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# PRELIMINARY STUDY ON THE ASPECTS OF THE BIOLOGY OF SNAKEHEAD FISH *Parachanna Obscura* (Günther) IN A NIGERIAN WETLAND

**Bolaji BB*[2], Mfon TU[1], and DI Utibe[2]**

**Benard Bolaji**

*Correspondence author's email: afababs@yahoo.com

[1]Department of Fisheries and Aquaculture, University of Uyo, P.M.B 1017, Uyo, Akwa Ibom State.

[2]Department of Animal and Environment Biology, University of Port Harcourt P.M.B 5323 Port Harcourt, Rivers state, Nigeria.

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**ABSTRACT**

Between October 2000 and March 2001, a preliminary study on the aspects of the biology of *Parachanna obscura*, was carried out. Sex ratio revealed female preponderance ($\div^2$ = 4.733, df = 1, P < 0.05). There was no variation in sex ratio during the wet season but there were more females than males in the dry season ($\div^2$= 4.735, df = 1, p = <0.05). A curvilinear plot was delineated in the regression of the total length (9.0-18.0 cm TL) and total weight (5.6-40.11g TW), where TW = 0.018621 $TL^{2.697}$, n = 408, r = 0.869, ([p<0.001). Trophic spectrum of *P. obscura* size range 9.0-18.0 cm comprises ten food items. The items were re-classified into seven major groups consisting of detritus [coarse and fine detritus], fish [juvenile and remains of fish], insects (un-identified adult and remains of insects, macrophyte materials, mud, nematode, and biogenic sand. Fish, insects and nematodes were eaten as primary food items. There was a complete ingestion of the array of the dietaries by both sexes of *Parachanna obscura*. Exception of one item (coarse detritus), during the wet season, *Parachanna obscura* consumed all the dietaries during the seasons. Nevertheless, the later season increased in the ingestion of nine out of 10 items in conformity with optimal foraging theory. *Parachanna obscura* is considered a piscivore-insectivore-invertivore in feeding habits. In the wake of doubt about the viability and prospects of aquaculture, farming of *P. obscura* could be desirable. This species possesses a number of positive attributes when it comes to aquaculture. It is likely that efforts to culture this hardy carnivorous and fast-growing fish will spread in the coming years in Nigeria, if breeders and fish farmers will give it a chance. Further studies are, however, required to delineate the full biology of *P. obscura* in order to highlight its viability for domestication and cultivability. *P. obscura* is widely enjoyed by natives of its natural habitats all over the world as a source of protein.

**Key words:** *Parachanna obscura,* Biology, Economic Potentials, Nigeria

## INTRODUCTION

Fish is an important source of protein in terms of its nutritional value and affordability especially to the world's poorest people who rely on fish as their primary source of protein. However, the protein requirement of most African countries still grossly outweighs its supply. In Nigeria, less than 40% of the total protein requirement by the people is met, out of which fish constitutes about 41%. It is also reported that more than 60% of this source of protein (fish) is imported using foreign exchange, about 15% is caught by local fishermen and less than 15% comes from aquaculture [1]. Recent efforts by the authorities responsible for fisheries resources focus on increasing the cultivation of fish species in aquaculture to boost local production and save the country's hard earned and scarce foreign exchange.

There are scarce reports on the flood plains and wetlands in Nigeria in particular and Africa in general. However, some reports exist that delineate the status of these flood plains and wetlands. In Nigeria, for instance, there are reports on the productivity of the Cross River flood plains and the Northern Akwa Ibom Swamp Resources Survey [2]. The documentation highlights untapped fishery resources from the flood plains of two important tributaries of Cross River System-Enyong Creek and Ikpa River. The wetlands here are typified by a complex biodiversity of flora and fauna, reservoirs, rivulets and streams. Conscious development of these ecosystems would generate many tonnes of fish and fishery products if exploited sustainably. Reports from the flood plains/wetlands indicate the presence of *Parachanna obscura* **(**Günther), a fish species commonly known as snakehead or black fish.

