Some Aspects of the Ecology of *Macrobrachium macrobrachion* Herklots, 1851 (Crustacea: Decapoda: Natantia) in the Brackish Water Zone of the Benin River at Koto, Southern Nigeria

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Abstract

An ecological study to evaluate some aspects of the ecology of the prawn *Macrobrachium macrobrachion* Herklots, 1851, along a 5 km stretch of the Benin River at Koko, Southern Nigeria was carried out for a period of 24 months from March 1986 to February 1988 at fortnightly intervals. Of the five stations studied, three (I, III, V) were situated along the main river channel, while two stations (II, IV) were located on creeks entering the main river. Relatively higher numbers of *M. macrobrachion* were recorded at stations II and IV than at stations I, III and V. The fluctuations in numbers and biomass showed distinct seasonality. They were generally high during the rainy season and low during the dry season. The abundance of *M. macrobrachion* at stations I, III and V were significantly influenced ($P < 0.005 - 0.05$) by environmental conditions. The overall size frequency distribution of the species indicated the occurrence of mixed populations in the study area. The recruitment of young occurred during the rainy season.

Introduction

Twenty-six species of the genus *Macrobrachium* widely distributed throughout the Indo-pacific are used in aquaculture (Powell, 1982). *M. macrobrachion* Herklots, 1851 is one of West African species of potential importance in aquaculture (Evers, 1979). Few literature are available on *Macrobrachium* sp. in Nigeria. Powell (1982) reported that *M. macrobrachion* is the most common species of the genus in all tidal waters. It is commercially important, comprising 80% of the *Macrobrachium* catches in Lagos lagoon (Marioghae, 1984). The food and fecundity (Omo-Malaka, 1970) and the biology and distribution (Marioghae, 1984) of the genus in water bodies around Lagos, Nigeria have also been reported. For the development, exploitation and management of prawn fisheries, data on their ecology and biology is necessary. The lack of such basic scientific data is a common feature in the Nigerian fishery (Awachie, 1973; Edokpayi *et al.*, 2000). The objective of this study is to provide some data on the ecology of *M. macrobrachion* in Benin River, southern Nigeria.

Materials and methods

Study area

The study sites were on a 5 km stretch of the Benin River at Koko (6° 00' N, 5° 30'E). The Benin River (Fig. 1B) is an estuary through which many rivers drain into the Atlantic Ocean (Udo, 1970). The upstream of the Benin River is completely fresh, while at Koko, where the tidal fluctuations of the sea are pronounced, it is characterized by low salinity, which increases downstream

