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DESIGN CHARACTERISTICS AND THE SPECIFICATIONS FOR THE CONSTRUCTION OF TURTLE EXCLUDER DEVICE IN SHRIMP TRAWL NETS IN NIGERIA

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ABSTRACT

The design characteristics, specifications and procedures for the construction and the installation of the Turtle Excluder Devices (TED) in shrimp trawl nets in Nigeria are presented. The super shooter or bent rod grid with a maximum of 10.0cm deflector bar spacing is installed in the polyethylene codend extension (R1500 text and 45mm stretched mesh size) at 45° for good performance. Details of the floatation, the reinforcement of the deflector bars, the exit opening and other modification of the locally fabricated TED are highlighted.

Keywords: Turtle excluder device, Shrimp trawl net, grid, deflector bars.

INTRODUCTION

Turtle Excluder technology is a conservation strategy and a recent development in shrimp trawling in Nigeria. Demersal trawl nets capture the endangered sea turtles as incidental catch to shrimps. Turtle excluder device (TED) is installed in shrimp trawl net to exclude the endangered sea turtles from being captured while the marine shrimps pass through the grid and are collected in the trawl net codend.

Nigeria exports marine shrimps to earn foreign currency and about U.S. $ 45 million was realised in 2001 (FAO, 2001). The U.S. Govt. placed an embargo on the export of shrimps from all nations where TED has not been installed in shrimp trawl nets. Therefore TED became a pre-condition and regulatory requirement in Nigeria with effect from 15th May 1996. It was mandatory to install TED in shrimp trawl nets in order to export shrimps to the U.S. markets in line with section 609 of U.S. Public Law 101-162 of 1989 (Mitchell *et.al.* 2001). That informed the urgent need to develop in a record time locally made 'bent rod' TED for the Nigeria shrimping industry. Consequently a national workshop on the fabrication of improved TED using locally available materials was conducted by the Nigerian Institute for Oceanography and Marine Research in collaboration with Federal Department of Fisheries between 17th and 19th June 1998. The trawler fishermen from Nigerian Trawlers Owners' Association (NITOA) participated actively in the workshop and the field trials. Turtle Excluder Device was adopted by the Fishing companies and installed in all the shrimp trawl nets. The ban was lifted on 21st July, 1998 and the Fishing companies resumed the export of shrimps to the U.S.A. markets to earn foreign currency. The design details and specifications for the construction and installation of TED in shrimp trawl nets in Nigeria are highlighted.

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SEA TURTLES IN NIGERIA

Trawling in Nigeria targets mainly demersal fish and marine shrimps. The marine shrimps include *Penaeus notialis*, *Parapenaeopsis atlantica*, *Parapenaeus longirostris*, *Penaeus kerathurus*, and *Penaeus monodon*.

The six species of sea turtles which occur in Nigerian coastal water belong to two families (Table 1). The dominant species include the Atlantic hawksbill *Eretmochelys imbricata* (Chelonidae) and the Atlantic leather back *Demochelys coriacea* (Demochelydae). Other species include Atlantic logger head *Caretta caretta*, Atlantic green turtle *Chelonia mydas*, Atlantic ridley turtle *Lepidochelys kempii* and Olive ridley turtle *L. Olivacea* all of which belong to the family Chelonidae.

Sea turtles are protected under the Endangered Species Acts in Nigeria by the Conservation of sea turtles in Nigeria marine waters, Sea Fisheries Decree (No 17) of 1992 which is being reviewed and makes it mandatory to install Turtle Excluder Devices (TEDs) in shrimp trawl nets (Federal Republic of Nigeria Official Gazette, 1992).

TABLE 1 TURTLES IN THE EAST CENTRAL ATLANTIC

Family/Species	Common name
Chelonidae	
Caretta caretta	Atlantic logger head
Chelonia mydas	Atlantic green sea turtle
	Atlantic hawksbill
Eretmochelys imbricate	Atlantic ridley turtle
Lepidochelys kempii	*Olive ridely turtle*
L. Olivacea	
Demochelyidae	
Demochelys coriacea	*Atlantic leather back*

Source: Schneider (1990)

SPECIFICATIONS OF TED

The turtle excluder device (Plate 1) is made up of 2 major parts viz. the grid and the netting materials of the codend extension in which the former is installed.

