Testing of a Soft TED as a Bycatch Reduction Device

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Acknowledgements

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Abstract

A cooperative study was conducted with commercial fishermen in 1997 in which a soft Turtle Excluder Device (TED) was tested for its potential as a bycatch reduction device (BRD) for finfish and other marine fauna incidentally captured in commercial shrimp trawling operations. A pilot study conducted during spring 1997 indicated that a similar gear was successful in reducing bycatch while shrimp catches actually increased. A full-scale study of a soft TED that had recently been certified for use the National Marine Fisheries Service was conducted during late summer and fall. A soft-TED equipped trawl was tested against a standard hard-TED (metal grate) equipped net on a double-rigged trawler. Thirty tows of roughly three hours each were conducted during regular shrimp trawling activities off Charleston, South Carolina. A protocol developed by the South Atlantic Fishery Management Council was employed to test the gear as a BRD. This protocol requires at least thirty valid tows and for a tow to be valid, at least one Spanish mackerel, *Scombermorus maculatus,* and five weakfish, *Cynoscion regalis,* must be captured in the control (hard TED) net. Only 26 tows were valid for weakfish and 18 tows for mackerel. The protocol requires release rates of 40% for mackerel and weakfish. We found average release rates for weakfish of 20.8% by number and 33.3% by weight. Spanish mackerel release rates, for the valid tows only, were 77.3% by number and 75.0% by weight. White shrimp, *Penaeus setiferus* were reduced by 12.3% by weight. Average release rates for other species were 24.1 % for spot, *Leiostomus xanthurus,* 48.2% for Atlantic croaker, Micropogohis *undulatus,* 72.0% for Atlantic menhaden, *Brevoortia tyrannus,* and 56.5% for southern flounder, *Paralichthys lethostigma.* Lower release rates were found for other species, many of which were represented by small individuals. Although the testing was not adequate to pass the soft TED as a BRD, substantial quantities of fish and invertebrates were released by the soft TED. This study further suggested that the inability of small fish to escape a BRD was because they were apparently incapable of maintaining swimming speeds that would allow them to find exits. We also found that the current BRD protocol is cumbersome and may dissuade fishermen and net designers from testing better BRDs. Specific problems and recommendations are provided.

Introduction

Bycatch reduction, particularly for finfish, in the penaeid shrimp trawl fishery of the United States has been an ongoing objective of conservationists, fishermen, and fisheries managers for several years. Many have expressed concerns that recruitment or growth overfishing of some finfish populations could be, in part, attributed to the shrimp trawl fishery. Use of bycatch reduction devices (BRDs) in 1996 was mandated by South Carolina state law (SC Code 50-17-423) in response to Amendment 3 of the Atlantic

States Marine Fishery Commission (ASMFC)1 weakfish fishery management plan. It was hypothesized that juvenile weakfish from the "South Atlantic" region are recruited to the adult, reproducing population north of Cape Hatteras. Additionally, the South Atlantic Fishery Management Council (SAFMC) has expressed concern regarding the bycatch of finfish, particularly king *(Scomberomorus cavalla)* and Spanish *(S. maculatus)* mackerels.

Another conservation requirement on the shrimp trawl fishery was the mandatory use of turtle excluder devices (TEDs), beginning in 1988 in South Carolina (SC Code 50 17-685). These devices can be grouped into two categories -- hard TEDs and soft TEDs. Hard TEDs are typically metal grates that are sewn into a trawls tailbag at an angle. Hard TEDs force sea turtles up or down, depending upon the design, and through a hole in the net. Soft TEDs are made entirely of large-mesh webbing which is also sewn into the tailbag at an angle. Soft TEDs typically direct turtles and other large animals or objects to a hole in the top of the net. Both types of TEDs are effective in eliminating some vertebrate and invertebrate species, particularly the larger individuals.

In spring 1997 soft TEDs were decertified by the National Marine Fisheries Service (NMFS) due to reports of improperly functioning TEDs and continued high stranding rates of turtles. NMFS was particularly concerned that juvenile turtles may become entangled in the mesh of the soft TED. Members of the commercial shrimp industry, including representatives from South Carolina, requested that NMFS assist in testing some modified soft TEDs with the aim to re-certify a version(s) that would pass the "small sea turtle testing protocol." In spring 1997, a modified Morrison soft-TED was tested off Panama City, Florida and passed the protocol for small sea turtles.

South Carolina shrimpers asserted that soft TEDs could be very efficient bycatch reduction devices. SCDNR agreed to collect data on potential bycatch reduction capabilities of the recently certified soft-TED. In May and June 1997 preliminary testing was done by SCDNR off the coast of Charleston. Based upon these initial observations, full scale testing of a modified soft-TED as a bycatch reduction device was conducted from September to December 1997. This paper reports the results of the initial pilot study and the full-scale testing of the soft-TED.

Methods

Spring Pilot Study

Sampling was conducted in May and June 1997 comparing catches from a 13.0m mongoose trawl (with standard 4.7-cm stretch mesh) fitted with a 15.2-cm stretch mesh soft-TED against an identical trawl fitted with a "super shooter" hard TED and a 15.2-cm X 30.4-cm "fisheye" bycatch reduction device (BRD) sewn into the bag. Six tows of approximately three hours duration were made in nearshore waters off Charleston. Total catches were weighed, and finfish and shrimp from a one-basket subsample were separated and weighed. Weakfish, Spanish mackerel, and southern kingfish, *Menticirrhus americanus* were enumerated.

' Mercer, L.P. 1994. Fishery management plan for weakfish *(Cynoscion regalis)* fishery. ASMFC Fisheries Management Report No. 7. North Carolina Department of Natural Resources and Community Development. Division of Marine Fisheries Special Scientific Report No. 46. 129pp.

