INTERNATIONAL JOURNAL OF NATURAL AND APPLIED SCIENCES (IJNAS), VOL. 4, NOS.1& 2 (2009); P. 32 – 43, 5 TABLES, 5 FIGS.

Influence of environmental variables on meiofaunal nematode communities of the inner continental shelf waters of the Gulf of Guinea, S. E. Nigeria.

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ABSTRACT

The major features of meiofaunal nematode assemblages are described for 12 locations in the inner continental shelf region of the Gulf of Guinea. (S. E. Nigeria). Dominant species within communities were identified in relation to environmental variables and possible anthropogenic activities.. Nematode assemblages showed characteristic patterns that revealed a high spatial stability of distribution in terms of species composition. Density and specie richness increased significantly with reducing median particle diameter of sediment, water depth and mobility of faunal group. Similarity of faunal species was observed in locations with similar water depth, sorting coefficients and sediment type. Acute effects of oil and gas activities on nematode in the study region seems unlikely

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INTRODUCTION

Although considerable progress has been made in describing structural aspects of the biological communities of off-shore demersal ecosystems in the world oceans, very little or nothing has been achieved for the tropical marine ecosystem, particularly with reference to the Gulf of Guinea, (South Atlantic West Africa).

The determinants of nematode population distribution and abundance of species and the assemblages in which they occur are also poorly understood in the Guinea Gulf as few data sets are available despite expense of the Gulf and the critical contribution of its inherent fauna to benthic-pelagic biomass and productivity. One of the best benthic data set is available from the Enlarged Gulf of Guinea Marine Ecosystem survey, a synoptic sampling exercise in 1998, covering the entire Gulf of Guinea in South Atlantic West Africa (Fig. 1). This also corresponds with data set obtained during the short-and long-term assessment of 12 January 2002 Exxon-Mobil pipeline rupture at Idoho platform. Sediment-dwelling macro-infauna species composition and biodiversity patterns in the Guinea Gulf have been reported by several workers (Ekweozor, 1985, Ombu, 1987, Ewa-Oboho, 1988, 1992, 1994, 2006, 2008).

Although some information describing meiofauna densities and copepod assemblage structure have been published (Ewa-oboho, 2006), there has been no comprehensive assessment of assemblage structure of other meiofaunal groups such as nematodes as is readily available from the coastal waters of Germany, Belgium, Nether lands and the USA; (Heip et al., 1990; Vanreusel, 1990; Vinex, 1990; Steyaert et al., 1999; Schratzberger et al., 2006). Numerically, nematodes dominate in most marine meiobenthic habitats and thus provides more robust data sets that can be obtained from macro and mega fauna (Heip et al, 1985; Bongers and Van de Haar, 1990; Ewa-Oboho, 2006, 2007). In the benthic realm, nematodes absorb dissolved organic compounds, feed on fungi and other organisms, regenerate nutrients, influence sediment texture, enhance gas diffusion and serve as food for other organisms. The ecological and practical advantages associated with the use of nematodes in benthic ecological studies (Schratzberger et al, 2000) provide excellent reasons to study nematode communities in the Gulf of Guinea Marine Ecosystem where this group of organisms have not been studied in detail

The purpose of this investigation was therefore to assess the contribution made by this important biological component to the benthic community of Gulf of Guinea marine region. Specifically, this study is to provide a first hand information on the species composition and abundance of this Gulf's meiobenthos, identify the main environmental variables and anthropogenic factors that could determine the distribution of community types and to compare the present biotic data with that of other animal groups previously obtained in the same area to provide a more comprehensive view of the Gulf of Guinea ecology.

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Manuscript received by the Editor March 5, 2008; revised manuscript accepted August 18, 2008.

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Influence of environmental variables on meiofaunal nematode communities

