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HYDROBIOLOGICAL STUDIES ON IBIEKUMA RIVER AT EKPOMA, SOUTHERN NIGERIA, AFTER IMPOUNDMENT: THE FAUNAL CHARACTERISTICS

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ABSTRACT : *A study of a 3 Km stretch of a perennial rainforest stream in southern Nigeria describes the macrobenthic faunal characteristics of pools (dam site stations) and runs. A total of 84 invertebrate taxa made up of 2,535 individuals were recorded. The overall faunal abundance was not significantly different at the study stretch. The abundance of the major taxonomic groups was however significantly different ($P < 0.05$) at the study stations. Hemiptera and Diptera were the most abundant invertebrate groups recorded. The high number of benthic invertebrates observed is a reflection of the physical and chemical stability of the study stream.*

Keywords: *Rainforest stream; Macrobenthic fauna; Nigeria; Impoundment*

INTRODUCTION

This paper is the second of two papers on the post-impoundment hydrobiological studies of a perennial rainforest stream in southern Nigeria. This first paper (in press) deals with the fluctuations in the physical and chemical characteristics of the stream after the dam construction. Pre-impoundment ecological investigations on the stream are available (Idamughe, 1987; Okenyi, 1991; Edokpayi and Gbugbemi, 1998). The present paper presents the results of a study conducted to evaluate the macrobenthic faunal characteristics of the Ibiekuma stream after impoundment

STUDY AREA

The Ibiekuma stream is a perennial First Order rainforest stream in Ekpoma, southern Nigeria (Lat. 6° 00¢ N, 6° 06¢ S; Long. 6° 00¢ E, 6° 05¢ W). The stream takes its source within the Ambrose Alli University permanent site (Fig. 1) and joins other rivers one of which empties into the Atlantic Ocean (Udo, 1970; Aiboni, 1988).

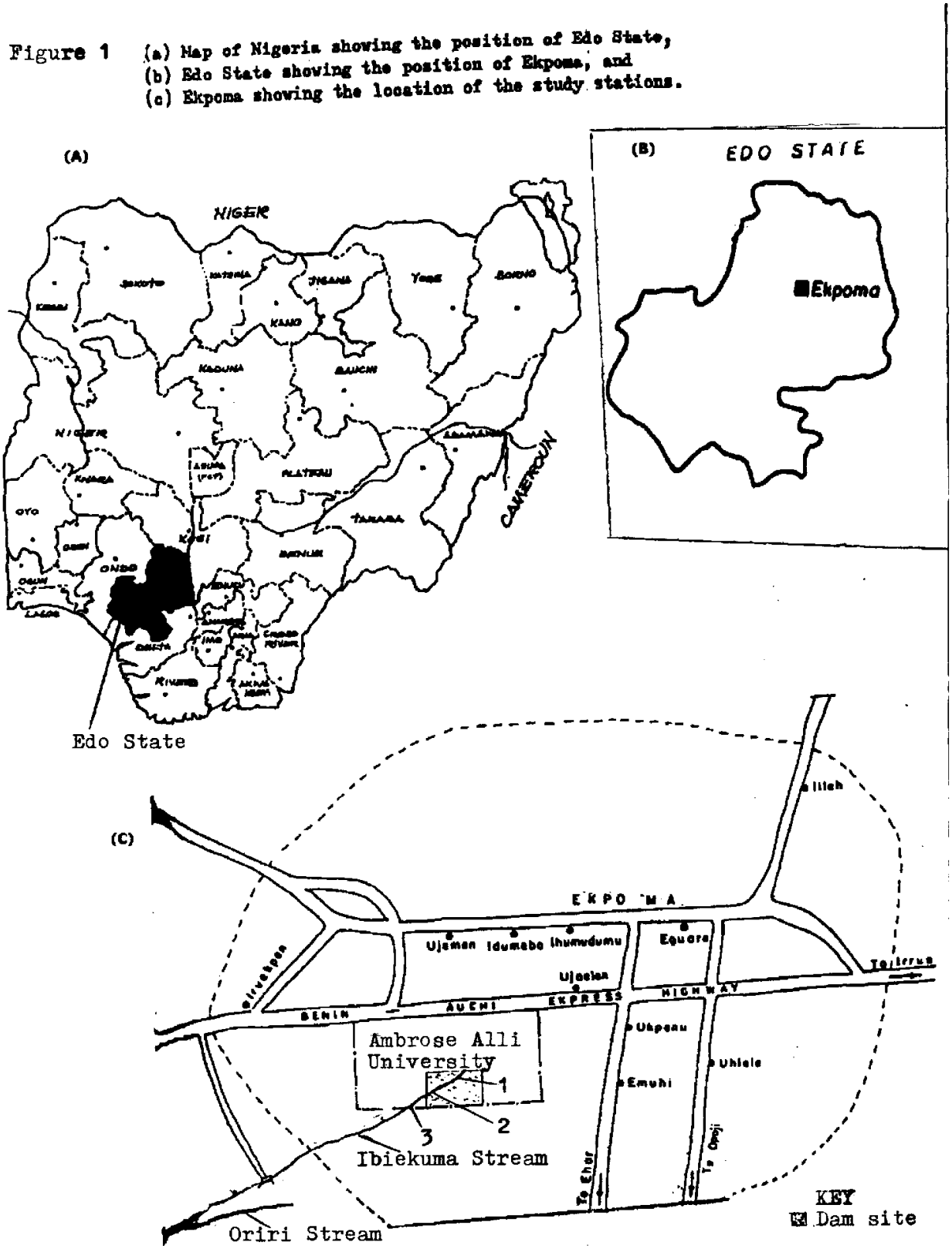
The study area is characterized by flat land surface, easily worked sandy loam soils. Geologically, the area is composed of the basement complex of the Precambrian era. The Ibiekuma stream overlies detritus of Bendel Ameki Shales and sandstones with a unique toposequence (Aiboni, 1988). The University impounded the stream in 1993, with assistance from the EEC primarily to supply water to the University community and its environs.

