EVALUATION OF THE CATCH PERFORMANCE OF THE NMFS FLOUNDER TURTLE EXCLUDER DEVICE (TED) WITH A LARGE OPENING IN THE SOUTHERN NEW ENGLAND WHITING TRAWL FISHERY

FINAL REPORT
Contract Number EA133F08CN0182

Submitted to

NOAA, NMFS, NEFSC
Protected Resources Branch
Woods Hole, Ma.

Submitted by

Joseph DeAlteris and Christopher Parkins
DeAlteris Associates Inc.
PO Box 251
Jamestown, RI 02835

2 December 2009

"Although released by NOAA, the information in this paper does not reflect, represent or form any part of the support of the policies of NOAA or the Department of Commerce. Further release by NOAA does not imply that NOAA or the Department of Commerce agrees with the information herein."

ABSTRACT

Previous studies of the catch performance of bottom trawls equipped with NMFS certified flounder TEDs in the mid-Atlantic region have documented losses of target species ranging from 35% in the summer flounder fishery (TED was 32x51 inches), (Lawson, DeAlteris and Parkins, 2007) to 7% in the sea scallop fishery (TED was 43x51 inches), (DeAlteris and Parkins, 2009). This study has documented a 22% loss of whiting or silver hake (*Merluccius bilinearis)* in the directed whiting trawl fishery, and this was a statistically significant loss based on 16 paired tows. Additionally, the study documented a loss of one of the dominant bycatch species groups, the flounder complex. The use of the TED resulted in a 27% loss of flounder catch, and this was a statistically significant loss of flounder. There was no significant effect on catch performance as a result of using the TED on the skate complex, the dogfish complex, and butterfish, however these latter species were not captured in sufficient number provide adequate data for a robust statistical analysis.

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 specifically in the Mid-Atlantic and southern New England regions, as well as other areas (72 FR 7382, February 15, 2007). NMFS has concerns about potential 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. More recently, NMFS has conducted scoping sessions to receive public input on mitigation measures to address sea turtle bycatch in trawl fisheries (FR Doc. E9-10674, May 8, 2009).

In January, 2007 Dr. DeAlteris was contracted by NMFS to conduct a workshop with fishing industry, and non-Governmental Organization (NGO) 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. In the summer of 2007, Dr. DeAlteris was contracted by NMFS to conduct some preliminary research evaluating the catch performance of the NMFS flounder TED (32x51 inches) with a turtle opening (36x16 inches) in the summer flounder trawl fishery. That study demonstrated that there was 35% loss of the targeted summer flounder, but that there was no difference in the size distribution of retained summer flounder (Lawson, DeAlteris and Parkins, 2007). Other recent studies of the catch performance of a NMFS certified whelk TED and a NMFS certified, larger flounder TED in the scallop trawl fishery have demonstrated a 7% loss of the target species in that fishery (Lawson and DeAlteris, 2006 and DeAlteris and Parkins, 2009)

The purpose of this report is to describe the results of an evaluation in 2009 of the performance of a 43x51 inch NMFS certified turtle excluder device (TED) with a large top opening and a single flap cover, required to release leatherback sea turtles, in the whiting or silver hake (*Merluccius bilinearis)* trawl fishery of the southern New England and the mid-Atlantic.

METHODS

The study was conducted during three trips late summer and early fall of 2009 using the alternate tow design. In this design the same trawl is alternatively rigged with either an extension section with a TED installed or a standard extension section. The NMFS flounder TED (Figure 1) is 43.4 x 51.0 inches in size, constructed of aluminum pipe around the perimeter, and is designed to have three windows or opening in the lower section that were 14.1x10.0 inches in size. The interior section of the TED was constructed of aluminum flat bars oriented vertically, and spaced to provide 4 inch openings. The TED was installed at 50^{o}, (the NMFS recommended angle of attack is 45-55^{o} for these TEDs) in an extension section constructed of double twine, braided polyethylene netting, 27 meshes in depth, and 100 meshes around. The mesh size in the TED extension section was 3.5 inches. The opening in the extension section above the TED was 41x28 inches (21x8 meshes), rectangular in shape and was designed to meet the large opening requirement, it was closed with small mesh (1.5 inch) single flap cover. The control extension section was identical to the TED section, but the aluminum grate was not installed, nor was there an opening in the section.

