International Journal of Research in Agriculture and Forestry
Volume 4, Issue 11, 2017, PP 26-31
ISSN 2394-5907 (Print) & ISSN 2394-5915 (Online)

Impacts of Petroleum Hydrocarbon Pollution on Fish Fauna of Oluasiri River, Bayelsa State

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Received Date: 14-10-2017 ***Accepted Date: 23-10-2017*** ***Published Date: 07-11-2017***

ABSTRACT

A total of 31 fish species belonging to 18 families were studied in Oluasiri River. The highest number of 159 fishes constituting 13.81% of the total monthly catch was recorded in the month of January 2013, while the least monthly catch of 63 fishes (5.47%) was observed in the month of June, 2013. The most abundant families were Mochokidae (19.61%), Cichildae (18.98%), Characidae (14.99%), Bagridae (7.97%), Momyridae (7.34%), Citharinidae (6.8%) and Schibedae (4.78%). The distribution per station revealed that station 1 had the highest catches (21.47%), followed by station 2 (12.34%), station 3 (9.21%), station 4 (5.58%) and station 5 (4.4%). The resident fish species Brycinus nurse and Oreochromis niloticus were highly adapted to the changes in the studied environment and this was dependent on their trophic relationship within the environment. These species had great affinity for hydrocarbon waste, because they feed on waste remains, mud/sediment silts and annelids. The condition factor (K) indicated that the four different species had their monthly changes varies from January to June 2013, such as Oreochromis nititicus (7.40 ± 5.44 – 5.48 ± 3.91), Citharinus citharus (1.34 ± 0.10 – 1.41 ± 0.07), Chrysichthy nigrodigitatus (0.76 ± 0.19 – 0.81 ± 0.21) and Brycinus nurse (1.45 ± 0.42 – 1.49 ± 0.58). These species lived under stress condition. It was recommended that stiff penalty should be provided in the New Petroleum Industry bill for polluters and saboteurs.

Keywords: *Fishes, condition factor (K), hydrocarbon, environment and pollution.*

INTRODUCTION

The Niger Delta is the major source of over 90% of Nigeria's crude. The environmental degradation caused by oil production activities is one of the reasons for social unrest in the area. To this end, emphasis is often placed on the environmental impact of petroleum hydrocarbon pollution in the area.

Crude oil is a mixture of hydrocarbon. In water, crude oil exhibits a number of behaviours which elicit a variety of responses from the environment and the organisms which are exposed to it (Qutnick and Rosenberg, 1977). The perennial exposure of these aquatic lives to crude oil and its products have produced varying levels of adverse effects (Cossa *et al.* 1993), damage of organs, causing deformities, decline in feeding and water intakes, swimming performance of juveniles (Cote, 2006).

According to Mackay (1999), aquatic pollution is the undesirable change in the physical, chemical and biological characteristics of water that may adversely affect organisms within that environment. The rapid increase in the contamination of the aquatic environment with hydrocarbons in the recent years has resulted in escalation of scientific interest in the biology of hydrocarbon pollution.

The impact of petroleum pollution on aquatic lives is therefore a concern, since most of the world's population is dependent upon aquatic animals for food and this dependency increases as the demand for food increases. This study is aimed at identifying the impacts of petroleum hydrocarbon pollution on the fish fauna of Oluasiri River and will provide a baseline data for the continuous monitoring and protection of its aquatic biota for economic growth.

Study Area

The study area is at Oluasiri river, Nembe Local Government Area of Bayelsa State. Oluasiri river is located within latitude N4^0.41' 25.26" and longitude E6^0.33' 36.29" in the Niger Delta of Nigeria. The river flows from the Okilo river

in Abua Odua, LGA of Rivers State into the Bonny estuary through San Barbara and San Bartholomew river and is fresh water till Benikiri, after which it is Brackish (Fig. 1). Leading to Ijawkiri where the disputed Oluasiri – souk oil wells and gas plant is located.

The river is about 10km in length from Okilo creek to Benikiri or Otumakiri and has an average width of 80m with a large flood plain circumference. The river is tidal except during the month of July, August, September and October, because it is subjected to flooding. The tidal range is a maximum of about 3.0m with rainfall typical of a tropical rainforest.

During low tide the river is confined to the lowest tide zone with a water depth of about 5 – 10m, its main channel has substrate mixture of soft clay, mud and mostly sand. For the purpose of this study, the river was divided into five (5) stations (Fig. 1).

