Species Composition of Rotifers in a Tropical Lotic Freshwater Ecosystem in South - Eastern Nigeria.

Ibemenuga Keziah Nwamaka,
Department of Biological Sciences, Chukwuemeka Odumegwu Ojukwu University, Uli Campus, Anambra State, Nigeria.
jesusvesselofhonour@yahoo.com

Obi Valentina Chioma
Department of Biological Sciences, Chukwuemeka Odumegwu Ojukwu University, Uli Campus, Anambra State, Nigeria.
valex.2000@yahoo.com

Nwosu Moses Chukwuemeka
Department of Biological Sciences, Chukwuemeka Odumegwu Ojukwu University, Uli Campus, Anambra State, Nigeria.
chukellisnwosu@yahoo.com

ABSTRACT

Fortnightly samples of rotifers were collected from Okpu Stream for two seasons (wet and dry seasons) using plankton net with 55 µm mesh size. Ten species of rotifers composed of 91 individuals belonging to eight families and two orders were collected from all the study stations. Stations 1, 2 and 3 had the overall percentage abundance of 52.75%. The most abundant and diverse family was Brachionidae which was represented by three species encountered in the study. The most abundant species was Brachionus sp. which occurred most in stations 2 (7,25.93%) and 3 (7,14.58%) with overall percentage composition of 17.58%. The least rotifer species in Okpu Stream was Euchlanis sp. (Family Euchlanidae) which was recorded only in stations 1 and 3. Margalef's taxa richness index was highest in station 1 and least in station 2. Shannon's index of diversity was maximum in station 3 and least in station 1. Evenness had its highest value in station 3. Dominance index which was highest in station 2 was least in station 3. Bellinger's coefficient showed that stations 1 and 3 and stations 2 and 3 were significantly similar in trend with each other while stations 1 and 2 were dissimilar. The composition and density of rotifers are influenced by both biotic and abiotic factors. The low abundance of rotifers in station 1 may be due to factors such as fast water current. The ability of rotifers to undergo initial migration which minimizes competition through niche exploitation and food utilization, could be probably the reason for their dominance in aquatic environments. The significantly higher diversity in station 3 is a reflection of an ecologically favourable environment. This is justified by the high evenness. The result of the study showed that biotic and abiotic factors, short development rates and vertical migration influence the composition and density of rotifers.

Keywords: Composition, rotifers, freshwater, ecosystem, Nigeria.

INTRODUCTION

Rotifers are minute animals without coelom and backbones commonly found in freshwaters. Their multicellular triploblastic bodies are recognizable into anterior ciliated corona, a middle trunk and a posterior foot with one or more toes (Egborge, 1993). The study on rotifers in Nigeria waters started with lotic freshwaters. Green (1960) conducted the first study in River Sokoto (Egborge, 1994) where he recorded ploimates and bdelloids. Since then, several studies have been conducted on Nigeria lotic waters. Such works include Ikpoba River (Egborge and Chigbu, 1988), Benin River (Onwudinjo and Egborge, 1994) and Omi River (Fatioye and Omoyinmi, 2006). However, such studies have not been conducted in Okpu stream. The present study is therefore, aimed at providing information hitherto unavailable on the rotifers of Okpu stream in Anambra State, South-eastern Nigeria.

Study Area

The Okpu Stream which almost surrounds Okija is located between latitude 5^{o} 52^{1} N and latitude 5^{o} 60^{1} N and longitude 6^{o} 50^{1} E and longitude 6^{o} 55^{1} E (Figure 1). It takes its source from Otagirigiri Stream in Umuarugwu Uzoakwa village in Ihiala town and flows through Umuofo and Umuohi Okija where it empties into River Orashi. The stream serves the inhabitants of Okija and her environs for domestic, agricultural and recreational purposes (Figure 1).

There are farmlands within the catchment area of the stream from which fertilizers applied by farmers to their farms are washed by flood into the stream. Fishing is not practiced in Okpu Stream. This is because the heathens of Okija superstitiously believe that Ogwugwu Mmiri (god) of Okija originated

from the stream and the resident fishes are his younger children. They believe strongly that whoever harms or kills the fishes will be killed by the god.