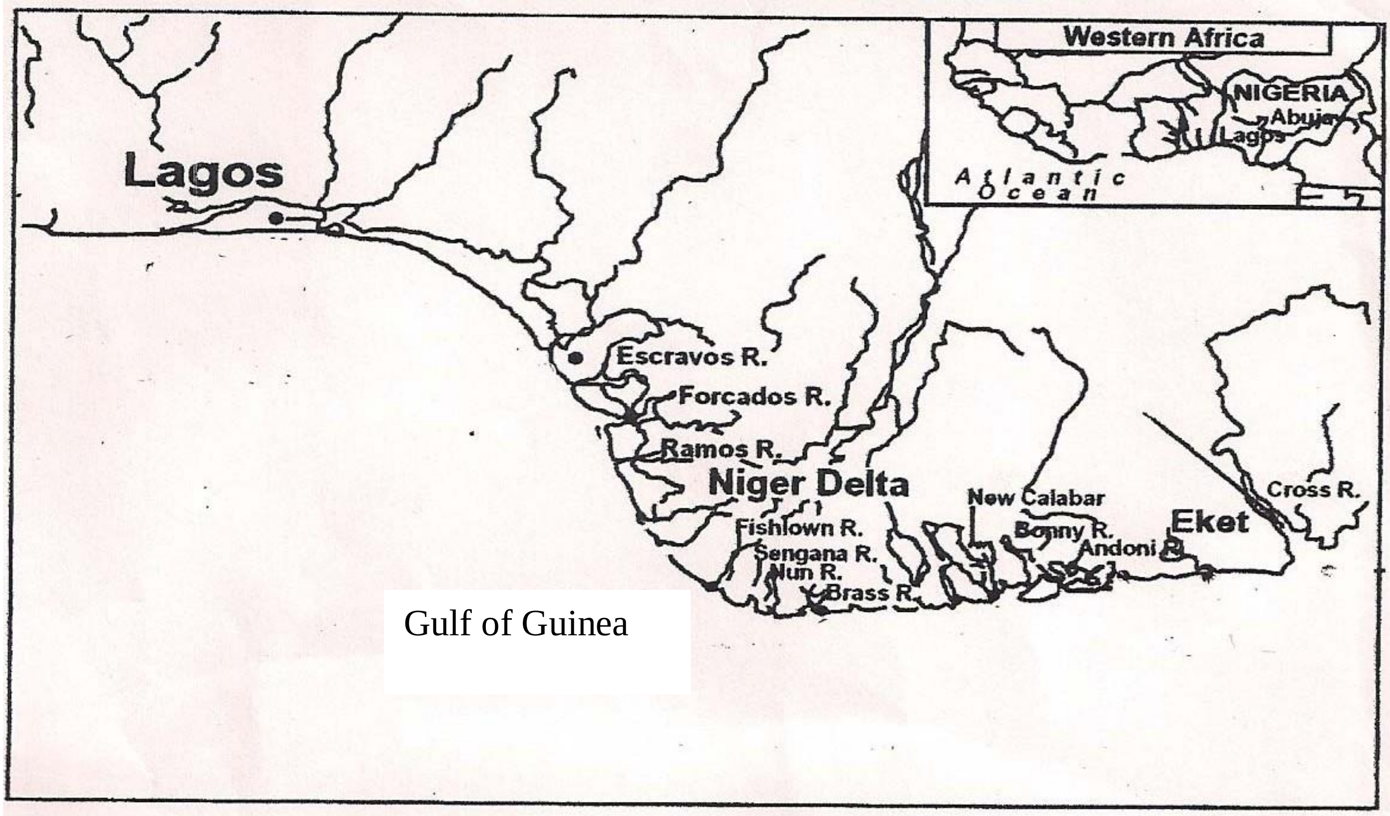

FIG.1. Gulf of Guinea in South Atlantic West Africa

MATERIALS AND METHODS

The environment and sample collection

The study area was located on the inner continental shelf of the Gulf of Guinea off the coast of South Eastern Nigeria (Fig. 1). The nearest of the 12 sampling stations (St 6) along the southern Nigeria coastline was about 3km off-shore while the furthest (St 10) was 45km. Most samples were collected in January 2002, all stations corresponding with those of the IDOHO 1998 oil spill and the Enlarged Gulf of Guinea Marine Ecosystem Surveys (1999/2000)(Table 1).

To minimize the possible effect of anthropogenic activities on nematode communities, most stations studied were located far away (at least 1000m) from point-source impacts such as dredging-disposal sites and oil and gas wells, off-shore flow stations and platforms. At each station, three replicate sediment samples were collected from within a 100m range ring (using SEXTANT^{TM} software and DGPS position fixing) by means of a 0.1m^2 Day Grab. From each grab, two sub-samples, one for particle size and organic carbon content analysis and one for the study of meiobenthos, were collected with a Perspex cover (3cm diameter, 7.1cm^2 surface area) to a depth of 5cm. The remainder of the sediment was retained for analysis of macro infaunal invertebrates. At each station a sediment surface of one Day Grab sample was scraped off with a stainless steel metal spoon for analysis of trace metal concentrations. All samples were fixed in 5% formaldehyde in 63µm filtered sea water. Sample for particle size and chemical analyses were frozen to a temperature of -20^{0}C pending analysis.

Laboratory processing of samples

After sample preparation, sediment granulometry was determined by a combination of dry sieving and laser sizing to give the full particle size distribution (Dyer, 1986). Organic carbon and nitrogen content of the sediment fraction <63µm was determined with a Leeman CE 440 elemental analysis and the concentration of trace metal was analyzed in an aqua regia extract using an inductively-coupled-plasma mass spectrometer (Jones and Laslett, 1994). Mercury concentrations in the extracts were determined by cold vapour atomic absorption spectro-photometry, with metal concentration normalized against the non-contaminant element lithium to account for Lithogenic variability. Meiofauna were extracted from sediments sub-samples washed into a 63-µm sieve with Ludox^{TM} 40, following the method described in Somerfield and Warwick (1996). The extraction process was repeated three times before the extracted material was evaporated slowly in anhydrous glycerol and mounted on slides for identification and counting. Consistently, nematodes comprised > 90% of total meiofauna abundance at all station, and were identified to genus or species level. For macrobenthic infaunal studies, three replicates of sediment samples were obtained at each station with Day Grab. Samples were initially washed through a 1-mm sieve and all retained individuals were counted and identified to family or species level. Detail diversity and distribution data are published elsewhere.

For comparison, epifaunal and fish samples were collected by bottom trawling at the sites with a 2-m beam trawl fitted with chain mat and towed at approximately 1 knot for 5 min. Samples were washed through a 5mm sieve and epifauna identified to family or species level. Sampling of fish communities was undertaken with one to three 30-min tows at 4 knots with a Grande Ouverture Verticale (GOV) otter trawl. Catches were sorted into species.

