MACROINVERTEBRATE FAUNA OF A TROPICAL FRESHWATER STREAM IN NIGERIA

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ABSTRACT

Macroinvertebrate fauna of Ogbei stream in Anambra state, Nigeria was studied from monthly samples taken from six stations or sites with a benthic scoop net and a serrated cylindrical sampler (SCS) for 12 months (May, 2002 – April, 2003). A total of 11420 macroinvertebrates were collected belonging to 4 classes, 13 orders, 28 families and 50 species. The fauna was dominated numerically by Insecta (98.29 %), Arachnida (0.81%) and Oligochaeta (0.66%). Diptera was the most abundant taxon (42.62%), followed by Odonata (36.89%), Coleoptera (9.76 %) and Hemiptera (8.22 %). Station 3 had the highest percentage of abundance of the macrofauna (28.56 %) followed by station 2 (19.54 %). The highest faunal diversity was recorded in station 6. The macroinvertebrate composition, distribution abundance and diversity were influenced by substrate composition, good water quality and availability of food.

Keywords: Tropical freshwater stream, Macroinvertebrate composition, Abundance, Distribution, Diversity

INTRODUCTION

Aquatic macroinvertebrates are an assemblage of aquatic community represented by members of almost all the invertebrate taxa. Most macroinvertebrate are benthic (benthos), others are planktonic or nektonic or surface water dwellers. Macroinvertebrates have attracted a lot of interest among biologists and environmentalists in view of their importance in food chain of fishes and as long term indicators of water quality. Macroinvertebrates play a crucial role in the transfer of energy from primary producers and detritus to fish (Turcotte and Harper, 1982; McQueen *et al.*, 1986; Hanson, 1990). They are also involved in nutrient recycling in aquatic system (Gladden and Smock, 1990) and are used as biological indicators in the assessment of water quality (Rosenberg and Resh, 1993; Crown *et al.*, 1995; Ajao and Fagade, 2002).

Substantial literature on Nigerian aquatic macroinvertebrates are available. Apart from Egborge's (1993) attempt to put together available information on the diversity of aquatic faunal resources of Nigeria, information on the biology and ecology of aquatic macroinvertebrates fauna in different bodies of water in Nigeria are scattered. Egborge (1993) compiled a check list of over 1620 species of invertebrates so far identified in Nigeria, out of which 67.3 % would be considered as macroinvertebrates.

Studies on aquatic macroinvertebrates in some Nigerian water bodies (Victor and Ogbeibu, 1985 and 1991; Ogbeibu and Victor 1989; Ogbeibu and Egborge, 1995; Eyo and Ekwonye, 1995; Ogbeibu and Oribhabor, 2001; Idowu *et al.*, 2004; Odo, 2004) indicate variations in the faunal composition of the water bodies studied. Hence the need to study the macroinvertebrates of a particular water body if the resources of the system are to be managed properly.

Ogbei stream is a major source of water in Nkpologwu community, as a number of human activities take place in and around the stream. Secondly the stream has been proposed for impoundment for domestic and agricultural purposes. Impoundments have been known to create conditions that affect the stability of aquatic life in the system. As there has been no previous scientific study on the stream, this pre-impoundment study was deemed necessary.

A comprehensive scientific study of Ogbei stream aimed at documenting its physico-chemical and biological characteristics is on. The present paper only reports the species composition, abundance, distribution and diversity of the macroinvertebrate fauna of the stream. It is hoped that the comprehensive report on the stream will provide useful pre-impoundment data on which future development and management of the stream resources will be based.

MATERIALS AND METHODS

Study Area: Ogbei stream arises from Umuezeagwu highlands, flows eastwards through Isioji village in Nkpologwu town (5^0 58^1 and 6^0 01^1 N and 7^0 06^1 and 7^0 08^1 E) and stretches through Akpo (in the south) before joining Otalu river to empty into Anambra river (Figure 1). There are two distinct seasons in the area. The rainy/ wet season (April – September) which is sometimes punctuated with a short break of no rain for about two weeks in August. The dry season lasts from October to March and may be punctuated by harmatan (dry and cold north – South wind) between December and January. The temperature of the area ranges between 24 ^{0}C and 32 ^{0}C in the rainy and dry seasons respectively (Emejulu *et al.,* 1992).

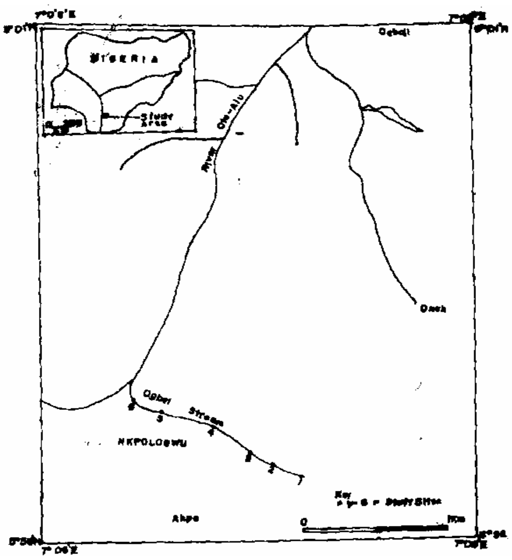

Figure 1: Map of the study area showing the sampling stations

The stream is fringed with riparine vegetation among which are *Pandamus tectorius, Costus afar, Cyathea medullaris*, *Marantochola leucantha*, *Acioa barteri* and *Raffia hookeri.*

A number of activities like bathing, fermenting and sieving of cassava, soaking and washing of tapioca; collection of sand and fishing take place in the stream. A few agricultural activities (farming and gardening) also take place around the stream.

