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Research Article

Condition Factor and Length-Weight Relationship of Berried African River Prawn (*Macrobrachium vollenhovenii)* in Asejire Reservoir, Nigeria

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ABSTRACT

The condition factor and length-weight relationship of 209 berried *Macrobrachium vollenhovenii* from Asejire Reservoir was examined for a period of six months. Regression analysis was used to determine the length-weight relationship while the data were also subjected to Descriptive analysis, Standard deviations and frequency distribution to evaluate means. The relationship among parameters was determined by correlation. The mean total length was 13.45±1.41 cm while the mean total weight was 76.25±9.63 g. The mean length and mean weight of cephalothorax were 6.98±1.13 cm and 21.05±3.49 g respectively. The total weight had strong and positive correlation with weight of walking leg (0.93); Body weight (0.94) and length of walking leg (0.95). The condition factor which measures the general well-being of fish ranged from 2.79 to 3.33 (mean = 3.14) while the regression coefficient (*b*) of weight and length ranged from 1.98 to 2.33. The study revealed that berried *M. vollenhovenii* exhibited negative allometric growth while their condition factor showed that prawns from Asejire reservoir were healthy even in their reproductive stages. This showed that the study area is conducive for the development and sustenance of *M. vollenhovenii* despite the various human activities in the reservoir and its seed could be used for aquaculture industry.

Keywords: Asejire Reservoir, Condition factor, Length-Weight relationship, *Macrobrachium vollenhovenii*, Prawn
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INTRODUCTION

The freshwater prawns of the genus *Macrobrachium* consist of over two hundred species that are distributed throughout the world, especially in the tropical and subtropical regions (Jimoh *et al*., 2011). *M. vollenhovenii* and *M. macrobrachion* are particularly of high economic importance in the diversification of both aquaculture and artisanal fisheries in the West African region (Bello-Olusoji, (2004). Asejire Reservoir in Oyo State, Nigeria, is prominent in abundant freshwater prawns and different tilapia species. *M. vollenhovenii* among other species contribute to the fisheries of the reservoir that the species integrity and survival is threatened due to environmental degradation (Omobepade & Ajibare, 2015).

Macrobrachium vollenhovenii which is found in both brackish and fresh waters of West Africa is a suitable choice for aquaculture in Nigeria due to its large size (Bello-Olusoji, 2004). However, its post-larvae and broodstocks are usually obtained from the wild due to the constraints of getting hatchery-raised prawns (Anetekhai *et al*., 2007). Since, morphometric parameters such as length and weight are generally used as criteria for selecting broodstocks. It is therefore essential to ascertain the well-being of the broodstocks and post-larvae before being raised for consumption. Hence, knowledge about their growth pattern and state of health is important.

Moreover, some aspects of biology including morphological traits of *Macrobrachium* species have been documented in recent studies in Southwest and the Niger Delta, Nigeria (Deekae & Abowei, 2010; Jimoh *et al*., 2012; Lawal-Are & Owolabi, 2012; Olawusi-Peters *et al.*, 2014). Incidentally, most studies on length-weight relationship and condition factor are not on berried species. Also, Lameed & Obadara

(2006) and Aladesanmi *et al*. (2013) reported that Asejire reservoir has high levels of contaminants because of effluents from various industries as well as breakdown of ecological balance as a result of widespread destruction of flora and fauna diversities. Despite all this, the reservoir still supports aquatic lives which serve the populace.

Growth of fish is usually reflected through increase in length and weight (Bolarinwa & Popoola, 2013). Length-weight relationship being an important fishery management tool is important in assessing the average weight of fish at given length group (Olawusi-Peters *et al.,* 2014) and in estimating the relative well-being of a fish population (Ajibare *et al.,* 2017). The study of Length-weight relationship which has its applied value in fish biology is widely used in stock assessment models and estimations of biomass from length observations (Paiboon & Kriangsak, 2015).

