SOUTHEAST UNITED STATES FISHERIES BYCATCH REDUCTION RESEARCH IN SHRIMP TRAWL FISHERIES

by

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Bycatch of non-target species has become a serious problem in fisheries around the world. Where bycatch was once viewed as a nuisance rather that a waste of resources, today many fish stocks are overexploited and bycatch contributes to the reduction of fish stocks. With rapid growth in populations and greatly improved technological methods to harvest resources, many species of finfish can be taken faster than they replenish themselves. For this reason finding ways to utilize much of the bycatch instead of discarding it is no longer an answer. Today resources must be harvested more selectively to improve yield. Future fishery development has to include sustainability of resources as its primary goal which includes releasing unharmed parts of the bycatch which can mature, reproduce, and help to maintain harvestable stocks.

Finfish bycatch in shrimp trawl fisheries was recognized as a potential problem in the Southeastern United States during the 1960s. The Mississippi Laboratories of the National Marine Fisheries Service began conducting research on modification of shrimp trawls to provide escapement of juvenile and unwanted finfish bycatch in the early 1970s (Seidel, 1975). Panels of webbing of various mesh sizes were installed in the interior of shrimp trawls in an attempt to sort shrimp from the rest of the catch and provide for escapement of fish while retaining the shrimp. Some of the early work showed good potential, but finfish bycatch studies were halted when capture of sea turtles in shrimp trawls became the focus of concern by environmental interests. Passage of the Endangered Species Act in 1973 made it necessary for researchers to look at the incidental catch of threatened or endangered species, and to find solutions to the problem even if it meant closing commercial fisheries. In the Southeastern United States, research was directed toward sea turtles to prevent their drowning in shrimp trawls.

1. TURTLE EXCLUDER DEVICE (TED)

The Harvesting Technology Group of the Mississippi Laboratories began conducting research in 1978 to develop a Turtle Excluder Device (TED), and developed a successful prototype by 1981. Research continued to optimize TEDs, develop solutions to problems caused by fishing conditions, and insure that can a commercial model of a TED could release essentially all sea turtles without a significant loss of shrimp catch. Used correctly and with proper attention, several models of TEDS are very effective.

All testing and development of TED designs by the Harvesting Technology Group was done on board commercial shrimp boats. Government observers lived

aboard shrimp boats while testing experimental TEDs to record shrimp, bycatch and sea turtle catch data directly under commercial fishing conditions.

The first TEDs studied were constructed of webbing barriers to prevent turtles from entering a shrimp net. Figure 1 shows a diagram of a itforward" tapered barrier, and figure 2 describes a "reverse" tapered barrier. These webbing barriers were tested for two years in an attempt to use materials and an approach that were familiar to fishermen. The webbing barriers were reasonably effective at preventing turtle captures, but the large panels of webbing had an inherent shrimp loss that could not be eliminated. After extensive testing on commercial vessels, this approach was discontinued.

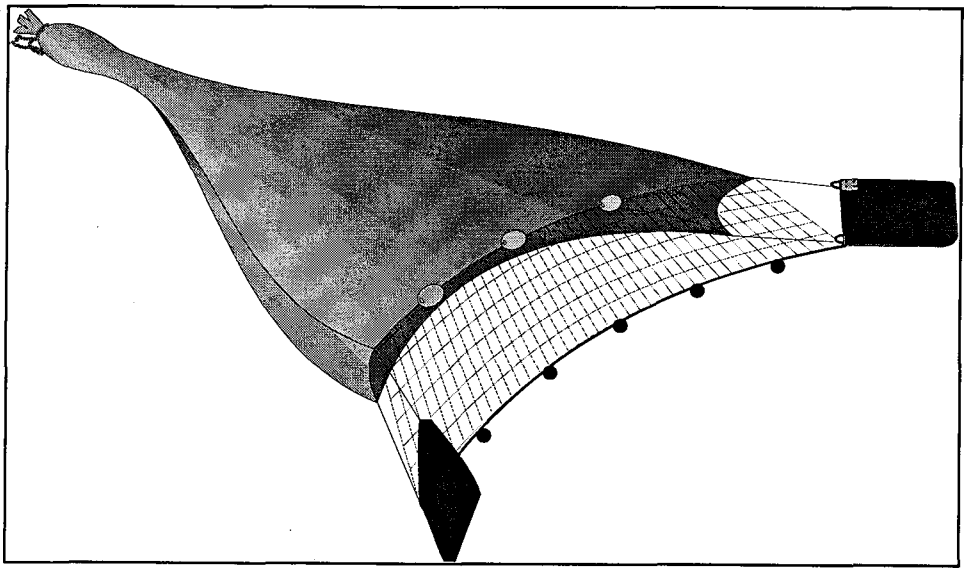

Figure 1 Forward turtle barrier (NMFS 1978)

