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Preliminary Chemical and Biological Assessment of Ogbe Creek, Lagos, Nigeria

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Abstract

The study was aimed at assessing the quality of water from the Ogbe Creek during the months of flooding (September- December 2001) and its implications for the health of the inhabitants of the densely-populated city of Lagos, Nigeria. The hydrochemistry of the creek was strongly influenced by the seasonal flooding. The surface water of the creek was characterized by high total dissolved solids (> 200 mg/l), Biological oxygen demand (> 50 mg/l) and alkalinity (> 250 mg/l). Low values of Dissolved oxygen (< 5.0 mg/l) and transparency (< 18 cm) were also recorded. The levels of the nutrient elements $P0^{3-}$ (> 2.00 mg/l) and NO_3- (> 5.0 mg/l) were moderately high, suggesting organic pollution and nutrient enrichment of the creek. A high concentration of heavy metal salts such as Fe (> 50 mg/l), Na (> 135 mg/l) and K (> 30 mg/l) reflected the impact of domestic and industrial waste on the creek. One thousand and seventy three phytoplankton comprising 15 species and 106 zooplankton made up of 14 species were collected from the creek, mostly pollution tolerant species. Toxic plankton such as *Oscillatoria* which produces anatoxin, an alkaloid, *Microcystis aeruginosa* which produces an acutely lethal hepatotoxin called microcystin and *Epistylus* were harvested within the creek. The macro benthos harvested consisted of 123 invertebrates comprising four pollution tolerant taxa, *Erpobdella*, *Chironomus*, *Eristalis* and *Brachydeutera*. The low plankton and macro benthos diversity further indicated the impact of the perturbational stress on the organisms inhabiting the creek. Monitoring and evaluation of the creek, and education on health measures and hygiene are, therefore, essential.

Introduction

Maintaining the quality and quantity of aquatic resources is an increasing challenge because of the continued growth of the world's population. Rivers, streams, creeks, lakes and even oceans are becoming polluted at an alarming rate, making clean potable water a scarce resource and endangering aquatic ecosystems, many of which provides economically valuable food resources.

Creeks are valuable part of the aquatic resources serving as feeder rivers, providing flood control, storm water drainage, and habitat to wildlife, creating neighborhood beauty and improving quality of life.

In developing countries, there has been a systematic loss of creeks to overuse, pollution, diversion or filling. In Nigeria, currently, there is a dearth of information on the community structure and effects of pollutants on the macro benthic communities of creeks except the investigations of Chukwu & Nwanko (2004) on the impact of land based pollution on the Porto Novo creek.

The paper shows the results of a short term chemical and biological assessment of Ogbe creek, a tropical West African creek, with a view to evolving management and conservation strategies for such aquatic bodies.

Materials and methods

Study area

Ogbe creek is found on the coast of south-west Nigeria on the University of Lagos, campus, (6° 30° N and longitudes 3° 29' E), covering a total area of 77410.8 $m^{2.}$ It is a sluggish nontidal, eutrophic body of water that drains into the Lagos lagoon. (Nwankwo & Akinsoji, 1988). The creek harbours many aquatic plants such as *Ipomea aquatica*, *Pistia stratiotes*,(Araceae), *Azolla pinnata* (Azollaceae), *Diplazium sammatii* (Athyriaceae), *Eclipa alba* (Asteraceae) and *Cyperus difformis* (Cyperacea). Owing to seasonal distribution of rainfall, the creek experiences seasonal flooding which introduces a lot of detritus and pollutants from the land. The creek presently

serves as a major drainage channel receiving domestic wastes as well as industrial effluents from industries in the area.

The study was carried out from the 8th September to 22nd December 2001, corresponding with high water levels and peak flooding in the creek.
The hydrochemistry of the lake was investigated on a fortnight basis and para-meters such as temperature, transparency, *p*H, conductivity, salinity, dissolved oxygen, oil and grease, total dissolved solids, alkalinity, biological oxygen demand, nitrate and phosphates, heavy metal content of (Pb, Fe, Na and K) were determined (APHA, 1985).

Plankton samples were collected using standard plankton net of 55 µm mesh size. The plankton count was carried out using a 1 ml Sedgwick rafter counting cell. The rafter cell was placed under the microscope and 50 cells were chosen randomly for analysis and estimation. The different plankton species in each cell were identified (Ward & Whipple, 1950; Needham & Needham, 1962).

