Evaluation of the Trawl Shrimp Cage

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Abstract: A trawl shrimp cage[1] (TSC), which was a modification of the cod end of a conventional wingnet, was evaluated for its ability to reduce the bycatch associated with shrimping. The webbing of the cod end was stretched around a box-like aluminum frame. This prevented the webbing in the cod end from collapsing under the weight of water pressure and cod end contents, thus releasing undersized shrimp and finfish directly into water. The TSC was evaluated between 6 June 1985 and 13 August 1985 in the estuarine marshes of eastern Louisiana. A 6.4-m aluminum flat bottom boat was outfitted with a conventional wingnet on 1 side and wingnet rigged with the TSC on the other. Although the TSC caught less shrimp overall, it retained approximately the same number of the larger, more valued shrimp (<104/kg heads on) as the conventional wingnet. The TSC reduced the finfish catch by an average of 75%. The small shrimp and finfish not retained by the TSC has the potential of growing to a marketable size and being harvested at a later date.

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Very little information exists concerning bycatch in the Gulf of Mexico wingnet shrimp fishery. The subject, however, is well documented for offshore bottom trawls. In Texas, approximately 23% to 43% by weight of shrimp captured aboard a commercial vessel from 23 to 25 June 1972 were discarded because of their small size (Baxter 1973). A study on the Texas brown shrimp grounds during June and August 1962–1964 indicated that discards averaged 22% of the catch by weight and 33% by number, with few of the discarded shrimp surviving (Berry and Benton 1969). Klima et al. (1986) projected that between 1 million and 1.2 million kg of 119-to-171-kg (heads on) shrimp could have been discarded by the Texas shrimp fleet during the first 2 weeks of the 1985 shrimp season.

Of equal concern is the amount of finfish taken in shrimping operations. Blomo and Nichols (1974) estimated that 24.0 million to 167.1 million kg of fish may be discarded each year in Texas waters. The mean annual discard of Texas shrimpers

[1]The Louisiana Department of Wildlife and Fisheries does not endorse or recommend the use of any products mentioned in this paper.

was estimated at 248.7 million kg including 219.1 million kg of fish (Chittenden and McEachran 1976). Bryan et al. (1982) estimated total annual discards on the Texas brown shrimp grounds to be 69.9 million kg including 3.3 million kg of small shrimp, 22.9 million kg of other invertebrates, and 43.7 million kg of fish. The weight of the individual fish and invertebrates in the study were generally <50 g and were deemed unmarketable.

The finfish catch rates for the northern Gulf, including Louisiana, were estimated by Moore et al. (1970) to be 2 to 5 times that of Texas. Watts and Pellegrin (1982) reported the average finfish-to-shrimp ratios by weight in Louisiana waters for 1980 and 1981 to be 22:1 and 37:1, respectively.

In 1983, in an attempt to control the bycatch associated with shrimping, a Louisiana shrimper developed a trawl shrimp cage (TSC) (Fig. 1). The TSC was designed to replace the conventional cod end of a wingnet. The walls of the TSC were formed by webbing stretched around a box-like aluminum frame. This arrangement prevented the cod end webbing from collapsing under the weight of water pressure and cod end contents, reducing the retention of undersized shrimp and finfish.

Finding a method of controlling bycatch is important because of the recent dramatic increase in shrimping, reflected by a 16-fold increase in Louisiana shrimp license sales, and the potential effects of habitat loss. The objective of this

