Sea Turtle Excluder Trawl Development

Annual Report

October, 1981

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Sea Turtle Excluder Trawl Development

Annual Report

This report presents the status of the sea turtle excluder trawl development project through FY81. The project was completed as scheduled (Figure 1). The sea turtle excluder trawl FY81 project objectives were:

1. Complete development and evaluation of the sea turtle excluder device.
2. Prepare to transfer sea turtle gear technology to the shrimping industry.
3. Analyze data and prepare report and recommendation on gear and techniques to reduce the mortality of sea turtles in shrimp trawls.

In FY81 testing was conducted and evaluations made on the "state of the art" sea turtle excluder trawl design. This design is the sea turtle excluder device developed in 1980 and refined and tested in 1981. The turtle excluder device (T.E.D.) is a 4x3x3 ft frame constructed of 3/8 in galvanized pipe with bars slanting at approximately 45^{0} spaced 3-6 inches apart and a 3 ft square door. The TED is placed inside the trawl at the intersection of the trawl body and the codend or bag. As a turtle or other large object enters the bag, it strikes the slanted bars and exits through the hinged door. Testing has been conducted with the TED door opening both on the trawl bottom (Figure 2) and on the trawl top (Figure 3). Other modifications were also tested including a webbing funnel inserted ahead of TED to accelerate water flow through the device and prevent shrimp loss through the door. In test areas where dense concentrations of cannonball jelly (Stomolophus meleagris) and loggerhead sponge occurred, the TED door was removed and horizontal bar spacing reduced to 3" to determine the effectiveness of TED for reducing these bycatch items. A complete description of the TED modifications is presented in the Appendix. The bottom and top

PROJECT SCHEDULE

EVENT	FISCAL YEAR			
	1978	1979	1980	1981
● Commercial Evaluation of Initial Prototype Designs	X			
● Commercial Evaluation of Best Prototype Designs		X		
● Statistically Define Performance of Best Prototype Designs			X	
● Establish "State of the Art" Excluder Design			X	
● Prepare for Technology Transfer of "State of the Art" Design				X
● Complete Testing of "State of the Art" Design on Major Shrimp Grounds				X
● Terminate Turtle Excluder Trawl Development				X
SEFC DIRECT COST	490K	391K	350K	260K

