The Zoologist Vol. 7: 213-218 (2009)

THE POPULATION DYNAMICS OF THE *PROROCENTRACEAE, GONYAULACACEAE PERIDINIACEAE, EUGLENOPHYCEAE AND CERATIACEAE,* IN A LAGOON BORDERING HEAVY INDUSTRY IN LAGOS STATE, NIGERIA

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Abstract
An investigation into the dynamics of Protozoan populations in Ologe lagoon was carried out for a period of 24 months. It covered identification, diversity and elucidating the influence of some physical and chemical parameters on temporal abundance and spatial distribution of the Protozoa. Four villages around the lagoon were sampled using standard techniques. Data obtained were statistically analyzed using linear regression and hierarchical clustering. Five protozoan populations were identified. The Pearson's correlation coefficient showed that positive correlation occurred between the protozoa and Salinity (r = 0.043) and with surface water dissolved oxygen (r = 0.300). The correlations were positive with NO3-N at Ibiye (Rsq =0.022) and Gbanko (Rsq =0.013), PO4-P at Ibiye (Rsq =0.258), K at Idoluwo (Rsq =0.295) and SO_4-S at Oto (Rsq = 0.945) and Gbanko (Rsq = 0.456). The most dominant species was Phacus (29%) followed by Prorocentrum sigmoides (14.2%). The protozoan populations in Ologe lagoon, were patchy in spatial distribution, undergo seasonal perturbations and were highly influenced by nutrient inputs from Agbara industrial estate and surrounding farmlands.

Introduction

Ologe lagoon is of great socio-economic importance (aquaculture, fishing, sand dredging and drainage) to the various towns and villages bordering it, especially, as it drains river Owo, into which partially treated/untreated effluents from the Agbara industrial state is discharged. The effluents of these factories/industries are discharged into Ologe Lagoon all-year round after some treatments. It is therefore of great economic importance not only to Lagos State and Nigeria but to the entire coastal countries of West Africa as ecological catastrophes occurring upstream, could have grievous consequences down stream, (through bioaccumulation of chemicals in aquatic organism in the upper echelon of the food chain) if not checked.

This study is aimed at elucidating seasonal fluctuations of ecological parameters in ologe lagoon and to establish the distribution pattern, abundance and seasonal variations in the total protozoan populations, relating to prevailing abiotic factors.

Materials and Method

A GPS model - 12 was used to mark the 11 sample stations, such that samples were collected from exactly the same locations on all sampling days and to measure the inter-station distances and altitude above sea level. Sub-surface water samples were collected from January, 2001 to December 2002 for physical, chemical and

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phytoplankton analysis. The sampling density was for one sample in an average of 1.44km-9.28 km along transects designed to cover the whole lagoon system including portions relatively unaffected by human activity. Salinity, conductivity and surface water dissolved oxygen concentration were analyzed using the Horiba U 10 water quality checker, in-situ bottom water dissolved oxygen concentration and bottom water temperature were analyzed using the YSI model 7 dissolved oxygen / temperature meter. Other physical parameters were measured in-situ according to standard methods (APHA, 1980)1, using a mercury-in-glass thermometer for air and surface water temperature and a sechi disc for transparency. A standard phytoplankton net (55um mesh size) was hand-dragged from a motorized canoe for ten minutes at each sampling station to concentrate sub-surface plankton. Collected samples were fixed and preserved, using 4% formalin. Enumeration was done per unit area of the floor of a Sedgwick rafter counting chamber while the identification was done using the taxonomic keys by Chapman et al, 1981and Marshall et al, 1982.

Data obtained were analyzed using:

(a) Linear regression to decipher the relationship between plankton population flush/crash, physical and chemical parameters and nutrient imputes in to Ologe lagoon.

(b) Absolute correlation between vectors of values of the individual organisms was done using the Pearson methods, to produce a proximity matrix

Results

The Protozoan Abundance and Distribution

Some physical and chemical features and protozoan species of Ologe lagoon were studied for a period of 24 months. The spatial and seasonal variations of the mean annual air (29.6), surface water (28.5) and bottom water temperature revealed an ecotonal difference at sample station 4 (Oto bridge). The annual mean secchi disc transparency was 0.62m with a minimum of 0.2m at station 10 in December and a maximum of 1.5m at sample station 4 in august. Salinity ranged between 0.05ppm and 0.6ppm with an average measure of 0.17ppm. The range of the Surface water dissolved oxygen is between 2.0 mgl^{-1} to 8.2 mgl-1 with a mean of 5.6 mgl-1 while the bottom water dissolved oxygen ranged between 1.0 mgl^{-1} to 5.8 mgl^{-1} and a mean of 4.44 mgl^{-1} .The power of hydrogen (pH) had a minimum of 4.8 and a maximum of 8.5 with a mean of 6.8. The average measure of conductivity was 632.7 mhoms / cm^2 while the range was between 124 mhoms / cm^2 and 1656 mhoms / cm^2.

