduce sea turtle interactions with trawls, but not affect the catch of the target species. The project was a true collaboration between academia, NMFS and the fishing industry. The northeast modified TED was designed based on ideas from academia, the fishing industry and NMFS. It was tested with fishing industry, academia and NMFS participation at the flume tank in Newfoundland with NMFS support. The northeast modified TED was evaluated for releasing small turtles and was certified in 2008 after the bar spacing was reduced to 10 cm (4 in). Finally, this project, funded by the Commercial Fisheries Research Foundation and conducted in summer of 2009, allowed for a field evaluation of the catch performance of the northeast modified TED with larger bar spacing as compared to the NMFS flounder TED.

Unfortunately, the northeast modified TED did not significantly improve the catch retention of the target species as compared to the NMFS flounder TED. The NMFS flounder TED experienced a 35% loss of summer flounder in the 2007 study, and much of the loss is speculated to be related to the clogging of the TED with skates and rays. The summer flounder trawl fishery as conducted in the mid-Atlantic from the south shore of Long Island to the Virginia Capes is a high bycatch fishery. Summer flounder represents only a small portion of the catch (about 10% on average); while the major portion of the catch is skates, rays, and dogfish, and these species clogged both the NMFS certified TED and the northeast modifies TED at high catch rates. The previous study also documented a loss of bycatch equivalent to the loss of summer flounder with the NMFS TED. In summary, this study found essentially no difference between the catch performance of the NMFS flounder TED and the northeast modified TED for summer flounder, total catch, non-target bycatch, the skate complex, and the dogfish complex. While there were small differences between the catch rates of the FV Darana R and the FV Excalibur for the different categories tested, there were no statistically significant differences between the catch rates.

So, while the results of the study were disappointing, they have been used by NMFS, to determine that research must continue into alternative methods to reduce sea turtle interactions with the summer flounder trawl fishery, and at perhaps there are other technological strategies that may provide the desired results in lieu of a grid. In the summer 2010 we evaluated a topless trawl and comparing the catch performance of that trawl to an identical traditional trawl. The topless trawl has no square section and the upper belly is cut back, so essentially the sweep leads the headrope, rather than the headrope leading the sweep. Preliminary analyses of the results of this evaluation indicate that the topless trawl catches summer flounder at the same rate as the traditional trawl. The next step is to certify that the topless trawl will not catch sea turtles.

SUMMARY OF CONCLUSIONS

- .The results of this study found essentially no difference between the catch performance of the NMFS certified flounder TED and the northeast modified TED for summer flounder, total catch, non-target bycatch, the skate complex, and the dogfish complex.
- It is believed that both TEDs suffer from clogging of the grate with larger fish, therefore expelling both water and catch out the opening of the TED extension section. The northeast modiefies TED with its larger surface area and reduced angle of attack did not reduce the clogging effect as we had hoped.

ACKNOWLEDGEMENTS

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LITERATURE CITED

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Table 1. Tow start locations for FV Darana R and FV Excalibur expressed in degrees. minutes. hundredths of minute.

FV Darana R

Date	Tow No.	Latitude	Longitude
22-Jun-09	1	37.50.35	75.09.27
22-Jun-09	2	37.50.23	75.09.62
22-Jun-09	3	37.52.59	75.08.90
22-Jun-09	4	37.51.49	75.09.71
22-Jun-09	5	37.48.86	75.12.75
22-Jun-09	6	37.51.53	75.09.61
23-Jun-09	1	38.05.26	75.04.54
23-Jun-09	2	38.05.26	75.04.54
23-Jun-09	3	38.09.64	75.04.52
23-Jun-09	4	38.10.92	75.04.05
24-Jun-09	1	38.49.70	74.44.17
24-Jun-09	2	38.47.66	74.45.35
25-Jun-09	1	40.35.63	73.10.16
25-Jun-09	2	40.36.80	73.07.18
25-Jun-09	3	40.36.26	73.07.80
25-Jun-09	4	40.36.39	73.01.86
25-Jun-09	5	40.36.64	73.08.25
25-Jun-09	6	40.36.51	73.03.12
26-Jun-09	1	40.37.87	72.59.90
26-Jun-09	2	40.40.14	72.58.28
26-Jun-09	3	40.36.77	73.01.34
26-Jun-09	4	40.37.92	73.05.14
26-Jun-09	5	40.36.96	73.00.01
26-Jun-09	6	40.39.65	72.58.18
26-Jun-09	7	40.37.45	73.60.65
26-Jun-09	8	40.40.15	72.56.37
27-Jun-09	1	40.38.90	73.00.41
27-Jun-09	2	40.40.84	72.57.95
27-Jun-09	3	40.37.52	73.00.71
27-Jun-09	4	40.35.78	73.06.06
27-Jun-09	5	40.37.09	72.59.69
27-Jun-09	6	40.39.30	72.55.29
28-Jun-09	1	40.40.10	72.55.00
28-Jun-09	2	40.37.69	73.00.45
29-Jun-09	1	40.56.75	72.04.43
29-Jun-09	2	40.54.83	72.09.72
29-Jun-09	3	41.06.34	71.57.11
29-Jun-09	4	41.04.83	72.01.00
30-Jun-09	1	40.43.91	72.45.58
30-Jun-09	2	40.42.37	72.50.51
30-Jun-09	3	40.43.17	72.48.46
30-Jun-09	4	40.41.27	72.53.45
30-Jun-09	5	40.43.22	72.47.45
30-Jun-09	6	40.41.79	72.51.11
1-Jul-09	1	40.40.98	72.53.64
1-Jul-09	2	40.39.21	72.58.00