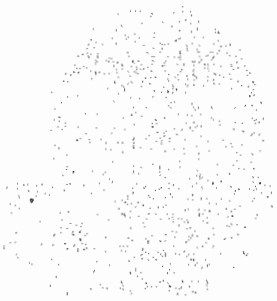

Plate 1: Turtle Excluder Device

THE TED GRID

Many types of TED grids have been developed in the United States of America to meet specific design criteria such as grid size, bar spacing and construction materials. They include the oval Georgia Jumper, hooped grid (circular or round), the fixed angle, the Anthony Weedless, the flounder and the super shooter which is a variation of the bent rod grid (Appendix 1). The latter which has a simple design has been adopted for the industrial shrimp fishery in Nigeria. Among other characteristics, the bent rod grid is specifically designed to reduce the accumulation of debris e.g. grass on the deflector bar in order to allow the shrimps to pass freely into the codend.

BENT ROD GRID MATERIALS AND DIMENSION

In Nigeria the bent rod grid (Plate 2) is constructed with solid steel rod with minimum diameter or thickness of 0.64cm in order to withstand the rough condition of the sea and the stress of trawling. The same material is used for the main frame and the grid bars. The steel rod is relatively cheap and readily available. It is very important to note that smooth iron rod is more environmentally friendly and will cause less damage and bruises to the shrimps as compared with twisted rod.

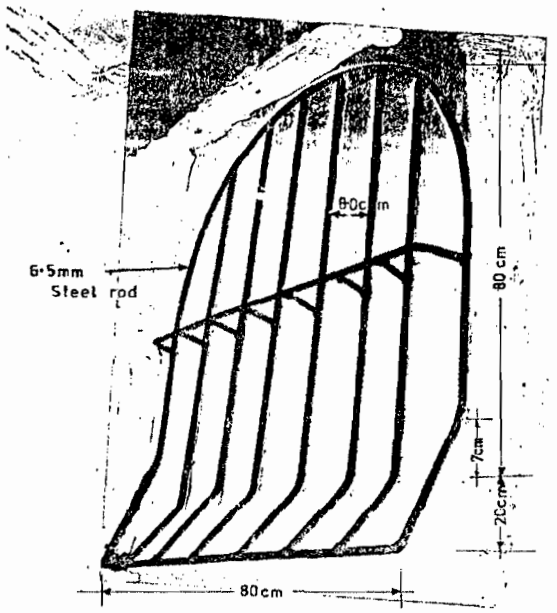

Plate 2: Dimensions of a TED grid

Other materials that can be used are costly and include fibre glass reinforced plastic (FRP) or aluminium rod with a minimum size of 1.17cm. Steel or aluminium tube or pipe (1.27cm minimum diameter and 0.32cm minimum wall thickness) can also be used. The grid size is expected to match the circumference of the codend extension. The minimum dimension of the grid is 70.0cm height by 70.0cm width. The grid deflector bars should have a maximum spacing of 10.0cm between the main frame and the bars and also between two adjacent bars. Plate 1 shows the dimension of a typical grid.

NETTING MATERIALS, TWINES AND ROPE

Polyethylene (PE) netting material with a twine thickness of R1500 tex and 45mm stretched mesh size is required to form a cylindrical codend extension for the enclosure or installation of the TED grid. The size of netting material depends on the design or size of the trawl net. For example a typical TED may require a rectangular piece of netting material approximately 160 meshes by 60 meshes for wrapping the grid.

Twine: Twine material is preferably polyethylene twine with R1500 tex thickness. Nylon polyamide (PA) twine of the same thickness can also be used

Rope: Polyethylene (PE) rope with minimum diameter of between 14mm and 18mm is required.

MOUNTING RINGS AND BRIDLES

Mounting rings and bridles are required specifically for the installation or fixing of the grid in the netting material. They are used to suspend and stretch the cylindrical piece of net into which the grid is installed.

Two units of mounting rings are required. Each 5.0cm thick ring is approximately 250cm in circumference. The two ends are flattened so that a small pin or bolt and nut can be fixed to fasten them together.

The bridles are made up of 14-16mm polyethylene rope and include:

(a) 2 units of 4m bridles each with eye or ring on one end.

(b) 4 units of 1.5m bridles each with eyes or rings on both ends.

INSTALLATION OF THE GRID IN THE NETTING

A rectangular piece of polyethylene netting material (PE R1500 Tex.) with 45mm stretched mesh size is cut to size of 160 meshes by 60 meshes for the construction of the codend extension using "all points" cutting pattern. The two sides (60 meshes) are joined together to form a cylindrical tube of netting with 160 meshes circumference. Two pieces of mounting rings fixed along the circumference on each side of the net are suspended with 6 bridles as shown in Fig 1.

