Environmental Research Journal 2 (6): 299-305, 2008
ISSN: 1994-5396
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Sand Dredging Impact on the Fish Catch in Bonny River Estuary, Nigeria

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Abstract: The impact of sand dredging off Atlantic Ocean of the Bonny River Estuary on fish catch in the surrounding fishing communities was studied. This study was conducted to assess the major fish species commonly caught at the selected major landing sites in the area. Sampling was carried out for three consecutive days twice a month between October and November 2002 from three major fish landing sites (Bonny Coal Beach, Amariaria/Lighthouse and Bregidi). The fish catch study was carried out within and around the areas that could be affected by the runoff water from the stockpiled dredged sand. A total of 45 fish species (finfishes and shellfishes) from 33 families were identified during this study. The finfish families were Ariidae, Bagridae, Cichlidae, Clupeidae, Carangidae, Cynoglossidae, Dasyatidae, Ephippidae, Lutjanidae and amongst others. The observed shellfish families were Portanidae, Palaemonidae, Muricidae, Crassostredae, Ocypodidae and Potamidae. The estimated total fish landing values of this study were higher except at Bregidi than the values obtained in previous studies. The results showed that the river system was still a good fishing ground indicating that the sand dredging activities had no significant impact on the fish catch.

Key words: Dredging, fish catch, Bonny river estuary, Nigerian fisheries

INTRODUCTION

Bonny Estuary is one of the several estuaries in the Niger Delta swamps through which the lower Niger river flows into the ocean. The estuary is richly endowed with abundant aquatic resources but prone to pollution resulting from industries located along its shore which discharge their effluents directly into the estuary. It contributes to the Rivers State fish resources and provide livelihood for the fisherfolks (Allison *et al*., 1997).

Dredging activities are going on around the Niger Delta Areas. The goal of dredging operations has always been canalization for transportation purposes, reclamation of land for construction of harbours. Dredging destroys spawning, breeding, feeding or growth to maturity grounds of fishes. Generally dredging degrades habitats of organisms (plants and animals). Effects of dredging have been reported, by among others on fish Oysters (Winger and Lasier, 1985; Wirth *et al*., 1996) and lobsters (Greig and Pereira, 1993). Environmental impacts observed in these studies included reduction in numbers of benthic species, increased turbidity, reduction of primary productivity and mobilization and increased bioavailability of sediment trace metals.

Fish constitutes more than 70% of the protein intake in Rivers State and other Niger Delta States (Chindah and Osuampkpe, 1994). Artisanal or small scale fisheries using dug out canoes with or without motorized engines is the predominant fisheries of the Niger Delta (Allison *et al*., 1997). Sand was dredged from off the Atlantic Ocean of the Bonny River Estuary between April 8, 2002 and May 24, 2002. The dredged sand was stockpiled in two locations in a construction site at Bonny Estuary bank between Coal Beach and Amariaria. The run-off water from the stockpiles was directed through a channel of water at the estuary bank and through Finima Creek into the Bonny Estuary.

This study was therefore conducted to assess whether or not there has been any change in the productivity of the local fisheries as a result of the dredging operations.

MATERIALS AND METHODS

Study area: The Bonny River Estuary lies between longitudes 6°58' and 7°13' East and latitudes 4°19' and 40°34' (Fig. 1) and covers an estimated area of 206 km^2. The Bonny River is one of the 19 rivers that empty