FV Excalibur

Date	Tow No.	Latitude	Longitude
9-Jul-09	1	41.01.35	71.54.36
9-Jul-09	2	41.01.45	71.54.31
10-Jul-09	1	40.46.88	72.34.00
10-Jul-09	2	40.46.84	72.34.13
10-Jul-09	3	40.54.21	72.13.15
10-Jul-09	4	40.54.34	72.13.09
11-Jul-09	1	41.00.08	71.58.10
11-Jul-09	2	41.01.21	71.54.21
12-Jul-09	1	41.11.18	70.06.22
12-Jul-09	2	41.11.23	70.06.25
12-Jul-09	3	41.11.95	70.08.78
12-Jul-09	4	41.12.02	70.08.99
13-Jul-09	1	41.01.26	71.54.50
13-Jul-09	2	41.01.51	71.54.31
13-Jul-09	3	40.57.90	72.00.90
13-Jul-09	4	40.59.57	71.56.70
13-Jul-09	5	40.59.36	72.00.10
13-Jul-09	6	41.01.13	71.55.32
15-Jul-09	1	40.59.40	71.56.84
15-Jul-09	2	40.57.60	72.02.39
15-Jul-09	3	40.59.38	71.56.56
15-Jul-09	4	40.57.53	72.01.72
16-Jul-09	1	40.59.52	71.56.88
16-Jul-09	2	40.57.29	72.03.15
16-Jul-09	3	40.59.86	71.56.21
16-Jul-09	4	40.58.20	72.01.51
17-Jul-09	1	40.55.82	72.05.70
17-Jul-09	2	40.54.26	72.09.78
17-Jul-09	3	40.56.92	72.06.80
17-Jul-09	4	40.55.05	72.11.00
17-Jul-09	5	40.45.82	72.25.30
17-Jul-09	6	40.43.60	72.28.96
17-Jul-09	7	40.44.62	72.23.95
17-Jul-09	8	40.41.60	72.25.00
18-Jul-09	1	40.41.49	72.49.73
18-Jul-09	2	40.42.62	72.45.86
18-Jul-09	3	40.40.37	72.56.86
18-Jul-09	4	40.38.39	72.59.70

Table 2. Total catch weight (kg) by date and tow number for tows with the NMFS flounder TED and the northeast modified TED for the FV Darana R (22 June 2009 – 1 July 2009) and FV Excalibur (9 July 2009 – 18 July 2009).