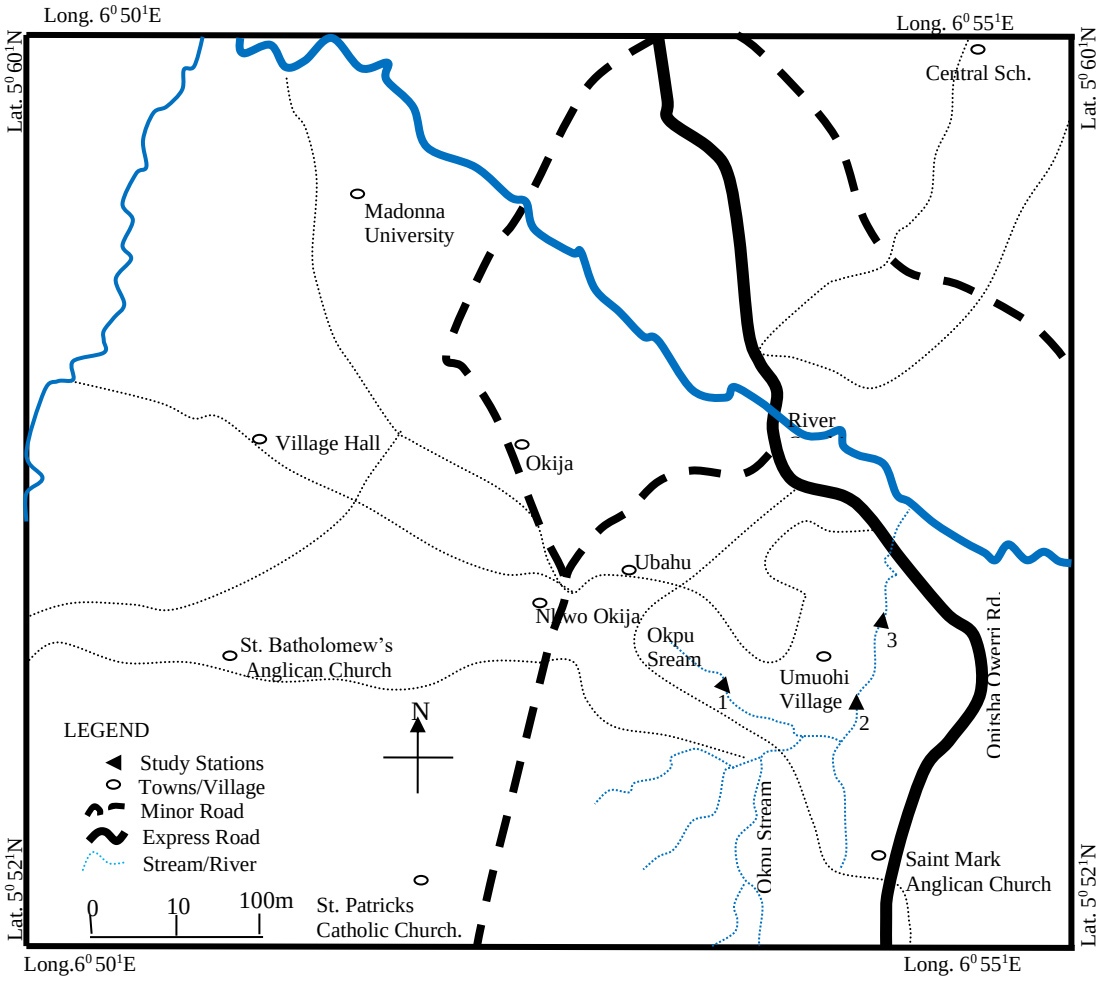

Figure 1: Map of the study area showing study stations

Study Stations

Okpu Stream was demarcated into three study stations on the basis of type of habitat, human activities and accessibility (Figure 1).

Station 1: This is the head of the stream. The water channel of this station is very narrow and straight. Water flows fast in this station. Human activities occurring in this station include fetching of water for drinking and other domestic purposes. The littoral vegetation observed in this station include *Oxytenanthera abyssinica*, *Bambusa* sp., *Azolla* sp. and *Raphia hookeri*.

