



FOOD AND FEEDING PERFORMANCE OF *PELLONULA LEONENSIS* (REAJON, 1917) (CLUPEIDAE) FROM CROSS RIVER ESTUARY, NIGERIA

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ABSTRACTS

The diet of *Pellonula leonensis* was studied in Cross River estuary, Nigeria, from January to December. The major food component were fish larvae, fine particulate organic matter, coarse particulate organic matter (detritus), crustaceans, ants, scales sand and plant matter. Scales and sand were secondary items while macrophyte matters were incidental items. Females had greater feeding activity than males all the items while males consumed only seven items. The wet season diet comprised 10 items and dry season diet comprised seven items. There was no significant difference in feeding activity in dry and wet seasons. Adult fed more on ants and fish larvae while juveniles fed more on detritus, crustaceans and sand. The observed ontogenetic diet shift enhances co-existence of the size groups. *Pellonula* was considered piscivorous and cannibalistic its feeding habit. Since it feeds on the same item throughout the years, the food resources were considered important factor in the elimination of the fish population.

Key words: *Pellonula leonensis*, stomach contents, Nigeria, piscivorous, cannibalistic.

INTRODUCTION

The clupeid *Pellonula leonensis* is commercially very important to riparian communities in West Africa (Ikomi, 1993). In Africa it is found in Lagoons, Lakes, lower and upper reaches of rivers from Senegal to Cameroon. It is also present in lower reaches of coastal river basins from Cameroon to Democratic Republic of the Congo, upper Niger and lower Benue. It is also reported in Cross River system (Kunzel et al, 1985 and Kunzel and Lowenberg, 1990). They enter brackish water bodies and are mainly nocturnal and occur in schools. It is a common and accessible source of protein to low income earner because it could be sold in small affordable quantities in local markets either fresh or smoked.

According Ikomi (1993), there is apparently scanty data on the species from natural rivers. The present study therefore aimed at providing information on food and feeding habit and some ecology of this fish from the Cross River estuary, Nigeria.

THE STUDY AREA

This study was conducted with specimens of *P. leonensis* bought from fishers at Oron, Akwa Ibom State, Nigeria. They caught the fishes at Cross Rivers estuary (Fig. 1). Detailed description of the Cross River system had been reported by Moses (1988) and Ekanem and Adegoke (1995).

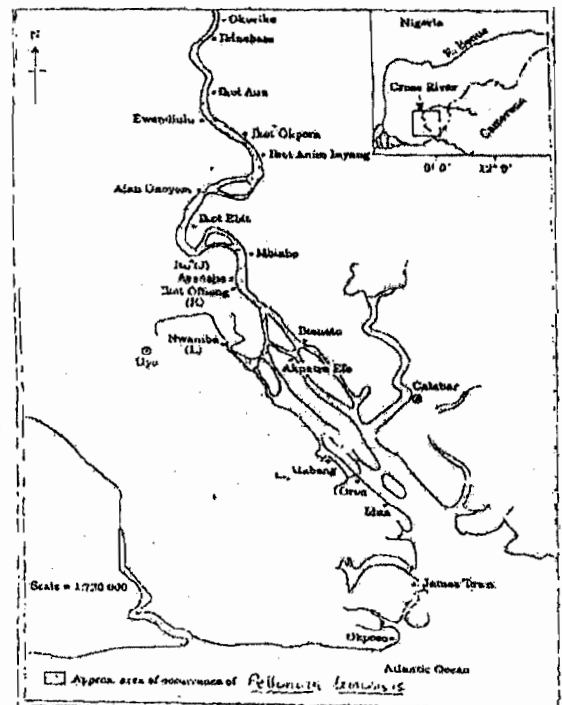


FIG. 1: MAP OF THE LOWER PARTS OF CROSS RIVER SHOWING AREAS WHERE *PELLONULA leonensis* OCCURS

MATERIALS AND METHODS

Samples of *P. leonensis* were collected monthly (January - December, 2004) from fishermen at Oron beach, Akwa Ibom State, Nigeria. Total lengths (TL) of the specimens were measured.