Full-scale Soft TED Study

The full-scale sampling study was conducted from 3 September through 15 December 1997 with a soft TED that passed the "small sea turtle testing protocol" during summer 1997. This soft TED was constructed of 20.0-cm mesh in the body with 10.0-cm mesh panels along the sides where the TED attaches to the trawl net. All sampling was conducted within 4 miles of the coast north of the Charleston jetties off Sullivan's Island aboard the commercial shrimp trawler "Lowcountry Lady". The trawler fished with four twin-rigged trawls (two on each side of the vessel). The outer trawl on each side served as the experimental and control net, respectively. Thirty tows were conducted with tow times of approximately three hours (+/- 19 minutes) providing roughly 90 hours of total towing time. The experimental and control nets were switched to the opposite sides of the boat after 15 trawl tows had been completed. Catches were analyzed using the newly adopted SAFMC BRD Testing Protocol of March 19972. Total catches were weighed from the net equipped with the experimental, modified Morrison soft TED and the control net equipped with an aluminum super-shooter hard TED. Fisheyes measuring 30.4-cm X 15.2 cm were present in both nets, but were rendered non-functional to focus only on TED effectiveness and bycatch reduction. The entire catch from the control net and experimental net was equally distributed in baskets, and one basket was selected as a subsample for each net. The contents of these baskets were analyzed by separating and weighing commercial shrimp species, finfish, and miscellaneous invertebrates. High priority finfish species were sorted, weighed and enumerated by species. Total catches of these finfish species for each trawl tow were estimated by extrapolating the total catch from the sub-sample. The highest priority finfish (target) species, weakfish and Spanish mackerel, were counted, weighed and measured (up to 30 individuals per net) from both the subsample and the entire remaining catch, while white shrimp were weighed from both the subsample and the entire catch. Based on SAFMC protocol, a tow was considered valid for weakfish if five or more individuals were in the control net's catch. At least one Spanish mackerel in the control net was required for a tow to be valid for mackerel. Reduction rate for statistical testing was calculated for each target species for each tow by subtracting the number or weight observed in the experimental (soft TED) net from that of the control net, then dividing by the number or weight in the control net. Overall percent reduction for all species was calculated by subtracting total number and weight in total combined experimental tows from total control tows then dividing total catch by total catch of control tows. A modified t-test was used to test for statistical significance (PS20.10) for the two target finfish species, and the Kolmogorov-Smimov test (Pn0.05) was used to compare length frequency distributions of weakfish in control and experimental gears.

Results

Spring Pilot Study

Data collected in preliminary sampling during spring revealed an overall 40.7 reduction in weight of total catch in the soft-TED trawl, a 34.7% reduction by weight in

[2] Bycatch reduction device testing protocol manual. South Atlantic Fisheries Management Council, Charleston, S.C. 1997. 34 pp.

finfish catch, and a 35.7% increase in shrimp catch by weight (N=6). Low numbers of weakfish and Spanish mackerel (less than one per tow) precluded further analysis for these species. Catch rates of southern kingfish (the only other fish species examined) were virtually identical (56.9 individuals per hour per basket for the hard TED versus 57.5 individuals per hour per basket for the soft TED).

Full Scale Soft TED Study

Total catches were noticeably different between the experimental and control nets. The total volume of catches taken with the soft TED was often approximately half that of the hard TED. Of 30 tows made between 3 September and 15 December 1997, 26 were valid for weakfish and 18 for Spanish mackerel. Differences in catch rates in the experimental gear ranged from an 77.3% reduction for Spanish mackerel to a 160.3% gain in silver seatrout (Table 1).

Several finfish species, based on extrapolated subsample data, demonstrated good rates of reduction (Tables 1 and 2). Atlantic croaker, Atlantic menhaden, and southern flounder, all had reduction rates above 40% by number and 50% by weight. Spot, experienced a 24.1% reduction rate by number and 14.3% by weight. An exception was silver seatrout, *Cynoscion nothus,* for which the catches by number were 160.3% higher in the experimental TED and 117% higher by weight. These were relatively small fish, averaging 159 fish/kg (6.3 g each) in the soft TED net and 132.5 fish/kg (7.5 g each) in the hard TED net, suggesting that a portion of the larger fish were escaping in the soft TED net. Kingfish (whiting) catches by number were also higher in the experimental TED by 21.9%, yet showed a small reduction of 3.7% by weight. Small individuals also dominated the catch of this species. Casual observations on catch of sharks in trawls assumed that most were Atlantic sharpnose, *Rhizopriodon terranovae,* chiefly small individuals < 0.5 kg in weight, although unidentified larger sharks were landed and sold at dockside.

Overall reduction for all fish species combined (by weight) in the soft-TED equipped net was calculated to be 21.1%, shrimp loss was 12.3% (Table 2), and the remainder (miscellaneous invertebrates) was reduced by 30.5%. Weakfish reduction in the 24 valid tows was 20.8% by number and 33.3% by weight (Fig. 1 a and 1 b). An average reduction rate of 26.2 % was calculated by individual tow (Appendix 1). Results of the Kolmogorov-Smimov test revealed significant differences (PQ0.05) among total lengths of weakfish captured between the two gear. Relatively larger fish, 13cm or larger, were apparently released in greater numbers through the soft TED (Fig. 2). Although few weakfish 20 cm or greater were taken in this study, reduction rates were generally above 40% for these size classes (Fig. 3).

We collected a total of 218 Spanish mackerel in the 30 tows with the control net compared to 36 in the experimental net. However, the control net had one or more mackerel in only 18 tows, resulting in reduction rates of 77.3% by number and 75.0% by weight. Size distribution of Spanish mackerel did not vary noticeably between the two gears, but reduction rates were good for most size classes (Fig. 4).

Table 1. Average number of individuals per tow and reduction rates of fish species collected in trawls equipped with hard and soft TEDs, 3 September-15 December 1997. Negative reduction rates indicate an increase in catch per unit effort in the experimental gear. (White shrimp were not enumerated).

Species	**Hard TED**	**Soft TED**	**Reduction Rate reduction)**
Weakfish*	36.0	28.5	20.8
Spanish Mackerel*	8.8	2.0	77.3
Spot	61.8	46.9	24.1
Atlantic Croaker	36.3	18.8	48.2
Kin ish (Whiting)	223.8	272.7	-21.9
Menhaden***	46.1	12.9	72.0
Southern Flounder	4.6	2.0	56.5
Summer Flounder	2.0	2.2	-10.0
Silver Seatrout	79.5	206.9	-160.3

Table 2. Average weight (kg) per tow and reduction rate of fish species collected in trawls equipped with hard and soft TEDs, 3 September-15 December 1997. Negative reduction rates indicate an increase in catch per unit effort in the experimental gear.