Figure 1

SEA TURTLE "EXCLUDER" DEVICE
BOTTOM - OPENING DESIGN

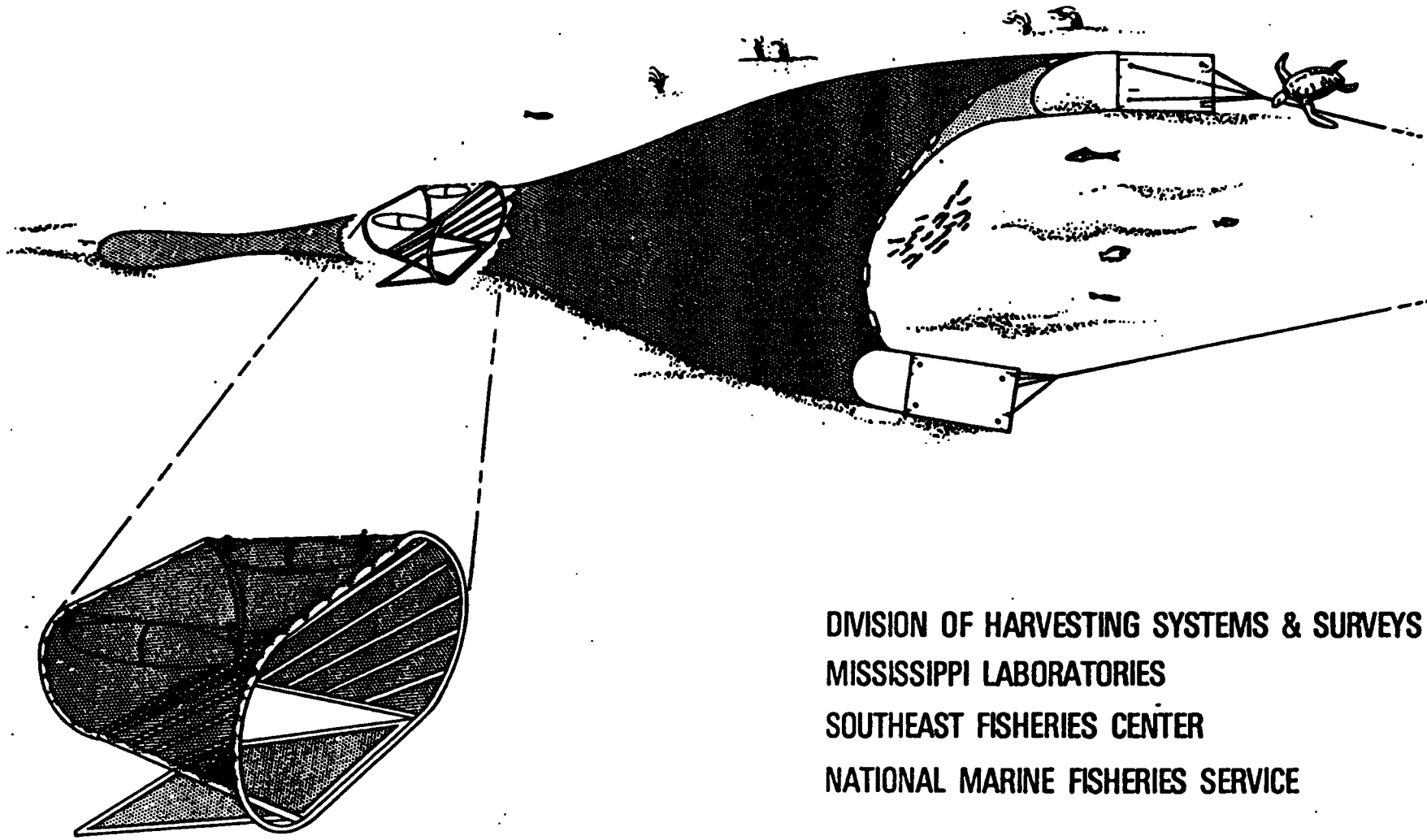

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Figure 2

SEA TURTLE "EXCLUDER" DEVICE
TOP - OPENING DESIGN

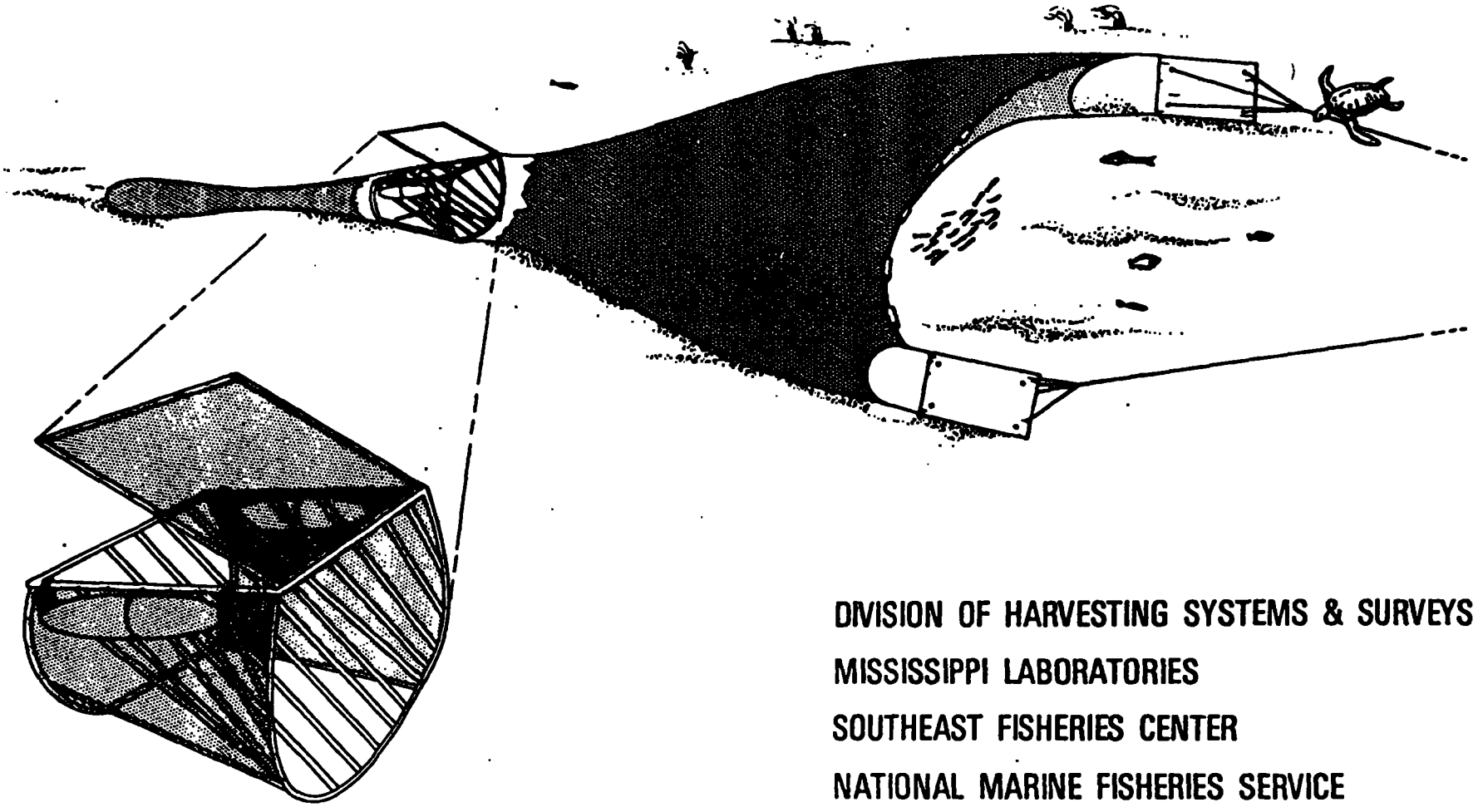

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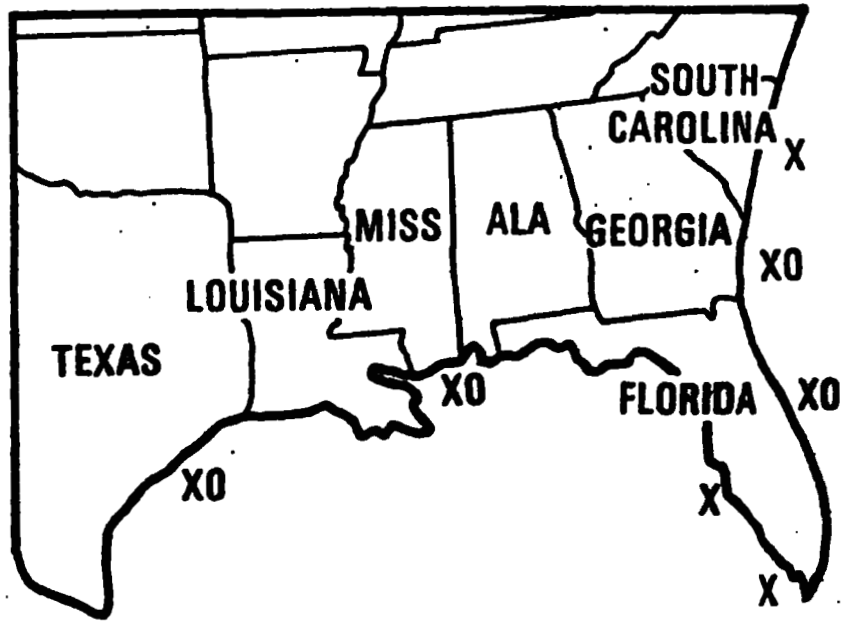
Figure 3

opening TED designs were tested on the major shrimp grounds in the southeastern United States (Figure 4). Testing of the TED was conducted on cooperative and chartered commercial shrimp vessels. The major objectives of the tests were to determine the effectiveness of the TED in (1) reducing turtle capture and (2) maintaining equal shrimp catch rates when compared to standard shrimp trawls. Secondary objectives were to determine the effectiveness of TED in reducing bycatch and to collect data on the relative towing tensions of the TED modified and standard trawls. The experimental design was to make paired tows with a standard rigged shrimp trawl on one side of the vessel and an identical trawl with a TED installed in it on the other side. Shrimp, turtle, and total catch rates were recorded by an NMFS observer for each tow. A bycatch sample was also taken from each trawl once a day. Trawling gear was rigged and maintained by NMFS gear specialists and the vessel captains.

Turtle and Shrimp Catch Rates

The mean turtle catch rates for the bottom opening TED and standard shrimp trawl are presented in Table 1. The mean catch rates were 1.41 turtles per hour for the standard trawl and .16 turtles per hour for the TED. There was an 89% difference in the mean turtle capture rates with a 95% confidence interval of 39%. A t-test for paired comparisons indicates a significant difference for the turtle capture means at the 99% level. The mean shrimp capture rate for the bottom opening TED was 16.74 lbs per hour compared to 16.66 lbs per hour for the standard trawl (Table 2). The percentage difference between the mean catch rates was 0 with a 95% confidence interval of 2.6%. The calculated t_s value shows no significant difference between the sample means. Shrimp catch data for the bottom opening device with the webbing funnel modification is presented in Table 3. The mean shrimp catch rate for the TED was 25.77 lbs per hour as compared to 23.98 lbs per hour for the standard trawl. There was a 7% increase in shrimp catch with

EXCLUDER DEVICE TEST AREAS



X- BOTTOM OPENING DESIGN
0- TOP OPENING DESIGN

1980 - 4 VESSELS
1981 - 1 VESSEL

Figure 4

Table 1. Turtle catch rates for the bottom opening sea turtle excluder device.

Trawl Type	Mean Catch Rates*	Total No. Turtles
Standard trawl	1.41	113
Excluder trawl	.16	16
Percent difference and 95% confidence interval	89 $\pm$ 39	

$t_s = 4.425$ $P < 0.001$

*Turtle catch as turtles per hour per 60 ft of trawl headrope

N = 340

Table 2. Shrimp catch rates for bottom opening sea turtle excluder device.

Trawl Type	Mean Catch Rates*
Standard trawl	16.66
Excluder trawl	16.74
Percent difference and 95% confidence interval	0 ± 2.6

$t_s = .311$ ns

*Shrimp catch as lbs of shrimp per hour per 60 ft of trawl headrope,
N = 220

Table 3. Shrimp catch rates for the bottom opening sea turtle excluder device with funnel modification.

Trawl Type	Mean Catch Rates*
Standard trawl	23.98
Excluder trawl	25.77
Percent difference and 95% confidence interval	7 ± 4

$t_s = 3.446$ $\quad 0.01 > P > 0.001$

*Shrimp catch as lbs per hour per 60 ft of trawl headrope

N = 22

the TED with a 95% confidence interval of 4%. The calculated t_s value indicates a significant difference between the sample means.

Mean turtle catch rates for the top opening device and comparative standard trawls are presented in Table 4. The mean catch rate for the TED was .04 turtles per hour as compared to 1.43 turtles per hour for the standard trawl. These catch rates represent a 97% reduction in turtle capture with a 31% confidence interval at the 95% probability level. The calculated t_s value indicates a significant difference between the sample means at the 99% confidence level. Table 5 presents the mean shrimp catch rates for the top opening TED and standard trawls. The mean catch rates are 43.61 lbs per hour for the TED and 40.45 lbs per hour for the standard trawl or a 7% increase in shrimp catch with the TED and a 4% confidence interval. The t_s value is significant at the 99% confidence level.

Shrimp Catch Rates for Major Shrimp Grounds

One of the analysis objectives of FY81 research was to determine if there was any significant difference in shrimp catch rates between the TED and standard trawls for different shrimp grounds. The major shrimping areas in the southeastern United States are the South Atlantic (North Carolina to Florida), West Florida (Tortugas to northwest Florida), northern Gulf (Alabama, Mississippi, Louisiana and Texas).

Mean shrimp catch rates for the bottom opening device in the three areas are presented in Table 6. The bottom opening device was tested without the funnel modification in the South Atlantic. The funnel modification was developed after testing was completed in the South Atlantic and was employed in West Florida and the northern Gulf. Mean shrimp catch rates for the South Atlantic were 11.54 lbs per hour for the TED and 11.63 lbs per hour for the standard trawl. The mean shrimp catch rates for West Florida were 13.67 lbs per hour for the TED and 13.11

Table 4. Turtle catch rates for the top opening sea turtle excluder device with funnel modification.

Trawl Type	Mean Catch Rates*	Total No. Turtles
Standard trawl	1.43	129
Excluder trawl	.04	3
Percent difference and 95% confidence interval	97 ± 31	

$t_s = 6.253$ $P < 0.001$

*Turtle catch as turtles per hour per 60 ft. of trawl headrope

N = 133

Table 5. Shrimp catch rates for top opening sea turtle excluder device with funnel modification.

Trawl Type	Mean Catch Rates*
Standard trawl	40.45
Excluder trawl	43.61
Percent difference and 95% confidence interval	7 ± 4

$t_s = 3.472$ $P < 0.001$

*Shrimp catch as lbs of shrimp per hour per 60 ft of trawl headrope.

N = 112

Table 6. Shrimp catch rates for bottom opening excluder device for major shrimp grounds.