Six sampling stations were selected along the stream based on accessibility, human influence and type of substrate/habitat. The features of which are summarized in Table 1. Each station was about 10 - 12 m apart.

Sample Collections: The macroinvertebrates were sampled with a scoop net and serrated cylindrical sampler. The scoop net was used in the shallow areas along the shore by dragging it with the open end against the water current. It was also used around the aquatic vegetation, in which case the vegetation was disturbed by kicking to dislodge the invertebrates. Sampled specimens were sieved using 0.2 mm and 0.6 mm mesh size sieves and sorted into taxa. The specimens collected were preserved in 10 % formalin and labelled according to stations. Submerged branches of trees, logs and stems were also examined for attached macroinvertebrates.

The SCS was used for quantitative macroinvertebrate sampling. The sampler was pushed into the substratum as fast as possible and the contents of the sampler scooped out into a bucket for washing. The invertebrates were sieved, sorted and preserved in labelled specimen bottles.

All specimens were identified in the laboratory under a dissecting microscope using appropriate taxonomic keys, manuals and texts books (Hutchinson, 1970; Bidwell and Clarke, 1977; Gladden and Smock, 1990; Ajao and Fagade, 2002).

Faunal Diversity and Dominance: Faunal diversity index for taxa richness was analyzed using Shannon-Wiener index (H) (Shannon and Wiener, 1963). General diversity, evenness of distribution (E) were determined according to Krebs (1978). Hutchinson's t-test was used to detect significant differences between general diversity indices (Hutchinson, 1970).

RESULTS

Species Composition and Abundance: A total of 11420 macroinvertebrates collected during the sampling period were identified into 4 classes, 13 orders and 50 species (Table 2). The fauna was dominated numerically by Insecta (98.29%) with 44 species followed by Arachnida (0.81 %) and Oligochaeta (0.66 %) with three species each. The major taxa of the Insecta were Diptera (42.62 %), Odonata (36.89 %) and Coleoptera (9.76 %). *Chironomus transvalensis* (23.58 %), *Coenagrion scitulum* (12.69 %), *Polypedium* sp (11.96 %) and *Libellula* sp (11.15 %) were the prominent species encountered in the collections.

Distribution in Relation to Stations: Oligochaetes represented by *Dero obtusa* and *Dugesia polychroa* were more at station 4 (1.33 %) than in other stations. *D. obtusa* was recorded in all the stations (Table 2).

Decapod crustaceans represented by *Sudanonautes* sp. were found in all the stations but mostly at station 4 (0.44 %). Most of the arachnids were more in station 5 (1.59 %) followed by station 1 (1.53 %). Though *Agronecta aquatica* and *Arrenurus* sp were found in all the stations, *A. aquatica* were most abundant at station 5, (0.84 %) while *Arrenurus* sp were mostly recorded at station 1 (1.02 %).

The major taxa of Insecta were variously distributed in all the stations. Plecopterans were most abundant in station 6 (1.29 %) and Odonata in station 3 (46.26 %). *Coenagrion scitulum, Libellula* sp, *Cordulia* sp were the most important odonatan species present in all the stations. *Hemipteran* spp (Order: Hemiptera) were most abundant at station 6(23.04 %) while *Hydropsyche* sp (Order: Tricoptera) was the most abundant species found particularly in station 4 (1.27 %).

Coleopterans (Order: Coleoptera) were prominent in stations 1 (20.45 %) and 2 (17.11 %). *Gyrinus* sp was the most abundant species contributing 75.74 % of all the coleopterans recorded, followed by *Hydrophilus* sp (20.0 %). Both species were recorded in all the stations. The order Diptera dominated the samples at all the stations and the number of individuals (4867) was significantly higher than those of other orders ($P < 0.05$). The most important diptera recorded in all the stations were *Chironomus transvalensis, Polypedilum* sp and *Strictochiromus* sp. *C. transvalensis* contributed 55.3 % of all the dipterans and were most abundant at station 1 (39.11 %). Generally, most of the macroinvertebrates were recorded in station 3, followed by station 2 (Figure 2).

Table 1: Characteristic features of selected stations

Station	Substrate	Human activities	Vegetation canopy	Light penetration
1	Swampy bank, sand, mud.	Soaking /sieving of cassava, bread fruit, tapioca; washing of clothes, bathing	No	Little
2	Sand, detritus	None	Yes	Little
3	Organic debris/ detritus, sand	Fishing, Lumbering, Palm wine tapping	Yes	Little
4	Sand, mud, stones	Palm wine tapping, lumbering	Yes	Little
5	Sand, mud, organic debris	Palm wine tapping, collection of *Pandamus tectorius* leaves	No	Much
6	Rocky swampy bank, sand and mud	Palm wine tapping	No	Much