Farming is the major human activity in the study area. The main crops cultivated are cassava, yam, rice and corn.

For this survey, three stations within 3Km stretch of the stream were recognized (Fig. 1). All the samples were collected from the bank-root biotope. Station 1 is about 700m upstream of the Gravity dam with no visible unidirectional flow. The depth at this site is about 0.45m with an average width of 3m. It is shaded with fringing vegetation of mainly shrubs like *Sagitaria sagittifolia* and *Phonix* palm. The substratum is mainly coarse sand and granite mixed with clay and large quantities of allochthonous matter, mainly logs and leaves of reparian vegetation. Human activity at this site is limited to occasional fishing and idol worshipping.

The upstream face of the dam with a depth of 1.5m and width of 10.2m locate station 2. This station is unshaded with visible unidirectional flow. Bankroot vegetation was mainly grass such as *Andropogon techtorum, Digitaria* sp., *Penisetum* sp., and *Talinum triangulare*. The substratum is coarse sand and granite. Human activities include bathing and washing of implements by rubber tapers.

Figure 1 (a) Map of Nigeria showing the position of Edo State;
(b) Edo State showing the position of Ekpoma, and
(c) Ekpoma showing the location of the study stations.



Station 3 is located about 2.3km downstream of station 2. The stream channel at this site is narrow of about 0,36m deep and 1.0m wide. It is shaded with trees (*Alstonia boonei, Nauclea diderrchi, Havea braziliensis* and *Eleasis guinensis*) and shrubs (*Dryopteris* sp., *Sagittaria sagittifolia, Smilax krussiana* and *Phoenix* palm). The stream is fast flowing at this station. The substratum is sand mixed with decaying leaves and fallen logs. A summary of the physical and chemical conditions of the study stations is presented in table 1.

Table1 The composition, distribution and abundance of macrobenthic invertebrates in Ibiekuma stream; February to August, 1995; Numbers indicate abundance; - indicates absence.

