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Full Length Research Paper

Food and feeding habits of *Ophiocephalus obscura* (African snakehead in the Cross River estuary, Cross River State, Nigeria

George Ubong Uwem[1], Ekanem Albert P.[1]* and George Eni[2]

[1]Department of Fisheries and Aquaculture, University of Calabar, Cross River State, Nigeria.
[2]Department of Zoology and Environmental Biology, University of Calabar, Cross River State, Nigeria.

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Studies conducted on the food and feeding habits of *Ophiocephalus obscura* in the Cross River estuary, Cross River State, Nigeria, between February and April, 2009 revealed that the species feed mostly on food from animal origin, although diatoms and other plant materials were also identified. A total of 149 plant materials (15.95%) and 77 diatoms (8.24%) were consumed by the species. Food from animal origin consumed by the species included polychaete worm 110 (11.77%), shrimps 84 (8.99%), shrimp parts 33 (3.55%), juvenile fish 33 (3.33%), fish bones 44 (4.71%), fish scales 40 (4.28%), bivalves 61 (6.53%), insect larvae 2 (0.21%), adult insects 2 (0.21%), daphnia 62 (6.63%) and water snails 2 (0.21%). The condition factor calculated for the species varied during the study period with a mean value of 2.09 in February, 1.05 in March and 0.76 in April. Based on the food items isolated from the gut of the *O. obscura,* the species could be considered as a voracious carnivore in the Cross River system, while the variations in the condition factor of the species in the river system may indicate a period of high yield or otherwise of the species in the river system.

Key words: Food, feeding habits, *Ophiocephalus obscura*, Cross River estuary.

INTRODUCTION

The knowledge of the food and feeding habits of fishes provide answers to practical problems which arise in relation to human exploitations. Niskolsky (1963), found that the primary problems posed in the study of the fish feeding habits, is to have a broad knowledge of the different species of prey in order to understand the qualitative and quantitative bridge between fish and their food organism. The diversity in feeding habit of fishes is the result of evolution leading to structural adaptation for getting food from equally great diversity of situations that have evolved in the environment.

Parachanna obscura belongs to the family Channidae. It is commercially important and has a wide range of distribution. Lowe-McConnell (1988) reported that this species is "widely distributed" in marshy habitats and are also found in bank vegetation of river channels. Teugels et al. (1992) listed the species as common in stagnant channels of the Cross River, Cameroon and Nigeria. Bonou and Teugels (1985) stated that this species occupy a wide variety of habitats including streams, rivers, lakes, lagoons, and marshes. In flowing water they occupy calm areas.

The existing literature on food and feeding habits of *P. obscura* is rather scanty. (Adebisi, 1981) reported that the stomach content of many African in-land water fishes have been studied with a view to ascertaining their dietary requirement in their natural habitats and biotic environments. Seasonal changes in the composition of the stomach contents probably reflected an abundance and availability of each item recorded (Beumer, 1978).

Adult *P. obscura* appear to prey on other fishes, while juveniles feed on prawns, copepods, and aquatic insect

*Corresponding author. E-mail: albertekanem@yahoo.com.

larvae (Teugel et al., 1992; Adebisi, 1981). It has been observed that snakehead could easily devour a fish half of its length (Chen, 1976). Snakehead is highly predacious as they swallow their whole prey (Diana et al., 1985). Immediately after the mouth is formed, the larvae of *P. obscura* feed on protozoa and algae, while early fry apparently subsists on plankton and crustacean. With further growth, the fry restrict their diet to purely animal food such as shrimps, prawns, aquatic insects, young fishes and tadpoles. Adults are extremely voracious carnivorous feeding on large aquatic animals such as frogs, other fishes and even aquatic snakes. *Channa punctata* and Channa *gachua feed* mainly on minnows, shrimps, insects and molluscs, but *Channa striatus* and *Channa marulius* feed on fishes, frogs and insects. At the fry stage they generally feed on zooplankton and fingerlings feeds on insects and their larvae, shrimps and fish fry. However, the young *C. punctata* prefer phytoplankton (Lewis, 1974).