Fulton (1902) as reported by Paiboon and Kriangsak, (2015) proposed the use of $K = 100W/L^3$ for estimating the conditions of fish which is referred to as 'Condition Factor'. Condition factor quantifies the health of individual fish in a population or determines if a fish population is healthy compared to other populations (Abowei & George, 2009; Paiboon & Kriangsak, 2015). Condition factor can be used as an index of growth and feeding intensity (Fagade, 1979; Abowei *et al.*, 2009, George *et al.*, 2013, Omobepade & Ajibare, 2015). It was also linked with reproductive cycle of fishes (Fawole & Arawomo, 1998; Abowei, 2009; 2010, Omobepade & Ajibare, 2015) and as indicator of environmental quality (Ajibare *et al.,* 2017).

Thus, there is need to assess the condition factor and length-weight relationship in order to obtain reliable information on the growth pattern and state of well-being of berried *M. vollenhovenii* in Asejire reservoir, Oyo State Nigeria for sustainable harvest of the species. The results will also serve as documentation for this species until any further change is observed. Furthermore, the findings would contribute to habitat protection and species conservation programme.

MATERIALS AND METHODS

Study Area

Asejire Reservoir (Lat: 7°21'N Long: 4°7'E) is in Egbeda Local Government Area of Oyo State, Southwestern Nigeria. The reservoir was constructed on River Osun in 1972 with catchment area of 7,800 km^2 above the dam while the impounded area is 2,342 ha (Aladesanmi *et al.,* 2013).

Collection and Preservation of Prawns

A total of 209 individuals of berried *M. vollenhovenii* were collected from March to August 2014 from the catches landed by artisanal fishermen at Asejire Reservoir, Oyo State, Nigeria. The fishermen used two sets of traditional basket traps to catch the prawns. The traps (which were made from canes) measured 31–62 cm in length with a mouth opening of 3 – 4 cm in diameter and rectangular mesh sizes of about 3 by 0.5 cm (Kibria & Ahmed, 2005). The samples were transported in ice to the Fisheries and Aquaculture research laboratory of the Federal University of Oye-Ekiti, Nigeria.

Identification of Prawns

The prawns were identified according to Holthius (1980) and Powell (1980; 1982) as reported by Jimoh *et al.* (2012). The sex of each *M. vollenhovenii* was determined visually based on morphological features (Deekae & Abowei, 2010). All prawns were sexed by gonad observation under microscope (Model 5033000 L x 200) to identify the berried females for this study.

Determination of Length and Weight

Total length (tip of the rostrum to the extremity of the telson), rostral length (from the tip of rostrum to the posterior margin of the orbit), carapace length (from the posterior margin of the carapace to the extremity of the telson), and body length (from the posterior margin of the orbit to the extremity of telson) were determined on graduated measuring board to the nearest 0.01 cm. Also, the corresponding weights i.e. total weight (weight of the entire prawn), body weight (weight of the prawn excluding appendages), rostral weight (weight of rostrum), carapace weight (weight of carapace) and weight of walking legs (WWL) were measured (after excess water had been removed from the prawns) to the nearest 0.01g with OHAUS digital balance (Model CP4-13). The length and weight data were subjected to Descriptive analysis, Standard deviations and frequency distribution to evaluate means while correlation was used to determine the relationship among parameters (p = 0.05) using SPSS 20.0.