	STATION 1		STATION 2		STATION 3		OVERALL	
	No. of Taxa	No. of individuals	No. of Taxa	No. of individuals	No. of Taxa	No. of individuals	No. of Taxa	No. of individuals
ANNELIDA								
Naididae	3	7	3	5	3	4	9	16
Tubificidae	-	-	1	2	-	-	1	2
INSECTA								
COLEOPTERA								
Hydrophilidae	1	2	-	-	1	1	2	3
Dytiscidae	2	4	-	-	1	1	3	5
Hydrinidae	1	2	-	-	-	-	1	2
Helodidae	1	1	-	-	-	-	1	1
Elmidae								
a. Family type A	1	1	-	-	-	-	1	1
b. Family type B	-	-	-	-	1	1	1	1
Halipidae	1	1	-	-	-	-	1	1
UNIDENTIFIED FAMILY								
a. Family type A	1	2	1	2	-	-	2	4
b. Family type B	1	1	-	-	-	-	1	1
COLLEMBOLA								
Isotomidae	1	6	-	-	1	4	2	10
EPHEMEROPTERA								
Baetidae	1	191	1	116	1	27	3	334
Ephemeridae	1	1	-	-	1	2	2	3
Siphlonuridae	1	1	1	1	1	1	3	3
HEMIPTERA								
Nepidae	2	3	2	2	1	1	5	6
Pleidae	1	1	1	1	-	-	2	2
Coroxidae	1	777	1	134	1	78	3	989
Naucoridae	1	3	1	4	-	-	2	7
Mesoveliidae	1	1	-	-	-	-	1	2
Notonectidae	1	2	-	-	-	-	1	2
Gerridae	1	1	-	-	-	-	1	1
a. Family type A	1	1	1	2	-	-	2	3
b. Family type B	1	2	-	-	-	-	1	2
ODONATA								
Aeschnidae	1	1	-	-	-	-	1	1
Petaluridae	1	1	1	2	-	-	2	3
Libellulidae	3	9	5	9	-	-	8	18

	STATION 1		STATION 2		STATION 3		OVERALL	
	No. of Taxa	No. of individuals	No. of Taxa	No. of individuals	No. of Taxa	No. of individuals	No. of Taxa	No. of individuals
Coenagriidae	2	12	4	22	1	4	5	38
PLECOPTERA	-	-	1	1	-	-	1	1
TRICHOPTERA	-	-	-	-	1	1	1	1
DIPTERA								
Ceratopogonidae	4	60	2	15	2	13	5	88
a. Family type A	-	-	-	-	1	1	1	1
Anthomyiidae	-	-	1	1	-	-	1	1
Chironomidae	10	235	8	113	5	54	15	402
Chaoboridae	1	2	-	-	-	-	1	2
Culicidae	5	39	2	2	-	-	7	41
a. Family type A	-	-	1	1	-	-	1	1
b. Family type B	-	-	1	1	-	-	1	1
ARACHNIDA								
HYDRACHNELLA	1	218	1	104	1	30	1	352
PROSTIGMATA	1	1	-	-	-	-	1	1
CRUSTACEA								
Conchostraca	1	4	-	-	-	-	1	4
Cyclopoida	1	116	1	46	1	14	1	176
Decapoda	-	-	-	-	1	3	1	3
NEMATODA	1	2	-	-	-	-	1	2
TOTAL	**58**	**1708**	**41**	**585**	**25**	**239**	**84**	**2535**

METHODS

The macrobenthic sampling program covered a period of seven months from February to August 1995. Fortnightly samples were taken between 0800h and 1200h on each sampling day. Samples were collected using the kick sampling technique (Hynes, 1970) and analyzed using standard procedures (Lenat *et al.*, 1981; Victor and Ogbeibu, 1985; Ogbeibu and Egborge, 1995). All benthic samples were fixed in the field using small quantities of 40% formalin. Further analyses carried out in the laboratory include sieving (mesh size 1.4mm - 250mm) and isolation of fractions were examined under suitable magnifications (7 – 40X). The benthic fauna was sorted and preserved either in 10% formalin or 70% methanol. The macrobenthic invertebrates were identified using manuals listed in Ogbeibu and Egborge (1995).

All statistical procedures, were appropriate, were adopted from Zar (1984). SPSS 6.5 window application and Excel were used for the calculations and to plot the graph respectively.

RESULTS

Eighty-nine invertebrate taxa (2,535 individuals) were collected in the stream during the entire study period. Table 2 lists the higher taxonomic categories of invertebrates, the number of taxa recognized within each category, their distribution and abundance at the three study stations. The overall abundance of fauna was highest at station 1 (1708) and lowest at station III (239) (Fig. 2). Wide fluctuations in the abundance of major taxonomic groups were observed among the study stations (Fig. 3). Aquatic insects where more abundant representing over 86% and 78% respectively of the overall taxa and individuals recorded (Fig. 4). The dominant insect taxa were the ubiquitous *Corixa* sp. (Hemiptera: Corixidae); *Chironomus* sp., *Chryptochironomus* sp., *Polypedolum* sp. and *Tanytasus* sp. (Diptera: Chironomidae); *Baetis* sp.

Table 2. Summary of the physical and chemical conditions at the Ibiekuma River study stations; Mean (± S.E.) values (except that of pH) are given (minimum and maximum are in parenthesis), February to August 1995.

