LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF *Atya gbonensis* AND *Macrobrachium felicinium* FROM RIVER BENUE AND RIVER NIGER, NIGERIA

[*1]AKISANI, C.A., [2] ANNUNE, P.A. and [3] SOLOMON, S.G.
Department of Fisheries and Aquaculture, Federal University of Agriculture, P.M.B 2373, Makurdi, Nigeria.
[*]Corresponding Author:akisanichristy@gmail.com +2347036564806

ABSTRACT

Length-weight parameters (a and b) of the equation: $W = aL^b$ *were determined for Atya gabonensis and Macrobrachium felicinium caught fortnightly from August 2016 to May 2018 using baskets, fishing net and handpicking in River Benue (Makurdi) and River Niger (Lokoja). Length measurements were made with a plastic ruler while the weight of each specimen was taken using a digital weighing balance. The mean b values were 2.74 and 3.03 for A. gabonensis from Lokoja and Makurdi respectively, showing that A. gabonensis from Makurdi has an isometric growth and A. gabonensis from Lokoja has a negative allometric growth. A. gabonensis from Makurdiwere in better condition than A. gabonensis from Lokoja. The mean b values for M. felicinium from Lokoja and Makurdi were 0.07 and 0.61respectively, showing negative allometric growth for M. felicinium from both Lokoja and Makurdi. M. felicinium from Makurdi were in better condition than M. felicinium from Lokoja. The mean b values for A. gabonensis and M. felicinium were 2.76 and 0.08 respectively, showing that A. gabonensis has a negative allometric growth and M. felicinium negative allometric growth. M.felicinium were in better condition than A. gabonensis*.

Keywords: Freshwater, Prawn, Size distribution, Allometric growth, Isometric growth

INTRODUCTION

Shrimps constitute a large group of crustaceans varying in size from few millimeters to about 35 cm long. They are valued food organisms that are heavily exploited in West Africa, it is an important export commodity (Chemonics International Inc, 2002; Enin, 1998).

Freshwater prawns constitute a group of economically important macroinvertebrate fauna. They support tremendous artisanal and capture prawn fisheries activities both in the coastal and inland water bodies in Nigeria and other tropical and subtropical countries (Abowei *et al*., 2006; Abohweyere 2008; Abohweyere *et al.,* 2008).

Species of the freshwater prawn's genus *Macrobrachium*are distributed throughout the tropical and subtropical zones of the world. They are found in most inland freshwater areas like lakes, rivers, swamps, irrigation channels, canals and ponds as well as estuarine areas. Most species required brackish water in the initial stages of their life cycle although some complete their cycle in inland, saline and freshwater lakes (Banerjee, 2003).

The Atya gabonensis (Atyidae) is one of the freshwater prawns common in West Africa and was first reported in Gabon (Powell, 1982). The species is known to inhabit freshwater and streams of rocky or non-rocky bottom type from Senegal to Gabon. Atya gabonensis is widely distributed in tropical freshwaters where they support commercial or artisanal fisheries.

In fisheries research, length-weight relationships are important for the estimation of weight where only length data are available and as an index of the condition of the fish (Pauly, 1993 and Goncalves *et al*., 1997). King (1996a) noted that only a few estimates of species length-weight relationship parameters are available for Nigerian fishes. Of the 149 species of fish in Nigeria's inland and coastal waters compiled by King (1996a, 1996b) from various studies, none of the publications contained information on the length-weight relationship of shell-fishes (shrimps) from the inland waters. Shrimps are valued food organisms that are heavily exploited. Freshwater shrimp constitute one of the most desirable candidates for freshwater aquaculture in different parts of the indo-pacific region. Knowledge of the biology of these species is important, since they are highly demanded. The most common prawn species found in Nigerian rivers are the *Macrobrachim* species (Holthius, 1980); freshwater prawns abound in Benue river system. In River Mu, Fiidi and Makurdi, Okayi and Iorkyaa (2004) reported the biology of *A. gabonensis* and *Macrobrachium felicinum*

The objective of the study is to determine the size distribution, length-weight relationship and relative conditions of *A. gabonensis* and *M. felicinium* from River Benue (Makurdi) and River Niger (Lokoja).