Data analysis

Nematode analysis

Total nematode abundance and number of species (Hill number No) were calculated for each sample. Diversity and dominance were expressed as Hill numbers N_1 and N_2 (Hill, 1973) respectively, which these numbers describe different aspects of the community and differ only in their tendency to include or ignore the rarer species.

$N_1 = e^{H'}$ (1)

where: $H' = \sum_{i=1}^{s} pi$

$N_2 = SI^{-1}$ (2)

where: $SI = \sum_{i=1}^{s} \left[ni(ni-1) / N(N-1) \right]$

S = no of species

ni = no of individuals in the ith species

N = no of individuals

pi = ni/N of each species

Bartlett's and Cochran's tests were used to test for homogeneity of variance before spatial differences in univariate indices were employed using a ONE-WAY ANOVA. Following the detection of significant differences (P≤0.05) between stations, the Tukey HSD multiple comparisons test was used. The relationship between environmental variables and (a) sampling location and (b) univariate community attributes was investigated using simple regression analyses. All univariate analyses were performed using the software package STATGRAPHICS plus version 3.3.

A correlation-based principal components analysis (PCA) using normalized Euclidean distance was applied to show spatial differences in environmental parameters(Table2). Non-metric Multi Dimensional Scaling (MDS), was carried out to assess local differences at the community level using square-root transformed nematode species abundance data (Fig.3). A Bray-Curtis similarity was calculated and the resultant similarities used in the MDS ordination. One-way analysis of similarities (ANOSIM), the multivariate analogue to one-way ANOVA, was performed to test the significance (P=0.10) of differences in assemblage composition between stations. The community groupings identified in the MDS ordination was harnessed to determine the contribution of individual species to the average dissimilarity between samples (SIMPER procedure). The relationship between environmental parameters and community structure was assessed by calculating rank correlations between similarity matrices derived from the biotic data matrices from various environmental data (BIOENV and RELATE procedure)(Table 4). All multivariate analyses were carried out using the software package PRIMER version 6 β (Clarke and Warwick, 1994).

Table 1. Some environmental parameters in the study area

Station	Median (μm)	Organic C (%)	Sand (%)	Silt-clay (%)	Sorting coefficient	Depth (m)
1	112(126)	5.1(4.6)	78.0(81.2)	14.8(18.1)	2.31	75(78)
2	188(192)	3.0(6.8)	92.4(90.6)	8.6(9.0)	2.12	70(65)
3	138 (135)	4.8(6.1)	96.1(94.3)	3.9(5.1)	1.05	65(65)
4	126 (131)	6.0(3.5)	98.8(99.2)	3.6(7.9)	1.02	80(84)
5	148 (156)	3.7(4.0)	96.1(99.8)	1.2(2.8)	1.40	30(26)
6	130 (151)	4.9(2.7)	97.9(95.1)	1.0(0.8)	1.36	35(40)
7	165 (143)	4.2(5.3)	98.2(99.8)	3.3(5.8)	1.48	50(52)
8	140 (201)	3.9(4.8)	98.6(98.2)	1.0(0.8)	1.18	64(58)
9	173 (180)	3.1(4.8)	96.5(94.1)	0.7(0.5)	1.01	21(18)
10	315 (302)	4.5(5.6)	97.4(92.5)	1.4(1.2)	0.81	20(22)
11	162 (151)	3.0(4.1)	84.8(88.2)	15.5(10.1)	0.72	23(25)
12	340 (345)	1.4(1.8)	97.7(95.5)	0.3(0.5)	1.86	72(76)

Values in parentheses were recorded at same station during 1998 IDOHO investigation and the Enlarged Gulf of Guinea Marine Ecosystem survey.

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Table 2 Trace metal concentration (PPM) in the study area in 2002/2003

Station	Zn	Cu	Cd	N_1	Pb	Cr	As
1	2.51	0.60	0.01	0.61	1.53	2.10	0.30
2	2.63	0.42	0.01	0.65	1.89	2.12	0.41
3	2.56	0.38	0.01	0.63	2.50	1.86	0.58
4	2.68	0.58	<0.01	0.58	1.78	1.91	0.42
5	2.01	0.30	<0.01	0.72	1.01	1.89	0.38
6	2.42	0.30	0.01	0.51	0.88	1.66	0.35
7	2.91	0.38	0.01	0.62	3.86	1.60	0.86
8	3.02	0.42	0.01	0.68	3.16	1.56	1.12
9	2.30	0.36	<0.01	0.31	2.01	1.72	0.61
10	2.91	0.34	<0.01	0.67	2.46	1.78	0.56
11	2.26	0.39	0.01	0.74	3.42	1.66	1.41
12	2.12	0.42	<0.01	0.70	0.82	1.85	1.36

Table 3. Correlation between mean community characteristics and environmental factors, Nematode abundance and all trace metals were log transformed.