South Atlantic

Trawl Type			Mean Catch Rates*
Standard trawl			11.54
Excluder trawl			11.63
Percent difference			0
N = 212	t_s = .587	ns	

West Florida (Tortugas)**

Trawl Type			Mean Catch Rates*
Standard trawl			13.11
Excluder trawl			13.67
Percent difference			4
N = 10	t_s = 1.168	ns	

Northern Gulf**

Trawl Type			Mean Catch Rates*
Standard trawl			33.03
Excluder trawl			35.86
Percent difference			8
N = 12	t_s = 3.706	0.01> P > 0.001	

*Shrimp catch as lbs per hour per 60 ft of trawl headrope

**Bottom opening device with funnel modification

lbs per hour for the standard trawl and for the northern Gulf the rates were 35.86 lbs per hour for the TED and 33.03 lbs per hour for the standard trawl. The t_s values calculated for the different areas indicates a significant difference between the means in the northern Gulf of Mexico but no significant difference in the South Atlantic and West Florida areas. The results are bias for the South Atlantic where the funnel modification was not employed. The apparent increase in shrimp catch with the TED in the northern Gulf is probably due to the funnel modification.

Mean shrimp catch rates for the top opening device for the South Atlantic and northern Gulf are presented in Table 7. The mean shrimp catch rates for the South Atlantic were 6.63 lbs per hour for the TED and 6.09 lbs per hour for the standard trawl. For the northern Gulf the rates were 75.66 lbs per hour for the TED and 70.23 lbs per hour for the standard trawl. The calculated t_s values indicate a significant difference in the shrimp catch means for both areas.

Bycatch Rates

A secondary objective in the FY81 research was to investigate the bycatch reduction potential of the TED. The TED is presently not designed to reduce bycatch other than turtles. The major research emphasis has been to reduce turtle capture and maintain shrimp catch. Very little effort to date has been devoted to reducing bycatch. It is felt that the TED can be optimized to reduce other bycatch components, but budget and time constraints in FY81 prevented extensive research in this area. Bycatch data was collected, however, on the TED designs tested. Limited design modification was attempted when necessary to overcome high concentrations of cannonball jellyfish (S. meleagris) and loggerhead sponges. No design modification was attempted to reduce finfish bycatch.

Table 7. Shrimp catch rates for top opening excluder device with funnel modification for major shrimp grounds.

South Atlantic

Trawl Type	Mean Catch Rates*
Standard trawl	6.09
Excluder trawl	6.63
Percent difference	8

N = 52 t_s = 2.082 0.05 > P > 0.02

Northern Gulf

Trawl Type	Mean Catch Rates*
Standard trawl	70.23
Excluder trawl	75.66
Percent difference	7

N = 60 t_s = 3.329 0.01 > P > 0.001

*Shrimp catch as lbs per hour per 60 ft of trawl headrope

Bycatch rates for the bottom opening TED and standard trawls is presented in Table 8. Total bycatch rates were 218.98 lbs per hour for the standard trawls and 200.28 lbs per hour for the TED. Finfish catch rates were 114.90 lbs per hour for the standard trawl and 114.86 lbs per hour for the TED. Invertebrate catch rates (other than shrimp) were 104.08 lbs per hour for the standard trawl and 85.41 lbs per hour for the TED. Calculated t_s values indicate a significant difference in the total bycatch rates and the invertebrate bycatch rates but no significant difference in the finfish rates. Mean bycatch rates for the top opening TED and standard trawls are presented in Table 9. The total bycatch rates were 117.62 lbs per hour for standard trawls and 115.57 lbs per hour for the TED. Finfish catch rates were 82.91 lbs per hour for the standard trawl and 84.22 lbs per hour for the TED. Invertebrate bycatch rates were 34.71 lbs per hour for the standard trawls and 31.35 lbs per hour for the TED. The calculated t_s values show no significant differences in the mean catch rates.

A modification was made to the bottom opening device to determine if large catches of cannonball jelly (S. meleagris) encountered during TED testing in the South Atlantic could be reduced. The bar spacing on the TED was reduced from 6" to 3" to prevent the jellyfish from entering the bag forcing them through the device door. The catch rates for the modified device are presented in Table 10. The mean shrimp catch rates for the standard and TED trawls were 16.12 lbs per hour for the standard trawl and 13.41 lbs per hour for the TED. Total bycatch rates were 635.21 lbs per hour for the standard trawls and 187.61 lbs per hour for the modified TED. Finfish rates were 207.63 lbs per hour for the standard trawls and 71.28 lbs per hour for the TED. The invertebrate bycatch rates which includes S. meleagris were 427.58 lbs per hour for the standard trawls and 116.34 lbs per hour for the TED. The percentage of bycatch reduction and the confidence

Table 8. Finfish, invertebrate, and total bycatch rates for the bottom opening excluder device.

Trawl Type	Total Bycatch*	Finfish*	Invertebrates*
Standard trawl	218.98	114.90	104.08
Excluder trawl	200.28	114.86	85.41
Percent difference and 95% confidence interval	9 ± 8	0 ± 11	18 ± 11
N = 60	$t_s = 2.130$	$t_s = .006$	$t_s = 3.185$
	$0.05 > P > 0.02$	ns	$0.01 > P > 0.001$

*Catch rates as lbs per hour per 60 ft of trawl headrope.

Table 9. Finfish, invertebrate, and total bycatch rates for top opening excluder device.

Trawl Type	Total Bycatch*	Finfish*	Invetebrates*
Standard trawl	117.62	82.91	34.71
Excluder trawl	115.57	84.22	31.35
Percent difference and 95% confidence interval	2 ± 7	-2 ± 5	10 ± 19
N = 16	$t_s = .460$ ns	$t_s = .563$ ns	$t_s = 1.024$ ns

*Catch rates as lbs per hour per 60 ft of trawl headrope

Table 10. Shrimp and bycatch rates for bottom opening device with 3 inch bar spacing.

Trawl Type	Shrimp Catch*	Total Bycatch*	Finfish*	Invertebrates*
Standard trawl	16.12	635.21	207.63	427.58
Excluder trawl	13.41	187.61	71.28	116.34
Percent difference and 95% confidence interval	-17 ± 8	70 ± 31	66 ± 63	73 ± 40
N = 65 (shrimp)	$t_s = 5.046$	$t_s = 4.393$	$t_s = 2.059$	$t_s = 3.526$
	$P < 0.001$	$0.01 > P > 0.001$	$0.1 > P > 0.05$	$0.01 > P > 0.0($
N = 12 (bycatch)				

*Catch rates are lbs per hour per 60 ft of trawl headrope.

levels were 70 ± 31 percent for the total bycatch, 66 ± 63 percent for the finfish and 73 ± 40 percent for the invertebrates. The shrimp loss rate associated with the TED modification was 17 ± 8 percent. The t_s values indicate a significant difference between the mean catch rates for shrimp, total bycatch, and invertebrate bycatch.

Another modification which was tested on a limited basis was the removal of the TED door leaving a 3 ft by 3 ft hole. This modification was tested in conjunction with the funnel modification to determine if S. meleagris and loggerhead sponge catches could be reduced without significantly reducing shrimp catch. The modification was tested on S. meleagris in the South Atlantic and on loggerhead sponge in West Florida. The results are presented in Table 11. Mean bycatch rates in the South Atlantic was 610.47 lbs per hour (80% S. meleagris) for the standard trawl and 114.58 lbs per hour for the modified TED. Mean shrimp catch rates were 10.08 lbs per hour for the standard trawls and 8.96 lbs per hour for the TED. Bycatch rates were reduced 81 ± 46 percent with a corresponding shrimp loss of 11 ± 8 percent. Total bycatch mean rates for West Florida was 272.12 lbs per hour (50% loggerhead sponge) for the standard trawls and 153.66 lbs for the TED. Mean shrimp catch rates were 15.83 lbs per hour for the standard trawls and 12.84 lbs per hour for the TED. Total bycatch reduction was 44 ± 21 percent with a shrimp loss rate of 19 ± 9 percent. The t_s values indicate a significant difference between the mean shrimp and total bycatch rates for both areas.

Table 11. Shrimp and bycatch rates for bottom opening device with door removed.

South Atlantic

Trawl type	Shrimp Catch*	Total Bycatch*
Standard trawl	10.08	610.47
Excluder trawl	8.96	114.58
Percent difference and 95% confidence interval	11 ± 8	81 ± 46
N = 14	$t_s = 3.128$	$t_s = 3.809$
	$0.01 > P > 0.001$	$0.01 > P > 0.001$

West Florida (Tortugas)

Trawl type	Shrimp Catch*	Total bycatch*
Standard trawl	15.83	272.12
Excluder trawl	12.84	153.66
Percent difference and 95% confidence interval	19 ± 9	44 ± 21
N = 22	$t_s = 4.371$	$t_s = 4.268$
	$P < 0.001$	$P < 0.001$

*Catch rates as lbs per hour per 60 ft of trawl headrope.