MATERIALS AND METHODS

Two thousand seven hundred and sixty-five (2765) *A. gabonensis* and four hundred and seventy-four (474) *M. felicinium* were caught from two sampling locations, River Benue (Makurdi) and River Niger (Lokoja) between August 2016 and May 2018.*A gabonensis* were gotten by scooping them from under the rocks in the water using baskets or handpicked, while *M. felicinium* were gotten by catching in a fishing net. Total length (cm) and body weight (g) were taken using a plastic ruler and a digital weighing balance respectively (king, 1996b). For each species, the parameter a (proportionality constant) and b (exponent) of the LWR of the equation were estimated using base 10 logarithm transformation of L - W data pairs and ordinary least - square linear regression (i.e. log transformed versions of $W = aL^b$) as $LogW = Loga + bLogL$. The condition factor was calculated using Fulton's condition factor, $K = 100W / L^3$ (Carlender, 1969), were L = length (cm), W = weight (g) and 3 derived from exponential b of $W = aL^b$.

RESULTS

The mean length of female *A. gabonensis* from Lokoja was8.47 ± 0.06 and the weight mean value was 14.39 ± 0.28^b (Table 1). The mean value for the length of male A. *gabonensis* was 8.50 ± 0.13 while the weight mean value was 15.64 ± 0.30^a (Table 1). The slope values (b) for female and male were2.55 and 2.30 respectively indicating negative allometric growth. The male had higher condition factor (k) indicating a better condition than the female.

The mean length of female A. *gabonensis* from Makurdi was6.58 ± 0.05^{b}and the weight means value was7.47 ± 0.22^b (Table 2). The mean value for length and weight of male A. *gabonensis* were8.58 ± 0.23^{a}and 15.59 ± 0.38^a respectively. However, the slope values (b) for female and male were2.94 and 1.98 indicating isometric growth for the female and negative allometric growth for the male. Values of the condition factor (k) for the species show that male had higher condition factor and was therefore in better condition than the female.

The mean length and weight value of *A. gabonensis* from Makurdiwere7.48 ± 0.05^{b}and 12.08 ± 0.26^b respectively. The mean length and weight value of A. *gabonensis* from Lokoja were8.44 ± 0.07^{a}and 15.13 ± 0.21^a respectively (Table 3). The slope values (b) of *A. gabonensis* from Makurdi and Lokoja were 3.03 and 2.74 respectively indicating isometric growth for *A. gabonensis* from Makurdi and negative allometric growth for *A. gabonensis* from Lokoja. *A. gabonensis* from Makurdi had higher condition factor indicating a better condition than *A. gabonensis* from Lokoja (Table 3).

The mean length and weight value of female *M. felicinum* from Lokoja were5.27 ± 0.09^b and 2.91 ± 0.12^a respectively (Table 4). The mean length and weight of male *M. felicinum* were 5.62 ± 0.06^a and 2.35 ± 0.11^b respectively. The slope values (b) for female and male were 1.19 and 1.54 respectively indicating negative allometric growth for both. However, the condition factor (k) for the species revealed that female had higher condition factor and was therefore in better condition than the male (Table 4).

The mean length and weight value of female *M. felicinuim* from Makurdi were 5.35 ± 0.07^{b}and2.84 ± 0.08 respectively. The mean length and weight value of male *M. felicinum* were4.98 ± 0.08^a and2.74 ± 0.11 respectively (Table 5). The slope values (b) for female and male were 0.07 and 0.75 respectively indicating negative allometric growth for both. However, the condition factor (k) for the species show that male had higher condition factor and were therefore in better condition than the female (Table 5).

The mean length and weight value of *M. felicinuim* from Makurdi were 5.1 7 ± 0.05^{b}and 2.79 ± 0.09 respectively (Table 6). The mean length and weight value of *M. felicinum* from Lokoja were5.45 ± 0.05^{a}and 2.63 ± 0.08 respectively. The slope (b) for *M. felicinum* from Makurdi and Lokoja were 0.61 and 0.07 respectively indicating negative allometric growth for both. However, the condition factor (k) shows that *M. felicinum* from Makurdi had higher condition factor and were therefore in better condition than *M. felicinum* from Lokoja (Table 6).

The mean length and weight value of A. *gabonensis* were 7.95 ± 0.04^a and 13.57 ± 0.17^a respectively (Table 7). The mean length and weight value of M. felicinium were5.25 ± 0.04^b and2.71 ± 0.05^b respectively. The slope values (b) for *A. gabonensis* and *M. felicinum* were 2.76 and 0.08 respectively, indicating negative allometric growth for both. However, the condition factor (k) for the species show that *M. felicinium* had higher condition factor and were therefore in better condition than *A. gabonensis* (Table 7).

