



Research Article

Ostracods Diversity in Some Selected Water Bodies of Arid Zone, Maiduguri, Borno State, Nigeria

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ABSTRACT

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Studies on Ostracods species in some selected water bodies in Maiduguri, was carried out for the period of four months. A total of six (6) different species were identified, belonging to the same family; Cypridoidae; namely *Cypris ophthalmica*, *Cypridopsis vidua*, *Eucypris virens*, *Heterocypris incongruens*, *Cypris bispinosa* and *Sarscypridopsis aculeate* were identified. The *Eucypris virens* has the largest percentage of occurrence, while *Sarscypridopsis aculeate* has the lowest percentage. It was also discovered that physiochemical parameters have effects on ostracods abundance and composition.

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INTRODUCTION

Ostracods are a diverse group of small bivalve crustaceans, which occur in almost all aquatic environments. They occur in different sizes and shapes. Ostracods are also called “Mussel shrimps”. They generally range from 0.7-1.0 mm long, their sizes range between 0.3 and 5.0 mm in freshwater systems. The most common shapes in freshwater ostracods are kidney or bean-shaped, elliptical, trapezoid, triangular and sub-triangular or elongated. (Karanovic, 2009). The valves are composed of low magnesium, and calcium (Griffith and Holmes,

2000; Horne *et al.*, 2002). Ostracods are small, poorly-segmented entomostracan crustaceans in which body parts are enclosed within a calcareous bivalve carapace. They occur in almost all aquatic habitats, the extreme antiquity of the group and the ready preservation of their values in a wide variety of depositional environments, make them an important tool in both palaeocological and biostratigraphic analysis. They are small, and hence sediments samples and core horizons may contain values in great numbers and represent a variety of species. Thus, a

comparatively small sample provides high-resolution information on both the community and population levels that are unavailable to other paleozoologist (Griffiths and Evans, 1991).

Ostracods are rarely used for biodiversity studies, as initial identification requires full dissection of individuals, which is time-consuming. However, once species identity has been established, the morphology is sufficient to allow confident identification within a given region (Martens *et al.*, 2008). The diversity of the Ostracods is not yet fully documented, only estimates of the total number of species have been established. There are more than 6500 living and fossil Ostracods taxa at the species level that have been described (Ikeya *et al.*, 2005). Modern classification of quaternary comprises 10 suborders, and 16 superfamilies' of *Myodocopida*, living Ostracods comprises of- *Holocyrida*, *Platycopida*, *Podocopida*, and *Palaecopida* (Horne *et al.*, 2002).

The subclass *Podocopida* includes Marine and non-Marine benthonic Ostracods with carapaces exhibiting high morphological variations, but with no anterior nostrum or compound lateral eyes. Females have six to eight pairs of limbs, plus a furca (which in some groups is greatly reduced) positioned to the anterior to the anus. The antenna bears a well-developed endopodite and reduced exopodite. Detailed comparative descriptions of the morphology of different groups of Ostracods are provided by Horne *et al.* (2002, 2005).

Diversity changes and geochemistry signals are also indicative of environmental modification in transitional coastal regions, where changes in sea level produce ecological displacement of the benthic Ostracods communities, (Boomer and Eisenhower, 2002). Ostracods are usually distinguished from other crustaceans by their compressed body, head and seven thoracic limbs. Ostracods feed on plant materials, notably phytoplankton. They reproduce both sexually and asexually, by pathogenesis. There are 2,500 living species of ostracods, (Griffith and Holmes, 2000). There are many factors

influencing the ostracod's distribution and abundance in water bodies. These include temperature, depth, transparency, vegetation, Dissolved oxygen, pH, etc. Ostracods are used as bioindicator species for water quality estimation. Ostracods show positive ecological requirements, tolerance, and habitat preferences to some physicochemical variables. (Kulkoyluoglu, 2004).

The Ostracods are very interesting crustaceans having bivalve carapace, constituting one of the most important groups of zooplanktons, and it plays an important role in transferring the energy from producers to the consumers, and they occupy the immediate positions in the aquatic food web- Therefore abundance of zooplankton in a water body is regarded as an indicator of productivity. The present study was carried out to evaluate the seasonal occurrence of some ostracods in relation to physicochemical parameters.

