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Some Aspects of the Biology of *Protopterus annectens* (Owen) in Jachi Dam near Katsina, Katsina State, Nigeria

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Abstract: Some aspects of the biology of *Protopterus annectens* (Owen) were studied using 176 specimens purchased from fishermen in Jachi dam, near Katsina, northern Nigeria, from August to October 2005. The fish length ranged from 19.30 to 39.60 cm while the weight ranged from 13.0 to 420 g. The regression coefficient (b) was 3.17, indicating positive allometric growth pattern. The mean condition factor (k) was 0.47, but individual k-values ranged from 0.20 to 0.73. The pectoral-pelvic fins' length relationships showed high proportionate growth rate (b = 0.99). The correlation coefficient (r) of pectoral and pelvic fins relationships with total length of fish was 0.64 and 0.73, respectively. Analysis of the gut content showed that the fish consumed more plant material (86.81%) than insects (7.24%), molluscs (4.97%) and fish remains (0.97%).

Key words: Biology, length, weight relationship, gut content, *Protopterus annectens*

Introduction

Protopterus annectens (Owen), commonly called African lungfish, is the only species of the genus *Protopterus* occurring in West African swamps (Irvine, 1947; Bond, 1979) while *P. dolloi* and *P. aethiopicus* are found in the Congo basin and Upper Nile of the Sudan, respectively (Nichols and Griscom, 1917; Sandon, 1950).

Protopterus annectens grows to a length of about 100 cm (Reed *et al.*, 1967), length of 200 cm has been reported (Webb *et al.*, 1981), but most common length in the market ranged from 30.00 to 40.00 cm (Reed *et al.*, 1967).

Published information on the biology of *P. annectens* is limited to basic description and taxonomy (Reed *et al.*, 1967; Lewis, 1974), in contrast to appreciable works on various aspects of the biology of several fish species in Nigeria (Olatunde, 1978,1979,1989; Fagade and Adebisi, 1977; Nwadiaro, 1986; Ikomi, 1996; Ikomi and Odum, 1998; Eyo, 2002; Oniye and Aken'Ova, 2002; Oniye *et al.*, 2004). Despite scarcity of published research, *P. annectens* is of commercial importance in the landings of fishermen in Yobe, Borno, Adamawa, Katsina, Jigawa and Taraba States of northern Nigeria. Initially this fish was assumed to be of minor commercial importance, but its occurrence in high number in recent times in the landings of fishermen in northern Nigeria has changed its status to a species worthy of study. Information on the length-weight and pectoral-pelvic fins' relationships are unavailable to the authors. Reed *et al.* (1967) and Teugels *et al.* (1988) reported that *P. annectens* is carnivorous and reputed to feed on frogs, mollusks, fish and seeds.

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Therefore, the objectives of this study was to determine the length-weight and pectoral-pelvic fins length relationships and the stomach content of *P. annectens* in Jachi dam, near Katsina, Katsina State, Nigeria.

Materials and Methods

Live samples of *P. annectens* were purchased monthly, from August to October 2005, from the landings of fishermen of Jachi dam, located 8 km from Mani, along the Mani-Mashi road in Mani Local Government Area of Katsina State, Nigeria. Fish specimens were transported in iced-box to the laboratory of the Department of Biological Sciences, Ahmadu Bello University, Zaria.

The total length of each fish (distance from the tip of the snout to the distal tip of the caudal fin) and the standard length (the distance from the tip of the snout to the point of murgence of the dorsal and anal fins) were measured to the nearest 0.1 cm. The lengths of the pectoral and pelvic fins, were measured to the nearest 0.1 cm using a measuring board. Weight of each specimen was measured to the nearest 1.0 g using a spring balance. The length-weight relationship of each fish was determined by using the expression:

$$W = aL^b \text{ (Bagenal and Tesch, 1978)}$$

Where, W = Weight of each fish specimen; L = Total length of each fish; a = Regression intercept; b = Regression coefficient.

This expression was transformed into logarithmic form as:

$$\text{Log } W = \text{log } a + b (\text{log}L)$$

To produce the logarithmic data described by LeCren (1951) and Ricker (1968).

The Fulton's condition factor (k) was calculated using the formula:

$$K = 100W/L^3 \dots\dots \text{(Bagenal and Tesch, 1978)}$$

Where, K = Fulton's condition factor; W = Weight of each specimen; L = Total length of each specimen.