Determination of Length-Weight Relationship and Condition Factor

The length-weight relationship of the prawns was expressed by the equation:

$$W = aL^b \quad \text{……...……} \text{ (Pauly, 1983)}$$

Where W = Weight (g); a = Constant (intercept); L = Length (cm); b = Length exponent (slope)

The value of a and b was obtained from a linear regression of the logarithm of length and weight of prawns according to the following formula:

$$logW = \log a + blog\ L \quad \text{...…} \text{ (Le Cren, 1951).}$$

Also, the condition factor (K) was calculated as:

$$K = \frac{100\mathrm{W}}{\mathrm{L}^3} \quad \text{……} \text{ (Ricker, 1975)}$$

Where W = Weight of prawns (g) and L = Length of prawns (cm)

RESULTS

Morphometric Data

The morphometric data of berried *M. vollenhovenii* collected in Asejire reservoir, Oyo State, Nigeria as presented in Table 1 showed that total weight (TW) of examined prawn ranged between 74.96±9.23 g and 77.86±9.70 g with an average of 76.25±9.63g. Average total length (TL) and body length (BL) was 13.45±1.41 cm and 6.66±0.94 cm respectively while the mean rostral weight (RW) and length (RL) was 0.06±0.02 g and 1.39±0.33 cm respectively. Carapace weight (CW) ranged between 19.35±2.74 g and 21.73±3.80 g with mean of 21.05±3.49 g. Also, weight of walking legs (WWL) ranged between 0.27±0.44 g and 0.32±0.16 g while the average length of walking leg (LWL) was 6.06±0.02 cm. The results of the correlation analysis of morphometric parameters of berried *M. vollenhovenii* in Asejire reservoir, Nigeria is presented in Table 2. The Table showed that TW had positive and strong correlation with BW (0.94); WWL (0.93) and LWL (0.95) while weak and negative correlation exists between CL and BL (-0.03); CL and RW (-0.27); CL and RL (-0.10); CW and RL (-0.11) and WWL and RL (-0.05).

Length and Weight Frequency Distribution

The length frequency distribution (Table 3) revealed that the length range of 14.0-14.9cm had the highest percentage frequency (39.23%, K=2.71, *b*=3.37) and was followed by the 13.0-13.9cm range (33.97%; K=3.05; *b*=3.70) while the weight frequency distribution revealed that 41.15% (K = 2.61; *b* = 2.43) of the prawns fell between 70.00-79.99g while 0.48% (K = 2.16; *b* = 1.21) of the prawns fell in the range of 50.00-59.99 g.

Length-Weight Relationship and Condition Factor

Length-Weight Relationship and Condition Factor of berried *M. vollenhovenii* in Asejire reservoir, Oyo State, Nigeria is presented in Table 4. The overall mean condition factor was 3.14 with the minimum (2.79) and maximum (3.33) recorded in the months of August and April respectively. Also the result of the length-weight relationship revealed that the '*b*' recorded throughout the study was less than 3 (indicating negative allometry). The minimum '*b'* of 1.98 (a = 0.90; R^2 = 0.57) was recorded in July while the max '*b*' of 2.33 (a = 0.77; R^2 = 0.55) was recorded in March.

Table 1: Morphometric characteristics of Berried *Macrobrachion vollenhovenii* in Asejire reservoir, Nigeria

Parameter	March	April	May	June	July	August	Mean±SD
Total Weight (g)	74.96±9.23	75.88±10.64	76.61±9.26	77.86±9.70	76.12±9.89	76.02±9.32	76.25±9.63
Total Length (cm)	13.21±1.44	13.17±1.53	13.31±1.35	13.45±1.33	13.57±1.34	13.97±1.36	13.45±1.41
Body Weight (g)	52.63±7.40	53.20±8.41	53.86±7.42	54.57±7.28	53.06±7.93	53.36±7.33	53.45±7.59
Body Length (cm)	6.65±0.84	6.58±0.81	5.59±0.66	6.80±0.84	7.06±0.80	7.26±0.74	6.66±0.94
Carapace Length (cm)	6.77±1.07	6.74±1.13	7.92±1.06	6.84±1.02	6.74±1.01	6.90±1.07	6.98±1.13
Carapace Weight (g)	19.35±2.74	21.15±3.74	21.25±3.18	21.73±3.80	21.54±3.58	21.15±2.44	21.05±3.49
Weight of Walking Legs (g)	0.27±0.14	0.30±0.16	0.28±0.14	0.32±0.16	0.29±0.15	0.28±0.14	0.29±0.15
Length of Walking Legs (cm)	5.97±0.61	6.09±0.69	6.00±0.60	6.18±0.65	6.06±0.65	6.03±0.61	6.06±0.63
Rostral Weight (g)	0.06±0.02	0.06±0.02	0.06±0.02	0.06±0.02	0.07±0.02	0.06±0.02	0.06±0.02
Rostral Length (cm)	1.40±0.32	1.36±0.32	1.40±0.32	1.38±0.35	1.44±0.35	1.38±0.32	1.39±0.33

