

Wet Season Variation in Some Physicochemical Parameters of Brackish Water Fish Ponds and Main Channels in Buguma, Rivers State, Nigeria

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Abstract: Some physico-chemical variables of Nigerian Institute for Oceanography and Marine Research (NIOMR), Brackish water fish farm, Buguma, Rivers State, Nigeria, were monitored bimonthly from April to October, 2005, covering the period of wet season in the region. The results obtained indicated that pH range for ponds was 6.06-6.78; salinity 9.01-15.25‰ and temperature 27.40-32.00°C. While the main channel pH range was 5.50-6.80; salinity 10-17‰ and temperature 28-31.4°C. Significant difference ($p < 0.05$) in salinity between main channel and ponds was observed for the month of April, while other parameters in other months (under investigation) were not significantly different.

Key words: Water quality, brackish water, main channel, ponds, wet season

INTRODUCTION

Water is made up of physical and chemical factors, which directly and indirectly influence its quality and consequently its suitability for fish culture (Abezi, 2006). All aquatic life requires water as a support system and as a medium in which to move about in obtaining food and other materials, therefore any water body is a potential medium for the production of aquatic organisms (Sikoki and Veen, 2004). Fish growth largely depends on the quality of the culture medium. Physicochemical parameters are known to affect the biotic components of any aquatic environment in various ways (Ugwumba and Ugwumba, 1993). Therefore knowledge of hydrological conditions of water body is not only useful in assessing its productivity, but also allows a better understanding of the population and life cycle of the fish community (Adebisi, 1981; Ayodele and Ajani, 1999; Adeogun *et al.*, 2005). Fin and shell fishes of fresh and brackish water habitats survive within certain limits of water quality and there is usually an optimum level and a range within which they will survive (Austasia Aquaculture, 2003). According to Davenport (1993) limitation to an aqueous habitat is the most fundamental physiological constraint imposed upon fish.

Physicochemical parameters like, pH, salinity, temperature, dissolved oxygen are very fundamental to

the basic metabolic activities of the fish and are very vital to its survival most especially in the brackish water environment (Francis *et al.*, 2007). Hence assessing the quality of water being utilized in fish culture in brackish water cannot be over emphasized. Fish farms in brackish water areas are constructed on a low-lying tidal mudflat, to ensure steady exchange of tidal waters between the farm and the adjoining creek. Tidal water is allowed into the farm through the main channel to flood the ponds to optimal depth or as may be required by the cultured fish and allow water to flow out of the ponds during low-tide to a minimum tolerable depth (Akinrotimi *et al.*, 2005). Hence, there is constant exchange of water between the main channel which is directly linked to the creek and the ponds. In view of this, monitoring of water quality which centers on determination of optimal, sub lethal and lethal values of physicochemical parameters standardized for fish culture into brackish water is highly essential to ensure maximum productivity. Few studies have been carried out on the physicochemical parameters of important rivers in Niger Delta. This includes Bonny River (Dublin Green, 1992), Andoni River (Yoloye, 1976; Francis *et al.*, 2007) lower river Nun (Yakubu *et al.*, 1998) and lower New Calabar river (Erondu and Chinda, 1991); but no data is available on variation between the main channel from the creek and ponds in brackish water fish farms. Hence, the need to carry out this study.

