Dynamics of Zooplankton of Azuabie Creek in the Upper Bonny Estuary of the Niger Delta

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Abstract: The dynamics of zooplankton community of Azuabie Creek in the Upper Bonny Estuary of the Niger Delta was studied over a one-year period from April 2006 to March 2007. Ten sites which included locations with sources of human and industrial pollutant inputs and relatively uncontaminated control points along the creek were chosen for the study. Water and plankton samples were collected monthly from each station using standard methods, followed by laboratory analyses. A total of 35 species of zooplankton belonging to eight major taxonomical groups were recorded during the study periods. Out of the total number, 20 species representing 57.14% belonged to the class copepoda; 2 species (5.71%) represented the class euphausiaceae; 1 species (2.86%) represented class spionidae; 2 species (5.71%) belonged to the class protozoa; 4 species (11.43%) belonged to the class cladocera; 3 species (8.57%) belonged to the class insecta, 2 species (5.71%) belonged to cumacean while 1 species (2.86%) represented the class nematoda. In terms of abundance, the highest number of occurrence found was the class copepoda (88.95%), followed by cumacean (2.76%); cladocera (2.35%), protozoa (1.99%), spionidae (1.63%), insecta (1.28%); nematoda (0.76%) and euphausiid (0.26%). There were significant spatial and monthly (seasonal) differences (p<0.001), as well as interactions in the abundance of major zooplankton taxa. Community indices had significant differences between sampling locations and months, with the wet season months generally having higher species richness, diversity and evenness but lower dominance.

Keywords: Abundance, Bonny Estuary, diversity, dominance, Nigeria, plankton

INTRODUCTION

The economic development of many coastal regions depends on the quality and capacity of their water ways (Cruz-Motta and Collins, 2004). Owing to this, the ecological study of the Bonny Estuarine System due to increasing urbanization and industrialization is very vital. The Bonny Estuary is one of the richest estuaries in the Niger Delta aquatic ecosystem, with a network of creeks/tributaries linking various habitats of highly economic and ecological importance. The estuary is open with abundant composition of flora and fauna of unique biodiversity. The system is vulnerable to pollution by organic, industrial and chemical pollutants/wastes from several industries and human habitats located by the banks and water fronts and has been the subject of much research over the last two decades (Chindah et al., 1993; Ekweozor et al., 2004; Daka and Abby-Kalio, 1997; Inyag et al., 2006; Ekeh, 2005, Ikomah et al., 2005; Molson et al., 2005; Daka et al., 2007).

Plankton constitutes the primary producers of the aquatic food chain. Any variation in the water quality affects their abundance, species composition and diversity, stability, productivity and physiological condition. Therefore, an expression of the nature and health of the aquatic communities is an expression of the quality of the water. The plankton of the Upper Bonny Estuary have been the focus of studies by different authors (Chindah, 2003; Chindah and Pudo, 1991; Ogamba et al., 2005; Ekeh, 2005) but none of these covers the Azuabie creek. The Azuabie creek is located between latitude 7°3’ N, longitude 4°48’ E and latitude 7°1’ 30” N and longitude 4°52” in the upper Bonny Estuary, Southern Nigeria. The dominant vegetation along the banks of the creek are Nypa palm, Rhizophora sp, Avicinia sp and some water ferns. Azuabie village is a settlements along the river bank. The major abattoir in the city of Port Harcourt, Nigeria, is located by the bank of the creek; major production industries are also located by the bank of the creek and the effluents from a vegetable oil factory drain into the creek via a creeklet. This study therefore focused on the spatial and seasonal dynamics of the zooplankton community of Azuabie creek over a full year.