Soil samples were collected using a Vanveen Grab and the sediments sieved with a 0.5-mm mesh size sieve. The sediments were sorted and the invertebrates handpicked by forceps, preserved in 4% formalin and identified (Quigley, 1977). The species richness of the invertebrates was estimated according to Margalef (1951).

Results and discussion

The hydrochemistry of the creek is as shown in Fig 1. The surface water of the creek was characterized by high total dissolved solids (> 200 mg/l), biological oxygen demand (> 50 mg/l) and alkalinity (> 250 mg/l) and low values of dissolved oxygen (< 5.0 mg/l) and transparency (< 18 cm).This physico-chemical regime is an indication of the deteriorating water quality of the creek due to the impact of heavy rains on the creek. Webb (1960) pointed out that rainfall in the tropics is more important than temperature in determining environments.

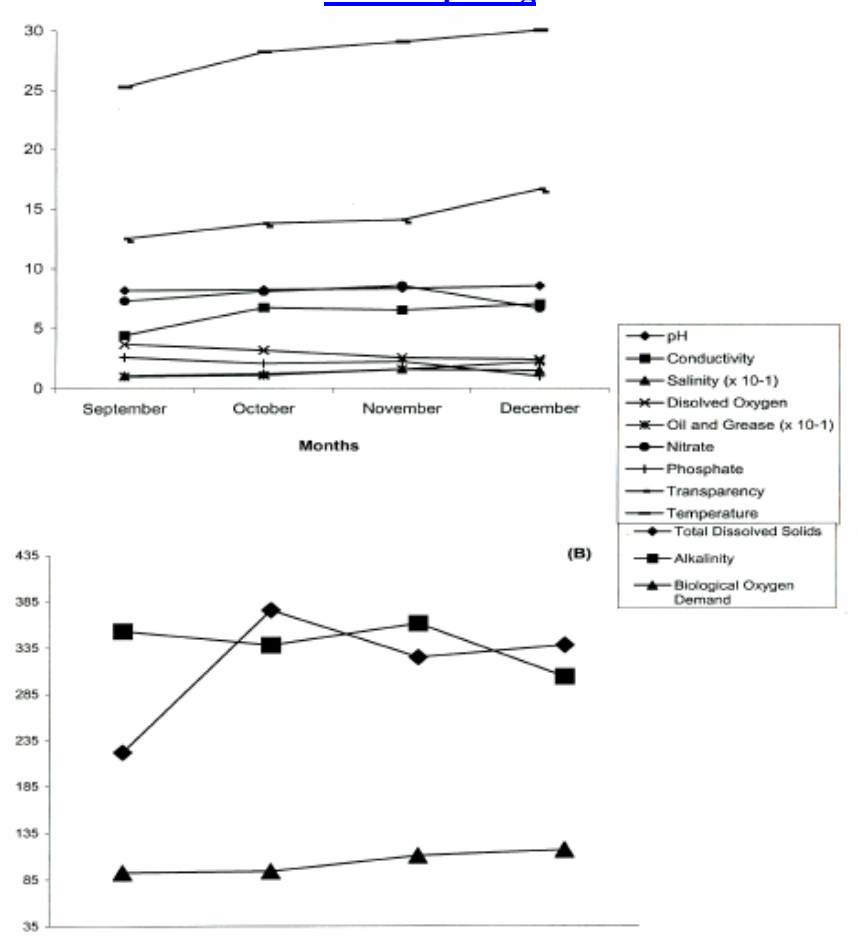

Fig. 1. Physico-chemical parameters of Ogbe Creek, Lagos, Nigeria

Similarly, Olaniyan (1957), Hill & Webb (1958) and Nwankwo (1984) implicated two physiographic factors, rainfall and salinity, as determining the hydro-climate of the coastal lagoons of south-western Nigeria. Rains cause flooding which then resulted in the transport of nutrient detritus, and industrial and domestic wastes into the creek. The high BOD and low dissolved oxygen recorded in this study could be due to the bacterial degradation of the organic load mainly from biodegradable wastes which drain into the creek.

The levels of the nutrient elements, PO_4^- and NO_3^- were moderately high, suggesting organic pollution and nutrient enrichment of the creek. A high concentration of heavy metal salts such as Fe (> 50 mg/l), Na (> 135 mg/l) and K (> 30 mg/l) was observed in the creek (Fig. 2). Similar concentrations of Zn, Cu, Pb, Fe, Ni, Co were observed in the Lagos lagoon (Don-Pedro *et al.*, 2004). This high concentration of metal salts is as a result of pollution from industrial and domestic wastes. The biological significance of this is the disruption of the delicate ecological balance of the ecosystem, a reduction in population of organisms, and a subsequent loss of the already depleted biodiversity of the creek.

