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ASPECTS OF REPRODUCTIVE BIOLOGY OF MACROBRACHIUM FELICINUM IN THE LOWER RIVER BENUE, MAKURDI, NIGERIA

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ABSTRACT

One hundred and one (101) specimens of prawn, *Macrobrachium felicinum* were collected from Lower River Benue from January to August 2012 using non-return valves.Thirty(30) of the prawns were berried females and were examined for fecundity. Morphometric and merismetic features were measured as well. It was found that *M. felicinum* occurred mostly in July and August. The prawns exhibit sexual dimorphism such as larger size of male than female, presence of groove on the abdominal region of female, presence of knob which could be felt on the ventral abdominal region in male, numerous thread-like setea on the pleopods of female and presence of appendix masculina on the second pleopod of male. Sex ratio was found to be 1:4 (M:F). Mean total length was5.68±0.10cm, mean carapace length was 2.39±0.05cm, and mean weight was 3.21±0.21g.Condition factor ranged from 0.47 to 3.08. Fecundity estimate ranged from 59 to 33,680. Gonadosomatic index ranged from 5 to 28%. It was concluded that *M. felicinum* is seasonal in the Lower River Benue can be considered a good aquaculture species, as the parent stock is readily available.

INTRODUCTION

Almost all the freshwater prawns that have been used in aquaculture and associated experiments belong to the genus *Macrobrachium*. The genus is one of the most challenging decapod crustacean groups to describe (Chace and Bruce, 1993) due to the great similarities possessed by these freshwater prawns. It is the largest genus of the family Palaemonidae, superfamily Palaemonoidea, infra-order Caridea, order Decapoda, suborder Pleocyemata. About 230 species of macrobrachium have been described so far (Fransen and De Grave, pers. comm. 2008). Species of the genus Macrobrachium are found in almost all types of freshwater habitats and estuarine environments including lakes, rivers, swamps, irrigation ditches, canals and ponds (New, 2002; Valencia) and along the Atlantic Coast. They are a remarkably successful group both in number of living species and in the colonization of varied habitats. Although members of this genus are commonly referred to as 'freshwater' prawns, some are entirely restricted to estuaries and many require marine influence during development (New, 2000). The most common prawn species found in Nigerian rivers are Macrobrachium species (Bello-Olusoji *et al.* 2004). Powell (1983) mentioned three important species of freshwater prawn that dominate Nigerian inland water as *Macrobranchium felicinum* (Niger River prawn), *Macrobranchium vollenhovenii* (African River Prawn) and *Macrobranchium macrobranchion* (Brackish River prawn). *M. felicinum* have been found

in large white water rivers, both with sandy and rocky bottoms, at least as far inland as Kainji (River Niger), Federal Capital Territory (Abuja area) and Makurdi (River Benue) (Powell, 1983).

Many body structures of prawns show clear morphological differences in both meristic and metric aspects as a result of sexual dimorphism (Hartnoll, 1985). Bauer (2004) observed that sexual dimorphism in body size and weaponry in carideans such as *M. felicinum* is highly dependent on the mating system. Correa and Thiel (2003) and Bauer *et al.* 2014) added that Species in which males are significantly larger than females and possess hypertrophied weaponry (chelipeds, third maxillipeds) are characterized by mating systems that include fighting for or defense of females, and/or maintenance of grounds or other resources important for female reproductive success. In contrast, the selective pressures have led to smaller males and larger females in species in which the males do not guard the females (Correa and Thiel, 2003; Bauer, 2004).

Females exhibit a typical broodchamber formed by the first, second and third abdominal pleurae. The pleura of the abdomen are lower and broader in the female than in the male bauer and Thiel (2011). New and Singholka (1982) reported that genital pores are found between the bases of the fifth walking leg for males and at the base of the third walking legs for female. And male possesses appendix masculina, a spinous process adjacent to the appendix interna on the endopod of the second pleopod (Martínez-Mayén and Román-Contreras 2000). There is presence of central lump on the ventral side of the first abdominal somite in male whereas this feature is absent in female (Sandifer and Smith, 1985). Some authors have observed varieties of fecundity in different species of prawns: *M. acanthurus* (mean fecundity 18,000 eggs) (Valenti *et al*. 1989), *M. carcinus*, and *M. rosenbergii* (between 80,000 and 100,000 eggs) (Silva *et al.* 2004). Egg size has various interrelated ecological implications that may influence the following: 1) size of the species at sexual maturity, 2) timing of juveniles release, 3) number of egg masses produced per unit of time, 4) number of eggs per clutch, 5) stage of development, and 6) juvenile's size when released into the environment (Scaico, 1992).