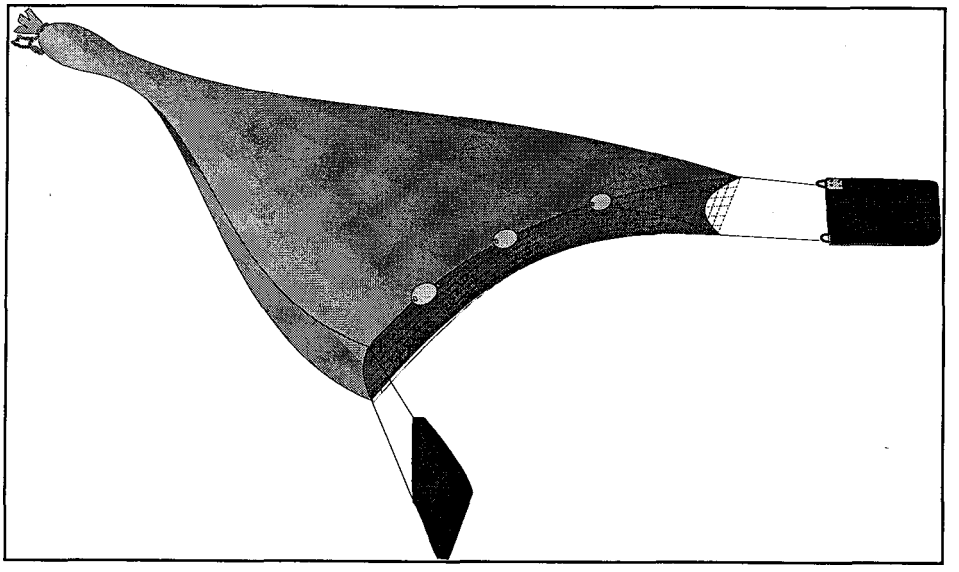

Figure 2 Reverse turtle barrier (NMFS, 1979)

Research continued and eventually produced TEDs that use a rigid grid or frame to guide a turtle from a net while allowing shrimp and fish to pass through and be retained for harvest. Figure 3 illustrates the first approved grid style TED that was collapsible and included side openings to allow fish to escape.

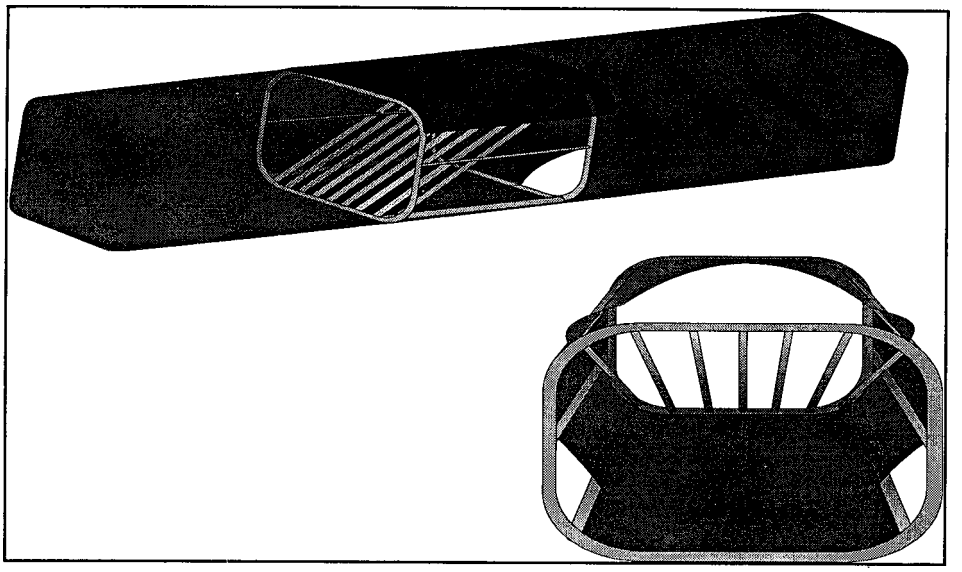

Figure 3 National Marine Fisheries Service TED with finfish excluder modification (1985)

