

GROWTH PATTERN OF FRESHWATER PRAWN (*ATYA GABONENSIS* GIEBEL, 1875 (CRUSTACEA: ATYIDAE) IN THE LOWER RIVER BENUE, MAKURDI, NIGERIA

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ABSTRACT

The growth pattern of freshwater prawn (*Atya gabonensis*) in the lower river Benue, Makurdi, Nigeria was carried out. A total of 1,030 Specimens of *Atya gabonensis* were collected with the aid of fishermen from January to August 2015. These were transported in an ice box to the laboratory for further studies. The length-weight relationship was calculated as described by Bagenal. The condition factor was calculated using an equation by Ricker. The allometric coefficient 'b' was highest in August (3.114) and lowest in February (1.119). The mean condition factor (K) was highest in May (2.99 ± 0.08) and lowest in March (2.25 ± 0.05). Carapace length ranged from 0.90cm in February to 6.20cm in June (mean = 2.31 ± 0.04 cm). Total length ranged from 3.0cm in February to 14.4 cm in January (mean = 8.55 ± 0.06 cm) and body weight ranged from 1.50g in March to 73.0g in January with a mean value of 18.03 ± 0.38 g. Correlation ranged from 0.8025 in June to 0.9550 in January. It was concluded that *A. gabonensis* is well adapted to the freshwater body of River Benue and it is suspected to make a good candidate for prawn culture in the freshwater system in Nigeria.

Keywords: Lower River Benue, Freshwater prawn, Length-weight relationship, condition factor, Allometric growth

INTRODUCTION

Freshwater prawns of Atyidae family are an important resource for the artisanal fishery due to their high economic and ecological importance (Gooré Bi, 1998; Vanga, 2007; Almeida *et al.* 2010; Boguhé, 2011). *Atya* is a genus of the family Atyidae, ranging from the Antilles and along the Atlantic and Pacific slopes of Central and South America and in western Africa (Obetta *et al.*, 2020; ITIS, 2022). Among the species of this genus, *Atya gabonensis*, taxonomically classified by (ITIS, 2017), was reported to occur in abundance in Nigeria's main rivers and tributaries (Okayi *et al.* 2015).

Its presence was reported in River Niger (Motwani and Kanwai, 1970) and River Benue (Powel, 1982). This amphi-atlantic species is also found in Brazil, Cameroon, Congo, The Democratic Republic of Gabon, Ghana, Liberia, Mali, Sao Tomé and Príncipe (São Tomé), Senegal, Suriname, Venezuela, and the Bolivarian Republic of (Venezuela (mainland)) (De Grave and Mantelatto, 2013). Aquatic Arts (2017) reported that it is certainly among the most fascinating and unique aquarium shrimp available, and it is commonly called African Filter Shrimp, Viper Shrimp, Gabon Shrimp, and Cameroon Shrimp.

With good nutritional value and substantial economic benefits, prawn production in Nigeria is mostly wild-caught and in small quantities (about 12,000 tonnes annually) (Zabbey *et al.*, 2010). It is important to develop prawn culture in Nigeria to increase production for improved nutrition, foreign exchange earnings, and employment generation. Hence, in-depth knowledge of biology, especially

growth patterns, of indigenous species such as *A. gabonensis* is important.

Growth is an important component of biological production, which affects overall production (Oyebamiji *et al.*, 2018). The negative change in the growth rates may result in decreased individual health, reproductive success, and an increased risk of predation and mortality (Wootton, 1992). Length-weight relationships and condition factors are important for a wide range of studies, such as estimating growth rates, age structure, and prawn population dynamics (Tsoumani *et al.*, 2006).

A few studies have been done on the biology of *A. gabonensis* in Nigeria. These include Powell (1982), Solomon *et al.* (1999), Nwosu (2000), and Obande and Kusemuji (2006). This study aimed to provide information on the length-weight relation and condition factor of *A. gabonensis* in Lower River Benue. This would provide basic information for sustainable management of the stock and possible culture of the species for increased prawn productivity. The result of this study could also be compared with and provide an update on the reports of Solomon *et al.* (1999), Okayi and Iorkyaa (2004), and Obande and Kusemuji (2006)

MATERIALS AND METHOD

Study Area

The study area, Lower River Benue, Makurdi (Figure 1) is located on latitude 7° 55' and 7° 56' North of the equator and longitude 8° 20' and 8° 40'

East of the Greenwich meridian. River Benue originates from Adamawa hills and flows from the Southern part of Cameroon through Makurdi and Southwards to Lokoja where it forms a confluence

with River Niger. At bank full, the River is about 129,000 hectares with as much as 25m difference between high and low water levels.



Figure 1: Map of Lower River Benue showing Makurdi, the sampling site. Source: Wikipidia.com (2015)

Prawn Sample Collection and Identification

About 1,030 prawns were collected with the help of fishermen and transported in an ice box to the laboratory for further studies. The prawns were identified to the species level, using keys provided by Powell (1982).

