Journal of Fisheries International 2 (1): 27-31, 2007

Physico-Chemical Parameters of the Andoni River System-Niger Delta, Nigeria

[1]A. Francis, [2]F.D. Sikoki and [3]E.J. Ansa
[1]Department of Animal Science and Fisheries, Faculty of Agriculture,
University of Port Harcourt, P.M.B. 5323, Port Harcourt, Nigeria
[2]Department of Animal and Environmental Biology, University of Port Harcourt,
P.M.B. 5323, Port Harcourt, Nigeria
[3]African Regional Aquaculture Centre, Aluu Port-Harcourt, Nigeria

Abstract: Monthly variations in the physico-chemical parameters of the brackish waters of the Andoni River System were conducted from January 1999 to December 2000. Parameter ranges for the two years were 26.05 to 32.1°C (temperature); 6.38-8.90 (pH), 12-22$^{0}/_{00}$ (salinity) and 5.00-12.3 mg L^{-1} for dissolved oxygen. Observed fluctuations seemed to agree with the dynamic nature of brackishwater system.

Key words: Physico-chemical, brackish water, Niger delta

INTRODUCTION

Growth of fishes cannot be separated from the effects of physico-chemical characteristics of their aquatic habitat. These physico-chemical characteristics affect distribution and growth of the ichthyofauna (Kutty, 1987; Moses, 1983; Ibe, 1985; Nsentip, 1985; Onuoha and Nwadukwe, 1989; Dublin-Green and Tobor, 1992). Some of these characteristics include temperature, dissolved oxygen, pH and salinity. Interrelationships, to some degree exist between these parameters.

Temperature, an important abiotic factor in the aquatic ecosystem, not only affects the abundance, availability and distribution of fishes (Ibe, 1985), but also influences their activities such as breathing, growth and reproduction (Onuoha and Nwadukwe, 1989; Marioghae, 1991; Dublin-Green and Tobor, 1992). Nsentip (1985) in reviewing Bonga (*Ethmalosa fimbriata*) fisheries of the Cross River state, Nigeria, stated that temperature was possibly the basic limiting factor to the longitudinal distribution of *Ethmalosa fimbriata.*

Temperature is inversely related to Dissolved Oxygen (DO); which decreases with higher temperatures and vice versa. It has been established that at 0°C Dissolved Oxygen (DO) is 14.62 mg L^{-1}; 11.33 mg L^{-1} at 10°C; 9.17 mg L^{-1} at 20°C and 7.3 mg L^{-1} at 30°C (Onuoha and Nwadukwe, 1989). Dissolved oxygen in the aquatic system is fundamental to the basic metabolic activities of the fish, which is vital to its survival.

Fishes grow best in waters between pH 6.5 to pH 9, but slightly alkaline waters that are close to neutral pH Kutty (1987) are best for them. Very acidic waters which do develop in mangrove swamps Ezekiel (2002) are lethal to them or affect their well being.

Salinity and the other physico-chemical parameters of brackish waters are liable to fluctuations since the water ebbs and flows on regular basis (Lowe-McConnell, 1977). Yoloye (1976) reported that the Andoni River fluctuates between 10 and 25‰; while the salinity of most ocean water is within the range of 34-36‰ (Tait, 1972). From the works of Ikusemiju (1973) and Ezenwa (1978, 1981) as quoted by Ezenwa *et al.* (1987); the Nigerian water environment as classified according to salinity, consists of marine waters (salinity is above 30‰); high brackish waters (20-29.9‰ salinity), mid-brackish water (0.5 - 19.9‰ salinity) and fresh water (0.0-0.5‰ salinity). According to Ibe (1985) salinity is not as regulatory as temperature; although it affects osmoregulation and development of fish eggs thereby making the quantity of future stocks at least in part dependent on salinity. Scott (1966), reported that salinity in the brackish waters of the Niger Delta is higher in the dry season when sea water penetrates far up the rivers, than in wet season when rain water and the flood waters from the Niger and Benue drive the salt water back towards the sea.