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They were dissected after measurement and weighing; and sexed by examining the gonads. The stomach of each specimen was removed and excised. Stomach fullness was estimated on a 0 - 20 point - scale. Thus 0, 5, 10, 15 and 20 points were allotted to: empty, 0.25 full, 0.50 % full, 0.75% full and fully distended stomach respectively. The stomach repletion index (R) (i.e. number of stomach containing food as a fraction of total sample x 100), and mean stomach fullness (MSF) (i.e. average point per stomach), were used to evaluate pattern of feeding activity. The contents of each stomach were placed on a clean slide and teased. A few drops of distilled water were added and examined macroscopically and microscopically (10 X - 100 X). The relative frequency and relative dominance of the food items were estimated. The integrated importance of each item was expressed as an index of food preponderance (IFP).

$$IFP = 0.5 (RF + RD)$$

This index has a range of 0 - 100%. Items with IFP ≥ 10.0% were considered primary dietaries, those with IFP between 1.0 and 9.6% as secondary and those with IFP ≤ 1.0% as incidental. Unadjusted food richness (UFR) was considered as the total number of items recorded in the diet (King 1989).

The fishes were divided into to 20 sized groups; small sized groups (SSG) (80 mm TL) and large - sized group (LSG) (≥ 80 mm TL) for the purpose of assessing ontogenetic variation in diet. 80 mm TL was considered a median value.

Determination of temporal, ontogenetic and sex-based differences in diet composition were assessed by the percentage similarity coefficient (S) (Moss and Eaton 1966):

$$S = \sum_{m=1}^n \min(X_i, Y_i)$$

where x, and y, are proportions of the components of the series of items comprising the diets of x and y. This index ranges from zero, for totally dissimilar items to 100% for incident diets. How widely dispersed the food items were between the various groups was assessed with index of bial dispersity (IBD) (Koch 1957) and Diet Breadth (B) (Angermeier, 1982)

$$IBD = \frac{(T - S) \times 100}{S (N - 1)}$$

where T = sum of dietaries in each of n compared months / seasons, S = total list of dietaries in n

(compared months / seasons). The index (IBD) ranges from 0 (for completely different set of items) to 100% for identical set of items in each month / season.

$$B = [(\sum P_j^2)^{-1} - 1] / (n - 1) \dots \dots \dots 3$$

Where P - proportion of the diet comprised by resources type j and n - number of food categories in the diet.

The growth condition of the fish was assessed using Felton condition factor (K)

$$K = \frac{W \times 100}{L^3} \dots \dots \dots 4$$

Where w = weight and L = total length.

RESULTS

A total of 668 specimens of *P. leonensis* measuring 40 - 1220 mm TL were examined (Fig 2). Males measured between 52 and 750 mm TL and females between 38 and 1220 mm TL. The size frequency distribution showed that 98.70% of the specimens were in the 41 - 110 mm TL sized group while those > 110 mm TL were rare. There was a significant correlation between total length and weight (r = 0.458 df = 666 P < 0.05). The exponential relationship is of the form;

$$W = - 9.18 TL^{1.745}$$

The overall diet composition of the specimen is shown in Table 1. It consists of 10 food items. The primary food items were preyfishes, detritus (coarse particulate organic matter- CPOM, and fine particulate organic matter-FPOM), microcrustaceans (crayfish) and ants (formicids). Sand was of secondary importance while macrophyte is an incidental item. Most of the prey fishes identified were *P. leonensis* juveniles, that were not digested beyond recognition.

Intersexual variation in diet (Table 2) shows five items for males and eight items for females. Males consumed more microcrustacean, preyfishes and sand grains than females. Formicids were absent in males diet.

Seasonal changes in diet composition (Table 3) shows that crayfish, crustacean parts, preyfishes and scales were greater in dry season than wet season, while sand and detritus were of higher importance in the wet season. The items occurred in wet and dry season except the macrophyte which occurred only in wet season.