Station 2: This station is deeper than station 1. The water channel which is undulating has a muddy substratum. Human activities in this station are bathing, laundry and swimming among others. Plants growing in and around this station include *Pistia stratiotes*, *Azolla* sp. and *Oxytenanthera abyssinica*.

Station 3: This is the widest and deepest station occupying a large surface area. Its substratum is very muddy. The water velocity is very slow. The water channel is undulating. Soaking and sieving of cassava and sieving of breadfruit are among the human activities occurring in this station. Aquatic macrophytes observed in this station include *Azolla* sp., *Costus afar and Oxytenanthera abyssinica.*

MATERIALS AND METHODS

Samples of rotifers were collected fortnightly from Okpu Stream for two seasons (wet and dry seasons) using plankton net of 55µm mesh size. The samples were collected from study stations, preserved with 4% formalin in specimen bottles carefully labeled according to stations and transported to the laboratory.

The samples were mounted and observed under a dissecting microscope following the method in Fafioye and Omoyinmi (2006). Relevant texts such as Jeje and Fernando (1986), Pennak (1978) and Thorp and Rogers (2011) were used in identification of rotifers.

Data Analysis

Faunal diversity and dominance were calculated using Diversity indices. Margalef's richness index (d) which is species richeness index was calculated as follows:

$$d = \frac{\mathrm{S} - 1}{\mathrm{In\ N}}$$

Where,

D = Margalef's richness index

S = total number of species

N = total number of individuals

In = Naperian logarithm

Shannon's index (H^1) of diversity, a function derived which is widely used in community ecology (Ogbeibu, 2005) was evaluated using the formula

$$H^1 = \sum_{i=1}^{s} pi\ Lnpi$$

Where,

Pi = the proportion of individuals belonging to i^{th} species.

Evenness index (E^1) which Ogbeibu (2005) described as a measure of the ratio of the observed diversity to the maximum diversity was calculated as follows:

$$\mathrm{E}^1 = \frac{\mathrm{H}}{\mathrm{In\ s}}$$

Simpson's index (D) which measures dominance in infinite populations, was calculated using the formula

$$H = \sum_{i=1}^{s} \frac{ni(ni-1)}{Ni(Ni-1)}$$

Where,

ni = number of individuals belonging to i^{th} species

Ni = total number of individuals

The reciprocal form of Simpson's index (D^1) which is the number of very abundant species and which according to Margurran (1988) increases with increasing diversity, was calculated using the formula:

$D^1 = \frac{1}{D}$ which is the reciprocal form of Simpson's index

Bellinger's coefficient, a similarity index was used to compare the study stations and determine which ones were similar in taxa composition. The similarity index is given by the equation:

$$\text{Belinger's scoefficient} = \frac{(p-q)^2}{p+q}$$

Where,

p = number of occasions on which the

species occur in greater number in station 1 than in station 2

q = number of occasions when the reverse is the case

Analysis of variance (ANOVA) at 5% level of significance was used to determine differences in the abundance of rotifers collected in the study stations.

RESULTS

Table 1 shows the species of rotifers collected during the study. Ten rotifer species belonging to 8 families and 2 others were recorded from all the study stations. The maximum abundance occurred in station 3 (48), followed by stations 2 (27) and 1 (16) with respective overall percentage abundance of 52.75, 29.67 and 17.58 (Figure 2). Analysis of variance (ANOVA) performed showed that there was significant difference ($p < 0.05$) in the abundance of rotifers collected in the study stations. While station 3 had the highest number of species (12), stations 1 and 2 had equal and least number of 8 species each. The other Ploima, with the highest species composition (7) had the highest relative percentage composition of 79.22%. The most abundant and diverse family was Brachionidae (Figure 3) which was represented by 3 species namely *Brachionus* sp., *Keretella tropica* and *Keretella cochlearis*. The most abundant species was *Brachionus* sp. It had equal and highest abundance in stations 2 (7,25.93%) and 3 (7,14.58%) with an overall relative percentage composition of 17.58%. The least rotifer species in Okpu Stream during the study was *Euchlanis* sp. (Family Euchlanidae) (3, 3.30%). It was recorded only in stations 1 (1, 6.25%) and 3 (2, 4.17%), being absent in station 2.

