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The Sex Ratio, Gonadosomatic Index, Diet Composition and Fecundity of African Pike, *Hepsetus odoe* (Bloch, 1794) in Eleyele Lake, Nigeria

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Abstract

The Sex ratio, Gonadosomatic index, Fecundity and Diet composition of *Hepsetus odoe* in Eleyele lake, Southwest, Nigeria were investigated to document aspect of biology and population dynamic of the species. This will serve as baseline information necessary for bringing the species to culture. Samples (n=205) of *H. odoe* were collected on a bi-monthly basis from Eleyele Lake using gill nets and baited long line over a period of 3 months (June to August, 2012). Specimens were measured for Length (cm) and Weight (g) using graduated metre rule and Top load weighing balance (Model) respectively. The Stomach was opened for Gonad examination and Food content analysis. The total length ranged from 20.3-31.9 cm (males), 21.8-35.8 cm (females) while the total body weight ranged between 51.0-219.0 g (males) and 95.0-250.0 g (females) Sex ratio of 1: 2.73 (♂:♀) was observed. Gonadosomatic index ranged from 0.64 to 15.54% with a mean of 4.4 ± 0.12%. Three stages (Immature, Maturing and Matured) Ovary were observed for females. Fecundity ranged from 245 to 3,920 eggs with a mean of 2082.5 eggs. The relationships of fecundity with body weight and gonad weight were highly significant ($P<0.05$), while those between fecundity and standard length was not significant ($r^2=0.026$, $P<0.05$). Out of 205 stomach examined, 71 (34.63%) was empty while 134 (65.37%) contained various food items. The dominant food items were Fish (tilapia), Daphnia, Copepods and Insects, and occurred in 51.0%, 14.2%, 12.0 and 10.5% stomach respectively. Cyclops, Mysis, Chydorus, Euplypha and Hemisiriella had the least occurrences of 1.5%, 1.5%, 0.75%, 0.75%, and 0.75% respectively suggesting the species to be Carnivorous. This study gives relevant clues on reproductive biology and feeding habits required for artificial propagation of *H. odoe*.

Keywords: Feeding habit; Fecundity; Egg diameter; Gonado somatic index

Introduction

Important human uses of freshwaters include drinking, fishing, industry, irrigation, recreation and transportation [1]. Nigeria is blessed with numerous freshwater bodies including vast networks of rivers, streams, seasonally flooded plains as well as natural and man-made reservoirs, which form habitat for fish [2]. The contributions of fish to human nutrition and health are well documented with fish constituting almost half of the total number of vertebrates in the world [3]. According to Olaosebikan [4], Nigeria fresh water is the richest in West Africa with 316 fish species inventoried. A large number of these species are better known to the rural population due to the importance they attach to them as a vital and affordable source of nutrition. The African river pike, *Hepsetus odoe* is one these fish species, it is economically important for artisanal fishery in Nigeria. *H. odoe* is highly valued in the riparian community of the Southwest, Nigeria principally because of its availability (all year round), affordability, tasteful flesh, economic and nutritional value [5].

The family Hepsetidae is a perciform taxon represented by a single species commonly called African river pike. It is a predatory freshwater fish with enlongated, pike-like body. The most striking feature of *H. odoe* is its dentition, somewhat like that of crocodile equipped on both jaws with a formidable array of large canines interspersed with smaller conical teeth. The species mostly occupy inland habitats of tropics where they feed voraciously on other small fish, especially *Alestes* [5]. This species prefers quiet and deep water, can reach up to about 70 cm in length and 4 kg in weight (Figure 1).

Information on the reproductive biology of fish is considered as paramount importance for sustainable management of exploited stock. It includes knowledge of fecundity, diet composition and sex ratio which are essential for evaluating the commercial potential of stock, life history, practical culture and actual management of the fishery [6]. Nautiya opined that studies on fecundity and other reproductive features are essential from the viewpoint of production, stock management and assessment in any water body. Considerable work has been done by researchers on the growth patterns and condition factor, gonadal cycle and reproductive physiology of many species of fresh water fishes of Nigerian waters [7-13]. However, there is little information available on the study of eco-biology of *H. odoe* especially in Lake Eleyele, Southwest Nigeria. Hence, this study deems it important to carry out research work on this species to exploit its commercial viability in the area by investigating the sex ratio, gonadosomatic index, diet composition and fecundity of *H. odoe* in Eleyele Lake, Oyo State, Nigeria.