MATERIALS AND METHODS

Study Area

The study area comprises of five (5) different ponds, two from the Faculty of Science, namely Station A and Station B, two from landscape nursery unit, named Station C and Station D, and the fifth one from central park, behind central mosque, University of Maiduguri, named Station E.

Determination of Physicochemical Parameters

Water sample for physicochemical analysis was obtained once, every month, for the period of 4 months in a 500ml bottle, and was taken to the laboratory for analysis; Boyd (1979), Karanovic (2011) and APHA, (1980) description was adopted.

Collection of Ostracods Samples and Identification

Samples were collected from five stations within 4 months namely (August, September, October and November) covering both wet and dry season. Samples were collected using plankton net, made of bolting nylon cloth (mesh 25ml) by sieving a known volume of water sample. The sample were fixed in 4%

formalin and preserved in 100ml bottles. Identification of ostracods species, samples was done by morphological examination in details under the microscope with high magnification X 40 as described by Martin (2016)

Simple percentages were used, and hence: X_1, X_2, X_3 = No of identified species per station.
 $\sum X_n$ = Total number of Identified Species per station
 $\sum X_n/100$ = % composition of Identified Species per family.

Statistical Analysis
RESULTS

Table 1: Level of Physicochemical parameters at Study Stations

Sample	Parameters				
	pH	Temp. (°C)	DO(mg/L)	BOD(mg/L)	Turbidity (NTU)
A	5.5	33.4	1.49	0.11	15
B	5.8	33.2	1.50	0.8	12
C	5.8	30.0	2.04	0.8	14
D	6.5	31.0	1.00	0.0	14
E	9.6	31.1	1.80	0.6	18

The temperature recorded ranges from 30⁰C to 33.4⁰C with station C recording the lowest temperature of 30.0⁰C, and the highest in station A with 33.4⁰C. The pH ranges from 5.5 to 9.6, with station A, recording the lowest of 5.5; slightly acidic in condition and station E recording the highest of 9.6; slightly alkaline in condition (Table 1)

Dissolved oxygen (DO), ranges from 1.00 to 2.04mg/l. The highest value of DO was recorded in station C, and the lowest in station D. there was no significance difference

between station A and B. Biochemical oxygen demand (BOD) ranges from 0.0 to 0.11Mg/l with station A recording the highest value of 0.11Mg/l and station D, the lowest value of 0.0Mg/l while station B and C recorded the same value of 0.8Mg/l (Table 1).

Results for turbidity shows that the highest value was recorded in station E with 18 NTU, and the lowest value was at station B of 12 NTU. There is no significance difference between station C and station D respectively (Table 1).

Table 2: Ostracods species per station (August)

Species	Number of species per Sample					
	A	B	C	D	E	Total
<i>Cypria ophthalmica</i>	2	2	1	0	2	7
<i>Cypridopsis vidua</i>	2	0	1	2	1	6
<i>Eucypris virens</i>	0	3	2	2	1	8
<i>Cypris bispinosa</i>	1	0	1	1	2	5
<i>Heterocypris inconguens</i>	1	4	0	1	1	7
<i>Sarscypridopsis aculeate</i>	1	0	0	2	3	6

Table 2 shows that the species of *Eucypris virens* has the highest frequency of occurrence, while the species of *Cypris bispinosa* has the lowest frequency. The species of *Heterocypris inconguens* has the highest number of species

per station, while *Cypria ophthalmica*, *Cypridopsis vidua*, *Cypris bispinosa* and *Sarscypridopsis aculeate* have the lowest number per station.

Table 3: Ostracods species per Station (September)

Species	No. of species per Station					Total
	A	B	C	D	E	
<i>Cypris ophthalmica</i>	1	0	2	1	1	5
<i>Cypridopsis vidua</i>	1	1	2	0	2	6
<i>Eucypris virens</i>	2	3	2	1	1	9
<i>Cypris bispinosa</i>	0	1	1	0	2	4
<i>Heterocypris inconguens</i>	0	1	1	0	1	3
<i>Sarscypridopsis aculeate</i>	1	0	1	2	1	5

Table 3 above shows that the species of *Eucypris virens* has the highest frequency of occurrence, while the species of *Heterocypris inconguens* has the lowest frequency. The species of *Eucypris virens* has the highest

number of species per station, while *Cypria ophthalmica*, *Cypridopsis vidua*, *Cypris bispinosa*, *Heterocypris inconguens* and *Sarscypridopsis aculeata* have the lowest number per station.

