FOOD AND FEEDING HABITS OF *Schilbe intermedius* IN LOWER CROSS RIVER, NIGERIA

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ABSTRACT

The food and feeding habits of *Schilbe intermedius* from the Lower Cross River of Nigeria was investigated for a year. The food items in the stomach of the *Schilbe intermedius* covered spectrum of various types of invertebrates (mainly worms and insects), fish, algae and detritus. Temporal and seasonal variations were also observed in the stomach content of *S. intermedius* over the period of investigation. The predominant food items found in the stomach were plankton genera, *Caridina africana*, *Parailia pellucidia*, *Oxdaxothrissa mento*, *Spirulina* spp, *Oscillatoria* spp, *Coscinodiscus* spp and detritus. Coleopteran, Isopteran and Ephemeroptera were also observed. This suggests that *S. intermedius* is an insectivore – piscivore with algivore affiliation.

INTRODUCTION

The *Schilbe intermedius* (family Schilbeidae) catfishes inhabit Asian and African fresh water (Teugel *et al*, 1992). They are prominent components of the icthyofauna of many West Africa fresh water bodies. Moses (1979) noted that Schilbeids are commercial important fishes in the Cross River. They have also been found widely distributed along the Cross River course from Itu (the present study site) upward to the upper reaches in the Camerouns. Moses (1987) has identified them as one of the fluvial fishes of the lower Cross River basin and are distributed from the main river channel to flood plains and flood lakes during the food seasons.

Various investigations have been conducted on the food and feeding habits of fish with the aim to determining their dietary requirements. Findings have shown that there is great diversity of organisms that serve as food for fish based on their sizes and nutrients habits etc. Fagade and Olaniyan (1973) found *Tilapia asculenta* in Lagos to feed on algae and diatoms. The same researchers reported that the same species found in Eastern African depend mainly on a mixture of phytoplankton and zooplanktons. Other Cichlids (*Tilapia guineense and T. mariae* have been reported to be omnivores (Fagade 1971 & 1978). Olatunde, (1978) has shown that the Schilibeids subsist in a wide variety of food items. However, the small sized group depended primarily on small invertebrate and phytoplankton while lager Schilbeids feed on larger invertebrates and other prey – fishes.

Although enormous literature exists on the food and feeding habits of the fish in most inland water bodies, there is still paucity of information on the dietary requirement of *S. intermedius* in West Africa. The few available reports are on the fish population in Lake Volta in Ghana and Kainji Lake in Nigeria. Reynolds (1970) and Petr (1967) found that *S. mystus* in lake Volta, Ghana depends on large invertebrates. Olatunde (1978) made similar observations on fishes in Kainji Lake, Nigeria. Although these findings were at variance with the works by Verbeke (1959), who reported a mixture of plant tissues, fish and insect larvae as food of *S. mystus* in Lake Albeit, Egypt. Similarly, Meron and Mann (1985) suggested that the *Schilbe* species in Okavange Delta, Bostwana are principally piscivore with insect as secondary food item in the diet. The present study aims at revealing the diet spectrum of *S. intermedius* in the Lower Cross River, Nigeria.

MATERIALS AND METHODS

The Cross River basin (Fig. 1) covers an area of $70,000m^2$ within Cameroun (Teugel *et. al*, 1992). The entire Cross River is located within the rain forest belt except a small savannah patch of latitude 7^0N and drained by the Anyim tributary. The river is categorized into the Cameroun section referred to as the "Upper Cross River" and the Nigerian section, the "Lower Cross River" based on the physicochemical, geographical, ecological and zoo-geographical attributes of the water body (Teugel *et al*, 1992). The study area (Itu) where the Schilbeids were harvested for analysis lies between latitude 8^0E and 15^0E in the lower Cross River. The area is characterized by the dry season (October – March) and wet season (April – September) where 82.6% of precipitation occurs (King, 1989). There is noticeable interruption of rainfall, during the wet season's months of July and August creating an unexpected dry period referred to as the 'little dry season' (Ireland, 1962) or 'August break' (Moses, 1979).

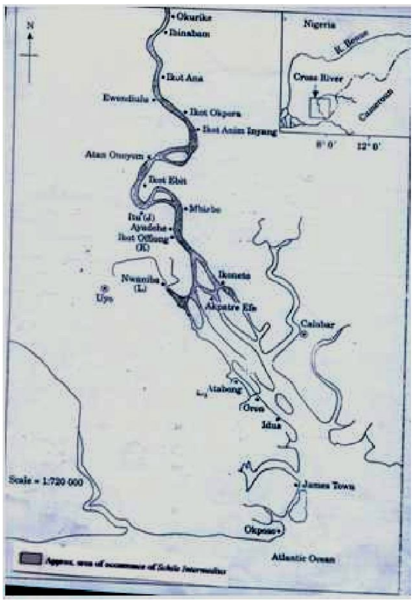

Figure 1: Map of lower part of cross river showing were *Schilbe intermedius* occurs.