Energy Efficiency

Some limited data was taken in FY81 to investigate the relative efficiency between the standard shrimp trawls and the TED equipped trawls. The lack of adequate mensuration equipment due to budget constraints limited the amount and quality of data collected. Fuel consumption data taken on a chartered shrimp vessel did not indicate any difference in fuel rates although the data is limited and the variability associated with the data is a serious problem that can only be solved by more refined measuring techniques. Towing warp tensions were measured employing Dillon dynometers. This data is presented in Figure 5. Towing tensions were measured at 30 minute intervals during eight paired tows between standard and top opening TED equipped trawls. The data indicate that there is a difference in the relative towing tension with the TED equipped trawl having between 3 and 6 percent less towing resistance than the standard trawl. The beginning tensions are the same in the figure because the data have been normalized for comparison. These data indicate that there may be potential savings in fuel consumption with the TED equipped trawl. The mechanism for the reduced resistance is not known and further research will be required to determine the mechanism of reduced resistance and accurately measure potential fuel savings.

PAIRED COMPARISON OF TOWING TENSIONS ON CONVENTIONAL AND T.E.D.-EQUIPPED TRAWLS

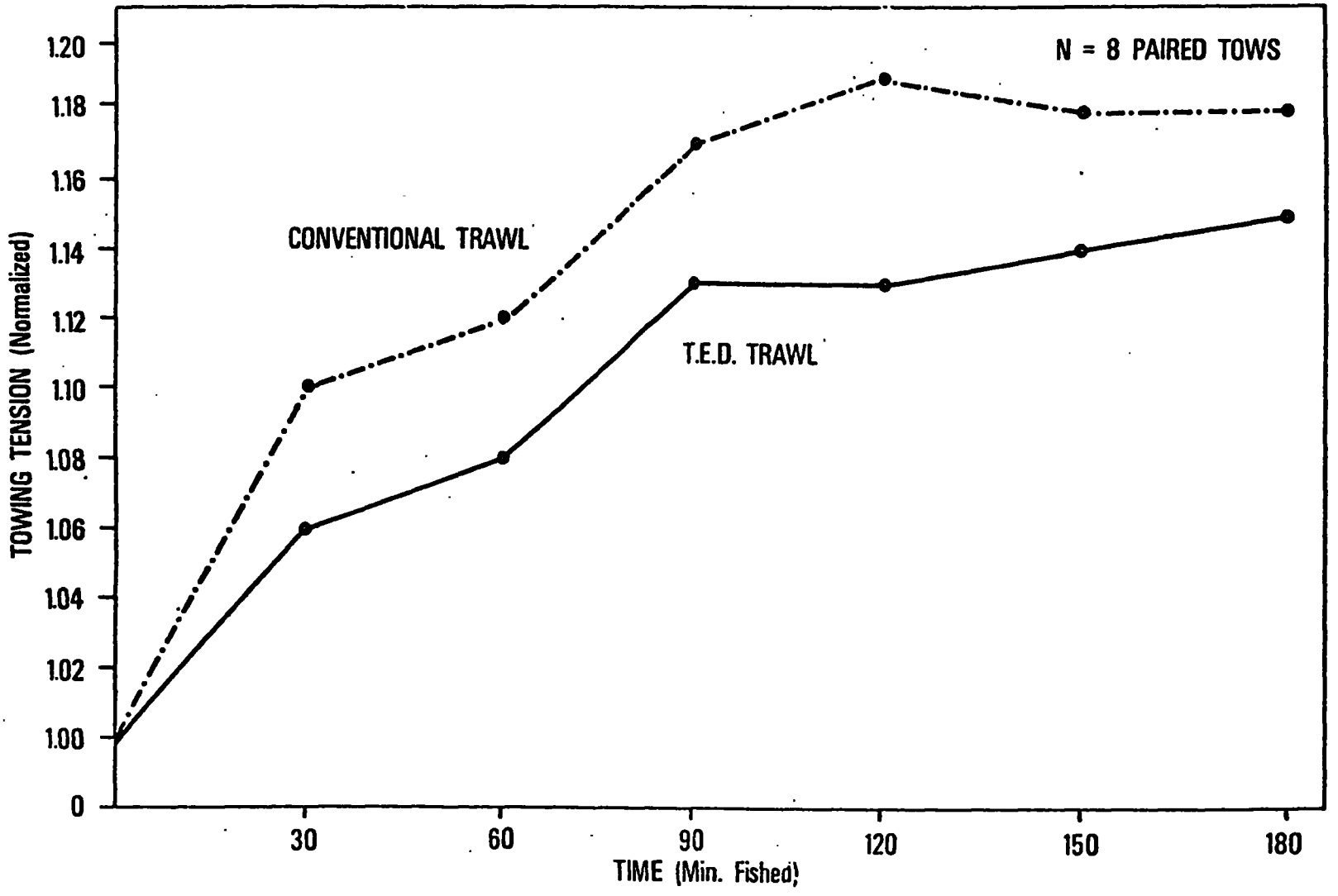


Figure 5

Summary

The objectives of the FY81 sea turtle excluder trawl development research have been accomplished and the development of the sea turtle excluder device and evaluation of its performance have been completed. The results of evaluations of the TED indicate that the gear exceeds the initial project design criteria of 75% turtle reduction and 10% shrimp loss. Both the bottom and top opening versions of the device meet these criteria. The top opening device has several advantages in handling and maintenance characteristics, and behavioral observations by scuba divers of turtles encountering the top and bottom opening TED indicate that turtle escapement is more difficult in the bottom opening design. The bottom opening design may have some advantages in bycatch separation potential when compared to the top opening design, however, adequate testing of the top opening design for bycatch reduction potential has not been conducted. The data indicates that with the addition of the funnel modification there is an increase in shrimp production with the TED equipped trawl and the increase appears to be statistically significant at the present testing level. Additional testing is needed to verify the increased shrimp catch for different fishing conditions and shrimp species.

The bycatch reduction potential for the TED has been demonstrated, however, more developmental research and testing will be required to optimize the gear design to reduce the bycatch components and maintain equal shrimp catch rates.

The towing tension data indicates some potential for energy savings with the TED technology, however, more research will also be required to determine the savings potential and optimize the gear for fuel efficiency.

The turtle excluder device is a gear solution to the incidental mortality of sea turtles in shrimp trawls and can be employed as a management method.

Another method investigated during this project was limiting towing duration. A complete report on this data was submitted to the NMFS Southeast Fisheries Center and was included in the Regional Office DEIS for sea turtle regulations. Preparations for technology transfer of the sea turtle excluder trawl technology accomplished in FY81 include: the preparation of a technical memorandum describing the gear and an addendum describing the alternate modifications, delivery of 5,000 copies of the technical memorandum to the Southeast Regional Office, the preparation of gear models and slide presentations distributed to Sea Grant groups, the participation of technical experts in four gear technology workshops and a demonstration contract conducted by the Southeast Regional Office, and the initiation of production of two films demonstrating the construction and use of the sea turtle excluder device trawl. Finally, a project proposal was submitted for a technology transfer effort in FY82 which would initiate voluntary acceptance of the sea turtle excluder device trawl by the shrimping industry.

Appendix: Construction, Installation, and Handling Procedure for the National Marine Fisheries Service's Sea Turtle Excluder Device

NOAA Technical Memorandum NMFS-SEFC-71

Construction, Installation, and Handling Procedure for the National Marine Fisheries Service's SEA TURTLE EXCLUDER DEVICE

February 1981

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Center
Mississippi Laboratories
Pascagoula Facility
P.O. Drawer 1207
Pascagoula, Mississippi 39567

NOAA Technical Memorandum NMFS-SEFC-71

ACKNOWLEDGEMENTS

The development of the TED was the result of hard work and dedication by several individuals. As in most successful research projects, teamwork resulted in its success. The following individuals from the National Marine Fisheries Service, Southeast Fisheries Center, Mississippi Laboratories, are recognized for their dedicated effort and contributions:

Wilber R. Seidel	John W. Watson
Anthony F. Serra	Andrew J. Kemmerer
Ian K. Workman	Jane P. Corliss
Noel H. Watts	Charles W. Taylor
Charles McVea	Alan R. Bunn