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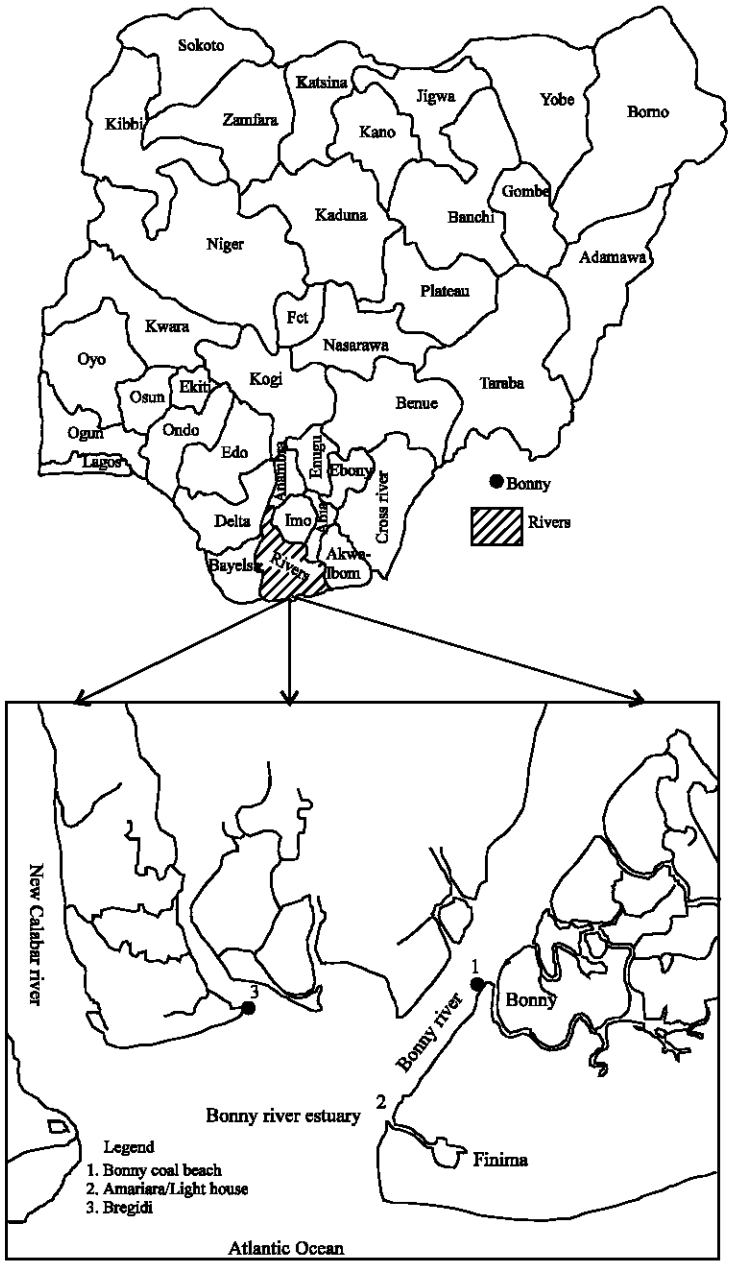

Fig. 1: Map of the lower bonny system fish catch study locations

into the Atlantic Ocean at the Bight of Benin and Bonny within the Niger Delta. The vegetation of Bonny River Estuary is dominated by the red mangrove *Rhizophora racemosa* and *R. mangle* (Wilcox, 1980).

Fish landing sites: Three major fish landing sites were chosen namely: Bonny Coal Beach, Amariaria /Lighthouse and Bregidi (Fig.1).

Bonny coal beach: Bonny Coal Beach is not a fishing site but only a landing site. This is a multi-purpose waterfront and is the commercial gateway to Bonny Island. It is located on the eastern bank of the Bonny River by the Bonny Creek, in the north-east of Nigeria Liquified Natural Gas (NLNG) export site.

Amariaria/lighthouse: This landing site is situated South of NLNG operational area towards the Bonny River channel into the Atlantic Ocean. It is located on the eastern bank of the Bonny River by the Finima canal.

Bregidi: Bregidi fishing settlement is located south of NLNG operational area on the western bank of the Bonny River by Cawthorne channel.

Sampling: Sampling of fish catches were done for 3 days twice in a month between October, 2002 and November 2002. Before the actual fieldwork, the sampling sites were visited to ascertain the fisheries activities of the area. On each sampling day, 5 canoes were randomly selected for sampling in accordance with FAO (1984).

Fish identification: The fishes were identified using flash cards, checklists, photographs and scientific identification keys by Tobor and Ajayi (1979), Fischer *et al.* (1983) and Schineidar (1990). The fishes were weighed using a table top scale or spring balance.

Catch statistics: Catch statistics were estimated for the major fish species landed using the formula:

$$X = \frac{x - n}{n} \text{ (FAO, 1980)}$$

where:

X = Daily total fish landed.
X = Sample total fish landed observed at the site.
N = Total number canoes landing at site.
N = Number of fish canoes sample for fish catch.

The total fish landed was then estimated by summing all the total landing for each sampling site and per month.