MATERIALS AND METHODS

Study sites: Ten sampling stations were located along the Azuabie Creek, to cover of land-based sources of
Fig. 1: Azuabie Creek showing locations of sampling stations. Inset -The Niger Delta showing location of the creek contaminant inputs into the creek as well as presumably uncontaminated locations (Fig. 1). The sampling stations and their geographical coordinates of these stations are as follows: Stations 1 (4°48'08.871"N, 7°04'15.763") and 2 (4°48'19.958"N, 7°03'46.932"E) were relatively away from any visible anthropogenic influence but stations 3 (4°48'28.591"N, 7°03'29.218"E), 4 (4°48'12.462"N, 7°03'16.906"E) and 5 (4°48'18.675"N, 7°03'25.946"E) were located along the creeklet that receives industrial effluents from Trans-Amadi Industrial drains in addition to a waste dump site that is close to station 3. Stations 6 (4°48'40.150"N, 7°03'28.370"E) and 7 (4°48'48.411"N, 7°03'30.411"E) were close to a domestic waste dumpsite and a pier latrine. Station 8 (4°48'52.041"N, 7°02'49.661"E) was close to a major abattoir and some industries while stations 9 (4°49'09.796"N, 7°02'50.446"E) and 10 (4°49'26.711"N, 7°02'44.237") were also close to domestic waste inputs upstream of the creek.

Sample collection and analyses: The sampling was done monthly for one year (April 2006 to March 2007) to determine spatial and temporal dynamics. In situ measurements were taken for fast-changing surface water parameters such as temperature, dissolved oxygen, total dissolved solids and conductivity. Water samples were also collected in appropriate containers
and transported to the laboratory for analysis using standard methods. Zooplankton was collected by sieving fifty liters of water through plankton net of mesh size 45 µm, after which the filtrate was transferred into a one liter open mouthed plastic container, fixed with 5% formalin and then taken to the laboratory for identification. At each station, five replicates were collected.

The zooplankton samples were kept to stand for a minimum of 24 h in the laboratory and supernatant decanted until a 50ml concentrated sample was achieved. The concentrated sample was mixed carefully by shaking and 1mL of the sub-sample was taken and transferred into a Bogorov counting chamber using a stampel pipette. Before enumeration and identification of the organisms under a binocular compound microscope with modifications of 40x and 100x, few drops of laboratory prepared lugols iodine were added for staining to aid the viewing process. Five replicates of the samples were analysed for each station. Results were expressed as number of organisms per mL. Identification plates from Barnes (1980), Durand and Lévesque (1980) and Newell and Newell (1963) were used as guides for the zooplankton identification.

![Fig. 2: Spatial differences in the abundance (mean±SD, n = 60) of zooplankton in the Azuabie Creek of the upper Bonny Estuary of the Niger Delta](image-url)
Two-way ANOVA with replicate was used for statistical analysis of zooplankton taxonomic groups. Where ANOVA result showed a significant difference, Bonferoni test were performed for mean separation. PRIMER (Plymouth Routines in Multivariate Experimental Research) and MINITAB (R14) was used to carry out the statistical analysis.

RESULTS AND DISCUSSION

A total of 35 species of zooplankton belonging to eight major taxonomical groups (Copepoda, euphausiaceae, nematoda, sionidae, cladocera, cumaceane, protozoa and insect) were recorded during the study periods (Table 1). Out of the total number, 20 species representing 57.14% belonged to the class
copepoda; 2 species (5.71%) represented the class euphausiacea; 1 species (2.86%) represented class spionidae; 2 species (5.71%) belonged to the class protozoa; 4 species (11.43%) belonged to the class cladocera; 3 species (8.57%) belonged to the class insecta, 2 species (5.71%) belonged to cumaceae while 1 species (2.86%) represented the class nematoda. The most common genera in the class copepoda were the Cyclops and Calanus; whilst the most common of the calanoid were Temora metridia and Macrosetella. In terms of abundance, the highest number of occurrence found was the class copepoda (88.95%), followed by cumacean (2.76%); cladocera (2.35%), protozoa (1.99%), spionidae (1.63%), insecta (1.28%); nematoda (0.76%) and euphausiid (0.26%).