Table 2: Abundance of macro-invertebrates in relation to the study stations

TAXA		STATIONS					
	Total No. (%)	1	2	3	4	5	6
OLIGOCHAETA	75(0.66)	3(0.19)	19(0.85)	14(0.43)	24(1.33)	13(1.21)	2(0.14)
Plesiopora	75(0.66)	3(0.19)	19(0.85)	14(0.43)	24(1.33)	13(1.21)	2(0.14)
Naididae	41(0.36)	2(0.13)		8(0.25)	12(0.66)	7(0.65)	2(0.14)
Dero obtusa	41(0.36)	2(0.13)	10(0.45)	8(0.25)	12(0.66)	7(0.65)	2(0.14)
Lumbricidae	31(0.27)	1(0.06)	8(0.36)	6(0.18)	10(0.55)	6(0.56)	-
***Lumbricus* (unidentified)**	31(0.27)	1(0.06)	8(0.36)	6(0.18)	10(0.55)	6(0.56)	-
Dugesiidae	3(0.03)	-	1(0.04)	-	2(0.11)	-	-
Dugesia polychroa	3(0.03)	-	1(0.04)	-	2(0.11)	-	-
CRUSTACEA	28(0.25)	2(0.13)	8(0.36)	8(0.04)	8(0.44)	1(0.09)	1(0.07)
Decapoda	28(0.25)	2(0.13)	8(0.36)	8(0.04)	8(0.44)	1(0.09)	1(0.07)
Sudanonidae	28(0.25)	2(0.13)	8(0.36)	8(0.04)	8(0.44)	1(0.09)	1(0.07)
Sudanonautes sp.	28(0.25)	2(0.13)	8(0.36)	8(0.25)	8(0.44)	1(0.09)	1(0.07)
ARACHNIDA	92(0.81)	24(1.53)	7(0.31)	15(0.46)	7(0.39)	17(1.59)	22(1.49)
Araneae	40(0.35)	8(0.51)	6(0.27)	7(0.21)	3(0.17)	9(0.84)	7(0.47)
Dolomedidae	2(0.02)	-	1(0.04)	1(0.03)	-	-	-
Dolomedes fimbriatus	2(0.02)	-	1(0.04)	1(0.03)	-	-	-
Agronectidae	38(0.33)	8(0.51)	5(0.22)	6(0.18)	3(0.17)	9(0.84)	7(0.47)
Agronecta aquatica	38(0.33)	8(0.51)	5(0.22)	6(0.18)	3(0.17)	9(0.84)	7(0.47)
Hydrachnella	52(0.46)	16(1.02)	1(0.04)	8(0.25)	4(0.22)	8(0.75)	15(1.02)
Arrenuridae	52(0.46)	16(1.02)	1(0.04)	8(0.25)	4(0.22)	8(0.75)	15(1.02)
Arrenurus sp.	52(0.46)	16(1.02)	1(0.04)	8(0.25)	4(0.22)	8(0.75)	15(1.02)
INSECTA	11225(98.29)	154(198.15)	2198(98.48)	3225(98.87)	1769(97.84)	1041(97.11)	1451(98.31)
Plecoptera	47(0.41)	4(0.25)	4(0.18)	7(0.21)	12(0.66)	1(0.09)	19(1.29)
Perlidae	47(0.41)	4(0.25)	4(0.18)	7(0.21)	12(0.66)	1(0.09)	19(1.29)
Dinocras sp	39(0.34)	4(0.25)	-	6(0.18)	11(0.61)	1(0.09)	17(1.15)
Neoperla sp	8(0.07)	-	4(0.18)	1(0.03)	1(0.06)	-	2(0.14)
Odonata	4213(36.89)	382(24.33)	797(35.71)	1509(46.260)	703(38.88)	401(37.41)	421(28.52)
Aeshnidae	158(1.38)	13(0.83)	22(0.99)	50(1.53)	8(0.44)	20(1.87)	45(3.05)

Table 2: Abundance of macroinvertebrates in relation to the study stations (continues)