Species	**Hard TED**	**Soft TED**	**Reduction Rate (% reduction)**
White Shrim	26.9	23.6	12.3
Weakfish*	0.9	0.6	33.3
Spanish Mackerel"	0.4	0.1	75.0
Spot	2.1	1.8	14.3
Atlantic Croaker	1.5	0.7	53.3
Kin ish (Whiting)	8.1	7.8	3.7
Southern Flounder	0.8	0.3	62.5
Summer Flounder	0.3	0.3	-----
Silver Seatrout	0.6	1.3	-116.7
Menhaden***	2.2	0.7	68.2
Total Fish	30.7	24.2	21.1

* for 26 valid tows
** for 18 valid tows
* * * taken in later tows

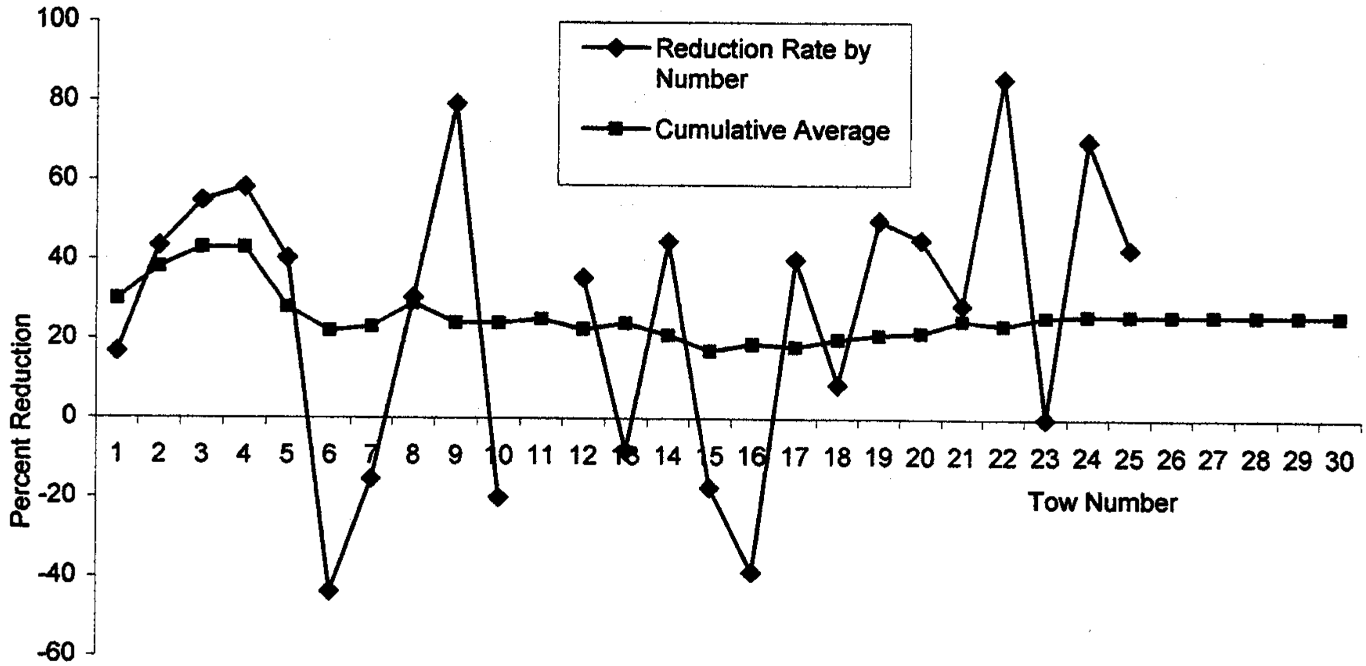

Figure 1a. Reduction rates of weakfish, *Cynoscion regalis*, by number in the trawl equipped with the soft TED.

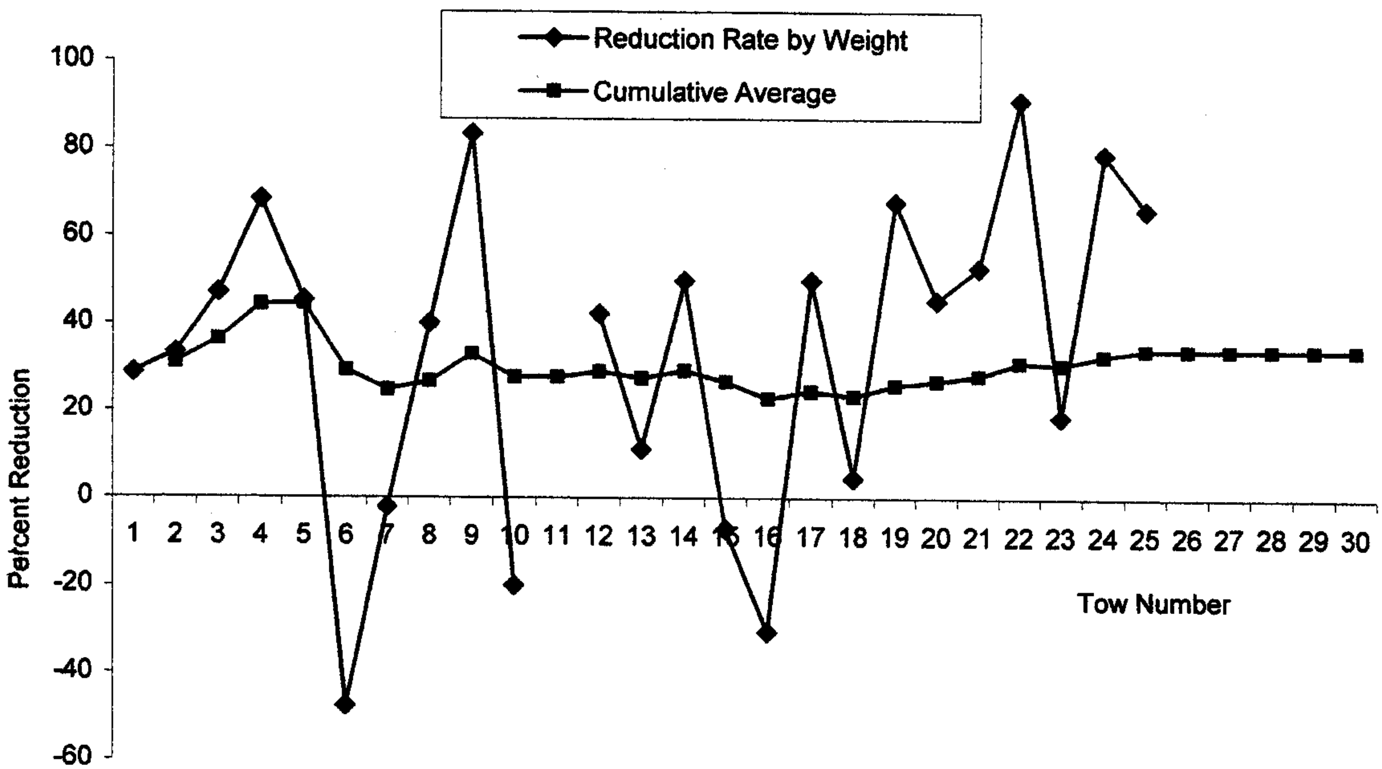

Figure 1b. Reduction rates of weakfish, *Cynoscion regalis*, by number in the trawl equipped with the soft TED.