Prawns of the genus Macrobrachuim and Penaeus are highly cherished. They are used as condiments in the preparation of food because of their high protein value (Powell, 1983). They are highly priced and are in high demand in the market. Proshare (2018) reported that shrimps and prawns are Nigeria's third largest agricultural export. and many Nigerians are gainfully employed in the areas of prawn and shrimp capture, production and processes (FAO, 2008). The aspects of prawn biology in the Nigerian fresh and brackish aquatic ecosystem has been generally reported by Holthius (1980), Powell (1983), Anetekhai (1986) and Ayoola,*et al.;*(2009) but not much was mentioned about *Macrobrachium felicinum* possibly due to lack of information on the species. This study on some aspects of reproductive biology of *M. felicinum* in Lower River Benue, Makurdi is a contribution to existing knowledge in the biology of prawns.

MATERIALS AND METHODS

The study area, Lower River Benue, Makurdi, is located on latitude 7˚ 55' and 7 56' North of equator and longitude 8˚20' and 8˚ 40' East of the Greenwich meridian. River Benue (figure 1) 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 area of Lower River Benue is about 129,000 hectares with as much as 25m difference between high and low water levels. A total of one hundred and one (101) specimens of *M. felicinum* were collected from catch statistics from fishermen from January to August 2016, using various gears such as drag net; "Gula" in tiv language or "Mari" in Hausa and Jukun Languages (with unknown English name); and unbaited local non-return set trap, "Ahina" in Tiv language. The collected specimens were transported live to the fisheries laboratory, University of Agriculture, Makurdi in icebox containing water. The prawns were identified to the species level, using keys provided by Anetekhai (1990). The sexes were determined with the aid of specific morphological features that were peculiar to male and females of the prawns. The features used were appendix masculina, reproductive chamber and nubs on the first abdominal segment as adopted and demonstrated by Anetekhai (1990). The total length (cm) was measured, using a meter rule as the distance from the tip of the telson to the tip of the dorsal teeth; carapace length (cm) was measured with the aid of a meter rule as the distance from the tip of the rostrum to the end of the carapace. The total body weight (g) was taken using a top loading electronic Metler balance (Model 59174) to the nearest gram. Abdominal length (cm) was measured as the distance between distal extremity of rostrum and the medium point of posterior part of carapace. Carapace diameter was measured as the distance between lateral margin of cephalothorax. Condition factor was calculated using the equation of Fulton's condition factor (Ricker, 1975).

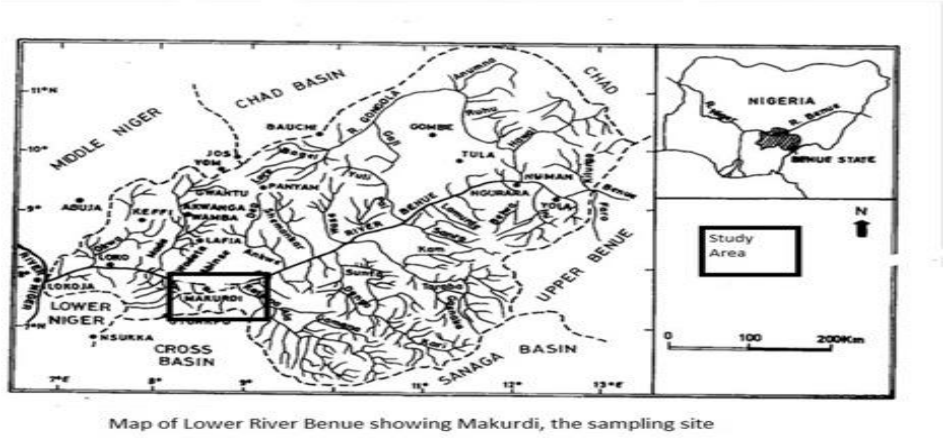
$$K = \frac{100w}{L^3}$$

Where K= condition factor, L= Standard length (cm), W= Weight (g).

The total number in each female was estimated by galvametric method described by Bagenal and Braum (1978).
Gonadosomatic Index was determined using equation:

$$GSI \quad \frac{\text{Gonad weight}}{\text{Body weight}} \times 100 \quad \text{(Bagenal, 1987)}$$

The relationships between morphometric measurements were established using regression analysis. All statistical inferences were based on a significant level of 0.05.



Map of Lower River Benue showing Makurdi, the sampling site

Figure 1: Map Showing the Site for Sample Collection, Lower River Benue, Makurdi (Modified from Obaje, 2009).