The GSI is particularly helpful in identifying days and seasons of spawning, as the ovaries of gravid females swiftly increase in size just

Figure 1: Clear picture of *Hepsetus odoe*.

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prior to spawning. If it is possible to collect reasonable numbers of gonads each month from adults (e.g. 30-50 individuals) over a year, one can usually determine the spawning season for the fish.

As the introduction on different aspects of biology of this species is very scanty and considering its importance an attempt is made to study the different aspects of gonadosomatic index (GSI) (ovary and testis) and hepatosomatic index (HSI) of this species. H.S.I. value also provides us information about the healthy condition of fish and also about the quality of water, because higher H.S.I. value means fishes are growing rapidly and have a good aquatic environment and if H.S.I. value is less it means fish is not growing well and it is facing unhealthy environmental problems. Thus both G.S.I. and H.S.I. values gives us indications of development pattern of fishes *B.carnaticus* which is a food of poor people and thats why they must be reproduced in large number and must be made available to them throughout the year. To know the breeding potentials of this fish it is essential to know about their G.S.I. values (Figure 1).

Materials and Methods

Eleyele Lake receives water principally from Ona- River and has an area of 546 km^2 with a storage capacity of $70{,}460\times10^{10}$ litres. It lies North-west of Ibadan at an altitude of 125 m above sea-level. It has a maximum water elevation of 0.9 m, catchment area of 323.7 cm^2, water depth of 6.0 m and flooded area of 0.5 km^2 [14]. The collection site was located between longitude 3° 53'E and latitude 9°25'N. Samples (n=05) were collected using a gill nets and baited long line over a period of 3 months from June to August, 2010. Samples were anaesthetized at the collection site, preserved in 5% neutral formalin and transported to the Wet laboratory of Aquaculture and Fisheries Management Department, University of Ibadan for further examination. The standard and total lengths (in centimeters) were measured on a measuring board while the weights (in grams) were determined using a sensitive weighing balance. Also, various measurements including stomach weight, stomach sizes, gonad weight (GT), head length (HL), eye diameter and the mouth gap (MG) were taken and recorded. The fish was dissected and the gut taken out for dietary analysis. The state of fullness of each stomach was recorded and expressed as empty (0/4), one-quarter full (1/4), half-full (2/4), three-quarters full (3/4) and full (4/4). The food composition in each gut was determined using a points and occurrence method as described by Hyslop [15]. Of the 205 specimens, 55 males ranged in length from 20.3-31.9 cm and 150 females ranged from 21.8.0 -35.8 cm in total length.

The gonads were carefully dissected and colour, shape and weight of each gonad recorded. A few ripe stage ovaries were preserved in 5% formalin. A quantitative assessment of the condition of the gonad, employing the technique of gonado somatic index (GSI), expressing the gonad weight in terms of the percentage of the body weight, was worked out.

$$GSI = \frac{Weight\ of\ gonad}{Weight\ of\ fish} x\,100$$

Sex ratios were determined on the basis of histological examination of gonads and calculated as the percentage of males and females in each monthly collection. From the samples of ovaries, sub samples were taken and the eggs counted, and the fecundity determined [16].

Results

During investigation period, 205 *H. odoe* individuals were examined. The total length of the specimens ranged from 20.3-31.9 cm (males), 21.8-35.8 cm (females) while the total body weight ranged between 51.0-219.0 g (males) and 95.0-250.0 g (females) (Table 1). Out of the total *H. odoe* specimens assessed throughout the study (N=205), 55 (26.8%) specimens were males, 150 (73.2%) were females. Result revealed that the overall sex ratio was 26.8:73.2% (♂:♀, 1:2.73) indicating that females were dominant in the population.

The Gonadosomatic Index (GSI) result calculated show a value ranged from 0.64 to 15.15 for individual fecund species while the mean GSI is 4.4 and the correlation coefficient between the GSI and Body weight was 0.21. In this study, only three stages of gonadal development were observed in specimens examined (Table 2).

Table 2 shows the macroscopic features of the stages of ovarian development of *H. odoe*. The observed matured female *H. odoe* was in stage I (Immature) with an estimated fecundity of 245 eggs and GSI of 0.96 while the maximum length of the female *H. odoe* was in stage III (matured) with an estimated fecundity of 3,920 and GSI of 5.93. The eggs vary in size from 2.5-2.9 mm in diameter.