In the years that followed, several additional models of grid style TEDs were approved for use in the United States shown in Figures 4, 5, 6, and 7. All approved TEDs are first tested to demonstrate that the design will successfully release 97% or more of the sea turtles which enter a net. Once installed in a net, the currently certified models of TED vary in shrimp catch efficiency, but properly installed the best configurations release sea turtles without any significant shrimp loss.

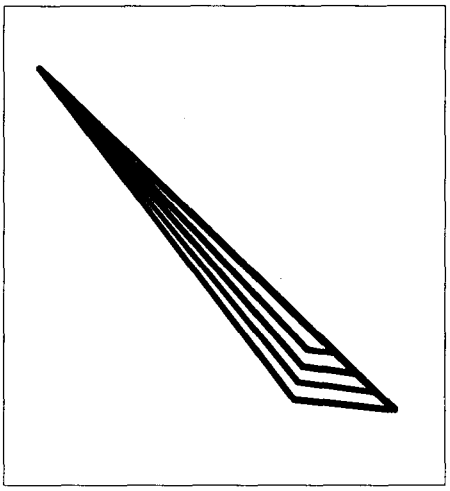

Figure 4 Super Shooter TED, side view (1990)

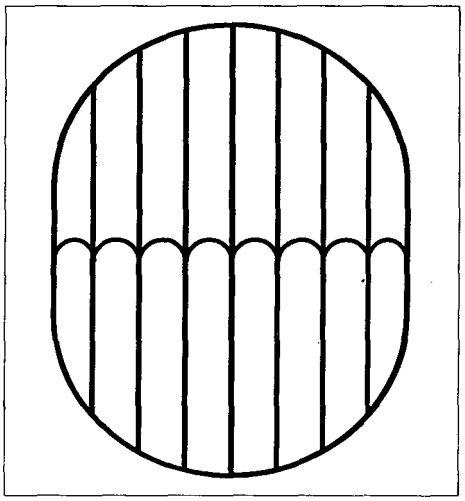

Figure 5 Georgia Jumper TED (1986)

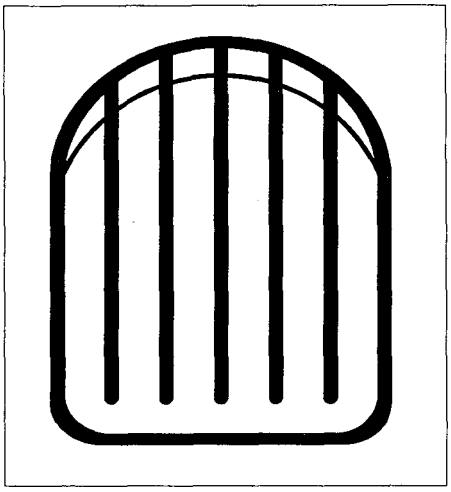

Figure 6 Anthony Weedless TED (1992)

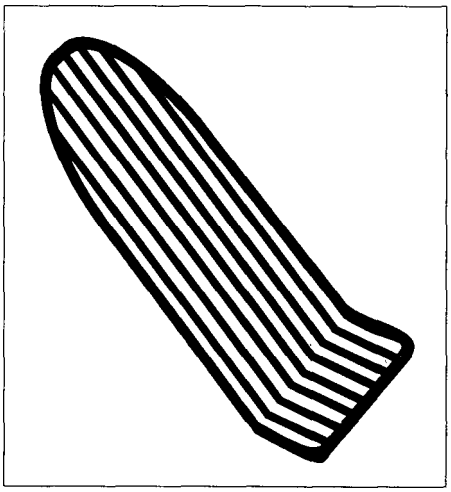

Figure 7 Seymour TED (1994)

Various features have been built into TED frames to solve the following operational problems encountered in widespread commercial

a) Physical Damage

b) Shrimp Loss
- Clogging
- Improper Grid Angle
- Inadequate Flotation

- Loose Exit Flap
- Lazy Line Rigging
- Twisting

Figure 8 illustrates clogging problems caused by a grid angle too steep, while Figure 9 shows the problem of loss of catch caused by a low angle of attack or a loose exit flap. A loose flap results from using the wrong type of webbing, or from eventual stretching of the webbing, and can be prevented by use of polyethylene webbing and proper flotation shown in Figure 10.