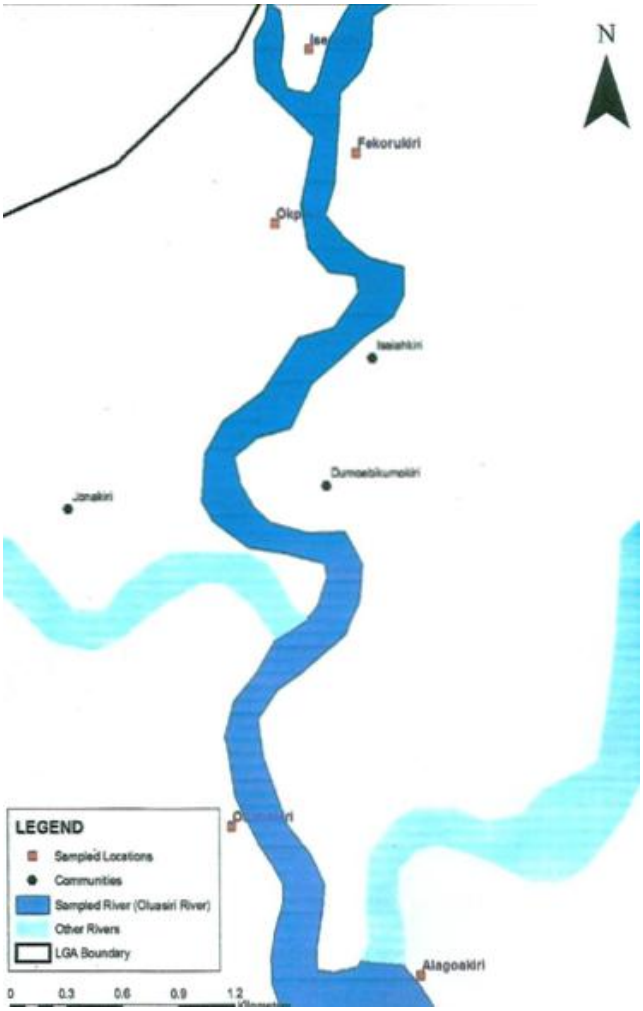

Fig1. *Map of Oluasiri River Showing the Sampling Stations*

Station1

(Okpikirikiri) possesses the features of a typical freshwater environment with high vegetation mainly *Clapaca* sp. And oil palm. It includes water fern, water hyacinth and *Vossia cuspidate* at its bank. The substrate is composed of layers of mud and sand and the height of the water at full tide was 5.2m.

Station2

(Iserekiri) vegetation is dominated by *Vossia cuspidate*, *Clapaca* sp. Few oil palm, water fern and water hyacinth. The height of the water at full tide was 6.5m.

Station3

(located at Fekorukiri) with many oil bunkering stations. Vegetation is also dominated by *Pandonus* sp, *Clacapa* sp, water hyacinth, Lettuce and fern. The height of the water at full tide was 7.5m.

Station4

(Is at Alagoakiri) also inundated with petroleum hydrocarbon pollution owing to its bunkering

activities. There is a shell gas pipe line at this station. Vegetation is dominated by *Razophora racemosa* (red mangrove), *Clapaca* sp, bamboo and water hyacinth. The height of the water at full tide was 9.2m.

Station5

(situated at Otumakiri Community). This station is special because it is at a T-junction where the river empty into San Batholomew river (brackish water) leading to the Bonny estuary. This is the river mouth closer to the brackish water. A cyclic current occurs here and a lot of sediments settled at the Delta. Vegetation is dominated by *Razophora racemosa* (red mangrove) and few *Avicennia africana* (white mangrove), few *Pandonus* sp. The height of the water at full tide was 10m.

MATERIALS AND METHODS

Fishes or fish specimens were caught at low or reversed tide in the shallow water at the depth of three to five meters using a cast net of stretched mesh size 30mm and base circumference of 15-25m were thrown randomly at 3 spots per sampling locations. Its operation involved a fisher standing in the canoe and throwing the net upwards and allowing it to open out like an umbrella before it falls into the water to enclose the catch. The canoe partner who had stopped motion of the canoe, about 10 minutes after the net had been cast into the river begins to paddle the canoes backwards. While the operator of the net commences the pulling of the net into the canoe and in the process picket the enclosed and entangled fish into the canoe.