Table 1: Species composition and relative abundance of rotifers collected in Okpu Stream

Order	Family	Species	Stations							
			1		2		3		Total	
			No.	%	No.	%	No.	%	No.	%
Monimotrocha	Gastropodidae	*Ascomorpha* sp.	1	6..25	-	-	3	6.25	4	4.40
	Testudinellidae	*Testudinella* sp.	-	-	1	3.70	4	8.33	5	5.49
	Filinidae	*Filinia opoliensis*	2	13.50	3	4.29	5	10.42	10	10.99
Ploima			13	81.25	23	85.19	36	75.00	72	79.12
	Euchlanidae	*Euchlanis* sp.	1	6.25	-	-	2	4.17	3	3.30
	Trichocercidae	*Trichocerca* sp.	1	6.25	2	7.41	7	14.50	10	10.99
	Asplanchnidae	*Asplanchna* sp.	2	12.50	4	14.81	5	10.42	11	12.90
	Brachionidae	*Brachionus* sp.	2	12.50	7	25.93	7	14.58	16	17.58
		Keretella tropica	3	18.75	6	22.22	6	12.50	15	16.48
		Keretella cochlearis	4	25.00	2	7.41	6	12.50	12	13.19
	Lecanidae	*Lecane* sp.	-	-	2	7.41	3	6.25	5	5.49

Total number of species	**8**	**-**	**8**	**-**	**10**			
Total number of individuals	**16**	**17.58**	**27**	**29.67**	**48**	**52.75**	**91**	**100**