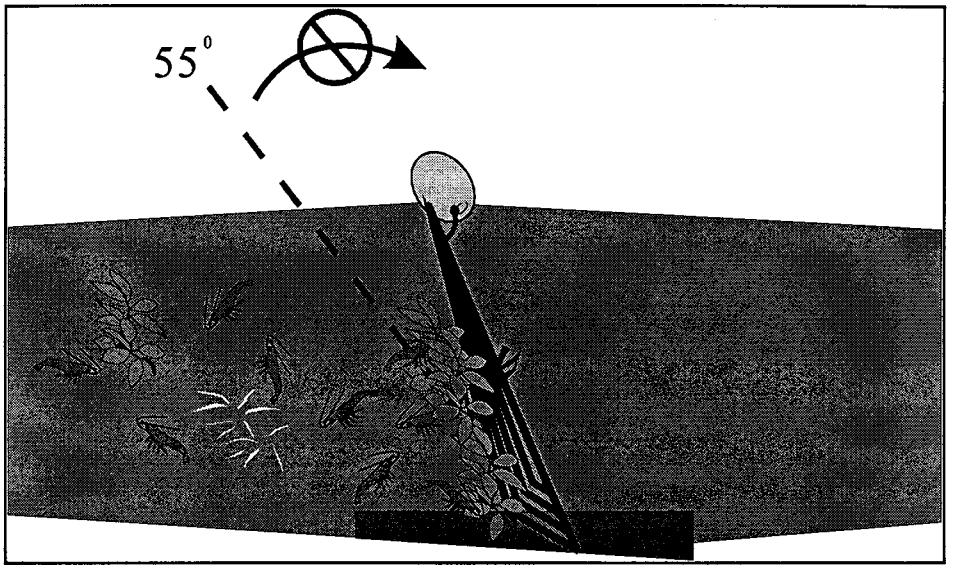

Figure 8 Illustration of Clogging Problems when TED angle is too steep.

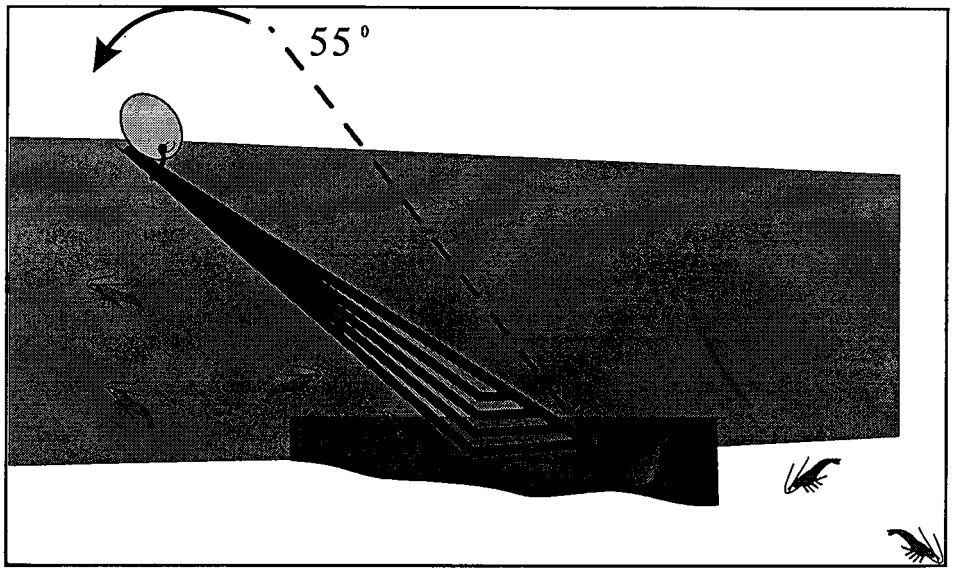

Figure 9 Illustration of loss of catch due to low grid angle.