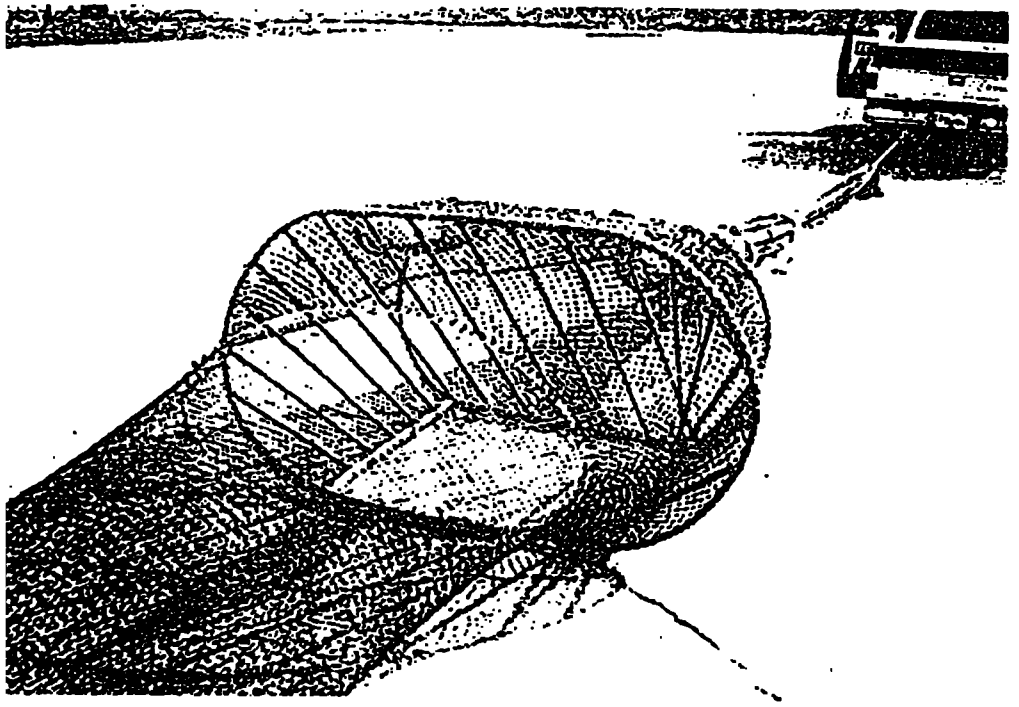
Special recognition is given to Captain Eddie Toomer. His vessel, "TOOMER BOYS" was contracted to support the development of the TED. Captain Toomer's experience and dedication played a significant role in the development and testing of the excluder trawl. His innovative ideas and enthusiastic support during the development and field testing were important contributions to the successful development of the TED.

Special recognition also goes to the many captains, crews, and vessel owners who volunteered their services to test the excluder trawls, and particularly to Bob Jones, Executive Director, Southeastern Fisheries Association; Ralph Rayburn, Executive Director, Texas Shrimp Association; and William Utz, Executive Director, National Shrimp Congress for their full support and cooperation.

Finally, the successful development of the TED was the result of a major commitment throughout NOAA and the National Marine Fisheries Service.

CONSTRUCTION, INSTALLATION, AND HANDLING PROCEDURE FOR NATIONAL MARINE FISHERIES SERVICE'S SEA TURTLE EXCLUDER DEVICE

February 1981



Turtle excluder device installed in shrimp trawl

INTRODUCTION

The Southeast Fisheries Center's Mississippi Laboratories Harvesting Technology Branch, Pascagoula, Mississippi, has been conducting research on techniques to reduce the incidental capture and mortality of sea turtles in shrimp trawls. The research has resulted in the development of the "turtle excluder device" (TED). The TED was tested aboard commercial shrimp vessels on shrimp grounds in the South Atlantic. It reduced turtle captures 89% while maintaining shrimp catches equal to standard shrimp trawls. Similar results are expected on other shrimping grounds off the southeastern United States, and testing on shrimp grounds in the Gulf of Mexico will be conducted during 1981.

The TED also has the potential capability to significantly reduce by-catch associated with shrimp trawling. This capability has not been fully developed, but research is planned to test modifications of the TED to optimize by-catch reduction and further improve turtle separation.

Test results to date indicate that, used correctly, the TED should have a minimum impact both economically and operationally on the shrimp industry. The effectiveness of the device can be enhanced by further research devoted to fully developing the by-catch reduction potential.

DESCRIPTION

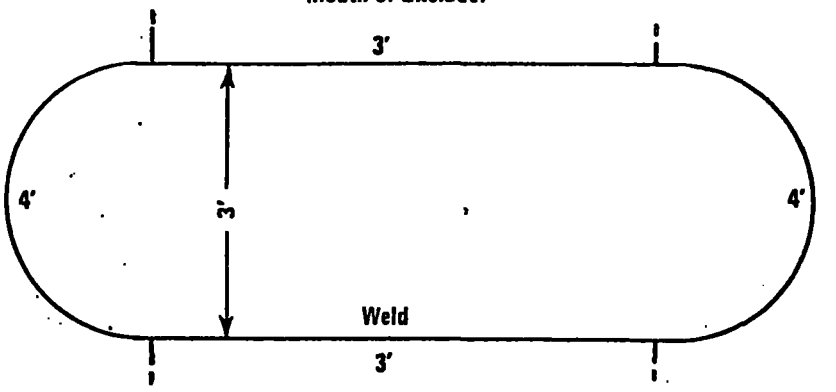
The purpose of this pamphlet is to provide descriptive information on the construction, installation, and proper use of the TED to reduce sea turtle captures without adversely affecting shrimp catch. The TED consists of a 4x3x3' frame constructed of 3/8" galvanized pipe with bars slanting at approximately 45° spaced 3"-6" apart and a 3' square door in the bottom. The TED is placed inside the trawl at the intersection of the trawl body and the codend or bag. As a turtle or other large object enters the bag, it strikes the slanted bars and is forced toward the "trap door". The door opens on hinges when preset tension is exceeded, allowing the object to pass out of the trawl. The trap door closes as the pressure is released. Smaller objects, shrimp, etc., pass through the bars and into the bag. Since the door is opened only when a large object is passing through the trawl, shrimp loss is kept to a minimum.

LIST OF MATERIALS REQUIRED TO CONSTRUCT A TURTLE EXCLUDER DEVICE

1. 110' of 3/8" galvanized pipe.
2. 120 x 120 mesh 1-3/4" x #36 bag webbing.
3. 25' 3/8" polyethylene rope.
4. #36 twine.
5. Four 6 x 12" spongex floats.
6. 8' of 3/8" nylon backed bungy cord.
7. Two single links of 3/16" galvanized chain.
8. One link of 5/16" chain.
9. 10' of 1/4 x 2" flat bar.

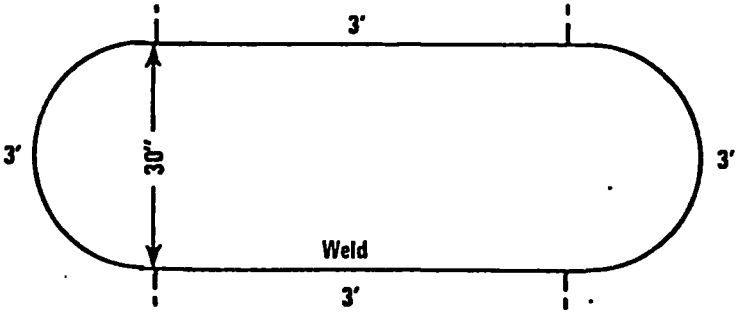
CONSTRUCTION OF EXCLUDER DEVICE FRAME

Mouth of Excluder



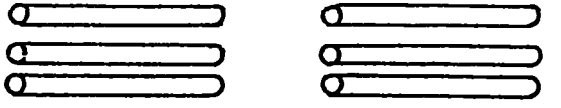
MATERIALS: 3/8" Galvanized pipe 14 ft. long.
CONSTRUCTION: Find center of pipe and mark 1-1/2' on each side. Bend 4' on each side so that the mouth is 3' wide. Weld ends together.