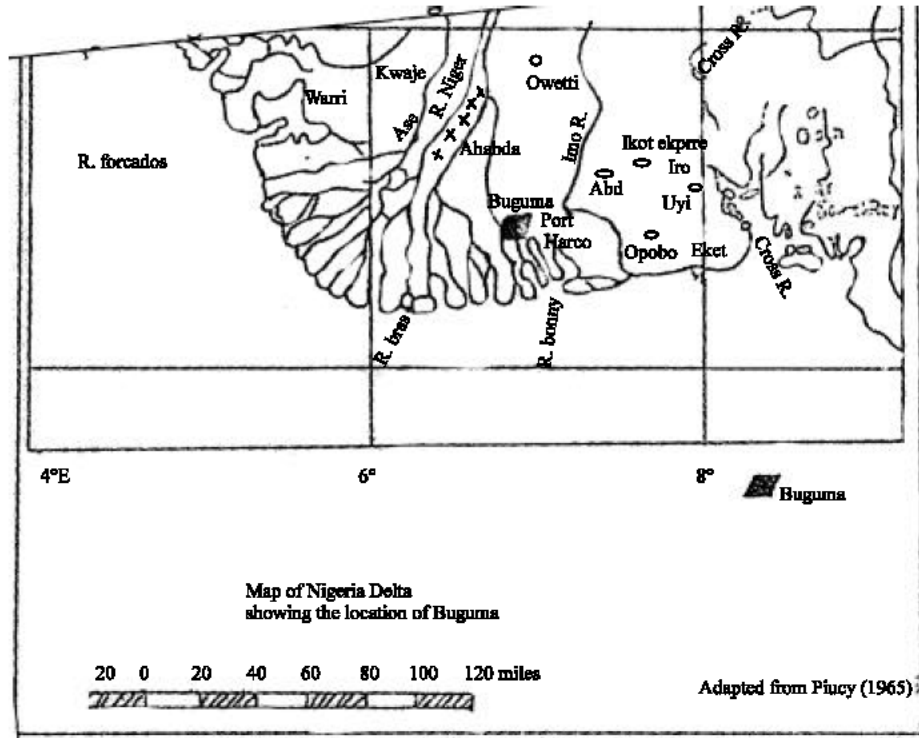


Fig. 1: Map of Niger Delta showing NIOMR, Buguma fish farm

MATERIALS AND METHODS

The study was carried out at Nigerian Institute for Oceanography and Marine Research Brackish water fish farm Buguma, located in the Niger Delta area of Nigeria (Fig. 1). The farm has a main channel which is linked to Buguma creek via a main sluice gate. The channel serves as a means of water supply and drainage for the ponds, each of which also has a sluice gate for water control (Fig. 2). Physiochemical parameter of the water in 19 ponds and main were determined in the rainy season months from April to October 2005.

Sampling was conducted bimonthly and parameters monitored include pH, temperature and salinity. pH was determined directly with a Hanna hand-held digital pH meter, model HI8915, Salinity was measured with Atago hand-held refractometer S/mill-E cat No. 2442; while surface temperature was determine with a thermometer. Data obtained from the study were subjected to analysis with the General Linear Model (GLM) at 0.05% probability and differences among means were separated using Duncan Means Separation (DMS).

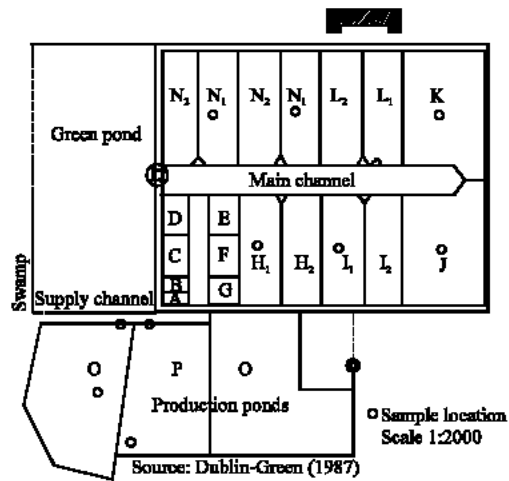


Fig. 2: Buguma fish farm showing the ponds and main channel

RESULTS

The average pH for the ponds in April, May, June, July, August, September and October were 6.49, 6.01, 6.14, 6.22, 6.67, 6.56 and 6.47, respectively; while for the main channel it was 6.60, 5.50, 6.10, 6.24, 6.48, 6.77 and 6.48,