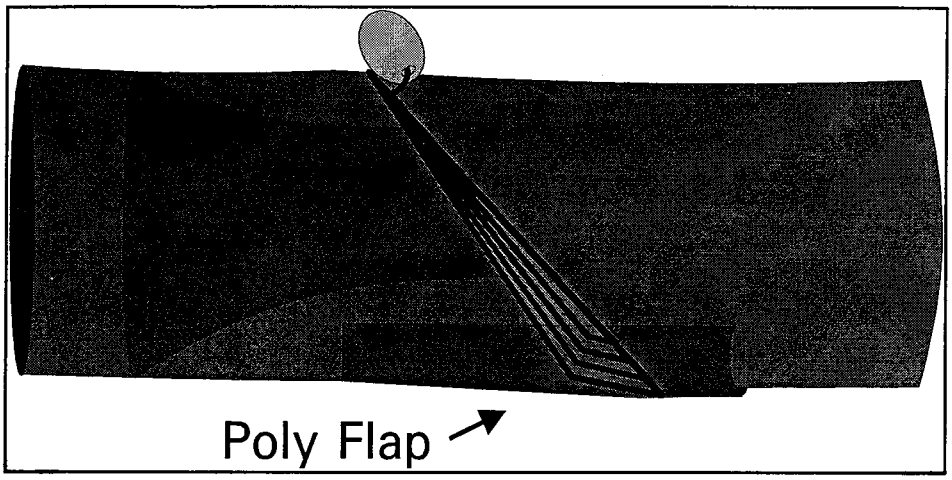

Figure 10 Installation of a polyethylene flap and proper flotation on a grid TED.

A grid style TED can be installed with the exit hole either on top or on bottom of the net's extension. When installed in a downward exit position, use of an accelerator funnel shown in Figure 11 is recommended. Sometimes trash conditions will clog an accelerator funnel and it has to be removed, but if it can be used it improves the retention of shrimp. Whenever conditions allow, a TED should be used with an upward exit which minimizes concern for the flap and makes use of an accelerator unnecessary.

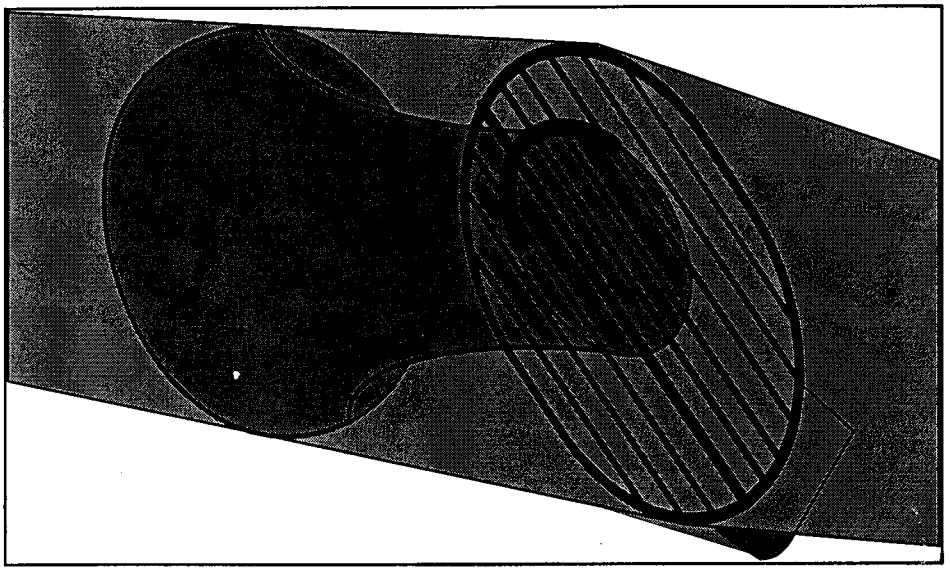

Figure 11 Installation of an accelerator funnel in a grid TED.

Sea grasses, sponges, and other types of bottom debris can produce clogging problems when encountered in heavy concentrations. The bent frame modifications shown in earlier figures were introduced to reduce clogging effects, and today a properly built TED can be selected to fish effectively under almost any shrimping condition.

Once it was demonstrated that a TED could be used in the commercial shrimping industry without serious economic effects, regulations were written to require southeast United States shrimp vessels to use TEDs. At first some parts of the commercial shrimp fishery strongly resisted TEDs. However, once use of TEDs was mandatory and regulations effectively enforced, many vessel Captains found that TEDs do not reduce their shrimp catch. TEDs also improve shrimp production in some bycatch conditions, and improve the quality of the shrimp catch. Today TEDs are required year round on all southeast shrimp vessels, in all water depths, in nets larger than 4 meters head rope length.