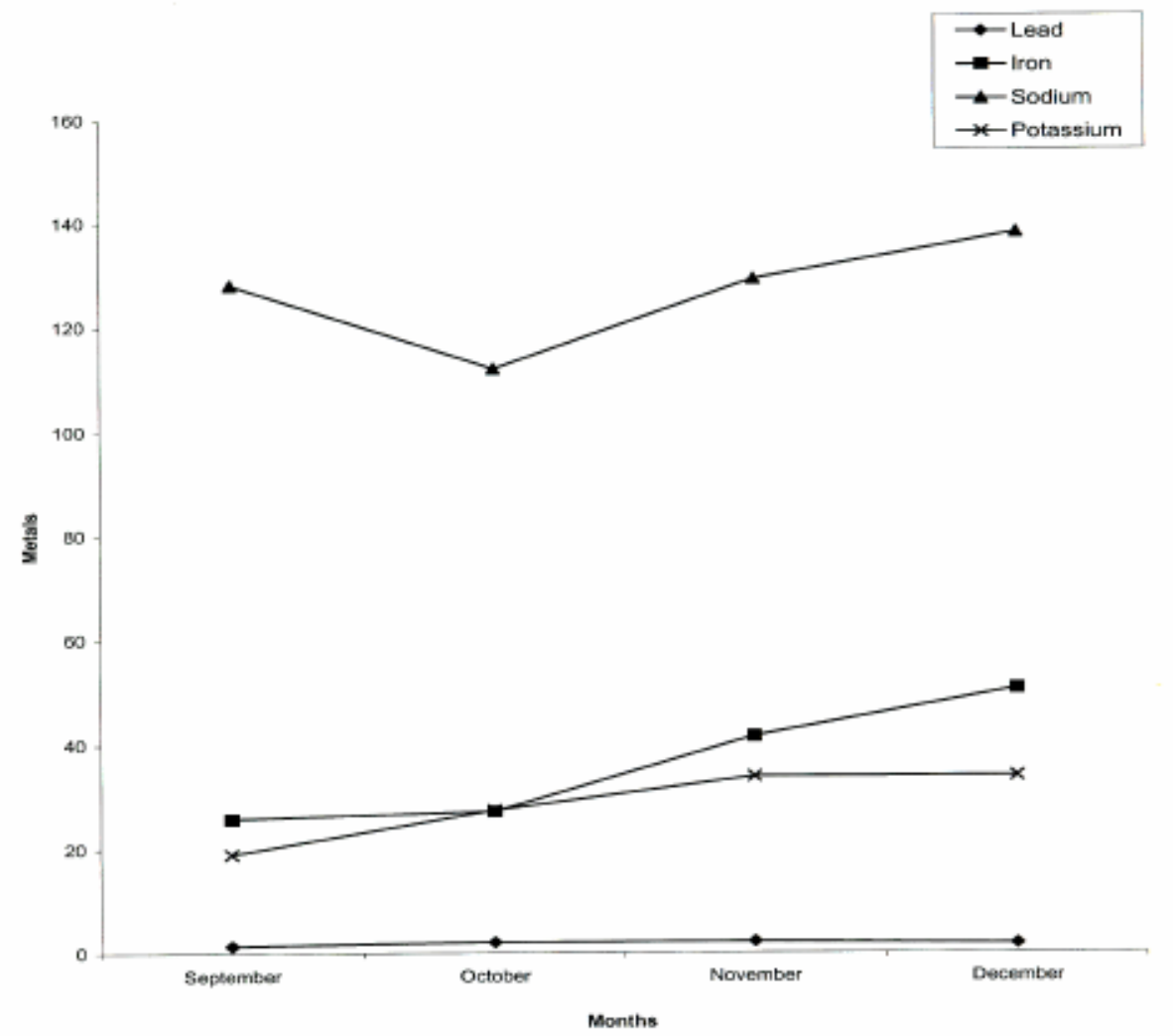

Fig. 2. Trace metal analysis of Ogbe Creek, Lagos, Nigeria

Low plankton diversity was recorded in the creek. The total number of phytoplankton species was 1073 individuals comprising 15 species (Fig. 3) and the total number of zooplankton obtained comprising of 106 individuals made up of 14 species. (Fig. 4). The low plankton species diversity of the creek is an indication of the impact of perturbation stress on the floating community of the creek. Ecological surveys using algae as indicator organisms are commonplace (Patrick, 1973; Klan, 1989). This is further confirmed by the assemblage of plankton that characterized the creek, most of which are pollution-tolerant species.