*Parachanna* is one of the two genera of the family *Channidae* found in Africa. The family consists of long cylindrical predatory fishes, common in Asia. *Parachanna* is widely distributed in marshy places and all *Parachannids* have accessory respiratory organs [3]. Based on the reproductive guild of fishes, eggs and young *Channidae* are guarded by both parents [4]. Reproductive biology of some allied species revealed that *Channa striatus* (Philippines) produces 100-1,000 eggs at a time, which take three days to hatch in a cleavage in the vegetation; breeding occurs every month and individuals may breed twice a year. Similarly, *Punjan* spawns between April and July, and the surviving strong broods are guarded for a month, until they are 10 cm long.

In Nigeria, two species are recognized, *Parachanna obscura* and *P. africana*. The distinguishing features between the two species are the transverse "shaped" dark bars on the flanks in adults, which contrast with the longitudinal blotches seen in *P. obscura* [5]. Distinctive characters in the genus include: long dorsal and anal fins, and a short nasal appendage. However, there are scanty reports on the breeding success of the species in aquaculture. So far, efforts at culturing the species merely start and end at collecting them from the wild and watching them grow. The present paper is a contribution to understanding the biology of *Parachanna obscura* with a view to developing its aquaculture. Aspects considered include sex ratio, length-weight relationship and diet composition.

## MATERIAL AND METHODS

The study was conducted in the swamp/flood plains of the Enyong Creek in Ikpe Ikot Nkon and Nkana –Ikpe villages in Ini Local Government Area (LGA) in Akwa Ibom State, Nigeria. The study area located between 5$^{o}$ 20' and 5$^{0}$ 30'N and 7$^{0}$ 40' and 7$^{0}$ 50'E) is drained by two major tributaries: the Igwu and Itu Rivers. The Ini LGA has a mean annual rainfall of 262 mm and 20 mm higher than the surrounding Ikono LGA, which has a humid tropical climate of 70-80% [6].

Monthly samples (October, 2000-March, 2001) of *Parachanna obscura* were collected from the study sites by means of traditional basket traps [7]. The collection of the samples for 6 months only was due to disappearance and/or un-availability of the species in the traps between April and September 2001.

The specimens caught were preserved in formaldehyde (10%) immediately after collection to stop digestive action. In the laboratory, the specimens were measured by means of a wooden measuring board to the nearest 0.1cm total length (TL) and weighed on a top-loading electronic balance to the nearest 0.01g total weight (TW). The length-weight relationship was computed using the formula [8]

TW = ( )

Where: TW=total weight of fish, TL= total length of fish, a and b = constants. The values of a and b were estimated by least square regression using double transformed weight and length data pair according to the formula.

Log TW=Log a+b log TL

The specimens were dissected and sexed by examining the gonads. Sex ratio was determined using the Chi-square test. To evaluate feeding intensity of *P. obscura,* the 'points' method and Stomach Repletion Index (SRI) were used [9].

In the 'points' method, each stomach was assigned a number of points proportional to its degree of fullness according to an arbitrary 0-20 points scale.

Thus, empty, ¼ full, ½ full, ¾ full and full stomachs, respectively (where empty is 0 on a scale of 0-20, ¼ full =5, ½ full=10, ¾ full=15 and full=20). The frequency of occurrence of each item ($f_i$) and point score of each item ($p_i$) were noted. The integrated importance of each item was then expressed by food preponderal index (FPI) according to the formula:

$$FPI = (f_i + p_i)/\sum (f_i+p_i).\ 100$$

The index has a range of 0-100%; items with FPI > 10% were arbitrarily considered as primary dietaries, those with FPI = 1.0 -9% secondary and those with FPI < 1.0% as incidental. The percentage composition was used to describe the overall diet, and

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intersexual and seasonal changes in food habits. Food richness was estimated and diet breadth (B) computed as follows:

$$B = [(\sum P_1)^{2-1}-1]/n-1$$

Where p= proportion of the diet type and n-1 = number of food categories in the diet.

**RESULTS**

The overall sex ratio was significantly different from the expected 1:1 ratio. Out of the 244 specimens of *P. obscur*a studied, 105 (43.03%) were males and 139 (56.97%) females giving a sex ratio of 1.00 male: 1.32 female, which was different from unity ($\div^2$ = 4.738, df = 1, P < 0.05) in favour of females.