2. BYCATCH REDUCTION DEVICE (BRD)

During the 1970s and 80s, stocks of many finfish species declined. One of the major causes for decline in the southeastern United States has been bycatch in shrimp trawl fisheries. Some of the species impacted as shrimp trawl bycatch serve a directed fishery for recreational and commercial catches such as red snapper, mackerels, and sea bouts. As noted earlier, most of the finfish bycatch in United States shrimp trawl fisheries is discarded in large part because the species of interest are caught as juveniles and have no commercial value.

Fish stocks in the United States are managed under the Magnuson Fishery Management Act. Pressure from recreational interests, target commercial fisheries, and from environmental groups focused concern for the large amount of shrimp fleet discards. The Harvesting Technology Group which had continued to study fish behavior in trawls during TED research began to focus efforts to either modify TEDs, or further modify shrimp trawls to enable fish to escape unharmed.

The key to achieving bycatch reduction in shrimp trawls is understanding the behavior of fish in a net in relation to the dynamics of the net and the internal water flow as water passes through a net. The Harvesting Technology Group maintains the capability and expertise to conduct empirical studies on fishing gear to learn the behavior of the target species during the trawling process. This includes trained divers, electronics, remote sensing devices, and video techniques. Research on reducing capture of finfish particularly juveniles in shrimp trawls has led to the development of Bycatch Reduction Devices or BRDs as they are called in the United States.

There are several important species in the Gulf of Mexico, but the one of most concern is red snapper which is caught commercially and as a recreational species by both individual sport fishermen and on commercial charter boats for sport fishing. The Magnuson Act requires management measures to be taken to bring over fished stocks back to a healthy sustaining population. Red snapper have been very depressed and

became the driving species in the Gulf of Mexico because it is caught in large numbers in shrimp trawls as juveniles in the first two years of its life stage.

Finfish bycatch research in the southeast United States has been conducted since 1992 under a cooperative research program involving Federal Government and state researchers, and the shrimping industry. This research to develop shrimp trawl modifications called Bycatch Reduction Devices or BRDs, is conducted under a 4 phase protocol as described in Figure 12. The Harvesting Technology Group conducts most of the prototype development and proof of concept studies. Operational testing and industry evaluations are conducted entirely on commercial shrimp

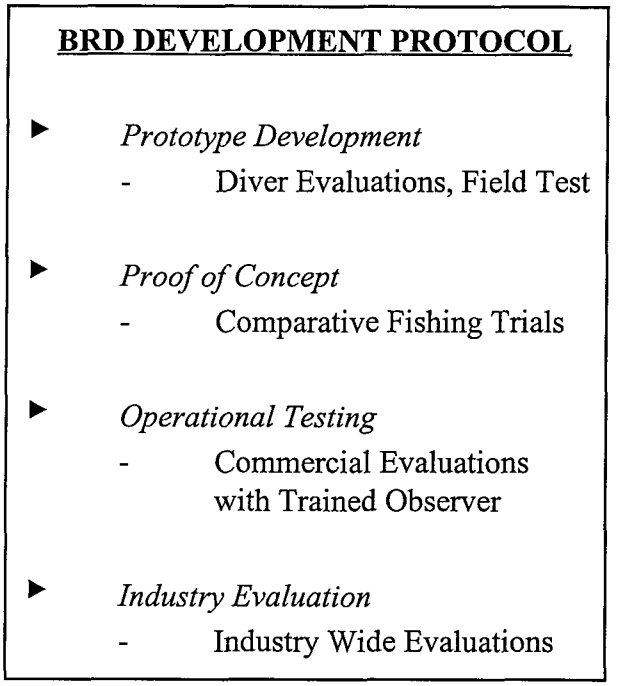

Figure 12 Four phase BRD development protocol

Bycatch reduction criteria was established for red snapper, as listed in Figure 13. BRD research on red snapper and other related bycatch species have progressed through the four stage protocol. Over 100 prototype designs have been considered or evaluated to date. Out of the research, two basic designs of BRDs have been developed which are currently required by regulation in commercial shrimp nets in some of the shrimping areas of the United States. One device is commonly called a "fish-eye". This device shown in Figure 14 is relatively non-selective. It is essentially a hole in the net placed at key locations in the trawl. In use by United States commercial fishermen for many years, the device is fairly effective at releasing finfish from the catch including around 40 percent of red snapper. However, it does cause a shrimp loss of 4-10 percent. In operation, the closer the device is placed to the end of the bag the more fish it releases, while fish release decreases the farther forward it is installed from the tie rings of the bag. Effect on shrimp catch is the opposite with loss increasing as the device is