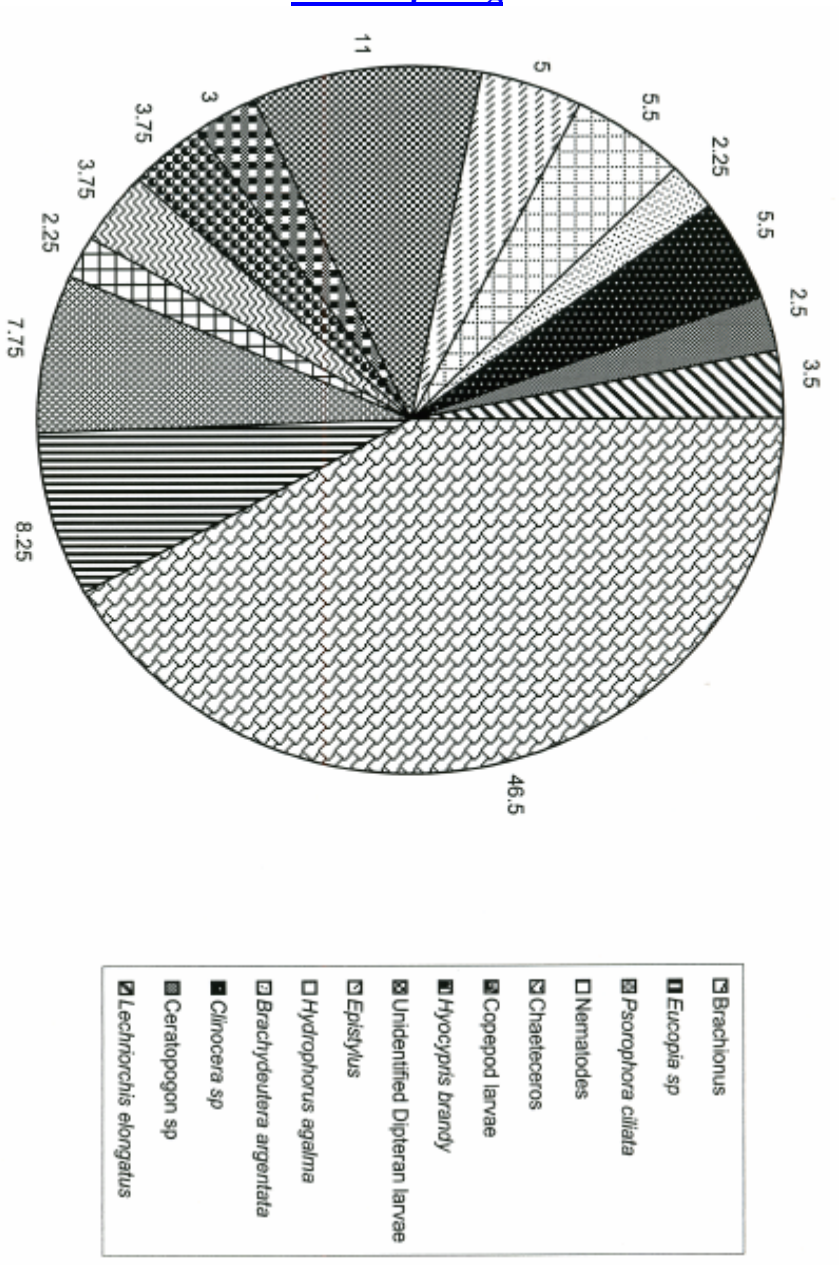

Fig. 3. Phytoplankton numbers in Ogbe Creek, Legos, Nigeria

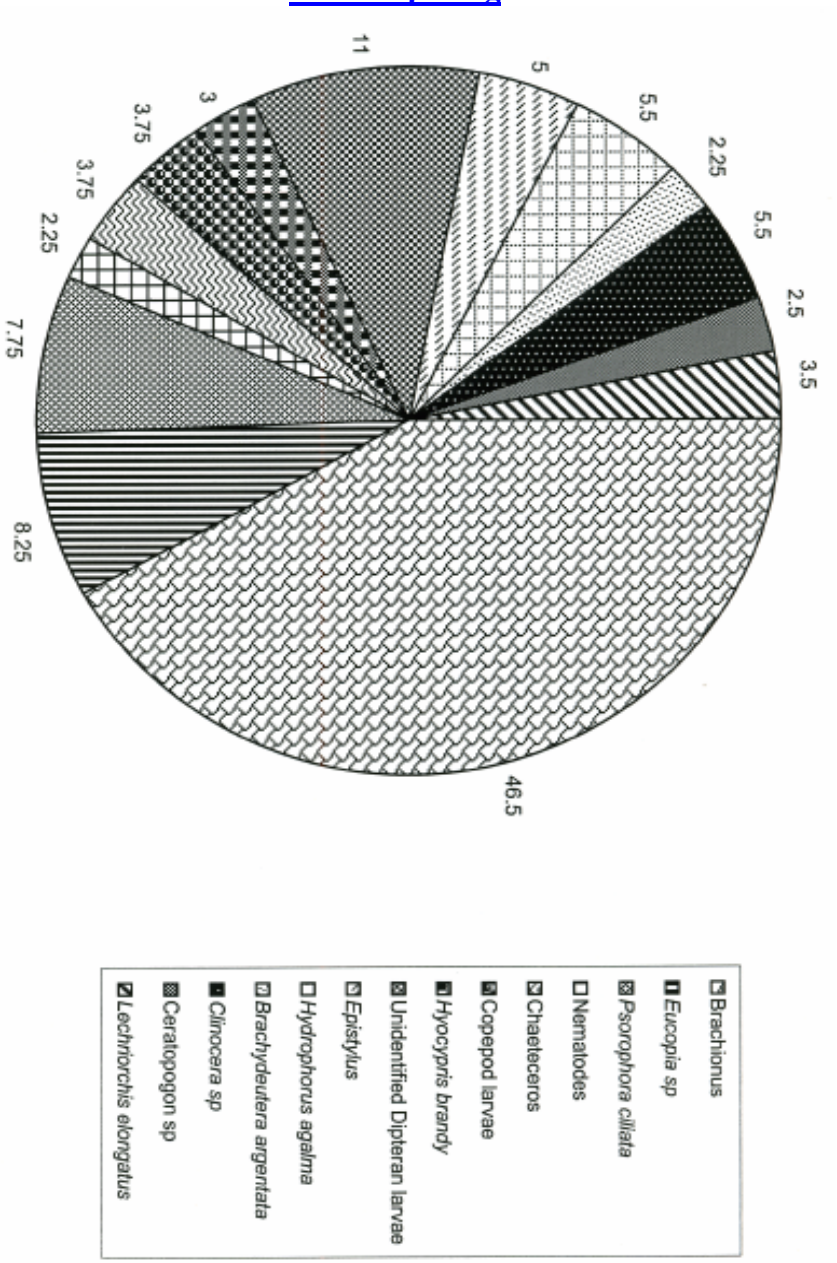

Fig. 4. Zooplankton numbers in Ogbe Creek, Lagos, Nigeria

The dominant phytoplankton species genera were *Oscillatoria, Anabaena, Bacillaria* and *Nitzschia.* (Fig. 5). Toxic phytoplankton species such as *Microcystis aeruginosa* and *Enteromorphia filiformis* were also represented. *M. aeruginosa* is known to produce a rapidly-acting and acutely-lethal hepatotoxin called microcystin which adversely affect domestic animals, fish and human being (Carmichael, 1995). Oscillatoria produces a neurotoxic alkaloid called anatoxin which is a post-synaptic neuromuscular blocking agent causing death by respiratory failure (Falconer, 1999). Since conventional water treatment techniques such as coagulation, sedimentation and filtration are only partly effective for removing cyanotoxins, it is necessary to monitor their presence in water bodies.

