Seasonal Trend in the Ecological Variables of a Tidal Creek in the Niger Delta, Nigeria

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ABSTRACT

A study was carried out in Ekpan Creek, Niger Delta area of Nigeria. The Niger Delta, an area drained by River Niger into the Atlantic Ocean, is situated in the southern coastal region of Nigeria.

The purpose of the study was to provide pioneer limnological information for the effective monitoring and management of the creek, coupled with filling the gap of the ostensibly gross neglect, in Africa, of studies of smaller waterbodies in general and rivers in particular. It also sought to ascertain the influence of season on the ecological variables. Climatically, two seasons prevail in the study area- wet season, May-October with a break in August - September; and dry season, November-April. Five study sampling stations were selected to cover respective ecological zones. Samples were collected monthly for fifteen months and analyzed for physical and chemical variables.

The ecological parameters were defined by season and space. There were distinct seasonal and spatial trends in most environmental variables. Temporal trend showed significant difference in monthly readings. Parameters like total solids, total dissolved solids, salinity, conductivity, Na, K and Cl showed bimodal pattern, exhibiting dry season maxima and rainy season minima while others-temperature, pH, SO_4 PO_3, NO_3, SiO_3 and dissolved oxygen fluctuated greatly. The creek was essentially slightly acidic to slightly basic, rich in nutrients, with an order Na > K >Mg > K for cations and Cl> SiO_3, > PO_3, > SO_4, > NO_3 for anions. Three categories of variables were observed- dry season maxima, wet season maxima and those with no discernible trend.

The study is novel as it has generated a hitherto absent comprehensive background limnological database useful for the management of the creek and a pertinent reference point against future environmental impact e.g eutrophication, pollution in the Niger Delta. Such information is of immense benefit in fisheries, recreation, tourism and water use.

KEYWORDS:Tropics, Niger Delta, Ecology, Tidal. Nigeria, Seasonal

INTRODUCTION

The study was carried out in Ekpan Creek situated in the Eastern Niger Delta.

Niger Delta is the area/delta where River Niger enters the Atlantic Ocean in Nigeria. The Niger Delta is a geographically distinctive area in Nigeria and is very important economically as oil exploration which is the main stay of the country is done in the area. It is situated between latitude 3-9°E and longitude 4°3'- 7°20' N. This region harbors the world's third largest mangrove. Three types of swamps namely, non-tidal freshwater swamps, tidal freshwater swamps and mangrove swamps, exist in the region (Nwankwo 1996). The dominant aquatic vegetations are *Rhizophora mangle, Avecina arotischum, Laguncularia* and *Paspalum* (Nwankwo, 1996).

The climatic condition of the area is governed by two seasons-wet season (May –October) & dry season (November to April).

The Niger Delta area is very important for several reasons:

- It is one of the largest deltas in the world, covering an area of 70,000 km^2
- It comprises four ecological zones-coastal barrier islands, mangrove forests, freshwater swamps, and lowland rainforest.
- It harbors the world's third largest and Africa's largest contiguous mangrove Swamp Forest
- Its freshwater swamps (area 11,700 Km^2) is the most extensive in West and Central Africa (Moffat & Linden, 1995)
- It is endowed with immense natural resources, particularly crude oil which is the mainstay of Nigerian economy

STUDY AREA

EKPAN CREEK

- an anastomosing creek interconnecting and eventually emptying into the Atlantic Ocean.
- a tributary of the Warri River
- Located between latitudes 5˚ 30˝ - 5˚ 35˝ north of the equator and longitudes 5˚ 45˝ - 5˚ 46˝ east of the Greenwich Meridian.
- Width = 0.2 – 1Km. Widest region empties into Warri River.
- Depth = 1-12 m
- Length = 15 kilometers
- is subjected to tidal action with about 80% of its length fringing with tropical mangrove swamp.
- Sediment consists of mud, sand and detritus from plants and animals.
- Effluent from the Nigeria National Petroleum Company housing complex Ekpan, Chevron-Texaco production company (western division complex), Shell Petroleum Development Company (SPDC) residential area at Edjeba as well as the western part of Effurun – Warri metropolis empty into the creek. The Ekpan creek drains into Tori creek at the NNPC jetty. The Tori creek in turn empties into the Warri River by Bennett Island.
- 5 study stations (Fig. 1): Station 1(1.5m deep) is located near the source, station 2(4m deep) in Ogboroke town, commonly called Ijaw town, station 3 (5.75m deep), is located between Ogoroke town and Ekpan town, station 4 (9m deep) by Chevron, Texaco Companies and station 5 (12m deep) located by Warri Refinery and Dewoo oil Company.

