Size Composition of Fish By-Catch Species from Industrial Shrimp Trawl Fishery in Nigerian Coastal Waters

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Abstract

Fish species composition of by-catch in the industrial shrimp trawl fishery in Nigeria was investigated with the Sciaenidae family being the most prevalent by-catch fish species. In order of prevalence Pseudolithus elongatus with a mean weight and length of 15.28g and 86.39mm, respectively and Pseudolithus typus (n= 102) having an average weight of 18.76g and mean length of 88.01mm. Other fish by-catch species include Pseudolithus senegalensis (n= 99, mean weigh = 15.49g, mean length= 88.60mm); Galeoides decadactylus (n= 59, mean weight= 15.26g, mean length= 87.66mm); Pteroscion peli (n= 48, mean weight= 16.05g, mean length = 88.23mm); Drepane africana (n= 33, mean weight= 13.29g, mean length= 45.73mm) and Cynoglossus senegalensis (n= 11, mean weight= 21.78g, mean length = 86.45mm). Despite the small number of Cynoglossus senegalensis, it had the highest weight contribution to the by-catch. Significant (P<0.01) relationship exists between weight and length of fish species. The adjusted R^2 of the parameters indicated that 19.4% of the weight gained is accounted for by increase in length of Pseudolithus elongatus; 1.7% in Pseudolithus typus; 31.7% in Pseudolithus senegalensis; 13.7% in Galeoides decadactylus; 7.8% in Pteroscion peli; 57.4% in Drepane Africana; and 48.9% in Cynoglossus senegalensis. The by-catch associated with shrimp trawls should be properly monitored and controlled to reduce the quantity of non-target fish species in their catch. Also, the use of diamond-shaped 44mm mesh size for shrimp should be encouraged or made mandatory for fishers to reduce fish by-catch.

Keywords: *Shrimp, by-catch, fishery, weight*

Introduction

Shrimp is a very high value seafood product, accounting for 20% of the total value of internationally traded fishery products (FAO, 2012). The Penaeid shrimps found in the Nigerian coastal waters include *Penaeus notialis* (Pink shrimp*), P. kerathurus* (Zebra shrimp), *Parapenaeopsis atlantica* (Brown Shrimp), *Penaeopsis miersi.* Others are *Aristeus varidens, Plesiopenaeus edwardsianus* and *Parapenaeus longirostris* (Red shrimp). The Pink shrimp, *P. notialis* dominates the shrimp fishery because it is the most abundant and commercial species often consisting as much as 90% of the shrimps' landing (Adetayo, 1984). Marine shrimp resources in Nigeria are exploited by industrial and artisanal fisheries, with the former being a limited entry fishery (FDF, 2000); in which about 266 otter-board trawlers are licensed to catch principally pink shrimp, *Penaeus notialis* in inshore and offshore waters for export (FDF, 1).

The shrimp production in Nigeria has a great demand potential in both local and international markets. It is export-oriented with Japan, U.S.A, and Britain being the main importers (Adetayo, 1984). However, the shrimp fisheries have been presently characterized by high percentage fish by-catch which consists of large quantities of unmarketable juvenile fish. These include *Brachydeuterus auritus, Galieodes decadactylus, Illisha africana* and, *Pseudolithus* sp. Thus making shrimp trawling less profitable and a seriously threat to fish stock population and the ecosystem at large (Adetayo, 1984).

This by-catch is either thrown back to sea, where likelihood of survival can be low (Hall *et al.* 2000) or, if of adequate commercial value, kept and landed. Bycatch levels vary among fisheries in quantity and species caught (Revill, 2003). By-catch to shrimp ratios varies according to the fishery can be as high as 40:1, as recorded by a study carried out on the Venezuelan Shrimp fishery (FDF,2000). Other by-catch to shrimp ratios are found in Indonesia (26:1) (FAO, 2001) and Australia (21:1) (Salini, 2000). On average, it is estimated that shrimp trawling produces by-catch to shrimp ratio of

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5:1 in the temperate and sub-tropical waters, and 10:1 in tropical waters (Ye *et al.*, 2000). Yet, as the previous figures indicate, these can often be much higher. High by-catch rates are partly linked with the nature of demersal trawling: large numbers of fish (and other organisms) congregate on or just above the seabed. Queensland's East Coast trawl fishery (Australia) is estimated to have caught a minimum of 750kg of by-catch per boat per day, with an annual total of 56,486,250 kg or 56,000 tonnes (WWF, 2002).

