REPORT

AN EVALUATION OF THE CATCH EFFICIENCY OF A NMFS CERTIFIED, STANDARD TURTLE EXCLUDER DEVICE (TED) REQUIRED IN THE MID-ATLANTIC SUMMER FLOUNDER FISHERY

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A Report to the
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INTRODUCTION

In January 2007, a workshop was conducted by the University of Rhode Island (URI) to solicit input from the trawl fishing industry on methodologies and priorities to reduce sea turtle interactions in the inshore trawl fisheries in the Mid-Atlantic and New England regions. Fishing industry participants in the workshop clearly indicated their concern that reduced catches of target species (i.e., summer flounder) associated with the use of the required turtle excluder devices (TEDs) in the inshore trawl fishery targeting summer flounder (*Paralichthys dentatus*) were problematic, and that improvement in the efficiency of the TED required in this fishery was a very high priority. Although this TED has been certified by NMFS in terms of its ability to separate and eject sea turtles from a trawl, there is limited quantitative information concerning its efficiency to retain the target species. Summer flounder are harvested in the winter offshore by large vessels (20+m in length), and in the summer inshore by both small (15-20m in length) and large trawl vessels.

In April 2007, the URI proposed to the Northeast Fisheries Science Center (NEFSC) of the National Marine Fisheries Service (NMFS) to use existing grant and contract resources dedicated to protected species issues to evaluate improved TED designs in the summer flounder trawl fishery. The NEFSC subsequently authorized this research, and requested that an initial test be conducted to assess catch losses using the existing TED. During summer 2007, field research was conducted on the effect of the currently mandated TED on the catch of the target species in the mid-Atlantic, inshore, summer flounder trawl fishery. The work was undertaken by URI staff in cooperation with NMFS using the F/V *Darana R*, which owned and operated by Capt. Jim Ruhle and based in Hampton VA. Additionally, one day of testing was conducted using a modified TED, and a second day of testing was conducted using the standard TED but with a larger opening. In both cases, the results are too limited to analyze and draw conclusions form in this report, but the data are included in the electronic files included in the appendix to this report.

METHODS

Gear

The TEDs used in this experiment were certified, standard TEDs provided by Wanchese Trawl Company, and are ones that are currently required in the summer flounder trawl fishery. Jon Knight, of Superior Trawl in Pt. Judith, RI, constructed the cylindrical webbing extension sections of the required 8.9 cm (3.5 in) mesh and Jack Forrester of the NMFS, Southeast Fisheries Science Center (SEFSC), Harvesting Systems and Engineering Branch in Pascagoula MS supervised the installation of the TEDs in the extension sections in Rhode Island. Control tows used an extension identical in size but without a TED in the same trawl net. Extensions were easily swapped using rings and lines that ran the circumference of the extension

The TED was evaluated using a 4-seam trawl commonly used by fishermen targeting summer flounder. 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 same 600 kg (1323 lb) trawl doors were used for all tows during the evaluation.

The 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 consisted of a 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.

Field Work

Comparative towing was conducted aboard the F/V *Darana R*. This vessel is 30m in length and is typical of the large class vessels in the summer flounder trawl fishery fleet. The original TED was damaged beyond repair at the end of the second day of the study after the first six pairs of tows were completed. This occurred because of large catches of rays and other bottom debris taken in the trawl. In order to continue working as close to the experimental protocol as possible, another certified flounder TED with a nylon extension belonging to the vessel was sewn into our experimental polyethylene extension. This was done in a manner that insured the angle of the grid in the extension was consistent with original configuration as determined by side-by-side comparison. This configuration was used for next 14 of the 37 paired tows completed in this study after which another TED was attained and sewn into the existing extension.

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 approximately 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 platform scale. In some circumstances, average basket or individual animal weights 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 dictated. 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 using Microsoft Excel. All of the catch data were standardized to a tow duration of 90 minutes. Catch weights were compared using one-tailed, paired T-tests to evaluate the effect of the TED on summer flounder retention and bycatch reduction. Separate analyses were conducted on the entire catch and on catch weights more and less than 50 kg. This division was based on review of the data and fishermen perception that a good catch of summer flounder was more than 50 kg per tow and an a poor catch of summer flounder was less than 50 kg per tow. In the bycatch analyses, the results were divided in groups of catches of dogfish of more than and less than 100 kg, skates and rays of more than and less than 500 kg, and total bycatch of more than and less than 900 kg. These divisions were based on a review of the data and perceptions of acceptable bycatch rates. Although not all sub-sets of the data met all the assumptions of a parametric statistical test, we decided that by invoking the Central Limit Theorem, the paired T-test is 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 between the experimental and control nets (Sokal and Rohlf 1981). A significance level of $p<0.05$ was used for all statistical tests.

RESULTS

A total of 37 successful comparative paired tows (74 total tows) were completed over 15 sampling days using a trawl equipped with a certified, standard flounder TED and a trawl without a TED installed. Approximately one half of the tows were east of the Delmarva Pennisula, and the other half of the tows were south of Long Island (Figure 2). Two tows accomplished during the field work were deemed unsuitable for analysis for reasons such as gear damage due to the presence of large quantities of bottom debris including "mud balls", discarded whelk traps, etc. and large catches of skates, rays and dogfish. Where appropriate, the tows were replicated again or the paired tows eliminated from analysis as not representative of the experimental sampling. A preliminary analysis was conducted on the 17 paired tows involving the TED which was rigged aboard the vessel. The results were consistent with those from the other paired tows, and therefore these tows were included in all the analyses presented in this report (see Appendix).

The objective of the research was to evaluate the effect of a NMFS certified, standard TED on summer flounder catches. The average catch weight of summer flounder per 90 minutes of tow time in the trawl without a TED was 111.4 kg and in the trawl with a TED was 72.1 kg. This result is a 35% reduction in efficiency in the TED equipped trawl, and is a statistically significant difference ($p \leq 0.001$, Table 1). During approximately one-half of the study, summer flounder catch rates were relatively low (<50 kg/90 minute tow). On tows in this portion of the study, the catches of summer flounder in the control net averaged 16.1 kg compared to 10.2 kg in the TED net, which is a statistically significant reduction of 37% ($p=0.001$, Table 2-A). When summer flounder catch rates exceeded 50 kg per 90 minute tow, the tows without a TED had an average catch of 212.0 kg compared to tows with a TED that had an average catch of 137.5 kg. This is a significant loss of 35% of the target species ($p \leq 0.001$, Table 2-B).

One critical issue surrounding TEDs is the potential clogging effects of catches and bycatches in the grid. To investigate this phenomenon, the impact of large catches and the presence of certain species on target catch efficiency were analyzed. The paired tows were assigned into 'small' and 'large' catch tows based on the criterion that if at least one of the tows in a pair had an overall total catch rate of at least 900 kg, then that pair would be considered a 'large' catch pair. For the 'small' catch tows (16 pairs), the control net averaged 67.3 kg and the TED net averaged 56.6 kg of summer flounder. The resulting loss was 16% and was statistically significant ($p=0.04$, Table 3-A). In terms of 'large' catch tows (21 pairs), the control net averaged 145.0 kg of summer flounder compared to 83.9 kg for the TED net. This is a significant reduction of 42% ($p \leq 0.001$, Table 3-B).

A total of 48 species or species groups were caught during this study (see electronic data appendix for details). The average total bycatch rate (catch per tow) in the control net for all pairs was 1,153.6 kg. In the TED net, the mean bycatch rate was 737.8 kg. The TED produced an overall 36% reduction in total bycatch, which is a statistically significant reduction ($p=0.001$, Table 1-C). A summary of the effect of the TED on the catches of various individual bycatch species (or species groups) is provided in Table 4. It is important to note that only tow pairs where the species or group was caught in at least one of the two tows were included in the analysis, so as to avoid a bias in the paired analyses when tow zero catches would result in a zero difference, when the difference was probable due to the lack of the particular species in the area, not the lack of an effect of the TED. Significant reductions in mean catch rates ($p \leq 0.05$) were detected for skates/rays, clearnose skate (*Raja eglanteria*), roughtail stingray (*Dasyatis centroura*), eagle ray (*Myliobatis* sp.), and roundfish sp. Observable -but statistically non-significant reductions occurred for two important commercial species: horseshoe crab (*Limulus polyphemus*) and monkfish (*Lophius americanus*). No statistically significant differences in catch rates between control and TED nets were detected for spiny dogfish, smooth dogfish, and *Loligo* squid.

Two groups of bycatch were dominant throughout the study and are 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 group. Successful paired tows were divided into two categories based on the criterion that if at least one of the tows in a pair caught 500 kg or more of skates and rays, it was considered a 'large' bycatch pair. For paired tows with less than 500 kg of skates and rays (14 pairs), the mean catch of summer flounder was 104.9 kg for control tows versus 74.4 kg for TED tows. This results in a 29% reduction, which is a statistically significant difference ($p=0.03$, Table 5-A). On 'large' skate/rays bycatch tows (23 pairs), the control net catches averaged 115.4 kg of summer flounder and the TED net averaged 70.7 kg. This represented a loss in target catch of 39%, which is significant statistically ($p=<0.001$, Table 5-B)

Smooth dogfish (*Mustelus canis*) and spiny dogfish (*Squalus acanthias*) were combined into a dogfish group, which occurred in every tow. Pairs were classified into two categories based on the criterion that if at least one of the tows in a pair had catches of 100 kg or more it was considered a 'large' dogfish catch pair. Considering all the 'small' dogfish catch tows (17 pairs), the mean catch of summer flounder in the control net was 37.8 kg compared to 32.5 kg for the TED net. This represents a loss of 14% and is a significant difference ($p=0.03$, Table 6-A). When the catch of dogfish was 'large'

(20 pairs), the control net averaged 173.9 kg and the TED net averaged 105.7 kg. This is a 39% reduction and is statistically significant ($p \leq 0.001$, Table 6-B).

Another important consideration of the performance of a TED is the size selectivity of the grid with respect to the target species, and species with a similar geometric morphology to the target species. During the summer 2007 study, over 4,200 summer flounder were measured for total length. Length frequency distributions for both control and TED caught summer flounder from all paired tows are depicted in Figure 3. The shapes of the two distributions are nearly identical. A K-S test indicated no statistically significant difference between the two distributions (Table 7). A similar comparison was performed on the length frequency distributions from the 2,400 summer flounder that were caught only in 'large' catch tow pairs (>50 kg). Figure 4 illustrates that these distributions are nearly identical and a K-S test failed to detect any significant difference between them (Table 7). With respect to a bycatch species, body size measurements (disk width) were obtained from approximately 1,400 clearnose skate. The size frequencies of clearnose skate caught in the control and TED nets are shown in Figure 5. A K-S test failed to detect any significant difference between the two distributions.

Several attempts were made to collect video data on TED tows during the middle daylight hours. Camera positions included 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. Some observations were successfully made with the camera behind the TED grid in the net looking forward. Mostly what was noted was dominant species of bycatch such as skates, rays, and dogfish being "hung-up" by the bars of the TED grid. Quite often it was only a temporary clogging by an individual or small number of fish, but the range of view provided did not usually allow for the determination of whether these fish escaped out of the opening, traveled back to the mouth of the net, or made it through the grid to the codend. It was observed in several instances that dogfish were capable of forcing their way through the grid after getting stuck. This highlights the potential for substantial clogging of the TED for at least short periods of time when the catch rates of dogfish are high. The effects of this clogging were clearly evident on occasion when the trawl was hauled back to the vessel (Figure 6), and on one occasion a large ray was found to be completely blocking the TED unable to pass either through the TED or out the opening (Figure 7).

