



International Journal of Fisheries and Aquatic Studies

ISSN: 2347-5129

(ICV-Poland) Impact Value: 5.62

(GIF) Impact Factor: 0.352

IJFAS 2016; 4(1): 209-213

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www.fisheriesjournal.com

Received: 12-11-2015

Accepted: 14-12-2015

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Occurrence and distribution of micro-crustaceans in cross river estuary, Niger delta region, Nigeria

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Abstract

Present Studies were conducted on the occurrence and distribution of micro-crustaceans in Cross River Estuary, Nigeria between August and October, 2014. The study was aimed to determine the abundance and diversity of micro-crustaceans in the Estuary. A total of 145 individuals of micro-crustaceans belonging to ten (10) taxonomic groups (Copepods, Crustacean larva, Isopoda, Ostracoda, Euphausiids, Acartidae, Cladocera, Harpacticoida, Sinus larva, and Mysidacea) were recorded during the sampling period. The order of dominance followed the pattern: Copepods > Crustacean larva > Isopoda > Ostracoda > Euphausiids and Acartidae > Cladocera > Harpacticoida and Sinus larva > Mysidacea. Abundance was observed to be higher in surface water, with a total of 51 micro-crustaceans (35.17 %), followed by 48 micro-crustaceans in muddy shore (33.10 %) and lowest in sandy shore with 46 micro-crustaceans (31.72 %). The higher numerical abundance observed in the surface water compared to muddy and sandy bottom was linked to nature of feeding of micro-crustaceans and favorable ecological conditions in the surface water. There was no significant variation ($P < 0.05$) found in the occurrence and distribution of micro-crustaceans in the different strata. Ecological indices of Micro-crustaceans from Cross River Estuary showed that Margalef index (D) and Shannon-Weiner index (H) in the present study range between 2.01 to 3.42 with mean of 2.71 and a range of 2.01 to 2.08 with a mean of 2.05 respectively. Given their diversity, and thus ecological information on the status of micro-crustaceans in the Cross River system and their relative insensitivity to confounding effects of habitat, a continued exploration of the value of micro-crustacean as ecological indicators appears to be warranted. Their relative low habitat specificity may also indicate that their broader use as bio-indicators for various anthropogenic stressors should be investigated.

Keywords: Occurrence, Distribution, Micro-crustaceans, Species Diversity, Cross River Estuary, Nigeria.

1. Introduction

Micro-crustaceans are arthropods, although they are small in size, these organisms often very abundant, consequently play an important trophic role in freshwater food webs supporting fish and numerous other animals in both aquatic and terrestrial ecosystem^[9]. Micro-crustaceans differ from other arthropods in possessing two pairs of antennae. They are larger zooplanktons which primarily include benthic species such as shrimps, crabs and crayfish dominating the aquatic system ranging from stream, lakes, rivers and estuaries^[13]. The copepods and cladocerans are also included in the micro-crustacean group. They evolved primarily in water and are mostly free-living animals and have radiated into immense numbers in the aquatic ecosystem^[14].

Studies on micro-crustaceans inhabiting the different aquatic ecosystem have been variously reported by^[25, 32, 24, 8, 11, 19, 20]. Various groups of micro-crustaceans inhabit different aquatic ecosystem. Studies relating to the distribution of micro-crustaceans in water bodies are important as they enhance the understanding of the classic food web of such water bodies.

Micro-crustaceans plays an important role in food supply in classic aquatic food web, as micro-crustaceans are zooplanktons which form a part of the primary consumers in the aquatic ecosystem^[22, 31, 6]. Therefore, the result of the present study is expected to provide information of the various micro-crustaceans species which form part of the zooplankton community in the Cross River Estuary, Nigeria.

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2. Materials and Methods

2.1 Study Area

The Cross River Estuary take its rise from the Cameroon Mountains and meanders westward into Nigeria and then southwards through high rainforest formations before discharging into the Atlantic Ocean through the Gulf of Guinea [5]. The Cross River Estuary is characterized by mangrove vegetation mainly *Rhizophora racemosa* and

Avicennia Africana species. The climate of the study area is characterized by a long wet season from April to October and a dry season from November to March [3]. The Cross River Estuary like other estuaries in the world has a wide diversity of fish species which provide the source of animal protein and source of income for both the riverine and upland populations. The Estuary and its tributaries represent the largest source of inland fisheries [17] (Fig 1).



