EFFECT OF INDOMIE INDUSTRIAL EFFLUENT DISCHARGE ON FISH FAUNA OF NEW CALABAR RIVER, PORT HARCOURT

G. N. WOKE, B. B. BABATUNDE AND WOKOMA ALELEYE

ABSTRACT

The effect of Indomie industrial effluent discharge on the fish fauna of New Calabar River was investigated in order to ascertain the influence of BOD, COD, DO, TDS, TSS, pH, salinity, phosphate and temperature on the composition and distribution of fish fauna. The diversity of the fish fauna was found to be poor, only 12 fish species in 6 families were identified. The highest number (10) of fishes was recorded in station 4 while the least number (1) of fishes was observed in station 1. The fish families were: Cichlidae (38.89%), Clupidae (33.33%), Pomadasyidae (16.67%), Bagridae (11.11%) while Genidae and Muglidae had zero percentage of fishes in its abundant. The resident fish species (*Ethmalosa fimbriata* and *Tilapia guinensis*) were highly adapted to the changes in the study environment and this was dependent on their trophic relationship within the environment. These species had great affinity for indomie industrial waste, because they feed on waste remains, mud/sediment silts and annelids, juveniles of shrimps and crabs. The deterioration of water quality was evident by the high BOD (12.80mg/L), COD (130mg/L), TDS (37mg/L), TSS (62mg/L), pH (5.2), salinity (50.54mg/L), phosphate (0.14mg/L) and temperature (27^0C) as well as the low dissolved oxygen (2.8mg/L) values observed. It was recommended that a routine treatment of the effluent before discharge into the water should be carried out so to maintain safe levels of industrial effluent in the immediate and extended environment.

KEYWORDS: Effluent, pollution, environment, fish and fauna.

INTRODUCTION

Environmental pollution is a global problem which has been with man for a very long time. However, in Nigeria its impact seem to have just been realized. This is attested by the effort of the present government in tackling the issue in recent times. This has led to the establishment of the Federal Environmental Protection Agency (FEPA) by decree number 58 of 1988, saddled with the responsibility of making and implementing environmental laws and standards in order to protect, restore and preserve the Nigerian environment from all kinds of pollution (Ogan and Nwiika, 1993).

The effect of Indomie effluent on the aquatic environment resulting from pollution have generated a lot of interest in the scientific research on oil pollution. The pollution in the environment is caused by the pollutant. The toxicity of the oil can be interpreted as the toxicity of a complex mixture of organic and inorganic chemical. Studies of some Nigerian rivers by Ajayi and Osibanjo (1981) and Asuquo (1989) reveled that water that was once an abundant natural resource is rapidly becoming scarce in

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quantity and the quality is fast deteriorating due to population increase, rapid industrialization and rural/urban migration. Almost all water used by man is returned as waste water and requires proper disposal to prevent it from reaching and contaminating water resources. In most cases, this is not practiced due largely to technical and economic reasons (Asuquo, 1989).

The organic pollution and influence of seasonal changes as well as industrial effluent on organic load of the river was also reported (Odokuma and Okpokwasili, 1997). Ten years later, Odokuma and Ijeomah (2003) on heavy metal resistance among bacterial populations of the New Calabar River.

The concern over water quality relates not just to the water itself, but also to the danger of diffusion of toxic substances into other ecosystems (Pretorius, 2000, Bezuidenhont *et al*, 2002). The aquatic environment for living organisms can be affected and bioaccumulation of harmful substances in the water-dependent food chain can occur (Alam *et al*, 2006). Surface water is vulnerable to pollution from untreated industrial effluents and municipal wastewater, run-off from chemical fertilizers and pesticides, as well as oil and lube spillage in the coastal area from the operation of sea and river ports (Odukuma and Okpokwasili, 1997; Krantz and Kifferstein, 1998). Similarly, increase of faecal pollution in source water is also a problem in developing as well as developed countries (Sinton *et al*, 1993).

Dissolved nutrient in natural waters are usually low (Asuquo and Okorie, 1987) and composition of surface waters is derived from the atmosphere, soil and rock sources. The relative contribution to surface waters from each of those sources is a function of the climate being modified increasingly by human activities (Alam *et al*, 2006).

Multiple antibiotic resistance in bacterial populations of some lower Niger Delta rivers including the New Calabar River were exported in the previous study (Ogan and Nwiika, 1993). This resistance was attributed to indiscriminate waste disposal in the fresh and brackish water-bodies.

Portable water for domestic use should be free from pathogenic microorganisms and toxic substances such as heavy metals and hydrocarbons. Drinking water should be odourless, tasteless, colourless and devoid of particulate matter (Reid *et al*, 1979). The protection of public health requires that people be supplied with water of adequate quality which satisfies the minimum quality standard. Pollution of fresh water bodies (rivers, lakes, ponds and streams) by nutrients is mostly experienced as a result of industrial discharge, municipal domestic sewage disposals, surface runoff from agricultural kinds, underground water and salt water intrusion and inundation (Asuquo and Okorie, 1987).