DISCUSSION

This study thoroughly quantified the effects of a certified, standard flounder TED on the catch of summer flounder, the target species in the summer flounder trawl fishery. Data in the experiment were collected under normal fishing conditions in areas along the mid-Atlantic coast where summer flounder are commercially targeted and where bycatch species are typically encountered. Comparative towing was performed under a standard paired ABBA experimental protocol used in conducting gear comparisons, with only minimal deviations in tow locations (see data appendix for actual begin/end tow information). The gear used during this study was maintained by crew of the *F/V Darana R,* and fishery operations remained consistent throughout the project. The vessel is typical of the large class vessels in the fleet and Captain, crew and vessel have a long history of participation in the summer flounder trawl fishery.

Overall, the certified, standard flounder TED resulted in a significant reduction in catch efficiency for both the target and bycatch species. This result appeared to remain consistent throughout the study regardless of the whether smaller or larger amounts of summer flounder were caught. There was no indication that the size composition of summer flounder captured was significantly affected by the TED. It is worth noting that nearly all summer flounder measured during the study were of a legal market size.

Target catch retention appeared to be related to the volume of bycatch in a given tow. When total catch rates where relatively high (>900 kg/90 min.), the retention efficiency of the target species was reduced more than 2.5 times than when total catch rates where relatively low (<900 kg/90 min.). This indicates that when high volumes of fish are encountered clogging of the TED grid is a significant factor influencing gear performance. Skates/rays and dogfish were the two dominant groups of bycatch species likely to induce clogging of the TED by virtue of their size and volume. During hauling of the net, both skates/rays and dogfish were commonly observed to be hung up on the grid. On several occasions, clogging of the TED was so severe that large volumes of fish accumulated ahead of the TED, filling up the extension (see data appendix for details). When skates/ray bycatch was large, target catch losses increased from 29% to 39%. Large stingrays such as roughtail stingrays were observed to get stuck in front of the grid and were unable to escape out of the opening. When dogfish bycatch was high (>100 kg/90 min.), summer flounder losses increased over 2.5 times the rate when dogfish bycatch was low. Video observations of dogfish indicate that while individual dogfish could fit through the openings of the grid, they often hung up due to their snake-like body motions. In these cases, dogfish probably cause temporary blockages until they pass through the TED.

Analysis of individual species and groups of bycatch species highlight the influence of body size and shape on the catch efficiency of TED-equipped trawls. Skates and rays caught in the study were often quite large and possessed a body shape that is essentially a flattened disk. Due to their body morphology, these species do not easily pass through the flounder TED grid unless they are oriented in a sideways fashion. Bycatch species such as monkfish and horseshoe crab have body shapes that allow large individuals to only pass through the larger openings along the bottom of the grid. Not surprisingly, *Loligo* squid pass efficiently through the grid because of their relatively small and streamlined body configuration. Although the roundfish species group was composed of many different species, much of the bycatch weight of this group was due to catches of relatively large striped bass (*Morone saxatilis*) and bluefish (*Pomatomus saltatrix*). By virtue of their size, these species did not pass through the grid very easily. The one interesting anomaly is with the dogfish species. The average catch rates for both spiny and smooth dogfish were nearly identical in the control and TED nets. Particularly with respect to spiny dogfish, the size and shape of this species suggest that individuals should have some difficulty in passing through the grid. Although there was visual evidence of dogfish getting caught up and clogging the grid during the tow and on haul-backs, the similarity in average catch rates of dogfish between the control and TED nets was not anticipated.

This study provides a useful baseline on the effects of the certified, standard TED design currently required in the Mid-Atlantic summer flounder trawl fishery on catches of both the target species and bycatch species. Future research should be directed to improving the efficiency of the TED so as to enhance the effect of the catch efficiency of the target species, while maintaining the ability of the TED to prevent or minimize sea turtles interactions with the trawl gear.

Table 1-A. Summer flounder catch and total bycatch data for all paired tows using a standard flounder TED. All data has been standardized to weight (kg) per 90 minutes of towing time.

tow	control sum fl wt	control bycatch wt	tow	TED sum fl wt	TED bycatch wt
1	10.5	579	2	3.9	217.4
4	3.5	83.6	3	0.4	34
5	8.8	789.6	6	4.9	419.6
8	13.3	285.7	7	12.3	228.9
9	16.3	413.6	10	5.2	265
13	8.7	453.7	14	7.5	221.6
26	6.2	229.8	27	4.1	436.1
29	8.7	752.7	28	13.7	718.4
30	12.3	1166	31	3.2	658.2
33	24.2	257.1	32	24.2	128.8
36	13.9	898.7	35	10.6	284.1
37	21.6	3967.4	38	7.7	1225.8
40	43.6	3432.3	39	20.7	1270.4
41	32	523.7	42	13	673.1
44	19.1	746	43	20.4	480.5
45	104	2612.1	46	9.9	977.8
48	97.4	1616.9	47	36.8	1480.2
49	107.6	1346	50	79	1226.8
52	112.1	840.5	51	87.3	1265.2
53	100.7	475.8	54	53.1	517.1
56	167.3	663.2	55	58.2	1328.8
57	202.2	607.1	58	200.9	556.1
60	226	425.2	59	147.8	413.9
61	236.9	506.3	62	210.5	634
64	455.2	1454.1	63	239.5	915.1
65	311.9	1500.9	66	148.3	854.6
68	286	678.3	67	211	769.3
69	160.2	498.2	70	183.2	481.9
72	177.4	1936.9	71	134.6	2857.4
73	205.6	760.4	74	157.1	421.7
76	274.7	677.8	75	179.3	503.6
77	389.9	657.8	78	206.4	471.4
80	201.4	2483.2	79	131.5	1517.3
81	15.9	1991.8	83	14.2	444.6
85	16.2	1126.5	84	6.6	471.3
86	13.1	1899	87	7.5	831.8
89	17.6	3346.5	88	12.8	1097.5

Table 1-B. A comparison of summer flounder catch for all paired tows using a standard flounder TED. All data has been standardized to weight (kg) per 90 minutes of towing time.

	control	TED
Mean	111.40	72.09
Variance	14770.60	6410.05
Observations	37	37
Pearson Correlation	0.93	
Hypothesized Mean Difference	0	
df	36	
t Stat	4.315	
p(T<=t) one-tail	<0.001	
t Critical one-tail	1.688	

% reduction	35

Table 1-C. A comparison of the overall total bycatch for all paired tows using a standard flounder TED.

	control	TED
Mean	1153.60	737.82
Variance	925593.92	285794.91
Observations	37	37
Pearson Correlation	0.58	
Hypothesized Mean Difference	0	
df	36	
t Stat	3.237	
p(T<=t) one-tail	0.001	
t Critical one-tail	1.688	

% reduction	36

Table 2-A. A comparison of flounder catch rates (kg/90 minutes) on paired tows where the total weight of summer flounder was less than 50 kg for both tows in the pair.

	control	TED
Mean	16.07	10.15
Variance	89.13	42.61
Observations	19	19
Pearson Correlation	0.67	
Hypothesized Mean Difference	0	
df	18	
t Stat	3.698	
p(T<=t) one-tail	0.001	
t Critical one-tail	1.734	

% reduction	37

Table 2-B. A comparison of flounder catch rates (kg/90 minutes) on paired tows where the total weight of summer flounder was greater than 50 kg for at least one of the pairs.

	control	TED
Mean	212.03	137.47
Variance	10306.45	4715.55
Observations	18	18
Pearson Correlation	0.80	
Hypothesized Mean Difference	0	
df	17	
t Stat	5.070	
p(T<=t) one-tail	<0.001	
t Critical one-tail	1.740	

% reduction	35

Table 3-A. A comparison of summer flounder catch rates (kg/90 minutes) when the total catch weight was less than 900 kg for both paired tows.

	control	TED
Mean	67.33	56.56
Variance	7610.97	6223.58
Observations	16	16
Pearson Correlation	0.96	
Hypothesized Mean Difference	0	
df	15	
t Stat	1.826	
p(T<=t) one-tail	0.044	
t Critical one-tail	1.753	

% reduction	16

Table 3-B. A comparison of summer flounder catch rates (kg/90 minutes) when the total catch weight was greater than 900 kg for at least one tow in the pair.

	control	TED
Mean	144.98	83.91
Variance	18140.66	6530.78
Observations	21	21
Pearson Correlation	0.95	
Hypothesized Mean Difference	0	
Df	20	
t Stat	4.445	
p(T<=t) one-tail	<0.001	
t Critical one-tail	1.725	
% reduction		42

Table 4. A comparison of individual species or species groups of bycatch from all paired tows using a standard flounder TED. Average weights are given in kg and the analysis of data involves only tow pairs in which a species or species group was present in at least one of the paired tows.

	control	TED	p-value
skates/rays	829.2	446.9	0.001
clearnose skate	410.9	205.8	0.007
roughtail stingray	187.2	21.8	0.006
eagle ray	149.7	12.0	0.003
spiny dogfish	339.2	333.8	0.466
smooth dogfish	57.4	58.8	0.454
roundfish	15.8	7.9	0.002
horseshoe crab	8.9	5.9	0.059
monkfish	9.2	4.7	0.075
loligo	1.1	0.9	0.218

Table 5-A. A comparison of summer flounder catch rates (kg/90 minutes) when the bycatch of skates and rays was less than 500 kg for both paired tows.

	control	TED
Mean	104.88	74.38
Variance	15656.40	7454.72
Observations	14	14
Pearson Correlation	0.93	
Hypothesized Mean Difference	0	
df	13	
t Stat	2.079	
p(T<=t) one-tail	0.029	
t Critical one-tail	1.771	

% reduction	29

Table 5-B. A comparison of summer flounder catch rates (kg/90 minutes) when the bycatch of skates and rays was greater than 500 kg for at least one tow in a pair.

	control	TED
Mean	115.37	70.69
Variance	14875.03	6078.75
Observations	23	23
Pearson Correlation	0.94	
Hypothesized Mean Difference	0	
df	22	
t Stat	3.808	
p(T<=t) one-tail	<0.001	
t Critical one-tail	1.717	

% reduction	39

Table 6-A. A comparison of summer flounder catch rates (kg/90 minutes) when the bycatch of dogfish (both smooth and spiny) is less than 100 kg on both tows in a pair.

	control	TED
Mean	37.84	32.51
Variance	3916.46	3890.68
Observations	17	17
Pearson Correlation	0.99	
Hypothesized Mean Difference	0	
df	16	
t Stat	2.067	
p(T<=t) one-tail	0.028	
t Critical one-tail	1.746	

% reduction	14

Table 6-B. A comparison of summer flounder catch rates (kg/90 minutes) when the bycatch of dogfish (both smooth and spiny) is greater than 100 kg on at least one of the paired tows.

	control	TED
Mean	173.93	105.73
Variance	15731.85	6275.74
Observations	20	20
Pearson Correlation	0.92	
Hypothesized Mean Difference	0	
df	19	
t Stat	4.938	
p(T<=t) one-tail	<0.001	
t Critical one-tail	1.729	

% reduction	39

Table 7. Results of K-S test for difference in size distribution of summer flounder and clearnose skate. The Max D is less than D alpha at p=0.05 for all test conducted, which indicates no observable significant difference.