Members of the phylum protozoa displayed a heavy spatial preponderance throughout the period of study in the lagoon. Most of the protozoons were abundant for most part of the period of study, except for Ceratium sp., which was a rainy season ephemeral (Figure 1).

Twenty different protozoan species were observed belonging to five different families. The families included Prorocentraceae (*Prorocentrum sigmoides* - 14.2%, *P. micans* - 7.2%, P. *rostratum* - 2%, and P. lima - 10.2%), *Gonyaulacaceae* (*Gonyaulax sp.* 3%), Peridiniaceae (*Peridinium sp.* 6.8%), Ceratiaceae (*Ceratium sp* 8.4 %.) and Euglenophyceae (Phacus sp. 29% and *Chilomonas sp*.8.2%).

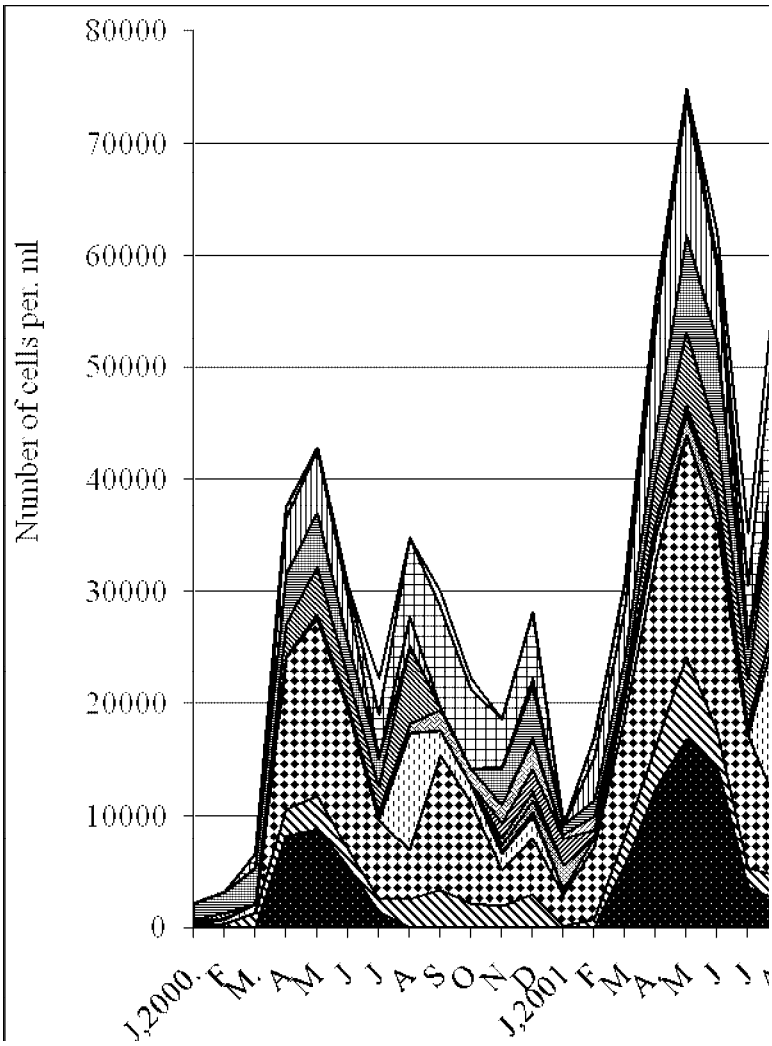

Figure 1. Seasonal variation in the population of protozoans in Ologe lagoon within the period of study.