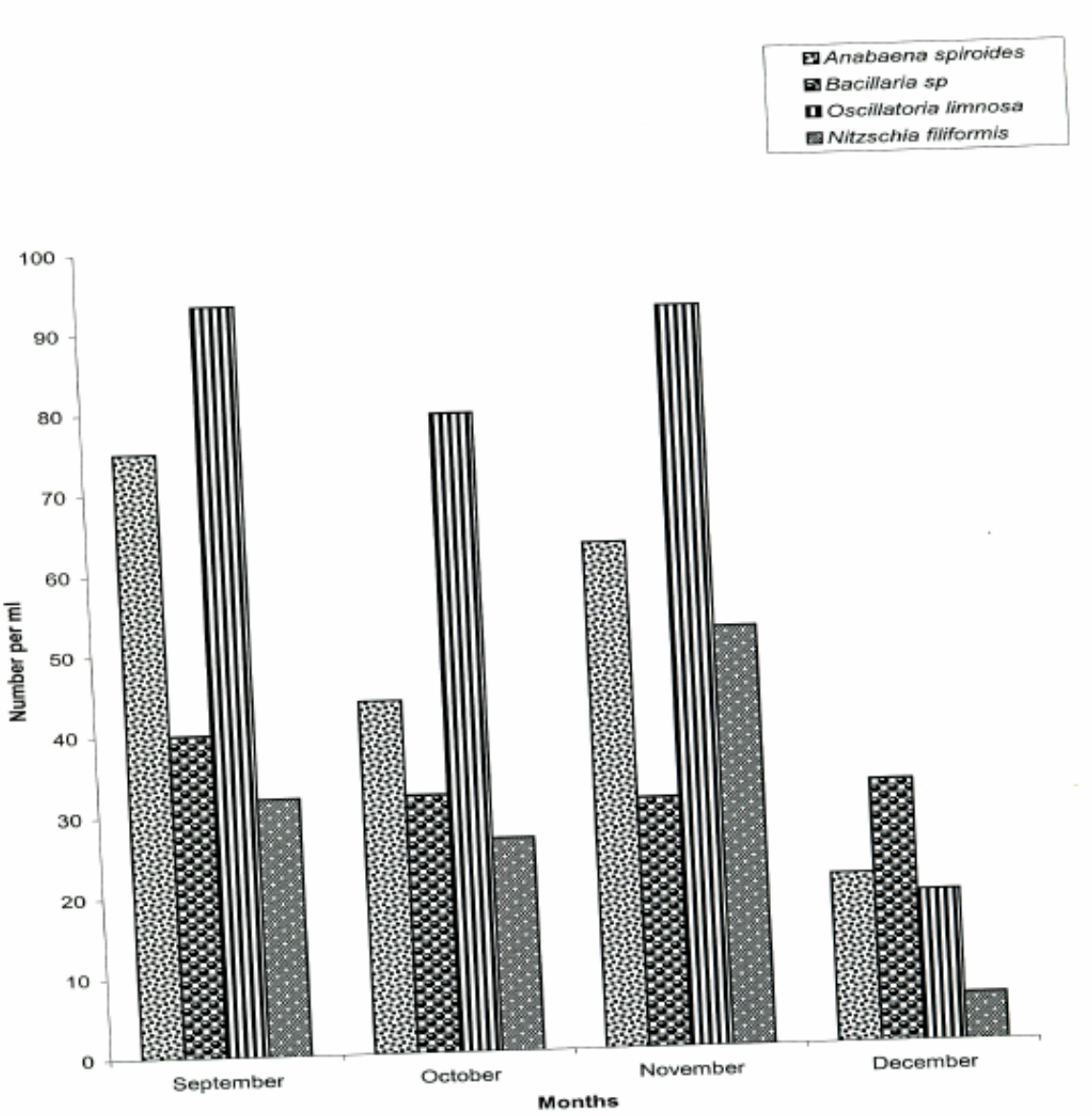

Fig. 5. Major phytoplankton species in Ogbe Creek, Lagos, Nigeria

Brachionus, *Psorophora* and *Eucopia* were the most dominant zooplankton (Fig. 6), while other toxic zooplankton such as *Epistylus* were also sampled regularly in the creek in small numbers. By virtue of their passive mobility, plankton has been known to integrate environmental changes in physical, chemical and ecological characteristics of their habitat over time and space. They also play a key role in bio-accumulation and transfer of contaminants to higher trophic levels in aquatic food webs (Kelly and Whitton, 1989). They are, thus, attractive agents in monitoring water quality (Oduwole,1990; Nwankwo, 1994).