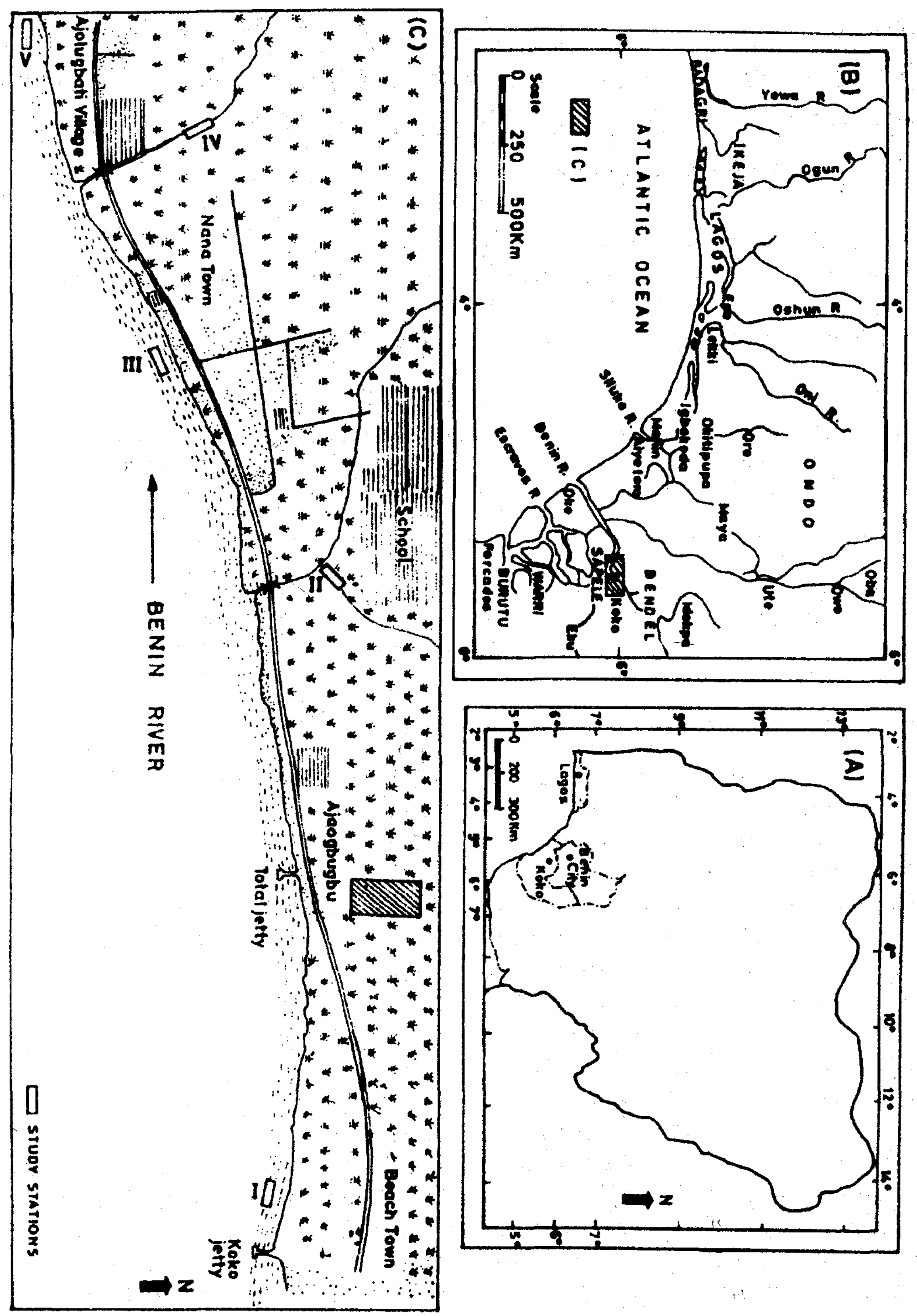

Fig. 1. Map of the study area, position of Koko in Nigeria (A), location of Benin River (B), study stretch showing the location of study stations (C)

towards the ocean.

Koko town (Fig. 1A, B) lies within the Benin lowlands, in an area subjected to annual flooding. Koko is a linear settlement situated along the northern bank of the Benin River. On the southern bank, the river is bordered by a secondary rain forest with scattered fishing camps (Omagbemi, 1986). The sedimentary formation of Koko area is quaternary and the specific age of this formation is Holocene. It is basically the alluvium of lower Delta made up of a combination of sand, clay and gravel (Anon., 1977). The vegetation cover of Koko is swampy, dominated by mangrove and light forest on the firmer ground. Five sampling stations reflecting the topographical features of the study stretch were selected for the study. Three of the stations I, III, V were located along the main river, while the other two stations II and IV were along the creeks (Fig. 1C).

The aquatic vegetation was composed of *Ceratophyllum submersum* L., *Nymphea odorata* Ait., *Pistia stratiotes* L., *Eichhornia crassipes* (Mart.) Solm-Laub., and *Lemnia* sp. The substratum of the main river stations was sandy, covered with a thin layer of mud. The substratum of the creek stations was muddy with large quantities of allochthonous matter, mainly leaves from the surrounding vegetation.

Fortnightly collections of prawns were carried out between March 1986 and February 1988 for a period of 24 months. Two methods, the cage-traps and the dragnet were used for capturing prawns. These methods are commonly used by artisanal fishermen in the study area, but were not suitable for sampling planktonic larvae (size range 1-20 mm) and prawns attached to the roots of floating vegetation. In addition, a preliminary prawn sampling (data not included in the result) was conducted in the study area using cage-trap, dragnet and other available palm-frond/ basket traps. The coefficient of variability (CV) evaluated for cage-traps and dragnet were similar and less than the variability in the other traps, thus justifying their selection. Prawns collected at each sampling station using both dragnet and cage-traps were pooled as composite sample.

Ten traps were set along the banks at each station by pinning each trap to the bottom of the river with a long peg. Each trap was baited with five palm fruits and left underwater for 48 h, after which they were removed and the prawns caught were collected in polyethylene bags. The dragnet measured 1.0 m high and 1.2 m long with a mesh size of 2 mm. The net was attached to sticks at each end of its length. Two fishermen holding the sticks at the ends dragged the net. Each drag was made across a distance of 100 m along the bottom of the river. The net was raised from the water at regular intervals along the distance to collect prawns. Drag samples were collected on each sampling day.

All prawns collected were stored in a deep freezer. Prior to identification and other biological examinations, the specimens were thawed to room temperature. After recording all required biometrics and biological data, the specimens were preserved in 10% formalin. Standard methods (APHA, 1985) were used for the collection and analysis of the environmental parameters.

The prawns were sexed and identified using the taxonomic keys of FAO (1978) and Powell (1982). Total length (TL) as defined by Powell (1982) was measured to the nearest 0.1 mm. The wet weight (WT) of prawns was measured using an electronic top loading balance (Mettler, P. 162) to the nearest 0.1g. All statistical analyses carried out were adopted from Bimbaum & Tingey (1951), Massey (1951), Stoodley *et al.*, (1980), Batschelet (1981) and Zar (1984).

Results

Spatial distribution

Out of a total number of 5,830 *M. macrobrachion* caught throughout the study period, 1,201 were recorded at station I, 1,642 at station II, 763 at station III, 1,457 and 785 at stations IV and V, respectively. This distribution tested by the Kolmogorov-Smirnov Goodness of Fit statistic (D) was significantly uneven ($D = 0.9456$; $p < 0.001$).

Changes in numbers and biomass

Seasonal variations in numbers and biomass of *M. macrobrachion* in the study area as reflected by monthly variations are presented in circular diagrams (Fig. 2 and 3) and subjected to circular statistic G (Batschelet, 1981). Fluctuations in numbers at stations II and I were unimodal in the first year and bimodal in the second year (Fig. 2). At stations III, IV and V, monthly variations in numbers in both years were similar with bimodal peaks occurring in June and August of each year (Fig. 2). Monthly fluctuations in numbers in the first and second year, respectively, at station I ($G = 453.46$ and 488.83; $p < 0.0001$), station II ($G = 266.31$ and 236.01; $p < 0.001$), station III ($G = 187.98$ and 219.48; $p < 0.001$), station IV ($G = 396.88$ and 269.67; $p < 0.001$), and station V ($G = 200.53$ and 168.57; $p < 0.001$) were significantly different.