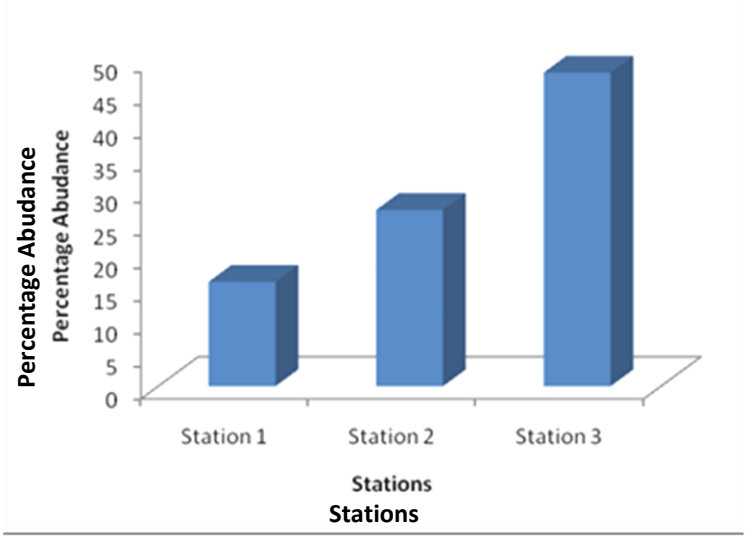

Figure 2: Percentage Abundance of rotifers in the study stations

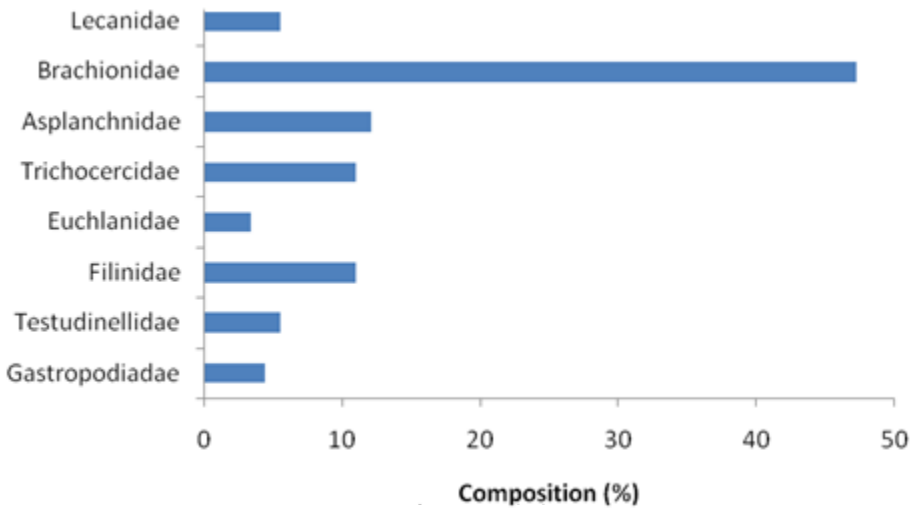

Figure 3: Percentage relative abundance of Rotifer families in Okpu Stream

Table 2 shows the diversity and dominance indices calculated for the study stations. Margalef's taxa richness index (d) was highest in station 1 (2.525) and least in station 2 (2.124). Shannon's index of diversity was maximum in station 3 (2.240), followed by station 2 (1.912). Station 1 had the least value of 1.789. Evenness index was highest in station 3 (0.973) and least in station 1 (0.860). Simpson's index was highest in station 2 (0.184) and least in station 3 (0.094).

Bellinger's coefficient (Table 3) showed that stations 1 and 3, and stations 2 and 3 were significantly similar with each other while stations 1 and 2 were dissimilar.

Table 2: Rotifer diversity indices in the study stations of Okpu Stream

	Stations		
	1	**2**	**3**
No. of taxa	8	8	10
No. of individuals	16	27	48
Margalef's richness index (d)	2.525	2.124	2.325
Shannon's index (H^1)	1.789	1.912	2.240
Evenness (E^1)	0.860	0.919	0.973
Simpson's index (D)	0.099	0.184	0.094
Simpson's index (D^1)	10.101	5.435	10.638

Table 3: Bellinger's coefficient of similarity of the Rotifer fauna in the study stations of Opku Stream

Stations	**1**	**2**	**3**
1			
2	2.67		
3	8.00*	6.00*	

* **Significant relationship ($p < 0.05$)**

DISCUSSION

The catch composition from this investigation revealed Ploima (79.22%) as the dominant order in the stream. The species of rotifers encountered were recorded in other Nigerian lotic freshwaters including Oshun River (Egborge, 1972), Ikpoba River (Egborge and Chigbu, 1988), Opa river (Akinbuwa and Adeniyi, 1991), Omi River (Fafioye and Omoyinmi, 2006). The 10 species encountered in this study compares well with 15 species which Idowu and Gadzama (2011) recorded in Lake Alau. However, it was lower than the following number of species recorded in some Nigeria water bodies: 50 in Benin River (Onwudinjo and Egborge, 1994), 53 in Ikpoba River Dam (Iloba and Egborge, 2002) and 49 in Orogodo River (Arimoro and Oganah, 2010). The composition and density of rotifers are influenced by both abiotic and biotic factors. Thus the low abundance in station 1 may be due to factors such as fast water current. The maximum abundance of rotifers in station 3 could be attributed to availability of microhabitats. The predominant family was Brachionidae. It is generally the most dominant in terms of species in West Africa freshwater ecosystems (Akin-Oriola, 2003). The dominant species were *Brachionus* sp., *Keretella tropica* and *Keretella cochlearis*. Akin-Oriola (2003) studying in Ogunpa and Ona Rivers and Ehkande *et al*. (2013) studing in Yashwant Lake obtained similar results. Herzig (1983) and Pourriot *et al*. (1997) attributed the high population densities of rotifers to their parthenogenetic reproductive pattern and short developmental rates under favourable conditions. Also the ability of rotifers to undergo vertical migration, which minimizes competition through niche exploitation and food utilization, could also be probably the reason for their dominance in aquatic environments (Arimoro and Oganah, 2010).

The significantly higher diversity in station 3 is a reflection of an ecologically favourable environment. This is justified by the high evenness and low dominance index. Other researchers (Victor and Ogbeibu, 1985; Ogbeibu, 2001) have correlated high evenness and diversity indices with low dominance index.