Aeshna sp. Fabricus	158(1.38)	13(0.83)	22(0.99)	50(1.53)	8(0.44)	20(1.87)	45(3.05)
Corduliidae	437(3.8)	64(4.08)	74(3.32)	124(3.80)	66(3.65)	53(4.94)	56(3.79)
Cordulia sp	437(3.8)	64(4.08)	74(3.32)	124(3.8)	66(3.65)	53(4.94)	56(3.79)
Macromiidae	27(0.24)	18(1.25)	4(0.18)	-	3(0.17)	1(0.09)	1(0.07)
Macromia Africana	27(0.24)	18(1.25)	4(0.18)	-	3(0.17)	1(0.09)	1(0.07)
Gomphidae	159(1.39)	11(0.07)	8(0.36)	34(1.04)	32(1.77)	28(2.61)	46(3.12)
Gomphus sp.	50(0.44)	-	2(0.09)	16(0.49)	10(0.55)	11(1.03)	11(0.75)
Haginus sp.	109(0.95)	11(0.07)	6(0.27)	18(0.85)	22(1.22)	17(1.59)	35(2.37)
Libellulidae	1862(16.30)	199(12.68)	433(19.40)	603(18.49)	270(14.93)	172(16.04)	185(12.53)
Libellula sp.	1273(11.15)	167(10.64)	312(13.998)	452(13..86)	155(8.57)	100(9.33)	87(5.89)
Sympetrum sp.	510(4.47)	30(1.91)	116(5.2)	143(43.8)	95(5.25)	47(4.38)	79(5.35)
Tetragoneuria sp.	79(0.69)	2(0.13)	5(0.22)	8(0.25)	20(1.11)	25(2.33)	19(1.29)
Coenagrionidae	1570(13.75)	77(4.90)	256(11.49)	698(21.40)	324(17.92)	127(0	88(5.96)
Coenagrion scitulum	1449(12.69)	42(2.68)	234(10.48)	680(20.85)	301(16.65)	114(10.63)	78(5.28)
Ischnura sp.	121(1.06)	35(2.23)	22(0.99)	18(0.55)	23(1.27)	13(1.21)	10(0.68(
Hemiptera	939(8.22)	157(10)	140(6.27)	131(4.02)	74(4.09)	97(9.05)	340(23.04
Belostomatidae	1(0.01)	-	-	-	-	1(0.09)	-
Poissonia sp.	1(0.01)	-	-	-	-	1(0.09)	-
Gerridae	310(2.71)	59(3.76)	52(2.33)	40(1.23)	12(0.66)	46(4.29)	101(6.84)
Geris lacustris	233(2.04)	38(2.42)	51(2.58)	33(1.01)	12(0.66)	24(2.24)	75(5.08)
Naboandelus sp.	77(0.67)	21(1.34)	1(0.04)	7(0.21)	-	22(2.24)	26(1.76)
Hydrometridae	56(0.49)	29(1.85)	2(0.09)	2(0.06)	9(0.50)	4(0.37)	10(0.68)
Hydrometra sp.	56(0.49)	29(1.85)	2(0.09)	2(0.06)	9(0.50)	4(0.37)	10(0.68)
Mesoveliidae	251(2.20)	28(1.78)	49(2.20)	5(0.15)	4(0.22)	8(0.75)	157(10.64)
Microvelia sp.	251(2.20)	28(1.78)	49(2.20)	5(0.15)	4(0.22)	8(0.75)	157(10.64)
Naucoridae	25(0.22)	4(0.25)	2(0.09)	5(0.15)	8(0.44)	2(0.19)	4(0.27)
Naucoris cimicoides	25(0.22)	4(0.25)	2(0.09)	5(0.15)	8(0.44)	2(0.19)	4(0.27)
Nepidae	280(2.45)	31(1.97)	33(1.48)	78(2.39)	35(1.94)	36(3.36)	67(4.54)
Nepa apiculata	107(0.94)	1(0.06)	13(1.58)	37(1.13)	15(0.83)	15(1.40)	26(1.76)
Lacotrephes sp.	164(1.44)	27(1.72)	20(0.90)	39(1.20)	20(1.11)	20(1.87)	38(2.57)
Ranatra fusca	9(0.08)	3(0.19)	-	2(0.06)	-	1(0.09)	3(0.20)
Notonectidae	16(0.14)	6(0.38)	2(0. 09)	1(0.03)	6(0.03)	-	1(0.07)
Notonecta sp.	16(0.14)	6(0.38)	2(0. 09)	1(0.03)	6(0.03)	-	1(0.07)
Neuroptera	1(0.01)	-	1(0.04)	-	-	-	-
Sialidae	1(0.01)	-	1(0.04)	-	-	-	-
Sialis sp.	1(0.01)	-	1(0.04)	-	-	-	-
Tricoptera	40(0.35)	-	6(0.27)	4(0.12)	24(1.33)	2(0.19)	4(0.27)
Hydropsychidae	30(0.26)	-	3(0.13)	1(0.03)	23(1.27)	1(0.09)	2(0.14)
Hydropsyche sp.	30(0.26)	-	3(0.13)	1(0.03)	23(1.27)	1(0.09)	2(0.14)
Hydroptilidae	7(0.06)	-	2(0.09)	2(0.06)	-	1(0.09)	2(0.14)
Ochrotrichia sp.	7(0.06)	-	2(0.09)	2(0.06)	-	1(0.09)	2(0.14)
Philopotamidae	3(0.03)	-	1(0.04)	1(0.03)	1(0.06)	-	-
Philopotamus sp.	3(0.03)	-	1(0.04)	1(0.03)	1(0.06)	-	-
Orthoptera	2(0.02)	-	-	1(0.03)	1(0.06)	-	-
Gryllotalpidae	2(0.02)	-	-	1(0.03)	1(0.06)	-	-
Gryllotalpa robusta	2(0.02)	-	-	1(0.03)	1(0.06)	-	-

Table 2: Abundance of macroinvertebrates in relation to the study stations (continues)