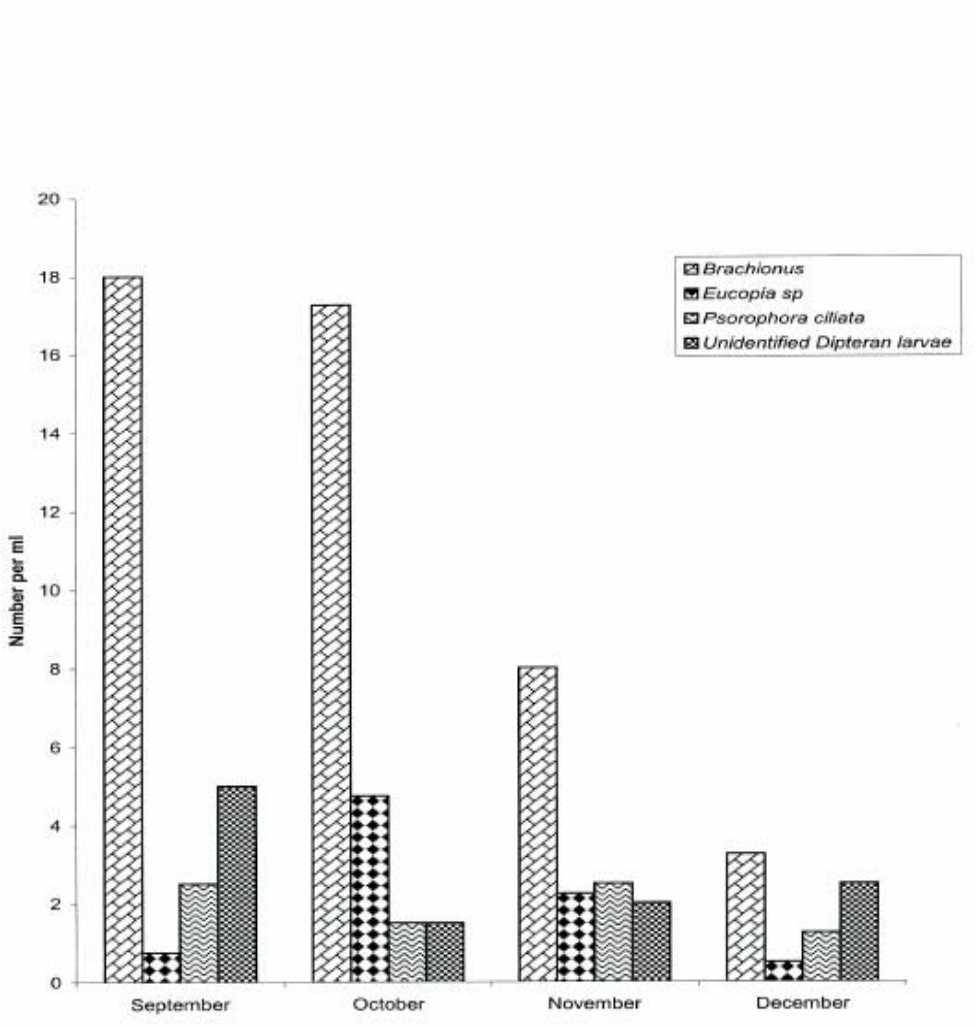

Fig. 6. Major zooplankton species in Ogbe Creek, Lagos, Nigerai

One hundred and twenty three invertebrates comprising of four taxa were collected (Table 1). The low number of macro benthos recorded, the absence of sensitive species and presence of only tolerant species such as *Erpobdella*, *Chironomus*, *Eristalis*, and *Brachydeutera* also served to confirm that the creek was organically polluted.

TABLE 1

Macrobenthic faunal abundance and composition in Ogbe Creek, Lagos, Nigeria

	Taxa	*Months*				*Total of individuals*	*Sept.*	*Oct.*	*Nov.* *Dec.*
1	Family Erpobdellidae								
		Erpobdella sp	03	05	04	04	16		
2	Family Chironomidae								
		Chironomus sp	10	07	09	06	32		

3 Family Syrphidae						
	Eristalis sp	05	08	09	09	31
4 Family Ephydridae						
	Brachydeutera sp	09	09	13	13	44
	Total number of individuals	27	29	35	32	123

Margalef's Index (d) = 1.44
Biotic Index = 2.00

A Margalef' species richness (d) of 1.44 was obtained indicating a low diversity of macro benthos in the creek. The low species richness (d), may be a further indication of the impact of the perturbation stress on the macro-invertebrate benthic communities. The biotic index (DePauw & Vanhooren (1983) obtained for the creek was 2.00, which categorized the creek as very heavily polluted. Since smaller water bodies are more susceptible to human impacts, these systems require close monitoring and evaluation.

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