The FV Excalibur is owned and operated by Captain Joel Hovanesian, and is home ported in Point Judith, Rhode Island. The FV Excalibur is a 75-foot steel hull stern trawler, with 750 HP engine. The bottom trawl used on the FV Excalibur had 98-foot sweep, and had 2.4 inch (6 cm) stretched mesh codend. All tows were commercial length in duration, ranging from approximately 60 to 90 minutes in duration depending on the abundance of whiting in the fishing area, and all pairs of tows were of equal duration. Towing speed was approximately 3.0-3.2 knots. Most tows were conducted in the night as the whiting tended to aggregate on bottom making them more susceptible to a bottom trawl. If the vessel encountered a hang and the trawl was damaged, or the tow was hauled in early for any reason, catch data for the tow was not collected, and the tow was repeated. Additionally, some short tows were made searching for the presence of whiting in the catch, and no catch data was collected for these tows. Hence, only good tows are included in the analysis, as these as pairs of tows where whiting was captured in commercial quantities.

At the end of each tow, the cod-end of each trawl was dumped into a bin, and sorted by species. The entire whiting catch was weighed in baskets, and a sub-sample of the whiting catch was measured for total length to the next largest cm. All other finfish catch was weighed and measured when possible. Observations were made of the condition of the TED, possible blockage of the TED, and condition of the trawl and cod-end. Digital still pictures were taken of the fishing operations, and underwater video was attempted during daylight when possible.

The data were analyzed by first comparing the paired whiting catch weights in the TED and the control trawls for each set of tows in each leg of the study using a paired T-test calculated using Microsoft Excel. The null hypothesis was no difference in the catch weights, and this was evaluated at $\alpha=0.05$ in a one tailed comparison, assuming that the TED equipped net would only catch **an equal or less** weight of scallops. Then, the mean ratio of the weight of the whiting catch in the TED equipped trawl to the whiting catch in the control trawl for each pair was estimated, and evaluated using descriptive statistics in Excel to determine if it was significantly different from 1 at $\alpha=0.05$. The null hypothesis was that if there was no difference between the whiting catch rates, the ratio would be 1. The value of the ratio test is that it is not unduly influenced by pairs of tows with large catches and hence potentially large differences between the experimental and the control nets, as compared to other pairs of tows with small catches and small differences. The paired T-test provides more weight to large differences than to small differences, whereas the ratio test essentially normalizes the differences by making a ratio of catch weights for the experimental to the control. The length-frequency (LF) distributions of the whiting catches in the TED and control trawls were evaluated using a Kolmorgov-Smirnoff test on the cumulative L-F distributions with α=0.05. The null hypothesis was that there was no significant difference in the L-F distributions. Finally, the total catch weights and catch weights of dominant bycatch in the tows were also evaluated. A paired T-test was implemented in Excel at α=0.05. The null hypothesis was that there is no difference between the total catch weights nor in the catch weights of skate, all flounders, dogfish and butterfish in the TED equipped trawl as compared to the control trawl.

RESULTS

Field Observations

A total of three trips were completed, resulting in 32 good tows, (16 pairs of tows) available for statistical analysis. The first trip of the study was 3 days in duration and was conducted between 11 and 13 August 2009. A total of 12 good tows were completed. The second trip of the study was 4 days in duration and was conducted between 13 and 16 August 2009. A total of good 12 tows were completed. The third trip of the study was 2 days in duration and was conducted between 25 and 26 August 2009. A total of 8 good tows were completed. All tows were conducted in an area south of Martha's Vineyard in Statistical Area 537. The locations of all tows are shown in Figure 2, and listed in Table 1.

At sea observations noted that catches of the whiting directed tows were variable with respect to the percentage of bycatch species. Catches of some tows were primarily whiting (Figure 3), while catches of other tows were mixed with whiting, dogfish, skates, and flounders (Figure 4). Both the control and TED-equipped tows experienced clean and mixed species catches. During the study the trawl net did not encounter any large schools of dogfish or large rays that could potentially clog the TED. We were unsuccessful in obtaining any underwater video observations of fish behavior around the TED due to poor water clarity.