Environmental factors	Abundance		No of species		Diversity		Dominara		Assemblage structure	
	r	p	r	p	r	p	r	p	r	p
Median	-0.58	0.01	-0.52	0.02	-0.16	0.51	-0.05	0.85	0.66	<0.01
C(%)	0.35	0.16	0.21	0.36	0.18	0.50	0.07	0.75	0.14	0.08
Sand (%)	0.08	0.38	0.32	0.30	0.24	0.29	0.21	0.24	0.32	0.01
Silt (%)	0.21	0.48	0.39	0.10	0.22	0.28	0.23	0.35	0.35	0.02
Sorting	-0.08	0.87	0.15	0.52	0.31	0.36	0.26	0.29	0.25	0.04
Depth	0.2	0.65	0.56	0.01	0.65	0.01	0.48	0.04	0.31	<0.0
Zn	0.35	0.16	0.48	0.07	0.28	0.35	0.07	0.87	0.15	0.1
Cu	-0.08	0.85	-0.19	0.25	-0.18	0.54	-0.10	0.65	0.26	0.04
cd	-0.35	0.18	-0.25	0.36	0.05	0.78	-0.11	0.81	0.31	0.01
N_1	-0.3	0.65	0.18	0.42	0.21	0.25	0.23	0.34	0.06	0.37
Cr	0.16	0.72	0.38	0.15	0.19	0.47	0.05	0.86	0.16	0.15
Pb	0.22	0.39	0.29	0.25	0.28	0.25	0.20	0.52	-0.04	0.6
As	-0.34	0.11	-0.31	0.32	0.03	0.89	0.01	0.98	0.15	0.11

RESULTS

Environmental setting

The sedimentary environment of the study area is stable. It decreases significantly in depth towards the north and southward with lower tidal currents which result in increasingly finer sediments. The sediment consists mostly of poorly sorted muddy sands with low silt-clay fraction and low concentrations of heavy metals(Table 3). The ordination of stations based on environmental data shows a clear separation of samples (Fig. 2). Principal components (PC) 1 and 2 explained 53% of the variability (PC 1, 32%, PC 2, 21%). On the first component, the finest substrates with the highest silt/clay content (Station I and II) in the Southern sector of the study area were clearly separated from the coarsest sediments with low silt content (Stations 8 to 12) in the north. Other stations occupied an intermediate position along PC 1. High negative values were associated with silt content and water depth, whilst high positive values were linked with median particle diameter and sand content. The separation of stations along the second principal component was less pronounced. High positive values along PC 2 were coupled with carbon, lead and zinc concentrations, while high, negative values with median particle diameter.

Nematode distribution

Considering the time of sampling 1998 or 2002, no significant difference existed on the abundance (F=3.68, P=0.07), species number (F=0.08, P=0.76), diversity (N_1; F=1.95, P=0.17) dominance (N_2; F=1.52, P=0.25) and structure (global R= -0.086, P=0.81) of nematode assemblages. Hence the factor "sampling year" could be eliminated from future data treatment. In terms of nematode abundance one-way ANOVA showed significant differences between sampling stations (log,F=6.85, P<0.01), total number of species (F=9.88, P<0.01), diversity (N_1; F=6.54, P<0.01) and dominance (N_2; F=3.86, P<0.01) (Fig. 4)

Mean nematode abundance per sample ranged from 56 at station 5 to 998 at station 11. Lowest species numbers were recorded at station 12 (20 species), highest at stations 2 and 6 (62 species). Diversity (N) was lowest at station 11 where highest nematode densities and dominance of few species (lowest N_2) were obtained.

Only 4 of 126 species in data set (*Paracyatholaimus*, sp, *Microlaimus Marinus*, and *Daptonema*) were found in all stations(Fig.3a&b). These 4 species accounted for 16% of total nematode abundance. Almost half of all species (58) species were found at five or fewer stations and these species accounted for 17% of all identified nematodes.

Nematode assemblages from the North eastern region Gulf of Guinea showed a characteristic pattern in the multi-variate ordination, revealing the following tends:

(1) A high spatial stability of distribution pattern observed in terms of species composition, is indicated by the generally close clustering of replicate samples collected at the same location. One-way ANOSIM results confirmed that nematode communities at all stations except (11 and 12) were significantly different from each other at the 10% probability level.

(2) Samples were arranged in two clusters in the MDS ordination based on mean species abundance: The left hand (group 1) one, which contained the more Southern stations and the right hand (group 2) including the more Northern stations (close to the coastline) (Figs.5). Apart from differences in faunistic composition, the clusters exhibited clear differences in specie diversity.