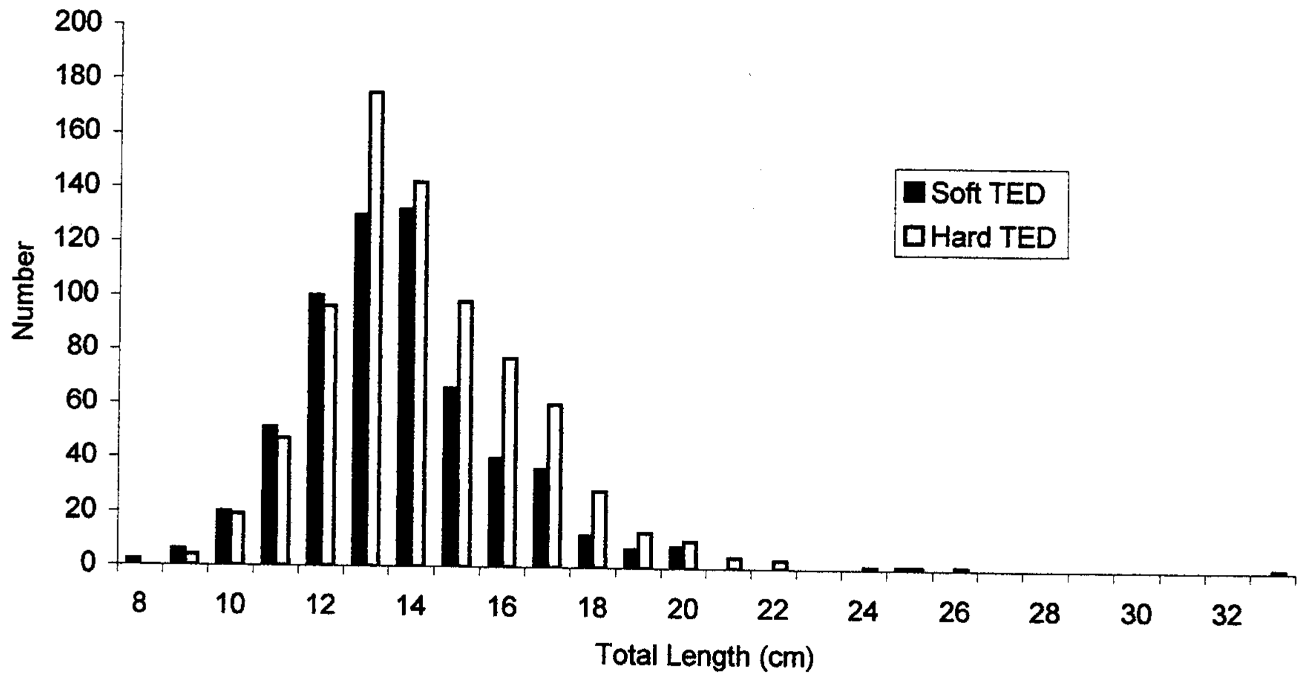

Figure 2. Length frequency of weakfish, *Cynoscion regalis,* collected in trawls equipped with hard and soft TEDs.

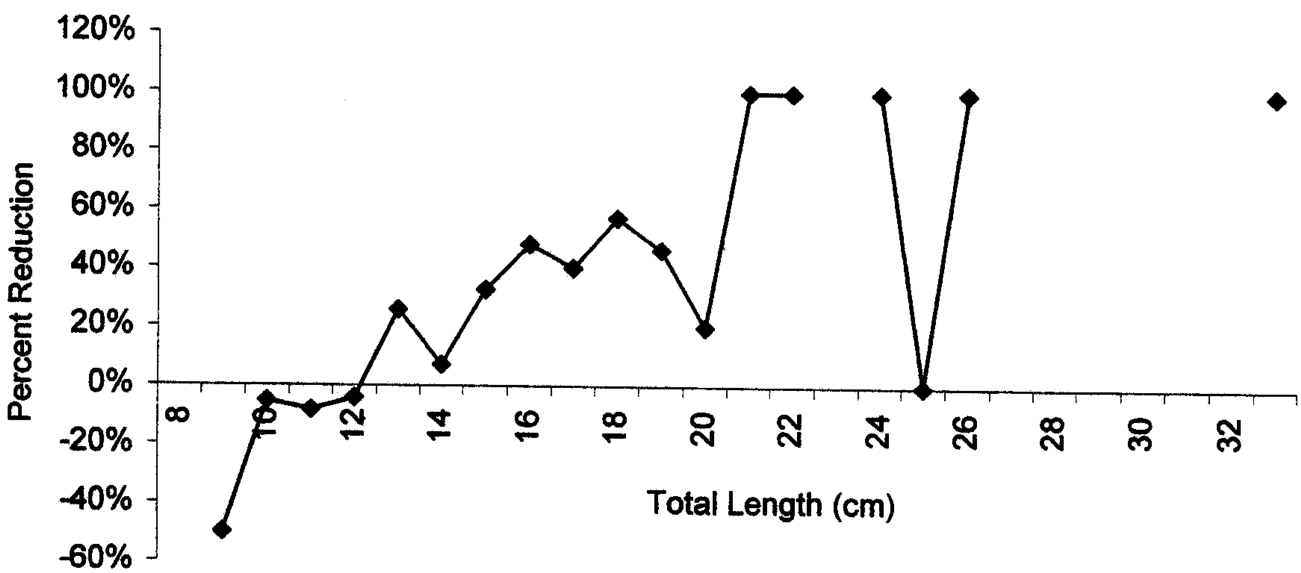

Figure 3. Reduction rates of weakfish, *Cynoscion regalis,* by size class in trawls equipped with the soft TED (see Fig. 2 for number of measured by size class).