The regression equations of fecundity with standard length, body weight, gonad weight and gonadosomatic index are presented in Table 3. The relationships of fecundity with body weight and gonad weight

Parameter	Sex	Number	Range	Mean ± SD
Total length	Male	55	20.3-31.9	22.3 ± 7.14
	Female	150	21.8-35.8	24.6 ± 6.30
Standard length	Male	55	16.6-26.2	19.7 ± 5.43
	Female	150	17.8-30.5	23.2 ± 7.64
Body weight	Male	55	51.0-219.0	109.5 ± 50.8
	Female	150	95.0-250.0	127.4 ± 45.3

Table 1: Total length, standard length and body weight distribution observed in female *H. odoe*.

Stages of gonadal development	Macroscopic characteristics of ovaries
I (Immature/Virgin)	The ovaries were rounded, elongated, translucent and creamy yellow. The gonad weight ranges 1.0 g to 3.5 g and this covered one- fifth of the body cavity.
II (Developing/Maturing)	The ovaries were rounded and pinkish yellow, they were of medium size occupying one-quarter to three-quarter of the body cavity. They have visible opaque Oocytes with the gonad weight of 4.0 g to 10.0 g.
III (Mature)	A large ovary occupies three-quarter, almost filling the entire body cavity with blood capillaries. The eggs were yellow in colour. They have visible opaque Oocytes without bruised areas. The gonad weight ranged from 11.0 g to 16.0 g. Eggs were clearly visible to the unaided eye.

Table 2: Stages of gonadal development of female *H. odoe*.

Y=a+bX	n	r	r^2	Fcal	S
logBW=-2051+3.105logSL	205	0.965	0.932	2788.334	***
logSTWT=3.487+2.787logSL	205	0.464	0.244	64.407	***
logBW=2.040+0.282logSTWT	205	0.496	0.246	66.194	***
GW=0.903+0.219SL	69	0.121	0.015	1.017	*
GW=2.822+0.021BW	69	0.232	0.054	3.857	**
GSI=6.623+(-0.015)BW	69	0.210	0.044	2.956	**
F=-167.863+7.0818SL	69	0.161	0.0260	1.774	*
F=578.062+5.740BW	69	0.266	0.071	5.092	***
F=6.436+239.170GW	69	0.981	0.963	1734.031	***

F=Fecundity, BW=Body Weight, SL=Standard Length, GW=Gonad Weight, STWT=Stomach Weight, GSI=Gonado Somatic Index, n=Sample size, r=Coefficient of correlation, r^2=Square of the coefficient, *=No Significant, **=Very Significant, ***=Highly Significant.

Table 3: Prediction Equations for Body, Stomach Analysis and Somatic Parameters of *H. odoe*.

were highly significant (P<0.05), while those between fecundity and standard length was not significant (r^2=0.026, P<0.05). The correlation between gonadosomatic index and body weight was very significant (r^2=0.054, P<0.05), suggesting gonad maturation stage with increase in body mass. Higher correlation was between gonad weight and body weight (r=0.232) while there was no significant relationship between gonad weight and standard length (r^2=0.015, P<0.05).

Out of 205 stomach examined, 71 (34.63%) had empty stomach and 134 (65.37%) contained various food items (Figure 2). The result of the stomach content analysis using the percentage numerical abundance method is given in Table 4. A total of 14 prey categories were observed in the stomach of *H. odoe*. The dominant food items were fish (tilapia), daphnia, copepods and insects, which occurred in about 51.0%, 14.2%, 12.0 and 10.5% stomach respectively. Meanwhile, Cyclops, Mysis, Chydorus, Euplypha and Hemisiriella had the least occurrences of 1.5%, 1.5%, 0.75%, 0.75%, and 0.75% respectively.