Monthly fluctuations in biomass at the study stations (Fig. 3) were a reflection of the variation in numbers at each station (Fig. 2). However, high biomass was recorded for low numbers in April 1986 and February 1987 at station 1 (Fig. 2 and 3); March and April 1987 at station II (Fig. 2 and 3); April 1986 and February 1987, station III (Fig. 2 and 3); July 1986, station IV (Fig. 2 and 3); July 1986, station V (Fig. 2 and 3). Also, in May 1987 at station V, low biomass was recorded for high numbers. Fluctuations in biomass were significantly different (G range, 126.87–1631.0.8; $p < 0.001$) in both years at the study stations.

Relationship between prawn abundance and environmental conditions

The influence of the environmental conditions on prawn abundance (numbers) was tested using the multiple regression analysis. The summary of the values for the environmental conditions is presented in Table 1. The multiple regression coefficients (r) calculated were tested using multiple analysis of variance (MANOV) to detect significant relationships. Each study station and each year of sampling were also considered independently. The occurrence of *M. macrobrachion* was significantly influenced by the environmental conditions only at station V ($p < 0.05$) during the first year, and at station II ($p < 0.0005$) during the second year (Table 2). No significant dependence was observed in the other stations during both years (Table 2).

Population structure

Ten size classes were recognized for *M. macrobrachion* with a total length range of 20-120 mm. In reference to total length ranges given by other workers (Rutherford,

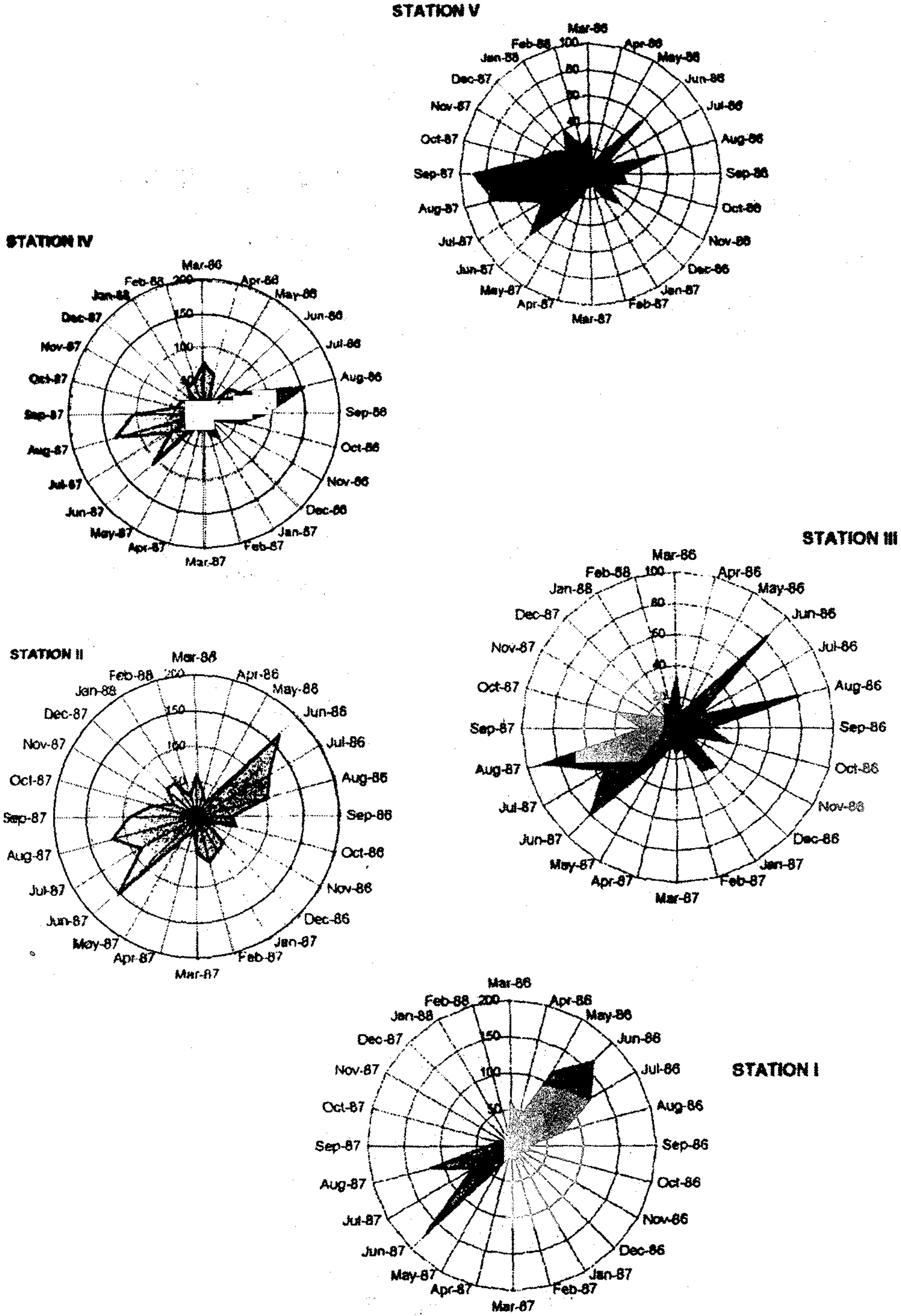

Fig. 2. Monthly variations in the abundance (number) of *M. macrobrachion* at the study stations

