

REDUCING BY-CATCH THROUGH FISHING GEAR MODIFICATION

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ABSTRACT ✓

There have been considerable efforts in recent years to modify fishing gears and practices to target particular sizes and species of fish (fin and shell) and other marine organisms more efficiently. By catch consideration and gear modification play an important role in regulation of several major fisheries and new by-catch reduction devices and other innovative gear modification are continuously being proposed and tested to mitigate against these problems, among which are the turtle excluder device (T.E.D.S) in the shrimp trawls to reduce mortality of endangered sea turtle; sorting grids and scaring device in long line fisheries. This paper assesses the incidence of by catch in fisheries, provides a review of successful developments and application of selective fishing techniques that have been used to achieve by-catch reduction. Recommendations were also made on effective monitoring of fishing gears to ensure that devices aimed at reducing by-catch are included and fishermen use only the appropriate gears to limit by-catch and discards.

INTRODUCTION

The world's fisheries resources are being subjected to exploitation at or above their capacity to produce maximum sustainable yields. At the same time as these trends are being felt, there is a very large wastage of fisheries resources from discarding unwanted catches at sea. FAO (2004) reported an estimate of global discard in commercial fisheries of 27 million tons per year compared to 50 million tons of direct human consumption. Recently, an estimated discards in the order of >20 million tons was reported (FAO, 2007). Commercial fishing involves a wide range of gear and techniques used in environments that are also occupied by organisms that are not targeted by the fisheries. The use of fishing gear in such environment sometimes creates unintended impacts such as removal of organisms that, for various reasons, should not be taken (e.g. juvenile, threatened species). The removal of non-target organisms has been a cause of concern for fisheries management for many years, the extensive capture of juvenile and young fish of commercially important species has frequently been regarded as a threat to recruitment of stocks. Many fisheries harvest individuals of the target species before they reach size in terms of future yield. The use of larger mesh in the collection (cod end) was among the first technical measures imposed by fisheries managers to prevent the capture of juvenile.

A more recent concern, beginning in the 1970s, was the unintended capture and killing of more charismatic animals, like marine mammals, seabirds and turtles, by commercial fisheries in particular, the incidental capture and mortality of endangered or threatened species that are long lived and have low reproductive rates has aroused growing conflict, the unseen mortality due to ghost fishing by lost gear has recently also attracted much attention which has stimulated extensive research and development efforts by many countries to solve the many problems. As the upper limits of production from capture fisheries especially marine have become more obvious, fisheries managers have introduced a variety of new controls, including regulation to limit access to fishing grounds, to limit fishing efforts and to set total allowable catches and by catch limits. Subsequent technological modifications in fishing gears and their operation have proved successful in many fisheries that are facing by catch problems. This paper reviews the incidence of by-catch in Nigeria and the effects of discarding them at sea; and highlights ways of ensuring effective monitoring of the modified fishing gears to achieve sustainability of the resources.

Incidence of by-catch in Nigeria

Past and present studies in Nigerian waters have shown the proliferation of fish by-catches, their species / size composition, and mode of utilization. In Nigeria, efforts have been made to ensure responsible inshore fishing practices through promulgation of sea fisheries law, act of parliament No. 71 of 1992. But effective monitoring and enforcement of these regulations is lacking. The occurrence of small but mature fish species in penaid trawling ground makes a selection within fishing gear rather difficult, even though, trawling for shrimps which attracts the highest incidental catch within the first five nautical miles of the Nigerian continental shelf and in waters shallower than 18m are prohibited and cod end of a shrimp trawl should have more than 44mm mesh size, yet observation of fish landing and activities at sea suggest that these statutory provision of the fishing regulations are not

being strictly complied with. The by-catch problem has been immensely compounded by the concentration of the shrimp trawl industry presently on brown shrimps at grounds, which appears to be nursery ground of young and juvenile fishes, apart from fin fishes, non-fish species are also caught as by-catch: Crabs - *Portunus validus* (smooth swim crab at around 30m depth) and Lobster- *Panulirus regius* (5-40m depth); brown cuttle fish- *Sepia officianalis* (down to 200m) and octopus; Turtle - *Eretmochyls imbricate* (hawksbill), Molluscs e.g snails and bivalves. Ajayi and Adetayo (1982) reported exploratory trawl hauls between November 1980 and March 1981 of commercial boats in the Niger delta area on catch and effort coupled with data gathered by FDF since 1970 from industrial fleet analysis reveals the major species and composition of fish by catch discarded (Table 1).