	p=0.05 D alpha		Max D
Summer flounder - all paired tows	0.042		0.017
Summer flounder - paired tows (at least 1 > 50 kg)	0.056		0.029
Clearnose skate - all paired tows	0.072		0.064

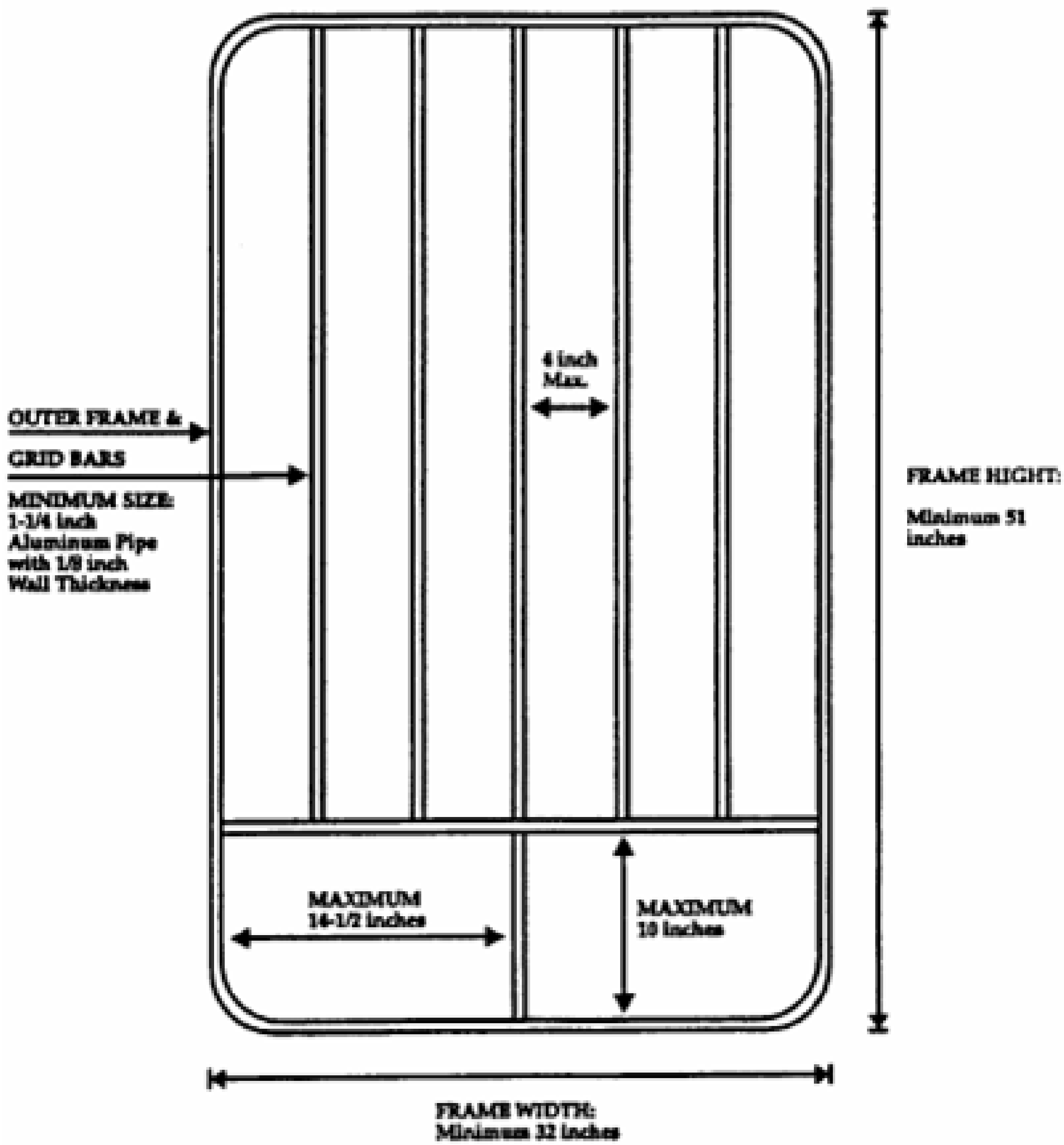

Figure 1. Diagram of flounder TED certified for use by NMFS.

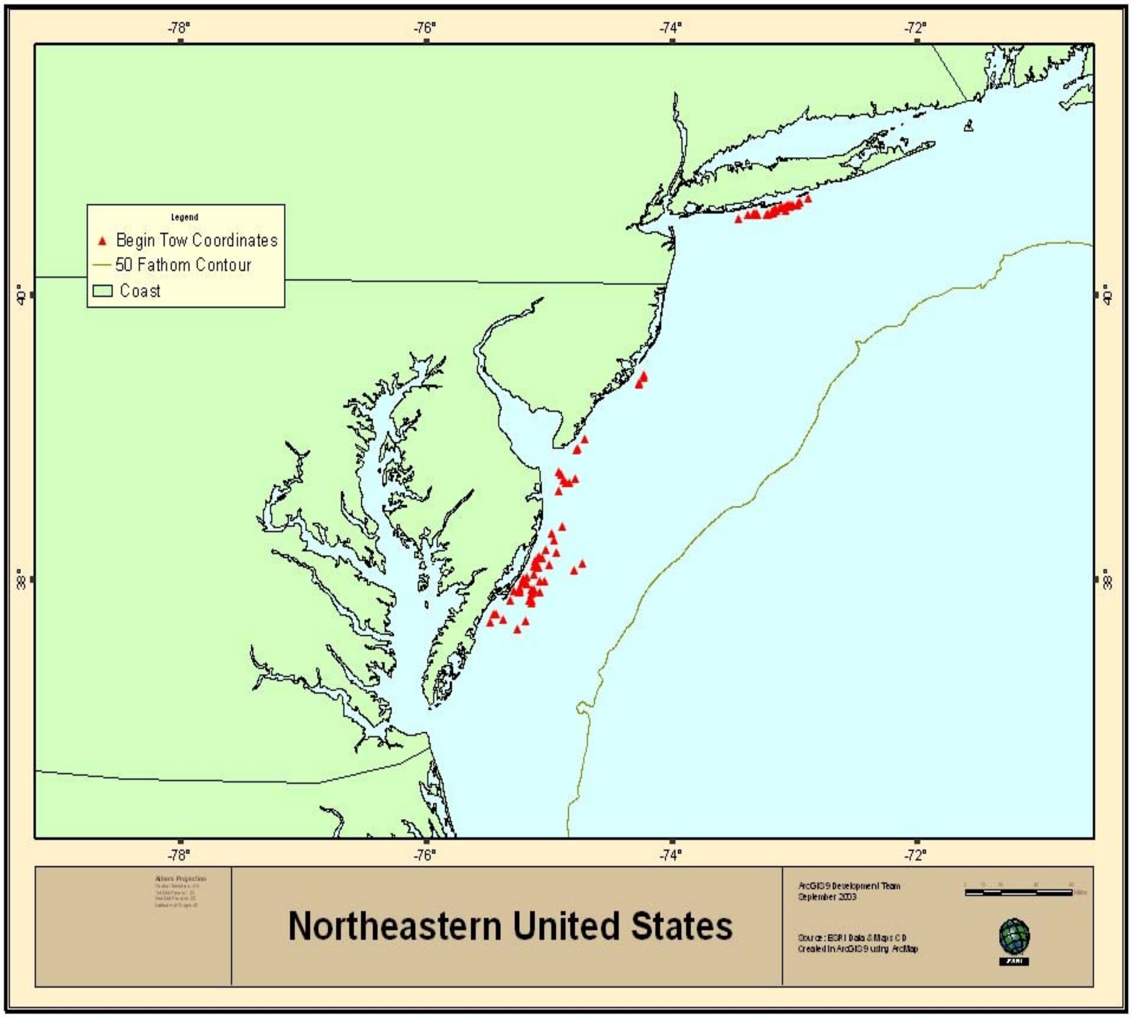

Figure 2. Location of starting positions for comparative tows conducted from 5 June – 2 July, 2007.

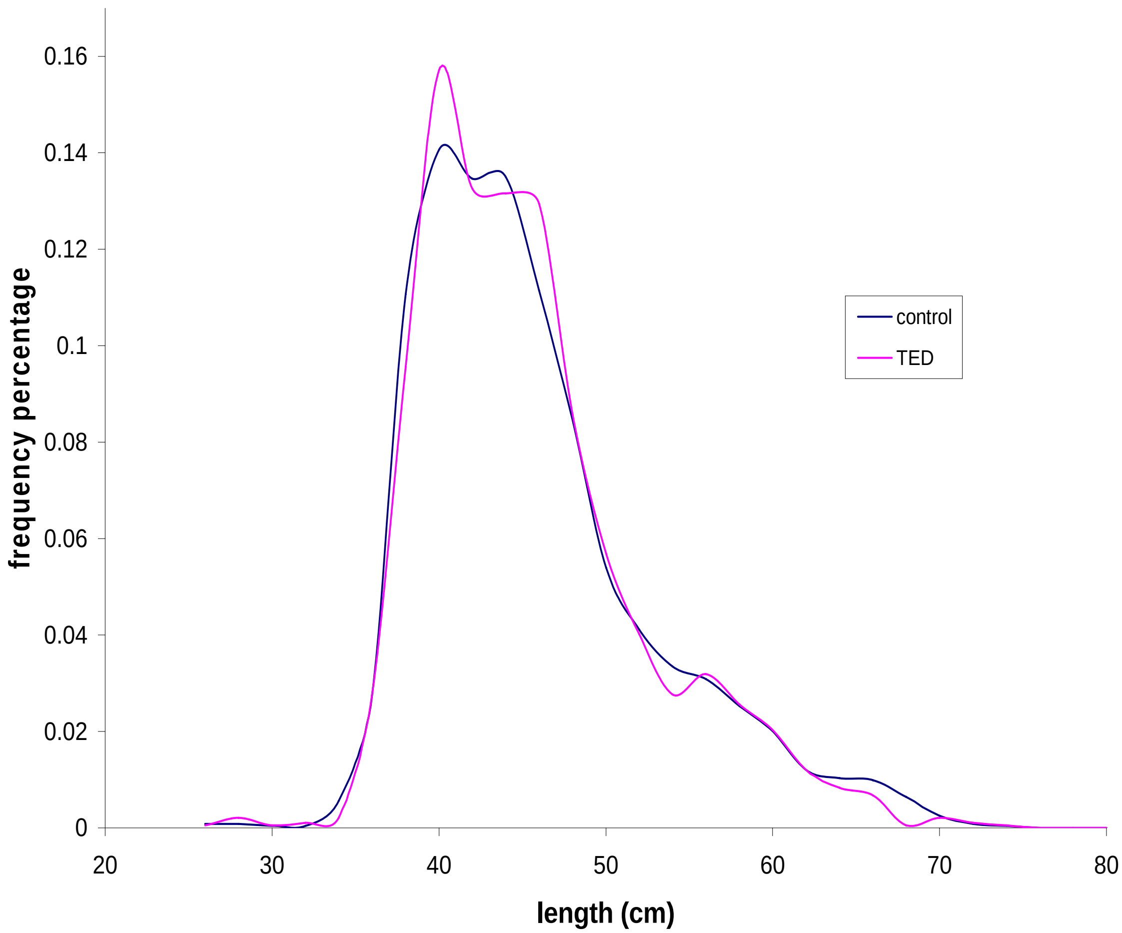

Figure 3. Length frequency plot as a percentage of measured summer flounder for all paired tows with a standard flounder TED. Length measurement is total length.