Only in recent years that snakehead caught the imagination of scientist particularly in view of its desirability and its ability to utilize the swampy areas, which are not suitable for carp culture (Victor et al., 1992). The aim of the study is to evaluate the food and feeding habits of *P. obscura* in the Cross River Estuary, Cross River State, Nigeria.

MATERIALS AND METHODS

Study area

The fish specimens were collected from the Cross River Estuary, Cross River State, Nigeria. The Cross River Estuary is formed from numerous tributaries arising from the western slope of the Cameroon Mountains which have two spurs in Nigeria as Oban hills in the South and Obudu hills in the North (Moses, 1988). It is observed that the main river enters Nigeria from the Cameroon and flows first in a west ward direction then turn southwards and enters the Atlantic Ocean with limited Delta formation (Moses, 1988). The whole Cross River Estuary lies approximately between longitude 7°30E and 10° 00E and latitude 4° and 8°N. The river basin covers an area of 54,008km^2 of which 14, 000 km^2 lies in the Cameroon and 39,500 km^2 in Nigeria. The river is subject to seasonal flooding and about 8,000 km^2 of the basin within Nigeria comes under flood. The estuary of the Cross River show large number of phytoplankton cell per unit volume and of these diatoms form 75%. The fish fauna of Cross River estuary is rich and varied (as reported by Moses, 1988).

Collection of samples

Samples of *Ophiocephalus obscura* were collected on a monthly basis for three months. (February to April, 2009) at Itu beach, Akwa Ibom State and Calabar River, Cross River State, Nigeria respectively from the landings of basket trap fisheries of the artisanal fishermen. A total of ninety freshly caught fish individuals belonging to all size classes (juveniles, sub-adults and adults) were collected.

The samples were stored in an ice crest on each day of sampling and taken to the Institute of Oceanography laboratory, University of Calabar, Nigeria for analysis.

Analysis of samples

In the laboratory, the standard lengths (beginning of snout to end of caudal peduncle) (Schineider, 1990) were taken to the nearest 0.1cm by the use of a measuring board. The wet weight of each individual was taken with an electronic weighing balance (Mettle P-1210N) to the nearest 0.1 g. The weight of each fish was matched against the corresponding length (cm).

The individual fish gut was carefully extracted by cutting-open the abdominal portion of the fish with the aid of a pointed nose pair of scissors. The gut (tip of oesophagus to the end of the rectum (Lagler et al., 1977) was carefully removed by use of forceps.

Determination of food volume

The food volume of each gut was determined by displacement method (Hyslop, 1980). This was done by placing 10 ml of distilled water in a 50 ml capacity glass cylinder. Each gut was individually dropped in the 10 ml water contained in the glass cylinder. The gut displaced some quantity of water and the volume displaced was noted as representing the food volume in the gut (Hyslop, 1980). This was matched with the individual fish length and weight which were previously taken.

Preservation of guts

Each gut was preserved in glass bottles containing 10% formaldehyde for 3 days prior to the determination of diet components. The preservation of the guts in 10% formaldehyde enhances the coagulation of the diet components for ease of identification (Longhurst, 1957, 1960; Haroon, 1998; Job, 2006). The contents of each gut was scrapped with a spatula into a glass Petri dish and examined with a stereo microscope.

Determination of numerical abundance of diet components

The diet components from each gut were enumerated and the total number noted for each diet group to enhance the determination of the relative percentage occurrence of each diet components from all the guts examined.

Determination of relative percentage occurrence of diet components

The relative percentage occurrence of each diet components was calculated from the formula.

$\%RA = \frac{n}{N} \times 100$ (Marioghae, 1982)

Where:

%RA = relative percentage occurrence
n = number of individuals diet components
N = total number of all diet components identified from the guts.

Determination of condition factor (K)

Condition factor (K) (the degree of fatness or corpulence or well-being of a specimen).

$K = \frac{W(100)}{L^3}$ (Ricker, 1975)

Table 1a. Diet composition, their numerical and relative percentage abundance observed in the gut of *Ophiocephalus obscura* from the Cross River System, Nigeria (February, 2009).