Data Analysis

The whiting catch weights are listed in Table 2. The mean catch per tow of whiting in the control trawl was 683 kg, while the mean catch per tow of whiting in the TED equipped trawl was 484 kg. The results of the paired T-test for whiting catch weights indicated a significant difference in whiting catch between the TED equipped trawl and the control trawl. On average the TED equipped trawl caught 78% of the whiting weight of the control trawl, representing a 22% loss in whiting. The mean of the catch weight ratios for whiting was significantly different from 1. The length-frequency distribution of the whiting catches between the TED equipped trawl and the control trawl are shown in Figure 5. Visual examination of the L-F plots for the whiting catches indicates a small difference in the mode of the distributions, with the TED equipped trawl catching smaller whiting and conversely the control trawl without the TED catching larger whiting;

however the results of the K-S test indicated no significant difference in the L-F distributions.

The total catch weights for trips 1-3 are listed in Table 3. The mean total catch in the control trawl was 957 kg per tow, while the mean total catch in the TED equipped trawl was 753 kg per tow. The results of the paired T-test for total catch weights indicated a significant difference in total catch between the TED equipped trawl and the control trawl. On average the TED equipped trawl caught 78% of the total catch weight of the control trawl, representing a 22% loss in total catch (note that this is an identical loss to the whiting catch loss). Total bycatch in the whiting trawl nets included shell, sponge, crabs, starfish, skate, flounder, dogfish, butterfish, and other finfish, and amounted to 35% of the total catch for the control trawl and 34% for the TED equipped trawl, essentially both trawls had the same bycatch rate. The dominant fish bycatch included the skate complex and the flounder complex. The skate complex included winter skate and clear nose skate. The skate catch weights for trips 1-3 are listed in Table 4. The skate complex had a mean catch weight of 49.9 kg per tow for the TED equipped trawl and 51.1% for the control trawl, or about 5-7% of the total catch weight. The results of the paired T-test for skate catch weights indicated no significant difference in skate catch between the TED equipped trawl and the control trawl. The flounder catch weights for trips 1-3 are listed in Table 5.The flounder complex included yellowtail flounder, summer flounder, winter flounder, four-spot flounder, and Gulf Stream flounder. The mean catch weight of flounder was 98 kg per tow in the control trawl, and 71 kg per tow in the TED equipped trawl, or about 10% of the total catch weight. There was a significant difference in the mean catch weight per tow of flounder between the TED equipped trawl and the control trawl, with the TED equipped trawl catching about 73% of the flounder of the control trawl, or a 27% loss of flounder catch in the TED equipped trawl. The dogfish catch weights for trips 1-3 are listed in Table 6. The dogfish complex included spiny and smooth dogfish. The mean catch weight of dogfish was 14 kg per tow in the control trawl, and 15 kg per tow in the TED equipped trawl, or about 2% of the total catch weight. There was no significant difference in the mean catch weight per tow of dogfish. Butterfish were captured in significant quantities in several, but not all tows. Butterfish catch weights for trips 1-3 are listed in Table 7. The mean catch weight of butterfish in those tows that captured butterfish was 34 kg per tow in the control trawl, and 40 kg per tow in the TED equipped trawl. There was no significant difference in the mean catch weight per tow of butterfish between the TED equipped trawl and the control trawl.

DISCUSSION AND CONCLUSIONS

Previous studies of the catch performance of bottom trawls equipped with NMFS certified flounder TEDs in the mid-Atlantic region have documented losses of target species ranging from 35% in the summer flounder fishery (Lawson, DeAlteris and Parkins, 2007) to 7% in the sea scallop fishery (DeAlteris and Parkins, 2009). This study has documented a 22% loss of whiting in the direct whiting trawl fishery, and this was a statistically significant loss based on 16 paired tows. Additionally, the study documented a loss in one of the dominant bycatch species groups, the flounder complex. The use of the TED resulted in the 27% loss of flounder catch, and this was a statistically significant loss of flounder. There was no effect on catch performance as a result of using the TED on the skate complex, the dogfish complex, and butterfish, however these latter species were not likely captured in sufficient number, consistently to provide an adequate data for a robust statistical analysis. It should be noted that these are from a single vessel fishing in a single area, and TED performance could vary in on other vessels, in other areas, or in other times of the year.