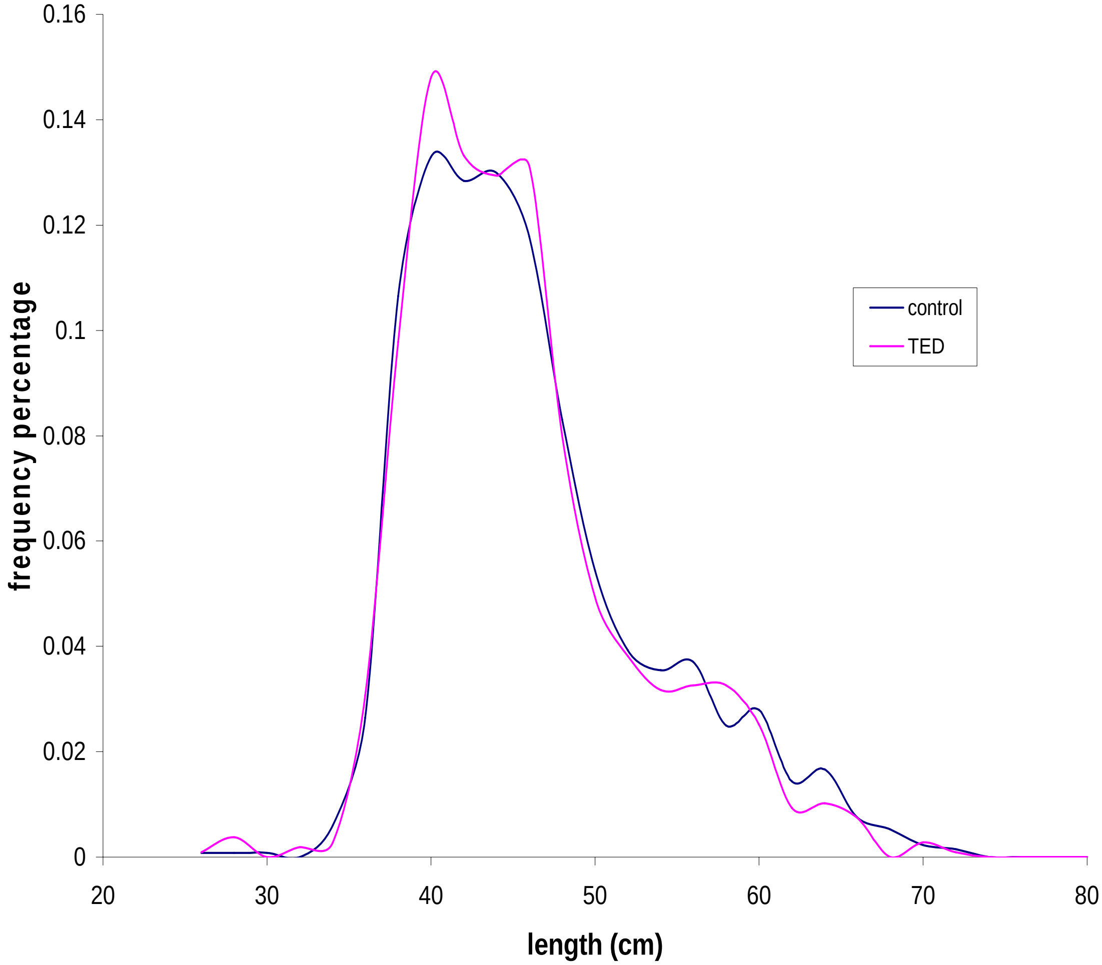

Figure 4. Length frequency plot as a percentage of measure summer flounder for all paired tows where the total weight of summer flounder was greater than 50 kg in at least one tow. Length measurement is total length.

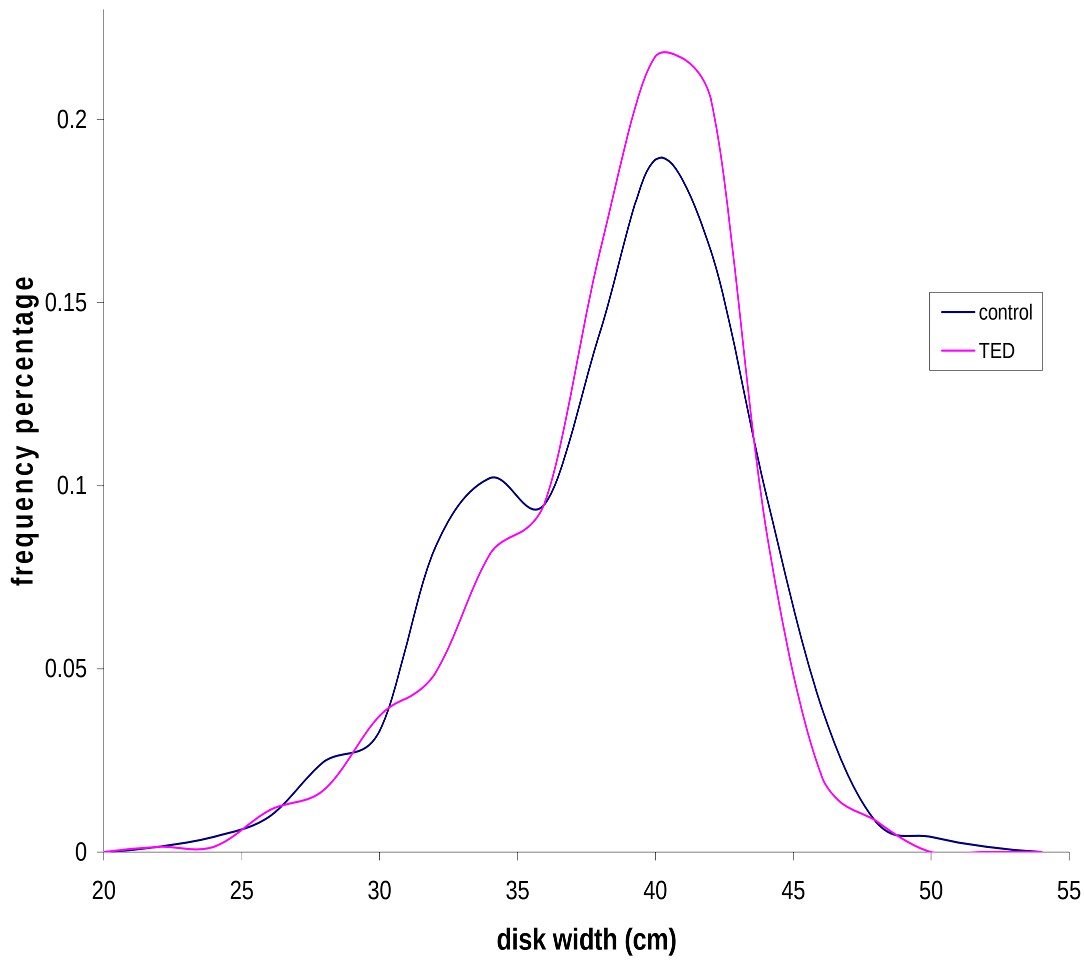

Figure 5. Size frequency plot as a percentage of clearnose skate measured for all paired tows. Measurement is disk width.

Figure 6. Photographs of the TED equipped trawl on haul-back showing the clogging by dogfish, skates and rays ahead of the TED grid.

Figure 7. Photograph of the single ray clogging the TED.

Gear 1 is the control net with no TED but an identical extension section
Gear 2 is the experimental net with standard TED and the small opening in an identical extension section
Gear 3 is the experimental net with standard TED and small opening in rigged in the field with a double webbing extension section
Gear 4 is the experimental net with modified TED in an identical extension section flat bars with a larger spacing
Gear 5 is the experimental net with standard TED with a large opening and double flap cover in an identical extension section