During the study period (January – December, 2011), 320 samples of *S. intermedius* were obtained from artisanal fishers using cast net and gill net. The specimens were measured to the nearest 0.1cm total length and weighted. They were eviscerated and the stomachs slit open. The fullness condition of each stomach was determined by the Point's Method and the Average stomach fullness (ASF) computed (King, 1989). The stomach content was examined microscopically (with varying magnification up to x40).

The Relative Importance of the food items were estimated by the percentage Relative frequency (RF) and Relative dominance (RD) Methods (king, 1989) according to the equations below:

$$RF = (Fi/\sum^{n}_{i=1} = Fi)\ 100 \qquad (1)$$

Where Fi = Frequency of item i

N = Total number of items

$$RD = [Di/\sum^{n}_{i=1} Di]\ 100 \qquad (2)$$

Where Di = frequency of item 'I' am dominant dietary.

N = total number of dominant items.

The integrated importance of each item was estimated by percentage index of food preponderance (IFP) (King, 1994).

$$IFP = [(Fi + Di)/(\sum Fi + Di)]\ 100 \qquad (3)$$

Where Fi and Di are as defined in Equations 2 and 3.

Primary dietaries were arbitrarily considered as those with IFP ≥ 10%, those with IFP = 1.0 – 9.9% as secondary and those with IFP < 1.0% as incidental. The percentage compositions were used to describe the overall diet and temporal changes in food habit.

Fi = Frequency of Item (i) as dominant dietary; n = total number dominant items.
The RF and RD of all dietaries sum up to 100% respectively.
The overall importance of each item was estimated by a percentage index of food preponderance (IFP) (King, 1994).

RESULTS

Fish Diets:
Healthy specimens of *S. intermedius* (size range 6.0 – 28.0cm) were analyzed to determine their food and feeding habits. The results have shown that the overall stomach contents of *S. intermedius* (Table 1) comprise 29 items. The food items ingested were categorized into 5 major groups viz Algae, Invertebrates, Prey fish, Macrophyte and Sediments. The algae detected were *Anabaena, Aphanizomenon, Lyngbya, Marcrocystis, Nostoc, Oscillatoria, Spirulina, Coscinodiscus, Rhizosolenia, Synedra and Spirogyra*. The invertebrates consisted of insects (Coleoptera, Diptera, Ephemeroptera, Hemiptera, Homoptera, Isoptera) and insect remains), annelids, Crustacea (*Caridina* Africana, crab remains, Copepoda). The preyed fish were mainly *Parailia pellucidia*, *Oxdaxothrisssa mento* and fish remains, while Macrophyte matter and sediments consisted of sand grains and detritus.

The Index of food preponderance (IFP) showed that *S. intermedius* fed primarily on insects (30.4%), prey- fish (30.2%), algae (19.3%) and sediment (11.9%). The secondary food item was mainly Macrophyte (1.7%).

Temporal Variation in Fish Diets:
There was considerable monthly variation in the relative importance of the food types, which alternated about the primary and secondary scales (Table 2). Algae formed primary dietaries in February – April and August – November and secondary dietaries in all the months. A marked decrease in the relative consumption of the item occurred as the months progressed from February – July but increased remarkably between November and December.

Two types of temporal dynamics in feeding habits were assessed. These were monthly and seasonal variations in fish feeding habits. Invertebrates dominated the diet of *S. intermedius* in all months except during the early wet season months (May – June) when they were replaced by prey – fish. Invertebrates were primary dietaries throughout the year except in May when they played secondary role. Prey – fish constituted primary dietaries in January – July and September – December and secondary dietaries in August. Sediments were secondary dietary in all the months except August – September and November, when they were primary dietaries. Macrophytes were of primary status in October and were of secondary importance in February, September and November. The Macrophytes were not consumed in the other months.

Table 1: Overall Trophic Spectrum of *S. Intermedius* in the Lower Cross River,

Food Items			% Index of Food Preponderance (IFP)
Algae			
Anabaena			1.5
Aphanizomenon			0.5
Lyngbya			0.4
Microcystis			2.0
Nostoc			1.7
Oscillatoria			2.6
Spirulina			4.4
Coscinodiscus			2.0
Cyclotella			1.7
Rhizoselenia			0.3
Synedra			1.0
Spirogyra			1.2
	Total	=	19.3
Invertebrates			
Insects: *Coleptera*			9.2
Diptera			2.4
Ephemeroptera			0.3
Hemiptera			1.0
Homoptera			1.1
Isopteran			2.6
Insect remains			13.8
Annelid earthworm			0.9
Caridina Africana			5.3
Crab remains			0.3
Copepoda			0.1
		Total	*37.0*
Prey Fish			
Parailia pellucidia			16.1
Oxodaxothrissa mento			8.6
Fish remains			5.5
		Total	30.2
Macrophyte			1.7
Sediments		Total	1.7
Sand grains			8.4
Detritus			3.4
		Total	11.8