Based on our experience, we believe that the loss of whiting and flounder due to the TED will result in increased effort to makeup for the loss, thus resulting in economic losses to the fishing industry and increased ecosystem impacts of trawling including habitat impact and bycatch species losses. The results of this study indicate the need for additional research on improving the catch efficiency of TEDs on target species in temperate water trawl fisheries.

LITERATURE CITED

Anonymous, 2007, Announcement of Proposed Rulemaking (ANPR), 72 FR 7382, February 15, 200772 FR 7382, February 15, 2007

Anonymous, 2009, Notice of Intent to prepare an EIS and conduct Scoping Hearings. FR Doc. E9-10674, May 8, 2009

DeAlteris and Parkins. 2009. Evaluation of the catch performance of the NMFS certified flounder TED with a large opening in the mid-Atlantic scallop trawl fishery. [Draft Final Report, 16p.] NOAA Contract No. EA133F08CN0182

Lawson and DeAlteris. 2006. Evaluation of a turtle excluder device (TED) in the scallop trawl fishery of the mid-Atlantic. [Final report; 145 p] NOAA Contract No. EA133F-05-SE6561

Lawson, DeAlteris and Parkins. 2007. An evaluation of the catch efficiency of the NMFS certified, standard Turtle Excluder Device (TED) required in the Mid-Atlantic summer flounder fishery. [Summary report; 26 p + appendix] NOAA Contract No. EA133F-05-SE-6561.

Figure 1. A diagram of the NMFS flounder TED, showing all dimensions in inches.