Seasonally, of the 203 specimens examined during dry season, 86 (42.36%) were males and 117 (57.64%) females giving a sex ratio of 1.00 male: 1.36 female, which was different from unity ($\chi^2$ = 4.734 df = 1, P < 0.05). Conversely, wet season sample of 41 specimens consisted of 19 (46.34%) males and 22 (53.66%) females, giving a sex ratio of 1:1.16, which was not different between the sexes ($\chi^2$ = 0.220, df = 1, p > 0.05).

The overall plot of total length (range 9.0 – 18.0 cm TL) and weight (range 5.68 – 38.34 g TW) of *P. obscura*, was positively correlated (r = 0.860, P < 0.001; n = 244), with a functional equation of the form:

$$TW = 0.018621\ TL^{2.607}$$

**Dynamics of feeding intensity**

Out of the 244 specimens of *P. obscura* (size 9.0 – 18.0cm TL) studied for feeding intensity, 57 (23.36%) had full stomachs, 184 (75.41%) 3/4 full stomachs and three (1.23%) had empty stomachs. Thus, a majority 241 (98.77%) had non-empty stomachs.

Stomach repletion showed that females were significantly different in stomach fullness, - (SF 9d = 17.709, P < 0.001) from males whereas the males increased in partially-filled stomachs, - (PS 9d = 9.817, P < 0.0001) different the former. However, there was no significant difference in non-empty stomachs, NES (d = test: P < 0.005) between sexes.

There was no significant seasonality in NES (P < 0.05). However, there was significant wet season increase in SF (d-=5.413, P < 0.02) and dry seasonality in PS (d = 20.164, P < 0.001).

The overall stomach contents of *P. obscura* (Table 2) revealed that 10 food items were ingested. The food items were re-classified into seven major groups comprising detritus (coarse and fine detritus), pisces (juvenile and remains of fish), insects (unidentified adults and remains of insects) macrophyte materials, mud, nematoda (earthworm) and biogenic sand. The diet comprised insects (31.61%), fish (28.67%), earthworm ( (25.26%) and mud (10.54%), while the rest of the dietaries were of minor importance each forming less than 3.92% of the diet.

Most of the stomachs of *P. obscura* examined were indicative of frequent feeding, evidenced by only three specimens having empty guts.

Sex – dependent changes in the food composition of *P. obscura* are summarized in Table 2. Food richness was the same as both sexes consumed a complete array of the dietaries. There was similarity in the intersexual rank-order of the food items (r = 0.9696, P< 0.002), although the proportions of some of them were different. Diet breadth was 0.82 in males and 0.85 females. *P. obscura* consumed all the major groups of dietaries in the two seasons except for coarse detritus during dry season (Table 1). Nevertheless, it was obvious that *P. obscura* ingested nine out of the 10 food items during the wet season. The observed feeding pattern probably accounted for high diet breadth during the wet season (r=0.82) in conformity with the optimal foraging theory. There was similarity in the rank-order of the food items (r = 0.6994, P < 0.05), although the proportions of some of them were different between the seasons.

## DISCUSSION

Sexes of *Parachanna obscura* could only be determined on dissection of the gonads, the overall sex ratio, which revealed female preponderance. Absence of sex-based dichotomy (that is sex ratio,) did not instantly change the female dominance [10].

The overall regression exponent in the length-weight relationship of *P. obscura* was markedly different from the expected cubic value. This finding suggests that the dynamics of the species population in the present study area cannot be studied using the various models [11].

The feeding intensity by males of *P. obscura* was higher than that of the females, although, the latter had more individuals with full stomachs. The exact reason for the observation is unknown but it may suggest energy requirements by the former to guard eggs and defined territory [12].

The trophic spectra of *P. obscura* indicated that it is an insatiable carnivore. In the wake of doubts of the viability and prospects of fish production from fish culture in Nigeria, attention paid to rearing of *P. obscura* could be desirable. Feeding is a crucial and indispensable activity in aquaculture, its efficiency must always translate into fish growth at minimum cultural period, and hence justification of investment. Considering that the species is an insatiable carnivore, it could be stocked for 3-4 months after stocking the pond with Tilapia *spp*. Overhead cost from feeds and feeding can thus be eliminated and profit maximized even though harvest will be once a year. Fingerlings/post fingerlings of *P. obscura* can attain an average of one kilogramme (in five months) when stocked in Tilapia ponds. The culture of *P. obscura* can, therefore, complement the already high and increasing farming of the catfishes (*Clarias* and *Heterobranchus*) in Nigeria and contribute to the much desired increase in the supply of fish protein.