Date	Tow no.	NMFS TED	Tow no.	MOD TED
22-Jun-09	2	171	1	181
22-Jun-09	3	311	4	315
22-Jun-09	6	316	5	260
23-Jun-09	1	1085	2	860
23-Jun-09	4	1501	3	2080
24-Jun-09	1	334	2	474
25-Jun-09	2	977	1	960
25-Jun-09	3	1048	4	1355
25-Jun-09	6	1308	5	1474
26-Jun-09	1	903	2	1041
26-Jun-09	4	665	3	869
26-Jun-09	5	771	6	808
26-Jun-09	8	1271	7	1153
27-Jun-09	1	741	2	675
27-Jun-09	4	751	3	696
27-Jun-09	5	1064	6	1198
28-Jun-09	2	1570	1	1270
29-Jun-09	1	1470	2	1388
29-Jun-09	4	1102	3	1164
30-Jun-09	1	655	2	967
30-Jun-09	4	637	3	824
30-Jun-09	5	1001	6	1003
1-Jul-09	2	656	1	1106
9-Jul-09	1	1295	2	2696
10-Jul-09	2	405	1	469
10-Jul-09	3	715	4	730
11-Jul-09	2	780	1	887
12-Jul-09	1	1016	2	1348
12-Jul-09	4	636	3	656
13-Jul-09	1	2218	2	2254
13-Jul-09	4	1071	3	1601
13-Jul-09	5	3076	6	1761
15-Jul-09	2	2787	1	2596
15-Jul-09	3	3037	4	2794
16-Jul-09	2	2652	1	2152
16-Jul-09	3	2009	4	1604
17-Jul-09	2	1033	1	1730
17-Jul-09	3	1130	4	1235
17-Jul-09	6	569	5	638
17-Jul-09	7	772	8	653
18-Jul-09	2	550	1	882
18-Jul-09	3	811	4	851

Table 3. Summer flounder catch weight (kg) by date and tow number for tows with the NMFS flounder TED and the northeast modified TED for the FV Darana R (22 June 2009 – 1 July 2009) and FV Excalibur (9 July 2009 – 18 July 2009).

Date	Tow No.	NMFS TED	Tow No.	MOD TED
22-Jun-09	2	7	1	11
22-Jun-09	3	22	4	23
22-Jun-09	6	11	5	24
23-Jun-09	1	23	2	25
23-Jun-09	4	32	3	30
24-Jun-09	1	14	2	19
25-Jun-09	2	126	1	135
25-Jun-09	3	230	4	224
25-Jun-09	6	174	5	216
26-Jun-09	1	174	2	188
26-Jun-09	4	74	3	151
26-Jun-09	5	164	6	115
26-Jun-09	8	192	7	166
27-Jun-09	1	13	2	37
27-Jun-09	4	227	3	166
27-Jun-09	5	216	6	184
28-Jun-09	2	405	1	330
29-Jun-09	1	139	2	150
29-Jun-09	4	87	3	78
30-Jun-09	1	198	2	159
30-Jun-09	4	222	3	253
30-Jun-09	5	241	6	178
1-Jul-09	2	202	1	315
9-Jul-09	1	125	2	286
10-Jul-09	2	93	1	44
10-Jul-09	3	171	4	119
11-Jul-09	2	129	1	175
12-Jul-09	1	55	2	55
12-Jul-09	4	28	3	36
13-Jul-09	1	117	2	365
13-Jul-09	4	115	3	125
13-Jul-09	5	339	6	151
15-Jul-09	2	274	1	228
15-Jul-09	3	91	4	276
16-Jul-09	2	127	1	349
16-Jul-09	3	174	4	182
17-Jul-09	2	38	1	27
17-Jul-09	3	302	4	289
17-Jul-09	6	0	5	4
17-Jul-09	7	0	8	0
18-Jul-09	2	26	1	35
18-Jul-09	3	110	4	254

Table 4. Total non-target species catch weight (kg) by date and tow number for tows with the NMFS flounder TED and the northeast modified TED for the FV Darana R (22 June 2009 – 1 July 2009) and FV Excalibur (9 July 2009 – 18 July 2009).

Date	Tow No.	NMFS TED	Tow No.	MOD TED
22-Jun-09	2	164	1	170
22-Jun-09	3	289	4	291
22-Jun-09	6	305	5	236
23-Jun-09	1	1062	2	835
23-Jun-09	4	1469	3	2050
24-Jun-09	1	320	2	456
25-Jun-09	2	851	1	826
25-Jun-09	3	819	4	1131
25-Jun-09	6	1134	5	1258
26-Jun-09	1	729	2	854
26-Jun-09	4	591	3	718
26-Jun-09	5	608	6	694
26-Jun-09	8	1078	7	988
27-Jun-09	1	728	2	638
27-Jun-09	4	524	3	531
27-Jun-09	5	847	6	1013
28-Jun-09	2	1165	1	939
29-Jun-09	1	1331	2	1236
29-Jun-09	4	1015	3	1086
30-Jun-09	1	456	2	808
30-Jun-09	4	415	3	572
30-Jun-09	5	760	6	824
1-Jul-09	2	454	1	792
9-Jul-09	1	1170	2	2410
10-Jul-09	2	312	1	426
10-Jul-09	3	544	4	610
11-Jul-09	2	650	1	712
12-Jul-09	1	962	2	1293
12-Jul-09	4	607	3	621
13-Jul-09	1	2101	2	1889
13-Jul-09	4	956	3	1476
13-Jul-09	5	2737	6	1610
15-Jul-09	2	2513	1	2367
15-Jul-09	3	2946	4	2518
16-Jul-09	2	2525	1	1803
16-Jul-09	3	1834	4	1423
17-Jul-09	2	995	1	1703
17-Jul-09	3	828	4	945
17-Jul-09	6	569	5	635
17-Jul-09	7	772	8	653
18-Jul-09	2	523	1	847
18-Jul-09	3	621	4	598