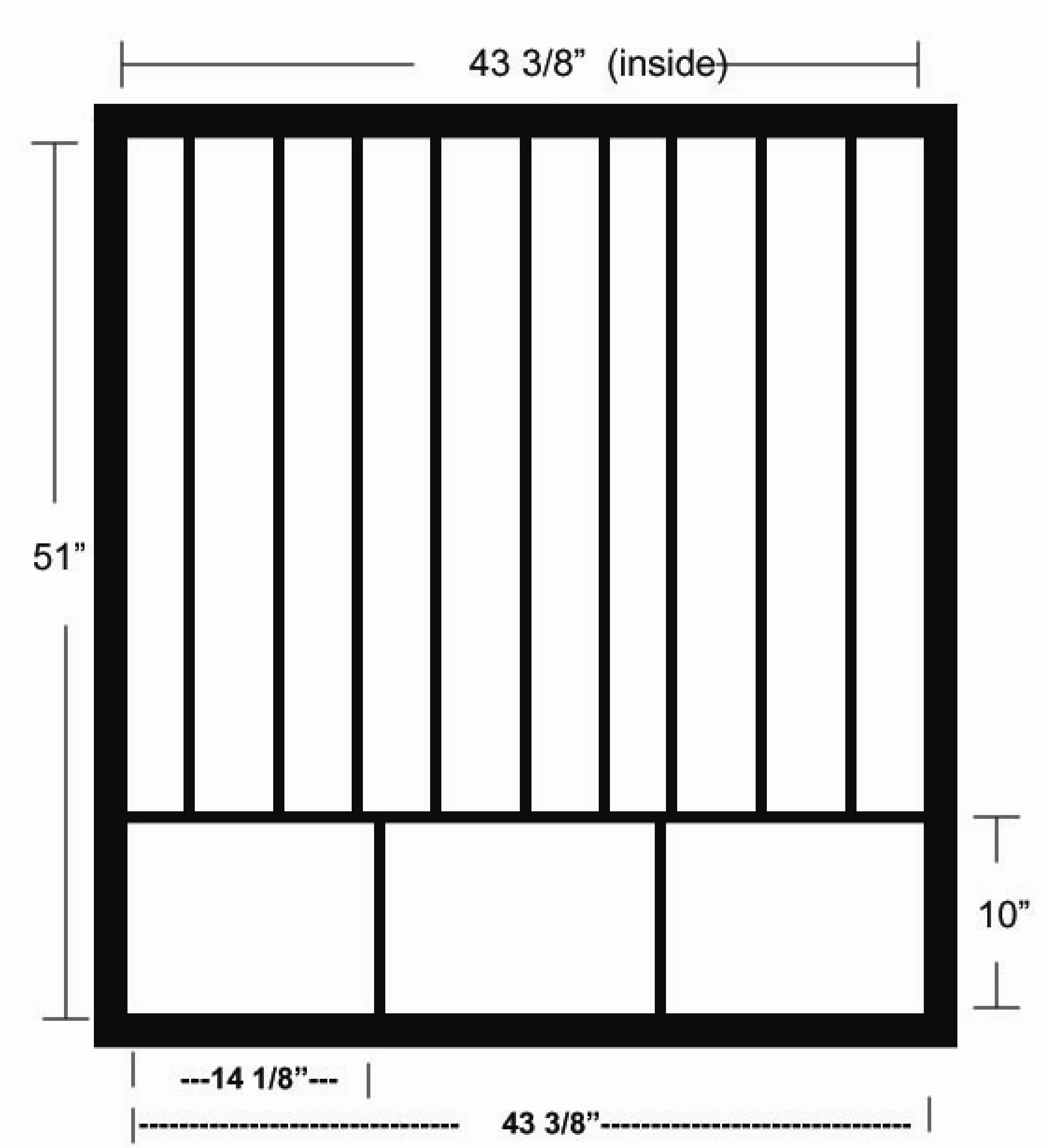

Figure 2. Chart showing the locations of the starting points (black dots) of all tows conducted during trips 1, 2 and 3 of this study.