Table 1: Mean values of pH in the ponds and main channel

Months	Ponds			Main channel		
	Mean*	Min.	Max.	Mean**	Min.	Max.
April	6.49±0.02 ^a	6.33	6.67	6.60±0.10 ^a	6.50	6.70
May	6.01±0.06 ^a	5.58	6.49	5.47±0.17 ^a	5.30	5.60
June	6.14±0.04 ^a	5.59	6.54	6.10±0.44 ^a	5.65	6.52
July	6.22±0.05 ^a	5.76	6.59	6.24±0.46 ^a	5.78	6.69
August	6.67±0.03 ^a	6.25	6.88	6.48±0.14 ^a	6.34	6.61
September	6.56±0.02 ^a	6.38	6.76	6.77±0.19 ^a	6.58	6.96
October	6.47±0.01 ^a	6.34	6.55	6.48±0.10 ^a	6.38	6.58

Means in the row with asterisks (*,**) with same superscripts are not significantly different (p<0.05)

Table 2: Mean temperature values in the ponds and main channel

Months	Ponds			Main channel		
	Mean*°C	Min.	Max.	Mean**°C	Min.	Max.
April	32.10±0.13 ^a	30.60	32.65	31.00±0.75 ^b	60.51	32.50
May	29.81±0.37 ^a	26.15	31.25	30.05±1.05 ^a	29.00	31.10
June	31.10±0.14 ^a	30.10	32.15	31.40±0.05 ^a	31.30	31.40
July	27.40±0.12 ^a	26.60	29.00	28.75±1.25 ^a	27.50	30.00
August	28.82±0.10 ^a	28.00	29.50	28.50±0.50 ^a	28.10	29.60
September	29.06±0.07 ^a	28.50	29.50	28.54±0.51 ^a	28.20	29.70
October	29.41±0.04 ^a	29.00	29.65	29.10±0.01 ^a	29.01	29.20

Means in the row with asterisks (*,**) with same superscripts are not significantly different (p<0.05)

Table 3: Mean salinity values in the ponds and main channel

Months	Ponds			Main channel		
	Mean*	Min.	Max.	Mean**	Min.	Max.
April	15.00±0.67 ^a	10.12	19.65	17.01±1.51 ^a	15.10	18.25
May	13.26±0.19 ^a	10.50	13.50	14.01±0.01 ^a	14.01	14.04
June	13.00±0.15 ^a	11.51	14.51	13.12±1.51 ^a	11.10	14.15
July	13.12±0.07 ^a	12.56	13.52	12.51±2.51 ^a	10.12	15.26
August	9.15±0.08 ^a	8.51	10.00	9.25±0.51 ^a	9.10	10.92
September	9.79±0.19 ^a	9.01	11.52	10.02±0.01 ^a	10.01	10.03
October	10.20±0.10 ^a	10.10	10.30	10.04±0.02 ^a	10.00	10.06

Means in the row with asterisks (*,**) with different superscripts are not significantly different (p<0.05)

respectively. The pH range for ponds was 6.06-6.78 and for main channel it was 5.50-6.80, the highest value (6.77) was recorded in the month of September, while the lowest value (5.47) was in May (Table 1).

For temperature, the range was between 28.10-31.4°C, the highest value 32.65°C was recorded in the month of April in the ponds (Table 2) while the lowest value of 27.40°C was observed in the month of July.

The values of salinity recorded during the study ranged between 10 to 15% for the ponds and 9.5 to 17% for the main channel. The highest value obtained in the ponds was 15% in the month of April while the lowest value of 9.01% was recorded. In the main channel the highest value of 17.00 and the lowest value 9.51 were observed in the month of April and August, respectively (Table 3).