Table 5. Skate complex catch weight (kg) by date and tow number for tows with the NMFS flounder TED and the northeast modified TED for the FV Darana R (22 June 2009 – 1 July 2009) and FV Excalibur (9 July 2009 – 18 July 2009).

Date	Tow No.	NMFS TED	Tow No.	MOD TED
22-Jun-09	2	155	1	144
22-Jun-09	3	239	4	260
22-Jun-09	6	262	5	175
23-Jun-09	1	937	2	714
23-Jun-09	4	1142	3	1641
24-Jun-09	1	268	2	356
25-Jun-09	2	584	1	653
25-Jun-09	3	620	4	467
25-Jun-09	6	822	5	1070
26-Jun-09	1	560	2	555
26-Jun-09	4	447	3	418
26-Jun-09	5	416	6	429
26-Jun-09	8	823	7	629
27-Jun-09	1	637	2	515
27-Jun-09	4	423	3	415
27-Jun-09	5	727	6	415
28-Jun-09	2	1058	1	821
29-Jun-09	1	958	2	1079
29-Jun-09	4	866	3	997
30-Jun-09	1	421	2	736
30-Jun-09	4	319	3	444
30-Jun-09	5	641	6	692
1-Jul-09	2	360	1	714
9-Jul-09	1	1083	2	2311
10-Jul-09	2	244	1	359
10-Jul-09	3	510	4	561
11-Jul-09	2	624	1	614
12-Jul-09	1	930	2	1193
12-Jul-09	4	554	3	539
13-Jul-09	1	2086	2	1874
13-Jul-09	4	818	3	1418
13-Jul-09	5	2703	6	1593
15-Jul-09	2	2469	1	2335
15-Jul-09	3	2891	4	2477
16-Jul-09	2	2475	1	1768
16-Jul-09	3	1777	4	1385
17-Jul-09	2	945	1	1635
17-Jul-09	3	796	4	914
17-Jul-09	6	433	5	523
17-Jul-09	7	525	8	442
18-Jul-09	2	485	1	809
18-Jul-09	3	573	4	439

Table 6. Dogfish complex catch weight (kg) by date and tow number for tows with the NMFS flounder TED and the northeast modified TED for the FV Darana R (22 June 2009 – 1 July 2009) and FV Excalibur (9 July 2009 – 18 July 2009).

Date	Tow No.	NMFS TED	Tow No.	MOD TED
22-Jun-09	2	0	1	0
22-Jun-09	3	0	4	0
22-Jun-09	6	0	5	0
23-Jun-09	1	0	2	0
23-Jun-09	4	0	3	0
24-Jun-09	1	0	2	12
25-Jun-09	2	193	1	99
25-Jun-09	3	130	4	586
25-Jun-09	6	190	5	76
26-Jun-09	1	103	2	223
26-Jun-09	4	115	3	231
26-Jun-09	5	155	6	226
26-Jun-09	8	206	7	305
27-Jun-09	1	39	2	93
27-Jun-09	4	41	3	78
27-Jun-09	5	91	6	253
28-Jun-09	2	4	1	40
29-Jun-09	1	338	2	133
29-Jun-09	4	13	3	0
30-Jun-09	1	0	2	30
30-Jun-09	4	42	3	77
30-Jun-09	5	39	6	50
1-Jul-09	2	35	1	21
9-Jul-09	1	70	2	45
10-Jul-09	2	0	1	3
10-Jul-09	3	0	4	4
11-Jul-09	2	0	1	0
12-Jul-09	1	7	2	60
12-Jul-09	4	14	3	18
13-Jul-09	1	3	2	0
13-Jul-09	4	49	3	30
13-Jul-09	5	0	6	0
15-Jul-09	2	3	1	6
15-Jul-09	3	23	4	11
16-Jul-09	2	26	1	2
16-Jul-09	3	14	4	5
17-Jul-09	2	42	1	50
17-Jul-09	3	22	4	13
17-Jul-09	6	2	5	0
17-Jul-09	7	0	8	0
18-Jul-09	2	0	1	0
18-Jul-09	3	7	4	15