Coleoptera	1115(9.76)	321(20.45)	382(17.11)	150(4.60)	102(5.64)	43(4.01)	117(7.93)
Chrysomelidae	11(0.10)	-	-	-	-	2(0.19)	9(0.61)
Donacia sp.	11(0.10)	-	-	-	-	2(0.19)	9(0.61)
Dytiscus sp.	3(0.03)	-	1(0.04)	2(0.06)	-	-	-
Dytiscidae	3(0.03)	-	1(0.04)	2(0.06)	-	-	-
Hydrophilidae	223 (1.95)	56(3.57)	41(1.84)	23(0.71)	41(2.27)	25(2.33)	37(2.51)
Hydrophilus sp.	223(1.95)	56(3.57)	41(1.84)	23(0.71)	41(2.27)	25(2.33)	37(2.51)
Gyrinidae	878(767)	265(16.88)	340(15.23)	125(3.83)	61(3.37)	16(1.49)	71(4.81)
Gyrinus sp.	878(7.67)	265(16.88)	340(15.23)	125(3.83)	61(3.37)	16(1.49)	71(4.81)
Diptera	4867(42.62)	677(43.12)	868(38.98)	1423(43.62)	853(47.18)	497(46.36)	549(37.2)
Thaumalaidae	5(0.04)	3(0.19)	-	-	2(0.11)	-	-
Thaumalia sp.	5(0.04)	3(0.19)	-	-	2(0.11)	-	-
Tabanidae	3(0.03)	-	1(0.04)	-	1(0.06)	1(0.09)	-
Tabanus sp.	3(0.03)	-	1(0.04)	-	1(0.06)	1(0.09)	-
Ceraptogonidae	1(0.01)	-	-	-	-	1(0.09)	-
Culicoides sp.	1(0.01)	-	-	-	-	1(0.09)	-
Stratiomidae	11(0.10)	1(0.06)	3(0.03)	1(0.03)	-	2(0.19)	4(0.27)
Stratiomyia sp.	11(0.10)	1(0.06)	3(0.03)	1(0.03)	-	2(0.19)	4(0.27)
Tipulidae	32(0.28)	-	-	4(0.12)	8(0.44)	-	20(1.36)
Tipula sp.	20(0.18)	-	-	3(0.09)	5(0.28)	-	12(0.81)
Megistocera longipinnis	12 (0.11)	-	-	1(0.03)	3(0.17)	-	8(0.54)
Simulidae	1(0.01)	-	-	-	-	-	1(0.07)
Simulium sp.	1(0.01)	-	-	-	-	-	8(0.54)
Syrphidae	13(0.11)	13(0.83)	-	-	-	-	-
Eristalis	13(0.11)	13(0.83)	-	-	-	-	-
Chironomidae	4801(42.04)	660(42.04)	864(38.71)	1418(43.47)	842(46.76)	493(45.99)	524(35.5)
Chironomous transvalensis	2693(23.58)	614(39.11)	520(23.30)	477(14.62)	416(23.01)	385(35.91)	281(19.04)
Polypedilium sp.	1366(11.96)	26(1.66)	286(12.81)	470(14.41)	311(17.20)	86(8.02)	187(12.67)
Strictochiromous sp.	720(6.30)	12(0.76)	54(2.42)	470(14.41)	110(6.08)	18(1.68)	56(3.79)
Tarnytarsus sp.	22(0.19)	8(0.51)	4(0.18)	10.03)	5(0.28)	4(0.37)	-
Hymenoptera	1(0.01)	-	-	-	-	-	1(0.07)
Mymaridae	1(0.01)	-	-	-	-	-	1(0.07)
Caraphractus sp.	1(0.01)	-	-	-	-	-	1(0.07)
Total	**11420(100)**	**1570(100)**	**2232(100)**	**3262(100)**	**1808(100)**	**1072(100)**	**1476(100)**

- *The figures in parenthesis show percentage relative abundance of the species*

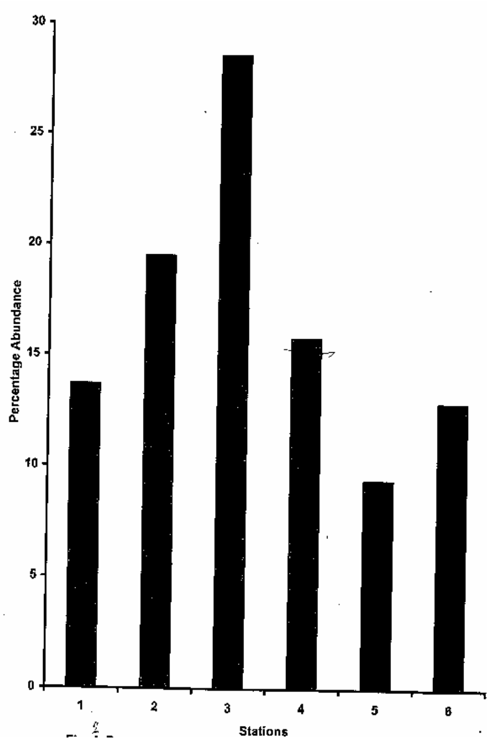

Figure 2: percentage abundance of macroinvertebrate in the stations

Monthly and Seasonal Variations of Macroinvertebrates: Table 3 shows the monthly and seasonal variations of the major taxa of the macroinvertebrates collected. Most invertebrates (13.9 %) were collected in the month of March; 11.0 % was recorded in May, while the least number of specimens was collected in August (3.3%). Crustaceans, odonatans and dipterans were most abundant in March, while hemipterans and coleopterans occurred mostly in December. The tricopterans occurred sporadically in September, December, January and March.

Generally, more macroinvertebrates were collected during the dry season (6321; 55.35 %) than during the rainy season (5099; 44.65 %). Apart from Neuroptera and Plecoptera all other taxa were recorded more during the dry season than in the rainy season (Table 3).

Faunal Diversity and Dominance: Table 4 shows the faunal diversity and dominance indices for the six stations. Species richness (Margalefs' index) was highest at station 5 (11.88) followed by station 6 (11.67).

Station I had the least species richness (10.013). Shannon-Wiener diversity index (H) was highest at station 6 (1.24) and was significantly different from other stations ($P < 0.05$). The diversity indices were statistically similar for stations 1 and 2 (1.038 and 1.035) respectively. The maximum species diversity (Hmax) was highest in station 3 (1.602), while stations 4 and 6 had the same diversity index of 1.580 respectively.

The equitability index (E) indicated that station 6 had highest evenness of distribution (0.78) while station 3 had the least evenness of distribution (0.632). Simpson's dominance index (D) was highest in station 6(11.813), followed by station 4 (7.804) and Station I had the lowest value (4.088).