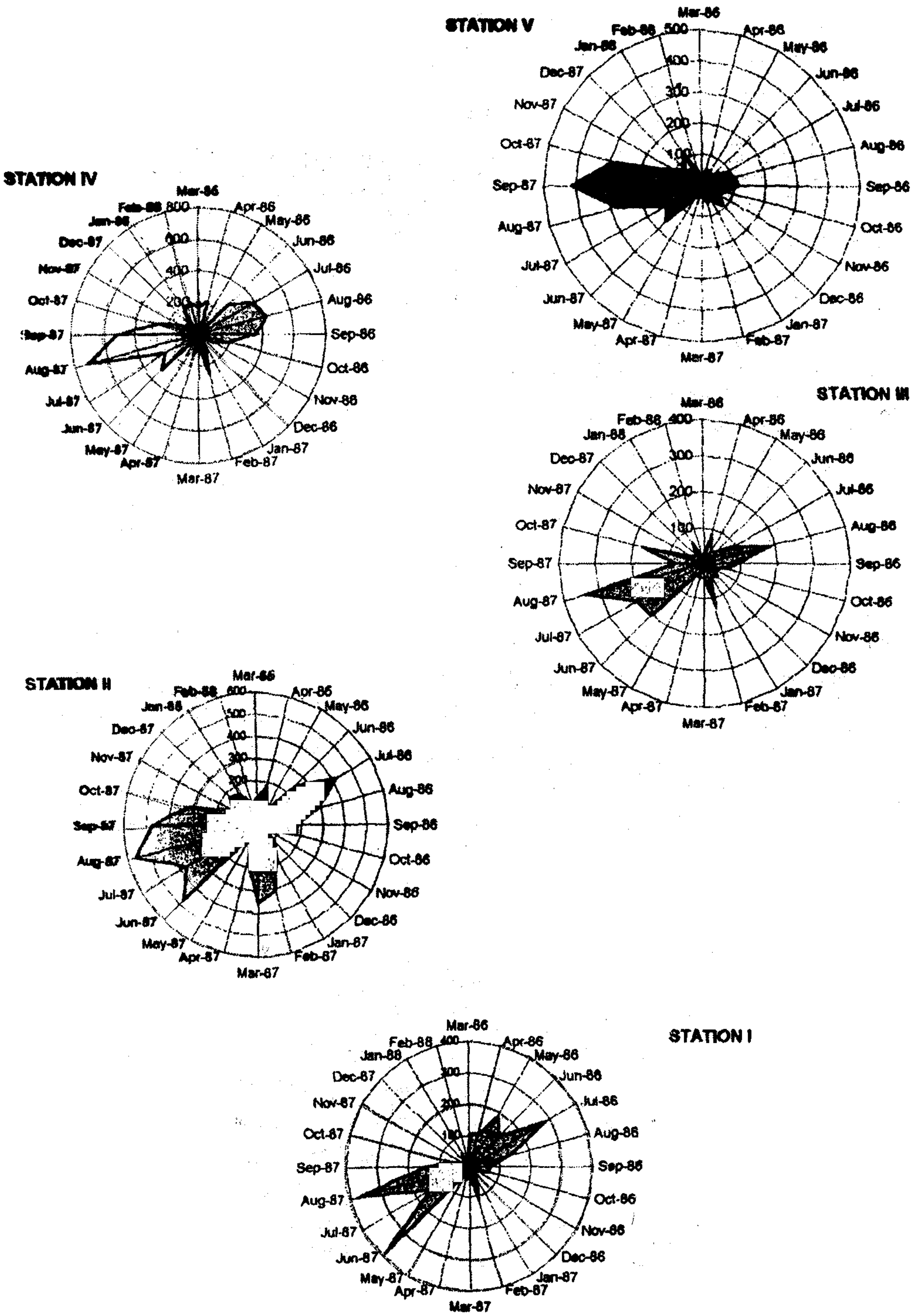

Fig. 3. Monthly variations in the abundance (biomass, mg) of *M. macrobrachion* at the study stations

TABLE 1

*Summary of some chemical characteristics of the Benin River surface water at the study stations in the first (Mar 1986–Feb 1987) and second (Mar 87–Feb 88) years; n=26 (number of samples); same lower case alphabets indicate no significant difference (P > 0.05; Duncan's New Multiple Range Test). * Indicates significance (P < 0.05); ** indicates significance (P < 0.01). N.C.=Not calculated*