Not much was seen in literature on the physico-chemical characteristics of Andoni River but some exist for the adjacent Bonny River and other fresh water systems located in the Niger Delta. The physico-chemical characteristics of Bonny River have been described by Dublin-Green (1992) quoted in (Hart, 1997). The temperature of the surface water in the Bonny River was reported to range between 27.5°C in the wet season to

Corresponding Author: A. Francis, Department of Animal Science and Fisheries, Faculty of Agriculture,
University of Port Harcourt, P.M.B. 5323, Port Harcourt, Nigeria

31.2°C in the dry season; pH ranged from 7.3 (wet season) to 7.6 (dry season); dissolved oxygen was higher in the wet season (6.0 ppm) as against 5.2 ppm recorded in the dry season; while salinity was between 25 and 30‰. Ezenwa *et al.* (1990) made the following observations in the fish nursery and schooling grounds of the Niger Delta where cultivable brackish water fish species occur. The dissolved oxygen content was 2.5-6.0 mg L^{-1}; salinity (0.0-25.5‰); pH (6.0-7.2) and temperature 26.5-29.0°C.

Dearth of data on the physico-chemical characteristics of the Andoni River System informed the objective of the research, which is to make available, data on the physico-chemical characteristics of the Andoni River System.

MATERIALS AND METHODS

The Andoni brackishwater River system lies between latitudes4° 28^{1} to 4° 45^{1}and longitudes 7° 45^{1} East and is located within the Niger Delta, Nigeria, West Africa. The Andoni River is one of the rivers that drains River Niger. The Niger Delta region in Nigeria is known for its beehive of activities in the area of oil exploration, exploitation and production.

Sampling for the physico-chemical parameters of the river water took place along the Okwan Isi Ajakajak River, which formed part of the Andoni River System. Figure 1. Sampling was done biweekly for a period of two years; from January 1999 to December 2000.