DISCUSSION

Species Composition and Abundance: Species composition, abundance and distribution of aquatic macroinvertebrates are influenced by a number of factors including the physico-chemical, geomorphic and biotic factors of the aquatic ecosystem. Bishop (1973), Dance and Hynes (1980) asserted that water quality and food supply were the major factors governing the abundance and distribution of macroinvertebrate fauna in aquatic environment. Wildish (1977) considers food supply, supply of colonizing larvae and interspecific competition as the major biotic factors that determine the community composition, biomass and productivity of macrofauna in marine and estuarine environment. Ogbei stream supports a diverse assemblage of macroinvertebrate fauna. The number of taxa recorded (50 species) far exceeds what have been reported from similar biogeographical zones (Victor and Ogbeibu, 1985, 1991; Ogbeibu and Oribhabor, 2001; Odo, 2004) probably because of the favourable conditions in the stream. The variable substrate composition (sand, mud, silt, debris/organic detritus, stones etc) provided different microhabitats for the diverse groups of the fauna. Organisms cannot survive in an environment without adequate food for the organisms' survival and growth.

Besides, it is possible that the cassava, bread fruits and tapioca soaked and washed in the stream could contribute to the food resource for some macroinvertebrates.

Ibemenuga (2005) reported on the good water quality of the stream, a factor which definitely contributes to the survival, growth and abundance of the macroinvertebrates in the stream. In terms of relative abundance, dipterans were the most dominant fauna. The dominance of the dipterans with respect to number of individuals and species is in agreement with the reports of Bidwell and Clarke (1977), Townsend (1983), Sharma *et al.* (1993), Ogbeibu and Oribhabor (2001) and Ogbeibu (2001). The dominance of dipterans in the system as in other aquatic ecosystems may be attributed to their morphological and physiological adaptations to the various habitats, availability of food and sustained reproduction (Mbah and Vijime, 1989; Umeham, 1989). Chironomids which were the most abundant dipterans are known to colonize all kinds of environments including polluted waters. This is due to their ability to extract oxygen from water of very low oxygen concentration.

Distribution: Water velocity, immediate substratum of occupation and animals are very closely related. Variations in water velocity can occasion variations in stream habitats.

Table 3: Monthly / seasonal distribution of major macroinvertebrates taxa of Ogbei stream, Nigeria (May 2002 – April 2003)

Taxa	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	Range in monthly samples	Season Rainy	Season Dry
Oligochaeta	10	7	8	1	9	5	4	5	7	9	9	3	1 - 10	36	39
Crustacea	5	3	4	1	-	2	2	-	-	5	6	-	1- 6	13	15
Arachnida	9	4	1	-	11	3	10	18	4	4	9	3	1-19	35	57
Insecta	1227	910	869	374	505	745	704	1144	1121	935	1561	1130	130 -1561	5051	6210
Plecoptera	1	5	8	2	12	2	7	3	3	1	1	2	1-8	30	17
Odonata	598	314	297	177	180	285	178	217	500	302	722	443	122 - 722	2009	2204
Hemiptera	68	41	71	30	47	55	80	336	41	46	80	44	30-336	301	638
Neuroptera	-	-	1	-	-	-	-	-	-	-	-	-	0-6	1	-
Orthoptera	-	-	-	-	-	-	-	1	-	-	1	-	0 - 1	-	2
Coleoptera	74	121	108	32	25	67	120	198	119	163	49	39	32 - 198	399	716
Diptera	486	429	384	133	238	336	319	382	433	423	703	601	133 - 703	2271	2596
Hymenoptera	-	-	-	-	-	-	-	-	-	-	1	-	0 - 1	-	1
Tricoptera	-	-	-	-	3	-	-	7	25	-	4	-		4	36
Total	**1251**	**924**	**888**	**377**	**523**	**752**	**730**	**1169**	**1132**	**953**	**1585**	**1136**	**377 – 1585**	**5099**	**6321**
	(11.0)	**(8.1)**	**(7.8)**	**(3.3)**	**(4.6)**	**(6.6)**	**(6.4)**	**(10.2)**	**(9.9)**	**(3.3)**	**(13.9)**	**(9.9)**		**(44.6)**	**(55.4)**

Numbers in parenthesis represent the percentages

Table 4: Diversity of macroinvertebrate in the study stations of Ogbei stream (May 2002 – April 2003)

	STATIONS 1	2	3	4	5	6
Number of taxa	33	39	40	38	37	
Number of individuals	1570	2232	3262	1808	1072	1476
Margalef's index (d)	10.013	11.348	11.100	11.359	11.88	11.67
Shannon Wiener index(H)	1.038	1.035	1.013	1.084	1.073	1.24
Maximum species Diversity (H max)	1.519	1.591	1.602	1.580	1.568	1.58
Equitability (E)	0.684	0.655	0.632	0.687	0.685	0.78
Dominance (D)	4.088	7.660	7.623	7.804	6.097	11.81

According to Connell (1975) distribution of animals among available habitats are generally mediated by food availability, predation intensity and tolerance of physico-chemical conditions of the system.

Oligochaetes which are often associated with silt and muddy substrata rich in organic matter were mostly encountered in station 4 rich in organic matter upon which they feed. This agrees with Petr (1972), Carter (1978), Ogbeibu and Egborge (1995) who reported the dominance of oligochaetes in muddy substratum rich in organic matter. Milbrink (1973, 1975), Janasson and Thorhauge (1976) and Mbagwu (1990) all reported that oligochaetes hid their cocoons in the deeper sediment strata for protection against predation and bacterial attack. The presence of aquatic insects is characteristic of most temperate and tropical freshwaters. They usually form a major part of the fauna in a natural stream. Aquatic insects were represented by various taxa. Hemiptera occurred mostly in station 6 where the water velocity was slow. Although Ogbeibu and Akinya (2001) reported that stones were usually devoid of insects, *Hydrophilus* sp. (Coleoptera) was found more in station 4 attached to stones/hard substrates. This is an adaptation to avoid being swept off by the current.