	Station I			StationII			Station III			Station IV			Station V			ANOVA
First year	*Mean ± S.E.*	*Max.*	*Min.*	*Mean ± S.E.*	*Max.*	*Min*	*Mean ± S.E.*	*Max.*	*Min*	*Mean ± S.E.*	*Max.*	*Min*	*Mean ± S.E.*	*Max.*	*Min*	*F - value*
*p*H		6.30	3.40		6.20	3.20		6.30	3.20		6.40	3.20		6.40	3.00	N.C.
Conductivity (μScm^{-1})	143.0 ± 2.8	400	20	140.88 ± 2.3	380	18	140.48 ± 2.3	390	20	114.02 ± 2.0	350	20	148.64 ± 3.0	410	20	0.27
DO (mgl^{-1})	$9.35^a \pm 2.8$	15.7	5.0	$7.13^b \pm 0.46$	13.3	2.3	$8.16^a \pm 0.5$	14.5	5.6	$6.75^b \pm 0.4$	11.7	3.6	$8.51^a \pm 0.2$	14.0	5.0	78.57**
Total alkalinity (ppm $CaCO_3$)	24.8 ± 1.86	43.0	13.0	24.12±1.55	36.0	7.0	22.46 ± 1.5	38.0	12.0	22.4 ± 3.10	41.0	8.0	23.96 ± 1.60	40.0	13.0	2.24
Salinity (‰)	$2.39^c \pm 0.3$	6.17	0.01	$2.21^c \pm 0.23$	3.64	0.02	$2.41^c \pm 0.30$	5.26	0.02	$1.78^d \pm 0.2$	3.82	0.10	$2.29^c \pm 0.30$	4.82	0.10	25.54**
Ca ($mg^{-1} \times 10^{-1}$)	117.6±1.9	252	52.8	115.04±1.7	22.4	38.4	104.91±7.4	117.6	32.8	110.5±7.2	162	35.2	105.13±7.8	182	24.8	0.48
NO_3-N(mgl^{-1})	1.8 ± 0.23	4.10	0.45	2.02 ± 0.31	6.90	0.35	1.68 ± 0.20	4.49	0.15	2.17 ± 0.20	5.50	0.45	1.17 ± 0.20	4.60	0.45	0.63
PO_4-) (mgl_{-1})	$1.16^e \pm 0.2$	3.50	0.00	$2.07^f \pm 0.24$	3.80	0.25	$1.20^e \pm 0.20$	2.89	0.00	$2.27^f \pm 0.30$	5.70	0.30	$1.61^e \pm 0.30$	4.20	0.20	4.45**
Second year																
*p*H		6.50	2.80		6.70	3.00		6.00	3.20		6.10	3.00		5.60	3.20	N.C.
Conductivity (μScm^{-1})	453.7 ± 11	2200	10.0	485.7±13.0	2600	14.0	452.6±10.0	1900	10.0	216.23±7	1500	12.0	416.98±10	2000	13.0	1.08
DO (mgl^{-1})	$9.72^g \pm 0.5$	16.4	5.4	$7.53^h \pm 0.40$	10.2	4.4	$8.48^g \pm 0.50$	15.3	3.3	$7.18^h \pm 0.4$	13.2	4.4	$8.68^g \pm 0.50$	15.3	3.3	4.48**
Total alkalinity (ppm $CaCO_3$)	20.62 ± 1.8	36.0	7.0	18.69±2.10	59.0	7.5	19.98 ± 1.6	32.0	7.5	14.29 ± 1.5	41.0	7.5	21.92 ± 1.9	38.0	7.0	1.94
Salinity (‰)	$2.02^i \pm 0.19$	2.80	0.10	$1.87^i \pm 0.20$	2.70	0.10	$2.05^i \pm 0.20$	2.70	0.10	$0.88^j \pm 0.10$	0.80	0.10	$2.09^i \pm 0.20$	2.80	0.10	2.80*
Ca (mg^{-1}) x 10^{-1})	76.42 ±7.5	144.8	17.0	73.56 ±7.9	154.2	22.3	75.99 ±7.1	142.4	28.4	72.47 ±7.7	155.2	25.3	73.69 ±7.0	153.5	18.4	0.05
NO_3-N (mgl^{-1})	2.36 ± 0.21	4.50	1.04	2.62 ± 0.30	5.0	1.0	2.39 ± 0.20	4.26	0.89	2.23 ± 0.20	4.50	0.64	2.04 ± 0.20	4.18	0.64	1.11
PO_4-P (mgl^{-1})	1.07 ± 0.16	2.80	0.0	1.17 ± 0.10	2.66	0.0	1.49 ± 0.10	3.41	0.12	1.05 ± 0.10	3.41	0.12	1.05 ± 0.10	2.80	0.18	2.33

TABLE 2

Multiple regression coefficients (r) and the results of MANOV (F) for the dependence of M. macrobrachion *abundance (number) on the environmental conditions of the Benin River in the first (Mar 1986–Feb 1987) and second (Mar 1987–Feb 1998) years; * indicates significant difference (P < 0.05).*

Stations	First year		Second year	
	R	F-values	R	F-value
I	0.81	2.04	0.69	1.04
II	0.66	0.84	0.94	7.61*
III	0.69	0.97	0.78	1.99
IV	0.84	2.52	0.82	2.36
V	0.85	2.81*	0.65	0.78

1971; Powell, 1982; Marioghae, 1982), prawns in the size range of 10–30 mm were classified as juveniles and prawns of 30–120 mm in size as adults. For convenience of interpretation, the adults were categorized into young adults (30-80 mm) and old adults (80-120 mm).

The size frequency distribution of males and females *M. macrobrachion* at each station for the entire study period is shown in Fig. 4. The size frequency distribution of females at all stations showed a normal distribution pattern. The modal size class at stations II, III IV and V was 61–70 mm, while that of station I was 51–60 mm. At stations I, IV and V, platykurtotic size frequency distribution (Fig. 4) of males were observed. Stations II and III with modal size class of 51–60 mm and 61–70 mm, respectively, showed a normal distribution pattern approximately. The overall size frequency distribution of both males and females in the study stretch were leptokutotic (Fig. 5).

Tables 3–7 show the monthly changes in the size frequency distributions in the 2 years at station I–V. The distribution patterns in both years at each station were almost similar with slight variations. Generally, juveniles appeared in the catch during the rainy season months (May–October) of both years at each station. During this period, regular size frequency distributions dominated by young adults were observed (Tables 3–7). Irregular distribution patterns were, however, observed during the dry seasons (November–April) at each station. These general patterns were relatively more prominent at stations II and IV (Tables 4 and 6), than at stations I, III and V (Tables 3, 5 and 7).