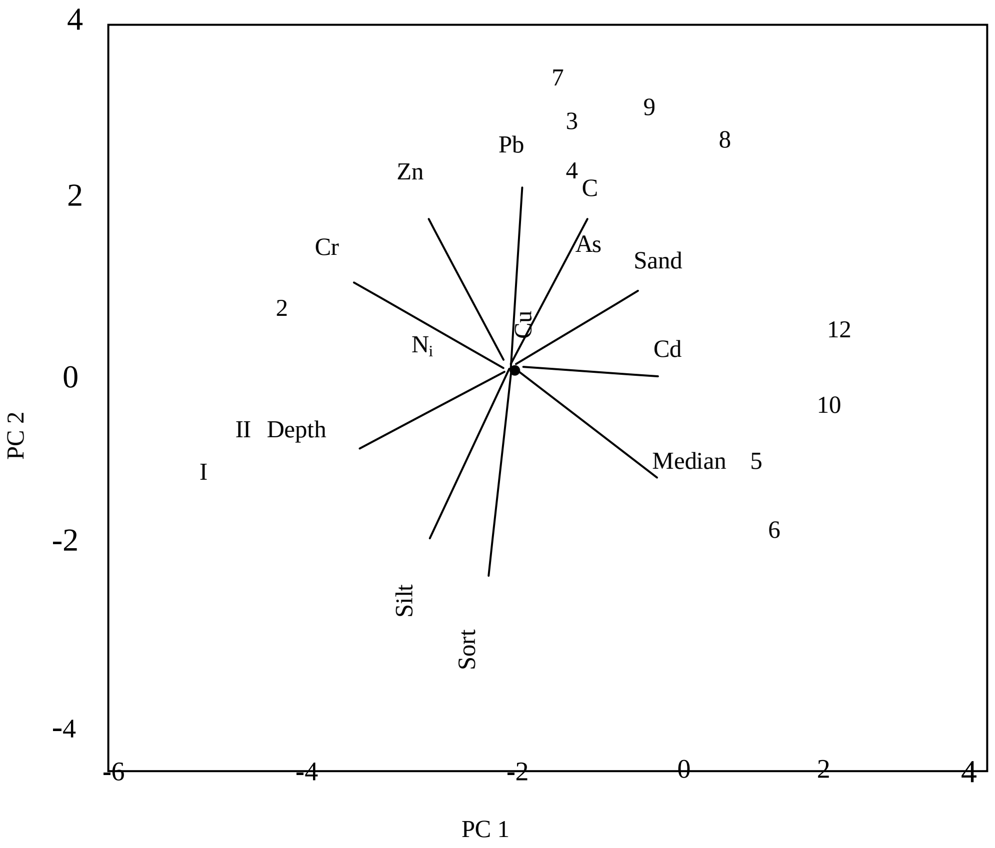
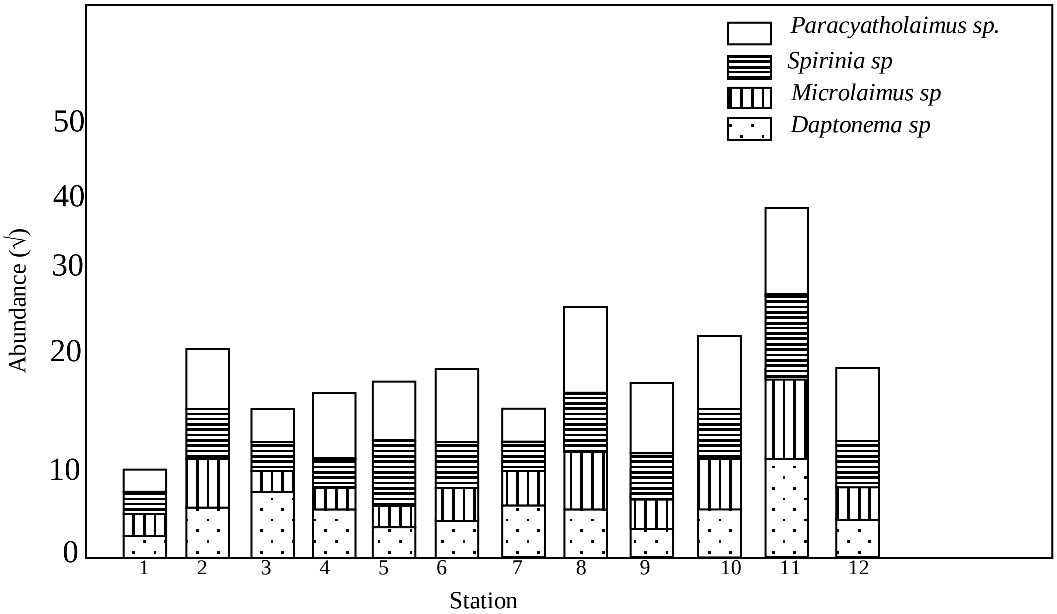
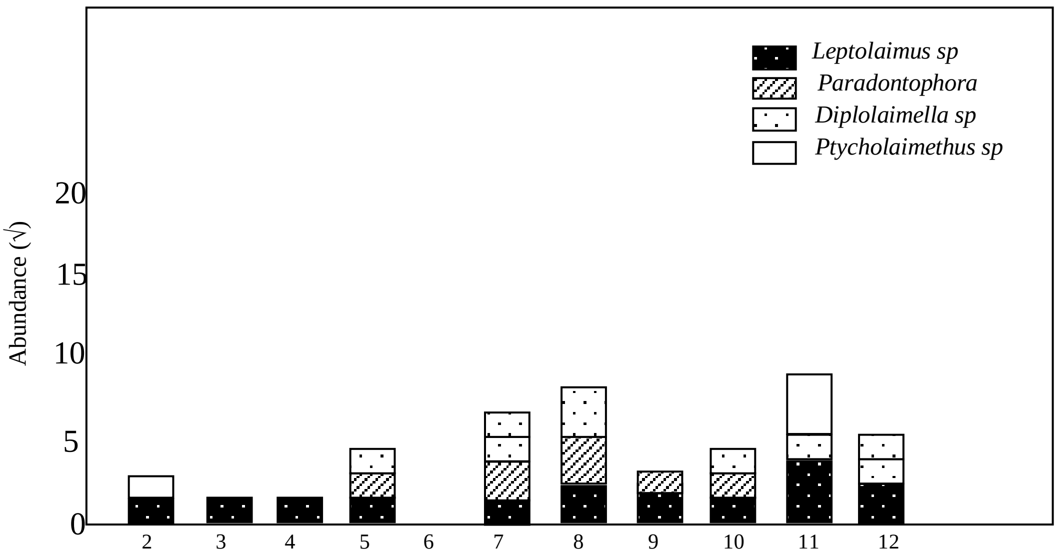


Fig. 2. PCA ordination (including variable vectors) based on normalized environmental data. Variables involved in the ordination were water depth, median particle diameter, total organic carbon content, silt/clay content, sorting coefficient, concentration of seven trace metals (Table 2). All metal concentrations were log transformed.