The relationships of pectoral-pelvic fins; pectoral/pelvic fins-fish length were determined by adopting the length-weight relationship formula of Bagenal and Tesch (1978).

Each fish was dissected to expose the viscera. The oblong gut with no distinct demarcation into oesophagus, stomach and intestine, was removed and placed in 4% formalin, then slit open lengthwise under a dissecting microscope to expose its content, which were identified to the lowest convenient taxon. These content were analyzed using the numerical and frequency of occurrence methods (Hynes, 1950; Windell, 1968).

Results

Of the 176 specimens of *P. annectens* examined, 84 (47.73%) were male while 92 (52.27%) were female, given a male: female ratio of 1:1.09. Total Length (TL) ranged from 19.30 to 46.60 cm. The longest male fish had TL of 46.60 cm while the longest female had a TL of 39.90 cm (Table 1). Weights

Table 1: Length-weight relationship of male and female *Protopterus annectens* from Jachi dam, near Katsina

Sex	Total length range (cm)	Weight range (g)	n	a	b	r
Male	19.30-46.60	13.0-425.0	84	-2.48	3.12	0.86
Female	19.40-39.90	15.0-175.0	92	-2.64	3.22	0.84
Combined sex	19.30-46.60	13.0-42.50	176	-2.50	3.17	0.85

n = Sample size, a = Regression intercept, b = Regression coefficient, r = Correlation coefficient

Table 2: Mean monthly condition factor (k) of male and female *Protopterus annectens* from Jachi dam, near Katsina

Month	Samples size (n)		Condition factor (k) range		Mean condition factor (\pm SE)	
	Male	Female	Male	Female	Male	Female
August	20	24	0.18-0.48	0.20-0.45	0.34(0.07)	0.33(0.07)
September	32	34	0.46-0.71	0.45-0.73	0.55(0.08)	0.54(0.07)
October	32	34	0.40-0.68	0.40-0.60	0.56(0.06)	0.52(0.06)
Total	84	92	0.18-0.71	0.20-0.73	0.48(0.07)	0.46(0.07)

n = Sample size, k = Fultons condition factor, SE = Standard Error

Table 3: Length-length relationship of pectoral and pelvic fins of *Protopterus annectens* from Jachi dam, near Katsina

Sex	Pectoral fin range (cm)	Pelvic fin range (cm)	n	a	b	r
Male	6.70-13.90	5.50-10.60	84	2.32	1.00	0.82
Female	7.50-12.40	5.60-10.70	92	2.80	0.92	0.71
Combined sex	6.70-13.90	5.50-10.70	176	2.62	0.99	0.78

n = Sample size, a = Regression intercept, b = Regression coefficient, r = Correlation coefficient

Table 4: Relationships of pectoral and pelvic fins with total length of *Protopterus annectens* from Jachi dam, near Katsina

Fin	Mean (cm)	Mean total length (cm)	a	b	r
Pectoral	9.81	23.70	4.27	0.23	0.64
Pelvic	7.44	23.70	2.55	0.20	0.73

a = Regression intercept, b = Regression coefficient, r = Correlation coefficient

Table 5: The frequency of occurrence (%) and percentage (%) of total number of food items in the stomach of *Protopterus annectens* from Jachi dam, near Katsina

Food items	Frequency of occurrence (%)	% Number
Adult dipteran wings (simuliidae)	4.93	0.52
Adult dipteran head	1.41	0.10
Adult dipteran (whole simuliidae)	5.63	2.97
Insect legs	2.11	0.20
Insect thorax	0.70	0.03
Insect pupae	10.56	3.08
Insect larvae	1.41	0.10
Total insect	-	7.24
Mollusc shells	13.38	3.57
Mollusc remains	7.75	1.40
Total Mollusc	-	4.97
Fish bones	1.41	0.17
Fish remains	5.63	0.80
Total fish	-	0.97
Plant seeds	23.94	75.83
Plant remains	20.42	10.98
Total plant	-	86.81
Leeches (Hirudinea)	0.70	0.10

Number with food = 142(80.68%), Number with fully digested food = 34(19.32%), Empty stomach = 0 (0%)

ranged from 13.0-425.0 g. The largest male weighed 425.0 g, while the largest female weighed 175.0 g. The regression coefficient (b) for the male and female fish was 3.12 and 3.22, respectively, while correlation coefficient (r) for male and female fish were 0.86 and 0.84, respectively (Table 1). Mean condition factors for male and female fish were 0.48 and 0.46, respectively (Table 2).