The catches were collected in different labeled containers (plastic) in which they were taken to the laboratory for identification using appropriate keys (FAO, 1990, Sneider, 1990). The entire operation lasted for five hours. The fishes caught per throw of net were also recorded for that location. The total fish catch per station were polled to get the average catch per station.

The fishes caught and taken to the laboratory were identified with the aid of a key provided by Powell (1981) modified from Doget and its key to families of common freshwater and brackish water of bonny fishes.

The fish species caught within the period were categorized by species per station/month. Their relative abundances were also calculated as a percentage of the total catch.

The condition factor analysis was carried out on the four most common fish species (Characide) *Brycinus nurse*, (Cichlidae) *Oreocromis noloticus*, (Bagridae) *Chrysichthys nigrodigitatus* and (Citharinidae) *Citharinus citharus*, using the relationship

$$K = \frac{W \times 100}{L^b}$$

K = $\frac{W \times 100}{L^3}$ FISAT (Pauly, 1983)

K = fultons condition factor

3 = ideal growth constant

L = total length of fish (cm)

W = weight of fish (g)

A = constant

B = growth exponent specific to each family

RESULTS/DISCUSSION

A total of 31 fish species belonging to 18 families were recorded in Oluasiri River (Table 1). The highest number of 159 fishes constituting 13.81% of the total monthly catch was recorded in January 2013. The least monthly catch of 63 fishes (5.47%) was observed in June 2013. Other monthly distribution of fishes recorded are as follows: February 126 (10.95%), March 93 (8.08%), April 101 (8.77%) and May 86 (7.47%) respectively (Table 1).

Results further showed that station 1 had the highest number of individual fish fauna 254 (21.47%), while station 5 recorded 49 fishes (4.14%) (Table 2). The most abundant fish fauna recorded during the sampled period was *Oreochromis niloticus* (53 fishes) 4.48% belonging the family Cichlidae, closely followed by *Brycinus nurse* (49) 4.14% in the family characidae while *Xenomystus nigri* (3 fishes) 0.25% was the least abundant followed by *Pomadasys jubelini* 4 (fishes) 0.34% (Table 2). Also monthly changes in the condition factor for four different fish families caught along Oluasiri river is presented in Table 3.

Table1. *Checklist of Fish Fauna of Oluasiri River Identified during the Study Period (January – June 2013).*

S/N	Families	Species	January	February	March	April	May	June	Total (%)
1	CHARACIDAE	*Brycinus macrolepidotus*	8	10	6	4	2	9	39(6.22)
		Brycinus nurse	15	11	5	2	10	6	49(7.81)
		Aletes bramose	3	1	-	2	-	-	6(0.96)
	Total		**26**	**22**	**11**	**8**	**12**	**15**	**94(14.99)**
2	CENTROPOMIDAE	*Lates niloticus*	-	2	3	4	3	-	12(1.91)
3	OSTEOGLOSSIDAE	*Heterotis niloticus*	6	-	2	-	3	4	15(2.39)
4	CICHLIDAE	*Oreochromis niloticus*	6	4	7	10	14	12	53(8.45)
		Tilapia guinensis	2	1	3	8	7	6	27(4.31)
		Tchysia ansorgi	3	-	4	6	7	4	24(3.83)
		Tilapia zilli	-	4	2	5	3	1	15(2.39)
	Total		**17**	**11**	**21**	**33**	**37**	**27**	**146(12.68)**
5	ANABANTIDAE	*Ctenopoma kingleyae*	3	2	1	-	-	-	6(0.96)
6	CITHARINIDAE	*Citharinus citharus*	11	10	8	10	4	-	43(6.86)
7	MOCHOKIDAE	*Synodontis membranaceous*	10	8	6	5	-	2	31(4.94)
		S. nigrita	25	10	4	1	-	3	43(6.86)
		S. schall	10	7	3	-	1	-	21(3.35)
		S. clarias	4	3	1	3	2	-	13(2.07)
		S. budgetti	3	4	5	2	-	1	15(2.39)
	Total		**66**	**44**	**28**	**21**	**7**	**6**	**172(14.94)**
8	HEPSETIDAE	*Hepsetus odoe*	6	4	4	3	-	2	19(3.03)
9	BAGRIDAE	*Chrysichthys nigrodigitatus*	9	8	10	7	3	4	41(6.54)
		Bagrus bayad	4	2	2	-	1	-	9(1.44)
	Total		**19**	**16**	**16**	**10**	**4**	**6**	**71(6.17)**
10	MOMYRIDAE	*Hyperopisus bebe*	4	5	3	-	1	2	15(2.39)
		Marcusenius harringtoni	7	4	1	3	2	-	17(2.71)
		Mormyrops deliciousus	-	1	2	4	5	2	14(2.23)
	Total		**11**	**10**	**6**	**7**	**8**	**4**	**46(7.34)**
11	CYPRINIDAE	*Cyprinus senegalensis*	3	4	-	4	6	1	18(2.87)
		Labeo coubie	-	2	4	5	3	1	15(2.39)
	Total		**3**	**6**	**4**	**9**	**9**	**2**	**33(5.26)**
12	SCHILBEDAE	*Schilbe mystus*	8	10	4	6	2	-	30(4.78)
13	GYMNARCHIDAE	*Gymnarchus niloticus*	-	-	1	3	3	2	9(1.44)
14	NOTOPTERIDAE	*Xenomystus nigri*	2	2	-	1	-	-	5(0.80)
15	POMADASYIDAE	*Pomadasys jubelini*	2	2	1	-	-	-	5(0.80)
16	MONODACTYLIDAE	*Monodactylus sebae*	2	-	1	-	-	-	3(0.48)
17	MUGILIDAE	*Liza falcipinus*	3	1	-	-	-	-	4(0.64)
18	DISTICHODONTIDAE	*Distichodus rostratus*	-	2	-	3	4	1	10(1.59)
	GRAND TOTAL	**31**	**159**	**126**	**93**	**101**	**86**	**63**	**1151(100.0)**
		Percentage (%) Monthly Catch	**13.81**	**10.95**	**8.08**	**8.77**	**7.47**	**5.47**	**100(100.0)**