date	haul	gear	time in	time out	pos in X	pos in Y	pos out X	pos out Y	depth (fm)	temp (°F)	wind (knt)	direction	sea (ft)	total catch	comments
6/5/2007	1	1	5:30	7:00	37.70167	-75.47944	37.76361	-75.438889	7	60.2	10	180	3	589.5	first tow
6/5/2007	2	2	8:00	9:30	37.76167	-75.44694	37.69	-75.480833	6	60.2	15	180	3	221.3	TED clogged with rays and skates, one large ray in particular which was about the size fo the TED. These fish slid out of escape opening as gear was hauled aboard. Approximately 75-100 kg escaped. Video used, poor visibility. No flounder measurements.
6/5/2007	3	2	11:30	13:00	37.65389	-75.25889	37.71472	-75.203889	10	62.1	10	180	3	34.4	video camera behind opening on top of net. Visibility better, but not good.
6/5/2007	4	1	13:50	15:20	37.71361	-75.19389	37.66528	-75.254722	11	63.1	10	180	3	87.1	no comment
6/5/2007	5	1	16:40	18:10	37.71944	-75.37889	37.75611	-75.438333	6	62.9	10	180	3	798.4	one slow turn west and south to avoid gear
6/5/2007	6	2	19:00	20:30	37.75361	-75.42889	37.71417	-75.370278	6	61.7	10	180	3	424.5	conch pot frame laying on TED. There were a number of skates on TED, but most made it through grid during haulback.
6/6/2007	7	2	5:40	7:10	37.83167	-75.14194	37.90417	-75.141667	9	62.4	10	315	2	241.2	some fish in front of TED, but most if not all made it back into codend
6/6/2007	8	1	8:10	9:40	37.89889	-75.14694	37.81889	-75.146667	8	61.1	10	315	2	299	no comment
6/6/2007	9	1	14:41	16:11	37.85278	-75.15806	37.93194	-75.165	10	61.9	10	1	2	429.9	no comment
6/6/2007	10	2	17:00	18:30	38.1625	-75.08444	37.85417	-75.1575	6	62.5	10	20	2	270.2	TED bent slightly - bowed inward toward the middle of the grid.
6/6/2007	11	2	19:05	20:35	37.85917	-75.14861	37.90778	-75.072222	10	63.2	10	20	2	109.2	TED frame cracked and bent along bottom corners just below cross bar
6/6/2007	12	1	21:24	22:54	37.91111	-75.07417	37.99694	-75.018611	11	64.1	10	25	2	132.1	no comment
6/7/2007	13	1	5:56	7:26	37.98556	-75.03639	37.64222	-71.798611	5	61.1	10	125	2	462.4	no comment
6/7/2007	14	3	9:52	11:22	37.98944	-75.07167	37.5075	-71.720556	8	61.9	5	125	2	229.1	rigged TED looks good in net. A large roughtail laying on TED (est. 40 kg)
6/7/2007	15	4	13:03	14:33	38.08556	-75.09806	38.15333	-75.051944	6	62.6	5	125	1	667.9	not many skates or rays clogging the front of TED
6/7/2007	16	1	15:30	17:00	38.15472	-75.05139	38.08972	-75.096389	8	63.7	10	125	2	1096.9	no comment
6/7/2007	17	1	17:41	19:11	38.09028	-75.08639	38.09667	-74.991389	5	64.2	10	125	2	692.4	no comment
6/7/2007	18	4	20:00	21:30	38.10583	-74.99444	38.08639	-75.077778	7	64.1	10	125	2	473.7	no comment
6/8/2007	19	4	6:02	7:32	38.06528	-74.79333	38.12528	-74.731111	7	63.2	10	225	2	132.9	Large roughtail stingray, bigger than TED, blocking grid. Animal too big to slide out of escape vent. Had to unzip extension from net and grab codend to let animal get away.
6/8/2007	20	1	8:32	10:02	38.11944	-74.73306	38.06444	-74.813056	12	64.8	10	225	2	264.8	no comment
6/8/2007	21	1	11:50	13:20	38.19	-74.94361	38.27306	-74.957222	7	64.8	10	125	2	317.9	tire hung up just behind extension
6/8/2007	22	4	14:15	15:45	38.27944	-74.96139	38.2075	-74.969444	11	66	10	180	2	464.3	no comment
6/8/2007	23	4	17:50	19:20	38.32694	-74.97806	38.36917	-74.898611	9	67.2	10	125	2	572.7	no comment
6/8/2007	24	1	20:10	21:40	38.37028	-74.895	38.32778	-74.971389	9	66.3	10	125	2	580.7	no comment
6/9/2007	25	1	6:00	7:30	38.62639	-74.92528	38.68222	-74.893889	8	63.2	10	305	2	none	large bag of junk, big rock, lots of mud, skates, dogfish. Captain didn't want to replicate tow so no data was collected.
6/9/2007	26	1	9:35	10:35	38.68722	-74.83472	38.71083	-74.783889	7	62.9	10	335	2	157.3	no comment
6/9/2007	27	3	11:35	12:35	38.71417	-74.78556	38.685	-74.844722	7	63.7	15	325	3	296.4	no comment
6/9/2007	28	3	13:15	14:15	38.68333	-74.86639	38.73389	-74.893889	13	63.4	15	325	3	488	no comment
6/9/2007	29	1	15:10	16:10	38.74056	-74.90333	38.69111	-74.872222	14	64.9	5	45	2	507.6	no comment
6/9/2007	30	1	16:55	18:25	38.69889	-74.87806	38.76389	-74.923611	13	65.5	5	325	2	1178.3	no comment
6/9/2007	31	3	19:25	20:55	38.75611	-74.91778	38.67417	-74.863889	7	64.4	20	60	4	661.4	no comment
6/10/2007	32	3	5:55	7:25	37.93	-75.12139	37.85361	-75.140278	8	64.8	10	70	3	153	no comment
6/10/2007	33	1	8:25	9:55	37.85083	-75.14139	36.52444	-75.673611	9	63.6	15	25	3	281.3	microwave and crab pot in the codend
6/10/2007	34	1	10:45	12:15	37.92778	-75.14278	39.28417	-74.59	7	64.6	15	25	3	299.1	no comment
6/22/2007	35	3	6:20	7:50	37.85083	-75.14139	37.91861	-75.139444	9	69.2	15	330	2	294.7	no comment
6/22/2007	36	1	8:40	10:10	37.91222	-75.135	37.82944	-75.149722	6	69.1	10	330	2	912.6	no comment
6/22/2007	37	1	11:50	13:20	37.91972	-75.23806	37.98361	-75.192222	6	68.6	10	330	2	3989	Used average weight of basket to calculate total weight of clearnose
6/22/2007	38	3	14:20	15:50	37.97861	-75.20083	37.92222	-75.233889	7	68.1	15	330	2	1233.5	Used basket weights. Video collected from behind TED - poor visibility. Lots of fish, primarily skates, clogged in front of TED. Several hundred pounds escaped out of opening during haulback right beside vessel.
6/22/2007	39	3	17:00	18:30	37.97028	-75.17694	38.03556	-75.127778	7	68.8	10	330	2	1291.1	Used basket weights for clearnose
6/22/2007	40	1	19:30	21:00	38.03389	-75.125	37.96417	-75.176111	8	68.9	10	330	2	3475.9	Used basket weights
6/23/2007	41	1	10:05	11:15	39.38806	-74.26528	39.42833	-74.215833	5	67.1	10	315	2	430.8	no comment
6/23/2007	42	3	11:55	13:05	39.42361	-74.225	39.38944	-74.264722	8	67.6	10	270	2	531.9	large lobster pot in caught up well in front of TED
6/23/2007	43	3	14:00	15:30	39.3725	-74.26556	39.44556	-74.225278	7	68.5	10	315	2	500.9	no comment
6/24/2007	44	1	16:25	17:55	39.44556	-74.22528	39.37083	-74.268611	6	68.8	10	315	2	765.1	no comment
6/24/2007	45	1	6:00	7:30	40.57972	-73.17917	40.60361	-73.0675	9	61.6	5	345	1	2716.1	used basket weights
6/24/2007	46	3	8:25	9:55	40.5975	-73.07083	40.58528	-73.165556	10	59.9	10	270	1	987.7	TED clogged with fish backed up a good 10 feet forward in the net. Probably twice what came up in the codend. Those fish were dumped out. Video and pictures taken of haul.
6/24/2007	47	3	11:50	13:20	40.57222	-73.22417	40.56972	-73.329444	10	61.3	10	225	2	1517	no comment
6/24/2007	48	1	14:25	15:55	40.57056	-73.33528	40.5725	-73.221944	9	62.8	10	250	2	1714.26	no comment
6/24/2007	49	1	16:55	18:25	40.57278	-73.22	40.57583	-73.323611	10	62.5	10	180	2	1453.6	no comment
6/24/2007	50	3	19:20	20:50	40.58222	-73.31556	40.57278	-73.22	9	63.3	10	180	3	1305.8	no comment
6/25/2007	51	3	5:30	7:00	40.5725	-73.22194	40.57083	-73.318611	10	62.3	5	180	2	1352.5	no comment
6/25/2007	52	1	8:00	9:30	40.57778	-73.33528	40.57722	-73.198333	8	62.6	5	135	1	952.6	no comment
6/25/2007	53	1	10:20	11:50	40.575	-73.21722	40.57639	-73.331667	10	62.9	5	180	1	576.5	camera on port wing looking into net
6/25/2007	54	2	12:40	14:10	40.56917	-73.305	40.57611	-73.206667	9	62.4	10	180	2	570.2	camera behind TED opening - cloudy
6/25/2007	55	2	14:55	16:25	40.57889	-73.18556	40.60806	-73.102778	10	64.3	10	225	2	1387	about 2000 lbs of dogfish and other stuff clogged in front of the grid. Most of it was eventually dumped out during the haul.
6/25/2007	56	1	18:05	19:35	40.61778	-73.08611	40.58361	-73.178333	8	63	15	200	3	830.5	no comment
6/26/2007	57	1	5:30	7:00	40.58583	-73.17556	40.62361	-73.070556	10	62.2	10	225	2	809.3	no comment
6/26/2007	58	2	7:50	9:20	40.62694	-73.05944	40.59972	-73.151667	9	62	5	225	3	757	no comment
6/26/2007	59	2	9:55	11:25	40.60417	-73.14639	40.62556	-73.055833	10	62.7	5	225	1	561.7	video camera behind TED and escape opening-decent visibility for 20 minutes-then cloudy
6/26/2007	60	1	12:25	13:55	40.62611	-73.0375	40.60028	-73.1475	10	63.9	10	200	2	651.2	no comment
6/26/2007	61	1	15:10	16:40	40.60361	-73.15056	40.6275	-73.041111	9	64.7	10	225	3	743.2	no comment
6/26/2007	62	2	17:30	19:00	40.63444	-73.03139	40.61611	-73.125	8	65.7	10	200	2	844.5	no comment
6/26/2007	63	2	19:40	21:15	40.62361	-73.11083	40.64083	-72.9975	8	64.7	10	225	2	1215.4	no comment
6/26/2007	64	1	22:20	23:55	40.64333	-72.97889	40.62583	-73.08	9	64.5	10	225	3	2009.8	no comment
6/27/2007	65	1	6:15	7:45	40.62333	-73.09889	40.6475	-72.975833	8	62.7	10	250	2	1812.8	no comment
6/27/2007	66	2	8:40	10:10	40.66139	-72.95861	40.63389	-73.047778	9	63	10	225	2	1002.9	no comment
6/27/2007	67	2	10:55	12:25	40.63528	-73.05139	40.60806	-73.145278	10	63.6	10	220	2	980.3	camera behind TED opening - cloudy
6/27/2007	68	1	13:25	14:55	40.61194	-73.15667	40.63111	-73.0425	8	65.5	10	220	2	964.3	no comment
6/27/2007	69	1	15:55	17:25	40.6425	-73.01333	40.61639	-73.123056	8	65.1	15	220	4	658.4	no comment
6/27/2007	70	2	18:20	19:50	40.62083	-73.11778	40.63944	-73.008056	8	64.8	20	220	6	665.1	no comment
6/28/2007	71	2	5:10	6:40	40.68306	-72.88528	40.65361	-72.972222	10	59.6	10	240	4	2992	no comment
6/28/2007	72	1	7:55	9:25	40.6625	-72.96222	40.6825	-72.875278	9	59.6	10	240	3	2114.3	no comment
6/28/2007	73	1	10:20	11:55	40.63306	-73.06806	40.60139	-73.1675	7	61.7	10	220	4	1016.8	no comment
6/28/2007	74	2	12:50	14:20	40.6025	-73.17333	40.62417	-73.078333	9	64.6	10	220	3	578.8	Right Eyed Fluke-40cm
6/28/2007	75	2	15:10	16:40	40.62972	-73.065	40.59278	-73.163611	9	63.8	10	220	3	682.9	camera in front of TED escape opening-cannot see all the way back to flap
6/28/2007	76	1	17:45	19:15	40.59028	-73.16833	40.62833	-73.061111	10	65.9	10	220	3	952.5	no comment
6/29/2007	77	1	5:30	7:00	40.60611	-73.15806	40.62917	-73.055	9	63.7	10	45	3	1047.7	no comment
6/29/2007	78	2	7:55	9:25	40.63	-73.05083	40.60972	-73.145	7	62.4	10	45	2	677.8	no comment
6/29/2007	79	2	11:20	12:50	40.57417	-73.3775	40.53056	-73.458333	7	65	5	115	2	1648.8	no comment
6/29/2007	80	1	13:55	15:25	40.54694	-73.45556	40.57611	-73.376944	6	67.1	5	130	2	2684.6	camera in front of TED escape opening-poor visibility
6/30/2007	81	1	12:30	14:00	38.92222	-74.77167	38.98278	-74.721944	6	70.1	10	210	2	2007.7	tagged dusky shark #K0446059 total length 109 forked length 88 7.3kg
6/30/2007	82	2	15:05	16:30	38.98972	-74.70806	38.95778	-74.729167	5	69.4	5	45	2	none	cut tow 5 minutes short because gear was hung up - gear came back with ground cables twisted and a trap hung up in the forward part of net tube. Decided to through tow out and stopped collecting data.
6/30/2007	83	2	19:00	20:30	38.915	-74.77444	38.97472	-74.708056	6	71.2	5	70	1	458.8	no comment
7/1/2007	84	2	5:30	7:00	38.15583	-75.07722	38.22306	-75.024722	7	70.8	15	25	2	477.9	grid clogged
7/1/2007	85	1	7:55	9:25	38.21278	-75.02556	38.14694	-75.090556	10	70	20	25	4	1142.7	no comment
7/1/2007	86	1	10:15	11:15	38.13028	-75.11694	38.0775	-75.134444	7	69.9	20	25	4	1274.7	hung up - no damage. Had to cut tow short
7/1/2007	87	2	13:30	14:30	38.09944	-75.11917	38.14806	-75.103333	6	69.5	15	5	2	559.5	camera behind TED opening - cloudy
7/1/2007	88	2	16:00	17:30	38.02194	-75.18	37.95417	-75.231111	6	69.6	10	240	2	1110.3	no comment
7/1/2007	89	1	18:35	20:05	37.93722	-75.23806	38.00889	-75.195556	6	69.2	5	70	2	3364.1	eagle ray neonates present - six or more about 10 cm in width. They were likely birthed in net or on deck.
7/2/2007	90	1	5:45	7:00	37.91556	-75.23972	37.97528	-75.2225	7	68.6	20	65	4	2558.4	no comment
7/2/2007	91	5	8:20	9:35	37.97667	-75.22194	37.91611	-75.246389	7	69.5	20	65	4	1209.8	large opening on TED with double cover
7/2/2007	92	5	10:10	11:15	37.91306	-75.24417	37.95806	-75.226111	6	69.1	20	65	4	1762.9	no comment
7/2/2007	93	1	12:20	13:35	38.00472	-75.21083	37.89444	-75.248333	5	69.9	15	65	3	2261	no comment
7/2/2007	94	1	14:40	15:55	37.91889	-75.28306	37.85111	-75.317778	4	70.4	10	65	3	1333	no comment
7/2/2007	95	5	16:30	17:45	37.855	-75.31278	37.9025	-75.293333	4	69.6	10	65	2	456.1	no comment