Back of Excluder



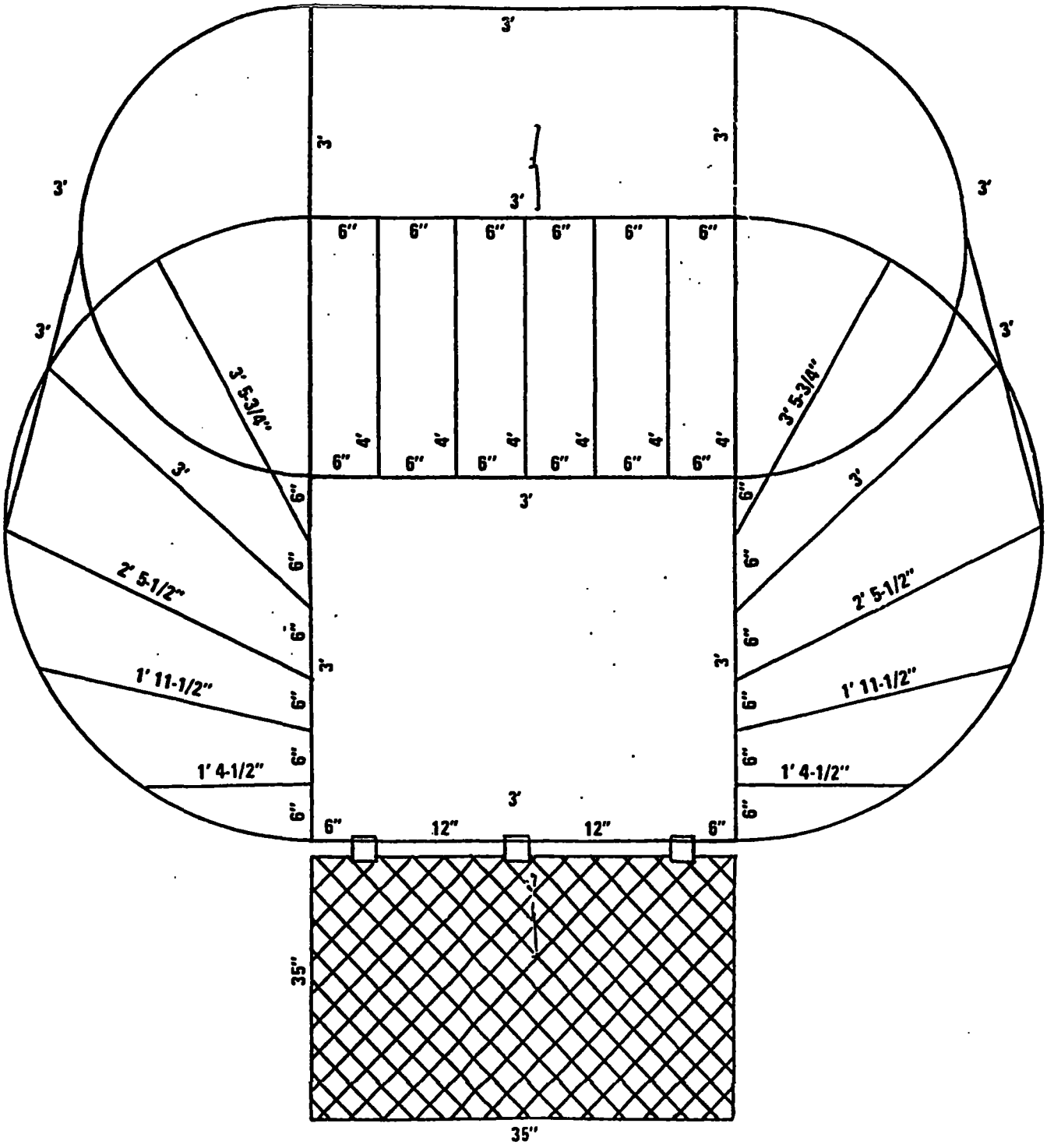
MATERIALS: 3/8" Galvanized pipe 12' long.
CONSTRUCTION: Find center and mark as above. Bend 3' of pipe on each side so that the frame is 30" wide. Weld ends together.

Braces for Frame

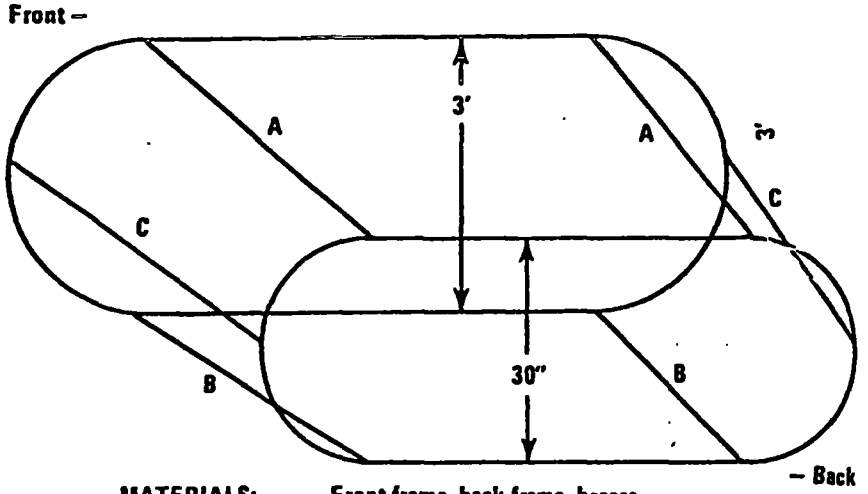


MATERIALS: 3/8" Galvanized pipe 18' long.

COMPLETED EXCLUDER DEVICE



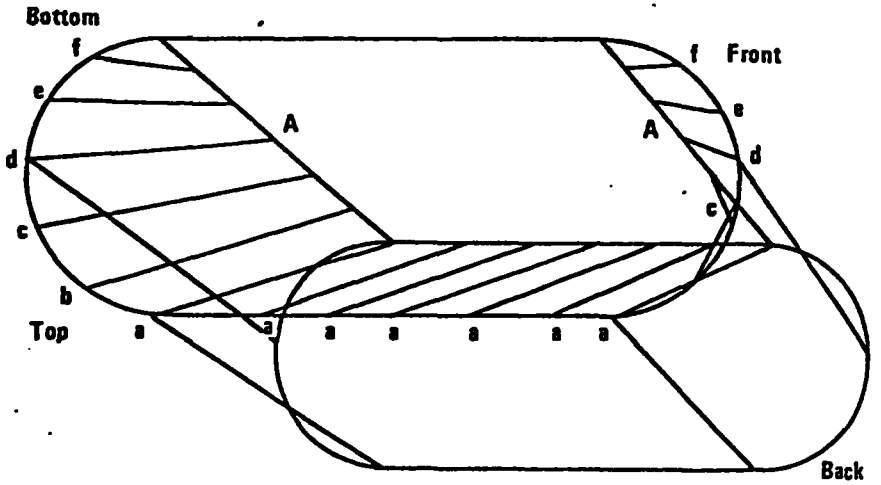
ASSEMBLY OF DEVICE BRACES



MATERIALS: Front frame, back frame, braces.

CONSTRUCTION: Weld braces, A, B and C as shown in diagram.

CONSTRUCTION OF FUNNEL BARS (REAR VIEW)



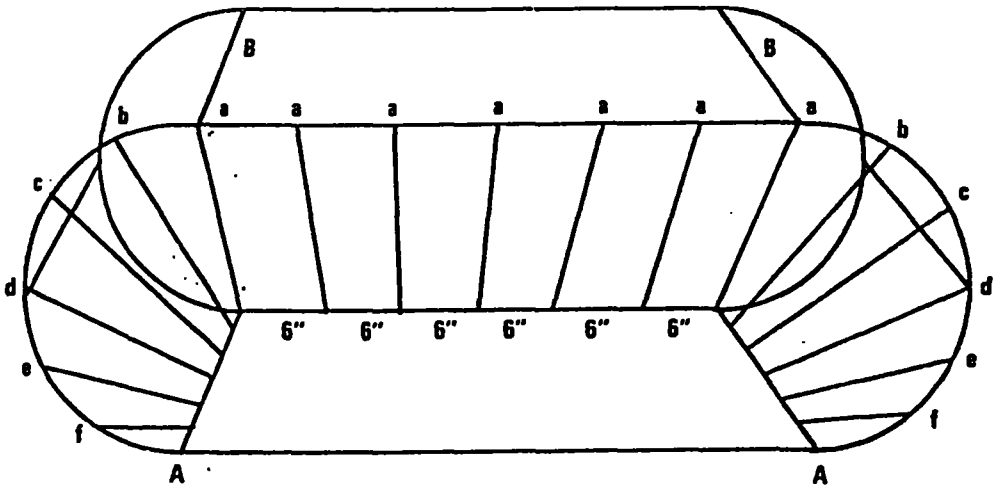
MATERIALS: *3/8" Galvanized pipe cut as follows:*

7 – 4'	(a)
2 – 3' 5-3/4"	(b)
2 – 3'	(c)
2 – 2' 5-1/2"	(d)
2 – 1' 11-1/2"	(e)
2 – 1' 4-1/2"	(f)

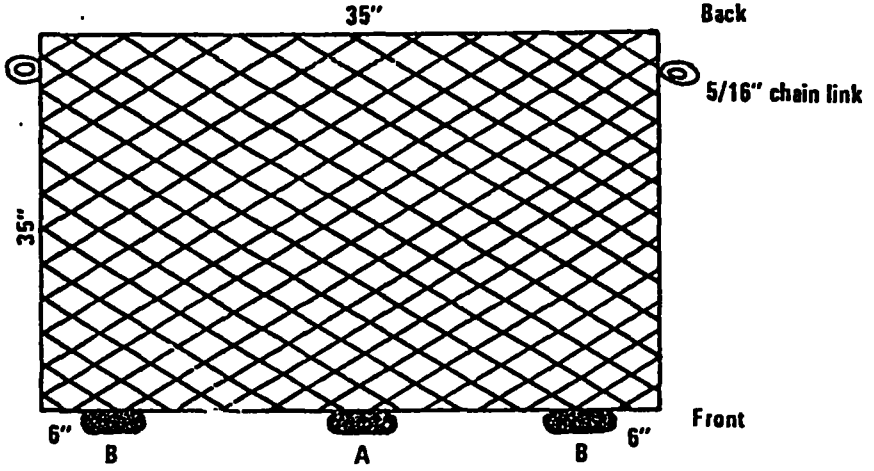
Weld bars 6" apart.