Table 1: The major groups and components species of incidental fish catch

Fish Group	Mean composition of commercial landing	Component species
Sciaenidae	16.83%	<i>Pseudolithus typus</i> , <i>P. senegalensis</i> , <i>P. elongates</i>
Cynoglossidae	9.32%	<i>Cynoglossus canariensis</i> , <i>C. senegalensis</i> , <i>C. monodi</i>
Ariidae		<i>Arius huedeloti</i> , <i>A. laticulatus</i>
Polynemidae		<i>Pentanemus quinquarius</i> <i>Galeoides decadactylus</i> <i>Polydactylus quadrifilis</i>
Pomadasydae		<i>Pomadasy jubelini</i> , <i>P. suillus</i>
Selachians		<i>Raja miraletus</i> <i>Dasyatis margarita</i>
Mixed	41.13%	<i>Charcharias taurus</i> <i>Brachydeuterus auratus</i> <i>Illisha africana</i> <i>Vomer setapinis</i> <i>Drepane africana</i> <i>Trichiurus lepturus</i> <i>Larimus peli</i> <i>Gerres melanopterus</i>

Source: Adebayo and Ajayi, 1982

The sale of discards estimated at about 3 metric tons daily. The species and size ranges of sampled fish by-catch sold into riverine local markets are shown in Table 2. The fish by-catch problem at various depths of some popular fishing grounds in Nigeria confirm high percentage of by-catches accompanying penaeid shrimping in Nigeria, with catch composition varying from one fishing ground to another depending on the targeted species. Table 3 indicates the % composition of shrimping operation at varying depth on major fishing ground in Nigerian waters. Notwithstanding the lower commercial value of non-target small sized fish species, the large quantity of juvenile of commercial species is a serious concern for biological diversity and sustainability of the shrimp trawling fisheries. The estimate based on the assumption of three and four trips/annum for white prawns and brown shrimps respectively is that about 3000mt/year of trash, juvenile and non-commercial species may be caught annually by 200 actively operating vessel (Olaniyi, 1999). Some naturally small sized fish species constituted >70% of catch at some grounds, and there were indications of severe impact of shrimp trawling on juvenile commercial finfish resources.

Table 2: Size ranges of fish samples of discards sold at sea by shrimp trawlers in Niger-Delta waters.

Family	Species	Number	Size Range (cm)
Carangidae	<i>Hemicaranz bicolor</i>	7	8-14
	<i>Selene dorsalis</i>	17	5-7
Cynoglossidae	<i>Cynoglossus senegalensis</i>	81	10-23
Drephanidae	<i>Drepane Africana</i>	92	4-11
Ephippidae	<i>Chaetodipterus spp</i>	1	6-12
Haemulidae	<i>Pomadasy jubelini</i>	26	9-14
	<i>Galeoides decadactylus</i>	27	10-16
Pristigateridae	<i>Polydactylus quadrifilis</i>	76	10-15
Scianidae	<i>Illisha africana</i>	67	5-23
	<i>Pseudolithus elongatus</i>	10	11-15

	<i>P. senegalensis</i>	183	7-18
Sparidae	<i>P. typus</i>	183	12-16
	<i>Pegalus bellotti</i>	2	11-14
	<i>Pegalus spp</i>	40	6-13

Table 3: Percentage composition of shrimping operations at 10-14 meters at various fishing grounds.

Fishing ground	Depth (m)	Fish (%)	Shrimp (%)	Crab (%)	By catch (%)
Lagos	10	50.7	4.7	0	41.6
Lagos entrance	14	28.2	0	0.1	71.6
Ibeju	10	27.5	0	0.4	72.1
Lekki	10	55	0	0	45
Escravos	13	36	1.7	4.8	57.4
Sengana	13	43	4.8	1.2	51
Opobo	10	62.8	2.8	0	34.4
Kwa Ibo	10	25.7	24	0	50.3
Calabar	10	69.9	9.1	3.6	17.3