Industrial shrimp trawling in tropical waters is a leading offender in the capture of by-catch and accounts for about 27% of all global discards. In 1994, by-catch from shrimp trawl was estimated to be around 11.2 million tonnes worldwide (Alverson, *et al.,* 1994). By-catch in shrimp trawls and associated discards is an issue affecting the sustainability of marine capture fisheries (Hall, 2000). Shrimp trawling is generally regarded as one of the least selective fishing methods because the by-catch may contain over hundreds of teleost species and outweigh the shrimp catch by 20 to 1 or more (Eayrs, 2007).

Global data on by-catch indicate that tremendous quantities of marine life are being removed. For many of the species incidentally caught in shrimp trawl nets, there is very little information (and sometimes none at all) from which to evaluate the sustainability of their mortality (Poiner *et al.,* 1998). Because tropical seas are multispecies fishery, this has made shrimp trawling in the tropics especially harmful in terms of its effects on biodiversity. By-catch in tropical shrimp fisheries can comprise hundreds of species For example a recent report indicated that 437 vertebrate species (*e.g.* fish, sharks, rays) and 234 invertebrate taxa (*e.g.* crabs, squids and scallops) are incidentally caught in Australia's Northern Prawn Fishery (Stobutzki, 2001). Furthermore, as a much larger part of the world's shrimp production originates from the tropics, the total by-catch from this area is higher (FAO, 2001).

In many tropical countries, the trawlers come very close to shore in search of shrimp (Adetayo, 1984). These nearshore habitats often act as nursery areas for juveniles or many fish species. Therefore, they contain millions of young fish that are necessary to maintain adult populations. When vessels trawl in these nursery grounds, large numbers of juvenile fish are caught. Sustained nearshore trawling and subsequent mortality of juveniles is thought to affect many fish populations, particularly those of commercial importance (Broadhurst, 2000; Rahman, 2001).

The study therefore seeks to investigate the number of fish by-catch species in the industrial shrimp-trawl fishery of Nigeria and the length and weight relationship of these by-catch species.

Materials and Methods

The study site was the Lagos port where the shrimp trawlers land their catch from sea. These trawlers do not have by-catch excluding devises and the mesh size in use was not the size (cod-end mesh size of 44mm) recommended for shrimp trawling. Data on quantity and composition of by-catch fish species and their physical parameters (length and weight measurement) was taken from randomly selected shrimp trawlers. The data were collected directly from the fishing companies for accuracy of catch composition between January and September, 2016.

The by-catch fish species were identified individually with the assistance of keys (Schneider, 1990). All measurements of length (L) and body weight (BW) were taken to the nearest 0.1cm and 0.1g respectively. The data collected was analyzed using frequency table, means and percentages. Correlation coefficient (r) was also used to determine the relationship between weight and length of the by-catch fish species while regression analysis was used to analyze the weight and length differentials of fish species caught as by-catch in the shrimp trawl fishery.

Results and Discussion

In this study, 461 fishes belonging to seven fish species from five families were observed as by-catch landed in the shrimp trawl fishery. The most prevalent family was Sciaenidae with three species. The remaining four families were represented only by one species each (Table 1.). The most prevalent by-catch fish species was *Pseudolithus elongatus* (n =109) with a mean weight of 15.28g and mean length of 86.39mm (Table 2). This was followed by *Pseudolithus typus* (n=102) with an average weight of 18.76g and mean length of 88.01mm. Other by-catch fish species included: *Pseudolithus senegalensis* (n=99, mean weight=15.49g, mean length= 88.60mm); *Galeoides decadactylus* (n= 59, mean weight=15.26g, mean length= 87.66mm); *Pteroscion peli* (n = 48, mean weight= 16.05g, mean length=88.23mm); *Drepane africana* (n= 33, mean weight=13.29g, mean length=45.73mm) and *Cynoglossus senegalensis* (n=11, mean weight= 21.78g, mean length= 86.45mm). Although, *Cynoglossus senegalensis* was the least in terms of number caught, it contributed the greatest weight of

the by-catch. This indicated that the bulk of the by-catch fish species juveniles of commercially important fish species. (FAO, 2001) had similar findings in a survey which was conducted between December 1998 and March 1999 in which 70% of the by-catch comprised juveniles of commercially important species with a maximum length at infinity not exceeding 35mm.

The relationships between the weight and length of the by-catch fish species significant at the 0.01 level of significance ($P<0.01$) except for *Pteroscion peli* ($r=0.313$, $P<0.05$) that is significant at the 0.05 level of significance (Table 3.). This indicates that as the length of fish increases weight increases and vice-versa giving a straight line when weight is plotted against length.