Two small bridles (1.5m in length) are passed through one eye of the 4m long bridle. The four eyes of the small bridles are fixed equidistantly on the mounting ring (which passes through 160 meshes) at approximately 40 meshes apart. The free end of each of the two long bridles are used eventually to suspend the codend extension on either side. The grid can then be installed in the suspended net at the appropriate angle of inclination. The TED grid should be installed at angles ranging between 30° and 55° and most preferably 45° which gives best performance as regards the collection of shrimps in the codend as well as the exclusion of the turtle specimens.

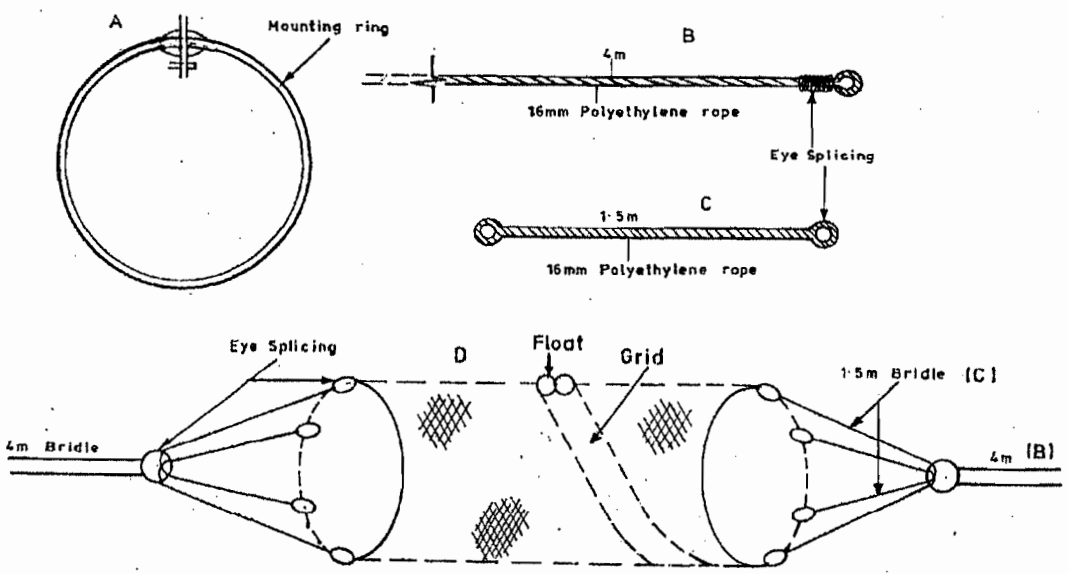

Fig. 1: Diagramatic Representations of the Mounting Ring (A) bridles (B & C) and Suspended Codend Extension (D)

The netting is fastened around the grid frame with a rope at an appropriate angle of inclination which is best at 45°. The angle can also be measured with a protractor or imported angle finder with magnetic base (e.g. Taiwan model P34214 Nr.2430). The angle of installation of TED in a completely rigged net can be confirmed with the angle meter by raising or suspending the TED with a whip-line attached to the net at about 1.5m from the point of attachment of the grid towards the trawl net mouth opening. There is need to ensure that there is no twist and that the codend hangs, directly under the TED frame.

After the initial construction involving the use of the angle meter, the point of attachment of the grid in a similar or identical design can also be replicated subsequently by counting the meshes of the codend extension in a completely rigged TED. Using the cylindrical codend extension measuring 160 by 60 meshes and 45mm stretched mesh size as an example, the point of attachment of the grid in replicates should be as indicated below:

(a) At the top, the point of attachment of the grid to the netting of the codend extension is approximately 10 meshes from the center of the mounting ring which is on the circumference facing the net mouth.
(b) At the bottom, the point of attachment of the grid to the netting of the codend extension is approximately 30 meshes from the center of the mounting ring which is fixed at the circumference facing the codend.

FLOAT AND FLOATATION

Float materials include Expanded polyvinyl chloride (PVC), Expanded ethylene vinyl acetate (EVA), Aluminium (AL) or Hard plastic (HP). The cylindrical float measures approximately 17.2cm diameter and 22.2cm length.

The floatation or buoyancy force provided by the floats (2 or 3 pieces) should be equivalent to or be greater than the TED weight in water. According to Mitchell *et al* (1995) a properly floated TED should operate 46-51cm off the sea floor.