The lengths of the pectoral and pelvic fins ranged from 6.70-13.90 and 5.50-10.60 cm, respectively for male fish, while in the female fish, the lengths of the pelvic and pectoral fins ranged from 7.50-12.40 and 5.50-10.70 cm, respectively (Table 3). In both sexes, the pectoral fins were longer than the pelvic fins. The relationship between the pelvic and pectoral fins' lengths have a correlation coefficient (r) value of 0.78 and a regression coefficient (b) value of 0.99. Table 4 shows that there was a positive correlation between the pectoral fin length and body length of fish ($r = 0.64$) and between the pelvic fin length and body length of fish ($r = 0.73$).

Out of the 176 guts examined, 142(80.68%) contained food items while 34(19.32%) had fully digested food (Table 5). Food items of primary importance were plant remains and seeds (86.81%). Others, of secondary importance included insects (7.24%), molluscs (4.97%), fish (0.97%) and leeches (0.10%). Simuliid flies were identified as the most important insect food material consumed (Table 5).

Discussion

The length-weight relationships of *Protopterus annectens* studied in Jachi dam showed positive correlation ($r = 0.85$) in both sexes, which indicates an increase in weight as length increases. The regression exponent ($b > 3$) for both sexes shows positive allometric growth pattern, evidence that the fish becomes "heavier for its length" as it grows (Tesch, 1968). Thomas *et al.* (2003) stated that the isometric value of $b = 3$ is for an ideal fish that maintains three-dimensional equality; when b -value is < 3 , the fish has a negative allometric growth and b -value > 3 is positive allometric growth (Khaironizam and Norma-Rashid, 2002). If fish have to maintain their shape as they grow, their b -values must be equal to 3, but there is no existing theory that says the b -value must be negatively or positively allometric (Pauly, 1993). Most fish species often deviate from isometric growth as the shape of their bodies change with growth (Thomas *et al.*, 2003).

The condition factor of the fish was low in August, which coincided with the end of spawning, as the factor is also influenced by breeding activities of fish (Ikomi and Odum, 1998). Reed *et al.* (1967) reported that the peak spawning period of *P. annectens* is between July and August. The condition factor of *P. annectens* appreciated in September and thus may be associated with weight regain immediately after their spawning period, which is directly reflected in the availability and utilization of food items for energy and growth.

The high regression coefficient obtained for the relationship between the pectoral and pelvic fins length should be taken that the pectoral fin grows at approximately the same rate as the pelvic fin in male and female *P. annectens*. In both cases, the pectoral fins were longer than the pelvic fins. The correlation coefficient of the pectoral/pelvic fins with the total length shows that they all increase at the same rate.

The preponderance of plant food materials (86.81%) consumed by the fish in Jachi dam suggests littoral feeding habit and high tendency towards being a herbivore, probably a strategy to get at plant matter that is richer in calories which may enable them survive aestivation when the water level is low in the dam. Similar food items were identified in both sexes, suggesting a lack of sex-linked preference for food in *P. annectens*. The various food materials identified in the fish is similar to those reported by Sandon (1950) and Reed *et al.* (1967), that the diet of *Protopterus* spp. consist of small animals such as fishes, molluscs, frogs and seeds of plants, except that frog was completely absent in our study. Present findings contrasts with Hicklin's (1961) report, that molluscs form a very high proportion of the food of *Protopterus* spp. and, that of Gunther (1880) that the species is exclusively carnivorous. The differences may be related to faunal dissimilarities of the aquatic environments where

these studies were conducted. Among the animal food materials, the fish fed mostly on insects, the simuliid flies, which breed on submerged plants, making them vulnerable to predation by the fish.

In conclusion, *P. annectens* has positive allometric growth pattern, its pectoral and pelvic fins grow proportionately. The fish has omnivorous feeding habit, but with higher tendency towards being herbivorous as a form of survival strategy, in obtaining food rich in calories in preparation for the long period of dry spell in Jachi dam, which contained low prey population at the time of this study.

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