RESULTS

Out of 101 specimens of *M. felicinum* encountered from January toAugust 2012, 81 were females while 20 were males. This shows an evidence of polygamy as indicated by a sex ratio of 4 females to one male (Table1). The morphometric parameters and condition factor of berried *M. felicinum*are is presented in Table 2. The fecundity ranged from 59 to 33,680 ($\bar{x}$ 4754±1313); egg diameter, 0. 60 – 0.97mm ($\bar{x}$ 0.73 ± 0.0171mm); Abdominal length, 1.50 – 2.60cm ($\bar{x}$ 1.99 ± 0.0485); weight, 1.3 – 3.1g ($\bar{x}$ 2.06 ±0.0971); total length, 4.40 – 5.9cm ($\bar{x}$ 4.96 ± 0.0676); carapace length, 1.40 – 2.90 cm(2.093 ± 0.0507); and the condition factor, 1.04 – 2.53 ($\bar{x}$ 1.67 ± 0.0531). Regression analyses revealed correlation between most of the morphometric parameters. However, no correlation was found between body weight and fecundity, and total length and fecundity. River Benue exhibited a high degree of sexual differentiation. The males were larger in size than the females; ventral view of the first abdominal segment of the male had a knob, which could be felt when touched with finger. There was no such lump in the female's abdominal region. The pleopods of the female had numerous threads - like setae for attachment of eggs during the breeding season. The male also had a feature called appendix masculina and appendix interna in the second pleopod while it is only appendix interna that was present in the pleopod of the female. The female prawn was also recognized by the presence of groove on the abdominal segment where the eggs were carried. The gonadosomatic index is the amount of body weight used for egg production by the female. The mean gonadosomatic index (GSI) calculated for *M. felicinum* females varied from 5-28.62% (Appendix 8) with the mean value of $\bar{x}$ 16.6±1.03

Table 1: Sex Ratio of *M. felicinum* caught from Lower River Benue (July and August 2012)

Month	Total no. of Male	Total no. of Female	Total Catch	Sex Ratio (M:F)
July	15	48	63	1:3
August	1	33	34	1:33

Table 2: Morphometric Parameters and Condition Factor of Berried Female *M. mfelicinum* from Lower River Benue (July, 2012)

Table 2: Morphometric Parameters and Condition Factor of Berried Female *M. mfelicinum* from Lower River Benue (July, 2012)

	Min.	Max.	Mean	Std. Deviation
Fecundity	59.43	33680.00	4754.33	7195.45
Egg Diameter (mm)	0.60	0.97	0.73	0.09
Abdominal Length (cm)	1.50	2.60	1.99	0.27
Weight (g)	1.30	3.10	2.06	0.53
Total Length (cm)	4.40	5.90	4.96	0.37
Carapace Length (cm)	1.40	2.90	2.09	0.28
Condition Factor (K)	1.04	2.53	1.66	0.29
Gonadosomatic Index	5.00	28.00	16.1033	5.63649

DISCUSSION

The sex ratio of 4:1 female:male shows an evidence of polygamy. It could mean that this area is a breeding ground and mostly, berried female come here to spawn. It could equally be due to their behavior during breeding season when females actively search for males, which are territorial. Anetekhai (2002) reported similar observation for *M. vollenhovenii* in Asejire Lake and attributed it to vulnerability of females during breeding season when female actively search for male. It is suspected that the *M. felicinum* breeds in July and August, since the specimens caught were mainly females, which were either berried or spent. Fecundity in *Macrobrachium* prawns is very variable. The highest fecundity in species of this genus was observed in *Macrobrachium rosenbergii* and *Macrobrachium carcinus*, where females could lay between 80,000 and 100,000 eggs in a spawn, when they are fully mature (Ismael and New 2000). Valenti*et al.* (1986, 1989) observed *Macrobrachium acanthurus* females hatch about 18,000 eggs; Shokita, cited by Scaico (1992) observed females with 13,600 eggs while da Silva *et al.* (2004) recorded 697 and 1,690 as the lowest and highest number of eggs respectively for *Macrobrachium amazonicu*. In this study, *M. felicinum*, presented a lower fecundity than *Macrobrachium rosenbergii* and *M. carcinus*. However, it has higher fecundity than *M. acanthurus; M. amozonicu*; *Macrobrachium shokitai*, whose fecundity is lower than 60 eggs; and *Macrobrachium jelski* with absolute fecundity lower than 200 eggs (Scaico, 1992). Compared to the fecundity of *Atya gabonensis* as recorded by Obande *et al*. (2009) in the Lower River Benue, M. felicinum is more fecund. Prawns of macrobrachium genus are averagely more fecund than other freshwater prawns (Anetekhai 1990). The lack of correlation observed between fecundity and weight and fecunsity and length was also observed by Courtney et al. (1996), who reported on the decline in number of eggs with an increase in the size of *Penaeus plebejus* and found that this could possibly be due to ovarian senescence in large (old) females. *M. felicinum* in the Lower**.** *M .felicinum* is a freshwater species and can compete with *M. vollehenveni* for recruitment into freshwater aquaculture. Lower River Benue, when water level is high, from July to August, is suitable for collection of broodstock of *M. felicinum* for commercial farming. The exploitation and subsequent culture of *M. felicinum* could reduce over dependence on finfishes and also enhance the nutritional intake and income of the local fishermen and the community.