RESULTS AND DISCUSSION

Fish catch characteristics before the study: The results of the preview of the selected sampling sites showed that sampling site 2 (Amariaria/Lighthouse) had the highest average number of fishing canoes (100-120 fishing canoes) followed by Bregidi (30-35 fishing canoes) and fishing canoes were absent in Coal Beach Bonny Site (Table 1).

Fish catch/assemblage during the study: As shown in Table 2, a total of 45 fish species from 33 families were recorded. Out of these, 33 species from 24 families were finfishes and 12 species from 9 families were shellfishes. The finish families among others are Ariidae, Bagridae, Cichlidae, Clupeidae, Carangidae, Cynoglossidae and Dasyatidae. The recorded shellfish families were Portunidae, Palaemonidae and Muricidae to mention but a few. These fishes were caught and landed at almost all the sampled landing sites. This similarity might be due to the fact that all the fisherfolks along the Lower Bonny River have a common fishing ground. Any catch difference observed was probably due to the fishing methods in use, the tidal movement and weather conditions.

The species composition recorded in this study was in agreement with reports of studies along the Bonny Rivers Systems (Chindah and Osuamkpe, 1994; Abby, 1996; Alfred-Ockiya and Inko-Tariah, 1996; Allison *et al.*, 1997). Nevertheless, the number of species

Table 1: Fish catch characteristic of the sample sites before the study (October-November 2002)

Name of fish landing site	Location from TSKJ	Average No. of fishing Canoe	Location on the Bonny River
Coal Beach Bonny	North of TSKJ operational base	-	Eastern Bank by Bonny Creek
Amariaria/Lighthouse	South of TSKJ operational base	100-120	Eastern Bank by Finima Canal
Bregidi	South of TSKJ operational base	30-35	Western Bank by Cawthorne Channel

Table 2: Fish fauna observed during the study (October-November 2002)

Fish common name	Family name	Species name	Coal beach Bonny	Amariaria/light house	Bregidi	Remark
Finfishes						
Baraccuda	Sphyraenidae	*Sphyreana sphyreana*	X	X	X	
Sea catfish	Ariidae	*Arius heudeloti*	X	X	X	
Grey catfish	Bagridae	*Chrysichthys nigrodigitatus*	X	X	X	
Longnose croakers	Sciaenidae	*Pseudotolithus elongatus*	X	X	X	
Shortnose croakers	Sciaenidae	*Umbrina canariensis*	X	X	X	
Golden fish croakers	Sciaenidae	*Pseudotolithus epipercus*	X	X	X	
Common grunter	Pomadasyidae	*Pomadasys jubelini P. rogeri*	X	X	X	
Big lip grunt	Pomadasyidae	*Diagramma macrolepsis*	X	X	X	
Sting ray	Dasyatidae	*Dasyatis margarita*	X	X	X	
Shark (dogfish)	Squalidae	*Squalus fernandinus*	X	X	X	
Silverfish/Ribbon fish	Trichiuridae	*Trichiurus lepturus*	X	X	X	
Shinny nose	Polynemidae	*Polynemus quadrifilis*	X	X	X	
Bonga	Clupeidae	*Ethmalosa fimbriata*	X	X	X	
Snapper	Lutjanidae	*Lutjanus agennes*	X	X	X	
		L. goreensis	X	X	X	
Spadefish	Ephippidae	*Chaetodipterus goreensis*	X	X	X	
Sardine	Clupeidae	*Sardinella eba*	X	X	X	
		S. rouxi	X	X	X	