Table 1: Mean (±SE) length-weight relationship and condition factor of the different sexes of *Atya gabonensis* from Lokoja.

Parameter	Female	Male	P- Value
TL (cm)	8.47 ± 0.06	8.50 ± 0.13	0.832
W (g)	14.39 ± 0.28^b	15.64 ± 0.30^a	0.004
K	2.26 ± 0.02^b	2.43 ± 0.02^a	0.001
a	-1.24	-0.99	-
B	2.55	2.30	-
r^2	0.92	0.76	-
N	549	806	-

Mean in the same row with different superscript differ significantly (P<0.05)
Key:TL = Total length; W = Weight; a = Intersect; b = Slope; r^2 = Regression coefficient probability; N = Sample number

Table 2: Mean (±SE) length-weight relationship and condition factor of the different sexes of *Atyagabonensis* from Makurdi.

Parameter	Female	Male	P- Value
TL (cm)	6.58 ± 0.05^b	8.58 ± 0.23^a	0.001
W (g)	7.47 ± 0.22^b	15.59 ± 0.38^a	0.001
K	2.36 ± 0.04^b	2.50 ± 0.02^a	0.001
a	-1.59	-0.70	-
B	2.94	1.98	-
r^2	0.89	0.65	-
N	610	800	-

Mean in the same row with different superscript differ significantly (P<0.05)
Key: TL = Total length; W = Weight; a = Intersect; b = Slope; r^2 = Regression coefficient probability; N = Sample number.

Table 3: Mean (±SE) length-weight relationship and condition factor of *Atya gabonensis* from Lokoja and Makurdi

Parameter	Lokoja	Makurdi	P- Value
TL (cm)	8.44 ± 0.07^a	7.48 ± 0.05^b	0.001
W (g)	15.13 ± 0.21^a	12.08 ± 0.26^b	0.001
K	2.41 ± 0.03	2.43 ± 0.01	0.497
a	-1.39	-1.65	-
B	2.74	3.03	-
r^2	0.93	0.94	-
N	1355	1410	-

Mean in the same row with different superscript differ significantly (P<0.05)
Key: SL = Total length; W = Weight; a = Intersect; b = Slope; r^2 = Regression coefficient probability; N = Sample number

Table 4: Mean (±SE) length-weight relationship and condition factor of the different sexes of *Macrobrachium felicium* from Lokoja.

Parameter	Female	Male	P- Value
TL (cm)	5.27 ± 0.09^b	5.62 ± 0.06^a	0.001
W (g)	2.91 ± 0.12^a	2.35 ± 0.11^b	0.001
K	2.20 ± 0.14^a	1.64 ± 0.15^b	0.005
a	-0.44	-1.65	-
B	1.19	1.54	-
r^2	0.15	0.14	-
N	112	115	-

Mean in the same row with different superscript differ significantly (P<0.05)
Key: SL = Standard length; W = Weight; a = Intersect; b = Slope; r^2 = Regression coefficient probability; N = Sample number

Table 5: Mean (±SE) length-weight relationship and condition factor of the different sexes of *Macrobrachium felicium* from Makurdi

Parameter	Female	Male	P- Value
TL (cm)	5.35 ± 0.07^{b}	4.98 ± 0.08^{a}	0.001
W (g)	2.84 ± 0.08	2.74 ± 0.11	0.497
K	2.11 ± 0.12^{b}	2.59 ± 0.17^{a}	0.018
a	0.37	-0.13	-
B	0.07	0.75	-
r^2	0.009	0.06	-
N	121	126	-

Mean in the same row with different superscript differ significantly (P<0.05)
Key: TL = Total length; W = Weight; a = Intersect; b = Slope; r^2 = Regression coefficient probability; N = Sample number.

Table 6: Length-weight relationship and condition factor of *Macrobrachium felicium* from Lokoja and Makurdi. Numbers in each cell are either means ± standard error or values of linear regression analysis.

Parameter	Lokoja	Makurdi	P- Value
TL (cm)	5.45 ± 0.05^{a}	5.17 ± 0.05^{b}	0.001
W (g)	2.63 ± 0.08	2.79 ± 0.09	0.133
K	1.92 ± 0.10^{b}	2.31 ± 0.09^{a}	0.005
a	0.31	-0.02	-
B	0.07	0.61	-
r^2	0.004	0.05	-
N	227	247	-

Mean in the same row with different superscript differ significantly (P<0.05)
Key: TL = Total length; W = Weight; a = Intersect; b = Slope; r^2 = Regression coefficient probability; N = Sample number.