Table 2: Correlation matrix of morphometric parameters of Berried *M. vollenhovenii* in Asejire reservoir, Nigeria

Parameter	TW	TL	BW	BL	CL	CW	WWL	LWL	RW	RL
Total Weight (g)	1.00									
Total Length (cm)	0.70*	1.00								
Body Weight (g)	0.94*	0.64*	1.00							
Body Length (cm)	0.54*	0.53*	0.42*	1.00						
Carapace Length (cm)	0.43*	0.80*	0.46*	-0.03	1.00					
Carapace Weight (g)	0.65*	0.50*	0.37*	0.51*	0.17*	1.00				
Weight of Walking Legs (g)	0.93*	0.57*	0.82*	0.56*	0.23*	0.71*	1.00			
Length of Walking Legs (cm)	0.95*	0.70*	0.86*	0.64*	0.36*	0.69*	0.97*	1.00		
Rostral Weight (g)	0.43*	0.02	0.39*	0.60*	-0.27*	0.29*	0.50*	0.49*	1.00	
Rostral Length (cm)	0.01	0.00	0.06	0.47*	-0.10	-0.11	-0.05	0.07	0.70*	1.00

* Significantly correlated (p<0.05)

Table 3: Frequency distribution of length and weight of Berried *Macrobrachium vollenhovenii* in Asejire reservoir, Nigeria

Parameter	Range	n	Frequency (%)	K	*a*	*b*	R^2	Min	Max	Mean
	9.0 -10.9cm	27	12.92	5.79	0.57	2.80	0.46	9.70	10.92	10.26±0.37
	11.0-12.9cm	22	10.53	3.46	-0.12	4.50	0.01	12.17	12.97	12.46±0.24
TL	13.0-13.9cm	71	33.97	3.05	3.08	3.70	0.21	13.00	13.97	13.66±0.22
	14.0-14.9cm	82	39.23	2.71	0.38	3.37	0.01	14.00	14.92	14.42±0.25
	15.0-15.9cm	7	3.35	2.37	-2.07	10.05	0.10	15.13	15.72	15.23±0.22
	50.00-59.99g	1	0.48	2.16	1.41	1.21	1.00	56.57	56.57	56.57±0.00
	60.00-69.99g	53	25.36	4.34	0.33	3.36	0.81	60.22	68.33	64.72±2.60
TW	70.00-79.99g	86	41.15	2.61	0.71	2.43	0.68	70.29	79.92	73.93±2.49
	80.00-89.99g	49	23.44	3.22	0.36	3.52	0.19	84.70	88.73	86.72±1.35
	90.00-99.99g	20	9.57	2.93	0.13	4.16	0.18	90.13	92.85	92.18±0.52

Table 4: Length-Weight Relationship and Condition Factor of berried *M. vollenhovenii* in Asejire reservoir, Nigeria

Month	N	*a*	*b*	R^2	K
March	32	0.77	2.33	0.55	3.25
April	38	0.80	2.27	0.52	3.33
May	34	0.82	2.22	0.56	3.25
June	35	0.83	2.19	0.53	3.20
July	36	0.90	1.98	0.57	3.05
August	34	0.82	2.17	0.54	2.79
Overall	209	0.80	2.25	0.52	3.14