The New Calabar River is subjected to industrial effluent of the Indomie load arising from effluent discharge and some other forms of anthropogenic functions. The continuous discharge of these Indomie wastes into the water and lack of information on the responses of aquatic biota (fish fauna) to the waste, necessitate this study. Therefore, the aim of this study is to carry out water quality assessment of New Calabar River where the industrial effluent of the Indomie industry is discharge, to ascertain the possible effects on the fish fauna.

STUDY AREA

The sources of New Calabar River run between Ibea and Ndele and this is about 5^0 10'N and 6^0 45'E. The river flows southwards into the Atlantic ocean near Bonny and it contains fresh water till Akpor, after which it becomes brackish.

The river is characterized by low sea inflow and high fresh water input from adjoining swamp forests and municipal sewers within the Choba area of Port Harcourt. The river is the main source of water for domestic purposes, traditional, recreational and commercial use as well as industrial. Within the area of study, the river receives discharge effluents from the community drainage systems, food processing company (Indomie), oil drilling company (wilbros) and run-off from large agricultural fields. For the purpose of this study, four stations were selected along the New Calabar River.

Station 1 (Indomie company): This is the point source where wastes from Indomie company is discharged into the water body. Station 2: Is 10m upstream from the source. Station 3 (Choba market): Is 10m downstream from the source. Station 4 (Choba bridge): is 30m downstream from the source and it serves as a control from the source point. The water flows from station 2 to 1 and 4 – 3. At high tides, the water flows upstream and when the direction of the water flow changes instead of flowing at the normal direction, the flow will be backwards. Hence at low tides, the water flow changes its normal direction.

MATERIALS AND METHODS

Collection of Samples

Fish samples were collected from each of the sampling stations. A dugout canoe with paddles was used for sampling at the various stations. Traw/nets of 60mm and stow nets of 50m wide were used along the course of the river, large species as well as small species of fish were caught or sampled. The fishing effort was the same in each station sampled. All fishes sampled were taken to the laboratory for immediate preservation with 10% formalin solution in labelled plastic containers. In the laboratory, fish were sorted, identified and counted using appropriate keys (FAO, 1990; Schnelder, 1996). Each sampling operation lasted for about three hours. The fishes caught per throw of net were recorded for that location. The total fish catch per station was pooled to obtain the average catch categorized by species per station/month. Their relative abundances were calculated as percentage of the total catch, using

$$\text{Density} = \frac{\text{Total number of animals}}{\text{Area of sample unit}}$$

Physico-chemical parameters such as Biochemical Oxygen demand (BOD_5), Chemical Oxygen demand (COD), dissolved oxygen (DO), total suspended solids (TSS), total dissolved solids (TDS), salinity, phosphate, pH and temperature (OC) were used to determine the water quality and effects of Indomie waste effluent. Water samples for the determination of BOD_5, COD, DO, TSS, TDS, salinity, pH and temperature were collected for each sample station. The Azide modification method was used to determine the initial dissolved oxygen (DO) (APHA, 1998). BOD_5 was computed from the difference between initial and final DO. Chemical oxygen demand is a measure of the oxygen equivalent of that portion of the organic matter in a sample that is susceptible to oxidation by a strong chemical oxidant was measured using (APHA, 1998). Temperature measurement of surface water was carried out with a mercury in glass thermometer (centigrade ^0C), whereas a measuring cylinder was used to measure TSS (APHA, 1998).

RESULTS

A total of 12 fish species belonging to 6 families were identified (see checklist of the fauna is presented in Table 1). The total number of organism per stations and relative species richness are show in Tables 2, 3 and 4. Identification of fish species was carried out based on keys provided by the following: Schneider (1990) and Tobor (1968).

Table 1: Fish fauna collected from New Calabar River, Port Harcourt

S/N	Fish families	Species
1.	Bagridae	*Chrysichthys aurantus*
		Chrysichthys longifilis
2.	Cichlidae	*Sarotherodon melanotheron*
		Tilapia guinensis
3.	Clupidae	*Ethmalosa fimbriata*
		Sardinella maderensis
4.	Gerridae	*Eucinostomus melanopterus*
		Geris nigri
5.	Muglidae	*Liza falcipinnis*
		Liza grandisquanis
6.	Pomadasyidae	*Pomadasys rogerii*
		Pomadasys jubelini

Table 2: Catch statistics from the different sampling stations

S/N	Species	Stations				
		1	2	3	4	Total
1.	*Chrysichthys auratus*	-	-	-	2	2
2.	*Chrysichthys longifilis*	-	-	-	-	-
3.	*Sarotherodon melanotheron*	-	-	-	2	2
4.	*Tilapia guinensis*	-	-	2	3	5
5.	*Ethmalosa fimbriata*	-	1	2	2	5
6.	*Sardinella maderensis*	-	1	-	-	1
7.	*Geris nigri*	-	-	-	-	-
8.	*Eueinostomus melanopterus*	-	-	-	-	-
9.	*Liza falcipinnis*	-	-	-	-	-
10.	*Liza grandisquanis*	-	-	-	-	-
11.	*Pomadasys rogerri*	1	-	-	1	2
12.	*Pomadasys jubelini*	-	-	1	-	1
		1	2	5	10	18