Fish common name	Family name	Species name	Coal beach bonny	Amariaria/Light house	Bregidi	Remark
Shad	Clupeidae	*Ilisha africana*	X	X	X	
Sole (tongue)	Cynoglossidae	*Cynoglossus goreensis*	X	X	X	
Thread fin	Polynemidae	*Galeoides decadactylus*				
		Pentanemus quinquarius	X	X	X	
			-	X	X	
Tilapia	Cichlidae	*Tilapia heudeloti*	X	X	X	
		T. guineensis	-	X	X	
Moonfish	Carangidae	*Vomer septinis*	-	X	X	
Mullet	Mugilidae	*Mugil falcippinnis*	X	-	-	
		M. celphalus	X	X	X	
		M. grandisquamis	X	-	X	
Angel fish	Monodacylidae	*Psette sebae*	X	X	-	
Mackerel	Scombridae	*Scomberomorus japancius*	X	X	X	
Yellowfin jack	Carangidae	*Trachinotus goreensis*	X	X	X	
		T. teraia	X	X	X	
Shellfishes						
Swimming Crab	Portunidae	*Callinectus anoniaala*	X	X	X	By catch
		C. marginatus	x	x	X	
Shrimp	Penaeidae	*Penaeus kerathurus*	X	X	X	
		P. notialis				
White Shinny	Palaemonidae	*Nematopalaemon hastatus*	X	X	X	
White Shrimp	Palaomindae	*Nematopalaemon maculates*	X	X	X	
Whelk	Muricidae	*Thais callifera*	X	-	-	
Mangrove oysters	Crassostreidae	*Crassos trenagascar*	X	-	-	
Fiddler crab	Ocypodidae	Uca tangeri	X	X	X	Observed in mangrove
Ghost crab	Ocypodida	*Ocypoda africana*	X	X	X	Observed in mangrove
Periwinkle	Potamidae	*Tympanotonus fuscatus*	X	X	X	
		Pachymelenia aurita	x	x	x	

Table 3: Fish fauna recorded at Bonny coal beach (October-November 2002)

Fish common name	Family name	Sampling October 2002			
		1st	2nd	1st	2nd
Finfishes					
Baraccuda	Sphyraenidae	X	-	-	-
Catfishes	Ariidae	X	X	X	X
Catfishes	Bagridae	X	X	X	X
Croakers	Sciaenidae	X	X	X	-
Grunter	Pomadasydae	X	X	X	X
Sting ray	Dasyatidae	-	X	X	X
Shinnynose	Polynemidae	X	X	X	X
Snapper	Lutjanidae	X	X	X	X
Sole	Cynoglossidae	X	X	X	-
Sardine	Clupeidae	X	X	X	X
Shark	Squalidae	-	X	-	-
Mullet	Mugilidae	X	X	X	X
Tilapia	Cichlidae	X	X	X	X
Yellowfin	Carangidae	-	X	X	X
Mackerel	Scombridae	-	X	-	-
Shell fishes					
Periwinkle	Potamidae	X	X	X	X
Oysters	Crassostreidae	X	X	X	X
Whelk	Muricidae	X	X	X	X
Shrimp	Penaeidae	X	X	X	X
White shrimp	Palaemonidae	X	X	X	X
Prawn	Penaeidae	X	X	X	X

and family appeared low when compared to the results of that study encountered 55 species of fish. This difference in species number might be attributed to the short study period and probably to sand dredging in the Bonny Rivers.

Table 4: Fish fauna recorded at Amariaria/lighthouse (Oct-Nov 2002)

Fish common name	Family name	Sampling October 2002			
		1st	2nd	1st	2nd
Finfishes					
Baraccuda	Sphyraenidae	-	X	X	X
Catfishes	Ariidae	X	X	X	X
Catfishes	Bagridae	X	X	X	X
Croakers	Sciaenidae	X	-	X	X
Grunters	Pomadasydae	X	X	X	X
Sting ray	Dasytidae	X	X	X	X
Shinnynose	Polynemidae	-	X	X	-
Snapper	Lutjanidae	-	-	X	-
Sole	Cynoglossidae	X	X	-	-
Shark	Squalidae	X	-	X	X
Shad	Clupeidae	-	X	-	-
Sardine	Clupeidae	-	X	-	-
Bonga	Clupeidae	X	X	X	X
Mullet	Mugilidae	-	X	-	-
Yellowfin	Carangidae	X	X	X	X
Spadefish	Ephippididae	-	X	-	-
Mackerel	Scombridae	-	-	X	X
Big lip grunt	Pomadasydae	-	X	-	-
Shell fishes					
Shrimp	Penaeidae	X	X	X	X
White shrimp	Palaemonidae	X	X	X	X
Periwinkle	Potamidae	X	X	X	X

Monthly fish landing: The monthly fish landing was observed in the sampling sites at Coal Beach Bonny, 16 families of finfishes and 4 families of shellfishes were encountered (Table 3), while at Amariaria/ Lighthouse, 18 finfishes and 3 shellfish families were recorded (Table 4) and at Bregidi, 15 finfish and 2 shellfish families were observed (Table 5).