CONSTRUCTION: Weld bars a from top front frame to bottom back frame. Weld bars b-f from Brace A to front curved sides. See following diagram.

FRONT VIEW OF CONSTRUCTED DEVICE



CONSTRUCTION OF DOOR

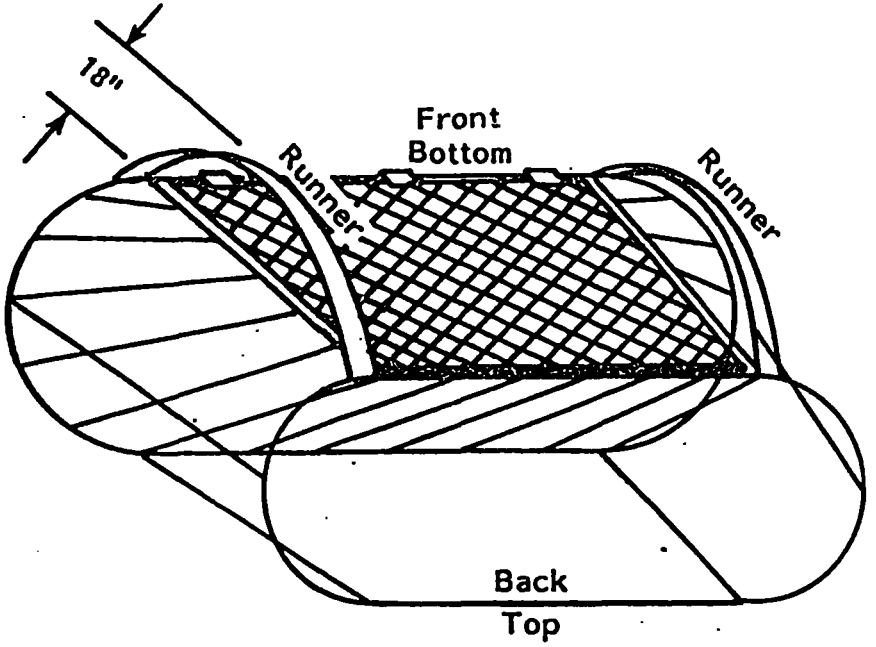


MATERIALS: 4 – 3/8" Galvanized pipe 35" long.
1 – 5/16" Chain links.
3 – 3/4" Galvanized pipe 2" long (hinges).

CONSTRUCTION: Form box with 35" pipe and weld corners. Cut 5/16" chain link in half and weld one on each side of back. Weld hinge A to center of front. Weld hinge B's 6" from side of door.

CONSTRUCTION OF RUNNERS

(Runners are installed on the bottom of the TED to prevent bottom chafing.)



MATERIALS: 2-5' lengths of 1/4 x 2" flat bar

CONSTRUCTION: Weld 5' flat bars to the front bottom frame on each side of the door allowing at least 1" door clearance. Bend flat bars to allow an 18" clearance from the bottom and weld ends to the back bottom frame.

INSTALLATION INSTRUCTIONS

A. Cut a hole 27 meshes x 27 meshes in the bottom center of the 120 x 120 1-3/4" #36 webbing bag, 18 meshes from the front of the bag. The cut out piece of webbing 26 x 26 mesh is laced to the device door with #36 twine using clove hitches, (one mesh every 1-3/8").

B. Place the 120 mesh bag around the device and lace the 27 x 27 mesh hole to the door opening in the device with clove hitches (one mesh every 1-3/8").

C. Lace the 18th row of meshes (from the front of the bag) to the front of the device using a clove hitch every fourth mesh.

D. Tie two 6 x 12" floats to each of the device top brace bars with 2/8" polyethylene rope.

E. Tie a 4 foot length of 3/8" nylon backed bungy cord at the intersection of the top brace and back frame on each side of the device and run behind the slanted bars through the 5/16" half chain link welded to the door and through a 3/16" link of chain. Tie an overhand knot in the end of the bungy cord.

F. Using 3/8" polyethylene rope, lace webbing to the device front frame going through previously laced meshes (every 2nd mesh from center of frame to the door opening on each side). Do not lace across door opening.

G. Attach the device to the trawl by removing the standard bag and sewing the device bag to the trawl with the top center of the device in line with the top center of the trawl. The standard 120 mesh bag is then sewn to the tail of the device bag.

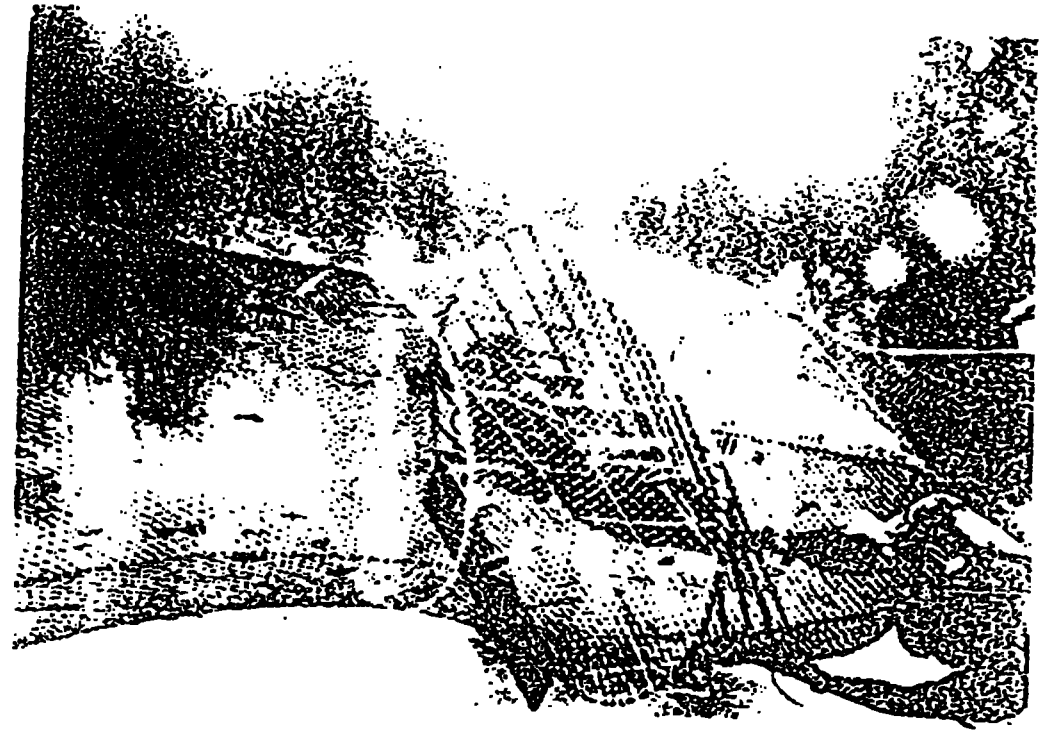
H. Install a bag lifting strap by sewing bag rings every 8 meshes around the bag approximately 45 meshes from where the standard bag is sewn to the device bag. Bag lifting straps should be long enough (4-6') so that the device remains alongside the rail when the bag is lifted.

HANDLING PROCEDURES

A. TED door tension - The door tension is checked using a spring scale with the device hanging (front down). The door opening tension should be maintained at 18 lbs at each bungy attachment point and 21 lbs at the door center for correct operation. After installing new bungy cords, the door tension should be checked after each tow for several tows. It is very important to regularly check the door tension. If the tension is too loose, it can result in shrimp loss; if too tight, turtles might not be released, and by-catch reduction will be reduced.

B. Setting out the excluder trawl - The TED should be set on the rail of the vessel at a 45° angle and the bag dropped over the side. After "breaking down" the trawl, the device should be held at the back allowing the trawl to pull the device out while steading it so it doesn't roll over. After the device is out in an upright position, the trawl may be "trailed out" in the normal manner. The "lazy line" attachment should be placed on the bag in a position so that the device doesn't roll to one side when pulled alongside, preventing twisting of the bag. This attachment point may be different for different vessel rigging designs.

C. Retrieving the excluder trawl - The trawl should be retrieved with the vessel headed into the seas to prevent catch in the bag from being washed into the device by following seas. If the device tends to roll when alongside the vessel, vessel speed should be reduced. The device should remain level when trailing. The bag is retrieved and the catch dumped with the device remaining alongside the vessel.



Turtle excluder device in operation

For further information concerning the NMFS turtle excluder device, contact:

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NOAA Technical Memorandum NMFS-SEFC-71

Construction, Installation and Handling Procedure for the National Marine Fisheries Services Sea Turtle Excluder Device

Addendum

Some T.E.D. construction and installation changes are required in order to update the system to the most efficient rigging configuration. Our recent studies indicate that the T.E.D. is more effective in reducing turtle captures, particularly small turtles, and in maintaining optimum shrimp catch efficiency with its "trap door" opening on the top of the device rather than the bottom. A webbing "funnel" has also been inserted in the bag directly ahead of the device which adds significantly to improved efficiency. In addition, these construction and rigging changes have been found to make use and maintenance of the T.E.D. easier.