Further investigation on the occurrence, life cycle, growth and habitat of native prawn species such as *M. felicinum* is important in order to develop appropriate technology for culture in Nigeria.

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LENGTH -WEIGHT RELATIONSHIP AND CONDITION FACTOR OF THE FRESHWATER PRAWN ATYA GABONENSIS (GIEBEL, 1875) FROM RIVER NIGER, JEBBA, NIGERIA

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ABSTRACT

The length-weight relationship and condition factor (K) of freshwater prawn, *Atya gabonensis* (Giebel, 1875) from Niger River, at Jebba, was investigated from January to December 2016. A total of one thousand, three hundred and seventy (1 370) samples of *A. gabonensis* were collected under rocks and crevices by the aide of fishermen. The specimens were transported to the laboratory on ice. Length-weight relationship revealed "b" value ranging from 1.918 – 2.064, thereby suggesting a negative allometric growth pattern for *A. gabonesis*. There was a strong positive correlation between length and weight of males, females and combined sexes. Total length and weight showed significant difference in all the months, condition factor ranged from 2.63±0.08 in May to 3.84±0.36 in December. The mean K values were 3.08 ± 0.08 and 3.09 ± 0.07 for males and females respectively and had no significant difference ($p<0.05$). Water quality ranged from 5.9 – 9.8 mg/L for dissolved oxygen; 5.6 – 8.9 for pH; 20.6 – 32.2 ºC for temperature; 95 – 150 µ/Scm for conductivity; 12 -28 mg/L for alkalinity; 48 – 76 ppm total dissolved solids; 0.1 – 0.5 mg/L ammonia; and 3.6 – 6.2 mg/L for BOD.

Keywords: Allometric growth, correlation, sex ratio, water quality

INTRODUCTION

Atya is a genus of freshwater prawn of the family Atyidae, ranging through the Antilles and along the Atlantic and Pacific slopes of Central and South America and in western Africa (Hobbs and Hart, 1982). One of the 430 species of this genus is *Atya gabonensis* (Giebel, 1875), which was first reported in Gabon. De Grave and Mantelatto (2013) reported that *A. gabonensis* was found in Brazil, Cameroon, Congo, The Democratic Republic of the Gabon, Ghana, Liberia, Mali, Nigeria, Sao Tomé and Principe (Sâo Tomé), Senegal, Suriname, Venezuela and Bolivarian Republic of (Venezuela (mainland). In Nigeria, *A. gabonensis* has been reported to occur in the main Nigerian rivers and their tributaries (Reed *et al*. 1967). Motwani and Kanwai (1970) reported the occurrence of this prawn in the coffer- dammed right channel of River Niger. It has been found to occur in great abundance in Lower Benue River as well (Powel, 1983). *A. gabonensis* has several common names such as African Fan Shrimp, African Filter Shrimp, African Giant Shrimp, Vampire Shrimp, Blue Rhino Shrimp, Gabon Shrimp, and Cameroon Fan Shrimp (Nwosu, 2000). It has been described in considerable details by Giebel (1875) and Bouvier (1904) as the most beautiful and largest species belonging to genus atya. Its size has been reported to range from 45mm to 138mm (Bouvier 1904)

Many authors have reported the length-weight relationship and condition factor among sexes, species, seasons, and sites for both wild and cultured populations of prawns. Alexis *et al.,* (2005) reported length-weight relationship for *Penaeus kerathurus* in the East Ionian Sea (Western Greece); Okayi and Iorkyaa (2004) reported for *A. gabonensis* in River Benue in Makurdi, Nigeria; Yakubu and Ansa (2007) reported for P. *indicus* and *P. monodon* in Buguma creek, Niger Delta Nigeria; that for *P. monodon* cultured in Pichavaram mangroves (Thailand) was reported by Gopalakrishna *et al*.,2015; while that of *P. atlantica* in the coastal waters of Ondo State was reported by Olawusi *et al.* 2014.