There were significant ($P<0.01$) differences between the weight gained length increases between the by-catch fish species (Table 4.). Thus a 19.4% increase in weight results in an increase in length in *Pseudolithus elongatus*, 1.7% in *Pseudolithus typus*, 31.7% in *Pseudolithus senegalensis*, 13.7% in *Galeoides decadactylus*, 7.8% in *Pteroscion peli*, 57.4% in *Drepane africana*, and 48.9% in *Cynoglossus senegalensis*. This indicates the rate of growth of the by-catch fish species with a growth rate of *Pseudolithus typus* in relation to weight the least.

FAO (2001) noted the high number of by-catch in the Nigeria shrimp trawl fishery which corroborates this study. However, stated that the exact number of by-catch and discards are not

Table 1. By-Catch Composition in the Shrimp Trawl Fishery

Family	Scientific name	Common name	Number	Percentage (%)
Sciaenidae	*Pseudolithus elongatus*	Short croaker	109	23.64
	Pseudolithus typus	Long neck croaker	102	22.13
	Pseudolithus senegalensis	Cassava croaker	99	21.48
	Pteroscion peli	Boe drum	48	10.41
Polynemidae	*Galeoides decadactylus*	Shiny nose	59	12.80
Drepaneidae	*Drepane africana*	Spade fish	33	7.16
Cynoglossidae	*Cynoglossus senegalensis*	Sole fish	11	2.39
Total			461	100

Table 2. Weights and Lengths of By-Catch Fish species

Fish Species	N	Mean weights	Standard dev.	Weight variance	Min. weight	Max. weight
Pseudolithus elongatus	109	15.2807	0.4719	0.2270	14.50	16.00
Pseudolithus typus	102	18.7647	0.4496	0.2021	17.60	19.60
Pseudolithus senegalensis	99	15.4899	0.3406	0.1160	15.00	16.00
Galeoides decadactylus	59	15.2593	0.7325	0.5366	14.00	16.90
Pteroscion peli	48	16.0500	0.6175	0.3813	15.00	17.00
Drepane africana	33	13.2879	0.7175	0.5148	12.00	14.30
Cynoglossus senegalensis	11	21.7818	2.6525	7.0356	18.00	25.50
Fish Species	N	Mean length	Standard dev.	Length variance	Min. length	Max. length
Pseudolithus elongatus	109	86.3853	4.0389	16.3131	80.00	95.00
Pseudolithus typus	102	88.0098	4.0459	16.2078	80.00	95.00
Pseudolithus senegalensis	99	88.5960	3.5911	12.8936	81.00	95.00
Galeoides decadactylus	59	87.6610	4.6484	21.6072	80.00	95.00
Pteroscion peli	48	88.2292	3.0683	9.4145	81.00	94.00
Drepane africana	33	45.7273	3.6252	13.1420	40.00	51.00
Cynoglossus senegalensis	11	86.4545	13.7504	189.0727	65.00	110.00

Table 3. Correlation analysis of the weights and lengths of the by-catch fish species

Fish Species	N	r value	p value	p level
Pseudolithus elongatus	109	0.449**	0.000	0.010
Pseudolithus typus	102	0.167**	0.099	0.010
Pseudolithus senegalensis	99	0.569**	0.000	0.010
Galeoides decadactylus	59	0.390**	0.002	0.010
Pteroscion peli	48	0.313*	0.030	0.050
Drepane africana	33	0.716**	0.000	0.010
Cynoglossus senegalensis	11	0.735**	0.010	0.010

* $p < 0.05$; ** $p < 0.01$

Table 4. Regression analysis of the weights and lengths differentials of the by-catch fish species

Fish Species	Constant	Estimates	R^2	Adj R^2	F value	P value
Pseudolithus elongatus	27.670 (11.303)	3.842 (0.739)	0.202	0.194	27.008	0.000
Pseudolithus typus	62.686 (15.44)	1.371 (0.823)	0.026	0.017	2.776	0.099
Pseudolithus senegalensis	-4.312 (13.64)	5.998 (0.880)	0.324	0.317	46.416	0.000
Galeoides decadactylus	49.915 (11.824)	2.474 (0.774)	0.152	0.137	10.214	0.000
Pteroscion peli	63.285 (11.177)	1.554 (0.696)	0.098	0.078	4.988	0.030
Drepane africana	-5.723 (7.757))	3.872 (0.583)	0.587	0.574	44.119	0.000
Cynoglossus senegalensis	3.456 (25.691)	3.810 (1.172)	0.540	0.489	10.578	0.010

known. The study indicated that the bulk of by-catch fish species were commercially important species which are taken before they can mature to reproduce. This development is thereby making shrimp trawling less profitable and seriously affect the population of fish stocks and the ecosystem at large (Adetayo, 1984).