The most abundance family/species were the *Synodontis* sp. belonging to the mochokidae family of different species. *Synodontis membranaeceous*, *S. nigrita*, *S. schall*, *S. claris* and *S. budgetti*. This family alone constituted (123 fishes) 19.62% of the total fish caught during the sampled period (Table 2).

This is closely followed by the Cichlidae (*Oreochromis niloticus*, *Tilapia guinensis*, *Tilapia zilli* and *Tchysia ansorgei*) which recorded 119 fishes (18.98%) of the total fish fauna caught. The least percentage (%) abundance and distributed family or species were the Monodactylidae (*Monodactylus sebae*) which constituted only 0.48% of the total catch. It is closely followed by the family mugilidae (*Liza falcipinus*) 0.64%, Notopleridae and Pomadasydae 0.80% (Table 2). Their low density and abundance demonstrated their sensitivity to the stressed environment under study.

The mean monthly changes in the condition factor of the sampled four fish families showed that Cichlidae and had K-values of 8.70 ± 4.79 in February, 7.40 ± 5.44 in January, 7.02 ± 6.06 in March, 6.84 ± 4.58 and 5.48 ± 3.91 in May

and June respectively. The lowest mean condition factor (1.42 ± 5.62) for Cichlidae was recorded in April.

The low diversity of fish fauna recorded in this study may be highlighting some degree of environmental stress. The controlling factors were probably waste metabolitics, such as petroleum hydrocarbon, silt waste remains and heavy metal (Sikoki and Zabbey, 2006). The combined effect of these elements have been known to be responsible for environmental stress (Akpofure, *et al*. 2000).

The chronic exposure of fish to low levels of chemical/heavy metals concentration at high temperature as observed in this study has been known to adversely affect their survival (Nwilo and Badejo, 2005; Lunberg *et al*., 2000). The possible reasons for the survival and well being of the dominant forms included the fact that the natural water environment contained large volume of water probably dissolved and diluted the degradable forms of waste. The water was thus dynamic and therefore buffered the impact of the study influx of the toxicants to their tolerable level (Omoregie and Okuntsebor, 2005).