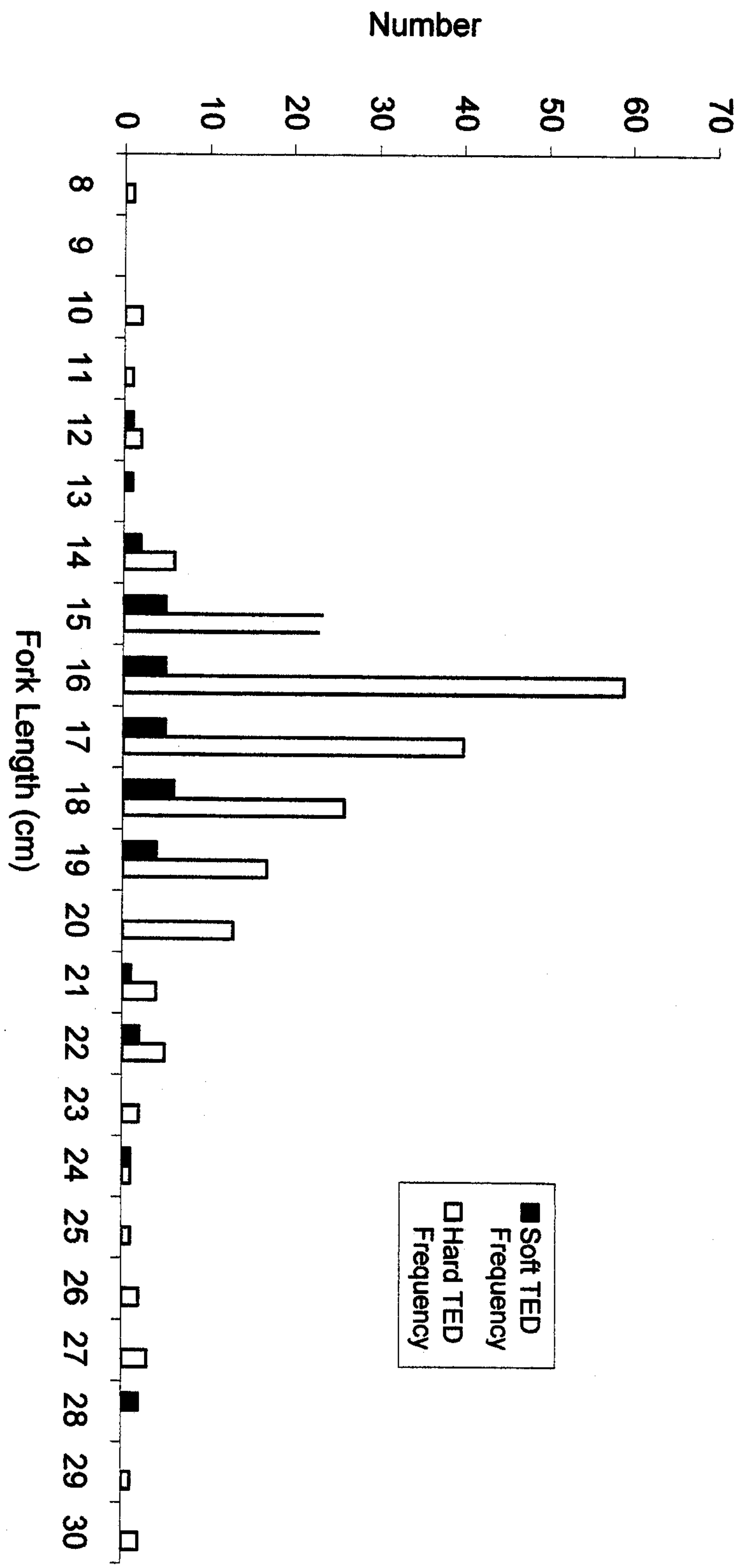

Figure 4. Length frequency of Spanish mackerel, *Scomberomorus maculates*, collected in trawls equipped with the hard and soft TEDs.

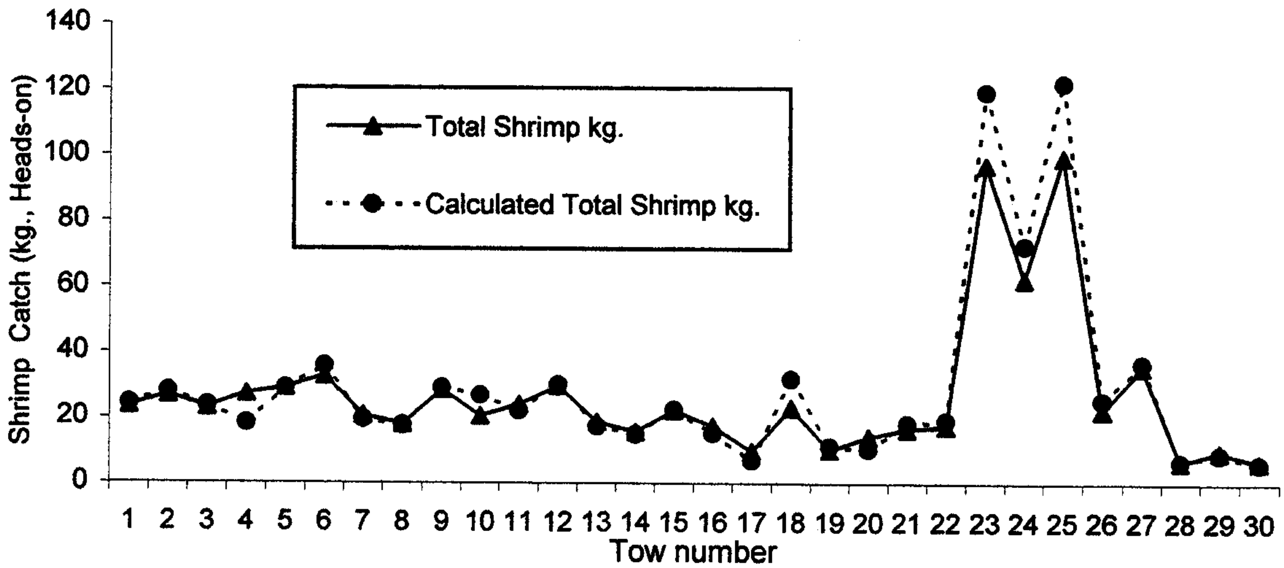

Figure 5a. Total catch of shrimp taken in the trawl equipped with hard TED compared to the quantity of shrimp estimated from subsamples.