TABLE 1: FOOD COMPOSITION OF *P. leonensis* FROM CROSS RIVER ESTUARY, NIGERIA

Food Types	% RD	%RF	%IFP
Formicidsl (Ants)	8.58	13.39	10.36
Crayfish	5.39	9.21	6.80
Crustaceans parts	8.33	8.37	8.35
Preyfishes	18.63	31.80	23.49
Scales	11.52	6.70	9.74
Sand	7.35	0.42	4.79
CPOM	18.14	14.23	16.69
FPOM	18.63	14.64	17.16
Macrophyte	1.47		0.93
Insect parts	1.96	1.26	1.70
Food richness	10		

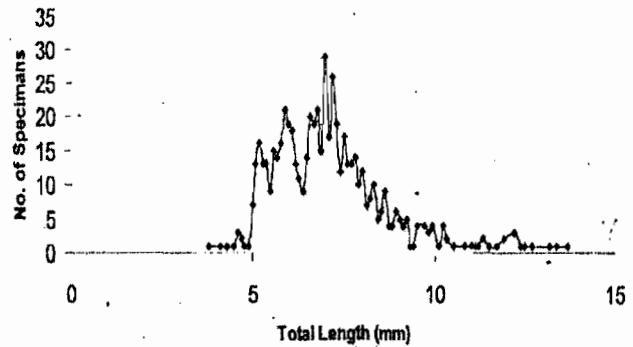


Fig. 2: LENGTH FREQUENCY DISTRIBUTION OF *PELLONULA leonensis* FROM CROSS RIVER ESTUARY, NIGERIA

TABLE 2: INTERSEXUAL VARIATION IN THE FOOD COMPOSITION OF *P. leonensis* FROM CROSS RIVER ESTUARY, NIGERIA

Food Types	Males			Females		%IFP
	%RF	% RD	%FD	%RF	% RD	
Formicids (ants)				8.97	5.00	11.23
Crayfish				6.79	10.91	8.33
Crustacean parts	5.56	7.69	6.45	5.71	7.27	6.29
Preyfishes	55.56	69.23	61.29	19.02	30.91	23.47
Scales	5.56	3.23		12.23	5.91	9.86
Sand	5.56	3.23		8.15	0.91	5.44
CPOM	11.11	7.69	9.68	17.66	14.55	16.50
FPOM	11.11	7.69	9.68	17.39	13.64	15.99
Macrophyte				1.63		1.02
Insect parts	5.56	7.69	6.45	2.45	0.91	1.87
Food richness	7			10		

The ten food items identified were found in the two sized groups except insect parts which was absent in the LSG. The large-sized group exceeded small-sized group only in formicid and preyfishes which constituted 51.47% of the item consumed by LSG. Small-sized group consumed preyfishes and detritus and these constitute 54.01% of the total food consumed.

There was quantitative dissimilarity in the diet of males and females ($S = 57.45\%$), wet and dry seasons ($S = 52.28\%$) ad the diet of small and large-sized groups ($S = 68.88\%$). The index of biotal dispersity was high between males and females ($IBD = 70.00\%$), seasons ($IBD = 90.00\%$) and between the size groups ($IBD = 90.00\%$).

The diet breadth (B) of females ($B = 0.706$) was greater than that of the males ($B = 0.315$). Diet breadth was also greater in the small sized group ($B = 0.704$) than the large sized group ($B = 0.529$). There was not much difference in the diet breadth of wet and dry season collection, $B = 0.629$ and 0.569 respectively.

The mean stomach fullness was higher in dry season than wet season and slightly higher in males than females (Fig 3)

Stomach repletion index was higher in male ($R = 42.86$) than females ($R = 37.06$) and in large sized group ($R = 41.05$) than small sized group ($R = 36.46$). It was also higher in dry ($R = 66.49$) than wet ($R = 36.46$) season. The condition factors (K) was higher in females (0.996) than males (0.720). It was also greater in dry season (1.164) than wet season (0.614).

DISCUSSION

Pellonula from Cross River estuary are mostly piscivorous cannibals. They feed mostly on their juveniles. They also feed an detritus, microcrustaceans, insects (ants) and scales. Sand was also observed as another important item. Macrophyte was relatively very small. About 54.41% of the item was made of animal matters, and was considered carnivorous also. Most of the items (80.64%) were from autochthonous source. The sand grains thought it may not have much nutritive value, could be considered important in internal trituration since the fish feeds on macro or bulky food items.