Prawn is of great economic importance. It is a very important export commodity and the most valuable fishery product export in Nigeria (Chemonics, 2002; FAO, 2008). Shrimps and prawns and their products are the second most important commodity export of Nigeria after petroleum, and many Nigerians are gainfully employed in the areas of prawn and shrimp capture, production and processes (FAO, 2008).

Some studies have been carried out on the biology of *A. gabonensis* (Solomon *et al.*, 1999; Obande and Kusemiju 2006; and Okayi *et al.*, 2010) in the Benue River but not much research has been conducted on the same species in the Jebba River. This study aims to provide information on the length weight relation and condition factor of *A. gabonensis* in the Niger River Jebba, Nigeria. The result of this study could be compared with that of Okayi *et al.*, (2010) in the Lower Benue River, to know how this species is doing in both rivers.

MATERIALS AND METHOD

Study Area

River Niger in Jebba is located on latitude 9° 35` and 9° 50` N and longitude 9° 30` and 5° 00` E. Apart from fishing and livestock activities, the River is also used for hydro electrical, irrigational and navigational purposes.

Sample Collection

Specimens of *A. gabonensis* were collected under rocks and crevices in the water by fishermen. The collected specimens were transported live to the fisheries laboratory of the University of Agriculture's Makurdi laboratory on ice, where identification to the species level were carried out using the keys provided by Powell (1983).

Measurements of total body length and body weight

The total body length was measured, using a meter rule (cm) as described by Yungdong e*t al.,* (2016) as the distance from the tip of the telson to the tip of the dorsal teeth on the rostrum. The total body weight (g) was taken using a top loading electronic Metler balance (Model 59174).

Length – Weight Relationship

Regression analysis was done between weight (W) and total length (TL) and the scattergrams plotted according to the model of Stooldley *et al.* (1980). This plot is best described by the formula: Logy = a+b logx

Where

y = weight of prawn (W);

a = regression constant (intercept on the Y-axis);

b = regression coefficient; and

x = total length of prawn (TL

Condition factor (K)

The condition factor is a measure of the degree of wellbeing of an organism. This was calculated monthly for males and females

using the equation of Fulton' condition factor (Ricker, 1975).

$K = 100W / L^3$

Where K = Condition factor;
W = weight in g; L = length in cm.

RESULTS

A total number of one thousand, three hundred and seventy (1 370) specimens were collected from January to December, 2016 from Niger River, Jebba (Table 1). Males were nine hundred and eighty one (981) while females were only three hundred and eighty nine (389), thereby giving an overall sex ratio of 1: 2.5 (F:M) with the range of 1:1.3 in November to 1:4.56 in April. The highest number of prawns were collected in the month of June (328) and the lowest in the month of November (145). Body weight ranged from 2.03-48.06 g, the highest mean was recorded in January (20.59 g ± 0.81) and lowest mean value in February (18.18 g ± 0.81), p-value = 0.033. The total length ranged from 1.90 cm in December - 12.60 cm in June, the highest mean value (9.05 cm ± 0.15) was recorded in May while the lowest value was recorded in December (8.16 cm ± 0.17^d), P-value = 0.002. Table 2 presents a summary of morphometric features of males and females *A. gabonensis* from River Niger, Jebba from January to December 2016. Males exhibited superiority in size over females. Weight ranged from 2.03 - 48.06 g (mean = 19.62 g ± 0.36) in males and from 2.36 - 44.39 g (mean = 17.64 g ± 0.46) in females. Total length ranged from 1.90-12.60 cm (mean = 8.66 cm ± 0.07) in males and from 4.00- 11.9 cm (mean = 8.37 cm ± 0.10) in females. The length-weight relationship of males, females and combined sexes of *A. gabonensis* from Niger River, Jebba from January to December 2016 as seen in Table 3, Figures 2, 3 and 4 showed strong correlation and negative intercept in all the groups. The "b" values showed negative allometric growth in males, females and combined sexes. The males had the highest "b" value (2.064), followed by combined sexes (2.020) and then females with the lowest "b" value of 1.9177.Table 4 shows the monthly condition factor of combined sexes, male and female of *A. gabonensis* from Niger River, Jebba from January to December 2016. The highest condition factor (K) value was recorded in December (3.84 ± 0.36) and the lowest in May (2.63 ± 0.08) with p- value of 0.001. Female had a slightly higher condition factor (K) of 3.09 ± 0.07 while male had 3.08 ± 0.08 and did not differ significantly ($p<0.05$).