Diptera was largely represented by chironomids. *Chironomus transvalensis* requires a substratum with high organic matter content. According to Petr (1972) *C. transvalensis* prefers muddy bottom to sandy substrate, hence they occurred in large numbers in all the stations with muddy bottom.

The presence of sand and macrophytes in almost all the stations, debris/detritus in station 2, 3 and 5, stones in stations 4 and 6; mud in all the stations except station 3 provide adequate habitat conditions for the high faunal abundance in stations 1, 2, 4, 5 and 6.

Seasonal Variation: Among the factors that influence the distribution and abundance of macroinvertebrate fauna in the stream is depth. Depth is a prime factor in aquatic environment. Apart from plecoptera and Neuroptera, the populations of the other taxa were consistently higher in the dry season than in the rainy season months when the level of water was high. The report of Odo (2004) that coleoptera and hemiptera were more abundant in Anambra River during the dry season than in the rainy season agrees with our observations in Ogbei stream. Faunal reduction in the rainy season may be due to spate. Sudden torrential rains cause rapid and sudden rise in the rate of flow beyond the extent animals can maintain their foothold may explain the low numbers of macroinvertebrates recorded in the rainy season months. Petr (1970), Turcotte and Harper (1982) report that the densities of benthos in Black Volta River (Ghana) and Andean stream (Ecuador) respectively were greater at the end of dry season than in the rainy season. They also attributed this to spate during the rainy season. Reduced invertebrate abundance in tropical streams has also been attributed to scourging discharge (Stout, 1982).

In principle primary productivity in aquatic system tends to increase during the dry season as a result of increase in light availability. Such a situation may favour many benthic macroinvertebrates that rely on algae for food. Food availability during the dry season may bring about increase in abundance of the fauna. However, Algermeir and Karr (1983) reported low population of benthic invertebrates in some streams in central panama during the dry season. This may be due to the short duration of dry season (3 - 4 months) (Algermeir and Karr, 1983) in central panama as against 5 – 6 months in our study area.

The developmental rate of small macroinvertebrates can generally cause faunal fluctuations. Most aquatic invertebrates are benthic only at the larval stages. Their adult lives are spent outside of water. This is true of all the macroinvertebrates collected except the crustaceans and water scorpions. The life cycles of some of the fauna could also account for seasonal difference in the population size.

Diversity: The general diversity (Shannon-Wiener index, H) differed slightly among the stations and was highest in station 6 as a result of the high value of Equitability index (E). According to Victor and Ogbeibu (1985) and Ogbeibu (2001), the higher the equitability, the higher the diversity. An assessment of community and ecosystem stability using overall diversity showed station 6 as the most complex and stable station. The overall diversity may be the product of all spatial and temporal changes affecting the community (Ogbeibu an Oribhabor, 2001).

REFERENCES

AJAO, E. A. and FAGADE, S. O. (2002). The benthic macro-fauna of Lagos Lagoon. Pages 1 – 27. *Paper presented at the international Conference in Honour of Prof. F. M. A. UKOLI.* 14 – 17th January 2002 at the Department of Zoology, University of Ibadan, Ibadan.

ALGERMEIER, P. L and KARR, J. R. (1983). Fish communities along environmental gradients in a system of tropical streams. *Environmental Biology of Fish, 9 (2):* 117 – 135.

BIDWELL, A. and CLARKE, N. V. (1977). The invertebrate fauna of lake Kainji, Nigeria. *The Nigeria Field, 42(3):* 104 – 109.

BISHOP, O. N. (1973). *Limnology of a small Malayan River.* Sungai Gomback W. J. Junk. The Hague. 485 pp.

CARTER, J. J. (1978). Diversity in tropical forest and coral reefs. *Science, 199:* 1302 – 1310.

CONNELL, J. H. (1975). Some mechanisms producing structure in natural communities: a model and evidence from field experiments. Pages 460 – 490. *In:* CODY, M. L. and DIAMOND, J. M. (eds.). *Geology and Evolution of Communities.* Belknap Press, Cambridge.

CROWN, J. E., CHESSMAN, E. C., MCEVOY, P. K. and WRIGHT, I. A. (1995). Rapid assessment in the Nepean river and Blue Mountains. *Australian Journal of Geology, 20(1):* 130 – 141.

DANCE, K. W. and HYNES, H. B. B. (1980). Some effects of Agricultural land use on stream insect communities. *Environmental Pollution Series A, 22:* 19 – 28.

EGBORGE, A. B. M. (1993). *Biodiversity of aquatic fauna of Nigeria.* National Resources Conservation Council, Abuja. 173 pp.

EMEJULU, C. A., OKAFOR, F. C. and EZIGBO, J. C. (1992). Gastropod fauna of Agulu lake and adjoining freshwater system in Anambra State. *Journal of Aquatic Sciences, 7:* 35 – 38.

EYO, J. E. and EKWONYE, U. C. (1995). The macroinvertebrate fauna of pools in the flood plain (fadama) of the Anambra river, Nigeria. *Freshwater Forum, 5(3):* 160 – 162.

GLADDEN, J. E. and SMOCK, L. A. (1990). Macroinvertebrate and production in the flood plains of two lowland headwater streams. *Freshwater Biology, 24:* 533 – 545.

HANSON, J. M. (1990). Macroinvertebrate size distribution of two contrasting macrophyte communities. *Freshwater Biology, 24:* 481 – 491.

HUTCHINSON, K. (1970). A test for comparing diversities based on Shannon formula. *Journal of Theoretical Biology, 29:* 151 – 154.