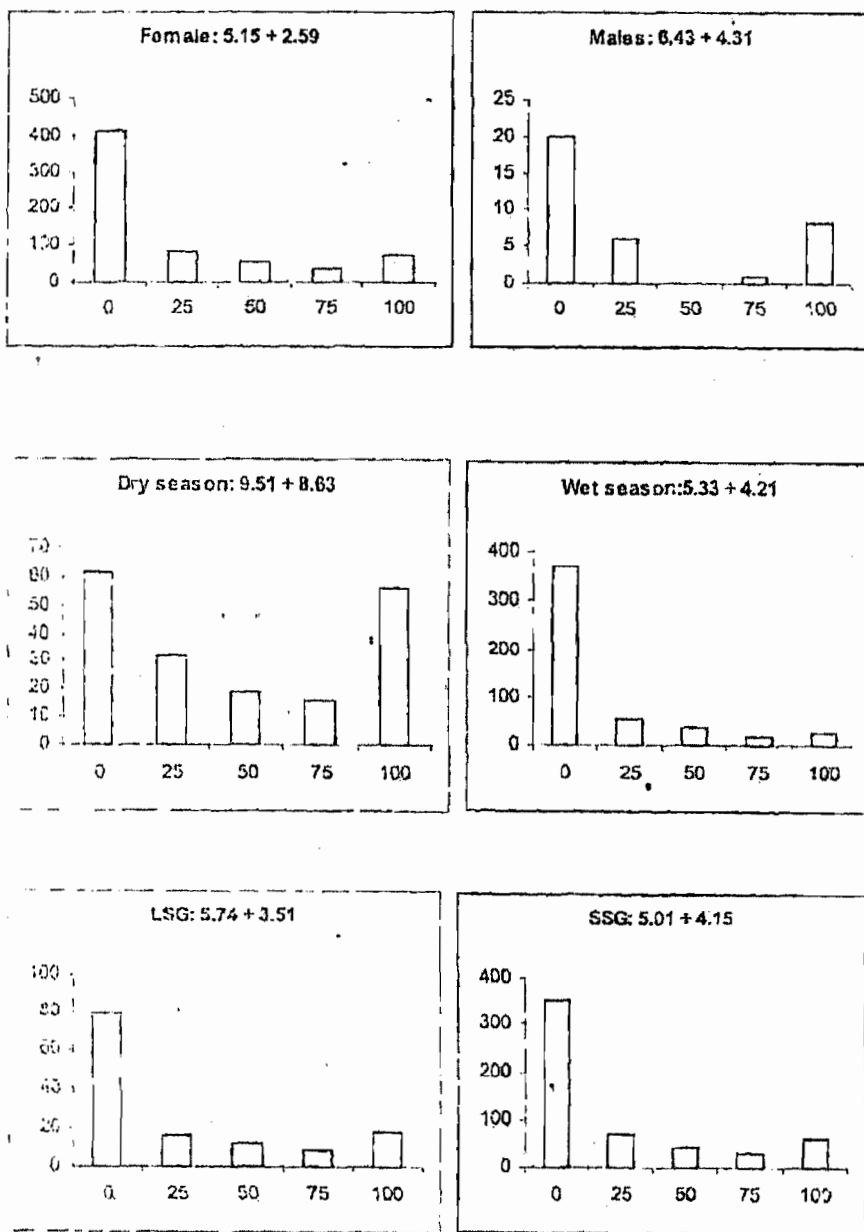


FIG. 3: VARIATION IN STOMACH FULLNESS OF *PELLONULA leonensis* FROM CROSS RIVER ESTUARY, NIGERIA WITH SEXES, SIZES AND SEASONS

Results on ontogenetic diet composition shows that LSG ate more preyfishes and ants than SSG while SSG ate more detritus, microcrustaceans, sand and insect parts than LSG. This is supported by the low similarity index ($S = 68.88\%$) between the two groups, which suggests qualitative differences in dietaries. Obviously there is a diet shift between the two groups. One of the reasons for the observed diet shift is that the LSG have wider mouth gape for taking the preyfishes and fast swimming speed also for preying (King et al., 1990 and King and Akpan, 2002). This ontogenetic diet shift reduces

intraspecific competition for food resources between small sized and large sized groups (Whyte, 1975, Jacob and Nair, 1982) and enhances successful coexistence of individuals of different sizes in the same environment. Results also showed that SSG had more empty stomachs and less 100% full stomachs than the LSG, which suggests greater feeding intensity in LSG than SSG. According to Walton et al. (1994), King and Akpan (2002) and Akpan et al. (2006) LSG individuals usually have higher feeding activity because of being more active than the SSG individuals. The condition factor was increasing

with increasing total length suggesting that energy expenditures was more in the smaller ones than the bigger ones.