Table 1: Monthly morphometric features and sex ratio of *Atya gabonensis* as recorded at River Niger at Jebba from January to December, 2016.

Months	Weight (g)			Total length (cm)			Total No.	Female	Male	*Sex ratio* (F:M)
	Min	Max	Mean±S.E	Min	Max	Mean±S.E				
January	4.70	48.01	20.59 ± 0.81^{a}	4.70	11.90	8.83 ± 0.16^{ab}	150	34	116	1 : 3.41
February	2.03	48.01	18.18 ± 0.81^{bc}	3.80	12.00	8.53 ± 0.16^{cd}	154	35	119	1 : 3.40
March	2.36	44.10	16.80 ± 0.79^{c}	4.10	12.50	8.35 ± 0.16^{cd}	149	54	95	1 : 1.76
April	4.16	48.01	19.07 ± 0.77^{ab}	4.80	11.90	8.68 ± 0.16^{bc}	150	27	123	1 : 4.56
May	4.68	48.06	19.93 ± 0.80^{ab}	4.80	12.30	9.05 ± 0.15^{a}	144	42	102	1 : 2.43
June	4.97	48.01	19.81 ± 0.92^{ab}	4.80	12.60	8.69 ± 0.18^{bc}	328	96	232	1 : 2.42
November	4.09	48.01	19.23 ± 0.85^{ab}	4.00	11.90	8.29 ± 0.18^{cd}	145	61	84	1 : 1.38
December	3.67	41.39	18.35 ± 0.76^{bc}	1.90	11.70	8.16 ± 0.17^{d}	150	40	110	1 : 2.75
TOTAL			P-value = 0.033			P-value =0.002	1370	389	981	1 : 2.52

Mean in the same column with different superscript differ significantly (P<0.05)

Table 2: Morphometric features of female and male *A. gabonensis* as recorded at River Niger at Jebba from January to December, 2016.

Sex	Weight (g)			Total length (cm)		
	Min	Max	Mean±S.E	Min	Max	Mean±S.E
Males	2.03	48.06	19.62 ± 0.36	1.90	12.60	8.66 ± 0.07
females	2.36	44.39	17.64 ± 0.46	4.00	11.90	8.37 ± 0.10
p - values	-	-	0.001	-	-	0.021

Table 3: Total length – weight relationship of *A. gabonensis* collected from River Niger at Jebba from January to December 2016

sexes	N	a	b	r^2
Male	400	-0.685	2.064	0.781
Female	178	-0560	1.918	0.770
Combined sexes	578	-0.647	2.020	0.778

N: sample size; a: intercept; b: slope; r: Coefficient of correlation; r^2: Coefficient of determination; K: condition factor; P < 0.00

Table 4: Monthly condition factor of combined sexes of *Atya gabonensis* from River Niger, Jebba from January to December 2016.

Month	k	N	p-value
Jan	3.05 ± 0.11^{b}	150	0.001
Feb	2.88 ± 0.10^{b}	154	0.001
Mar	2.85 ± 0.11^{b}	149	0.001
Apr	2.94 ± 0.11^{b}	150	0.001
May	2.63 ± 0.08^{b}	144	0.001
Jun	2.99 ± 0.11^{b}	328	0.001
Nov	3.52 ± 0.13^{a}	145	0.001
Dec	3.84 ± 0.36^{a}	150	0.001
Male	3.08 ± 0.08	981	0.912
Female	3.09 ± 0.07	389	0.912

Mean in the same column with different superscript differ significantly ($P<0.05$) Key: K= condition factor; N = Sample number Note: Due to flood and the nature of fishing activities in the sampling area, sample collection was not possible during the peak rainy season (July to October).