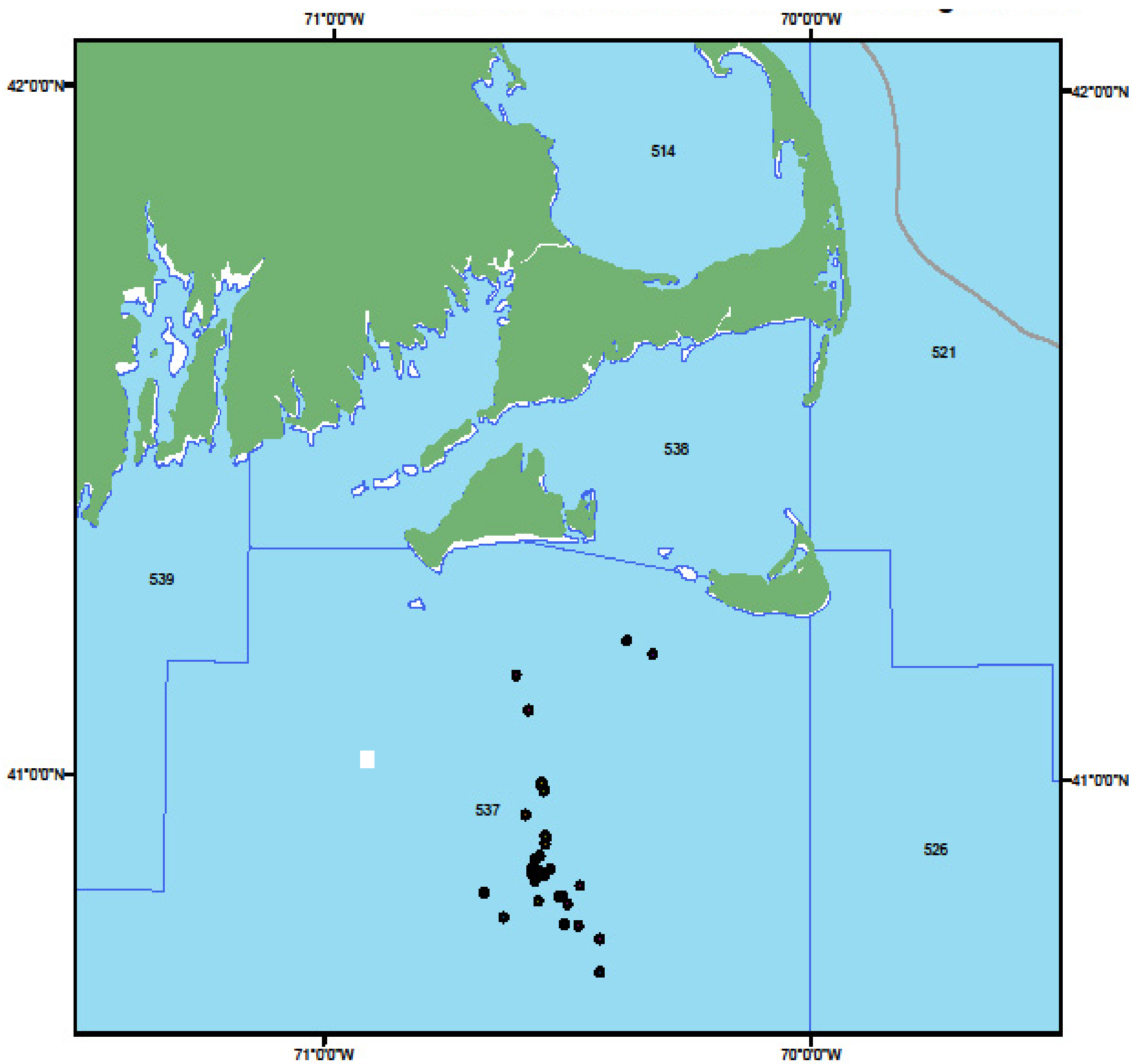

Figure 3. Photograph of the catch of a whiting tow that has minimal bycatch of butterfish and other species.

Figure 4. Photograph of the catch of a whiting tow that has a large bycatch of other species including dogfish and flounders.

Figure 5. Length-frequency distribution for whiting for the entire study. Lengths are in cm, and are total lengths. Note the shift toward larger fish in the mode of the distribution for the control trawl.

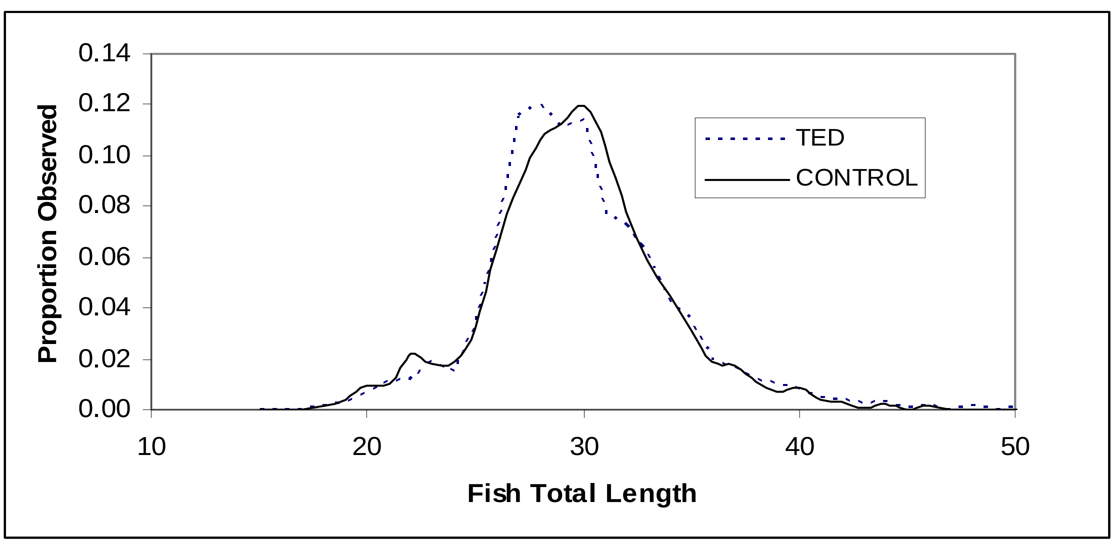

Table 1. Latitude and longitude (degrees. minutes. hundredths of a minute) of the starting locations of all experimental tows in trips 1, 2 and 3.