DISCUSSION

The average total length observed in this study was within the range (10.0-18.9cm) earlier stated by Holthius (1980), Powell (1980; 1982) and Marioghae (1982). Also, the observed weight (76.25±9.63 g) was higher than the observations of Oyekanmi (2011) and Jimoh *et al*. (2012) who reported a body weight of 66.14 g and 5.65 g for *M. macrobrachion* and female *M. vollenhovenii* in Asejire Lake and Badagry creek, Nigeria respectively. This may be as a result of the reproductive state of the examined prawns. Also, the morphometric data observed in this study were higher than the reports of different authors in different water bodies. Jimoh *et al*. (2012) in a study on female *M. macrobrachion* and *M. vollenhovenii* from Badagry creek, Nigeria observed weight of 5.65 g and 4.22 g; Total length of 7.88 cm and 7.73 cm; carapace length of 1.74 cm and 1.64 cm and rostral length of 1.75 cm and 1.73 cm respectively. Alphonse *et al*. (2013) documented the average weight of *M. macrobrachion* from Mono-River coastal lagoon system in the Republic of Benin as 15.74g with corresponding mean total and rostral lengths of 10.30cm and 4.24cm respectively. These discrepancies may be as a result of the presence or absence of eggs in the prawns as well as differences in the species, season and location.

The strong and significant correlation that exists between the body weight and total weight showed that the eggs present in the abdominal segment (body) of the prawns contribute significantly (p<0.05) to the weight and wellness of the berried prawns. Also, the positive (and strong) relationship between length of walking leg and total weight of examined prawns implied that the longer the walking leg of the prawns, the heavier/healthier the prawns. Moreover, the significant and positive correlation (r = 0.70) that exists between the total length and weight were similar to the observation of Bello-Olusoji (2004) who estimated strong relationship (r = 0.74) between body length and weight in rocky freshwater prawn.

The results of most of the correlation coefficient revealed a high relationship among all the parts of the prawns since the correlation coefficients are close to one. A strong correlation (r = 0.86) was also recorded between the total length and body weight of female *M. dux* by Meye and Arimoro (2005) while positive relationship was reported between the carapace length and weight of *M. macrobrachion* in Luubara creeks, Nigeria by Deekae and Abowei (2010). The high and significant correlation between carapace length and total length in the species indicated that either of the variables is suitable for establishing length-weight relationship for the species.

Also, the existence of *M. vollenhovenii* with differential growth patterns (as shown in the length and weight frequency distribution) in the reservoir means that some of the species in the study area had heterogenous groups with weights varying differently with the cube of total length. Moreover, higher variations observed in the proportionality constant (*a*) than in the exponents (*b*) in all length and weight group of this study agreed with findings of Offem *et al.* (2009) who noted that the values of (*a*) vary with environmental factors, wherein '*b'* (which represents the body form) tends to remain constant during a given life period.

The "*b*" value (2.25) of berried *M. vollenhovenii* in this study was less than three (b < 3) implying that the berried prawn exhibited negative allometric growth during the reproductive stage. This showed that the berried *M. vollenhovenii* in Asejire reservoir did not increase in length as it was increasing in weight probably due to transfer of energy to the gonads, i.e. during the reproductive state of the species, the weight increases faster than the length as a result of the gonad development, hence the opinion of Olawusi-Peters *et al*. (2014) that the development of aquatic organisms involves several stages and each stage has its own Length-Weight Relationship due to environmental conditions, maturity, sex and season was corroborated.

The results obtained in this study showed that the berried prawns were healthy and in good conditions (which means their seeds, larvae and juveniles could be used for aquaculture) compared favourably with the reports of other authors in different study area. Waribugo (2005), Lawal-Are and Owolabi (2012), Alphonse *et al.* (2013) and Olawusi-Peters *et al*. (2014) documented negative allometric growth (b < 3) for *Macrobrachium. macrobrachion* and *Nematopalaemon hastatus* respectively in Mono-River coastal lagoon system in the Republic of Benin and Southwest Nigeria.