Adjusted catch data per tow by species
Catch weights in kilograms
Gear 1 is the control net with no TED but an identical extension section
Gear 2 is the experimental net with standard TED and the small opening in an identical extension section
Gear 3 is the experimental net with standard TED and small opening in rigged in the field with a double webbing extension section
Gear 4 is the experimental net with modified TED in an identical extension section flat bars with a larger spacing
Gear 5 is the experimental net with standard TED with a large opening and double flap cover in an identical extension section

haul	gear	sum fl.	4-spot	windowpn	winter fl	butterfly ra	clearnose	cownose r	eagle ray	roughtail st	torpedo ray	little skate	winter skat	angelshark	Dusky	night shark	sandbar	sand tiger	scalloped h	smth hamm	smth dogfi	spiny dogfi	b. sea bas	Bluefish	butterfish	croaker	kingfish	pinfish	puffer	red hake	scup	sea robin	shad sp.	atlantic stu	short sturge	silver hake	spot	stargazer	striped bas	tautog	triggerfish	weakfish	amcn lobst	blue crab	crab sp.	horseshoe	loligo	monk	mantis shrimp	Total wt.	haul
1	1	10.5				6.7	451.7	1.7		38.7				16.6							6.9																					0.1	0.6	0.3		55.7				589.5	1
2	2	3.9				4.2	169.2			7.3											3.9																									32.8				221.3	2
3	2	0.4	1.2	0.6			8.6		6.1			8.3													2.6																				0.5	5.9	0.2			34.4	3
4	1	3.5	1.2	0.6			5		7.8			25		13.6							18.3		1.8		3.3							0.5						1.4									0.6	4.5		87.1	4
5	1	8.8		0.8		3	690		3.1	29.2				11.1							13																								1	38.4				798.4	5
6	2	4.9		1.1			360.9			14.9		0.5									2.9														2.8			1.9								34.6				424.5	6
7	2	12.3	2.4	7.7			135		7.2			51.5									6.8	7.9	0.2		0.7					0.1								5.5							0.3	3.5	0.1			241.2	7
8	1	13.3	3.1	2.9			85.8		5.4	52.6		81.7									27.6				0.7							1.1				0.1		2.3	16.8							3.1	0.2	2.3		299	8
9	1	16.3	0.9	2.5			188.3		24.3	91.9		53.5		11.2							38.6				0.2													1.8									0.4			429.9	9
10	2	5.2	0.7	2.6			160		13	16.6		48.4									17.9				0.7													0.9							0.7	0.4	0.1	3		270.2	10
11	2	11.1		5			35					37.5	4.8								4.9															0.1		4.3							0.4	4		2.1		109.2	11
12	1	0.5		1.5			30.3					19.5	1.6	8.7																		0.1														67	0.1	2.8		132.1	12
13	1	8.7	0.2	2.1			294		12.9	46.1		26.2	5.4								45.9		0.1		0.1													7.2							0.7	10	0.4	2.4		462.4	13
14	3	7.5	1.3	5.8			106.1			11.3		34.9	6.4								32.9	3.3			0.5													15.9								3	0.2			229.1	14
26	1	4.1		0.8			1.8					82.6	2.1								55.7	2.6			0.2							3.1						0.9								3	0.4			157.3	26
27	3	2.7		0.4			2.8					41.7	6.5								212.3	22.7			0.1							1.6						0.5								2	0.1			293.4	27
28	3	9.1	1.7	1.5			56.7					224.1	54.4								68.9	56.9	0.1		0.1							3														2.2	0.4	8.9		488	28
29	1	5.8	4.5	4.7			70.3					265.7	28.2								50	53.9			0.1					0.1			0.6													15	0.6	8.1		507.6	29
30	1	12.3	4	7.2			194.4					426.4	101.5								161.5	260.2			0.1					0.3		0.8														5.4	0.4	3.8		1178.3	30
31	3	3.2	2.2	3.6			111.1					258.8	36.2								113	109.2								0.2		0.2												0.1		20.8	0.7	2.1		661.4	31
32	3	24.2	2.4	2					7.6	6.5		55	3.9								39.2				0.1					0.2		0.5						4.8					0.3			4.3	2			153	32
33	1	24.2	2.5	0.4			105.4			17.4		59.4	5.7	21.3							38.7				0.5					0.1		0.1														2.1	3.5			281.3	33
35	3	10.6	0.6			4	224.8		18.1	10		8.7		13.5							3.5																										0.9			294.7	35
36	1	13.9		0.4			263		297	191.1		12.7		125.7					7.6						0.1						0.1	0.1									0.8						0.1			912.6	36
37	1	21.6		0.3		24.9	3441.8		344.8	96.3				6							16.7		0.1		0.2	0.2	21.4	0.1			0.7															14.1	0.1			3989	37
38	3	7.7		0.3			1165.5		32.7	14.1											4.6				0.4		4.2				0.2	0.1					0.5					0.4				2.8				1233.5	38
39	3	20.7		0.7			1106.3		37.8	83.1				11							5.2		0.1		1.6	0.1	18.2	0.1		0.3	1.7						0.6				1.5	1.9					0.2			1291.1	39
40	1	43.6		2.8		15	2156		417.6	679.9				81.7				21			15.5		0.2		4.5	0.7	13.7	0.1		1.4	1.3							0.7			1.1	8.9				10.1	0.1			3475.9	40
41	1	24.8	0.4	1.1			275.4		14.8			42.1	0.3				10.9				39											20.7													0.7		0.6			430.8	41
42	3	10.1	0.3	0.2			356		0.5			26.5	0.2								132.6			0.2								5.3																		531.9	42
43	3	20.4		0.6			351.2		5.1			31.1	0.4								76.8			5.7							0.1	9.1															0.4			500.9	43
44	1	19.1		2.4			532.2		34.3			50.7						12.4			98.5											15.2															0.3			765.1	44
45	1	104	11	3.4	6.2		2.3				14.3	737	279.6								252	1233.1		16.5	0.1						0.1	1.9				0.3										1.4	0.2	52.7		2716.1	45
46	3	9.9	1.4		0.7							13.7	11.9								52.6	896.7	0.7													0.1														987.7	46
47	3	36.8	3.5	1.5								246.6	283.8								98.2	820.7	1.7	9							0.2	1.2							7.8						0.5		0.1	5.4		1517	47
48	1	97.4	6.8	6	2.1		1.2					306.51	287.51								121.8	839.04	2.7									6.5							30.1						0.5		0.6	5.5		1714.26	48
49	1	107.6	6.2	4.9	3.8							427.3	232.1								125.7	534										4							4						0.3		0.3	3.4		1453.6	49
50	3	79	5.2	14.7	3.4							346.6	154.3								51.8	612		4.3								1.9							17.8						0.5	1.6	1.3	11.4		1305.8	50
51	3	87.3	6.7	4.8	1.5		4.1					289.5	164.2								181.4	610.3										1.2													0.7		0.8			1352.5	51
52	1	112.1	4.4	2.6	3.3		3.2					351.4	155.6								121.9	141.6										1.5							23.6						1	2.1	1	27.3		952.6	52
53	1	100.7	4.7	4.1	4.7							169.9	113.8								55.2	80.6	0.3	3.7								0.4							37.9					0.2			0.3			576.5	53
54	2	53.1	2.8	3.1	4.7		1					191.3	111.8								107.9	55.2		12								0.2							23.7					0.2			1.4			570.2	54
55	2	58.2	5	1.5	2.7		1.3					178.7	56.1								278.9	796.4	1.2	3.6								2											1.2				0.2			1387	55
56	1	167.3	6.9	3	2.6		1.5					347.5	159								110.8	28.9	1.5									1.4															0.1			830.5	56
57	1	202.2	8.4	5.8	1.4		10.8					206.8	226.7								47.2	84.6	2.1								0.5	1.2														2.1	1.2	8.3		809.3	57
58	2	200.9	6.2	7.2	1.6		16.9					240.9	193.9								35.5	40.9	2.5								0.6	2.8		3											1	2.1	1			757	58
59	2	147.8	8.3	3.1			25					136.9	172.9								42.9	14.1										1.4															1	8.3		561.7	59
60	1	226	7.1	3.5	1		28.5					152.3	103.6								84.4	23.2	2	3.2								4.6													1		0.2	10.6		651.2	60
61	1	236.9	8.6	6.6	1.8		30.7					230.8	174.2								23.5	18.1										3.2		2.9					3.6								2.3			743.2	61
62	2	210.5	9	5.8	2.4		23.1					269.9	298.4								16.5	1.7										3.9															0.7	2.6		844.5	62
63	2	252.1	15.6	30	0.8		41.6					310	198.2								9.5	333.1	4.3									6.2							4.7								2.2	7.1		1215.4	63
64	1	479.2	25.1	23.3	2.1		33.3					472.3	430.7								34.9	467.6	3.5							0.4	0.1	23.8											1.3			1.1	0.1	11		2009.8	64
65	1	311.9	9.1	11.4			61.5					272.3	193.9								33.6	888.3	0.6									12.1							5.4								2.9	9.8		1812.8	65
66	2	148.3	5.1	6.1			97.9					222.9	127.5								34.5	350.5	1.5	3.1								1.4							3.7								0.4			1002.9	66
67	2	211	4.9	5.7	2.1		32.4					159.3	144								52.6	360.4										2.2							5.6								0.1			980.3	67
68	1	286	6.7	8.7	0.8		15.1					232.2	289.7								19.7	63.8	1.7	3.1								2.7							25.5								3.3	5.3		964.3	68
69	1	160.2	3.1	9	0.7		12.2					212.2	172.3								27.6	32		2.8								8.3											1.6				0.6	15.8		658.4	69
70	2	183.2	6.3	13	2		14.1					185.5	185.5								21.4	32.8	0.5									3.4															2.8	14.6		665.1	70
71	2	134.6	6.1	13.7	0.5		66.3					1122	39.3								62.3	1541.8	0.7									3.1															1.6			2992	71
72	1	177.4	5.7	11.7			59.2				6.9	391.2	207.1								44.8	1176	1.1	2.5								8.2							12.4						0.8			9.3		2114.3	72
73	1	216.4	4.1	14.6			5.6					275.4	280.4								51.2	159.9										3.2							6											1016.8	73
74	2	157.1	2.4	4.9			6.4					264.3	67.8								29.9	19.8		5.3								3.1															1	16.8		578.8	74
75	2	179.3	6.2	4.2	1.5		4.2					154.2	161.5								34.7	117.1		3.4	0.1						0.1	3.9							8.6								1.7	2.2		682.9	75
76	1	274.7	10.3	17.6	1		8.5					245.3	149.7								55	157										9.1															4.7	19.6		952.5	76
77	1	389.9	9.3	26.1	2.6		5.3					305.2	171.7								28.2	92	4.6								0.1	1.7													1	1.1	8.9			1047.7	77
78	2	206.4	7.8	17.4	0.9		3.5					180.4	170.5								55.8	11.8									0.1	2.6											2.8		1		7.7	9.1		677.8	78
79	2	131.5	4.8	5.7	0.7		16.6					388.3	187.9								47.5	840		3.5								4.6				0.2			6					0.2	1.5		1.6	8.2		1648.8	79
80	1	201.4	12.6	11.6	1.1		18.4					551.1	265.5								57.7	1467.4		6.1	0.1						0.1	13.9							73.3				0.7		0.7	1.1	1.8			2684.6	80
81	1	15.9		1.1		135	1486.8		227.4			9.9		14.1	7.3						81		0.8				1				14.9	10.3								1.6							0.6			2007.7	81
83	2	14.2		0.4			422.5					1.9		16.7																															1.4		0.7			458.8	83
84	2	6.6		1.4			419.1			24.4				11.6							0.9		0.1		0.2																			0.2	0.9	12.4	0.1			477.9	84
85	1	16.2	0.4	1.1			754.4		134.2	152.9		0.6		70.3							5.4				0.6													0.7				0.2		0.1	0.5	5	0.1			1142.7	85
86	1	8.7		0.8			753.2		135.1	295.1				77.8											0.1					0.1							0.1								1.1	2.6				1274.7	86
87	2	5		0.7			502.9		7	29.9				13											0.1													0.8									0.1			559.5	87
88	2	12.8		0.2		4.3	1011.7		41.5	28.6						3.8					2				0.2			0.2			0.1						1.1				0.3	0.7			2.6	0.2				1110.3	88
89	1	17.6		0.4			2254.4		515.3	407.1				127.5		3.8				3					0.2		8.4	0.2	1.9	0.3	1						1.2	0.8			2.5	1.5			5.6	11.4				3364.1	89