DISCUSSION

The various physicochemical parameters recorded in the ponds and the main channel was favourable for fish culture and they are within the acceptable range already

documented. Mean surface water temperature range of 26.6 to 32°C recorded for both ponds and main channel agreed with the ranges recorded by Hassan (1974) in Lagos Lagoon and Ezenwa *et al.* (1990) in Niger Delta basin. The least mean temperature of 26.6°C recorded in ponds for the month of July (Fig. 3) may be due to long period of rainfall and reduced of sunshine in the region, at that time of the year. The highest temperature of 32°C observed in the month of April, according to Francis *et al.* (2007) may be due to the state of the river, water currents time of the day and tidal regimes, all which directly affects the temperature of the water. There is generally a decrease in the trend of temperature from April to October, this is in line with the findings of Ihuoma and Sikoki (2003) which may be due to increase in rainfall intensity and subsequent reduction in sunshine hours, which invariably results in reduction in surface temperature. However, the variations observed between ponds and main channel which was only significant (p<0.05) in the months of April and September may be due to tidal movement of water.

The average pH values of 6.06 to 6.78 and 5.50 to 6.80 recorded for ponds and main channel, respectively are

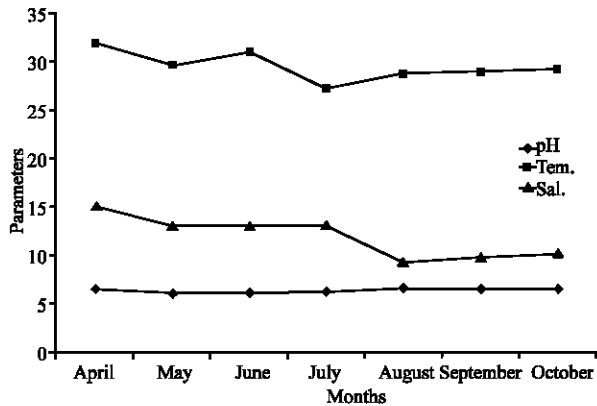


Fig. 3: Physicochemical parameters variations for pond from April to October 2005

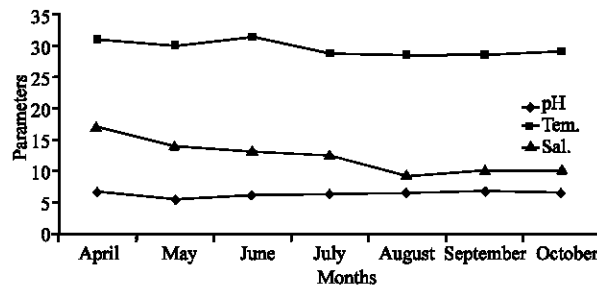


Fig. 4: Physicochemical variations for main channel from April to October 2005

consistent with the findings of Day (1981) in Mourumbere estuary in South Africa, Dagana (1985) in lower parts of Sombreiro river, Erondu and Chinda (1991) in New Calabar river and King and Nkata (1991) observations in some fish ponds in Niger Delta. From these results there are no major fluctuations in pH in ponds (Fig. 3) and main channel (Fig. 4). The results suggest that the system is well buffered. This is probably due to the unconfirmed presence of carbonates, bicarbonates and hydroxides as reported by Boyd (1979) and Austasia Aquaculture (2003). It was however observed that there is no variation between the ponds and main channel.

The salinity in the ponds ranged between 9.50 to 15.40‰ and 10.60 to 17.80‰ for the main channels. There is much fluctuations in the salinity values (Fig. 3 and 4) between the month of April and October, this corroborated the observation of Powel and Chindah (1986) in lower New Calabar river, Adeniyi (1986) in Bonny estuary and Francis *et al.* (2007) in Andoni rivers system in the Niger Delta.

Francis *et al.* (2007) noted that salinity is the most varied physico-chemical parameter in the brackish water environment of Niger Delta. The significant difference

($p < 0.05$) between ponds and main channel in the month of April, May and July may be due to tidal movement of water, during the high tide the salinity is expected to be high (Ezenwa *et al.*, 1990).

CONCLUSION

With increasing culture of fish in brackish water environment in Nigeria, water quality for intensive aquaculture must be closely monitored to enhance optimum fish production in these riverine communities. It is a known fact that sustainable fish production depends mostly on some environmental conditions, therefore proper management of these parameters will ultimately contribute in no small measure to higher yields and sustainable brackish water fish farming in Niger Delta.

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