placed closer to the end of the bag, so results depends upon the best compromise position for the species to be released. Selectivity is to some extent dependent upon the size of the fish-eye, although the device is basically non-selective.

RED SNAPPER BYCATCH REDUCTION CRITERIA

- Age 0 and 1
- Modal Length 60-100 mm
- Swimming Speed .2 - .3 M/SEC
- Trawling Speed 1.0 - 1.3 M/SEC
- Reduced Water Flow in Trawl
  Key to Snapper Escapement
- Behavioral Reactions key to Gear Design

Figure 13 Snapper Reduction criteria for Red Snapper

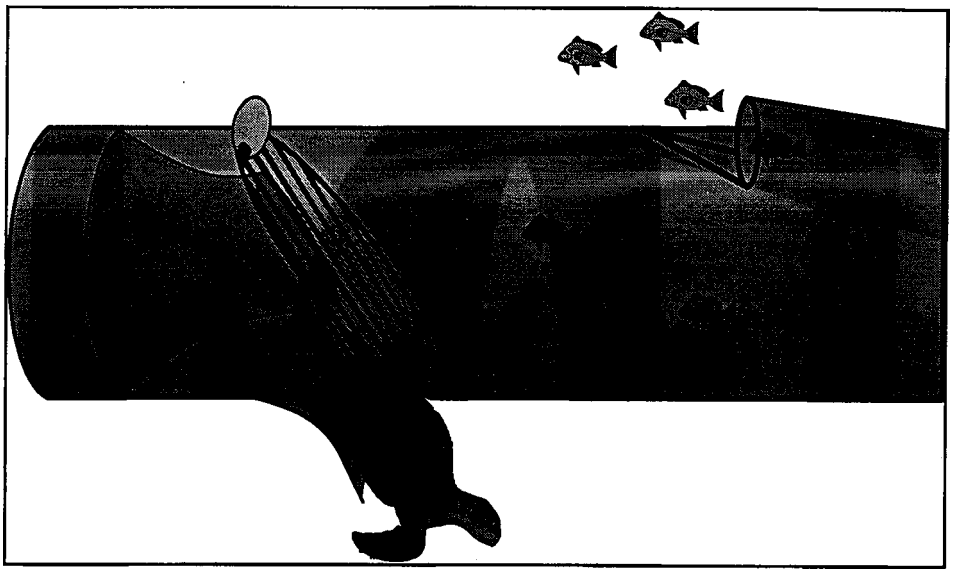

Figure 14 Fisheye BRD in combination with TED

The second device which is being regulated into use in the United States is the Extended Funnel shown in Figure 15, and a modified version shown in Figure 16. Extensive testing of this approach has produced excellent fish reduction rates without any statistical difference in shrimp catch under commercial fishing conditions.