The highest mean abundance of copepods was recorded at station 3 with the least value at station 8 (Fig. 2A). Insecta, nematode and spionidae also had the highest mean numbers at station 3, but the lowest values for these groups was obtained from station 5.
(Fig. 2B, G and H). Stations 7, 8, 9 and 10 had the highest abundances of cumacea, euphausiid, protozoan and cladocera respectively. ANOVA showed significant differences for all zooplankton groups between station and months as well as significant interactions (p<0.001, Table 2).

The mean density of copepods reached a peak in the rainy season month of September and the lowest was in the dry season month of December (Fig. 3A). Cladocera, euphausiid, insecta and nematoda were generally more abundant in the wet season months (April to October) than the dry season months (Fig. 3D, F, G and H). On the other hand, cumacea and protozoa had higher densities in the dry season months of November to March (Fig. 3B and E). Spionid abundances did not show appreciable monthly variations (Fig. 3B). There were significant differences between months (p<0.001) for all the zooplankton taxa (Table 2).

The 35 species of zooplankton (belonging to 8 taxonomical groups) recorded in this study was lower than the 62 species (from 13 taxonomic groups) reported by Ekeh (2005) for the Amadi creek. The zooplankton community was dominated by copepoda. This is in conformity with other studies carried out in the Niger Delta Waters (Environment Canada, 1996; Edoghotu, 1998; Ogamba et al., 2005). The entire area was dominated by copepoda (58.82%); cladocera (11.76%); insecta (8.82%); euphausiid (5.88%); cumacea (5.88%); nematoda, spionidae and protozoa 2.94% each. Low abundance, composition and diversity recorded in this study have been greatly affected by pollutant, as well as instability possibly arising from municipal and industrial waste input into the creek.

The community indices for zooplankton are shown Fig. 4 and 5. Marglel species richness index ranged from 0.78±0.46 at station 5 to 1.85±0.45 at station 9. Shannon Weiner diversity index and Pielou’s evenness measure had their highest values at Station 9 and lowest in station 1. The values of Simpson’s dominance index were broadly similar at stations 1, 4, 5 and 6 and these were higher than the other sites with an overall range of 0.59 to 0.83 (Fig. 4). The wet season months appear to have higher species richness, diversity and evenness but low dominance (Fig. 5). All the community indices for zooplankton showed significant difference both in space and time (p<0.001). The spatial and temporal variability in the zooplankton community indices agree with previously reported patterns by Environment Canada (1996), Edoghotu (1998) and Ogamba et al. (2005).

The relationships of zooplankton taxa with phytoplankton classes and water physico-chemical variables (Ekeh, 2010) were determined by calculating the product moment correlation coefficients (Table 3). Copepod had positive significant relationship with bacillariophyceae as well as pH, conductivity, TDS and BOD; negative significant relationship was also recorded with the same class and some heavy metals studied during the survey (Zn, Al and Cr). The class spionidae had positive significant relationship bacillariophyceae, cyanophyceae and NH3...Cladocera had a negative significant relationship with temperature, DO while positive significant relationship was recorded between salinity, NH3. Insecta showed a positive significant relationship with bacillariophyceae salinity, NH3 and negative correlation with DO. Nematoda also showed a positive significant relationship with bacillariophyceae but no significant relationship at all with any of the physicochemical parameters studied; while cumaceaen showed a negative significant relationship with cyanophyceae and positive significant relationship with DO. Euphausiidi, also showed positive significant relationship with turbidity, Cr, Fe and Zn while a negative significant relationship was also recorded with temperature. Positive and negative relationships were also recorded among the physicochemical parameters and the zooplankton.

In conclusion, the dynamics of the zooplankton community of the Azuabie creek is influenced by spatial differences in contaminant inputs from human and industrial activities in its catchment as well as...
Fig. 4: Spatial variation of zooplankton community indices in Azuabie Creek, upper Bonny Estuary

Fig. 5: Seasonal variation of zooplankton community indices in Azuabie Creek, upper Bonny Estuary
natural variations in the physicochemical along the upstream-downstream gradient. Seasonal differences in run-off inputs due to precipitation and phytoplankton abundances also had effects on the zooplankton community.

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REFERENCES


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