The door installed on the top of the T.E.D. allows turtles to escape with minimum effort and does not require bungy cords to hold the door at a specific tension, thus requiring less operational attention and maintenance. The door is simply held in a closed position by gravity and water flow over the net. This results in minimum pressure needed to open the door which improves the turtle separation rate. With a webbing funnel installed directly in front of the device, water flow is accelerated through the device and carries shrimp past the door and into the bag more effectively thus reducing or eliminating shrimp loss when the door opens. Except for these changes, the device is constructed in the same manner as previously described. Runners are welded to the bottom side of the device, but are on the opposite side from the door in the new configuration. The following is a list of materials and instructions for rigging the T.E.D. with a top opening door and a webbing funnel:

A. Top opening device:

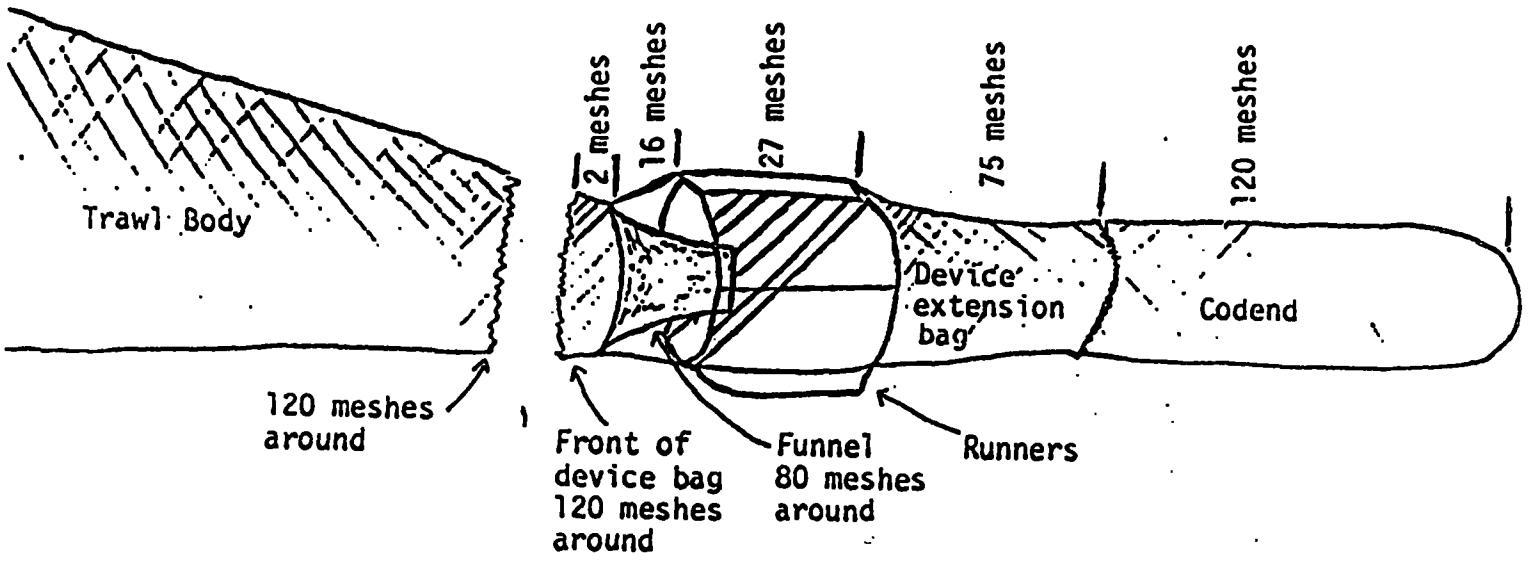
Materials needed:

1. 2 - 3'8" pieces of 1/4" x 1½" flat bar for runners.
2. 3 - 7/8" galvanized hex nuts (hinges).
3. 2 - 2' pieces of 3/8" nylon, polydacron or polyethylene rope.

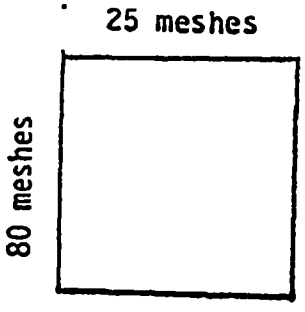
The top opening device is constructed and assembled according to the instructions provided in the NOAA Technical Memorandum NMFS-SEFC-71 except that an improved hinge design has been developed and smaller runners are required.

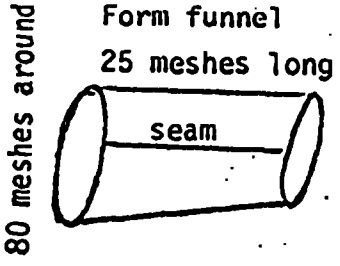
Hinge Assembly: slide three 7/8" hex nuts onto the front bar of the door assembly before the door corners are welded (the hex nuts replace the 2" x 3/4" galvanized pipe hinges). After the door is assembled, the 7/8" nuts are welded to the top front frame, one in the center and one 12 inches to each side of the center nut.

Installation of Webbing Funnel Ahead of T.E.D.

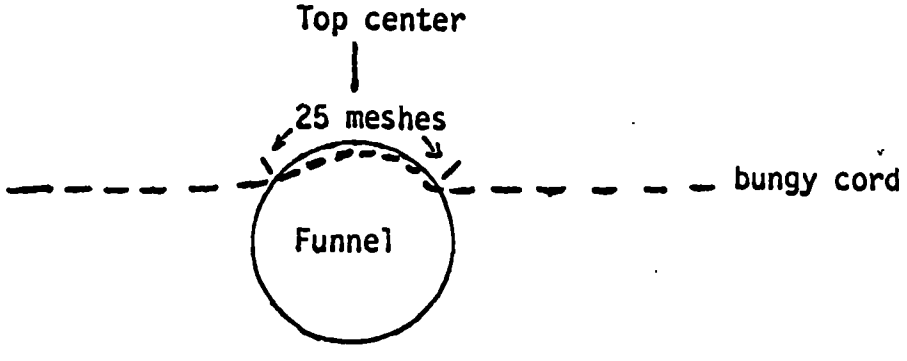


Funnel Material - 1-3/4" x #48 or #36 webbing, 25 meshes deep by 80 meshes around





Bungy cord installation in funnel



Door Stops: with the door opening on top of the T.E.D., the bungy cords which were used to hold the door closed in the bottom opening configuration are not required. Door stops, however, are still required to prevent the door from opening while handling the device, but are no longer tension loaded. The door stops are constructed from two 2' pieces of 3/8" rope. The rope pieces are laced around the top side braces (braces A) and the door side bars on each side forming loops. The loop sizes are adjusted so that the door opens only 18-24 inches. Once adjusted the rope ends are spliced or tied together forming the door stops.

Runners: smaller runners are used on the top opening device since door clearance above the bottom is not a problem. This change significantly improves the on-deck handling characteristics of the device. The runners are constructed of 1/4" x 1-1/2" flat bar. Two 3'8" pieces of flat bar are bent to form sled shaped runners allowing a 6" clearance between the device and ocean bottom. The runners are welded to the device bottom (opposite the trap door) at the intersection of the brace bars (brace B). The runners can be welded to the device after the bag extension is sewn around the device or the extension can be cut to fit over the runners and sewn back together.

B. Funnel:

Materials needed:

1. 1-3/4" #48 or #36 webbing 25 meshes x 80 meshes.

2. 5' 5/16" nylon backed bungy cord.

The funnel is constructed of 1-3/4" #48 or #36 webbing 25 meshes wide by 80 meshes deep. The webbing is sewn together along the 25 mesh edge to form a funnel (see attached figure). The funnel is attached to the device bag extension on the second row of meshes from the front of the extension (see figure) before the extension is sewn to the trawl body. The funnel is sewn to the device extension by doubling every other mesh on the extension to allow the 80 mesh funnel to fit evenly in the 120 mesh extension. After the funnel is sewn to the extension, a 5' section of 5/16" nylon backed bungy cord is laced through 25 meshes in the top back of the funnel (see figure). The ends of the bungy cord are attached to funnel bars (bar b) on each side of the device, 10 inches below the door opening. The bungy cord should be stretched and secured to the funnel bars using clove hitches. The first and last meshes laced by the bungy cord should be secured to the bungy cord with twine to prevent the funnel from sliding on the bungy. The bungy cord on the funnel is used to hold the funnel in the correct position to direct water flow into the trawl bag or codend. If this bungy cord is not used properly, shrimp loss could occur when the T.E.D. door opens. After the funnel has been secured, the device extension is attached to the trawl body as previously described except that the door of the device is on the top side of the trawl.