Discussion

The spatial distribution of *M. macrobrachion* at the study stretch was uneven. The numbers of prawns captured at the creek stations (II, IV) were significantly higher ($P < 0.001$) than those at the main channel stations (I, III, V). Powell (1982) suggested the preference of *M. macrobrachion* to more muddy and quiet environments. The creeks are shaded with reduced discharge and less variations in salinity (Edokpayi, 1989) than the main channel stations. The fallen leaves of the riparian vegetation, which form a high percentage of the allochthonous input at the creeks, probably create more suitable

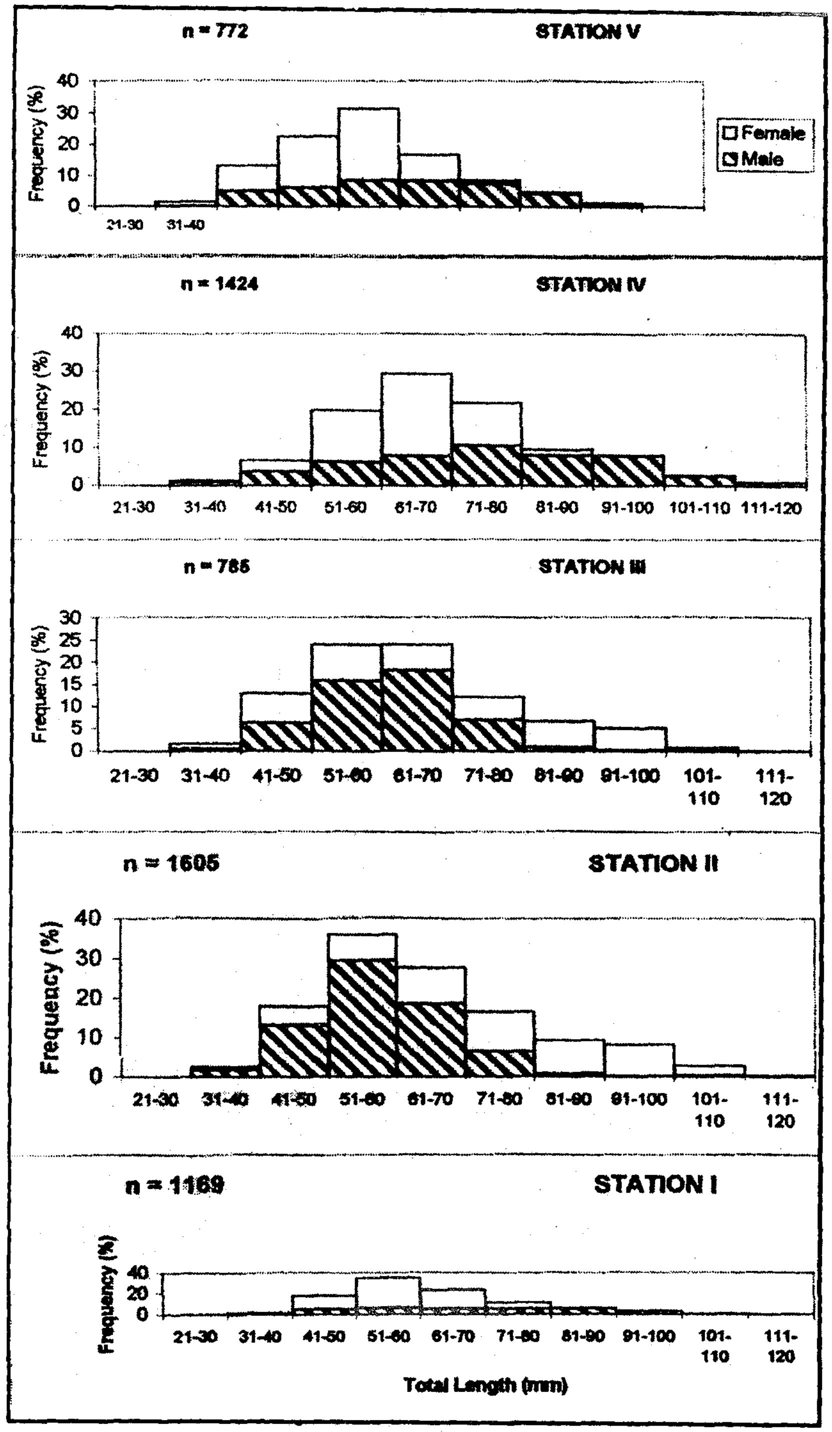

Fig. 4. Percentage frequency distribution of male and female *M. macrobrachion* at the study stations; n = total numbers