Anetekhai (1999), Oyekanmi (2011) and Jimoh *et al.* (2012) however obtained positive allometric (b > 3) for *M. vollenhovenii* in Asejire reservoir while Jimoh *et al*. (2005) recorded positive allometry for *M. vollenhovenii* in Ologe Lagoon, Nigeria. Enin (1994) established an isometric growth pattern in *N. hastatus* and a positive allometric growth pattern in *M. macrobrachion.* The differences in the observations may be as a result of the differences in the reproductive state, species and locality of the prawns as well as sex, age, season and other environmental conditions.

According to Offem *et al.* (2009) the magnitude of the parameters in the length-weight relationship can be used to indicate the condition factor of a population or sub-population of fishes with isometric growth (b = 3), the parameter '*a'* can be interpreted as the condition factor of the fish by multiplying it by 100 (Pauly, 1983), but since the '*b*' observed in this study is not equal to 3, the value of '*a*' cannot be an index of condition factor and cannot be interpreted biologically.

The Condition Factor (3.14) of berried African river prawn estimated in this study is within the values (2.12 - 7.98) recorded by Lawal-Are and Owolabi (2012) for *M. vollenhovenii* and *M. macrobrachion* from two interconnecting lagoons in Lagos state, Nigeria. The condition factor is however higher than the values reported by Meye and Arimoro (2005) for *M. dux* in Odogboro river, Nigeria and Olawusi-Peters *et al*. (2014) for *Nematopalaemon hastatus* and *Parapenaeopsis atlantica* in coastal waters of Ondo State, Nigeria. These discrepancies may be as a result of variations in environmental factors such as feeding activities, food availability, sex difference, change in season as well as gonad maturity level (Abowei, 2009), sampling size, habitat suitability and the length interval within different areas (Lawal-Are & Owolabi, 2012). Furthermore, David *et al*. (2010) pointed out that the value of 'K' of fish can be influenced by stomach fullness, length-weight relationship and decrease in water volume. Olawusi-Peters *et al*. (2014) also reported that stages of maturity, data pulling, sorting into classes, state of the stomach, and sex often affect the well-being of fish. Ajibare *et al.* (2017) argued that condition factor vary with seasons and are influenced by several environmental conditions.

Abowei and George (2009) reported that males showed higher condition factor than females in decapod crustaceans and this was corroborated by Lawal-Are and Kusemiju (2000), and Emmanuel (2008) on *Callinectes amnicola* in Lagos and Badagry Lagoons where they observed that mean condition factor for males were higher than the females indicating that the males were in better condition, and their general well-being was better than the females. The reason for this observation could be due to the fact that females expended a lot of metabolic energy that could have been used for body building, in egg laying and care of young ones.

However, Branco and Masunari (2000) reported higher condition factor for female *Callinectes danae* in Conceicao Lagoon, Santa Catarina, Brazil and attributed it to heavier female gonads. Hence, the result of this study suggested that prawns are heavier (when compared with male or non-berried female) during the berried stage due to transfer of resources to the gonads in the more developed gonad stages and disagree with the opinion of Olawusi-Peters *et al*. (2014) that species in their reproductive period may likely have reduced or low condition factor. This shows that the prawns from the study area are healthy even in their reproductive stages and that Asejire reservoir is conducive for the development and sustenance of *M. vollenhovenii.*

The sizes, condition factor and length-weight relationship of berried *M. vollenhovenii* in this study indicated that the prawns were healthy and exhibited negative allometric growth even in their reproductive stages. This showed that Asejire reservoir in Oyo State, Nigeria is conducive for the development and sustenance of *M. vollenhovenii* despite the various anthropogenic activities observed on the waterbody. Hence, their seeds (larvae and juveniles) could be used for aquaculture purposes.

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