PARAMETERS	*STATION 1*	*STATION 2*	*STATION 3*
Air Temperature (°C)	31.0 ± 0.67	30.8 ± 0.69	30.5 ± 0.72
	(27.0 – 36.0)	(27 – 36)	(27 – 36)
Water Temperature (°C)	28.71 ± 0.35	28.8 ± 0.32	28.5 ± 0.37
	(26.0 – 31.0)	(26 – 30)	(26 – 30)
Water Level (m)	0.54 ± 0.02	1.54 ± 0.01	0.36 ± 0.11
	(0.44 – 0.66)	(1.50 – 1.59)	(0.31 – 0.46)
Flow Velocity (Cm/Sec)	0.00	0.059 ± 0.008	0.35 ± 0.01
		(0.023 – 0.091)	(0.29 – 0.38)
Transparency (m)	0.51 ± 0.01	0.69 ± 0.037	0.36 ± 0.01
	(0.42 – 0.62)	(0.40 – 0.87)	(0.31 – 0.45)
Total Suspended Solid (mg/L)	3406.78 ±	3954.07 ±	3431.29 ± 542.25
	(1090 – 9910)	(1110 – 8820)	(1121 – 6970)
Conductivity (µS/Cm)	40.03 ± 13.76	30.38 ± 11.38	27.49 ± 8.39
	10.56 –	(10.11 –	(11.10 – 117.40)
PH	(4.60 – 6.40)	(4.80 – 6.30)	(4.50 – 5.70)
Total Alkalinity ($mgCaCO_3/L$)	5.90 ± 0.56	5.36 ± 0.69	6.43 ± 0.77
	(2.50 – 10.00)	(0.00 – 10.00)	(2.50 – 10.00)
Dissolved Oxygen (mg/L)	8.81 ± 0.48	9.28 ± 0.49	10.83 ± 0.53
	(6.80 – 13.00)	(7.40 – 12.30)	(8.80 – 15.30)
Biochemical Oxygen Demand (mg/L)	2.00 ± 0.12	1.71 ± 0.21	1.75 ± 0.39
	(0.80 – 2.6)	(1.00 – 3.20)	(0.80 – 2.40)
Calcium ($mgCaCO_3l^{-1}$)	3.04 ± 0.04	2.11 ± 0.48	2.69 ± 0.06
	(2.40 – 4.01)	(1.50 – 3.21)	(1.60 – 4.01)
NO_3-N (mgl^{-1})	0.94 ± 0.059	0.9 ± 0.32	0.9 ± 0.02
	(0.19 – 3.56)	(0.25 – 2.06)	(0.63 – 1.28)
PO_3 – P (mgl^{-1})	1.99 ± 0.029	1.83 ± 0.03	1.9 ± 0.13
	(1.07 – 2.31)	(1.49 – 2.31)	(0.83 – 2.23)

(Ephemeroptera: Baetidae) and the Arachnida which accounted for about 14% of the overall abundance were dominated by *Arranurus* sp. and *Hydrophantes* sp. (Hyrachnella) (Table 2, Fig. 4). Nematodes and crustaceans were poorly represented at the study stretch, while molluscs were not recorded throughout. In general, there was no statistical difference ($F_{0.05, 111} = 2.317$) in the overall abundance and distribution of the benthic invertebrate at the study sites.

DISCUSSION

The total number of invertebrate taxa (84) recorded in this stream is relatively high when compared to other temperate (Tsui and McCart, 1981; Lenat *et al.*, 1981), arid (Victor and Al-Mahrouqi, 1996) and some topical (Victor and Ogbeibu, 1985; Ogbeibu and Egborge, 1995; Oribhabor, 1995; Umeozor, 1995) streams. Pre-impoundment studies on this stream also recorded lower invertebrate taxa (Okenyi, 1991, Edokpayi, *et al.*, unpublished data). Diversity tends to be

Fig. 2. The overall percentage abundance in the number of taxa and individuals at the study statiions