S/N	Diet components	Numerical abundance	Relative abundance (%)
1	Copepods	21	6.21
2	Polychacte worms	54	15.97
3	Survenile fish	13	3.85
4	Mud/sand particles	37	10.95
5	Shrimps	37	10.95
6	Fish scales	16	4.73
7	Fish bones	22	6.51
8	Bivalves	18	5.33
9	Insect parts	21	6.21
10	Insect larvae	2	0.59
11	Plant materials	45	13.31
12	Shrimps	22	6.51
13	Diatoms	30	8.88
14	Detritus	*	*
	Total	338	100.0

* Determination not practicable.

Where K = condition factor
W = wet weight (g) of each specimen
L = length (cm)

RESULTS

Diet components

February, 2009

A total of 14 different diet components were recorded in the gut of *O. obscura* in February, 2009, showing varying numerical abundance and relative percentage abundance; copepods 21 (6.21%), Polychaete worms 54 (15.97%), Juvenile fish 13 (3.85%), Mud/sand particles 37 (10.95%), shrimps 37 (10.95%), Fish scales 16 (4.73%), Fish bones 22 (6.51%), Bivalves 18 (5.33%), Insect parts 21 (6.21%), Insect larvae 2 (0.59%), Plant materials 45 (13.31%), Shrimp parts 22 (6.51%), Diatoms 30 (8.88%) and detritus which could not be enumerated. Empirically, a total of 338 individual diet components were encountered in the gut of the fish in February, 2009 (Table 1a).

March, 2009

As in February, 2009, 14 diet components were also recorded in the gut of *O. obscura* in March 2009. Variations in numerical and relative percentage abundance were also observed among the diet components. The diet components with their respective numerical and relative percentage abundance were shrimps 29 (9.0%), plant materials 19 (53%), Juvenile fish 18 (5.59%), Fish scales 18 (5.59%), Fish bones 15 (4.66%), Bivalves 20 (6.21%), Diatoms 17 (5.28%), Mud/sand particles 28 (8.69%), Insect parts 29 (9.0%), Polychaete worms 31 (9.63%), Copepods 28 (8.69%), Water snails 2 (0.62%), Daphnia 24 (7.45%) and Detritus which could not be empirically determined (Table 1b).

April, 2009

In April, 2009, 15 different diet components were recorded in the gut of *O. obscura* in April, 2009. Similar variations in numerical and relative percentage were also observed in the diet of the species during the month of study. These were copepods 26 (9.48%), Insect parts 28 (10.25%), Bivalves 23 (8.39%), Polychaete worms 25 (9.12%), Diatoms 30 (10.94%), Daphnia 38 (13.86%), Mud/sand particles 17 (6.20%), Plant materials 41 (14.96%), Juvenile fish 2 (0.72%), Shrimp parts 11 (4.01%), Fish scales 6 (2.18%), Fish bones 7 (2.55%), Shrimp 18 (6.56%), Insects 2 (0.72%) and Detritus with no empirical value (Table 1c).

Index of relative importance of the diet components of *O. obscura*

February, 2009

Polychaete worms were the most important diet components of the species in February with a total of 54 individuals with the less important being insect larvae with 2 individual (Table 2a).

Table 1b. Diet composition, their numerical and relative percentage abundance observed in the gut of *O. obscura* from the Cross River System, Nigeria (March, 2009).

S/N	Diet components	Numerical abundance	Relative abundance (%)
1	Shrimps	29	9.00
2	Plant materials	63	19.57
3	Juvenile fish	18	5.59
4	Fish scales	18	5.59
5	Fish bones	15	4.66
6	Bivalves	20	6.21
7	Diatoms	17	5.28
8	Mud/sand particles	28	8.69
9	Insects parts	29	9.00
10	Polychaete worms	31	9.63
11	Copepods	28	8.69
12	Water snails	2	0.62
13	Daphnia	24	7.45
14	Detritus	*	*
	Total	322	99.98

* Determination not practicable.

March, 2009

In March, 2009, plant materials were the most important diet components of the species with 63 individuals with the less important being water snails with a total of 2 individuals (Table 2b).