Table 7. Summary of statistical T-tests for paired tows with the NMFS flounder TED and the northeast modified TED for the FV Darana R (22 June 2009 – 1 July 2009) and FV Excalibur (9 July 2009 – 18 July 2009).

Vessel	Catch	NMFS TED Mean CPT	MOD TED Mean CPT	Ratio MOD/NMFS	Sample size	T-test p value
FV Darana R	total catch	883	961	1.09	23	0.079
FV Darana R	summer flounder	149	138	0.99	23	0.927
FV Darana R	total non-target	774	824	1.11	23	0.056
FV Darana R	skate complex	595	623	1.05	23	0.499
FV Darana R	dogfish complex	75	110	1.46	23	0.184
FV Excalibur	total catch	1398	1449	1.04	19	0.682
FV Excalibur	summer flounder	122	158	1.30	19	0.165
FV Excalibur	total non-target	1272	1292	1.03	19	0.869
FV Excalibur	skate complex	1206	1220	1.01	19	0.906
FV Excalibur	dogfish complex	15	14	0.93	19	0.783
Combined	total catch	1116	1182	1.06	42	0.272
Combined	summer flounder	131	147	1.12	42	0.210
Combined	total non-target	983	1035	1.05	42	0.363
Combined	skate complex	872	894	1.03	42	0.701
Combined	dogfish complex	48	66	1.39	42	0.194