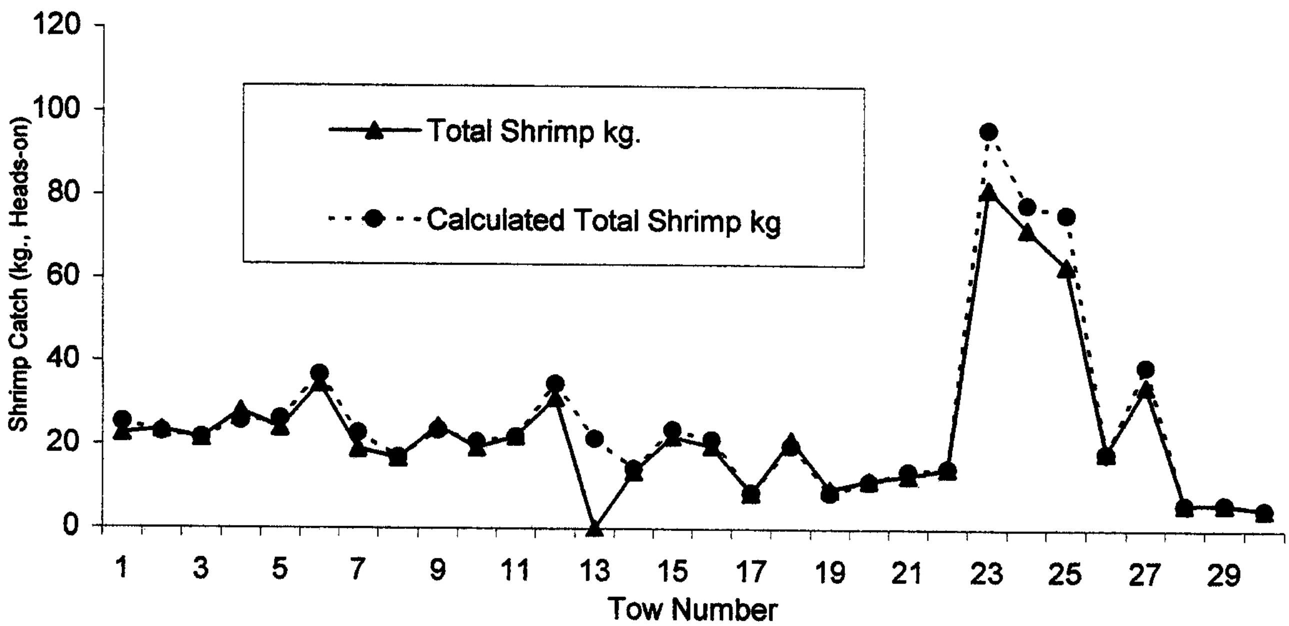

Figure 5b. Total catch of shrimp taken in the trawl equipped with soft TED compared to the quantity of shrimp estimated from subsample.

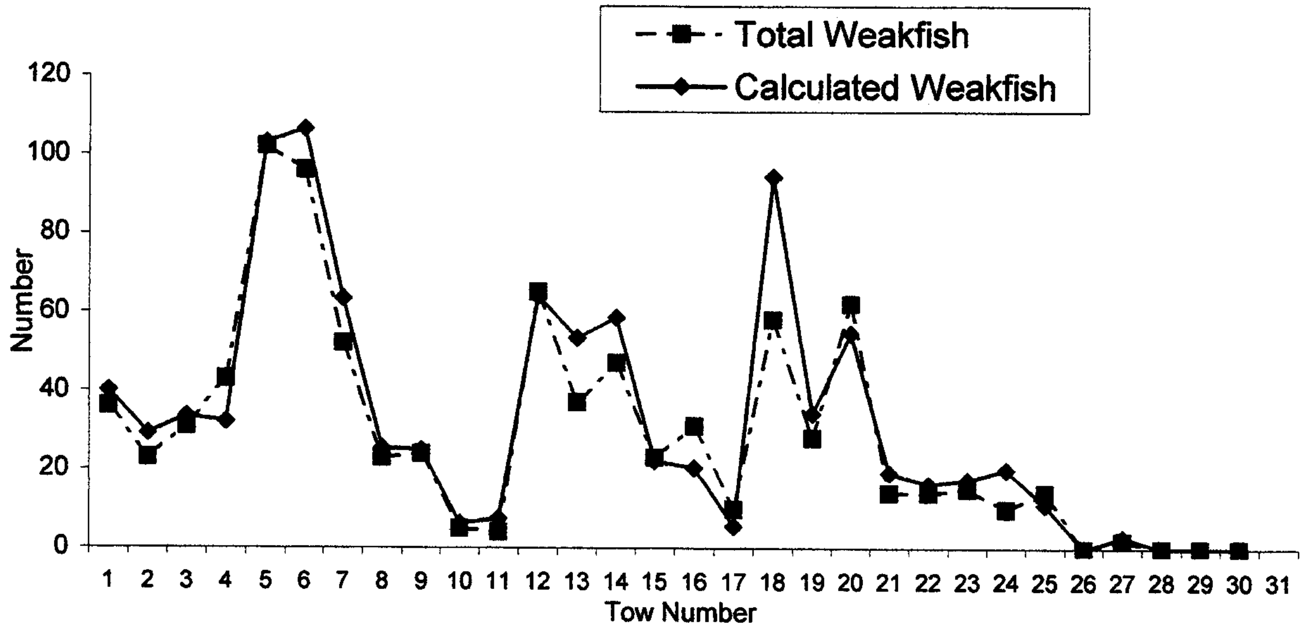

Figure 6b. Total catch of weakfish, *Cynoscion regalis*, taken in the trawl equipped with the hard TED compared to quantity of weakfish estimated from subsamples.