April, 2009

Plant materials were observed to be the most important diet components of *O. obscura* in April, 2009 with a total of 41 individuals while juvenile fish was considered less important with a total of 2 individuals (Table 2c).

Condition factor (index) K

The total condition factor of the species in February was 62.75 with mean of 2.09 ± 1.98; In March total condition factor was 31.61 with a mean of 1.05 ± 0.52 while in April total condition factor was 22.96 with a mean of 0.76 ± 0.39.

DISCUSSION

Examination of the gut contents of *O. obscura* revealed that the species feeds mostly on diets of animal origin including Polychaete worms, shrimps, shrimp parts, Copepods, fish bones, fish scales, bivalves, insects, insect parts, juvenile fish, insect larvae, daphnia and water snails. some plant matter and detritus were also consumed. Although 17 different diet components were encountered in the gut of the species during the investigation. However, diet components like shrimp parts, insect larvae, daphnia, adult insects, and water snail were not common in the gut of the species throughout the study months.

In March, shrimp parts were not recorded in the gut of the species while in February, daphnia, adult insects and water snails were absent in the diet of the species with a similar absence of insect larvae in the diet of the species in March and April. The availability or otherwise of these diet component in the diet of the species in these months might have been due to size selection of diet by the species.

Qin and Fost (1997) observed similar size selection in a sister species *Channa striatus* in South-east Asia as was similarly observed by Ng and Lim (1990) in the same area. Snakeheads feeding success depends upon vision, its ability to pursue and catch prey, and the ability of prey to escape (Qin and Fost, 1997; Ajah et al., 2005).

In any aquatic ecosystem and main feeding habit of any fish indicates where such fish can be found (Moore and Moore, 1976). For example, the presence of mud/sand particles and detritus indicated bottom feeders, the assumption being that these items are abundant in the benthos and that the species may be a benthic feeder. This however, is merely a reasonable guess as these materials might have been incidental diet components which were obtained alongside the main diet components of the species in the habitat (Qin and Fost, 1997; Job and Nyong, 2005; Ajah et al., 2005).

The various switches from one particular feeding habit to another during the study which is indicated by the

Table 1c. Diet composition, their numerical and relative percentage abundance observed in the gut of *O. obscura* from the Cross River System, Nigeria (April, 2009).

S/N	Diet components	Numerical abundance	Relative abundance (%)
1	Copepods	26	9.48
2	Insects parts	28	10.25
3	Bivalves	23	8.39
4	Polychaete worms	25	9.12
5	Diatoms	30	10.94
6	Daphnia	38	13.86
7	Detritus	*	*
8	Mud/sand particles	17	6.20
9	Plant materials	41	14.96
10	Juvenile fish	2	0.72
11	Shrimp parts	11	4.01
12	Fish scales	6	2.18
13	Fish bones	7	2.55
14	Shrimps	18	6.56
15	Insects	2	0.72
	Total	274	99.94

* Determination not practicable.

Table 2a. Index of Relative Abundance of the diet component, *Ophiocephalus obscura* from the Cross River System, Nigeria (February, 2009).

S/N	Diet components	Numerical abundance	Relative abundance (%)
1	Polychaete worms	54	15.97
2	Plant material	45	13.31
3	Shrimps	37	10.95
4	Mud/sand particles	37	10.95
5	Diatoms	30	8.88
6	Shrimp parts	22	6.51
7	Fish bones	22	6.51
8	Copepods	21	6.21
9	Insect parts	21	6.21
10	Bivalves	18	5.33
11	Fish scales	16	4.73
12	Juvenile fish	13	3.85
13	Insect larvae	2	0.59
14	Detritus	*	*
	Total	338	100.0

* Determination not practicable.

availability or otherwise of a particular diet component in the gut of the species in the different month is a general event which coincides with either the period the diet components are available in the habitat or the phenomenon of ontogenicity in organisms (Haroon, 1998; Olojo et al., 2003; Wu and Culver, 1992; Ajah et al., 2005).