The floats are attached outside or inside the net such that they do not obstruct the passage of shrimps through the grid into the codend. In case the floats are to be attached inside the net, it should be behind the TED grid on the side closer to the codend. The floatation or buoyancy force lifts the TED a little above the ground and thereby prevents the netting materials from being chafed against the sea floor. The netting lasts longer and frequent mending or maintenance associated with chafing and the cost implications are thereby removed. Lifting also allows debris to escape easily. The gap created by lifting also allows turtles to escape into the water without hitting the sea floor. The floats also help to stabilize the TED in water and prevent it from rolling over during deployment or retrieval.

ESCAPE OPENING OR EXIT ROUTE

The escape opening can be constructed at the top or bottom of the TED. In Nigeria the exit is constructed mainly at the bottom whereby the combination of the water flow and gravity assist the debris such as sea grass, sticks, shell and jellyfish to pass out of the TED. Therefore the marine shrimps which collect into the codend are not physically damaged by the debris which pass out easily. The sorting time is fast because the shrimps are relatively clean. Figure 2 shows a turtle being released from the net through the bottom escape opening.

According to Mitchell *et al.* (1995), the other option is the top exit, which appears to be good for trawling areas devoid of debris. It tends to retain more shrimps than the bottom hole because the marine shrimps naturally stay close to the bottom.

WEBBING FLAP

It is precisely an elastic piece of net webbing made from heat-set and depth stretched polyethylene netting materials with R1500 tex twine thickness and 45mm stretched mesh size. The heat-set polyethylene material is not readily available locally. The ordinary polyethylene netting material which is cheaper and available in the local markets is used instead of the heat-set polyethylene which is also very costly to import. The rectangular flap is approximately 80.0-90.0cm by 25.0-30.0cm. It is fixed over the exit opening to prevent shrimp loss but should open easily to allow sea turtles and other debris to escape or pass out.

The fabricated TED is finally attached to the shrimp trawl net at the entrance to the codend. The design details of a trawl net fitted with TED is shown in Fig 3. The sea turtles are prevented from entering the codend and allowed to escape into the sea. Shrimps pass through the grid and are collected in the codend.

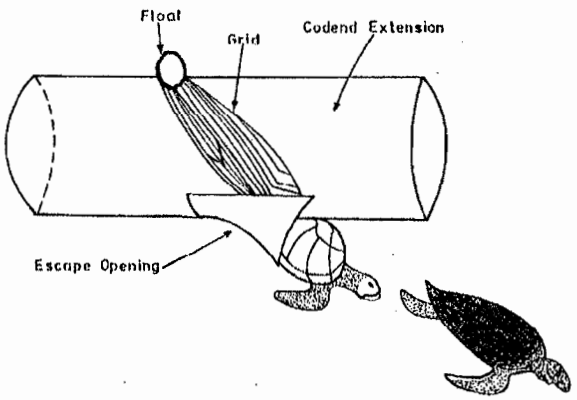

FIG. 2: TED SHOWING THE RELEASE OF TURTLE THROUGH THE ESCAPE OPENING

GENERAL MODIFICATIONS

The locally made TED has been subjected to a few modifications in order to improve the performance as well as increase the durability and make it more amenable and easy for adoption by the fishermen. The main modifications include the following:

(a) Cross bars have been introduced for bracing the defector bars of the TED grid. The bars are attached on the side facing the cod-end for reinforcement. The local TED was observed to be generally weak and was often replaced after one or two trawling operations. The frequency of replacement apart from other inconveniences and the cost

implications informed the need to strengthen the deflector bars of the grid with cross bars in order to withstand the stress of trawling.

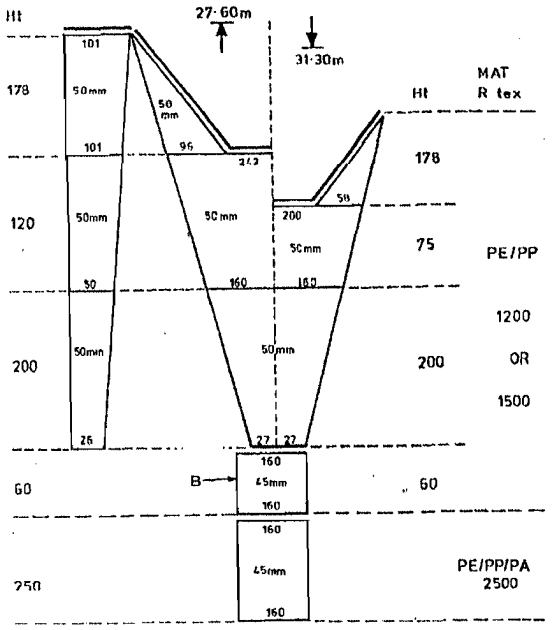

FIG. 3: NIGERIAN SHRIMP TRAWL NET SHOWING THE CODEND EXTENSION (B)