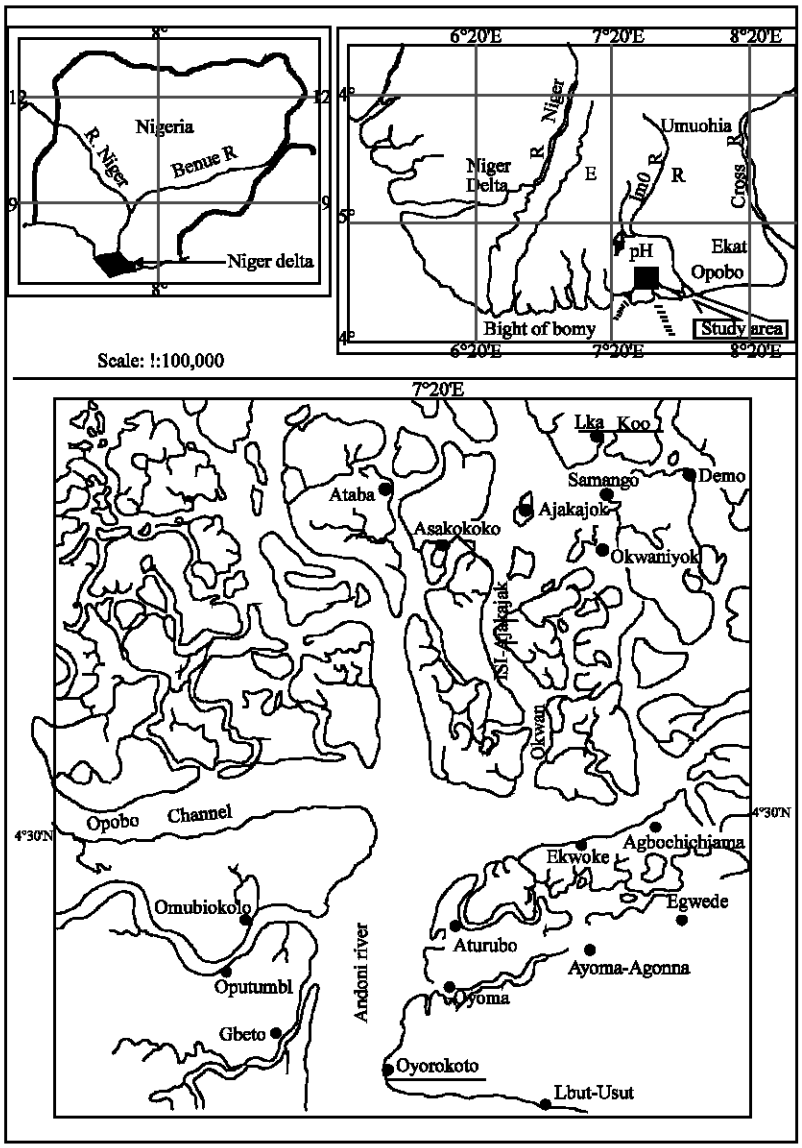

Fig. 1: Part of Niger delta showing andoni river system

The abiotic factors that were monitored included temperature, Hydrogen ion concentration (pH), Dissolved Oxygen (DO) and salinity. Dissolved oxygen meter of the model: OxyGuard Handy MK II was used in measuring dissolved oxygen and temperature. The pH was measured using pH meter (model: Hanna Instrument model No. H1 8915 ATC) while salinity was measured using salinometer, model: New S-100. For each of the parameters the probe end of the meter was dipped into the river to a depth of about half metre while the value at the pointer of the scale was read off and recorded. The measurements were taken while inside the canoe along Okwan Isi Ajakajak in front of Kaa landing site (one of the two landing sites for the Andoni artisanal fishers). Dissolved Oxygen (DO) was measured in milligrams per litre (mg L^{-1}); temperature in °C (degrees centigrade) and salinity was in parts per thousand (‰).

RESULTS

The monthly variation of the physico-chemical parameters for 1999 and 2000 are shown in (Fig. 2 and 3).

Temperature: The maximum temperature values of 32.1°C in May and 31.6°C in January were recorded for 1999 and 2000, respectively with corresponding minima of 26.05°C in October and 26.8°C in March for the two years, respectively. In 1999 the range was 26.05 to 32.1°C with a mean value of 28.50°C. A mean of 28.58°C and range of 26.8-31.6°C were obtained for 2000. Temperature fluctuations were very minimal from May to November in 1999 and from April to November in 2000. Statistical analysis showed that there was no significant difference between the values obtained for the two years ($p<0.05$).

Salinity: The salinity in the river system ranged between 5.5‰ in September to 19‰ (June) in 1999. The mean was 14.5‰. In the year 2000, the mean salinity was 17.25‰ and ranged between 13‰ (January) and 22‰ (May). Statistical analysis showed that there was no significant difference in the salinity measurements for the two years ($p<0.05$) but monthly fluctuations were greater in 1999 than in 2000.

Hydrogen ion concentration (pH): Hydrogen ion concentration (pH) values in 1999 were between 6.66 (August) and 8.09 (May) and ranged from 6.38 (May) to 7.76 (September) in 2000. The means for the two years were 7.29 and 6.96 for 1999 and 2000, respectively. Again, statistical analysis did not show any significant difference in the pH of the river water for the two years ($p<0.05$).

Dissolved Oxygen (DO): The dissolved oxygen content of the river water ranged from 6.2 mg L^{-1} (January) to 12.3 mg L^{-1} in September in 1999 and then 5.0 mg L^{-1} (December) to 12.1 mg L^{-1} (April) in 2000. The means for the two years were 8.45 and 8.56 mg L^{-1}, respectively: Dissolved oxygen fluctuated greatly between the months of August to February in 1999 and between September and April in 2000. In 1999 higher dissolved oxygen values were recorded at the beginning and towards the end of the rainy season, it was also the same in 2000. There was no significance difference in the means of the two years ($p<0.05$).

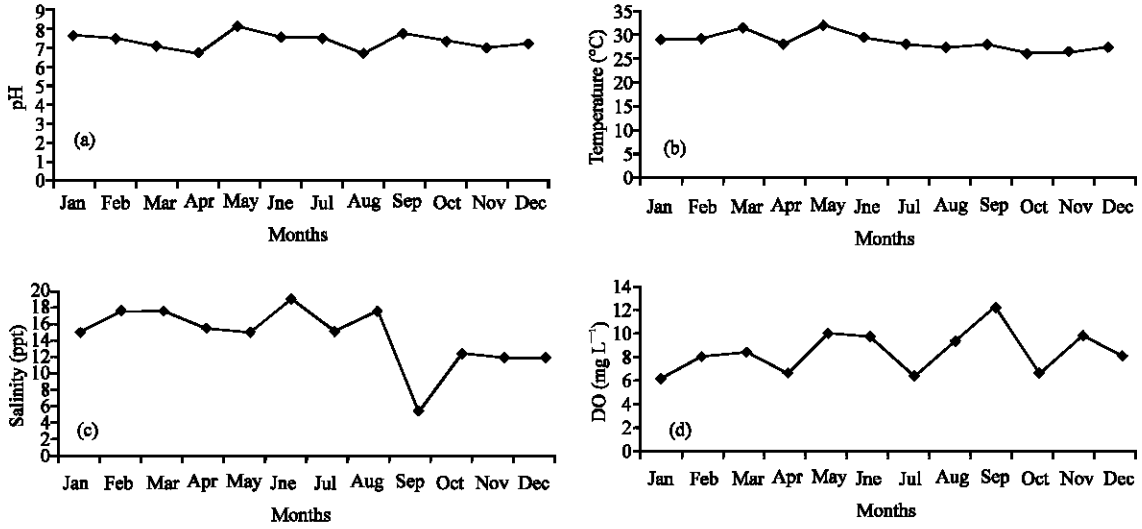

Fig. 2: Monthly variation of the physico-chemical parameters of the andoni river system (1999)