The person's correlation coefficient ("r" values) between total population of Protozoon's and some physical and chemical parameters showed negative correlations for transparency (-0.067), air temperature (-0.345), surface water temperature (-0.242), bottom water dissolved oxygen (-0.094),. Depth (-0.004), pH (-0.324), conductivity (-0.111) and rainfall (-0.024) with a high level of significance for transparency (0.754), bottom water dissolved oxygen (0.662), conductivity (0.606), and rainfall (0.945) positively correlated with the total population included, Salinity (r = 0.042) with high level of significance (0.842) and surface water dissolved oxygen (r = 0.300) with low level of significance (0.155).

Partial Regressopm Plot

Linear regression plots further showed that the total population of the protozoa were mainly influenced, and only increased with an increase in the value of surface water temperature and conductivity. The total protozoan population had a near neutral (zero correlation) with the surface water dissolved oxygen (SDO) and therefore does not significantly vary with a change in the level of SDO. The plots showed positive significant relationships between total protozoan population and nitrate-nitrogen (NO_3-N) at Ibiye and Gbanko (Table 1).

Table 1. Showing the relationship (Rsq values) between the total protozoan population and NO_3-N, PO_4-P, K and SO_4-S at Idoluwo, Oto, Ibiye and Gbanko representing Upstream, Midstream and Downstream sectors of Ologe lagoon within the period of study.

Total Protozoan Population/Nutrient Correlations	IDOLUWO	OTO	IBIYE	GBANKO
(NO_3- N)	-ve(Rsq = - 0.0521)	0.0003	+ve (Rsq= 0.0216)	+ve (Rsq = 0.0133
(PO_4- P)	-ve (Rsq= - 0.1317)	0.0001	+ve (Rsq= 0.2582)	-ve (Rsq = - 0.0225)
(K)	+ve (Rsq= - 0.2952)	-ve (Rsq= - 0.1578)	-ve (Rsq= - 0.0033)	-ve (Rsq= - 0.0784)
(SO_4- S)	-ve (Rsq= - 0.2108)	+ve (Rsq= 0.0945)	-ve (Rsq= - 0.3495)	+ve (Rsq= -0.45666)

Discussion

The highly concentrated assemblage of Protozoa showed high densities and diversity but short duration of occurrence, which is most likely a result of perturbations from the nutrient containing-effluents discharged into the lagoon.

Kemp et al (2001) also buttressed the nutrient-supply/ increase-in-biomass-hypothesis in their work on Nutrient enrichment, habitat variability and trophic transfer efficiency in simple models of pelagic ecosystems. Their simulation experiments revealed that trophic transfer

efficiency (TTE = zooplankton growth per unit phytoplankton production) tends to be enhanced with increased variability of resources, particularly at low nutrient levels. Numerical and analytical studies also showed that, regardless of resource variability, these model formulations produce a trend of initial enhancement of trophic efficiency with increasing nutrient levels, followed by a marked reduction in efficiency beginning at moderately eutrophic conditions. This precipitous drop in trophic efficiency is attributable to a saturation of the ability of zooplankton to utilize the increased primary production associated with nutrient enrichment. Under these conditions, an increasing fraction of the primary production is shunted to microbial food chains and associated respiratory losses. The steepness of this reduction in trophic efficiency with nutrient enrichment is related to the strength of predation (or disease) control at upper trophic levels. Model formulations simulating more intense top-down control (i.e. increasing mortality rates with increasing zooplankton abundance) resulted in sharper declines in TTE with increasing nutrients. Kemp et al (2001) speculated that these model results may help to explain how observed reductions in relative fish yield (per unit primary production) in many shallow nutrient-enriched estuaries and lakes are related to interacting effects of cultural eutrophication and intense fisheries exploitation. Furthermore, they surmised that these relationships are robust characteristics of most existing aquatic ecosystem models. These situations agree with Lewis (1979) on zooplankton community analysis, Ovie (1987) and Ovie (1993) in his contributions to zooplankton community studies of some water bodies in Nigeria.

Conclusion

The results herein, show that Ologe lagoon is a tropical, shallow, eutrophic and predominantly fresh water aquatic habitat with salinity increasing downstream. The lagoon is endowed with a broad diversity of protozoan species which showed patchiness in spatial distribution. It under-goes seasonal perturbations which were made manifest by the sigmoid and irruptive distribution of the protozoan species. The diverse protozoan populations were highly influenced by nutrient inputs from the Agbara industrial estates and surrounding farm lands and The most significant nutrient imputes into the lagoon are dissolved inorganic nitrates, sulphates, phosphates and potassium.

Acknowledgment

This project was sponsored by the Ford Foundation in collaboration with LASU/CDDS

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