Discussion

The body length and weights of female *H. odoe* were longer and heavier than male specimen. The overall sex ratio of sampled *H. odoe* showed a preponderance of females over males and significantly differs (♂:♀=1:2.73, P<0.05). According to Fagade and King [17,18], the wide disparities in sex ratio could be adjudged as a mechanism for population regulation. This result agree with the work of Oso [19] where a sex ratio of 1:2 (♂:♀) was found in *H. odoe* from a tropical reservoir in Southwest, Nigeria. Balogun [20] also reported similar skewed sex ratio of 1:3 (♂:♀) for *H. odoe* in Epe Lagoon, Nigeria. The mean GSI of *H. odoe* was 4.4 and have a very high significant correlation with total weight especially in females. Fagbenro [13] made similar observation for *H. odoe* in Asejire lake where he reported mean GSI of 4.5 and correlation coefficient of 0.22 between GSI and body weight. The dietary composition showed that *H. odoe* is a piscivore and this classification agrees with several authors including [5,20,21-23]. Tilapia, daphnia, copepods and insects were the major food items found in the gut. This is not surprising since tilapias are the most abundant fish in Eleyele Lake which made them available food for *H. odeo*. This result agrees with work conducted by Akintunde [20,21,23] that cichlids were the major fish prey of the species in Volta Lake, upper Ogun river and Leki Lagoon respectively. This also conform with the study on River Zambezi, that *H. odoe* consumed primarily cichlids and momyrids while insects, copepods, higher plants, gastropods, prawns, crustaceans, etc are their supplementary or minor food especially when the tilapia are in short supply due to high level of predation or competition with other piscivorous fishes such as *Gymnarchus niloticus*, *Parachana obscura*, etc. The percentage of empty stomach (71%) and quarter full stomachs (79%) shows a high limitation in the feeding habit of *H. odoe*. Aramowo [24] reported that the occurrence of high percentages of specimens with empty stomachs could be due to the reduction in the number of prey as a result of high predation and competition by different species inhabiting the water body. According to Lagler [25], there is a strong correlation among the types of dentition, feeding habits and food of fish. The teeth of *H. odoe* are sharp, numerous and pointed which make it very effective for seizing prey. This is also corroborated by Reed [5] by attributing their wide mouth gap to the nature of their jaw bone articulating to their skill. There was high correlation coefficient between F and GW (r=0.98) while there exist a moderate correlation coefficient (r=0.27) between F and BW. This result is similar to the findings of Merron [26] who reported correlation coefficient of 0.29 between F and GW and F and BW respectively for *H. odoe* in River Sokoto. This shows that both Gonad Weight and Body weight are reliable indicators of the fish's potential eggs production i.e. fecundity is proportional to Gonad Weight and Body weight. Also, there was a very low correlation coefficient (0.16) between F and SL. This agrees with the research carried out by Ugwumba [23] on *H. odoe* in Ado Ekiti that the value of r=0.15. This shows that there is no relationship between the fecundity and standard length.

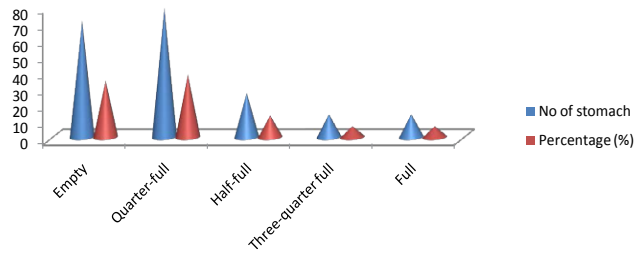

Figure 2: Stomach degree of fullness of sampled *H. odoe*.

S/N	Diet components	Numerical abundance	Relative abundance (%)
1.	Fish (Tilapia)	69	51.00
2.	Copepods	16	12.00
3.	Insect (nymph, larva, adult)	14	10.50
4.	Daphnia	19	14.20
5.	Mysis	02	01.50
6.	Chydorus	01	00.75
7.	Euplypha	01	00.75
8.	Hemisiriella	01	00.75
9.	Filamentous algae	05	03.70
10.	Cyclops	02	01.50
11.	Sagitella	01	00.75
12.	Fish eggs and scale	01	00.75
13.	Rivularia	01	00.75
14.	Zygnema	01	00.75
	Total	134	100

Table 4: Diet composition and their occurrence as observed in the gut of *H. odoe*.

Conclusion

This study gives information on sex ratio, gonadosomatic index, diet composition and fecundity of African pike, *Hepsetus odoe* [18] in Eleyele Lake, Nigeria. The overall sex ratio was calculated as 1:2.73 (♂:♀) with Gonado-somatic index ranged between 0.64 and 15.54 for *H. odoe* with mean GSI of 4.4. Tilapias be the major food organisms found in the stomach of the *H. odeo* shows that *H. odoe* could be made use of in aquaculture or fish farming as a promising candidate for combating and reducing prolific spawning by tilapia species population in earthen pond and other aquatic carnivorous insects that may fed on fry and fingerlings in hatchery ponds. The knowledge of the fecundity of *H. odoe* can be utilized to ascertain the time and number of recruitments and population dynamics. Further researches and studies should be carried out in order to obtain more information about the fish.

Hepsetus odoe is a species complex of three or four different species, and is in need of further taxonomic study. As it is currently recognized, this is a widespread species, known from Senegal to Central Africa Republic, and south to Namibia and Botswana. It is absent in the rift valley lakes.

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