Table 4: Ostracods Species per in Station (October)

Species	No. of species per Station					Total
	A	B	C	D	E	
<i>Cypris ophthalmica</i>	2	1	1	0	2	6
<i>Cypridopsis vidua</i>	0	1	1	0	0	2
<i>Eucypris virens</i>	2	1	1	2	1	7
<i>Cypris bispinosa</i>	0	2	2	0	1	5
<i>Heterocypris inconguens</i>	0	2	2	0	1	5
<i>Sarscypridopsis aculeate</i>	1	0	0	1	1	3

Eucypris virens has the highest frequency of occurrence, while *Cypridopsis vidua* has the lowest frequency. *Cypria ophthalmica*, *Eucypris virens*, *Cypris bispinosa* and *Heterocypris inconguens* has the highest

number of species per station, while *Cypridopsis vidua* and *Sarscypridopsis aculeate* have the lowest number per stations (Table 4)

Table 5: Ostracods species per station in Month (November)

Species	No. of species per Station					Total
	A	B	C	D	E	
<i>Cypris ophthalmica</i>	1	0	0	1	1	3
<i>Cypridopsis vidua</i>	2	1	1	0	1	5
<i>Eucypris virens</i>	1	1	0	2	0	4
<i>Cypris bispinosa</i>	2	0	1	1	0	4
<i>Heterocypris inconguens</i>	1	1	0	1	2	5
<i>Sarscypridopsis aculeate</i>	0	1	0	1	0	2

In Table 5 shows that the species of *Cypridopsis vidua* and *Heterocypris inconguens* have the highest frequency of occurrence, while the species of *Sarscypridopsis aculeate* have the lowest frequency. The species of *Cypridopsis vidua*,

Eucypris virens, *Cypris bispinosa* and *Heterocypris inconguens* have the highest number of species per station, while *Cypris ophthalmica* and *Sarscypridopsis aculeate* has the lowest number per station (Table 5).

Table 6: Species of Ostracods identified and their percentage composition for stations in August

Family	Species	No. of species collected	% Composition
Cypridoidea	<i>Cypris ophthalmica</i>	7	17.5
Cypridoidea	<i>Cypridopsis vidua</i>	6	15
Cypridoidea	<i>Eucypris virens</i>	9	22.5
Cypridoidea	<i>Cypris bispinosa</i>	5	12.5
Cypridoidea	<i>Heterocypris inconguens</i>	7	17.5
Cypridoidea	<i>Sarscypridopsis aculeate</i>	6	15
Total		40	100

Table 6 shows that - *Eucypris virens* have the highest composition of 22.5%, followed by the *Cypris ophthalmica*, and *Heterocypris inconguens* with 17.5% respectively, while

Cypridopsis vidua and *Sarscypridopsis aculeate* has 15%, and *Cypris bispinosa* with 12.5%. This indicated that *Eucypris virens* dominated the other species.

Table 7: Species of Ostracods identified into families and their percentage composition in September

Family	Species	No. of species collected	% Composition
Cypridoidea	<i>Cypris ophthalmica</i>	5	15.6
Cypridoidea	<i>Cypridopsis vidua</i>	6	18.8
Cypridoidea	<i>Eucypris virens</i>	9	28.1
Cypridoidea	<i>Cypris bispinosa</i>	4	12.5
Cypridoidea	<i>Heterocypris inconguens</i>	3	9.4
Cypridoidea	<i>Sarscypridopsis aculeate</i>	5	15.6
Total		32	100

Eucypris virens has the highest species composition with 28.1%, followed by the species of *Cypridopsis vidua* with 18.8%, *Cypris ophthalmica*, and *Sarscypridopsis*

aculeate with 15.6%. *Cypris bispinosa* with 12.5% and *Heterocypris inconguens* with 9.4%. This means that *Eucypris virens* appeared to be dominant (Table 7).