In summary, this premilinary study revealed that in the snakehead, *P. obscura:*

Females were more than males
Length-weight regression was allometric
Ecologically, the species is an insectivore – piscivore – invertivore in feeding habits.

In the allied species (*Channa striatus* and *C. punctatus*), fecundity estimates is between 500 and 1,000 eggs and breeding may occur year – round in individuals, but with peaks between April and July. However, successes in breeding technology and general reproduction of Nigeria species (*P. obscura* and *C. africana*), are urgently required to kick-start its suitability and sustainability for aquaculture.

Finally, *P. obscura* possesses a number of positive attributes and can be used successfully in aquaculture. It is likely that efforts to culture this hardy carnivore and fast-growing fish will spread in the nearest future in Nigeria and in other parts of Africa.

## CONCLUSION

It is well established empirically, that protein is important to the human body. It is also established that fish is as an important and cheap source of this protein. It is, however, unfortunate that despite its importance, the supply of protein is still grossly inadequate. One of the reasons for its scarcity may not be unconnected with burgeoning and ever increasing population of humans, which has outnumbered the natural resources of the world. In Nigeria most of the fish consumed is imported, with a small contribution from local fishermen. Aquaculture contributes a small quota to the fish requirements of the people, but if well harnessed can become a source of fish protein and revenue for the people and the Government.

This study, therefore, contributes to the growing need and efforts by the Government to enhance fish production through aquaculture in order to reduce the dependence on importation of fish. This will save the country's scarce foreign exchange that can be used to satisfy other more yearning desires of the people such as education.

Knowledge on the aspect of the biology of *P. obscura*, which is presented in this paper can, therefore, be utilized along with other reports to begin the cultivation of this hardy species in Nigeria and other African countries.

In addition, it will boost the number of species currently cultivated through aquaculture and thus enhance capacity building for farmers and employment generation for the people.

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**Table 1: Seasonal variation in food composition of *P. obscura***

| Food item | % food ponderal index (FPI%) | | |
|---|---|---|---|
| | Dry | Wet | d-statistic |
| Detritus: | | | |
| Coarse detritus | 3.42 | - | - |
| Fine detritus | 4.49 | 5.88 | 19.318** |
| Pisces | | | |
| Juvenile of fish | 4.97 | 2.35 | |
| Fish remains | 9.94 | 5.88 | 15.814 |
| Macrophyte materials | 3.73 | 3.53 | 1.230 |
| Mud | 11.18 | 8.24 | 11.174** |
| Nematode-Earth worm | 13.35 | 18.82 | 15.936** |
| Sand grains | 4.04 | 5.88 | 20.747** |
| Food richness | 10 | 9 | |
| Diet breadth | 0.84 | 0.82 | |

**P = ≥ 0.05 (highly significant)

**Table 2: Overall and sex – dependent variation in food composition**

| | % food ponderal index (FPI%) | | | |
|---|---|---|---|---|
| | | Sex | | |
| Food item | Overall | Males | females | d-statistic |
| Detritus: | | | | |
| Coarse detritus | 2.70 | 2.22 | 4.28 | 13.207** |
| Fine detritus | 3.92 | 1.48 | 3.27 | 12.703** |
| Pisces | | | | |
| Juvenile of fish | 3.92 | 4.44 | 5.35 | 4.651* |
| Fish remains | 24.76 | 28.88 | 23.00 | 13.031 |
| Insecta | | | | |
| Unidentified adults | 22.79 | 22.22 | 21.39 | 2.000* |
| Insect remains | 8.82 | 9.63 | 5.81 | 0.014ns |
| Macrophyte Materials | 3.68 | 2.96 | 4.28 | 7.904** |
| Mud | | | | |
| Nematode | 10.54 | 11.85 | 10.70 | 3.876* |
| Earthworm | 14.46 | 14.67 | 12.83 | 3.804* |
| Sand grains | 4.41 | 2.22 | 5.85 | 18.075** |
| Food richness | | 10 | 10 | |
| Diet breadth | | 0.82 | 0.85 | |

*P = ≥ 0.05 (significant)

**P = ≥0.05 (highly significant

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