Measurements of Carapace Length, Total Length, and Weight

Carapace length was measured by the use of a venier caliper as the distance from the tip of the rostrum to the end of the carapace. The total length was measured, using a meter rule (cm) as the distance from the tip of the telson to the tip of the dorsal teeth. A top-loading electronic mettler balance (Model 59174 made in China) was used to measure total body weight (g) to the closest gram.

Length – Weight Relationship

The length/weight relationship was computed by the equation of Bagenal 1978). The condition factor was calculated by the equation of (Ricker, 1975).

Results

Monthly variations in morphometric characteristics of *A. gabonensis* in Table 1 showed that the lowest mean carapace length of 2.93±0.07cm was in

February and the highest value in January (4.16±0.07cm). Mean total length was lowest in February (6.98±0.14) and highest in June (9.59 ± 0.15). The mean lowest body weight (10.24±0.61) was recorded in March and the highest (27.80 ± 1.29g) in April.

The monthly length-weight relationship and condition factor are in Table 2. The 'b' value of the regression equation ranged from 1.119 in February to 3.114 in August. The growth pattern revealed isometric growth in March and allometric in other months. Negative intersections were observed for "a" all through the months, with the highest value observed in August (-1.7349). The condition factor was higher in May (2.99) compared to other months (P<0.05). The lower condition factor was in January, March, June, and August.

Overall morphometric parameters and condition factor for male, female, and combined sexes are shown in Table 3. Total length ranged from 3.00 – 14.40 cm (8.55± 0.06 cm), carapace length ranged from 0.90 – 6.20 cm (3.56±0.03 cm), body weight ranged from 0.70 – 73.00 g (18.03±0.38 g) and condition factor (K) ranged from 1.03 – 6.68 with a mean value of 2.50 ± 0.02.

Table 1: Monthly Variations in Morphometric Characteristics of *A. gabonensis* in Lower River Benue from January 2015 to August 2015

Month	No.	Carapace length (cm)			Total Body Length (cm)			Total Body Weight (g)		
		Min	Max.	Mean±S.E	Min	Max.	Mean±S.E	Min.	Max.	Mean±S.E
Jan.	160	1.50	5.90	4.16±0.07	4.60	13.20	9.74±0.14	1.50	59.20	23.88±1.07
Feb.	125	1.20	4.90	2.93±.07	3.50	10.90	6.98±0.14	0.70	33.10	11.02±0.72
March	151	0.90	5.90	3.19±0.07	3.00	11.50	7.33±0.13	0.80	36.20	10.24±0.61
April	142	2.30	5.50	3.57 ± 0.06	5.50	12.80	8.48 ± 0.13	3.50	61.10	27.80 ± 1.29
May	120	1.90	6.10	3.65±0.08	4.70	13.60	8.76±0.16	3.10	52.10	18.05±0.97
June	104	1.50	6.20	3.67 ± 0.11	7.50	14.40	9.59 ± 0.15	10.00	73.0	17.18 ± 0.85
July	99	2.10	5.90	3.75±0.08	5.90	12.60	8.94±0.16	4.80	52.10	19.28±1.09
August	91	1.20	5.90	3.59±0.11	3.50	13.20	8.75 ± 0.22	0.70	51.00	19.14 ± 1.35

Table 2: Monthly Length-Weight Relationship and Condition Factor of *Atya gabonensis* collected from Lower River Benue from January to August 2015

Month	A	b	r	Condition factor
Jan	-1.4655	2.838	0.9550	2.34 ± 0.02 ^{de}
Feb	-0.479	1.119	0.9231	2.74 ± 0.06 ^b
Mar	-1.6728	3.012	0.8501	2.25 ± 0.05 ^e
Apr	-1.5175	2.912	0.8961	2.56 ± 0.04 ^c
May	-1.5100	2.969	0.7543	2.99 ± 0.08 ^a
June	-1.4673	2.823	0.8025	2.39 ± 0.13 ^{de}
July	-1.4031	2.781	0.9407	2.48 ± 0.03 ^c
August	-1.7349	3.114	0.9479	2.39 ± 0.05 ^{de}

Means in the same column with different superscripts differed significantly (P<0.05)

Table 3: Morphometric Characteristics and Condition Factor of Males, Females, and Combined Sexes of *Atya gabonensis* in Lower River Benue from January to August 2015 (n=1030)

Sexes	Carapace Length (cm)			Total Length (cm)			Weight (g)			Condition Factor (K)		
	Min.	Max.	Mean±S.E	Min.	Max.	Mean±S.E	Min.	Max.	Mean±S.E	Min.	Max.	Mean±S.E
Male	1.70	6.20	3.93 ± 0.037	3.90	14.40	9.21 ± 0.08	1.90	73.00	21.74 ± 0.52	1.03	6.50	2.47 ± 0.02
Female	0.90	5.20	2.30 ± 0.04	3.00	10.90	7.52 ± 0.07	0.70	41.00	12.23 ± 0.38	1.03	6.68	2.55 ± 0.03
Comb. Sexes	0.90	6.20	3.56 ± 0.03	3.00	14.40	8.55 ± 0.06	0.70	73.00	18.03 ± 0.38			

The correlations of morphometric parameters of female (Table 4) revealed high correlation between carapace length and total length (r = 0.789), carapace length and weight (r = 0.641), and total length and weight (r = 0.837), however condition factor only correlated significantly with weight (r = 0.550).