Table 8: Species of Ostracods identified into families and their percentage composition for stations in October

Family	Species	No. of species collected	% Composition
Cypridoidea	<i>Cypris ophthalmica</i>	6	21
Cypridoidea	<i>Cypridopsis vidua</i>	2	7
Cypridoidea	<i>Eucypris virens</i>	7	25
Cypridoidea	<i>Cypris bispinosa</i>	5	18
Cypridoidea	<i>Heterocypris inconguens</i>	5	18
Cypridoidea	<i>Sarscypridopsis aculeate</i>	3	11
Total		28	100

Table 8 shows that *Eucypris virens* has the highest composition with 25%, followed by *Cypris ophthalmica* with 21%, *Sarscypridopsis aculeate* with 11%, *Cypris bispinosa* and

Heterocypris inconguens with 18% and *Cypridopsis vidua* with 7%. This means that the species of *Eucypris virens* dominate the aquatic environment.

Table 9: Species of Ostracods identified into families and their percentage composition for stations in November.

Family	Species	No. of species collected	% Composition
Cypridoidea	<i>Cypris ophthalmica</i>	3	13.1
Cypridoidea	<i>Cypridopsis vidua</i>	5	21.7
Cypridoidea	<i>Eucypris virens</i>	4	17.4
Cypridoidea	<i>Cypris bispinosa</i>	4	17.4
Cypridoidea	<i>Heterocypris inconguens</i>	5	21.7
Cypridoidea	<i>Sarscypridopsis aculeate</i>	2	8.7
Total		23	100

Cypridopsis vidua and *Heterocypris inconguens* have the highest composition of 21.7%, followed by *Eucypris virens* and *Cypris bispinosa* with 17.4%, *Cypria ophthalmica* with

DISCUSSION

The ranges of physicochemical parameters in the study station have been presented (Table 1). These include temperature, pH, Dissolved Oxygen (DO), Biochemical oxygen demand (BOD) and turbidity. The temperature recorded is low in station C and high in stations A and B. Dissolved oxygen is low in station D, and high in station C. pH is recorded low in station A (weakly acidic) and high in station E (alkaline). (pH range, 5.5- 9.6). The balanced pH value indicates slight acidity of the solution, while the decrease in the pH number indicates higher acidity of the solution. Ostracods' composition and abundance about Physicochemical parameters as shown in table 1 show that temperature and pH were two primary factors that determine Ostracods' composition and abundance in the study area. It has also been suggested as a primary factor constraining ostracods' ecology, and distribution is related to carapace calcification during post-embryonic development when Calcium uptake in acid waters is difficult (Griffith and Holmes, 2000). It has been recognized that at pH<5,

13.1% and *Sarscypridopsis aculeate* with 8.7%. This means that species of *Cypridopsis vidua* and *Heterocypris inconguens* dominated this month (Table 9).

Ostracods species are absent in general (Boomer *et al.*, 2006).

Egborge (1974), and Holden and Green (1960), noted that climatic factors were the determining factors for water temperatures. Timms (2001) suggested that climatic factors were the determining factors for the increase and decrease in temperature of the arid zone, particularly Maiduguri Metropolitan shares climate of the arid zone. The water temperatures of this study fall within the normal temperature range (25°C -35°C) of the natural waters of the arid zone natural tropical waters. (Alabaster and Lloyd,1980). This also agrees with Boyd (1979) that water temperatures affect ostracods in various locations and sites.

The pH levels of the stations ranged from 5.5 – 9.6, an indication of weak acidity and weak alkalinity respectively. This agrees with Beadle (2001), that photosynthesis and respiratory processes determine to a large extent the hydrogen concentration in an aquatic ecosystem. Hutchinson (2005), Walnis and Toeman (2009), and Holden and Green (1960) noted that in African waters, alkaline

conditions are not typical. It agrees with Steeman- Nelsons (1977) that decay of allochthonous and autochthonous organic compounds in water bodies would decrease the pH to below 7.0.

The patterns of dissolved oxygen varied between stations. It ranges from 1.00mg/l to 2.04mg/l. the relative level of DO in all stations may be due to the less decomposition process of organic matter brought into the water bodies through surface run-offs. Duchene (2000) considers that whereas wind is a major oxygenator in water bodies, DO in small water bodies and other lentic water bodies is determined by the photosynthetic actions of phytoplanktons, not ostracods. Complete oxygen depletion was not observed in any station, apparently because of the non-lentic nature of the stations, and the prevailing winds of the northeast arid zone. This agrees with Wetzel (1975), that asserted that DO was the most critical variable in water. The amount available in water depends on the presence of phytoplanktons, time of the day, the turbulence of the water body, water temperatures and the amount discharged into water. Also, Helfrich *et al.* (1996) said that the solubility and dynamics of oxygen distribution in water bodies are the basis of the understanding of aquatic ecosystems. The result of this work indicates lower levels of primary productivity, which agrees with Wetzel (1975).