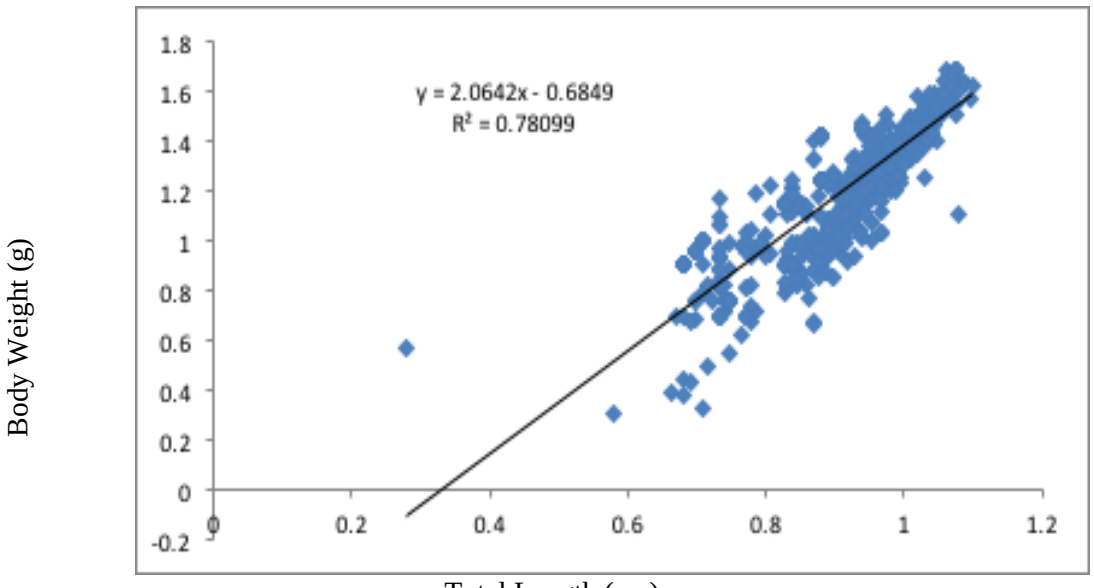

Fig 2: Plot of Length–weight relationship of *A. gabonensis* males collected from Niger River, Jebba, Nigeria from January to December 2016

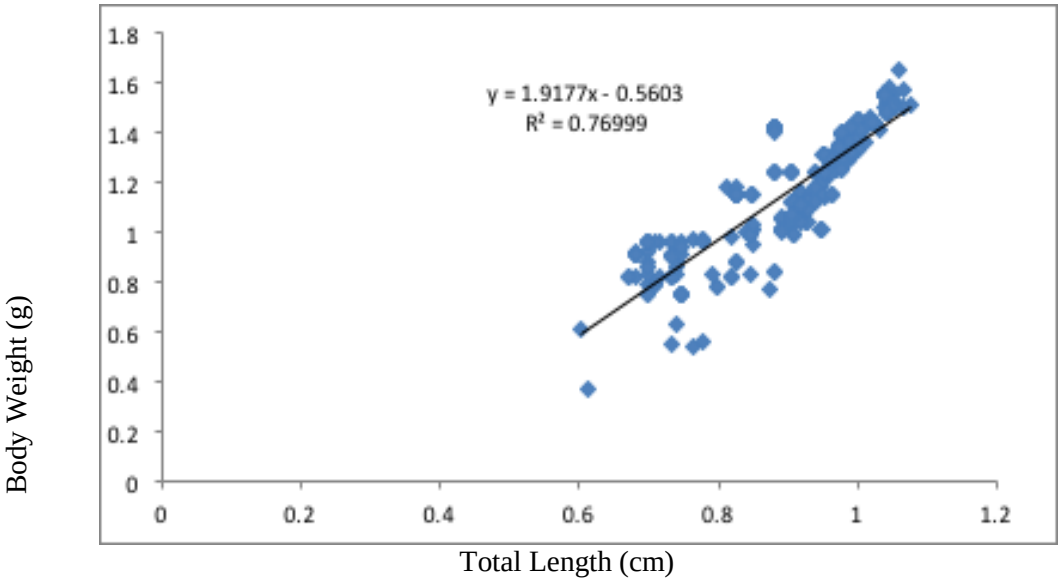

Fig 3: Plot of Length–weight relationship of *A. gabonensis* females collected from Niger River, Jebba, Nigeria from January to December 2016