In morphometric parameters of male specimens (Table 5), higher correlation levels were recorded between carapace length with total length

(r = 0.963) carapace length and weight (r = 0.890), and total length and total weight (r = 0.926) compared to the female. Though the result obtained shows a significant correlation between condition factor and weight, the correlation value was very low (r = 0.254) compared to females. Negative correlation was observed between condition factor and carapace length (r = -0.045) and total length (r = -0.031).

Table 4: Correlation Matrix between Morphometric Parameters of *Atya gabonensis* Female collected from Lower River Benue from January to August 2015

	Carapace length	Total length	Weight
Total length	0.789***		
Weight	0.641***	0.837***	
Condition factor	0.061	0.126	0.550***

Cell contents: Pearson correlation. P-value *** Significant (P<0.001)

Table 5: Correlation Matrix between Morphometric Parameters of *Atya gabonensis* Male collected from Lower River Benue from January to August 2015

	Carapace length	Total length	Weight
Total length	0.963***		
Weight	0.890***	0.926***	
Condition factor	-0.045	-0.031	0.254***
	0.257	0.434	

Cell contents: Pearson correlation. P-value *** Significant (P<0.001)

DISCUSSION

Sexual dimorphism was observed in the sizes, males are superior to females in sizes. It was reported by Martínez-Mayén *et al.* (2000) that *Atya gabonensis* is most likely among the few species of atyid that have males that are larger than females. *Atya scabra* likewise displayed the same size disparity between the sexes (Cubillas *et al.*, 1989). Larger sizes of males could indicate some sort of “female – guarding” or “protectionism” or intrasexual competition involving fighting and pushing, as confirmed by Almeida *et al.* (2010).

The b-values of show isometric growth in March, positive allometric growth in August, and negative allometric growth in other months. Isometric growth is an indication that an increase in weight of the prawn is proportional to an increase in length, while allometric growth reveals that an increase in length is not commensurate to weight gain (Daud and Ang 1995; Primavera *et al.* 1998; Abohweyere and Williams 2008; Gopalakrishnan *et al.* 2014; Sun *et al.* 2015). Isometric growth in *A. gabonensis* has been reported by Solomon *et al.* (1999), Okayi and Iorkyaa (2004), Obande and Kusemuji (2006), and Jimoh *et al.* (2012). The allometric growth pattern in prawns was also reported by many authors including New *et al.* (2010), Andem *et al.* (2013), and Kingdom and Erondu (2013). Variations in length increase to weight gain are an indicator in fishes and crustaceans that reflects fluctuations of uptake and allocation of energy. Further variations are affected by many factors such as food, stress due to overcrowding, reproductive cycle, temperature, pH, habitat, seasonal effects, degree of stomach fullness, gonad maturity, sex, health, and preservation techniques (Abrahamsson, 1966; Madeleine *et al.*, 2015 and Oyebamiji *et al.*, 2018).

The condition factor obtained from this study is within the range reported by Solomon *et al.* (1999), Okayi and Iorkyaa (2004), and Obande and Kusemuji (2006) in the Lower River Benue. The fluctuation observed was also reported by Thomas (1975) and Rao, (1969) on *Penaeus semisulcatus* and *Macrobrachium rosenbergii* respectively, and attributed to the availability of food and developmental stages of the gonads. Abowei, (2010) reported that condition factor varies with sex and stage of maturity. This could be the reason for the slightly higher condition factor in females. It might be related to the increased capacity of females in storing energy/fat for use during gonadal maturation, as well as the larger size and weight of the ovaries in comparison with testis. Lira *et al.* (2012) made a similar observation.

The correlation between length and weight is high and positive. This agrees with reports by Obande and Kusemuji (2006), Solomon *et al.* (1999), Jimoh *et al.* (2012), and Kingdom and Erondu (2013), indicating that the environment is

good for the adaptation of this species. This study provides information on the growth pattern of *Atya gabonensis* in Lower River Benue. More research is needed to understand their reproductive biology for possible culture.

CONCLUSION

Atya gabonensis is well adapted to the freshwater body of River Benue and it is suspected to make a good candidate for prawn culture in the freshwater system in Nigeria.

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