(a)



(b)

Fig. 3. Mean square-root transformed

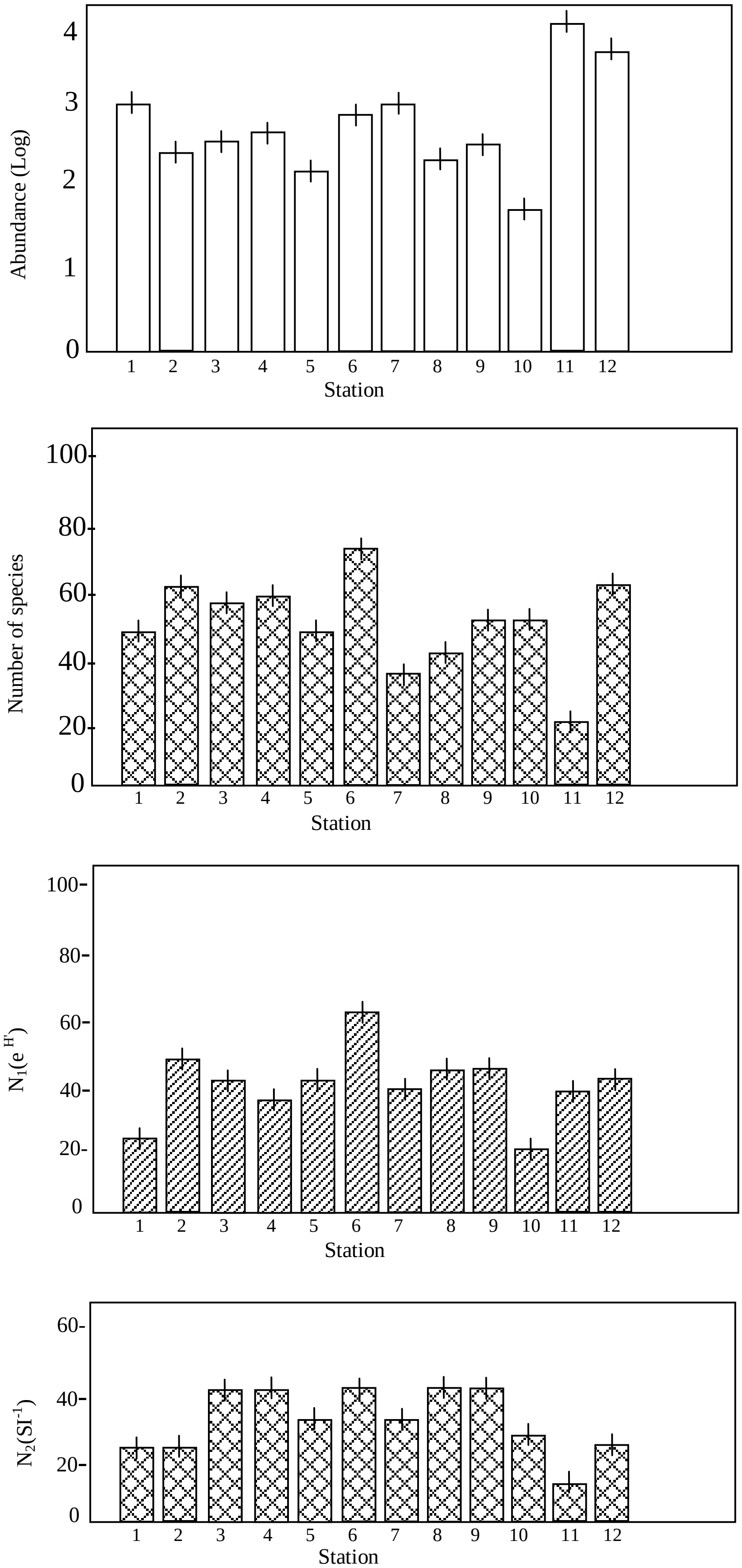


Fig. 4 Average (± 95% confidence interval) nematode abundance, number of species, diversity (N_1) and dominance (N_2)

Group 1 was characterized by high abundance of prevalent species including *Paracyatholaimus, Spirinia sp, Microlaimus marinus, Diplolaimelloides sp.* and *Daptonema*. (Fig. 4) and had the following sub-clusters within it:

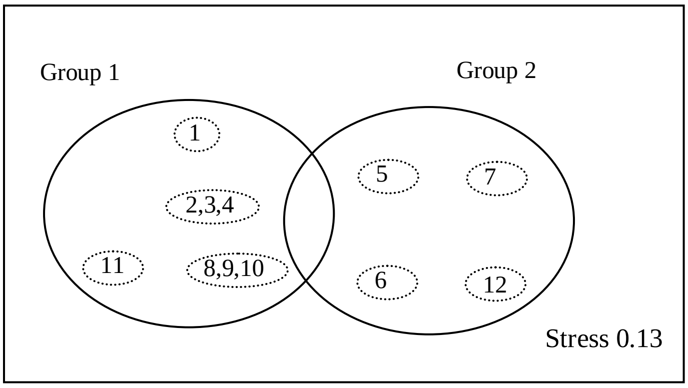


Fig. 5. Non-parametric mult-dimensional scaling (MDS) ordination based on square-root transformed mean abundance of nematode species lines indicate 40% (solid line) and 60% (dohed line) Bray-curtis similarity.