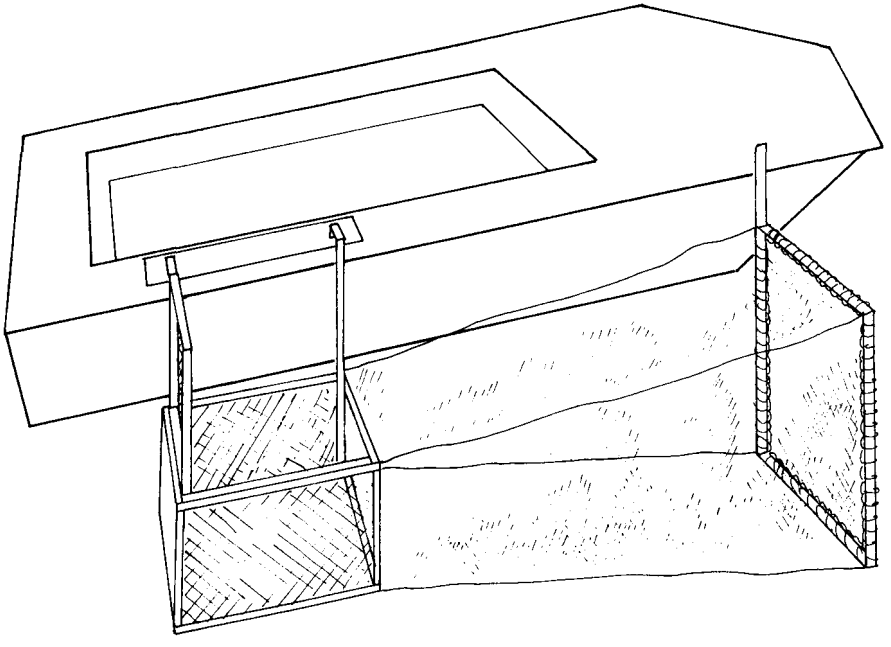

Figure 1. Trawl shrimp cage mounted on 1.52 × 2.13 m wingnet frames. Removable rear door is in the open position.

study is to determine whether or not using the TSC in Louisiana's inshore waters reduces the amount of bycatch that occurs during shrimping operations.

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Methods

A 6.4-m aluminum flat bottom boat was outfitted with a set of 1.52 × 2.13 m wingnet frames (Fig. 1). The cod end was removed from 1 of the nets and replaced with the TSC. Both nets were constructed of 3.48-cm stretch webbing in the throats and 3.18-cm stretch webbing in the conventional cod end and TSC. The webbing in the cod end of the TSC was stretched around an 1.2 × 0.8 × 0.7 m aluminum box-like frame. Each net was pushed simultaneously against a falling tide in either Bayou Bienvenu or in the Mississippi River Gulf Outlet, Louisiana, during nights with a full moon. Shrimp and fish from each net were identified, counted, and total lengths measured in 5 mm size groups. Four surveys were made between 6 June and 13 August 1985, with each survey consisting of 4 or 5 15- to 30-minute pushes.

In order to test the differences in the size distribution of shrimp and fish captured in the conventional cod end and TSC, the data was subjected to the Kolmogorov-Smirnov 2 sample test. The Kolmogorov-Smirnov test is a non-parametric test which calls for 2 independent samples and tests the null hypothesis that they came from identical distributions. The test criteria requires that the 2 sample distribution functions be compared. In particular, numerical differences between functions was sought.

Results

Results of the first 3 surveys made it impossible to evaluate those surveys for the effects of the TSC with regards to shrimp (i.e., too few shrimp were caught or shrimp were all of 1 large size). As a result, only the 13 August samples were subjected to analysis for shrimp. All 4 surveys, however, were used to generate data on the finfish catch.

A total of 691 brown and white shrimp were caught in the 13 August samples: 66.6% (460) in the conventional cod end and 33.4% (231) in the TSC. The TSC consistently caught shrimp $\geq$105 mm or $<$104/kg with heads on (Fig. 2). A total of 396 shrimp were caught in the $\geq$105-mm size range: 44% (174) in the TSC and 56% (222) in the conventional cod end. In the conventional cod end, 51.7% (238) of the shrimp were $<$105 mm. Of the shrimp retained by the TSC only 24.7% (57) were $<$105 mm.