The highest numbers of finfish (16 families) and shellfish (4 families) were recorded at Coal Beach Bonny. It was observed that Amariaria/Lighthouse is the home of the bonga, shrimp and catfish fisheries. These fishes were recorded in large quantities during the study period. However, the bonga, catfishes and sting ray were often caught from the coastal waters with ring net and line and hook, respectively.

Fish landed in terms of weight: The croaker fisheries had the highest returns, followed by mullet and catfish fisheries at Coal Beach Bonny Fishing Site (Table 6). At Amariaria/Lighthouse fishing zones, bonga and sardine fisheries ranked the highest (Table 7). This is understandable because of the massive use of ring net along the coastal water. With this method most Clupeidae coming into the estuary are encircled off at the coastal water by fishers. Furthermore, at Bregidi fishing settlement, the most important fisheries are croakers

Table 5: Fish fauna encountered during the study at Bregidi (October-November 2002)

Common name	Family name	Sampling October 2002			
		1st	2nd	1st	2nd
Finfishes					
Barracuda	Sphyraenidae	-	-	-	X
Catfishes	Bagridae	X	X	X	X
Croakers	Sciaenidae	X	X	X	X
Grunter	Pomadasydae	-	X	-	X
Sting ray	Dasyatidae	-	X	X	X
Shinnynose	Polynemidae	-	-	X	X
Snapper	Lutjanidae	X	X	X	X
Sardine	Clupeidae	X	-	X	-
Shark	Squalidae	X	X	-	-
Mullet	Mugilidae	X	-	-	X
Angel fish	Mondactylidae	X	-	X	-
Spadefish	Ephilppididae	-	-	X	-
Shad	Clupeidae	X	-	-	-
Robbin fish	Trichiuridae	X	X	X	X
Yellowfin	Carangidae	X	-	-	X
Shellfishes					
Shrimp/prawn	Penaecidae	X	-	-	X
White shrimp	Palaemonidae	X	X	X	X

Table 6: Total weight (kg) of fish landed at bonny coal beach (October-November 2002)

Common name	Family name	Oct. 2002 (kg)	Nov. 2002 (kg)	Total for study period (kg)	Rank
Finfishes					
Baraccuda	Sphyraenidae	29.12	0.00	29.10	11
Catfishes	Ariidae/Bagridae	488.70	248.40	737.10	2
Croakers	Sciaenidae	3593.80	9204.90	12798.70	1
Grunter	Pomadasydae	184.40	410.00	594.40	3
Sting ray	Dasyatidae	143.00	160.00	303.00	5
Shinnynose	Polynemidae	80.20	84.00	164.20	7
Sole	Cynoglossidae	81.00	0.00	81.00	10
Shark	Squalidae	0.00	0.00	-	
Sardine	Clupeidae	100.00	191.20	291.20	6
Mullet	Mugilidae	100.40	339.80	440.20	4
Snapper	Lutjanidae	45.30	100.50	145.80	8
Tilapia	Cichlidae	60.50	46.70	107.20	9
Bonga	Clupeidae	50.50	30.50	81.00	10
Shellfishes					
White shrimp	Palaemonidae	10,300.50	11,650.20	21,950.7	
Prawn	Penaecidae	9,680.50	8,560.50	18,240.5	
Periwinkle	Potamidae	10,380.0	8680.00	19,060*	
Oysters	Crassostreidae	685.2	759.00	1,480.2*	
Whelk	Muricidae	801.5	679.00	1,480.5*	

*Weight include shell

Table 7: Total weight (kg) of fish landed at Amariaria (October-November 2002)