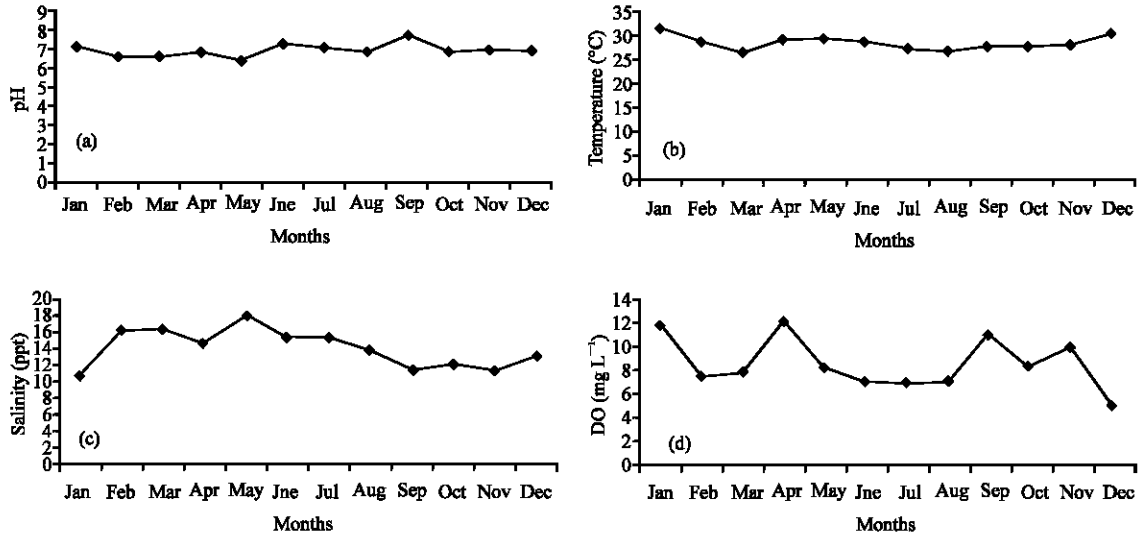

Fig. 3: Monthly variation of the physico-chemical parameters of the andoni river system (2000)

DISCUSSION

Combining the surface water temperature results for the two years of 1999 and 2000, the temperature range of 26.05 to 32.1°C recorded in this study compares very well with the range of 27.50°C in the wet season to 31.20°C in the dry season reported by Dublin-Green (1992) for the adjoining Bonny River and also 26.50 to 29°C, reported by Ezenwa *et al.* (1990) within the brackish waters of the Niger Delta breeding grounds of fingerlings of some cultivable brackish water fish species. The temperature maxima of 32.1 and 31.6°C observed for the surface waters of the Andoni River were also recorded in the dry season while more uniformly lower temperatures were recorded in the wet season (Fig. 2 and 3). However, the temperature maximum of 32.1°C recorded in the wet season month of May 1999 may be due to the state of the river at that particular time since many factors such as water current, time of the day and tide affect temperature. Besides, the atmospheric temperature for May 1999 was high.

The higher pH values observed in the wet season of 1999 and 2000 agree with the principle of higher pH in the rainy season that is due to the large volume of river water accumulated from rainwater (Yakubu *et al.*, 1998).

For the dissolved oxygen, the high values obtained in the rainy season from the Andoni river agrees with what Yakubu *et al.* (1998) observed for river Nun where the dissolved oxygen was higher in the early rainy season due to turbulence created by impact of rains and runs offs.

One of the most varied physico-chemical parameters in the brackish water environment is salinity and (Fig. 2 and 3) depict the fluctuating nature of the salinity in the Andoni River system. The salinity range of 12.5‰ to 22‰ and an instance of 5.5‰ (September, 1999) is in line with the observation of Yoloye (1976), Ikusemiju (1973) and Ezenwa (1978, 1981) that the Andoni River contains brackish water. In general the fluctuations observed in the physico-chemical parameters of the Andoni river system though showing some seasonality is due to the dynamic nature of brackish water systems (Devaraj *et al.*, 1994).