Date:	Haul Number:	Lat (deg.min.hund):	Long (deg.min.hund):
11-12 -Aug-09	1	40.50.51	70.27.92
11-12-Aug-09	2	40.46.12	70.26.05
11-12-Aug-09	3	40.49.15	70.30.04
11-12-Aug-09	4	40.53.10	70.33.63
11-12-Aug-09	5	40.47.21	70.28.42
11-12-Aug-09	6	40.43.19	70.25.63
11-12-Aug-09	7	40.49.54	70.30.69
11-12-Aug-09	8	40.51.53	70.34.34
12-13-Aug-09	1	40.48.02	70.37.57
12-13-Aug-09	2	40.51.69	70.33.38
12-13-Aug-09	3	40.49.53	70.30.37
12-13-Aug-09	4	40.53.89	70.32.51
14-15-Aug-09	1	41.10.62	70.19.36
14-15-Aug-09	2	41.12.11	70.22.51
14-15-Aug-09	3	40.51.43	70.32.54
14-15-Aug-09	4	40.46.89	70.29.85
14-15-Aug-09	5	40.52.85	70.33.31
14-15-Aug-09	6	40.48.90	70.31.43
15-16-Aug-09	1	40.58.63	70.32.64
15-16-Aug-09	2	40.54.61	70.32.40
15-16-Aug-09	3	40.54.69	70.32.52
16-16-Aug-09	4	40.59.48	70.32.80
15-16-Aug-09	5	40.54.70	70.32.53
15-16-Aug-09	6	40.51.76	70.32.13
25-26-Aug-09	1	40.55.68	70.36.36
25-26-Aug-09	2	40.51.65	70.34.64
25-26-Aug-09	3	40.50.74	70.33.69
25-26-Aug-09	4	40.50.11	70.39.81
26-Aug-09	1	40.51.84	70.34.28
26-Aug-09	2	40.56.59	70.35.19
26-Aug-09	3	40.58.97	70.32.88
26-Aug-09	4	40.59.12	70.33.01

Table 2. Whiting catch weights for trips 1-3 of the study. Catch weights are in kilograms. Ratio T/C is ratio of TED catch weight to Control catch weight.

Trip	Date	haul #	TED	haul #	Control	Paired ratio (T/C)
1	11-12-Aug-09	2	146	1	347	0.42
1	11-12-Aug-09	3	417	4	825	0.51
1	11-12 Aug 09	6	317	5	596	0.53
1	11-12-Aug-09	7	478	8	800	0.60
1	12-13-Aug-09	2	281	1	412	0.68
1	12-13-Aug-09	3	845	4	642	1.32
2	14-15-Aug-09	3	638	4	973	0.66
2	14-15-Aug-09	6	743	5	881	0.84
2	15-16-Aug-09	1	521	2	566	0.92
2	15-16 Aug 09	4	1108	3	1193	0.93
2	15-16-Aug-09	5	979	6	985	0.99
3	25-26-Aug-09	2	275	1	374	0.74
3	25-26-Aug-09	3	224	4	232	0.97
3	26-Aug-09	2	75	1	219	0.34
3	26-Aug-09	3	216	4	344	0.63

Table 3. Total catch weights for trips 1-3 of the study. Catch weights are in kilograms. Ratio T/C is ratio of TED catch weight to Control catch weight.

Trip	Date	haul #	TED	haul #	Control	Paired ratio (T/C)
1	11-12-Aug-09	2	364	1	647	0.56
1	11-12-Aug-09	3	685	4	1172	0.58
1	11-12 Aug 09	6	615	5	995	0.62
1	11-12-Aug-09	7	704	8	1124	0.63
1	12-13-Aug-09	2	665	1	852	0.78
1	12-13-Aug-09	3	1196	4	1079	1.11
2	14-15-Aug-09	3	1014	4	1569	0.65
2	14-15-Aug-09	6	973	5	1167	0.83
2	15-16-Aug-09	1	681	2	715	0.95
2	15-16 Aug 09	4	1392	3	1555	0.90
2	15-16-Aug-09	5	1117	6	1258	0.89
3	25-26-Aug-09	2	529	1	629	0.84
3	25-26-Aug-09	3	563	4	557	1.01
3	26-Aug-09	2	165	1	374	0.44
3	26-Aug-09	3	629	4	655	0.96

Table 4. Skate catch weights for trips 1-3 of the study. Catch weights are in kilograms. Ratio T/C is ratio of TED catch weight to Control catch weight.