Table 7: Mean (±SE) length-weight relationship and condition factor of *Atyagabonensis* and *Macrobrachium felicium*

Parameter	Atya	Macrobrachium	P- Value
TL (cm)	7.95 ± 0.04^{a}	5.25 ± 0.04^{b}	0.001
W (g)	13.57 ± 0.17^{a}	2.71 ± 0.05^{b}	0.001
K	2.42 ± 0.01^{b}	2.75 ± 0.25^{a}	0.004
a	-1.41	0.33	-
B	2.76	0.08	-
r^2	0.89	0.001	-
N	2765	474	-

Mean in the same row with different superscript differ significantly (P<0.05)
Key: TL = Total length; W = Weight; a = Intersect; b = Slope; r^2 = Regression coefficient probability; N = Sample number.

DISCUSSION

The negative allometric growth observed for *M. felicinum* in Makurdi and Lokaja agrees with the negative allometric growth observed by Akintola *et al*., (2010) in the Badagry Creek, Lagos, but differs from the isometric growth reported by Okayi and Ioryaa (2004), in the Mu River, Makurdi and also differs from the positive allometric growth observed by Kingdom *et al.,* (2014) in the Lower Taylor Creek, Niger Delta.

The condition factors of *M. felicinum* from Lokoja and Makurdi in this study are not in agreement with the report of Okayi and Ioryaa (2014) where they reported a condition factor of2.031for *M. felicinum* in Mu River, Makurdi. The Length-Weight shows that *M. felicinum* from both Makurdi and Lokoja get slimmer as it grows.*M. felicinum* from Makurdi were in better condition than *M. felicinum* from Lokoja.

Furthermore, the negative allometric growth observed for *A. gabonens is* from Lokoja in this present study is not in agreement with the isometric growth reported by Ikpi *et al.* (2013) and Serpil *et al*., (2009).

The condition factor of *A.gabonensis from* Lokoja and Makurdi were lower than 2.90 and 3.71

reported by Ikpi *et al*., (2013) for dry and rainy season respectively for the same species.

The Length-Weight shows that *A.gabonensis* from Makurdi do not change shape as it grows, while *A. gabonensis* from Lokoja get slimmer as it grows. *A.gabonensis* from Makurdi were in better condition than *A.gabonensis* from Lokoja.

The negative allometric growth observed for *M. felicinum* here agrees with the negative allometric growth observed by Akintola *et al*., (2010) in the Badagry Creek, Lagos, but differs from the positive allometric growth observed by Kingdom *et al.,* (2014) in the Lower Taylor Creek, Niger Delta. Also, the negative allometric growth observed for *A.gabonensis* in this study differs with the isometric growth observed by Okayi and Ioryaa (2004) in the Mu River, Makurdi.

The condition factor of *M. felicinum*in this study was higher than 2.031 reported for the same species in Mu River, Makurdi (Okayi and Ioryaa., 2004). Also, the condition factor of *A.gabonensis*here was also higher than 1.014 reported for the same species in Mu River, Makurdi (Okayi and Ioryaa, 2004).

The Length-Weight shows that *A.gabonensis* does not change shape as it grows, while *M. felicinum* gets slimmer as it grows. *M. felicinum* were in better condition than *A.gabonensis.*

Length-weight relationship values with positive allometry include 3.411 and 3.249 for *Acetesindicus,* and *A. intermedius* while isometric value was for *A. indicus* from the coastal waters of Malacca Peninsular in Malaysia as reported by Nurul *et al.,* (2009). Values of 'b' with negative allometry were reported by Chu *et al* (1995). These include 2.84 and 2.89 for two penaeid shrimps *Metapenaeusensis* and *M. joyneri*. Araneda., *et al* (2008) also reported high values which were isometric 3.07 at 90 shrimps m^{-2}, 2.99 at 130 shrimps m^{-2} and 2.97 at 180 shrimps m^{-2}.

This suggests crowding and competition for food as factors that inhibit growth and therefore affecting the value of 'b' in the length-weight relationship of any species.

CONCLUSION

The two species that were studied in the two sampling sites shows negative allometric growth. *M. felicinum* were in better condition than *A. gabonensis*

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