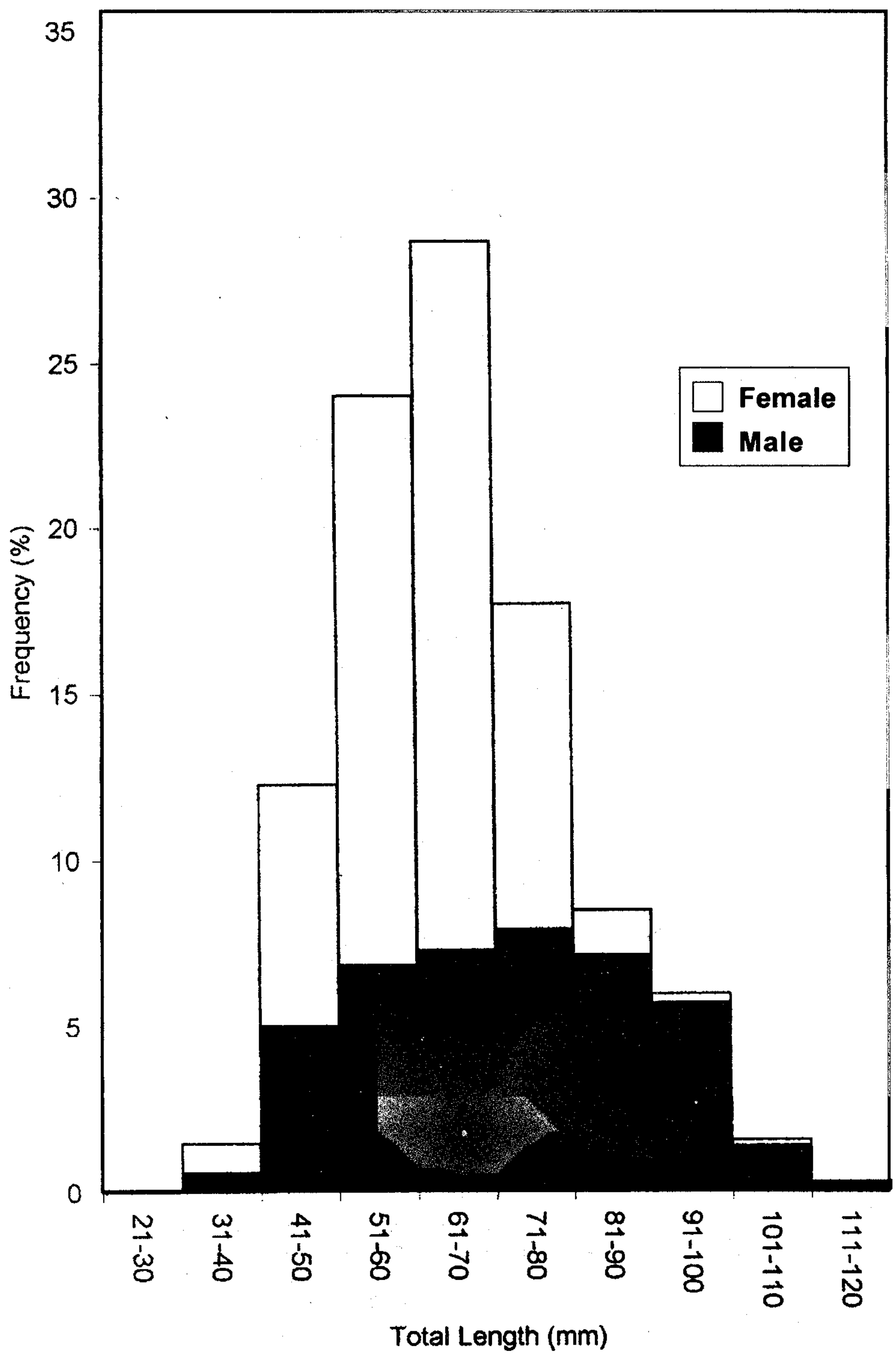

Fig. 5. Overall size frequency distribution of *M. macrobrachion* in the Benin River study stretch, Mar 1986–Feb 1988

TABLE 3

Monthly fluctuations in the size frequency distribution of M. macrobrachion *in station 1. - Indicates no specimen was recorded*

Size class (mm)	1986 Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1987 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1988 Jan	Feb
21-30	-	-	3	2	8	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
31-40	-	3	10	23	47	4	-	-	1	-	-	-	-	-	3	1	-	-	-	-	-	-	-	-
41-50	1	13	25	21	42	10	6	1	4	3	4	13	-	8	12	52	4	10	2	-	-	4	1	3
51-60	9	17	24	27	42	14	6	10	3	5	5	10	1	9	7	71	25	38	2	4	4	5	6	5
61-70	9	12	30	4	31	23	8	7	2	-	4	7	-	6	-	24	15	32	7	5	6	3	7	2
71-80	8	6	18	2	11	7	5	2	1	-	2	7	1	3	-	8	13	16	11	5	1	2	4	2
81-90	9	-	1	3	7	3	1	1	-	1	-	-	-	-	-	8	2	7	8	3	-	-	1	1
91-100	3	2	2	-	2	1	-	1	1	-	1	2	-	-	-	2	1	5	2	1	-	-	-	-
101-110	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	1	1	2	-	-	-	-	-
111-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-

TABLE 4

Monthly fluctuations in the size frequency distribution of M. macrobrachion *in station II. - Indicates no specimen was recorded*

Size class (mm)	1986 Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	1987 May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1988 Jan	Feb
11-20	-	-	-	-		1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-30	1	-	-	11	8	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-
31-40	1	-	2	21	25	11	1	-	1	4	1	1	1	-	3	2	2	-	-	-	-	-	-	1
41-50	4	12	4	10	27	9	8	2	1	19	14	16	3	2	10	26	6	6	2	6	2	10	10	3
51-60	9	16	3	23	41	17	8	16	6	15	8	18	2	6	3	45	17	11	7	8	12	8	20	7
61-70	8	14	3	21	24	35	25	24	4	7	8	13	8	5	1	39	29	52	26	9	12	21	9	12
71-80	4	8	5	12	17	10	11	8	2	3	7	15	7	2	2	18	21	17	26	21	4	11	14	3
81-90	5	8	2	6	11	5	3	4	-	-	6	8	11	3	2	16	5	16	15	3	3	3	3	5
91-100	1	5	2	2	9	3	-	1	-	-	4	6	10	7	4	10	5	13	12	1	1	1	1	1
101-110	3	-	2	2	2	1	1	-	-	-	-	1	2	3	-	1	1	-	4	3	3	1	-	-
111-120	-	-	-	-	1	1	-	-	-	-	-	-	1	-	-	-	2	-	-	-	-	-	-	-

Table 5

Monthly fluctuations in the size frequency distribution of M. macrobrachion *in station III. - Indicates no specimen was recorded*

Size class (mm)					1986											1987							1988	
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
21-30	-	-	-	1	5	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
31-40	1	1	3	8	15	5	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	3
41-50	3	5	2	7	11	5	2	3	2	6	6	7	-	9	5	14	4	7	-	3	-	-	-	5
51-60	1	6	4	11	15	16	7	3	1	4	4	13	-	5	5	23	9	21	1	10	5	3	3	2
61-70	4	9	3	4	9	24	10	8	3	6	2	9	-	8	2	26	13	22	7	12	5	3	9	2
71-80	2	3	2	2	3	18	5	6	1	1	-	2	2	2	2	8	18	25	9	8	3	2	4	3
81-90	1	1	1	1	3	3	1	1	2	1	1	-	1	2	-	5	4	8	1	3	1	-	2	-
91-100	-	3	2	-	1	-	2	-	-	1	1	3	1	-	1	3	4	2	3	2	-	1	1	-
101-110	-	1	-	-	-	1	-	-	-	-	-	1	1	-	-	-	1	-	-	-	-	-	-	-