Kolmogorov-Smirnov critical values at the 0.05 and 0.01 levels were 0.110 and 0.131 respectively (Massey 1951). The test statistic (Dmax = 0.27) exceeded

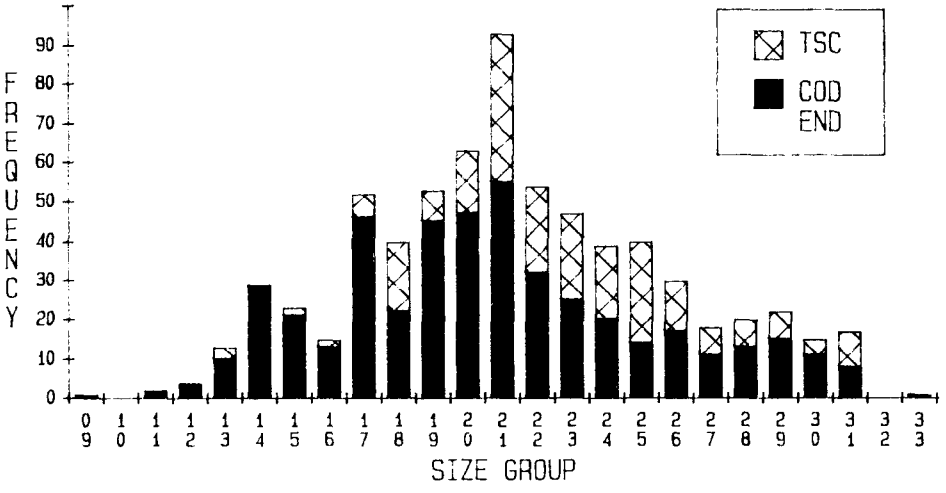

Figure 2. Cod ends vs. TSC shrimp catches (size group 9 = 45-49 mm, 10 = 50-54 mm, 11 = 55-59 mm . . . 33 = 165-169 mm).

either critical value, therefore the null hypothesis was rejected and it was concluded that the samples came from different distributions.

A total of 896 fish from 22 species (Table 1) were caught in the 4 surveys. There were over 4 times the amount of fish caught in the conventional cod end as there were in the TSC (731 to 165). For data analyses, all species of fish were combined. Size distributions of fishes captured in the 2 gear types was examined. The conventional cod end retained a greater number of smaller fish than did the TSC (Fig. 3). As with the shrimp catch, Kolmogorov-Smirnov critical values were obtained for the size distribution of fish at the 0.05 and 0.01 levels and were 0.128 and 0.154, respectively (Massey 1951). Again the test statistic (Dmax = 0.475) exceeded both critical values and it was concluded the populations reflected different distributions.

Discussion

In our limited number of tests, it appears the TSC retained fewer small shrimp and fish than the conventional cod end while capturing approximately the same number of the larger, more valuable (>104/kg) shrimp (174 vs. 222). By releasing small shrimp and unmarketable fish directly into the water, it would appear the TSC reduces some of the bycatch associated with shrimping operations. The released shrimp and fish will then potentially grow to a more marketable size and can be harvested at a later date.

If the discarded organisms survived trawling and culling and returned to the Gulf, this may achieve the same result as the utilization of a TSC. There are, how-