ACKNOWLEDGMENT

Our gratitude goes to God for inspiration to carry out this study and Mr. Ene Iwowari for typing the manuscript.

REFERENCES

Devaraj, M., V. Sundararaj and M.J. Prince Jeyaseelan, 1994. A report on rare and vulnerable Ichthyofaunal elements from a South Indian estuarine mangrove ecosystem. Nature Conservators: Muzaffarnagar (India), pp: 261-269.

Dublin-Green, C.O., 1992. Seasonal and spatial variations in some Physico-chemical parameters of the Bonny River (Niger Delta). Arch. Hydrobiologia, 34: 3-7.

Dublin-Green, C.O. and J.G. Tobor, 1992. Marine Resources and Activities in Nigeria. NIOMR Tech., 84: 2-25.

Ezekiel, E.N., 2002. The Fish Assemblage of the Local Fishpond in the Floodplains of Odhiokwu-Ekpeye, Niger Delta. Int. J. Sci. Tech., 1: 54-59.

Ezenwa, B., 1978. Studies on the distribution, age and growth of the catfish chrysichthys nigrodigitatus (B). M. Sc. Thesis University of Lagos, pp: 194.

Ezenwa, B., 1981. A study of the reproductive Biology of the catfish *Chrysichthys nigrodigitatus* (L.) in Nigeria, Ph.D Thesis University of Lagos, pp: 178.

Ezenwa, B.I., W.O. Alegbeleye, P.E. Anyanwu and P.U. Uzukwu, 1990. Cultivable Fish Seeds in Nigeria Coastal Waters: A Research Survey (Second Phase: 1986-1989) NIOMR Tech., 66: 1-37.

Hart, S.A., 1997. The Biology of Mugil cephalus Linnaeus, 1758 Perciformis: (Mugilidae) in Bonny estuary. M.Sc. Thesis Dept. of Zoology University of Port Harcourt Nigeria, pp: 1-102.

Ibe, A.C., 1985. The Role of Oceanography in Fisheries Resources Exploitation. In: Ita E.O. (Ed.), Proceedings of the 4th Annual Conference of the Fisheries Society of Nigeria (FISON) Port-Harcourt Nigeria, pp: 162-170.

Ikusemiju, K., 1973. A Study of the Catfish of Lekki Lagoon, with particular reference to the species *Chrysichthys walkeri* (B) Ph.D. Thesis Univ. of Lagos, pp: 188.

Kutty, M.N., 1987. Site Selection for Aquaculture. Chemical Features of Water. Lectures Presented at African Regional Aquaculture Centre (ARAC) for Senior Aquaculture Course Aluu. Port-Harcourt, Nigeria, pp: 31.

Lowe-McConnell, R.H., 1977. Ecology of Tropical Waters, The institute of biology studies series No. 76. Edward Arnold Publ. Great Britain, pp: 59.

Marioghae, I.E., 1991. Reproduction of fish in nature. In: Ayinla (Edn.) Proceedings of the Seed Propagation Course at African Regional Aquaculture Centre (ARAC) ALuu, Port-Harcourt, pp: 11-12.

Moses, B.S., 1983. Introduction to Tropical Fisheries. Ibadan University Press Nigeria, pp: 38.

Nsentip, N.U., 1985. Review of Bonga (*Ethmalosa fimbriata*) fisheries of the Cross River State, Nigeria. In: Ita (Edn.) Proceedings of the 4th Annual Conference of the Fisheries Society of Nigeria (FISON) Port Harcourt Nigeria, pp: 42-46.

Onuoha, G.C. and F.O. Nwadukwe, 1989. Water Quality Monitoring. In: Ayinla O.A. (Edn.). Proceedings of the Aquaculture Training Programme (ATP). African Regional Aquaculture Centre (ARAC) ALUU, pp: 12-23.

Scott, J.S., 1966. Report on the fisheries of the Niger Delta special areas. Niger Delta Development Board Port Harcourt Nigeria, pp: 109.

Tait, R.V., 1972. Elements of Marine Ecology. Butter Worth and Co. London, pp: 86.

Yakubu, A.F., F.D. Sikoki and J.R.M. Horsfall, 1998. An Investigation into the physico-chemical conditions and planktonic organisms of the lower reaches of the Nun River, Nigeria. J. Applied Sci. Env. Manag., 1: 38-41.

Yoloye, V., 1976. The ecology of the bloody Cockle Anadara (*Senilia senilis* (L.). Bulletin d' I. I. F.A. N. T. 38, Sér. No. 1: 25-56.