PERFORMANCE EVALUATION OF DIFFERENT SELECTIVE DEVICES FOR THE REDUCTION OF BY-CATCH IN SHRIMP TRAWLS

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ABSTRACT

By-catch landing in shrimp trawling accounted for 70 to 90% of the total catch due to non-selective fishing practice. This indiscriminate exploitation and large scale destruction of fish belonging to different species caught as by-catch including juveniles and young ones of some of the commercially important fisheries, lead to depletion of stock. The introduction of selective device in shrimp trawls enables to reduce the by-catch and other unwanted catch. These selective devices have been developed taking into consideration of the differential swimming pattern of fish and shrimp inside the trawl net. Different types of selective devices, known as by-catch reduction devices have been developed and successfully field tested in many countries. It has been reported that the reduction of by-catch varied from 15 to 35% by different devices without any significant reduction in the shrimp catch when compared to the control net. CIFT has developed four types of selective devices viz. square mesh window, radial escapement device, fish eye and grid for the reduction of by-catch in shrimp trawling. The general performances and advantages of these devices are discussed in this paper.

Introduction

Conventional trawl fishing is very poor in selectivity as it often catches large quantities of non-target species termed as by-catch or incidental catch. It is estimated that about 30% of these by-catch comprises juveniles and young ones of commercially important fishes which are invariably discarded due to various reasons. These factors pose a serious threat not only to the sustainability of the resources, but also to the ecosystem. Despite the government efforts to develop ecologically sustainable fishing practice no specific regulations have been declared to protect the fish stock. Limiting the destruction of juveniles and young ones is one of the ways for conservation of fish stock. Hence the urgent need of the hour is to protect the resources from indiscriminate exploitation, which can be achieved only by introducing selective devices in shrimp trawling.
Selective devices, known as by-catch reduction devices (BRD) facilitate the reduction of by-catch and other unwanted catch during shrimp trawling. These devices have been developed taking into consideration the behaviour pattern of fish and shrimp inside the trawl net. While the fishes are capable of swimming against the water flow inside the net and can escape any time if proper facilities are provided, the shrimps are carried away along with the water flow to the codend of the net. These differential behaviour is taken as the basic principle for designing the devices so as to reduce the by-catch and at the same time maintaining the shrimp catch in the cod end. Watson, et al. (1988 and 1993) reported different types of selective devices for shrimp trawl to reduce the by-catch in the United States. McGilvray (1997) described different types of by-catch reduction devices viz. Squaremesh window, Radial escapement device, Fish eye, TED etc. developed for Australian prawn trawl and Brewer et al. (1998) studied the relative assessment of different by-catch reduction devices in the tropical Australian prawn trawl fishery. Recently Central Institute of Fisheries Technology also initiated the studies on the development of by-catch reduction devices for shrimp trawl. The details of the different types of by-catch reduction devices and the preliminary fishing trials carried out with these devices are discussed in this paper.

Materials and methods

The following types of devices have been fabricated for the present studies and the details are given below:

1. **Squaremesh window**: This is a very simple device to reduce the by-catch, especially juveniles and young ones. This consists of a square mesh panel with a particular mesh size attached at the top of the conventional diamond mesh cod end to facilitate the escape of small fish. In the present studies a squaremesh panel of 60 x 90 meshes of 50.0 mm mesh size was attached at the top of the diamond mesh codend (Fig.1).

![Fig.1 Square mesh window](image-url)
2. **Radial Escapement System (RES)**: This is an improved type of squaremesh panel attachment developed by Watson and Taylor (1988). This consists of a small mesh funnel surrounded by a radial section of large square mesh panel supported by two rings on both sides. This section is attached ahead of the cod end of the net. The funnel guides the fish and shrimps to the codend, but the fish swim back and escape through the squaremesh. The details of the RES used for the present studies are given in Fig. 2.

![Fig. 2 Radial escapement device](image)

3. **Fish Eye**: This eye shaped device was developed for the Gulf of Mexico shrimp fishery (Watson *et al.* 1993). It is a steel frame fitted at the top of the codend, to provide an elliptical opening and the fish after reaching the codend turn back and swim forward to escape through this opening. Fig. 3 gives the details of the ‘Fish Eye’ used for the present studies.

![Fig. 3 Fish eye](image)
4. **Attachment of Grid**: This device consists of a metallic grid fitted inside the net ahead of the cod end at an inclined angle of 45 to 55 degrees. A funnel provided in front of the grid guides the catch towards the grid. While the small fish and shrimps enter through the vertical bars spaced 80 to 100 mm apart and reach the cod end, the large fishes like shark, rays, turtle etc. are guided upward by the vertical bars to the escape opening provided at the top of the grid. The escape opening is covered by a flapper to minimize the loss of shrimps. This device was originally developed in United States to exclude sea turtles (Watson and Taylor 1988). Subsequently grids with different shapes like oval, rectangular, spherical etc. were developed as by-catch reduction device and successfully field tested. Mounsey, et.al. (1995) developed an improved flexible type of grid (Austed) for Australian prawn fishery. In the present studies, two type of grids, an oval and spherical shaped have been used. The design details and the rigging are given in Fig.4.