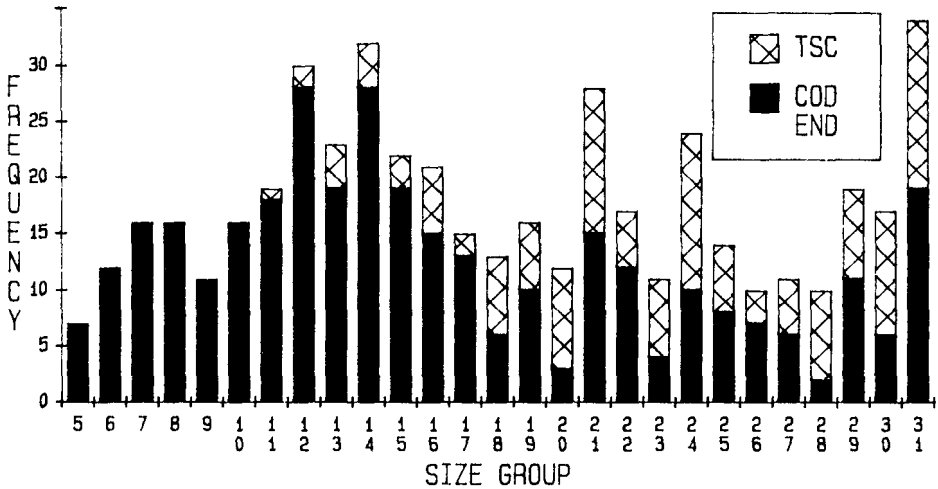

Figure 3. Cod end vs. TSC fish catches (size group 5 = 25-29 mm, 6 = 30-34 mm, 7 = 35-40 mm, . . . 31 = 155-159 mm.)

Table 1. Numbers of fishes retained by the conventional cod end and the TSC.

Species	Cod	TSC
Trinectes maculatus	3	0
Strongylura marina	1	1
Citharichthys spilopterus	6	8
Symphurus plagiusa	3	0
Micropogonias undulatus	1	1
Brevoortia patronus	91	26
Anchoa mitchilli	70	0
Opsanus beta	1	0
Arius felis	152	44
Bagre marinus	346	65
Cynoscion arenarius	13	8
Lagodon rhomboides	1	1
Gobioides broussonneti	3	1
Sphoeroides parvus	21	1
Bairdiella chrysura	3	2
Dormitator maculatus	1	0
Prinotus tribulus	1	0
Membras martinica	6	4
Menidia beryllina	4	0
Elops saurus	0	1
Fundulus grandis	0	1
Peprilus paru	1	1
Anchoa hepsetus	1	0
Trichiurus lepturus	2	0
Total	731	165

ever, indications that the majority of the shrimp do not survive (Berry and Benton 1969). Most of the other organisms captured also probably die (Blomo and Nichols 1974). A study conducted by Bryan et al. (1982) concurred, noting that many of the organisms had died during culling operations.

In addition to releasing the small organisms directly into the water, thus not exposing them to excessive deck time, the TSC also allows for the immediate removal of larger unwanted species that cannot pass through the net. As the larger organisms enter the TSC they can be readily spotted by the operator and removed without interruption of the shrimping operation. In the case of a conventional cod end, the cod end can go unretrieved from as little as 15 to 30 minutes to longer than 3 hours. This increases the chances captured organisms will come in contact with the webbing which would result in possible damage or, in the case of air breathing animals such as sea turtles, to possible drowning.

Although we have shown the TSC apparently does not retain small shrimp and fish, thus reducing the bycatch, we have no indication as to what percentage of these organisms survive an encounter with the net. If mortality is caused by contact with the net, only those organisms which pass cleanly through the webbing will survive to enter the fishery. Regan et al. (1956) reported that 100% of the small shrimp that passed through a net survived for at least 92 hours under artificial conditions and suffered only minimal damage. At this point, long term survival under natural conditions is only speculative, but organisms released directly into the water have a better chance of survival than those left on the deck of a boat for a period of time.

To ensure maximum effectiveness, it is important the TSC be emptied often. Allowing shrimp, fish, and debris to accumulate inside the cage negates any effectiveness for releasing small shrimp and fish gained by stretching the webbing around a frame. This frequent cleaning may also increase the chances of survival of released organisms.

Even though the TSC appeared to reduce the bycatch in this study, it still retains a significant portion of the unmarketable finfish (i.e. fish >109 mm but less than a consumable size). These fish, once retained by the TSC, are subjected to additional stress through culling procedures. It also must be noted that the TSC was only tested on a pair of 1.52×2.13 m wingnet frames. Extrapolation of these results across other sectors of the wingnet fishery or the TSC's applicability to the bottom trawl fishery is speculative.

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