Station I and II as separate sub-cluster: High abundance of *Ptycholaimellus sp* rarely found in other stations characterized these sampling sites. Dispite station similarity in terms of depth (>70m) and sediment type (lowers median and highest silt content), spatial saperation of stations I and II may have contributed to significantly differing assemblage structure. *Dichromadora,* a close relative of *Ptycholaimellus sp.*for example was found in large number at station II, while *Metadesmolaimus sp,* a close relative to *Paracyatholaimus sp.* was abundant at station I.

- Stations 8, 9 and 10. Nematode assemblages exhibiting comparatively low genus and specie, diversity, were typical of these relatively shallow stations in the 20 to 30m depth range.
- Stations 2, 3 and 4: This sub-cluster contained stations in the 65 to 80m depth range (Deepest Stations). Nematode assemblages displayed the highest species diversity within group 1. Group 2 contained stations 5, 6, 7 and 12 and was characterized by assemblages with variable species composition Dominant species include *Leptolaimus sp, Monhystem sp? Diplolaimella sp* and *Paradontophora sp.* (Figs. 3a&b).

Nematodes relationship with environmental factors

Nematode density and species richness increased significantly with reducing median particle diameter of the sediment. Species richness, diversity (N_1) and dominance (N_2) of resident biota were significantly correlated with water depth. High-diversity assemblages with a low degree of dominant were typical of deeper waters (>65m) southwards (outer inner shelf).

The most critical environmental measures were water depth, median particle diameter as well as the composition (% sand and silt fraction) and sorting of substrate (Table 1). Trace metal concentration and organic carbon content bore little relation to univariate community attributes and observed species distribution patterns(Table 2).

Nematode distribution patterns in relation to other faunal groups

The abundance of nematodes and macro infauna collected in the sampling stations (Fig. 1) differ by two orders of magnitude, whereas those for both invertebrate epifaua and fish differ by three orders. Consequently, multivariate analyses of the different faunal groups were based on different levels of data transformation. Whereas square-root transformation were used for meiobenthic nematode and macrobenthic infaunal data, double square-root transformation was considered appropriate for invertebrate epifauna and fish. Though the results from the multi-dimensional scaling (MDS) ordination are reported elsewhere (Ewa-oboho et al, in Press) it was generally observed that (1) invertebrate assemblages collected in the southern end of the study area displayed a more viable species composition than those collected nearer the shores. A clear separation occurred in the MDS. (2) Faunal communities collected in the southern part (stations 2, 3 and 4) where the sediment was finest with highest silt content, clustered separately from other more sandy stations located northward towards the coastline.

The species distribution patterns of all faunal groups were significantly correlated with each other at $P<0.05$ with Spearman rank correlation coefficients ranging from 0.28 to 0.85. Spatial location of the sampling area and associated differences in water depth were the main factors affecting assemblage structure. The influence of factors related to sediment granulometry (e.g median particle diameter, silt content etc) decreased with increasing size and mobility of faunal group (Table 5).

Table 5. Relationship between benthic community structure (based on mean species abundance data of macrobenthic infauna invertebrate epibenthic fauna and fish) and environmental factors.

	Macrobenthos (infauna)		Macrobenthos (epifauna)		Fish	
	BP	P	P	P	P	P
Median	0.81	<0.01	0.42	0.01	0.19	0.11
C(%)	0.1	0.19	0.38	0.01	-0.04	0.58
Sand (%)	0.42	0.01	0.06	0.32	-0.16	0.89
Silt (%)	0.36	0.03	0.31	0.04	+0.00	0.52
Sorting	0.28	0.08	0.23	0.08	-0.08	0.74
Depth	0.35	<0.01	0.32	0.04	0.24	0.03

DISCUSSION

This extensive Gulf of Guinea inner continental shelf surveys have provided a critical evaluation of the relationship between nematode fauna and their immediate habitats and other benthic forms. Analyses of meiofaunal nematode population density with varied substrates revealed close similarity in faunal species of locations with similar sediment type and water depth. This confirms previous studies that emphasized the critical role the median grain size and silt content play as determinant factors in benthic species abundance and diversity (Heip et al 1985, Buekema, and Essink, 1986, Ewa-oboho 1995, 1999, 2004, 2008). Sediment grain size directly affects the spatial and structural conditions of the interstitial matrix and subsequently determines the physical and chemical nature of the sediment environment (Schratzberger et al, 2006, Ewa-oboho 2006). Heip et al., (1990) review of 40 years meiobenthic studies showed that muddy bottoms where generally characterized by a few dominant genera (*Sabatieria, Terschellingia, Daptonema, Paracytholaimus, Ptycholaimellus sp.* and *Metadesmolaimus sp*), where as the chromadorids increased with increasing particle size. This to a large extent commensurate with the meiofaunal nematode species distribution patterns in the present study in the Guinea Gulf Shelf areas sampled.