Table2. *Catch Statistics from the Different Sampling Stations between January – June 2013*

S/N	Families	Species	Sampling Stations					Total
			1	**2**	**3**	**4**	**5**	
1	CHARACIDAE	*Brycinus macrolepidotus*	12	7	8	5	7	39
		Brycinus nurse	20	10	6	7	6	49
		Aletes bramose	3	1	2	-	-	6
	Total		**35**	**18**	**16**	**12**	**13**	**94**
2	CENTROPOMIDAE	*Lates niloticus*	4	2	4	-	2	12
3	OSTEOGLOSSIDAE	*Heterotis niloticus*	7	4	2	2	-	15
4	CICHLIDAE	*Oreochromis niloticus*	28	9	6	6	4	53
		Tilapia guinensis	12	6	4	3	2	27
		Tchysia ansorgi	6	9	-	4	5	24
		Tilapia zilli	10	2	1	2	-	15
	Total		**67**	**32**	**17**	**17**	**13**	**146**
5	ANABANTIDAE	*Ctenopoma kingleyae*	3	3	-	-	-	6
6	CITHARINIDAE	*Citharinus citharus*	22	10	6	3	2	43
7	MOCHOKIDAE	*Synodontis membranaceous*	8	10	5	5	3	31
		S. nigrita	15	13	10	2	3	43
		S. schall	8	5	6	2	-	21
		S. clarias	5	2	4	2	-	13
		S. budgetti	5	6	3	1	-	15
	Total		**66**	**46**	**34**	**15**	**8**	**169**
8	HEPSETIDAE	*Hepsetus odoe*	10	4	3	-	2	19
9	BAGRIDAE	*Chrysichthys nigrodigitatus*	12	9	10	6	4	41
		Bagrus bayad	4	2	2	1	-	9
	Total		**26**	**15**	**15**	**7**	**6**	**69**
10	MOMYRIDAE	*Hyperopisus bebe*	6	4	3	2	-	15
		Marcusenius harringtoni	8	3	4	2	1	17
		Mormyrops deliciousus	9	3	2	-	-	14
	Total		**23**	**10**	**9**	**4**	**1**	**46**
11	CYPRINIDAE	*Cyprinus senegalensis*	8	6	4	-	-	18
		Labeo coubie	7	4	3	1	-	15
	Total		**15**	**10**	**7**	**1**	**-**	**33**
12	SCHILBEDAE	*Schilbe mystus*	10	8	6	4	2	30
13	GYMNARCHIDAE	*Gymnarchus niloticus*	4	3	2	-	-	9
14	NOTOPTERIDAE	*Xenomystus nigri*	-	-	-	1	2	3
15	POMADASYIDAE	*Pomadasys jubelini*	-	-	1	2	1	4
16	MONODACTYLIDAE	*Monodactylus sebae*	6	2	1	1	-	10
17	MUGILIDAE	*Liza falcipinus*	2	2	1	-	-	5
18	DISTICHODONTIDAE	*Distichodus rostratus*	-	-	-	2	3	5
	GRAND TOTAL	**31**	**254**	**146**	**109**	**66**	**49**	**1183**
		Percentage (%) Monthly Catch	**21.47**	**12.34**	**9.21**	**5.58**	**4.14**	**52.74**

Table3. *The Condition Factor for Four Different Fish Families Caught along Oluasiri River*

Fish Family/Species	January	February	March	April	May	June
Cichlidae (*Oreochromis niloticus*)	7.40±5.44	8.70±4.79	7.02±6.06	1.45±5.62	6.84±4.58	5.48±3.91
Citharinidae (*Citharinus citharus*)	1.34±0.10	1.44±0.14	1.47±0.25	1.44±0.18	1.41±0.07	-
Bagridae (*Chrysichthys nigrodigitatus*)	0.76±0.19	0.85±0.22	0.80±0.22	0.69±0.11	0.64±0.08	0.81±0.21
Characidae (*Brycinus nurse*)	1.45±0.42	1.54±0.54	1.25±0.08	1.18±0.08	1.45±0.32	1.49±0.58

CONCLUSION

Oreochromis niloticus showed a better chance of surviving petroleum hydrocarbon polluted water, and death in species was caused by asphyxiation due to increased in waste influx into the ecosystem couple with reduction in the amount of dissolved oxygen available. In general, the low total fish fauna shows that the hydrocarbons effluent was toxicant to the aquatic environment.

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Citation: *G.N Woke and T.A Benson, " Radial and Among-Family Variations of Tracheid Length and the Relationships with Bending Properties in Pinus patula", International Journal of Research in Agriculture and Forestry, vol. 4, no. 11, pp. 26-31, 2017.*