CONCLUSION

The study revealed that there are various species of rotifers in Okpu Stream. Both biotic and abiotic factors, reproductive pattern, short development rates and vertical migration influence the composition and density of rotifers.

REFERENCES

Akin-Oriola, G. A. (2003). Zooplankton associations and environmental factors in Ogunpa and Ona Rivers Nigeria. *Revista de Biologia Tropical*, **51**(2): 391-398.

Arimoro, F. O. and Oganah, A. O. (2010). Zooplankton Community Responses in a perturbed Tropical Stream in the Niger Delta, Nigeria. *The Open Environmental and Biological Monitoring Journal*, **3**: 1-11.

Egborge, A. B. M. (1972). The physical hydrology of the River Oshun, Western State of Nigeria. *Archive Hydrobiology*, **70**(1): 71-81.

Egborge, A. B. M. (1993). *Biodiversity of Nigeria*. Natural Resources Conservation Council, Abuja. 173 pp.

Egborge, A. B. M. (1994). *Water pollution in Nigeria: Biodiversity and Chemistry of Warri River, Nigeria*: Ben Miller Publisher, Warri.

Egborge, A. B. M. and Chigbu, P. (1988). The rotifers of Ikpoba River: *The Nigerian Field*, **272**: 87-94.

Ekhande, A. P., Patil, J. V., Patil, R. D. and Padate, G. S. (2013). Water quality monitoring - study of seasonal variation of rotifers and their correlation with physico-chemical parameters of Yashwant Lake, Toranmal (M.S.) India. *Archives of Applied Science Research*, **5**(1): 177-181.

Fafioye, O. O. and Omoyimi, G. A. K. (2006). The rotifers of Omi River, Ago-Iwoye, Nigeria. *African Journal of Agricultural Research*, **1**(5): 186-188.

Green, J. (1960). Zooplankton of the River Sokoto. The Rotifera. *Proceedings of Zoological Society of London*, **135**: 491-523.

Herzig, A. (1983). Comparative studies on the relationship between temperature and duration of embryonic development of rotifers. *Hydrobiologia*, **104**: 237-246.

Idowu, R. T. and Gadzama, U. N. (2011). Rotifer Fauna in Lake Alau, Arid Zone of Nigeria in West Africa. *Nature and Science*, **1**(8): 261-267.

Iloba, K. I. and Egborge, A. B. M. (2002). Changes in the rotifers of Ikpoba River Dam, Benin City, Southern Nigeria. *Tropical freshwater Biology*, **11**(1): 37-46.

Jeje, C. R. and Fermando, C. H. (1986). *A practical guide to the identification of Nigerian zooplankton* (Cladocera, Copepoda and Rotifera). *Kainji Lake Resources*, **77**(2): 237-253.0.

Maguran, A. (1988). *Ecological Diversity and its Measurements*. London, Groom Helm.

Ogbeibu, A. E. (2001). Distribution, density and diversity of dipterans in a temporary pond in Okomu forest reserve, southern Nigeria. *Journal of Aquatic Sciences*, **16**: 43-52.

Ogbeibu, A.E. (2005). *Biostatistics: A Practical Approach to Research and Data handling*. Mindex Publishing Company Ltd., Benin City. 264 pp.

Onwudinjo, C. C. and Egborge, A. B. M. (1994). Rotifers of Benin River, Nigeria. *Hydrobiologia*, **272**: 87-94.

Pennak, R. W. (1978). *Freshwater invertebrates of the United States*, 2nd Ed. John Wiley and sons, New York.

Pourriot, R., Tougier, C. and Miquelis, A. (1997). Origin nad development of river zooplankton: example of the marine; *Hydrobiologia*, **104**: 237-246.

Thorp, J. H. and Rogers, D. C. (2011). *Field Gudie to Freshwater Invertebrates of North America*. Academic Press. USA.

Victor, R. and Ogbeibu, A. E. (1985). Macrobenthic invertebrates in a Nigerian stream after pesticide treatment and associated disruption. *Environmental Pollution Series A*, **41**: 125-137.