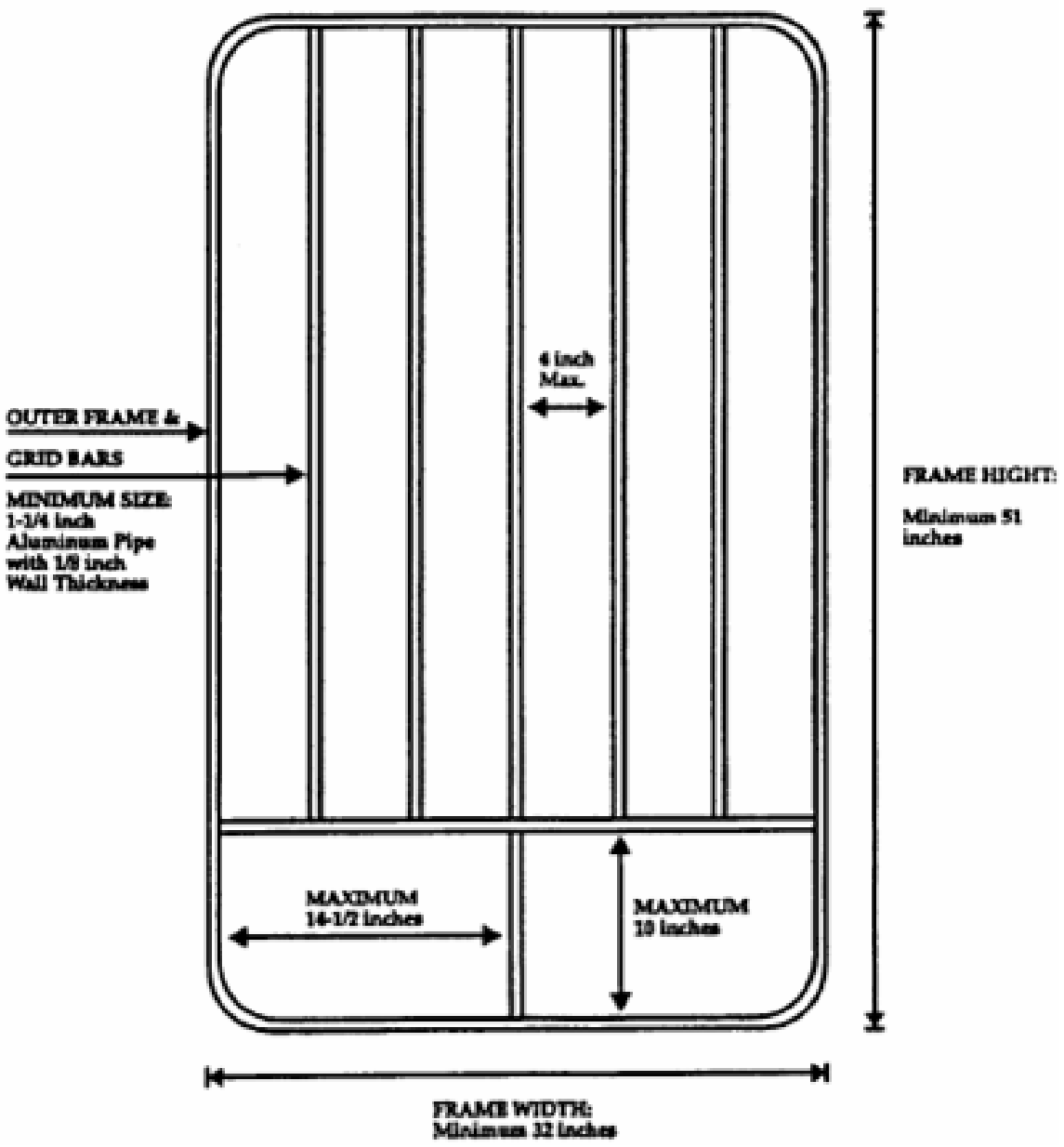

Figure 1. Diagram of the NMFS certified flounder TED evaluated in this study and in the 2007 study (Lawson et al. 2007).