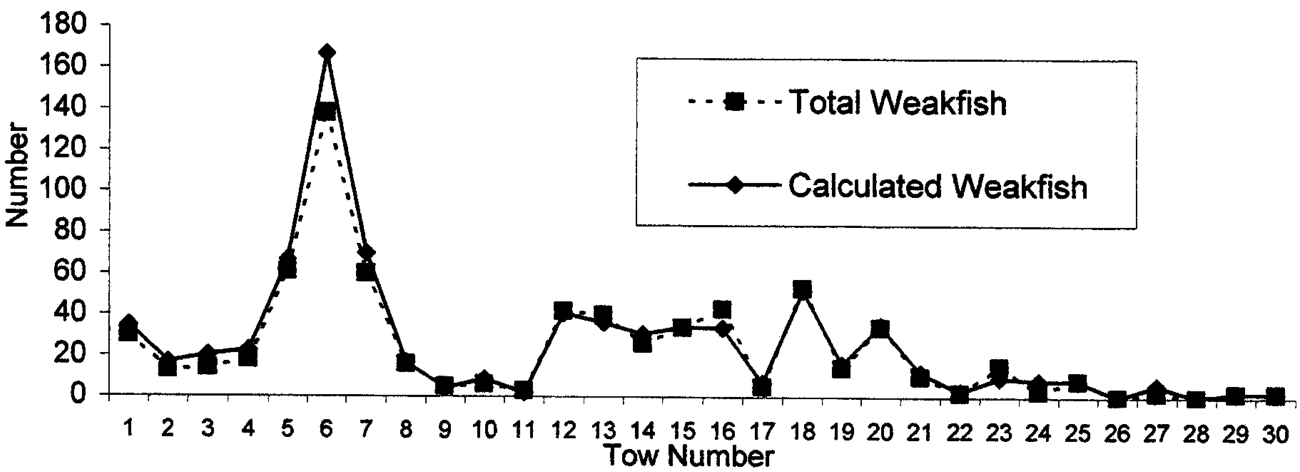

Figure 6b. Total catch of weakfish, *Cynoscion regalis*, taken in the trawl equipped with the soft TED compared to quantity of weakfish estimated from subsamples.

A total of 43 King mackerel was taken in six tows in the control net, and 10 in the experimental soft-TED equipped net, for a reduction of 76.7% by number.

Weakfish, Spanish mackerel, and white shrimp from subsample baskets were examined in relation to total catch to estimate the predictability of estimating total catch from sub-samples. For white shrimp and weakfish, the subsample was found to be a relatively accurate predictor of total catch (Figs. 5-6). Too few mackerel were taken for comparison.

Discussion

The spring 1997 pilot study using a soft TED with six-inch mesh provided encouraging results with substantial release rates of finfish (-34.7%), and an unanticipated large increase in catch rates of white shrimp (+35.7 %). Although weakfish and mackerel were too rare in the samples to judge the gear in terms of reduction rates for those species, the gear appeared worthy of further testing. The dramatic increase in shrimp catch rates in the soft-TED net may suggest that the net was fishing more efficiently than the control net, perhaps sweeping more bottom because of less non-shrimp weight in tailbag. If this assumption is made, the net may have been releasing much more finfish if each net encountered fish and shrimp in the same proportion Unfortunately, the 15.2-cm mesh TED had not been approved for sea turtles, so the soft TED with a combination of 10.0-cm and 20.0-cm mesh was utilized in the full-scale study. (The 15.2-cm TED was approved in fall of 1997).

The full-scale study of the modified Morrison (soft) TED found that the gear can be effective in reducing bycatch in shrimp trawls. The soft TED, which was originally designed to reduce the catch of cannonball jellyfish has been said to be effective in fish release - releasing many finfish (S. Morrison (pers. comm.), 1997; Harrington and Vendetti, 1995). We observed an overall release rate of 21.1 % (by weight) and shrimp loss of 12.3% compared to the hard TED. Some shrimp trawler captains prefer to use the soft TED despite the shrimp loss because the soft TED is easier to handle and maintain. Use by the shrimping industry of the soft TED examined in this study should help contribute to resolving the finfish bycatch problem. It is unknown how many fish would have been released by the BRDs, had they been functional. Additional study is required to assess the cumulative release rate of approved BRDs and soft TEDs.

The soft TED tested in this study falls short of the SAFMC protocol requirements for certification of new BRDs, in two respects for weakfish. Only 24 of the required 30 tows were considered valid with five or more fish in the control net. Additionally, the reduction rate of 20.1 percent for numbers of weakfish was well below the minimum of 40 percent required in the protocol. However, analysis of reduction rates by fish size, indicates that fish 17 cm and greater were usually released at a rate greater than 40 percent.

The overall reduction rate for Spanish mackerel (77.3%) was well above the 40 percent required in the SAFMC protocol. Unfortunately, mackerels were too rare in the catches to meet certification requirements, with only 18 of 30 tows having at least one mackerel in the control net. The limited data for king mackerels also suggested that the gear was highly effective in reducing that species. Mackerels caught during this study were relatively uniform in size (averaging about 17 cm), thus no obvious relationship between size and reduction rate was determined.

Because the reduction rate for weakfish fell well short of the specified 40% reduction in number of weakfish, it is unlikely that six additional "valid" tows would have resulted in the reduction rate equaling or exceeded the critical 40% level. It is highly likely, however, that thirty valid tows for Spanish mackerel would satisfy the protocol's requirement for that species.

We found a trend that suggested better reduction rates for larger weakfish than smaller weakfish. This is contrary to Branstetter's (1997) analysis of other South Atlantic BRD studies which, for unknown reasons, indicated that small fish were released by BRDs at higher rates than were large fish. He pointed out that average size of weakfish from sampling in South Carolina differed seasonally and also annually during the same seasons. He also noted that size of weakfish could be highly site specific. A previous study in Charleston Harbor with fisheye BRDs found that fish in the BRD net in all one-cm size classes greater than 11 cm were consistently less numerous than were fish in the control net (Whitaker et al, 1992), suggesting that larger fish escaped more readily through the BRD.

Intuitively, one would assume that larger, more strongly swimming fish would be more capable of maintaining position in a moving trawl, thus allowing them to find exits more easily. Watson et al. (1993) state, "Escapement of fish through the use of BRDs depends on the ability of the fish to sustain a swimming speed equal to, or exceeding the relative flow within the net." A standard estimate for swimming speed in fish is 10 times the body length in feet per second (Lagler, et al. 1962). For a 10-cm fish (0.3 ft), the estimated swimming speed is 1.9 knots (100.0 cm/sec). For a 12-cm fish (0.4 ft), the estimated swimming speed is 2.3 knots (120.1 cm/sec). Shrimp trawlers working off South Carolina typically travel at about 1 to 4 knots over the bottom, depending upon whether they are towing with or against the tidal current. However, speed relative to the water is usually around 2 to 2.5 knots. Using the above estimates, it would appear unlikely that fish less than 12 cm total length would be capable of maintaining position in a shrimp trawl in order to locate BRD exits. Juvenile red snapper tested in BRDs in the Gulf of Mexico were found to be incapable of producing the needed sustainable speed to keep constant position in a net if they were less than 11 cm (Branstetter, 1997).