TABLE 6

Monthly fluctuations in the size frequency distribution of M. macrobrachion *in station IV. - Indicates no specimen was recorded*

Size class (mm)	*Mar*	*Apr*	*May*	*Jun*	*1986 Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*1987 Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*1988 Jan*	*Feb*
21-30	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-40	3	-	3	8	11	6	-	-	-	-	1	1	1	1	1	-	3	2	-	1	-	2	-	-
41-50	5	13	1	6	10	9	7	5	3	1	7	5	-	5	5	6	4	8	2	1	4	6	4	3
51-60	13	27	3	27	18	34	24	14	6	5	6	14	3	7	6	21	7	11	9	2	9	3	4	14
61-70	13	13	3	18	34	58	32	12	2	-	4	12	2	9	1	42	22	46	27	9	13	6	14	8
71-80	11	13	1	14	19	14	27	16	5	-	6	10	3	5	-	19	8	38	38	14	7	5	14	13
81-90	5	5	2	5	11	7	5	4	2	1	2	6	3	3	-	11	4	9	11	5	4	1	3	9
91-100	6	5	1	5	7	5	6	2	3	-	-	4	1	4	-	4	7	7	5	5	-	2	5	4
101-110	2	1	-	2	1	4	-	1	-	-	-	3	1	-	-	1	1	5	3	3	-	-	1	-
111-120	-	-	-	-	1	1	-	-	-	-	1	-	-	-	-	1	-	-	3	2	-	-	-	-

TABLE 7

Monthly fluctuations in the size frequency distribution of M. macrobrachion *in station V. - Indicates no specimen was recorded*

Size class (mm)	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
					1986											1987							1988	
21-30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-
31-40	-	-	-	4	5	1	2	-	1	-	-	1	-	-	4	-	1	-	-	1	-	-	1	1
41-50	6	6	5	1	6	5	5	2	3	5	2	5	-	5	3	15	2	5	1	-	7	6	3	3
51-60	2	7	5	11	10	11	7	7	4	5	6	9	-	5	6	25	12	19	4	4	6	7	12	10
61-70	3	5	4	5	12	17	16	11	5	8	3	2	1	7	2	18	16	24	29	11	11	4	11	7
71-80	1	3	-	5	3	2	6	5	1	2	1	2	-	2	-	9	9	14	28	12	7	6	5	-
81-90	-	2	-	-	2	3	1	-	3	3	2	2	-	-	1	6	-	13	12	8	1	1	3	1
91-100	-	1	1	-	1	-	1	-	-	-	1	1	1	-	1	-	-	2	9	8	1	1	1	-
101-110	-	-	1	-	-	1	-	-	-	1		-	-	-	-	-	-	-	-	-	-	-	1	-

microhabitat for *M. macrobrachion*. A combination of these factors may have contributed to the occurrence of *M. macrobrachion* in higher numbers at the creek stations than the main channel stations.

Fluctuations in the number of *M. macrobrachion* caught showed distinct seasonality. Similar observation was made for *M. macrobrachion* and *M. vollenhovenii* at the Lagos lagoon (Marioghae, 1982) and for adult *M. felicinum* at the lower Niger River (Inyang, 1984). Such seasonal fluctuations in numbers have been reported as a common feature of prawn fisheries (Inyang, 1984). Seasonal fluctuation in the biomass of *M. macrobrachion* were similar to that of the fluctuations in numbers at each study station. However, the relatively high biomass recorded for low numbers in some months of the dry season was apparently the result of mainly large adults recorded during this period. Reduction in numbers accompanied by the increase in biomass due to the growth of survivors escaping natural mortality and predation is a known characteristic of benthic secondary producers (Mann, 1980; Jeffries & Mills, 1990; Williams & Feltmate, 1992).

The combined effect of the studied environmental conditions on the abundance of *M. macrobrachion* was evaluated. Studies considering the influence of the physical and chemical conditions on the abundance of prawns are rare. The influence of the physical and chemical conditions on the abundance of *M. macrobrachion* was significant ($P < 0.0005 - 0.05$) at stations II and V only. The fact that the other stations did not show any significant relationship does not necessarily mean that the physical environment has no influence on prawn abundance at these stations. A species can exist in an area because the physical and chemical conditions permit it (Zaret, 1980; Mason, 1992). However, species abundance could also be influenced by biological factors such as predation, competition and parasitism (Mann, 1980). It is, therefore, possible that the influence of those biological factors on species abundance may have been more important at those stations that showed no relationship between environmental factors and the abundance of *M. macrobrachion*.

The modal total lengths (60–70 mm for females; 70–80 mm for males) for *M. macrobrachion* observed here were similar to that reported by Marioghae (1982) at the Lagos lagoon. The leptokurtotic effect of the overall size frequency distribution for males and females indicate the occurrence of more than one population at the study stretch (Zar, 1984). The plathykurtotic frequency distribution of males at the main channel station (I, III, V) suggests the mixing of male populations along the main channel stations.

Young individuals were recruited during the rainy season as indicated by the monthly variation in the size frequency distribution. The progressive reduction in adults during the dry season months was probably due to predatory and non-predatory losses. The modal shift in frequency to large size classes during the dry season reflects the growth of survivors.

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