Fig 1: Map of the Study Area

2.2 Field Sampling

Samples were collected between August and October, 2014. Three sets of samples were collected from three stations (Inua Abasi, Jamestown and Oron) from three different substrata (muddy, sandy and surface) respectively and mixed to obtained a composite with regards to the respective strata which was used for the study. Surface water sample were collected by filtering 10 liters of habitat water through a hand net of mesh size 200µm according to [29, 31]. Samples were stored in plastic sample bottles of 500mls and preserved in 4% formaldehyde solution. For sediment study, the sediment for each of the station was taken with the help of hand trowel. Sediment sample for each station was sieved with zooplankton net of mesh size of 200µm. The micro-crustacean encountered were stored in plastic sample containers and preserved in 4% formaldehyde solution samples were then taken to the laboratory for analysis.

2.3 Laboratory Analysis

In the laboratory, subsamples were taken into the petri dish before sorting, identification and counting were done with the use of a light microscope of magnification x40 objectives based on [29, 15, 7, 26, 27].

2.4 Identifications and Classifications of Micro-crustaceans Species

Micro-crustaceans obtained from the three stations in the different substrate were sorted and identified to the lowest taxon possible based on [29, 15, 7, 26, 27].

2.5 Data Analysis

Data obtained from each bacteria and phytoplankton group were empirically analyzed using the formula:

$$\% R_a = \frac{n}{N} \times 100 \text{ [4]}$$

Where: %_{Ra} = relative abundance
 n = number of individuals
 N = total number of all individuals.

Margalef's diversity index d was used in determining the very current ecological status of the Estuary using the formular:

$$D = \frac{S-1}{\ln(N)} \text{ [23; 28]}$$

Where:
 D = Species diversity
 S = Total number of individual species observed
 N = Total number of all individual species observed
 ln = natural or Naperian logarithm (log_e).

Shannon-wiener index was used to determine the species density of the micro-crustaceans species using the formular:

$$H = \frac{N \log N - \sum f_i \log f_i}{N} \text{ [28]}$$

Where H = Shannon-wiener index
 N = Numerical abundance of all individual species
 Fi = Number of each individual species

One-way analysis of variance (ANOVA) powered by (SPSS, version 20.0) was used to test for significant spatial variation in the distribution pattern of micro-crustaceans in Cross River Estuary using data collected from the three stations with respect to different substrata. Data were also represented graphically.

3. Results

Results of the distribution of micro-crustaceans in the different strata were observed with a total of 145 individuals encountered during the study period. Numerical abundance of 48 individuals and a mean density of 4.8 was observed for muddy shore, sandy shore had 46 individuals with a mean density of 4.6 and 51 individuals with mean density of 5.1 was recorded for surface water (Table 1, Fig 2).

Variation in abundance of micro-crustacean family shows that in all the three strata, Copepods and Crustaceans larva are the most abundant followed by Isopoda, Ostracoda, Euphausiids and Acartidae, Cladocera, Harpacticoida and Sinus larva. Mysidacea was observed to be the least abundant in the study area (Table 2).

Numerical and relative percentage abundance of micro-

crustaceans in the different strata of the Cross River Estuary shows that the number of species in surface water is higher than that of muddy and sandy bottom (Table 3, Fig 3). Analysis of variance using one-way showed no significant ($P<0.05$) in the distribution of micro-crustaceans in the different strata of Cross River Estuary during the study period.

Table 1: Numerical Abundance of the Micro-crustaceans Families recorded from the different strata of the Cross River Estuary, Nigeria during the Study Period

Micro-crustaceans Taxa	Muddy	Sandy	Surface	Total
Copepods	2	4	12	18
Isopoda	9	3	5	17
Ostracoda	6	6	4	16
Mysidacea	4	3	4	11
Cladocera	4	5	4	13
Euphausiids	6	5	3	14
Harpacticoida	5	3	4	12
Acartidae	3	7	4	14
Sinus Larva	5	3	4	12
Crustaceans larva	4	7	7	18
Total	48	46	51	145
Mean	4.8	4.6	5.1	14.5