Table 2: Monthly variation in the food composition of *S. intermedius* expressed as IFP

Food items	Jan	Feb	Mar.	Apr	May	Jun	Jul.	Aug.	Sep	Oct	Nov	Dec.
Algae	6.7	27.9	19.6	17.6	4.5	2.1	2.7	29.2	19.0	5.8	25.7	41.4
Invertebrate	46.7	47.1	36.1	68.7	5.5	18.7	12.8	47.1	47.3	49.7	42.4	28.1
Prey – fish	46.7	14.6	36.1	13.7	88.8	78.1	82.7	4.4	14.5	22.4	12.8	22.1
Macrophyte	0	2.9	0	0	0	0	0	0	1.2	11.1	2.4	0
Sediments	8	7.5	6.3	0	1.2	1.1	1.8	19.4	18.0	9.1	16.7	8.3

Table 3: Seasonal variation in food composition of *S. intermedius* in the Lower Cross River

Food Items		%Index of Food Preponderance (IFP)	
Algae		Dry Season	Wet Season
	Anabaene	*2.3*	*1.2*
	Aphanizomenon	*1.3*	*0.1*
	Lyngbya	*0.9*	*0.2*
	Microcystis	*3.5*	*1.2*
	Nostoc	*2.5*	*1.3*
	Oscillatoria	*3.5*	*2.1*
	Spirulina	*6.9*	*3.1*
	Coscinodiscus	*2.4*	*1.7*
	Cyclotella	*2.3*	*1.3*
	Rhizoselenia	*0.1*	*0.5*
	Synedra	*0.9*	*1.0*
	Spirogyra	*1.3*	*1.1*
		27.9	*14.8*
Invertebrates			
Insects:	*Coleoptera*	*13.1*	*7.2*
	Diptera	*2.5*	*2.3*
	Ephemeroptera		*0.4*
	Hemiptera	*1.9*	*0.6*
	Homoptera	*1.5*	*0.9*
	Isoptera	*1.0*	*3.4*
	Insect and Remains	15.9	12.7
		36.5	27.5
Nematode:	Earthworm	0.1	1.4
Crustacea:	*Caridina Africana*	*4.4*	*5.8*
	Crab remains	*0.4*	*0.2*
	Copepoda	*0.3*	*0.1*
		5.2	*7.5*
Prey –Fish			
	Parailia pellucidia	*11.8*	*18.4*
	Oxdaxothrissa mento	*4.1*	*10.9*
	Fish remains	1.3	7.6
	Macrophyte	7.2	36.9
	Sediments	1.7	1.7
	Sand grains	6.1	9.5
	Detritus	6.0	2.1
		13.8	13.3

Monthly Variation in Fish Food Components:

Monthly dynamics in IFP of the food components (Table 2) indicated that Algae, invertebrates and fish dominated the diet of *S. intermedius* during the study period. However, specific peaks were observed during the months of February and April and August and in September, November and December for algae while invertebrates were primary diets between January and April and also between June and December. Fish was most prominent during the peak rains in May-July and reappeared between Septembers to January. Sediments were found to be secondary dietary during the period. Except in August, September and November where sediments were of primary importance, Macrophytes were of primary importance in October and assumed a secondary status in February, September and November. However, Macrophytes were not completely absent in other months.

Seasonal Variation in Feeding Habits:

Table 3: shows that the diet of *S. intermedius* was fairly similar in both seasons except in the absence of Ephemeroptera during the dry season. All the array of food items were ingested in both seasons. However, there was a significant dry season increase in the IFP paired

Comparison. Paired t-test: t =7.255, df = 25, p<0.001> of the food items. There was similarity in the rank - order of the food items (Spearman rank correlation: rs = 0.815, p< 0.002), although the proportion of some food items were different. Exception of the absence of Ephemeroptera in dry season, all the array of food items were ingested in both seasons (Table 3). However, there was significant dry season increase in the IFP (paired comparison: paired t-test: t =7.255, df =25, p< 0.001) of the food items.

Figure 2 shows the seasonal variation in indices of feeding intensity. There was significant dry season increase in SRI (d =1.674, p<0.05); SFI (d = 1.355, p<0.005) and ASF (t = 2.3334, df = 265, p<0.05). However, there was no significant seasonal increase. The result indicated similar seasonal feeding of *S. intermedius* in the lower Cross River.