Variations in the numerical abundance of the diet components consumed by *O. obscura* was also observed in each of the months. There were 338 in February, 322 in March and 274 in April. The variations might have been caused by an increase in the quantity of a particular food item in one month and a reduction in one or another food item consumed by the species in the month during the study. This again agrees with the report of Onyia (1973) during his studies on a contribution to the

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13	Water snail	2	0.62
14	Detritus	*	*
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14	Juvenile fish	2	0.72
15	Detritus	*	*
	Total	274	99.94

* Determination not practicable.

food and feeding habits of the thread fin *Galeoides decadactylus* in Lagos, Nigeria who attributed the variations in the food consumed by *G. decadactylus* to food preference and availability, Costa and Wanninayake (1986) when working on food, feeding and fecundity of the giant freshwater prawn *Macrobrachium rosenbergii* from natural habitats in Srilanka, Okon (2002), when working on some aspects of the food and feeding habits of *Ilisha africana* from Qua Iboe River estuary, Nigeria, Ajah et al. (2005), when studying the food and feeding habits of five freshwater and brackish water fish species in Nigeria, Job and Udo (2002), when reporting on the food, and feeding and the condition factor of the estuarine catfish *chrysichthys nigrodigitatus* of the Cross River, Nigeria.

The preference shown by a species to a diet component or group is a biological strategy which discouraged competition for available food resource within a species (Olojo et al., 2003; Job and Nyong, 2005). Hence, the absence of a particular food item in the gut of *O. obscura* at one stage and the reappearance at another stage is a common biological phenomenon in food and feeding ecology of both shell and fin fishes in their natural habitats.

Conclusion

The relative percentage abundance or index of relative importance of the diet components were observed to vary during the study period. The monthly rhythms in the relative percentage abundance and index of relative importance (IRI) of the diet components indicated polychaete worms as the most consumed diet component with 54 individuals which formed 15.97% of the diet of *O. obscura* in February, with insect larvae being the least with 2 individuals (0.59%), plant materials 63 (19.57%) in March with the least being water snails with 2 individuals which formed 0.62% of the diet of the species for the month while in April, plant material again appeared to form the most abundant diet components for 41 individuals forming 14.96% of the diet of the species for the month, with the least being juvenile fish and insects which contributed 2 individuals each (0.72%) to the diet of the species. These would not however be considered as the main diet of the species rather as more of the diet components were basically from animal origin, classifying the species as a carnivore which agrees the works of Ajah et al. (2005).

The mean condition factor showed an interesting variation pattern. This ranged between 0.76 and 2.09. In February, condition factor was 2.09, in March the condition factor reduced to 1.05 and a further reduction in April to a value of 0.76. These variations are indicative of the fact that in February, the species had good and varied diet components which might have been unconnected with favorable ecological conditions. These parameters might have continually undergone significant variations and changes resulting in the observed reduction in condition factor of the species in the habitat with time. Younger individual occurred in February and as would be expected, these individuals fed vigorously and grew more plumber, preparing for reproduction by developing gonads rapidly hence, the high condition factor value which might have been additionally induced by favorable ecological condition (Lagler et al., 1977, 1978).

In March mean condition factor of the species reduced to 1.05 indicating either a period of unfavourable ecological conditions or a period which the species might have undergone stress from low food availability and/or reproductive processes. When an organism undergoes starvation or has become spent, it condition factor reduces even when every other ecological factors is optimum (Odum, 1971). This might have been the case during this study.

A further reduction in mean condition factor was observed in April when a value of 0.76 was recorded. Condition factor is known to indicate the state of health of a particular species (Ricker, 1975). With a mean condition factor of 0.76 in April, the species has reached a stage in life where it only feeds for sustenance rather than for growth and development of sex organs for reproduction. Similar observations were made by Job and Udo (2002) during their studies on the food, feeding and the condition factor of the estuarine catfish *Chrysichthys nigrodigitatus* of the Cross River, Nigeria. Enin and Enidiok (2002) also reported monthly variations in the mean condition factor in *Cynoglossus senegalensis* in the Cross River Estuary, Nigeria which they attributed to environmental changes, state of growth and food availability which support the results of the present study.

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