Of the ten items identified males consumed seven items and females consumed all. The low similarity index between the sexes ($S=57.45\%$) indicates that the items of the two sexes are quantitatively dissimilar. Females consumed more

of the items than males except prey fishes (Table 2). Also the diet breadth ($B = 0.706$) of females was higher than that of the males ($B = 0.315$). There indicate greater feeding activity of the female than males. This high feeding performance of the females could be caused by the energy demand for egg production. Similar observations have been reported by Akpan and King (2006)

TABLE 3: SEASONAL VARIATION IN FOOD COMPOSITION OF *P. leoneis* FROM CROSS RIVER ESTUARY, NIGERIA

	Dry season			Wet season		%IFP
	%RF	%RD	%IFP	%RF	%RD	
Formicids (ants)	0.59	0.36		12.27	23.39	16.07
Crayfish	13.10		18.42 15.25	0.84	0.81	0.83
Crustacean parts	10.12		8.77 9.58	7.17	8.07	7.48
Preyfishes	29.76		43.86 35.46	12.24	21.77	15.51
Scales	18.45		12.28 15.96	6.75	0.81	4.71
Sand	3.57	2.13		10.55	0.81	7.20
CPOM	13.10		10.53 12.06	19.83	16.13	18.56
FPOM	10.72		6.14 8.87	24.05	25.81	24.65
Macrophyte				2.53		1.66
Insect parts	0.59	0.36		3.80	2.42	3.32
Food richness	9			10		

TABLE 4: ONTOGENETIC FOOD COMPOSITION OF *P. leoneis* IN CROSS RIVER ESTUARY, NIGERIA

Food types	SSG (80mm TL <)			LSG (≥ 80 mm TL)		%IFP
	%RD	%RF	%IFP%	%RD	%RF	
Formicids (ants)	5.78	9.47	7.13	22.06	30.61	25.64
Crayfish	6.38	11.05	8.09	1.47	2.04	1.71
Crustacean parts	9.12	10.00	9.44	2.94	2.04	2.56
Preyfishes	17.02	29.47	21.58	29.41	40.82	34.19
Scales	11.85	5.79	9.63	10.29	4.08	7.69
Sand	8.21	0.53	5.40	4.41		2.59
CPOM	18.54	15.79	17.53	10.29	6.12	8.55
FPOM	18.54	16.32	17.73	17.65	14.29	16.24
Macrophyte	1.52	0.96		1.47		0.86
Insect parts	4.56	1.58	2.51			
Food richness	10			9		

The seasonal biotal dispersity was high indicating diet similarity between dry and wet seasons. Also, the dry season diet breadth ($B = 0.569$) was not much different from the wet season diet breadth ($B = 0.629$). These suggest that the feeding activity of the fish in both seasons is about the same. This could be possible since more than 60% of the food item (microcrustaceans fish larvae) are autochthonous. Reports claim that tropical fishes show greater diet breadth in dry season than wet season. Welcomme, 1969, Zaret and Rand 1971, Lowe - McConnell 1975, Angemeier and Karr 1983, King and Akpan 2003).

One may consider this assertion true of only those fishes that have allochthonous food base.

This is because during rainy season rain carries materials from the terrestrial environment into water bodies and thus changes the diet breadth. The condition factor of dry season ($K = 1.164$) was slightly higher than that of the wet season ($k = 0.614$), which may not indicate much difference in the health condition of the fish between the two seasons. Since the fish feeds mostly on its younger ones and microcrustaceans which are constant in the estuary, seasonal variations in feeding activities and growth are more or less negligible.

The overall food spectrum suggests that *Pellonula* in Cross River estuary are piscivorous and cannibalistic. Secondly it feeds on the same items throughout the year. Such feeding habit