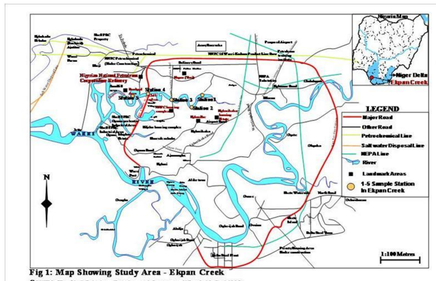

Fig 1: Map Showing Study Area - Ekpan Creek

SOURCE: The Shell Petroleum Development Company of Nigeria Limited 1980

OBJECTIVES

The objectives of the study were as follows:

- Investigate the abiotic factors-physical and chemical conditions in the Ekpan creek.
- Provide baseline data/ pioneer limnological information for effective monitoring of the creek event of future environmental impact.
- Check portability of creek as a source of drinking water supply

The reasons for the study area include the fact that:

- Rivers generally have received less attention than lakes
- Smaller water bodies have often been neglected in limnological investigations (John, 1986)
- The creek has not received any limnological investigation
- The creek serves as a source of water for domestic activities, farming and transportation for inhabitants in its vicinity

RESULTS

Tropical Temperatures

– Minimal variations between season, remarkably small (CV= 5.34% for air temp) and (CV= 4.06% for water)

Air- 25-30°C; Water 26-31 °C

Distinct seasonal (Temporal) & Spatial variation

Temporal Variation

Bimodal pattern (Dry season maxima & Rainy season minima)

-Total solids, Total dissolved solids, Salinity, Conductivity, Na, K -Cl

Rainy season Maxima

Color, Turbidity, Suspended Solids, SO_4 , DO saturation

Dry Season Maxima (but with no distinct bimodal pattern):

BOD, Mg, Ca, Total Hardness

No discernible seasonal pattern

Temperature (though with low values recorded in rainy season)

pH,PO_4,NO_3, SiO_3, Total Alkalinity

Spatial Trend

Gradient of increasing values from station 1 consistently to station 5 in:

Total solids, Total dissolved Solids, Conductivity, Salinity, Cl, Na, K, DO saturation

Dissolved Oxygen

Dissolved oxygen from under-saturation (6.41%) to super-saturation (≤254%) in June at all stations and some stations in other months

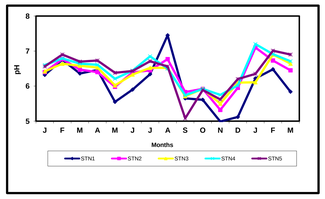

Fig. 2. Temporal & Spatial Trends in the pH of Ekpan Creek

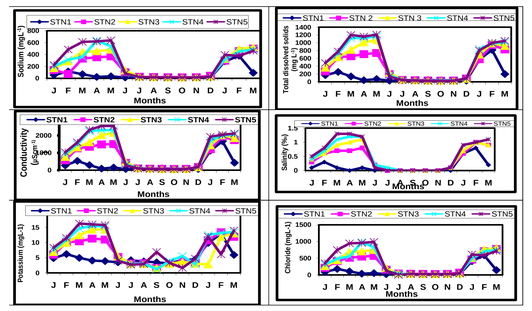

Fig. 3. Temporal & Spatial Trends in Some Chemical Variables of Ekpan Creek

DISCUSSION

Seasonality of the ecological variables is influenced by rainfall. The study area is in the dense rainforest zone of Nigeria with abundant rainfall (~398.3mm).

Rainy season maximum of color, turbidity & suspended solids is explained by the influx of storm water from drainage area carrying silt, debris, humic substance and other color producing substances like iron, manganese. On the contrary, rainy season minima are ascribed to diluting effect of rain. Other variables with rainy season maxima are a consequence of increased precipitation with concomitant increased storm water input into the creek whereas the dry season maxima could be due to low precipitation, coupled with evaporation from the creek thereby producing high concentration within a limited creek water volume as well as higher temperatures (Kadiri, 2000). Maximum BOD values in the dry season is attributable to more organic matter decomposition during this period (Chhetry & Pal, 2011), a phenomenon typical of tropical environments with high temperatures especially during the dry season.

The systematic spatial gradient of increasing values in certain variables from station 1 to station 5 is ascribed to the progressive nearness to the sea. Station 1 is close to the source of the creek while Station 5 is towards and relatively closest to the Atlantic Ocean. The spatial differences are a reflection of the different eco-zones in the study area, with tidal effect at play. This is particularly true of the distinct spatial trend in conductivity, salinity, Cl, Na, K and total dissolved solids.

A comparison of the values obtained for Ekpan Creek reveals that its values were above the permissible values of WHO in color, turbidity and chloride. Though the overall mean of conductivity was lower, most of the conductivity values of the creek, especially in the dry season were above WHO limits.

CONCLUSION

- The creek exhibited spatio-temporal variation. Seasonal variation was evident in ecological variables (total solids, total dissolved solids, salinity, conductivity, Na, Cl, & K) displaying bimodal pattern of dry season maxima and wet season minima.
- Data exceeded WHO drinking water guidelines in color, turbidity, chloride and conductivity.
- Simple water treatment techniques (boiling, clarification & sedimentation) before use is suggested.
- Baseline data established against monitoring of future pollution or eutrophication .
- Continuous pollution monitoring program for the creek for effective management of creek is suggested.

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