Table 3: Percentage composition of families and species in each class of fish fauna collected

Families	Total no. of families	Total no. of species	Percentage composition species
Bagridae	1	2	16.7
Cichlidae	1	2	16.7
Clupidae	1	2	16.7
Gerridae	1	2	16.7
Muglidae	1	2	16.7
Pomadasyidae	1	2	16.7
Total	6	12	100

Table 4: Percentage abundance of each class of individual fish fauna

Families	Total no. of individual	Mean total no. of individual	Percentage abundance
Bagridae	2	1.0	11.11
Cichlidae	7	3.5	38.89
Clupidae	6	3.0	33.33
Pomadasyidae	3	1.5	16.67
Total	**18**	**9.0**	**100.00**

Tilapia guinensis and *Ethmalosa fimbriata* were the most dominant species. Both has the total number of five (5) species in number while *Chrysichthys auratus* and *Sarotherodon melanothero*n had two (2) species each. *Sardinella maderensis* and *Pomadasys jubelini* are represented by one species.

The highest number of Ichthyo-fauna (10 individual fishes) were caught in station 4 where the water was always full, clear and well oxygenated and it served as a control site in the study area.

This observation gave an indication of their sensitivity to environmental stress and fish abundance resulted from the absence of Indomie waste dump. The lowest number of organisms was recorded in station 1 & 2 which indicated high level of pollution from Indomie waste metabolites and heavy metals that is associated with the station (Table 2). Stations 3 recorded total number of five species, probably because the fishes avoided areas with heavy organic wastes dumps, clouded by sediment silt/organic remains, low salinity, high concentration of

phosphate, and low dissolved oxygen that may be present at the other polluted stations.

The family Cichlidae (*Sarotherodon melanotheron* and *Tilapia guinensis*) was the most abundant fish fauna. This class constituted 38.89% of the total fishes caught during the study. Other groups included Clupidae (*Ethmalosa fimbriata* and *Sardinella maderensis*) 33.33%, Pomadasyidae (*Pomadasys roferii* and *Pomadasys jubelini* species) 16.67%, Bagridae (*Chrysichthys aurantus* and *Chrysichthys longifilis* species) had 11.11%.

Table 5: The level of BOD, COD, DO, TDS, TSS, pH, salinity, phosphate and temperature on the distribution of fish fauna

Samples/Station	1	2	3	4
BOD (mg/L)	7.36	11.52	14.72	12.80
COD (mg/L)	20	90	110	130
DO (mg/L)	2.8	10	12	15
TDS (mg/L)	34	36	37	31
TSS (mg/L)	51mg/L	49mg/L	56mg/L	62mg/L
pH	5.0	5.1	5.1	5.2
Salinity (mg/L)	38.99	40.43	50.54	44.76
Phosphate (mg/L)	0.08	0.14	0.139	0.11
Temperature (OC)	27	27	27	26

DISCUSSION

The low diversity of fish fauna recorded in this study may be due to some degree of environmental stress. The controlling factors were probably waste metabolites, such as total organic carbon, silt waste remains and heavy metals. The combined effects of these elements have been known to be responsible for environmental stress (Krebs, 1978; Bucklor *et al*, 1987). This study indicated that Indomie waste seemed to boost marine production by supplying the required nutrients for primary production through the release of organic metabolites into water column and sediment of the studied environment as adopted in (James and Head, 1972).

The abundant fish species were Cichlidae (*Sarotherodon melanotheron* and *Tilapia guinensis*) and Clupidae (*Ethmalosa fimbriata* and *Sardinella maderensis*). These species contributed more than 70% of the identified specimen of fish fauna in the river during the study. Reid *et al*, (1979) revealed that these groups have adapted to the physical environmental changes in the ecosystem.

Station 3 recorded total number of five species, probably because the fishes avoided areas with heavy organic wastes dumps, clouded by sediments silt/organic remains, low salinity, high concentration of phosphate, and low dissolved oxygen that may be present at the other polluted stations.

The chronic exposure of fish to low levels of chemicals/heavy metals concentrations at high temperature as observed in this study has been known to adversely affect their survival (Pudo and Fubara, 1988; Morgan, 1977). The possible reasons for the survival and well being of the dominant forms may include the fact that the natural water environment contained large volume of water which 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. Studies of this nature are important in enabling the understanding of the composition of fish populations especially in tropical waters of which little is presently known.

CONCLUSION

The results of the fish fauna of New Calabar River in Choba investigated have shown that Indomie food industrial effluent is a major source of environmental pollution through the discharge of the effluent into this water body. Elevated levels of these pollution would invariably effect the taste, smell, appearance and aesthetic properties of the water or could pose a potential health hazard of varying degrees to various life forms, which depend on the water for domestic and recreational purposes. Constant treatment of the effluent is recommended.

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