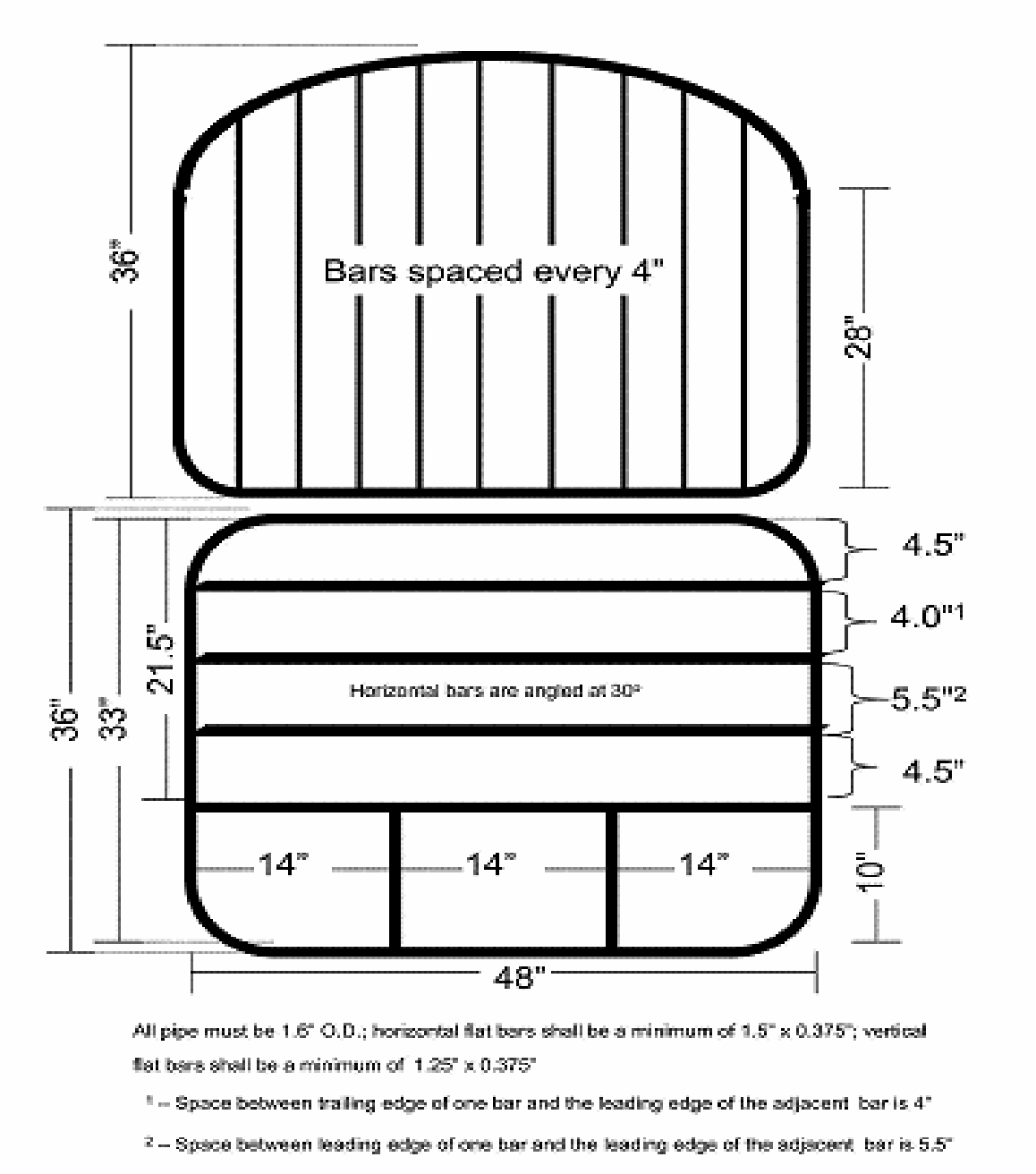

Figure 2. Diagram of the northeast modified TED that passed the small turtle certification with 4" bar spacing. Note that the design used in this field evaluation project used 15.2 cm (6 in) spacing between the vertical bars in the upper section at the request of NEFSC, NMFS. The prupose of the increased bar spacing was to minimize the likelihood of fish clogging.