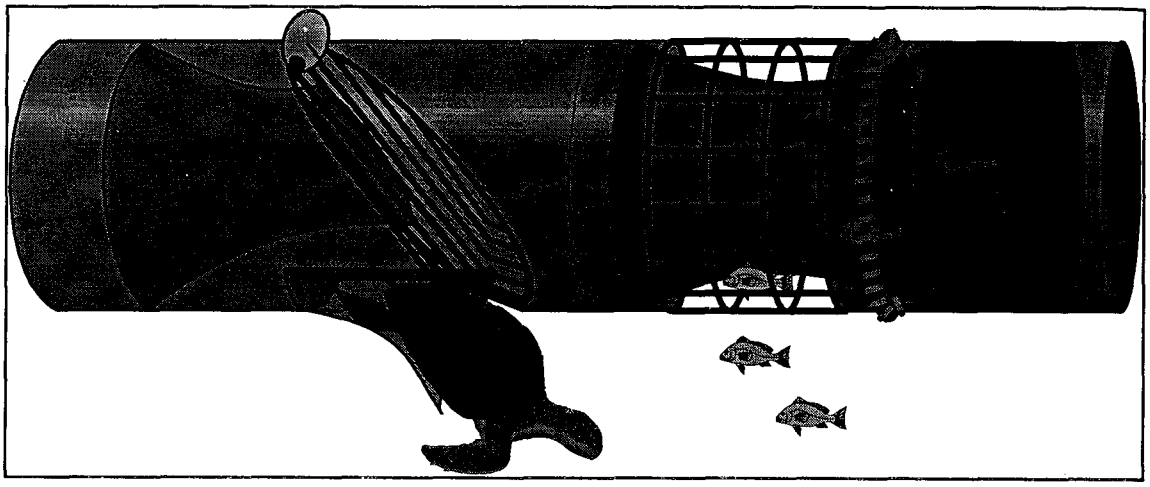

Figure 15 Extended Funnel BRD in Combination with TED

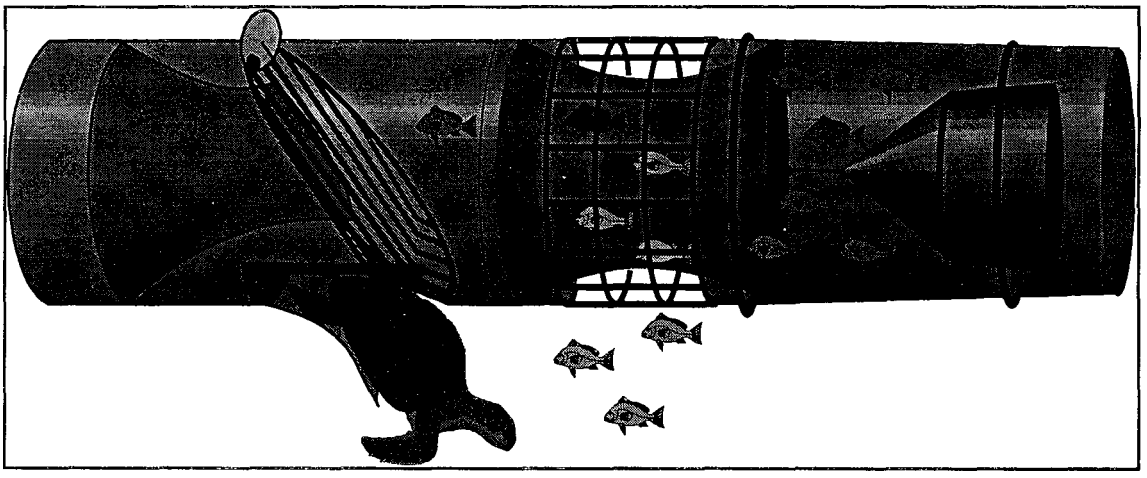

Figure 16 Modified Expanded Mesh BRD in Combination with TED

Some species of fish are reduced up to 90 percent with small juvenile red snapper released at rates of 40-50 percent. An added benefit of the expanded mesh BRD is there is some degree of selectivity in the size of fish released. By varying the size of the surrounding mesh, larger fish can be retained while allowing smaller fish to escape and grow to an economical size. This feature is particularly important to countries that retain some of the fish bycatch from shrimp harvesting operations.

In conclusion, it is important to realize that the research described in this report has shown that if gear modification is chosen as a way to release bycatch in trawls, it can be achieved in shrimp trawls with very little effect on the shrimp catch. BRDs can also be used effectively if commercial size fish are to be landed. The expanded mesh BRD may also be used in fish trawls as a gear modification to separate fish by size to release some part of the catch for reproduction.

Finally, an important point to remember is that understanding the behavior of fish within a net is the key to successfully developing gear modifications to retain target catch while releasing uneconomical bycatch. Fish behavior and their gear interactions must be studied to develop modifications that selectively harvest economically important parts of the catch. The capability to conduct fish behavior studies is difficult and expensive, but without the investment, progress will certainly be slow and most often unsuccessful. Fishing gear modifications are feasible that can allow resource managers to selectively harvest resources while maintaining viable resource abundance levels.

3. REFERENCES

Seidel, Wilber R. 1975. A shrimp separator trawl for the southeast fisheries. Proceedings of the twenty-seventh Annual Gulf and Caribbean Fisheries Institute. October, 1975, Miami, Florida: 6676.