The apparent ability of larger fish to be more successful in escaping through the soft TED examined in this study, and in other BRD studies, indicates that although the overall reduction rate of 40% by number is not being attained, the other objective of a reduction of 50% in fishing mortality may be attainable. This has been suggested to be the case in the Gulf of Mexico for juvenile red snapper (Branstetter, 1997). Although most weakfish captured in the South Atlantic shrimp trawl fishery are of the zero year class, some may be Age I's (Walton, 1996), and as fish become older and larger, their reduction rates by BRDs increase. A detailed examination of catch rate reductions for discreet size classes may show that a reduction in overall fishing mortality of > 50% for weakfish may be possible even though overall reduction by number for all sizes combined is less than 40%.

The primary objective in this study was to determine if the soft TED currently allowed by the National Marine Fisheries Service could be considered a bycatch reduction device. The SAFMC protocol for testing a device as a BRD uses weakfish and mackerel as the "indicator" species. Weakfish are considered because of the Atlantic States Marine Fisheries Commission's concern for declines in the Middle Atlantic stocks, and the assumption that weakfish from the South Atlantic are recruited to the fishery north of Cape Hatteras. Mackerels are included because of the South Atlantic Fishery Management Council's concern about this very popular sport and commercial fish and the stocks' history of being overfished (Spawning Potential Ratios -SPRs - less than 30%)

Limiting the approval of new BRDs to reductions of weakfish and mackerel raises the following concerns:

1) Little or no state or federal funding is available to compensate fishermen or scientific staff for testing industry-developed BRDs. This necessitates using private vessels on a voluntary basis. Net makers who do not own or have ready access to trawlers are often the individuals who develop new BRDs. As currently configured, tests of bycatch reduction devices will often drag out over weeks or months. Despite the shrimp fisherman being monetarily compensated for his assistance and scientific staff being eager to finish the work, this study took 112 days. Reasons for BRD field work lasting so long include:
    - Commercial fishermen will often make last-minute decisions to stay in port because of inclement weather, absence of a crew member(s), anticipation of poor catch rates, or mechanical problems.
    - Low CPUEs of targeted species require long tows.
    - Less than three tows are typically made per day; often, only one when shrimp catch rates are low.
    - Observers typically have numerous other duties and commitments, thus reducing the days available for sampling.
    - Observers are typically not available on weekends, particularly for "extension duties" of this type.

2) Because a study last on for several weeks or months, fish size composition in the catches often changes with time resulting in an overall average release rate that is based upon widely varying release rates which may be related to different sizes of fish. Theoretically, a device could pass the protocol with flying colors when only larger fish are caught, but fail in another season or year when small fish are dominant.
3) Given that shrimpers often believe that observers hamper their operations when shrimp catch rates are high, researchers are frequently asked not to participate in cruises when high catch rates are anticipated. This can result in the researcher not getting truly representative data of the fishery as a whole, particularly with respect to fish to shrimp ratios and shrimp retention rates.
4) It is highly unlikely, at least in South Carolina, that both mackerel and weakfish will ever be present in sufficient, testable quantities in the same thirty consecutive tows.

We had only 17 of 30 tows which were simultaneously valid for both species. Therefore, many more than 30 tows will be required to conform to the protocol.

5) Fishermen may change gears, as occurred in this study, mid-way through if they perceive that catch rates of shrimp would be higher with other types of nets. Alternatively, fishermen will change gears or refuse to fish if they perceive that a BRD is losing too many shrimp.
6) The drawn-out period required to test a BRD under the current protocol may deter develop of new BRDs, and most certainly will be a burden for observers and fishermen who conduct field tests.

Recommendations:

1) Consider modifications to the protocol that would allow field testing to be accomplished with relatively short tows, thus reducing the number of total days at sea. This may include testing for all or a selected group of acceptable finfish species that are routinely abundant in trawl catches.
2) Use only fish of 12 cm length and larger for testing of BRDs. It is unreasonable to test on small fish (<12 cm) that have little chance of escaping from any BRD design.
3) Examine fishing mortality of selected finfish size classes to determine overall reduction rate in F, and consider reductions in F when evaluating BRDs.

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Appendix 1. Results of statistical test on differences between numbers per hour (cpue) of weakfish, *Cynoscion regalis*, in the control trawl equipped with the hard TED and net equipped with soft TED. Cpue statistic = (1.0-0.4)x control cpue-experimental cpue.

Tow	Weakfish cpue(Control)	Weakfish cpue (Soft TED)	Cpue statistic	Percent Reduction
1	12.0	10.0	-2.8	17
2	7.7	4.3	0.3	44
3	10.3	4.7	1.5	55
4	14.3	6.0	2.6	58
5	34.0	20.3	0.1	40
6	32.0	46.0	-26.8	-44
7	17.3	20.0	-9.6	-15
8	7.7	5.3	-0.7	30
9	8.0	1.7	3.1	79
10	1.7	2.0	-1.0	-20
11	21.7	14.0	-1.0	35
12	12.3	13.3	-5.9	8
13	15.7	8.7	0.7	47
14	7.7	9.0	-4.4	-17
15	10.3	14.3	-8.1	-39
16	3.3	2.0	0.0	40
17	19.3	17.7	-6.1	9
18	9.3	5.7	0.9	50
19	20.7	11.3	1.1	45
20	4.7	3.3	-0.5	29
21	4.7	0.7	2.1	86
22	5.0	5.0	-2.0	0
23	3.3	1.0	1.0	70
24	4.7	2.7	0.1	43
Sum	287.7	228.0	-55.4	
Mean	12.0	9.5	-2.3	26
Std. Dev.	8.61	9.83	6.19	

Square root of n = 4.9

t= (0.6) x 12.0-9.5/6.19/4.9
t= -1.83
Significant at P S2 0.10