The Biochemical Oxygen demand (BOD), ranges from 0.0mg/l – 0.11mg/l. the lowest value of 0.0mg/l in station D is not surprising, as it is unstable in nature, because of its small surface area, and higher in station A, because of an increased depth and size, which agrees with Wetzel (1975). The BOD values are the same in station B and Station C, which could probably same rate of organic matter degradation that utilizes oxygen, which agrees with Umeham (1983) and Kolo and Yisa (2000). Moore and Moore (1976) reported that BOD is a measure of the cleanliness of any water body and classifies values less than

1,2mg/l as clean. Based on these, all the water bodies may be considered as clean.

The turbidity values ranged from 12 NTU to 15 NTU, with stations C and D with the same values of 14 NTU. The highest value of 15NTU recorded in Station B may be connected to occasional flooding, which brought in a high concentration of sediments into the water body, which affects the biotic community, notable ostracods are sediment-based, and Alabaster and Lloyds (1980) suggested that excessive turbidity might be harmful to aquatic life and demonstrated that turbidity can be directly responsible for reducing survival of zooplankton such as *Daphnia* spp.

A total of six (6) Ostracods species were identified and they belong to the same family. *Cypridoidae* for station A, station B, station C, station D, and station E respectively. The most abundant species in the studies was *Eucypris virens*, which occur throughout the period in sample collection. The most common species in station A, station B, station C, station D, and station E are *Cypria ophthalmica*, *Cyprodopsis vidua*, *Cypris bispinosa*, and *Heterocypris incongruens*, while the uncommon one is *Sarscypridopsis aculeate*.

The Ostracods species identified in the first Month show that *Eucypris virens* has the highest species composition with 22.5%. In the second month, it shows that *Eucypris virens* has the highest species with 28.1%, while *Heterocypris incongruens* has the lowest species with 9.4%. In the third month, it shows that *Eucypris virens* has the highest species with 32%, while *Cypridopsis vidua* has the lowest species with 8%. In the fourth month, it shows that *Cypridopsis vidua* and *Heterocypris incongruens* have the highest species with 21.7%, while *Sarscypridopsis aculeate* has the lowest species with 8.7% because ostracods species in the Cypridoidae can reproduce eggs, with drought resistance that can withstand temporary water bodies. (Martens and Hornes, 1998). This environment may provide a habitat for rare and endangered species (Martens *et al.*, 2010).

CONCLUSION

Studies on Ostracods community in the five different ponds revealed the presence of six different species that belong to the same family (Cypridoidae) distributed across the sampling point with varying number of species; consisting of *Cypria ophthalmica*, *Cyprodopsis vidua*, *Cypris bispinosa*, and *Heterocypris incongruens*, while the uncommon one is *Sarscypridopsis aculeate*

Ostracods species composition and abundance have been conditioned by environmental settings with temperature and pH as primary determinants, but also dissolved oxygen (DO) and Biochemical Oxygen demand (BOD) as secondary determinants. The potentials of five different temporary ponds, in the University of Maiduguri as important reservoirs of Ostracods fauna richness, were discovered and studied, despite the small size areas. Still other characteristics of the study area, not only pond but hydro period, aero-hydro-edaphic complex and microclimate should be considered, in explaining relative high Ostracods richness using Spatio- a surface area not depth and the relationship between Ostracods as benthos and their temporal position as pelagic. Temporary habitats hold significant biodiversity serving as repositories of a diverse composition heritage as encountered in these short-term studies. Based on the studies conducted, it is clear that the physicochemical parameters of the water in the ponds, hydro period, size and strata are determinants in Ostracods identification and composition and hence the recommendation for long-term seasonal variation inclusive correlation studies on the effects of physicochemical parameters on Ostracods in microcosm and in-situ lentic and lotic water bodies.

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