Besides water depth played a critical role in influencing nematode assemblage pattern, probably because it in turn, affect other factors such the amount and (quality) nature of phytoplankton-derived food reaching the seabed and the stability of physic-chemical conditions. At shallow depths, high wave actions, associated with sediment instability results in more variable species composition compared with higher sediment stability characteristic of the reduced ‘energy’ associated with deeper sampling locations and subsequent stable benthic community structure. Biological interactions between faunal species are potentially important in structuring nematode communities both within meiofaunal groups and between meio-and macro fauna. Diverse assemblages could result from intense macrofaunal predation and pronounced environmental perturbations, which exerts selection pressure leading to the dominance of a few opportunistic species. In this study we propose a *Paracyatholaimus-Ptycholaimellus* community often associated with silty sediment and characterized by low diversity, as a typical stable community. A comparable community was present at station II, where lowest species diversity and highest densities and dominance of few individuals were recorded. Most of the individual here perhaps belong to two species viz, *Ptycholaimellus sp. Microlaimus sp* which are adapted to survive in anoxic conditions of low oxygen and high sulphide concentrations unsuitable for many other nematode species (Tietjen, 1980; Hendelberg and Jensen, 1993; Steyaert et al, 1999). Some species are in symbiotic association with micro-organisms that populate their body surface which they feed on and supply with reduced sulfur compounds and oxygen as election receptor (Hoschitz et al. 1999). A high abundance and dominance of these species may thus signal a poorly oxygenated environment. Hypoxia and high density of deposit feeding nematode species (e.g Daptonema, Sabatieria) can be an indication of organic enrichment Montagna and Harper, 1996). The low diversity of nematode at station II could be attributed to the low concentration of organic carbon, considerable concentrations of heavy metal and the presence of a diverse macro-in epi-faunal assemblages. Although hydrodynamic data were not recorded during this study we strongly believe that the water circulation patterns within this region could influence distribution patterns and local abundance and dominance of meiofaunal nematodes. The present study along with previous investigations in the area have shown that, of all faunal groups patterns in the assemblage structure of benthic invertebrate coincided most closely with sedimentary conditions at the sampling stations.

This is explained by the fact that the shape, physiology and life-history characteristics of the macro-benthic fauna are also strongly influenced by the substrate. Fish on the other hand display a wider range of life-histories. In addition to the substrate environment, factors related to habitat topography, water flow proximity to source population and longevity of larval are critical in structuring fish assemblages in the Gulf of Guinea Besides, whilst benthic infauna and sediment samples were collected at comparable spatial scales, the trawl sample represented organisms from a wider range of substrates. Thus, in few of the relatively small surface area sampled for sediment analyses (i.e. 0.1m^2 Day Grab) results are not fully representative of the variety of habitats and environmental conditions prevailing in the trawled areas.

The Gulf of Guinea is one of the less investigated seas in the earth's planet and therefore very scanty data exist for the area. This makes it difficult to quantity effects of human activities on the benthic ecosystem (Ewa-oboho, et al., 2003, 2004). Many field surveys, designed to assess the potential effects of point-source impacts such as around oil rigs and dredging disposal sites, (Ewa-oboho, 2004, 2006, Moore et al., 1987; Somerfield et al 1995) revealed local responses of nematodes assemblages in the immediate vicinity of the impact (Ewa-oboho 1998, 2006). Incidentally, most of our sampling stations were located away from such potential point-source and evidently from our sediment contamination and faunal analyses, acute effects of such oil installation therefore seem unlikely.

Studies have shown that bottom trawling modifies the diversity, community structure, trophic structure and productivity of benthic invertebrate communities (Jennings and Kaiser, 1998, Ewa-oboho, 2006, Schratzberger et al., 2006). Larger body frauna with fragile bodies are more prone destruction than small-sized nematodes with rapid turn-over rates. A few specific studies have assessed the effects of trawling no nematodes (Schratzberger 2002). In terms of species composition and diversity meiofaunal nematode communities encountered in the present study were similar to those found in comparable soft-bottom environment worldwide (review by Heip et al., 1985). However we cannot rule out the effect of fishing on nematode in the Guinea Gulf. The shelf areas of the Gulf of south eastern Nigeria, is intensely harnessed for its rich source of crude oil and gas. This generally precludes a separation of combined influence of natural environmental factors from artificial effects of human activities. To therefore assess the relative roles of environmental variables and anthropogenic activities, all operating on different spatial and temporal scales, on biodiversity and the structuring of benthic communities in the Gulf of Guinea, offers interesting and challenging future research.

ACKNOWLEDGEMENTS

We BDX-Nigeria Limited for assisting in sponsoring the project and some members for assisting in the field. Thanks are due to Dr. Bell Selema for nematode identification keys. Initial samples collection was assisted by Exxon-mobile Nigeria. Extra special thanks goes to Dr. Larry Inyang (Late) who co-ordinated the Idoho, January 12, 1998 oil spill impact evaluation investigations during which period field samples for this study were collected.

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