Common name	Family name	Wt (kg) Oct.	Wt (kg) Nov.	Total Wt (kg)	Rank
Finfishes					
Baraccuda	Sphyraenidae	388.80	260.00	648.80	5
Catfishes	Ariidae/Bagridae	324.00	94.00	418.00	8
Croakers	Sciaenidae	1161.00	96.20	1257.20	3
Grunter	Pomadasydae	81.00	52.00	133.00	10
Ray	Dasyatidae	297.00	23.40	320.40	6
Shinnynose	Polynemidae	0.00	39.09	39.09	9
Snapper	Lutjanidae	58.50	403.70	462.20	7
Shark	Squalidae	604.80	130.00	734.80	4
Sardine	Clupeidae	972.00	650.00	1,622.00	2
Bonga	Clupeidae	688.50	1,814.00	2,502.50	1
Shellfishes					
White shrimp	Palaemonidae	15,500.00	18,200.00	33,700.00	
Prawn/Shrimp	Penaeidae	650.00	910.00	1,560.00	

Table 8: Total weight (kg) of fish landed at Bregidi (October-November 2002)

Common name	Family name	Wt (kg) Oct. 2002	Wt (kg) Nov. 2002	Total Wt (kg)	Rank
Finfishes					
Baraccuda	Sphyraenidae	0.0	35.00	35.00	12
Catfishes	Ariidae/Bagridae	235.0	639.00	874.00	2
Croakers	Sciaenidae	1,154.2	808.60	1,962.80	1
Grunter	Pomadasydae	51.3	70.20	121.50	10
Ray	Dasyatidae	0.0	301.60	301.60	7
Shinnynose	Polynemidae	0.0	810.00	810.00	3
Snapper	Lutjanidae	405.0	387.40	792.40	5
Sole	Cynoglossidae	607.5	189.80	797.30	4
Shark	Squalidae	168.8	0.00	168.80	9
Sardine	Clupeidae	108.0	117.00	225.00	8
Mullet	Mugilidae	607.5	0.00	607.50	6
Tilapia	Cichlidae	67.5	0.00	67.50	11
Shellfishes					
White/ shrimp	Penaeidae	650.5	980.5	1,631.00	
Prawn shrimp	Palaemonidae	10,100	12,500	22,600.00	

Table 9: Comparison of fish catch (Kg) from selected fish landing sites in the lower Bonny river

Study	Alfred-Ockiya (2002)			This study (October-November 2002)		
location	Amariaria (Kg)	Bregidi (Kg)	Coal beach (Kg)	Amariaria (Kg)	Bregidi (Kg)	Coal beach (Kg)
Oct	4,675.30	3,123.30	8,469.90	4,575.60	3,404.80	4,956.92
Nov	3,388.50	4,148.00	5,782.40	3,562.39	3,358.60	10,816.00
Total	8,063.80	7,271.30	14,252.30	8,137.99	6,763.40	15,773.12
Mean	4,031.90	3,635.65	7,126.15	4,069.00	3,381.70	7,886.56

and catfish followed by shinynose, sole and snapper (Table 8). This observation is characteristic of Bonny River System fisheries as noted by Fawumi (1985), Alfred-Ockiya and Inko-Tariah (1996) and Amadi (1990).

A prominent observation during this study was the extremely high amount of shrimps landed. These shrimps were abundant occasionally and were caught in large quantities off the coastal waters/continental shelf and not in the main Bonny River System.

Simpact of dredging operations on fish catch: The species composition in this study compared favourably with other related studies of the Bonny river system (Chindah and Osuamkpe, 1994; Abby, 1996; Allison *et al*., 1997) and is indicative of multi-species fisheries (Alfred-Ockiya and Inko-Tariah, 1996). Also, the estimated total weight of fish landed at the 3 fishing landing sites compared favourably with the recent studies of Alfred-Ockiya (2000), on the contribution of finfish catches on total fish production in the lower Bonny River (Table 9). The estimated fish landings of this study except at Bregidi, were higher than the values reported by Alfred-Ockiya (2002). Since, the data from both studies were taken from the same landing sites and within a reasonable time lag, it is inferred that the dredging operations had no significant effect on fish catch in the area. The present observation can be explained by Lewis *et al*. (2001) that impacts of dredging can be localized and of short duration.

The fish species composition of this study indicates that the Bonny Estuarine River System is still a good fishing ground. Also, based on Alfred-Ockiya (2002) reports, it is apparent that dredging activities had no significant effect on fish catch. The finfish and shellfish assemblages were rich in terms of number of families, species composition, species diversity, distribution and abundance. They were similar to results of previous studies on fish catch in Bonny River Estuary before the dredging operations and where dredging was not carried out.

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