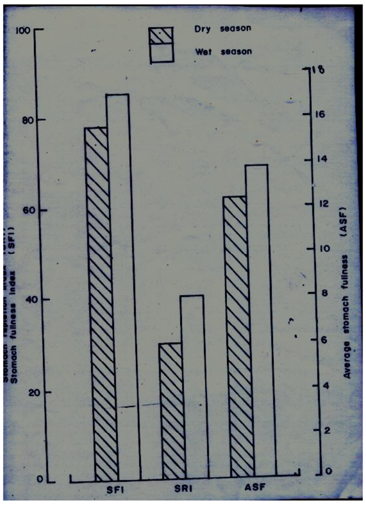

Figure 3: Variation in indices of feeding intensity with size ranges of *S. Intermedius*

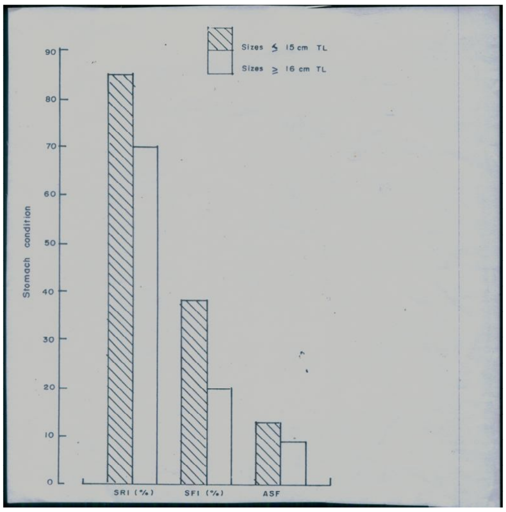

Figure 2: Seasonal Variation in indices of feeding intensity of *S. Intermedius.*

SFI – Stomach fullness index, SRI – Stomach repletion Index, ASF – Average Stomach Fullness

Variation in Feeding Intensity:

Figure 3 illustrates the feeding of *S. intermedius* relative to fish size. There was an ontogenetic difference in the proportion of index of feeding intensity SRI, SFI and ASF of *S. intermedius*. Although the inverse relationships between total length and SRI (r= -0.496, df = 12, p<0.05); SFI (r = -0.459, df =11, p<0.020); and ASF (r = - 0.464, df = 11, p<0.02) were weakly corrected. However, fish with sizes less than 15cm TL exhibited higher feeding intensity than those with sizes greater than 16cm TL.

DISCUSSION

The results of the present study have shown that the food composition of *S. intermedius*. comprised four main categories arranged in order of importance as follows; Insects, fish, algae sediments, Crustancea and Macrophytes were of secondary importance while *Lumbricus terrestis* were ingested as incidental items. These results are at variance with available reports by Olatunde (1979) which holds that *S. intermedius* relied only on fish and insect larvae for food.

In upper Nile, *S. intermedius* is a benthic feeder depending on mud, Chironomid larvae, beetles, Cladoceran and rotifers while in lake Albert it is an omnivore feeding on Macrophyte, fish and insects; in lake Victoria it feeds primarily on fish while subsisting on insects (Cobert, 1961), in lake Volta it feeds primarily on clupeids and terrestrial insects (Peter, 1967) while it depends solely on fish in lake Kainji (Imevbore and Bakare, 1970). The above accounts are in contrast to the present results. However, the pattern of relative importance and range of the dietaries of *S. intermedius* in Lower Cross River is largely higher than values reported by Cobert (1961), Peter (1967), Imevbore and Bakere (1970) and Olatunde (1979). The reasons for the wide range of the dietaries in this study could be attributed not only to differences in the habitat's conditions of the different geographical regions involved but also to great trophic flexibility which enables the species to switch easily according to food fluctuations in abundance.

The monthly and seasonal plasticity in the relative importance of the food item ingested by *S. intermedius* from lower Cross River are probably consequences of temporary regimes in availability and abundance of food items. The reliance of the species on fish and insects as primary dietaries throughout the year is probably guaranteed by the stability of the River system which offers optimal breeding ground to varied fish and insects communities in conjunction with abundant food resource (Lowe- Mc Connell, 1987). The high proportion of non-empty stomachs portrays the species as a frequent feeder. The study has also revealed that *S. intermedius* feeding intensity decreased with size of species. This is in conformity with the idea of a negative correlation between feeding intensity and fish size relative to metabolic rates (Lagler, *et al* 1977; Sarker, *et al*, 19870; Blay and Eyeson, 1982; king, 1989).

CONCLUSION

The seasonality in the dietaries of the species may be viewed as an adaptive design to ensure and maintain sound body condition all the year round in the habitat. Based on the above, *S. intermeduis* could be classified as an insectivore - piscivore with algivore affiliation.

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