prototype TED

haul	gear	sum fl.	4-spot	windowpn	winter fl	butterfly ra	clearnose	cownose r	eagle ray	roughtail st	torpedo ray	little skate	winter skat	angelshark	Dusky	night shark	sandbar	sand tiger	scalloped h	smth hamm	smth dogfi	spiny dogfi	b. sea bas	Bluefish	butterfish	croaker	kingfish	pinfish	puffer	red hake	scup	sea robin	shad sp.	atlantic stu	short sturge	silver hake	spot	stargazer	striped bas	tautog	triggerfish	weakfish	amcn lobst	blue crab	crab sp.	horseshoe	loligo	monk	mantis shrimp	Total wt.	haul
15	4	1.2		1.5		10.1	488.2		37.8	72.7		13.2	0.1								41				0.5							0.1						1									0.5			667.9	15
16	1	4.9					563.3		121.9	287.7		27.2	3.2	25.5				17.2			43.1																	2.6				0.1					0.2			1096.9	16
17	1	4.6		2.6			392.9		44.2	118.9		16.3	8.9	32.9							51.5				0.2													11.7								7.7				692.4	17
18	4	6.4		7.6		4.2	327.4		26.9	25.2		15.2	5.2	7.5							11.7											0.1						4.4								31.6	0.3			473.7	18
19	4	2		36.6			2			50		40.2	1.2												0.1							0.1															0.7			132.9	19
20	1	2.3		48.9					34.5	90		72.2	3.1								2.4			9.8								0.2													0.6		0.8			264.8	20
21	1	8.8	0.6	0.7			151.9		23.8	8.3		75.7	4								35.4		1.3		0.5							2.8						2.5							0.1		1.5			317.9	21
22	4	11.2		2.8			302.6		4.5	14.2		92.6	5.4								26.2		0.8		0.1													2.4								0.6	0.9			464.3	22
23	4	2.6	0.2	1.6		2.5	473.7		7.2			47.4	9.3								20.2	2.9			0.2							0.1						0.7								1	3.1			572.7	23
24	1	7.9		19.2			443.2		10.6			53.1	6.4								34											0.5															0.8	5		580.7	24

larger double cover opening

90	1	37.5		2.9		4.8	1591.2		521	318.4				22.3													4.1				0.1	0.2					0.5				2.3	0.2			8.8	44.1				2558.4	90
91	5	10				1.4	954.9		143.1	73.7				3							7						1.1										0.3				1.8				1.5	11.9	0.1			1209.8	91
92	5	10.6					1568		83.5	84				3.4							0.6						5.4				0.1						0.7								1.3	5.3				1762.9	92
93	1	23.8		0.8			1603.7		360.2	244.5				16.7		3.5					1.2						2.9				0.1	0.1					0.5								1.4	1.5	0.1			2261	93
94	1	2.9				31.8	886.2	83.4	140.6	111.6				14.8		3.5					1.2				0.1		0.7			0.1							0.1					0.2			0.8	55				1333	94
95	5	7		0.2		4.9	361.6	3.1	21.6	36.3															0.1		0.1			0.1							0.1								2	19			0.1	456.1	95

All lengths in cm

haul	gear	species / sum fl (sam. wt)	lengths
1	1	sum fl 10.5	53, 55, 56, 56, 26, 28, 40
2	2	no lengths	
3	2	sum fl 0.4	
4	1	sum fl 3.5	
5	1	sum fl 8.8	
6	2	sum fl 4.9	
7	2	sum fl 12.3	
8	1	sum fl 13.3	
9	1	sum fl 16.3	
10	2	sum fl 5.2	
11	2	sum fl 11.1	
12	1	sum fl 0.5	
13	1	sum fl 8.7	
14	3	sum fl 7.5	
15	4	sum fl 1.2	
16	1	sum fl 4.9	
17	1	sum fl 4.6	
18	4	sum fl 6.4	
19	4	sum fl 2	
20	1	sum fl 2.3	
21	1	sum fl 8.8	
22	4	sum fl 11.2	
23	4	sum fl 2.6	
24	1	sum fl 7.9	
25	1	sum fl — no data collected	
26	1	sum fl 4.1	
27	3	sum fl 2.7	
28	3	sum fl 9.1	
29	1	sum fl 5.8	
30	1	sum fl 12.3	34, 36, 36, 38, 39, 39, 43, 44, 46, 46, 51, 55, 56
31	3	sum fl 3.2	53, 41, 36
32	3	sum fl 24.2	
33	1	sum fl 24.2	
34	1	sum fl 36.8	
35	3	sum fl 10.6	
36	1	sum fl 13.9	
37	1	sum fl 21.6	
38	3	sum fl 7.7	
39	3	sum fl 20.7	
40	1	sum fl 43.6	
41	1	sum fl 24.8	
42	3	sum fl 10.1	
43	3	sum fl 20.4	
44	1	sum fl 19.1	
45	1	sum fl 104	
46	3	sum fl 9.9	44, 44, 46, 46, 62, 69
47	3	sum fl 36.8	
48	1	sum fl 97.4	
49	1	sum fl 107.6	
50	3	sum fl 79	
51	3	sum fl 7.7	
		species / sum fl	

haul	52	53	54	55	56	57	58	59	60	61	62	63
gear	1	1	2	2	1	1	2	2	1	1	2	2
species / sam. wt	sam. wt											
sum fl	112.1	100.7	53.1	58.2	167.3	202.2	200.9	147.8	226	336.9	210.5	252.1
		35	37	39	35	35	35	35	34	35	35	35
		37	39	39	35	35	36	35	36	36	35	35
		37	39	40	36	36	36	36	36	36	35	35
		37	40	40	37	36	36	37	36	37	36	36
		37	40	41	37	36	36	37	37	37	36	36
		38	41	43	37	36	36	37	37	37	36	36
		38	42	43	37	37	37	37	37	37	36	36
		38	42	43	37	37	37	37	37	37	37	36
		38	44	43	37	37	37	38	37	37	37	36
		39	46	43	38	37	37	38	37	37	37	36
		39	46	43	38	37	37	38	37	37	37	37
		39	46	45	38	37	37	38	37	37	37	37
		39	47	45	38	37	37	38	37	37	37	37
		39	47	45	38	37	37	38	37	37	37	37
		39	48	45	38	37	38	39	37	37	37	37
		39	48	46	38	37	38	39	37	38	37	37

haul	64	65	66	67	68	69	70	71	72	73	74
gear	1	1	2	2	1	1	2	2	1	1	2
species / sam. wt											
sum fl	237	138	148.3	113.5	130.3	160.2	118.1			124.5	157.1
	33	36	35	36	35	36	34	no lengths	no lengths	35	35
	35	36	35	36	36	36	36			35	35
	35	36	36	37	37	37	37			36	35
	36	36	36	37	37	37	38			37	36
	36	36	36	37	37	37	38			37	36
	36	36	36	37	37	37	38			37	36
	36	37	36	38	37	37	38			37	36
	37	37	37	38	37	37	38			37	36
	37	37	37	38	37	37	38			38	37
	37	37	37	39	38	38	38			38	37
	37	37	38	39	38	38	39			38	37
	37	37	38	39	38	38	39			38	37
	37	38	38	39	38	38	39			38	37
	37	38	38	40	38	38	39			38	37
	37	38	38	40	38	38	39			38	37
	37	38	38	40	38	38	39			38	37

haul	75	76	77	78	79	80	81	82	83	84	85
gear	2	1	1	2	2	1	1	2	2	2	1
species / sam. wt											
sum fl	179.3	123.2					15.9		14.2	6.6	16.2
	34	24	no lengths	no lengths	no lengths	no lengths	39	no lengths	38	39	42
	35	27					41		39	41	44
	36	27					42		41	43	44
	36	28					42		42	47	45
	36	28					43		43	49	48
	37	28					44		43	56	50
	37	28					44		43	clearnose 57.7	56
	37	28					44		46	28	57
	37	28					44		47	30	60
	37	28					46		48	30	68
	37	29					47		54	30	clearnose 66.7
	37	29					52		55	30	30
	38	29					56		56	30	31
	38	29					66		clearnose 128.6	30	32
	38	29					clearnose 125		31	32	32
	38	29					34		31	32	32

All lengths in cm

haul	86
gear	1
species	sam. wt
sum fl	8.7
26	
37	
42	
44	
46	
48	
51	
60	
clearnose	66.6
28	
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haul	87
gear	2
species	sam. wt
sum fl	5
42	
46	
46	
47	
47	
clearnose	54.8
27	
28	
29	
29	
29	
30	
30	
30	
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45	

haul	88
gear	2
species	sam. wt
sum fl	12.8
38	
43	
43	
45	
51	
66	
69	
clearnose	64.3
29	
31	
33	
34	
35	
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49	

haul	89
gear	1
species	sam. wt
sum fl	
messed up data	
recording	

haul	90
gear	1
species	sam. wt
sum fl	37.5
27	
27	
29	
29	
31	
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haul	91
gear	5
species	sam. wt
sum fl	10
36	
41	
42	
43	
44	
44	
46	
46	
48	

haul	92
gear	5
species	sam. wt
sum fl	10.6
28	
37	
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46	
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49	
50	
54	

haul	93
gear	1
species	sam. wt
sum fl	23.8
28	
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52	
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56	
65	

haul	94
gear	1
species	sam. wt
sum fl	2.9
37	
43	
43	
45	

haul	95
gear	5
species	sam. wt
sum fl	7
43	
44	
48	
49	
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52	