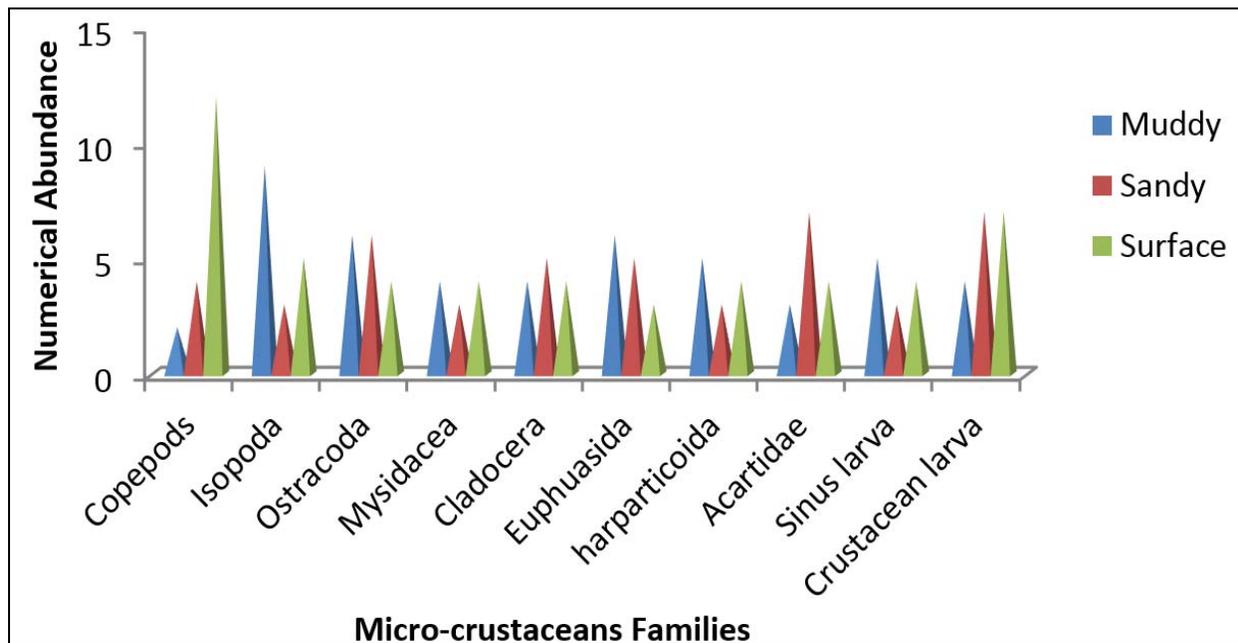


Fig 2: Variation in the Distribution of Micro-crustaceans families in the Different Strata during the Study Period

Table 2: Summary of Numerical and Relative percentage Abundance of the Micro-crustaceans Families Recorded from the three strata of the Cross River Estuary, Nigeria during the Study Period.

Micro-crustaceans Taxa	Numerical Abundance (n)	Relative percentage Abundance(%n)	D	H
Copepods	18	12.41	3.42	2.01
Isopoda	17	11.72	3.21	2.02
Ostracoda	16	11.03	3.01	2.03
Mysidacea	11	7.59	2.01	2.08
Cladocera	13	8.97	2.41	2.06
Euphausiids	14	9.66	2.61	2.05
Harpacticoida	12	8.28	2.21	2.07
Acartidae	14	9.66	2.61	2.05
Sinus Larva	12	8.28	2.21	2.07
Crustaceans larva	18	12.41	3.42	2.01
Total	145	100.01	$\Sigma D=27.12$	$\Sigma H=20.45$

Table 3: Numerical and Relative percentage Abundance of the Micro-crustaceans Families recorded in the different strata of the Cross River Estuary, Nigeria during the Study Period.

Stratum	Numerical Abundance (n)	Relative percentage Abundance(%n)
Muddy	48	33.10
Sandy	46	31.72
Surface	51	35.17
Total	145	99.99

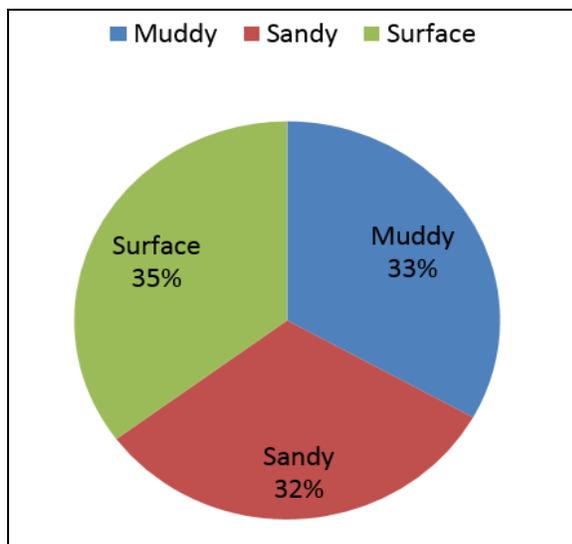


Fig 3: Pie Chart showing the Distribution/percentage Abundance of Micro-crustaceans in Different Stratum of Cross River Estuary, Nigeria during the Study Period.