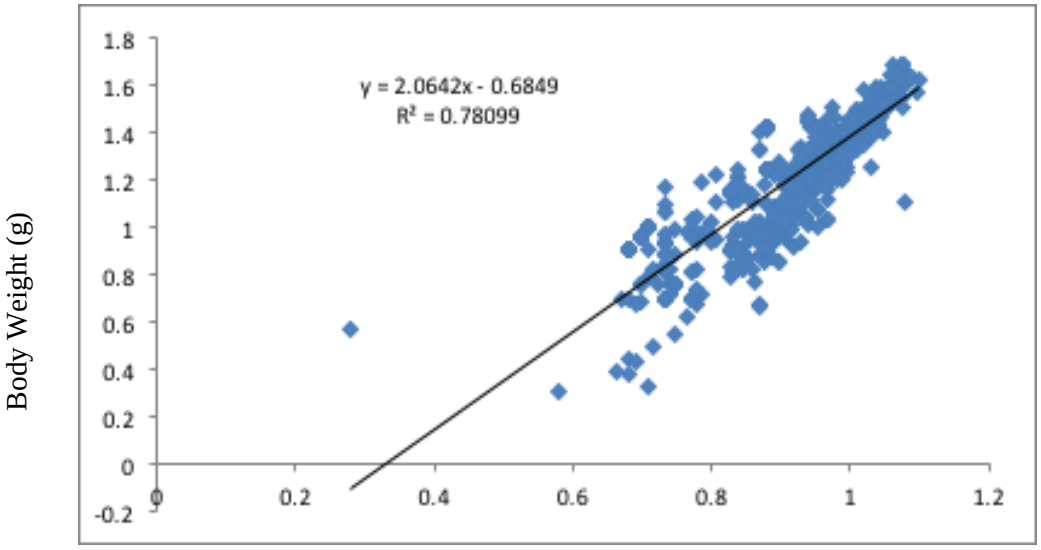

Fig 4: Plot of Length–weight relationship of combined sexes of *A. gabonensis* collected from Niger River, Jebba, Nigeria from January to December 2016

DISCUSSION

In this study, the smallest male of *A. gabonensis* was 1.90 cm and the biggest measured 12.60 cm. The smallest female was 4 cm and the biggest was 11.9 cm. The sizes recorded in this study differ from the findings of Konan *et al.*,(2015) who reported the size range of 7.3 to 8.1 cm in female and 12.9 to 13.8 cm in male *A. gabonensis* in Bandama River, Côte d'Ivoire; and Okayi *et al.* (2010) who reported the size range of 5-12.2 cm for the same species in Lower River Benue.

However, the results of this study agree with the report of Konan *et al.* (2015) as regards the superiority in size of male over female. This difference in size between the sexes was also observed in *Atya scabra* (Cubillas *et al*. 1989). The results of the length-weight relationship revealed negative allometric growth for males, females and combined sexes, but higher "b" value was observed in males than in females. The b values of negative allometric growth suggests that prawns had more weight increment in relation to length increment (Gopalakrishnan *et al.* 2014; Sun *et al*. 2015). According to Froese (2006), several factors could affect relationship between length and weight. These include habitat, seasonal effects, degree of stomach fullness, gonad maturity, sex, health, preservation techniques, differences in the observed length of specimens and ontogeny aspect. The result of this findings also differs from the report of Okayi *et al*. (2004) on isometric growth for *A. gabonensis* with "b" value of 2.989 in River Mu. This difference could be the result of availability of food and sufficient space to support the biomass (Araneda, 2008). Present study shows that condition factor was higher in all seasons, than those reported by Okayi *et al.* (2004) for *Atya gabonensis* (k = 1.014) in Mu River. The difference could be due to difference in habitats prospected, selective capture by local people for human consumption (Martínez-Mayén *et al.* 2000). The values obtained from the study of length weight relationship for both sexes showed a higher value of condition factor in January, November and December, which are within the dry season. This is an indication that *A. gabonensis* performs better in water with less turbidity. This is similar to the observations of Obande (2006); Obande and Kusemuji (2006); Solomon et al. (1999); Jimoh *et al*. (2012) and Udoinyang *et al*. (2016) that *A. gabonensis* prefers clear waters. The months with no catch in which no specimens were collected (July to October) coincided with periods of heavy rains when the water turbidity was high due to run off from adjoining tributaries. Strong correlation between length and weight, and good condition factor indicates that River Niger in Jebba as a good environment provides suitable habitat for growth of *A. gabonensis.* The difference between the values of the condition factor of males and females might be further related to the increased capacity of females in storing energy/fat to use it during gonadal maturation, as well as the larger size and weight of the ovaries in comparison with testis (Lira *et al.* 2012). There was strong correlation in prawns total length, weight and condition factor throughout the months of study. This coincides with the result of Amani *et al*., 2015 who worked on the length weight relationship and condition factor of a marine shrimp (*Parapenaeopsis sculptilis*). This study provides basic information on *A. gabonensis* in River Niger at Jebba. Further research is needed to elucidate aspects of its reproductive biology so as to ascertain its candidacy for aquaculture. The exploitation and subsequent culture of this stock from this river would help towards reducing over dependence on fin fishes. It will also enhance the nutritional intake and income of the local fishermen and the community. It is recommended that fisheries management authority should give fishermen orientation and encouragement to develop strategies that could be used to harvest this prawns in high quantity for consumption.

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