COMPARISON OF GEAR 1 AND 3: Gear 1 is the control net with no TED but an identical extension section, Gear 3 was the interim replacement standard TED rigged on the vessel

all weights in kilograms

haul	gear	sum fl.	4-spot	windowpn	winter fl	Sum Fl sp	butterfly ra	clearnose	cownose r	eagle ray	roughtail st	torpedo ray	little skate	winter ska	Sum skate
13	1	8.7	0.2	2.1		11.0		294.0		12.9	46.1		26.2	5.4	384.6
26	1	6.2	0.0	1.2	0.0	7.4	0.0	2.7	0.0	0.0		0.0	123.9	3.2	129.8
29	1	8.7	6.8	7.1	0.0	22.5	0.0	105.5	0.0	0.0		0.0	398.6	42.3	546.3
30	1	12.3	4.0	7.2		23.5		194.4					426.4	101.5	722.3
33	1	24.2	2.5	0.4		27.1		105.4			17.4		59.4	5.7	187.9
36	1	13.9		0.4		14.3		263.0		297.0	191.1		12.7		763.8
37	1	21.6				21.6	24.9	3441.8		344.8	96.3				3907.8
40	1	43.6		2.8		46.4	15.0	2156.0		417.6	679.9				3268.5
41	1	32.0	0.5	1.4	0.0	33.9	0.0	355.3	0.0	19.1		0.0	54.3	0.4	429.1
44	1	19.1		2.4		21.5		532.2		34.3			50.7		617.2
45	1	104.0	11.0	3.4	6.2	118.4		2.3				14.3	737.0	279.6	1033.2
48	1	97.4	6.8	6.0	2.1	110.2		1.2					306.5	287.5	595.2
49	1	107.6	6.2	4.9	3.8	118.7							427.3	232.1	659.4
52	1	112.1	4.4	2.6	3.3	119.1		3.2					351.4	155.6	510.2
14	3	7.5	1.3	5.8		14.6		106.1			11.3		34.9	6.4	158.7
27	3	4.1	0.0	0.6	0.0	4.7	0.0	4.2	0.0	0.0		0.0	62.6	9.8	76.5
28	3	13.7	2.6	2.3	0.0	18.5	0.0	85.1	0.0	0.0		0.0	336.2	81.6	502.8
31	3	3.2	2.2	3.6		9.0		111.1					258.8	36.2	406.1
32	3	24.2	2.4	2.0		28.6		0.0		7.6	6.5		55.0	3.9	73.0
35	3	10.6	0.6			11.2	4.0	224.8		18.1	10.0		8.7		265.6
38	3	7.7		0.3		8.0		1165.5		32.7	14.1				1212.3
39	3	20.7		0.7		21.4		1106.3		37.8	83.1				1227.2
42	3	13.0	0.4	0.3	0.0	13.7	0.0	459.2	0.0	0.6		0.0	34.2	0.3	494.3
43	3	20.4		0.6		21.0		351.2		5.1			31.1	0.4	387.8
46	3	9.9	1.4		0.7	11.3		0.0					13.7	11.9	25.6
47	3	36.8	3.5	1.5		41.8		0.0					246.6	283.8	530.4
50	3	79.0	5.2	14.7	3.4	98.9							346.6	154.3	500.9
51	3	87.3	6.7	4.8	1.5	98.8		4.1					289.5	164.2	457.8

haul	angelshar	Dusky	night shar	sandbar	sand tiger	scalloped	smth ham	smth dogf	spiny dogf	Sum shark	b. sea bas	Bluefish	butterfish	croaker	kingfish	pinfish
13								45.9	0.0	45.9	0.1		0.1			
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83.6	3.9	87.5	0.0	0.0	0.3	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	75.0	80.9	155.9	0.0	0.0	0.2	0.0	0.0	0.0
30								161.5	260.2	421.7			0.1			
33	21.3							38.7		60.0			0.5			
36	125.7					7.6				133.3			0.1			
37	6.0							16.7		22.7	0.1		0.2	0.2	21.4	0.1
40	81.7				21.0			15.5		118.2	0.2		4.5	0.7	13.7	0.1
41	0.0	0.0	0.0	14.1	0.0	0.0	0.0	50.3	0.0	64.4	0.0	0.0	0.0	0.0	0.0	0.0
44					12.4			98.5		110.9						
45								252.0	1233.1	1485.1		16.5	0.1			
48								121.8	839.0	960.8	2.7					
49								125.7	534.0	659.7						
52								121.9	141.6	263.5						
14								32.9	3.3	36.2			0.5			
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	318.5	34.1	352.5	0.0	0.0	0.2	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	103.4	85.4	188.7	0.2	0.0	0.2	0.0	0.0	0.0
31								113.0	109.2	222.2						
32								39.2		39.2			0.1			
35	13.5							3.5		17.0						
38								4.6		4.6			0.4		4.2	
39	11.0							5.2		16.2	0.1		1.6	0.1	18.2	0.1
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	171.1	0.0	171.1	0.0	0.3	0.0	0.0	0.0	0.0
43								76.8		76.8		5.7				
46								52.6	896.7	949.3	0.7					
47								98.2	820.7	918.9	1.7	9.0				
50								51.8	612.0	663.8		4.3				
51								181.4	610.3	791.7						

haul	puffer	red hake	scup	sea robin	shad sp.	atlantic stu	short sturg	silver hake	spot	stargazer	striped ba	tautog	triggerfish	weakfish	Sum rnd f
13										7.2					7.4
26	0.0	0.0	0.0	4.7	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	6.3
29	0.0	0.2	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
30		0.3		0.8											1.2
33		0.1		0.1											0.7
36			0.1	0.1									0.8		1.1
37			0.7												22.7
40		1.4	1.3							0.7			1.1	8.9	32.6
41	0.0	0.0	0.0	26.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.7
44				15.2											15.2
45			0.1	1.9				0.3							18.9
48				6.5							30.1				39.3
49				4.0							4.0				8.0
52				1.5							23.6				25.1
14										15.9					16.4
27	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	3.3
28	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8
31		0.2		0.2											0.4
32		0.2		0.5						4.8					5.6
35															0.0
38			0.2	0.1					0.5					0.4	5.8
39		0.3	1.7						0.6				1.5	1.9	26.1
42	0.0	0.0	0.0	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1
43			0.1	9.1											14.9
46								0.1							0.8
47			0.2	1.2							7.8				19.9
50				1.9							17.8				24.0
51				1.2											1.2

haul	amcn lobs	blue crab	crab sp.	mantis shr	Sum Arthr	horseshoe	loligo	monk	Total wt.	haul
13			0.7		0.7	10.0	0.4	2.4	462.4	13.0
26	0.0	0.0	0.0	0.0	0.0	4.5	0.6	0.0	236.0	26.0
29	0.0	0.0	0.0	0.0	0.0	22.5	0.9	12.2	761.4	29.0
30					0.0	5.4	0.4	3.8	1178.3	30.0
33					0.0	2.1	3.5		281.3	33.0
36					0.0		0.1		912.6	
37					0.0	14.1	0.1		3989.0	
40					0.0	10.1	0.1		3475.9	
41	0.0	0.0	0.9	0.0	0.9		0.8		555.7	
44					0.0		0.3		765.1	
45					0.0	1.4	0.2	52.7	2716.1	
48			0.5		0.5		0.6	5.5	1714.3	
49			0.3		0.3		0.3	3.4	1453.6	
52			1.0		1.0	2.1	1.0	27.3	952.6	
14					0.0	3.0	0.2		229.1	14.0
27	0.0	0.0	0.0	0.0	0.0	3.0	0.2	0.0	440.1	27.0
28	0.0	0.0	0.0	0.0	0.0	3.3	0.6	13.4	732.0	28.0
31		0.1			0.1	20.8	0.7	2.1	661.4	31.0
32	0.3				0.3	4.3	2.0		153.0	32.0
35					0.0		0.9		294.7	
38					0.0	2.8			1233.5	
39					0.0		0.2		1291.1	
42	0.0	0.0	0.0	0.0	0.0				686.2	
43					0.0		0.4		500.9	
46					0.0				987.7	
47			0.5		0.5		0.1	5.4	1517.0	
50			0.5		0.5	1.6	1.3	11.4	1305.8	
51			0.7		0.7		0.8		1352.5	

t-Test: Paired Two Sample for Means
summer flounde

	Variable 1	Variable 2
Mean	43.66729	24.14493
Variance	1740.496	707.2126
Observatio	14	14
Pearson C	0.762422	
Hypothesi	0	
df	13	
t Stat	2.656736	
P(T<=t) or	0.009878	
t Critical o	1.770933	
P(T<=t) tw	0.019757	
t Critical tw	2.16036	

0.447071

8.7	7.5
6.2	4.1
8.7	13.7
12.3	3.2
24.2	24.2
13.9	10.6
21.6	7.7
43.6	20.7
32.0	13.0
19.1	20.4
107.6	79.0
112.1	87.3

t-Test: Paired Two Sample for Means
summer fl. less two tow

	Variable 1	Variable 2
Mean	34.16183	24.27742
Variance	1364.996	802.7713
Observatio	12	12
Pearson C	0.97188	
Hypothesi	0	
df	11	
t Stat	2.968493	
P(T<=t) or	0.00639	
t Critical o	1.795885	
P(T<=t) tw	0.01278	
t Critical tw	2.20098	

0.289341

t-Test: Paired Two Sample for Means
clearnose skat

	Variable 1	Variable 2
Mean	573.60892	278.2762
Variance	1070172.5	165937.3
Observatio	13	13
Pearson Co	0.9477216	
Hypothesiz	0	
df	12	
t Stat	1.6101368	
P(T<=t) one	0.0666714	
t Critical on	1.7822875	
P(T<=t) two	0.1333429	
t Critical tw	2.178812	

0.5148678

t-Test: Paired Two Sample for Means
roughtail ray

	Variable 1	Variable 2
Mean	206.16	25
Variance	74493.79	1062.34
Observatio	5	5
Pearson C	0.973269	
Hypothesi	0	
df	4	
t Stat	1.678561	
P(T<=t) or	0.08427	
t Critical o	2.131847	
P(T<=t) tw	0.168539	
t Critical tw	2.77644	

0.878735

t-Test: Paired Two Sample for Mear
spny dog

	Variable 1	Variable 2
Mean	343.6322	352.4
Variance	192654.8	140917.1
Observatio	9	9
Pearson C	0.874816	
Hypothesi	0	
df	8	
t Stat	-0.1236	
P(T<=t) or	0.452341	
t Critical o	1.859548	
P(T<=t) tw	0.90468	
t Critical tw	2.30600	

-0.02552

t-Test: Paired Two Sample for Means
roundfish

	Variable 1	Variable 2
Mean	14.74307	9.306786
Variance	167.2205	83.31318
Observatio	14	14
Pearson C	0.423045	
Hypothesi	0	
df	13	
t Stat	1.657129	
P(T<=t) or	0.060708	
t Critical o	1.770932	
P(T<=t) tw	0.121416	
t Critical tw	2.16036	

0.368735