Trip	Date	haul #	TED	haul #	Control	Paired ratio (T/C)
1	11-12-Aug-09	2	6	1	13	0.46
1	11-12-Aug-09	3	2	4	11	0.18
1	11-12 Aug 09	6	63	5	52	1.21
1	11-12-Aug-09	7	26	8	23	1.13
1	12-13-Aug-09	2	56	1	64	0.88
1	12-13-Aug-09	3	63	4	113	0.56
2	14-15-Aug-09	3	19	4	47	0.40
2	14-15-Aug-09	6	14	5	24	0.58
2	15-16-Aug-09	1	2	2	1	2.00
2	15-16 Aug 09	4	51	3	117	0.44
2	15-16-Aug-09	5	12	6	14	0.86
3	25-26-Aug-09	2	104	1	104	1.00
3	25-26-Aug-09	3	68	4	62	1.10
3	26-Aug-09	2	3	1	5	0.60
3	26-Aug-09	3	259	4	117	2.21

Table 5. Flounder catch weights for trips 1-3 of the study. Catch weights are in kilograms. Ratio T/C is ratio of TED catch weight to Control catch weight.

Trip	Date	haul #	TED	haul #	Control	Paired ratio (T/C)
1	11-12-Aug-09	2	0	1	4	0.00
1	11-12-Aug-09	3	10	4	80	0.13
1	11-12 Aug 09	6	99	5	141	0.70
1	11-12-Aug-09	7	75	8	45	1.67
1	12-13-Aug-09	2	184	1	230	0.80
1	12-13-Aug-09	3	125	4	104	1.20
2	14-15-Aug-09	3	123	4	261	0.47
2	14-15-Aug-09	6	60	5	83	0.72
2	15-16-Aug-09	1	2	2	4	0.50
2	15-16 Aug 09	4	62	3	161	0.39
2	15-16-Aug-09	5	74	6	35	2.11
3	25-26-Aug-09	2	45	1	71	0.63
3	25-26-Aug-09	3	168	4	169	0.99
3	26-Aug-09	2	0	1	0	
3	26-Aug-09	3	43	4	88	0.49

Table 6. Dogfish catch weights for trips 1-3 of the whiting trawl study. Catch weights are in kilograms. Ratio T/C is ratio of TED catch weight to Control catch weight.

Trip	Date	haul #	TED	haul #	Control	Paired ratio (T/C)
1	11-12-Aug-09	2	30	1	26	1.15
1	11-12-Aug-09	3	44	4	45	0.98
1	11-12 Aug 09	6	35	5	41	0.85
1	11-12-Aug-09	7	23	8	25	0.92
1	12-13-Aug-09	2	14	1	0	
1	12-13-Aug-09	3	11	4	16	0.69
2	14-15-Aug-09	3	8	4	11	0.73
2	14-15-Aug-09	6	7	5	0	
2	15-16-Aug-09	1	6	2	1	6.00
2	15-16 Aug 09	4	17	3	11	1.55
2	15-16-Aug-09	5	0	6	0	
3	25-26-Aug-09	2	3	1	7	0.43
3	25-26-Aug-09	3	4	4	0	
3	26-Aug-09	2	3	1	8	0.38
3	26-Aug-09	3	13	4	15	0.87

Table 7. Butterfish catch weights for trips 1-3 of the whiting study. Catch weights are in kilograms. Ratio T/C is ratio of TED catch weight to Control catch weight.

Trip	Date	haul #	TED	haul #	Control	Paired ratio (T/C)
1	11-12-Aug-09	2	134	1	197	0.68
1	11-12-Aug-09	3	176	4	9	19.56
1	11-12 Aug 09	6	2	5	3	0.67
1	11-12-Aug-09	7	1	8	0	
1	12-13-Aug-09	2	0	1	0	
1	12-13-Aug-09	3	0	4	0	
2	14-15-Aug-09	3	2	4	0	
2	14-15-Aug-09	6	0	5	1	0.00
2	15-16-Aug-09	1	121	2	116	1.04
2	15-16 Aug 09	4	0	3	0	
2	15-16-Aug-09	5	0	6	66	0.00
3	25-26-Aug-09	2	0	1	0	
3	25-26-Aug-09	3	0	4	0	
3	26-Aug-09	2	165	1	121	1.36
3	26-Aug-09	3	0	4	0	