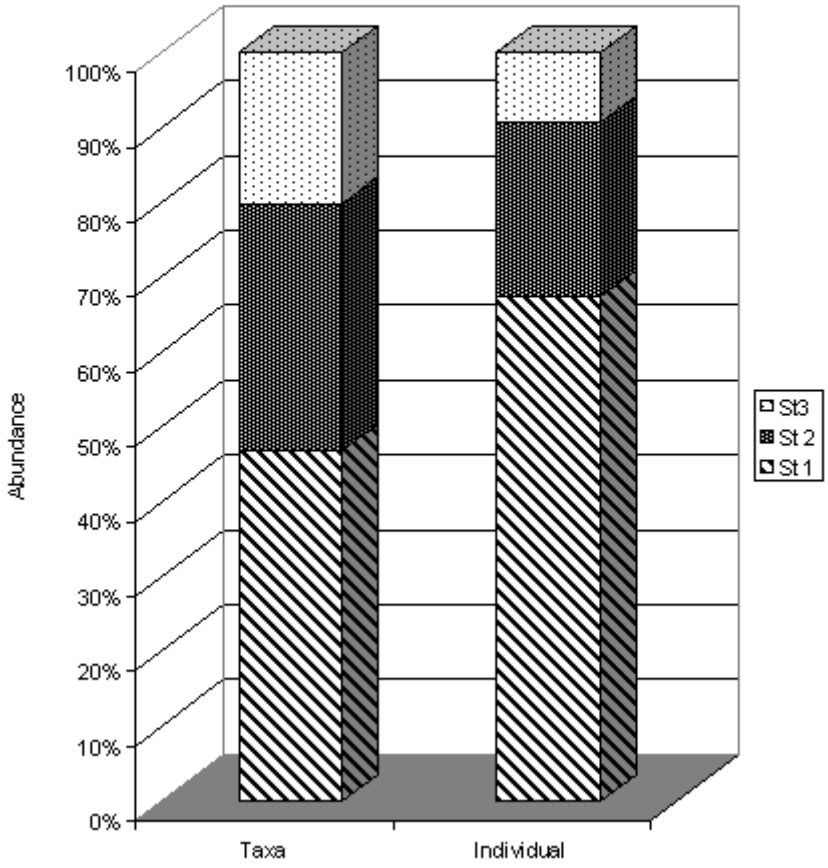


Fig. 3. The relative percentage abundance in the number of taxa and individuals of the major taxonomic groups at the study stream