IBEMENUGA, K. N. (2005). The Ecology of Macro-invertebrate fauna of Ogbei stream in Nkpologwu, Aquata Local Government Area of Anambra State, Nigeria. MSc Project Report, University of Nigeria, Nsukka. 105 pp.

IDOWU, R. T., INYANG, N. M. and MGBENKA, B. O. (2004). Macroinvertebrate studies of the littoral region in an arid zone lake (Lake: Alau), Maiduguri, Boronu State, Nigeria. *Pecop Resources Nigeria Limited, 1(1):* 1 - 12.

JANASSON, O. and THORHAUGE, E. (1976). Population dynamics of *Poramothrix harmmoniensis* in the profundal of lake Esrom with special reference to environmental and competitive factors. *Oikos, 27:* 193 – 203.

KREBS, C. J. (1978). *Ecology: The Experimental Analysis of Distribution and Abundance.* 2nd Edition. Harper and Raw Publishers, New York, 678 pp.

MBAH, C. E. and VIJIME, C. G. (1989). Preliminary Taxonomic survey of fresh water insects from northern Nigeria. *Journal of Aquatic Sciences, 4:* 27 – 39.

MBAGWU, I. G. (1990). Vertical distribution of macrobenthic invertebrates in the profundal sediment of the impoundment of the dammed river Danube (Alterworth, Lower Australia). *Journal of Aquatic Sciences, 5:* 19 – 25.

McQUEEN, D. T., POST, J. R. and MILLS, E. I. (1986). Trophic relationships in freshwater pelagic ecosystems, *Journal of Fisheries and Aquatic Sciences, 43:* 1571 – 1581.

MILBRINK, G. (1973). On the vertical distribution of oligochaetes in lake sediment. *Reports of Institute of Freshwater Research (Drottingholm), 53:* 34 – 50.

MILBRINK, G. (1975). Population biology of the cestode *Caryophyllaceous laticep* (Pellas) in Bream, Alabanis *brama* (L) and the feeding of fish on oligochaetes. *Institute of Freshwater Research Report, 54:* 36 – 51.

ODO, G. E. (2004). *Studies on the ecology of macroinvertebrate fauna as fish food in Anambra River Basin, Nigeria.* PhD Thesis, University of Nigeria Nsukka, 172 pp.

OGBEIBU, A. E. and VICTOR, R. (1989). The effects of road and bridge construction on the bank root macrobenthic invertebrates of a southern Nigerian stream. *Environmental Pollution, 56:* 85 – 100.

OGBEIBU, A. E. and EGBORGE, A. B. M. (1995). Hydrobiological studies of water bodies in the Okomo forest Reserve (sanctuary) in southern Nigeria. 1. Distribution and density of the invertebrate fauna. *Tropical Freshwater Biology, 4:* 1 – 27.

OGBEIBU, A. E. and ORIBHABOR, B. J. (2001).The ecological impact of stream regulation using benthic macro invertebrates as indicators. *Journal of Aquatic Sciences, 16(2):*132 – 138.

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

OGBOGU, S. S. and AKINYA, T. O. (2007). Distribution and abundance of insect orders in relation to habitat types in Opa stream reservoir system, Nigeria. *Journal of Aquatic Sciences, 17(1):* 27 – 30.

PETR, T. (1970). The bottom fauna of the rapids of the Black Volta River in Ghana. *Hydrobiolgia, 36:* 399 - 418.

PETR, T. (1972). Benthic fauna of a tropical man – made lake (Volta lake, Ghana, 1965 - 1968). *Archives fur Hydrobiologia,* 70*:* 484 – 533.

ROSENBERG, D. M. and RESH, V. H. (1993). *Freshwater Biomonitoring and Benthic Macroinvertebrates.* Chapman and Hall, New York, 488 pp.

SHANNON, C. E. and WIENER, W. (1963). *The Mathematical Theory of Communication.* University of Illinois press, Urban, 117 pp.

SHARMA, S., MARTHURM, R., SAXENA, M. N. and KAUSHIUK, S. (1993). Geological studies of insect communication in the Saonk, Asum and Kunuwari River of Madhya Pradesh, India. *Tropical Freshwater Biology,* 3: 287 – 294.

STUNT, R. J. (1982). Effect of harsh environment on the life history patterns of two species of tropical aquatic Hemiptera (Family, Neuioridae). *Ecology, 63:* 75 – 83.

TOWNSEND, C.R., HILDREW, A. G. and FRANCIS, J. (1983). Community structure in some South English streams. The influence of physico-chemical factors. *Freshwater Biology, 13:* 521 - 544.

TURCOTTE, P. and HAMPER, P. P. (1982). The macro invertebrate fauna of a small Andream stream. *Freshwater Biology, 12:* 411 – 419.

UMEHAM, S. N. (1989). Some aspects of the physico-chemical limnology of Lake Chad (southern sector). *Journal of Aquatic Sciences, 4:* 23 – 26.

VICTOR, R. and OGBEIBU, A. E. (1985). Macrobenthic invertebrates of a stream flowing through farmlands in southern Nigeria. *Environmental Pollution, 39:* 337 – 349.

VICTOR, R. and OGBEIBU, A. B. (1991). macroinvertebrate communities on the emotional biotope of and urban stream in Nigeria. *Tropical Zoology, 4:* 1 – 12.

WILDISH, D. J. (1977).Factors controlling marine and estuarine sublittoral macrofauna. *Helgolander Wiss Meeresunters, 30:* 445 – 454.