![Diagram of Grid with guiding funnel and escape opening](image)

**Fig.4 Grid with guiding funnel and escape opening**

A 32.0 m shrimp trawl was used for the fishing trials. Alternative hauls with standard codend and codend attached with device were carried out at depth range of 10 to 15 m off Cochin. The quantity of catch in respect of shrimps and fish was recorded for each haul to find out the catch variation between the net attached with BRD and without BRD. In the case of fish eye an outer cover codend was attached to find out the escapement rate.

**Results and discussion**

The percentage reduction of by-catch and the difference of shrimp catch between the standard codend and codend attached with different by-catch reduction devices are shown in Fig.5 (a & b). It is clear from the results that the
Grid device accounted for maximum reduction of fish catch (34.5%) followed by Fish Fye (22%). Radial escapement device (18%) and Squaremesh window (15.5%). In the case of shrimp catch there is no significant difference between the standard net and net attached with different selective devices indicating that the escapement of shrimp through the escape opening of the devices was very much restricted. The results also indicated that all the devices except the grid, facilitated the escapement of more small size fishes i.e., juveniles and young ones, through escape opening when compared to the standard codend. The percentage retention of different varieties of smaller size group fishes, in the standard codend and codend attached with squaremesh window and radial escapement device and the percentage escapement of smaller size fishes to the cover codend in respect of fish eye attachment are given in Table 1. According to Brewer, et.al. (1998) the reduction of unwanted by-catch in different by-catch reduction devices varied from 15 to 35% and the percentage of reduction of shrimps was 5 to 10% when compared to the control net. and a combination of two devices i.e. grid and square mesh window or fish eye was found to be more effective in reducing the small fish catch. The superiority of squaremesh over diamond mesh in eliminating the undersized fish has been already studied by Kunjipal, et.al. (1994). Pillai, et.al. (1994) and Varghese, et.al. (1996). The effectiveness of
squaremesh panel as a by-catch reduction device was also studied by Broadhurst and Kennelly (1994) and Pillai, et. al. (1996).

Table 1: Percentage retention of fishes in different size groups in respect of standard codend and codend with selective devices

<table>
<thead>
<tr>
<th>Length groups (mm)</th>
<th>Caranx Control net</th>
<th>Caranx Net with SMW</th>
<th>Sciaenids Control net</th>
<th>Sciaenids Net with SMW</th>
<th>Anchovies Control net</th>
<th>Anchovies Net with SMW</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-80</td>
<td>70.0</td>
<td>30.0</td>
<td>83.3</td>
<td>16.7</td>
<td>70.0</td>
<td>30.0</td>
</tr>
<tr>
<td>81-90</td>
<td>64.0</td>
<td>36.0</td>
<td>73.0</td>
<td>27.0</td>
<td>55.0</td>
<td>45.0</td>
</tr>
<tr>
<td>91-100</td>
<td>50.5</td>
<td>49.5</td>
<td>54.6</td>
<td>45.9</td>
<td>40.0</td>
<td>60.0</td>
</tr>
<tr>
<td>101-110</td>
<td>40.0</td>
<td>60.0</td>
<td>46.4</td>
<td>53.6</td>
<td>45.0</td>
<td>55.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length Group (mm)</th>
<th>Standard Codend</th>
<th>Codend with RES</th>
<th>Length Group mm</th>
<th>Standard Codend</th>
<th>Codend with RES</th>
</tr>
</thead>
<tbody>
<tr>
<td>61-70</td>
<td>100</td>
<td>0.0</td>
<td>101-110</td>
<td>100</td>
<td>0.0</td>
</tr>
<tr>
<td>71-80</td>
<td>66.6</td>
<td>33.4</td>
<td>111-120</td>
<td>100</td>
<td>0.0</td>
</tr>
<tr>
<td>81-90</td>
<td>61.5</td>
<td>38.5</td>
<td>121-130</td>
<td>51.8</td>
<td>48.2</td>
</tr>
<tr>
<td>91-100</td>
<td>14.0</td>
<td>86.0</td>
<td>131-140</td>
<td>46.2</td>
<td>53.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length Group (mm)</th>
<th>Standard Codend</th>
<th>Codend with RES</th>
<th>Length Group mm</th>
<th>Standard Codend</th>
<th>Codend with RES</th>
</tr>
</thead>
<tbody>
<tr>
<td>141-150</td>
<td>100</td>
<td>125</td>
<td>60-70</td>
<td>100</td>
<td>20.0</td>
</tr>
<tr>
<td>151-160</td>
<td>100</td>
<td>-</td>
<td>71-80</td>
<td>100</td>
<td>25.0</td>
</tr>
</tbody>
</table>
Another important observation made during the experiments carried out at CIFFT was the reduction of jelly fish in the codend fitted with grid. The high concentration of jelly fish during certain season is great menace as there are instances of damaging the net due to heavy catch of jelly fish. So by installing the grid the unwanted catch of jelly fish can be reduced substantially.

Some of the advantages in using the by-catch reduction device during shrimp trawling are (i) towing period of each haul can be extended as the cod end is not filled quickly due to escape of fish. (ii) BRD significantly reduces in the codend, resulting in maintaining better horizontal spread of the net for better catching efficiency. (iii) damage to shrimps will be less because of reduced fish catch and other larger animals like turtles, sharks, rays etc. and hence obtain better value. (iv) because of the fewer fish catch the onboard sorting is made easy. (v) popularization of the use of BRDs will help to meet the requirement for ecologically sustainable fishing practice.

Acknowledgement

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References