(b) The angle of inclination of many of the TED grids was found to be defective. The angle of inclination is best at 45%. The defect was due to non-availability of the imported clinometer or protractor. Therefore local protractor has been fabricated to facilitate accurate measurement of the angle of inclination.

(c) In many cases the floats are attached on the outside in order to allow for easy replacement of any one that may be lost during trawling.

(d) The locally available PE material is used to cover the escape opening instead of the imported heat-set PE netting material.

(e) Accelerator funnel is optional but useful for directing the shrimp through the grid into the codend. It is effective in minimizing shrimp loss during trawling. However, the accelerator funnel makes the design of the TED a lot more complex and not readily amenable for adoption by the local fishermen.

(f) Chafing webbing and roller gear are also considered optional and not compulsory in the construction of the local TED. They reduce or prevent chafing on the bottom of the TED. In addition to the cost implications they are considered by the net makers and the fishermen to be a lot more complex in design and very cumbersome to operate.

CONCLUSION

The certification of countries to export shrimps to the United States is ratified every year by be U.S. Govt. and is based mainly on compliance by the operators in the fishing industry. For the year 2001/2002 certification, two U. S. marine fisheries personnel visited Nigeria between March 12th and 16th 2001. They inspected TED facilities and confirmed that all the operators and fishermen in the Fishing Industry complied with the TED regulation. Based on the satisfactory performance Nigeria was certified as one of forty-three nations to export all categories of shrimps to the United States for the year 2001/2002. Therefore it is imperative that the skippers, fishermen and other operators and stake holders should continue to be educated and sensitized on the need to comply with the TED regulations in order to protect the foreign exchange earning capacity of Nigeria accruing from the marine shrimp trawling industry.

On tropical shrimp grounds, turtles and some non-targeted fish particularly juveniles occur and are found together. The reduction of incidental catch of turtles and unwanted fish in shrimp trawls is thus regarded as a priority issue in the global effort to develop more responsible fisheries as indicated by Broadhurst and Kennelly (1996), Broadhurst (1998) and Broadhurst *et al.* (1999). The future trend and development will involve a pragmatic approach to the modification of the trawl net by the introduction of a combination of Turtle Excluder and By-catch Reduction technologies. It is most important to educate, create awareness and promote strong collaboration among all the stake holders in order to facilitate the development of the selective and environmentally friendly fishing technology as indicated by Foster (2000). Skill acquisition and capacity building on trawl efficiency as well as trash fish excluder technologies are also desirable and imperative for sustainable fishery development in a multi-species tropical environment as ours. It is also very important to investigate the life cycle of the sea turtles and identify the nesting grounds and beaches where the eggs are often susceptible to other hazard including consumption by carnivores

or collection by fishermen and other beachcombers.

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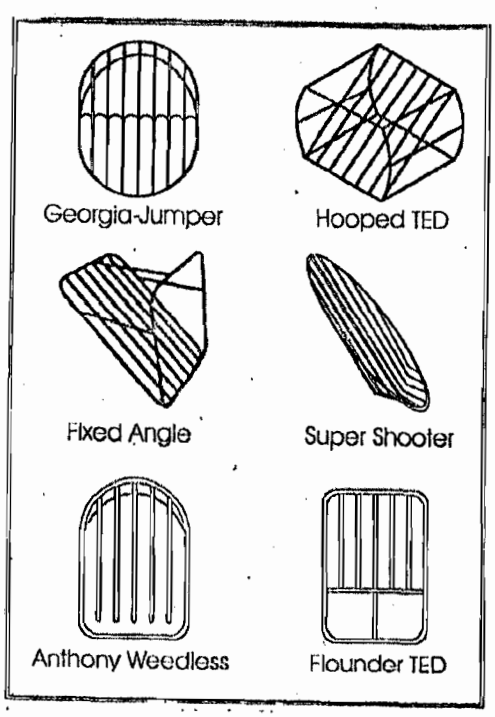
Appendix 1: Basic TED grid designs



Source: Mitchell et al. (1995)