4. Discussion

Results obtained from the study showed that a total of ten micro-crustaceans families were identified from the Cross River Estuary, Nigeria with 145 individuals encountered during the study period. Numerical and relative percentage abundance of the micro-crustaceans was found to vary in the different strata. Abundance of micro-crustaceans was observed to be higher in surface water, with a total of 51 micro-crustaceans (35.17 %), followed by 48 micro-crustaceans in muddy shore (33.10 %) and lowest in sandy shore with 46 micro-crustaceans (31.72 %). According to [16], the variation observed in this study in the distribution of micro-crustaceans in the different stratum may be attributed to several ecological factors such as reproductive behavior, recruitment pattern, predation, and human perturbations. The high abundance in the number of micro-crustaceans recorded for surface water may be an indication of the nature of feeding exhibited by herbivorous micro-crustaceans which feed on the surface of aquatic sediment, and to some extent on phytoplankton and periphyton attached to vegetation in the surface water or a phenomenon attributed to favourable ecological factors in the surface water compared to other stratum. Findings of [16] and [21] have revealed that certain periods of the year may have conditions that are optimal for organisms to reproduce and be recruited into the stock leading to increase in their abundance [1]. Had reported a similar observation that favorable ecological conditions usually give rise to high population of zooplankton in aquatic systems. The observed reduction in muddy and sandy bottom may be attributed to predation by larger organisms resident in these strata or ability to hide in sediments during the day [2]. Had observed that predation rate

can lead to a reduction in species population.

The micro-crustacean taxa recorded in this study is similar to the findings of [10] in Cross river Estuary who reported micro-crustacean taxa such as Mysid, Cladocera, Ostracod, Copepod, Isopod, Euphausiid and Crustacean larva. The observed reduction in the number of micro-crustaceans recorded during the study as compared to findings of [10] may be attributed to study duration and ecological condition of the habitat during the study period. Results of the study are also similar to findings of [18] who recorded micro-crustaceans taxa such as Copepods and Cladocera in Uwanse Stream. The high numerical abundance observed for these two taxa may be attributed to the differences in the aquatic system where the studies were conducted.

There are several possible explanations for the lack of significant differences in species composition between the three habitat types. First, it may be that the organisms have fairly broad feeding habits or are able to use multiple habitats; this is in consistent with suggestion of [30]. Specifically, herbivores Copepods and Cladocerans feed on the surface of aquatic sediment, and to some extent on phytoplankton and periphyton attached to vegetation [12, 33]. Further, mobility does not limit the habitat used by micro-crustaceans. Although many Cladocerans are substratum dwellers, most can also swim, indeed, could have only caught those individuals that swim or crawl upward on surface. Cyclopods that are generally good swimmers are still often bottom dwellers that actively colonize sediment interstices [8].

Secondly, the lack of difference suggests that, at least in estuary, micro-crustacean assemblages are not much affected by wind exposure.

Thirdly, the result suggests that predation has less of an effect on the composition of micro-crustaceans in the sediments as compared to surface or pelagic micro-crustaceans. Perhaps the small size of the animals and complexity of the habitat accounted for a reduced sensitivity to predation, along with their ability to hide in sediments during the day.

According to [4] ecological parameters of a group of species such as species abundance, species dominance, species evenness and Shannon wiener index are indicators of the health status of any habitat. Also, species diversity indices employed in ecological studies considers the total number of species found in the sample, which is expressed as richness, abundance and evenness [28]. Results obtained for species diversity indices including Margalef index (D) and Shannon-Weiner index (H) in the present study range between 2.01 to 3.42 with mean of 2.71 and a range of 2.01 to 2.08 with a mean of 2.05 respectively [4]. Have observed variations in species diversity indices in Indies River, Pakistan to prevailing ecological factors such as temperature, food availability and predation. This may suggest that ecological factors in Cross River Estuary were more favorable for micro-crustaceans in surface water than muddy and sandy shore.

4. Conclusions

The occurrence and distribution of micro-crustacean in Cross River estuary were studied at three stations using three different substrata (muddy, sandy and surface) respectively using 200µm mesh-size zooplankton net. The present study was based on the occurrence and distribution of micro-crustaceans in the different stratum of the Cross River Estuary and not based on stations. In conclusion, a total of one hundred and forty five (145) micro-crustaceans individual belonging to ten (10) taxonomic groups were recorded during the present

study. The order of dominance followed the pattern: Copepods> Crustacean larva> Isopoda>Ostracoda> Euphausiids and Acartidae>Cladocera>Harpacticoida and Sinus larva>Mysidacea. Abundance was observed to be higher in the surface water compared to muddy and sandy bottom and this was linked to nature of feeding and favorable ecological conditions in the surface water. There was no significant variation ($P<0.05$) observed in the occurrence and distribution of micro-crustaceans in the different strata. Given their diversity, and thus ecological information on the status of micro-crustaceans in the Cross River system and their relative insensitivity to confounding effects of habitat, a continued exploration of the value of micro-crustacean as ecological indicators appears to be warranted. Their relative low habitat specificity may also indicate that their broader use as bio-indicators for various anthropogenic stressors should be investigated.

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