Reasons for discarding fish by-catch

Management Measures

Management measures in some fisheries place a legal obligation on fishermen to discard part of their catch at sea. When the allowable catch quota is achieved for a species, landings of excess catch are prohibited and the fisherman theoretically have no other alternative but to dump the over quota volume at sea. However, in reality over quota catches are often landed illegally and are termed 'black fish'. Minimum landings size regulations protect juveniles from being landed but those that are caught by fishing gear must be discarded to ensure compliance. In some fisheries a specific small mesh size is allowed for a target species of small size but in order to protect other species being caught, there is a maximum threshold allowed in the landings for commercial non-target species expressed as a percentage to the retained catch. Closed and protected fishing areas are also used to restrict the catch of some commercial species which can not be caught at all or are allowed to be caught in a limited proportion. Some species are protected by regulations or international conventions such as the CITES list of endangered species (marine mammal, turtles) and should be immediately returned to sea when caught.

Economic measures

There is often a strong economic motivation for discarding. Some species have no commercial value locally or seasonally due to poor conditions whilst other species are caught in unmarketable sizes. After the majority of hauls, and especially during long trips, the catch is sorted to retain only that part of the catch which maximizes value. This is commonly referred to as high-grading and discards are made of part of the catch after taking into account the value of species, the processing time on board and the remaining storage space on board. Fish that are damaged during operations are often discarded because of their unmarketable aspects. Catch is sometimes returned to the sea even before it reaches the deck. This can occur on some pelagic trawlers if the species composition in the catch is not deemed to be of sufficient value before pumping process to bring that catch on board is initiated. The economic reasons for dumping fish by-catch are summarized in the following:

Damaged or mutilated fish

- Species with no current market
- Achievement of quota
- Undersized individuals
- Unmarketable species e.g. dolphins, sea turtles.

Technical Reasons

They are usually by-catch of fishing operations which compose of juveniles and those of netting damage adult individual. The selectivity of fishing operation varies depending on the type of gear being used which often has an effect on the survival rate of the fish being discarded. Using the same

fishing gear in different areas can induce different discard problems depending on local biodiversity and species abundance of the fishing area.

Effects of discarding fish at sea

Economic Effects

Income that has been forgotten as a result of juvenile and adult target species discards. Income forgone in other fisheries as a result of discarding juvenile and adult non-target species. Costs associated with discarding non-commercial species. The cost of managing discards and measuring their quantities.

Biological Effects

Survival of most discarded species is low. Discards therefore may be a significant part of fishing mortality. Reproductive activities of such fishes may be significantly affected. The populations of endangered species are further threatened. Certain ecological niches are created for scavenging fish.

Social Effects

Varies between nations and sections of society depending on ethical beliefs, cultural differences e.t.c. It affects the dynamics of the exploited stocks in terms of yields per recruits. They can affect other fisheries since the by-catch species in one fishery may be the target of other fisheries

Application of selective fishing techniques

In recent years some technological modifications in fishing gears and their operation have proved successful in many fisheries that are facing by-catch problems. The spectacular decline of the by-catches and discards of finfish in many fisheries have been the result of by-catch reduction device such as turtle exclusion device, sorting grids, square mesh panel, scaring device in longlines, and nordmore grids.

CONCLUSION AND RECOMMENDATIONS

Discarding of unmarketable, restricted species and small sized individual tagged by catch is a global, economic, environmental, and political problem which can be reduced through fishing gear modification. The technologies developed in recent years demonstrate that the impact of fishing gears on non -target species and habitat can be significantly reduced without negative effect on the profitability of the fishing operation. There are currently no universal methods of modifying gears to reduce habitat disturbance, solutions are specific to gears, fisheries and habitat and are strongly influenced by regulatory and economic considerations. Understanding the capture process of fishing gear in various environment is the key element in developing modification and practices that can reduce by-catch and ecosystem impact. There is a need for the government to enforce a strong policy to combat by-catch and discards reduction most especially in the wake of eco-labeling in the international market which adhere to strict fishing standard. The following are recommended.

- Enforcement of fishing regulations (use of correct mesh size and other devices) before going to sea, while at sea and on landing.
- Economic reward should be offered for the creation of new types of gear and modification that reduce by-catch and minimize impact on habitats.
- Enforcement of gear regulation for targeted fish species.

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