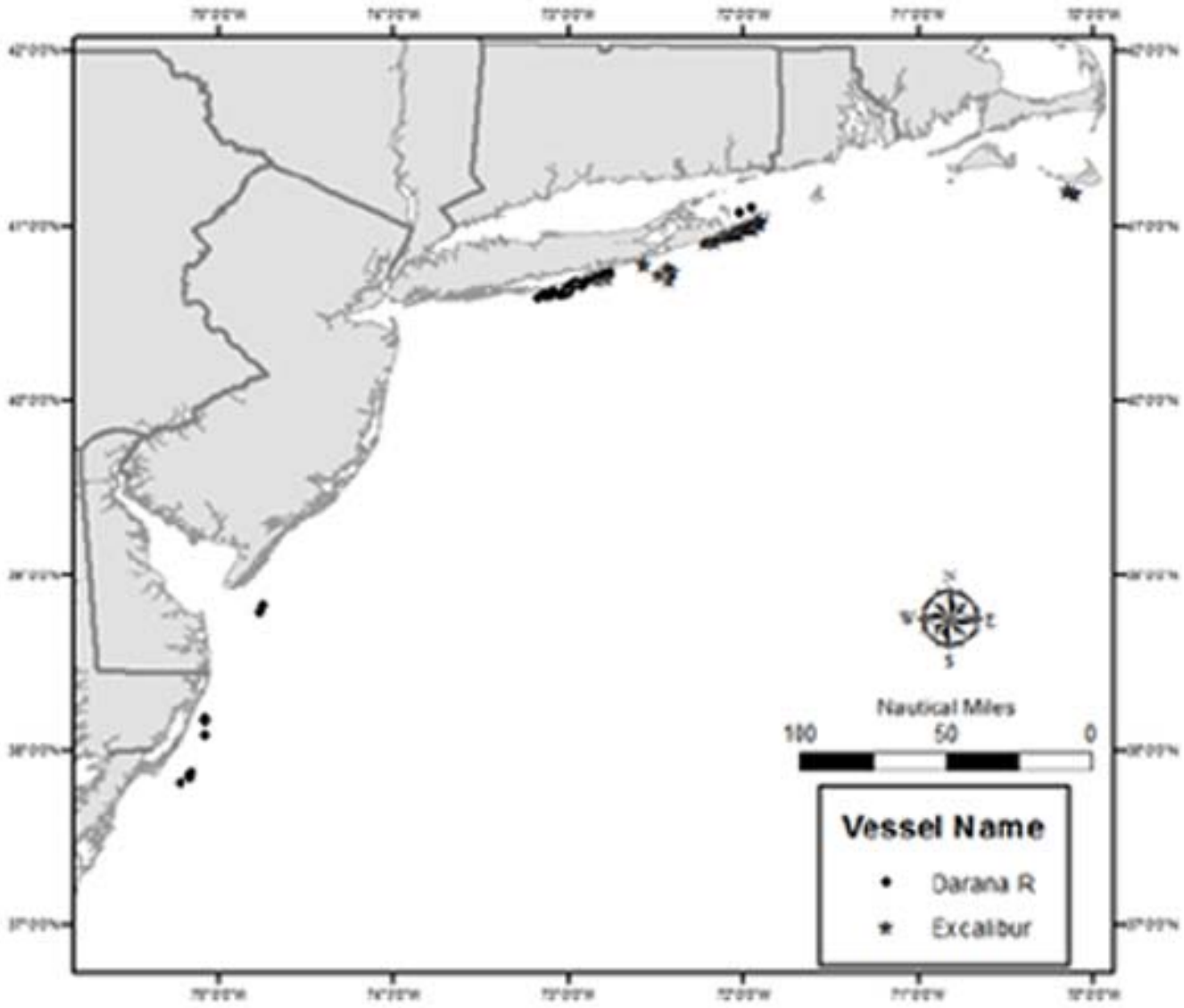

Figure 3. Location of starting positions for the tows conducted by the FV Darana R (22 June 2009 – 1 July 2009) and FV Excalibur (9 July 2009 – 18 July 2009).

Figure 4a. Photograph of the NMFS flounder TED being hauled back showing the clogging with skates and rays.

Figure 4b. Photograph of the northeast modified TED during haul-back.

Figure 5a. Photograph of the NMFS certified flounder TED showing the damage from being used.

Figure 5b. Photograph of the northeast modified TED showing damage from being used.

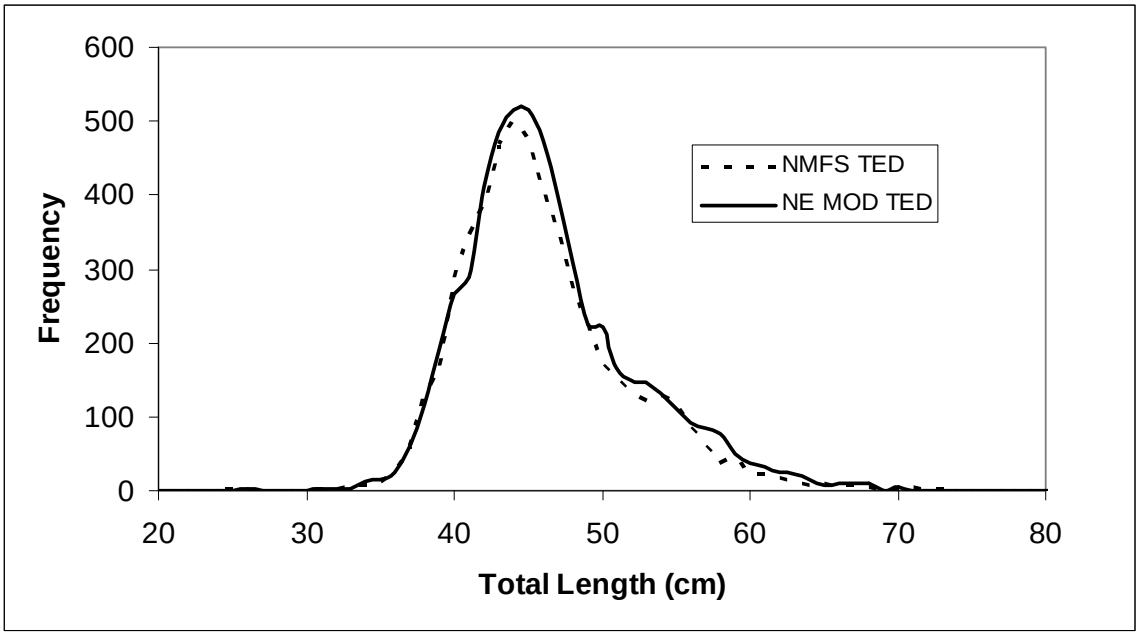

Figure 6. Length-frequency diagram of all measured summer flounder for all paired tows with the NMFS certified flounder TED and the northeast modified TED. Length measurement is fish total length and is expressed in centimeters.

APPENDICES:

The following appendices are attached as electronic files on a CD:

1. Folder of Excel files: Field data from the FV Darana R
2. Folder of EXCEL files: Field data from the FV Excalibur
3. Folder of EXCEL files: Summary data tables and all data analyses.
4. Folder of pictures from field work