Conclusion

The study indicated that the bulk of by-catch fish species were commercially important species which are taken before they can mature to reproduce. This is affecting the size of these commercially important fish species offered for sale in markets. The fish by-catch of target species and incidental catches of non-target species was found to be of considerable quantity.

Fish by-catch in the shrimp trawl fishery is a threat to food security and sustainable fish production. It is advisable that the cod end mesh size of 44 mm mesh for catching shrimps should be enforced. Shrimping should not be allowed at closed areas, which are the spawning and nursery grounds for these commercially important fish species. By-catch excluding devices should be introduced to allow juvenile or undersized fish to escape capture.

References

Adetayo, J.A. 1984. The recent trends and future prospects of the Nigerian shrimp fishery, *NIOMR technical Paper publication* pp3.

Alverson, D.L., Feeberg, M.H., Murawski, S.A. & Pope, J.A. 1994. By-catch and Discards in World Fisheries: Quantities, Impacts and Philosophical Bases for their Management. *FAO Fisheries Technical Paper* 339, 233p.

Broadhurst, M. 2000. Modification to reduce by-catch in prawn trawls. A review and framework for development. *Rev. Fish Biol. Fisheries.* 10: 27–60.

Eayrs, S. 2007. A guide to the By-catch Reduction in Tropical Shrimp - Trawl Fisheries Revised Edition. Food and Agriculture Organisation of the United Nations (FAO) Rome.108pp.

FAO. 2001. Tropical shrimp fisheries and their impact on living resources. Shrimp fisheries in Asia: Bangladesh, Indonesia and the Philippines; in the Near East: Bahrain and Iran; in Africa: Cameroon, Nigeria and the United Republic of Tanzania; in Latin America: Colombia, Costa Rica, Cuba, Trinidad and Tobago, and Venezuela FAO Fisheries Circular. No. 974. Rome, FAO. 378p.

FAO. 2012. The State of World Fisheries and Aquaculture (SOFIA) 2012 Food and Agricultural Organization of the United Nations, Rome, Italy 230pp.

Federal Department of Fisheries (FDF). 2000. Federal Department of Fisheries Report.

Hall, M.A., Alverson, D.L. & Metrzals, K.I. 2000. By-catch: problems and solution Seas of the millennium an environmental evaluation Vol III Global issue and processes (ed. CR Sheppard) pp 135 – 151.

Poiner, I., Glaister, J., Pitcher, R., Burridge, C., Wassenberg, T., Gribble, N., Hill, B., Blaber, S., Milton, D., Brewer, D. & Ellis, N. 1998. The environmental effects of prawn trawling in the far northern section of the Great Barrier Reef Marine Park: 1991- 1996. Final Report to the Great Barrier Reef Marine Park Authority and the Fisheries Research and Development Corporation.

Rahman, M. 2001. The impact of shrimp trawling fisheries on living marine resources of Bangladesh. Tropical shrimp fisheries and their impacts on living resources. Food and Agriculture Organization of the United Nations, Rome.

Revill, A. 2003. A study on the consequences of technological innovation in the capture fishing

industry and the likely effects upon environmental impacts. CEFAS series: Technological Advancement & The Environmental Impacts of Capture Fisheries. Royal Commission on Environmental Pollution, UK.

Salini, J. 2000. Assessment and benefits of damage reduction in prawns due to use of different by-catch reduction devices in the Gulf of Carpentaria, Australia. *Fisheries Res.* 45: 1-8.

Schneider, W. 1990. FAO Species identification sheet for fishery purposes. Field guide to the commercial marine resources of the Gulf of Guinea. FAO Regional office for Africa. Rome. FAO 1990. 268 p.

Stobutzki, I. 2001. By-catch diversity and variation in tropical Australian penaeid fishery: the implications for monitoring. *Fisheries Res.* 53: 283–301.

Ye, Y., Alsaffar, A.H. & Mohammed, H.M.A. 2000. Bycatch and discards of the Kuwait shrimp fishery. *Fisheries Res.* 45:9–19.

WWF Australia. 2002. Scrapping the bottom: seafloor trawling in the Great Barrier Reef World Heritage Area, WWF Australia, Sydney.