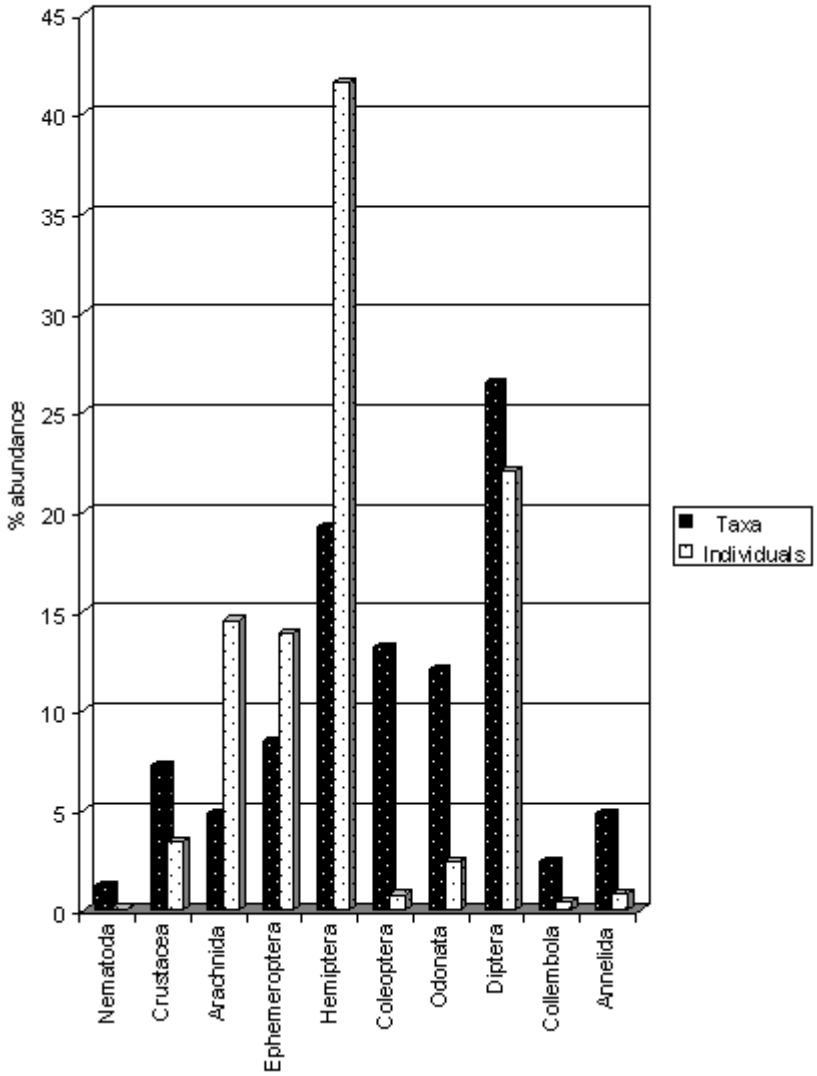
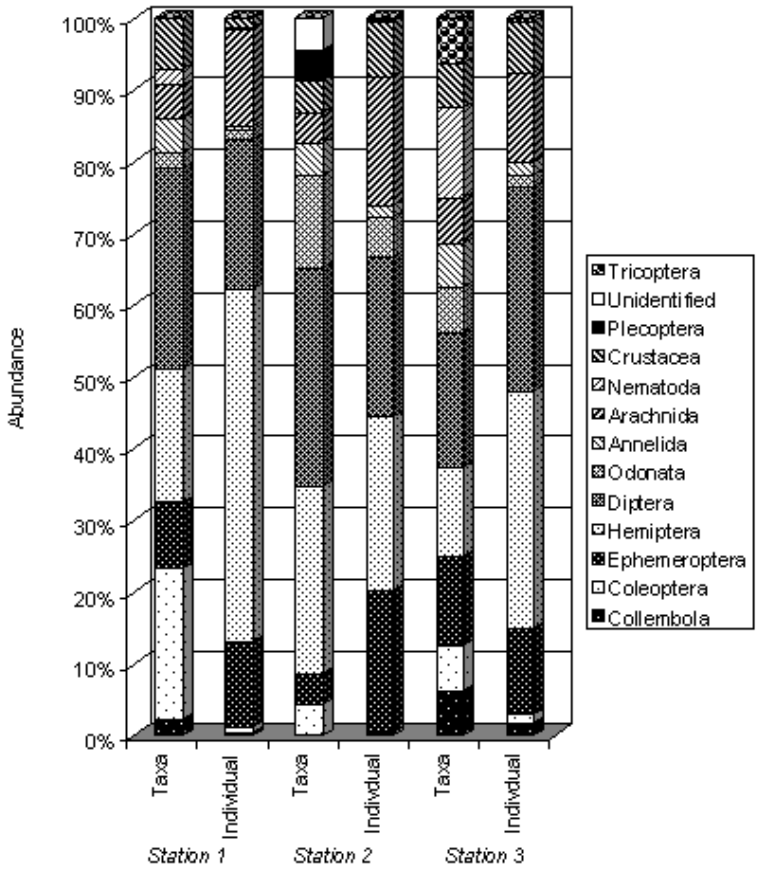


Fig. 4. Fluctuations in the percentage abundance in the number of taxa and individuals of the major taxonomic groups at the study stations



low in physically controlled systems (Odum, 1971). The high number of benthic invertebrates recorded here is a reflection of the stability of the physical and chemical characteristics of the study stream.

Insects were the most dominant group of invertebrate recorded in this study. Corixidae (Hemiptera) was responsible for this high abundance. Corixides have been reported to contribute greatly to the abundance of invertebrate in most water bodies (Pennark, 1953), except those low in dissolved oxygen (Ogbeibu, 1987, Oribhabor, 1995). The dissolved oxygen content of the surface waters at the study sites were high (Table 2) and similar to those reported for most tropical waters of unpolluted rivers (Ogbeibu and Victor, 1995). This high oxygen concentration may have influenced the dominance of hemiptera at the study stretch. The occurrence of Beatidae and Chronomidae in high abundance in this study is not unusual as this group of invertebrates have been reported to be common and major components of tropical streams (Victor and Ogbeibu, 1985; Victor and Matthew 1989; Ogbeibu and Victor, 1989; Victor and Al-Mahrouqi, 1996). The taxonomy and ecology of aquatic arachnids is poorly understood in Nigeria (Egborge, 1993). Hydrachnella (Arachnida) are usually abundant among aquatic weeds and plant debris (Cook, 1966). The increase in water level due to impoundment may have resulted in increase in shoreline and subsequent flooding of riparian vegetation. This could have encouraged the increase in abundance of hydrachnella observed in this study.

The occurrence of crustaceans was low, while mollusks

were not observed at the study stretch. Sedimentation due to impoundment (Baxter and Glaude, 1980), low pH and calcium content (Table 1) of the study stream may have contributed to the paucity of crustaceans and mollusk (Laurie, 1987).

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