IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402, p- ISSN: 2319-2399.Volume 18, Issue 12 Ser. 1 (December 2024), PP 24-29
www.iosrjournals.org

Length-Weight Relationship And Condition Factor Of West African Fiddler Crab *Uca Tangeri* From Elechi Creek, Niger Delta, Nigeria

Umesi, N.[1*], Ekweozor, I. K. E.[2], Eze, C. L[1]., Essi, D. I.[3] & Iyama, W.[1]
Institute Of Geosciences & Environmental Management, Rivers State University, Port Harcourt, Nigeria.
Department Of Animal & Environmental Biology, Rivers State University, Port Harcourt, Nigeria.
Department Of Statistics, Rivers State University, Port Harcourt, Nigeria.

Abstract
This study assessed the length-weight relationship and condition factor (K) of the fiddler crab Uca tangeri at the Elechi Creek in the upper Bonny Estuary of the Niger Delta, Nigeria. Crab samples were collected from 5 sampling stations were located on a littoral transect spanning approximately 4.56 km stretch from the exposed mudflats at low tide on a bi-monthly basis from January – December, 2023. The mean carapace width, carapace length and weight of the crab ranged from 3.25 – 3.70 cm, 2.70 – 3.05 cm and 18.85 – 25.70 g respectively. The slope weight for the regression equation indicated that longer carapace length predicted larger weight of U. tangeri. The 95% confidence interval for the slope (0.594 - 0.781) was positive throughout the range of the interval. Based on the magnitude of the correlation coefficient (r = 0.767), the study showed that carapace length is moderately related to weight of U. tangeri at the Elechi creek, with 59% (r^2 = 0.588) of the variance of crab body weight accounted for by carapace length. The calculated b value for U. tangeri was < 3 and showed negative allometric growth in crabs, t(147) = 14.476, p < 0.05. The condition factor (K_n) value of 1.0031 was > 1 and indicated that crab in the study area had good level of feeding and proper environmental condition.
Keywords: *Uca tangeri, Elechi Creek, Length-Weight Relationship, and Condition Factor*

Date of Submission: 24-11-2024 Date of Acceptance: 04-12-2024

I. Introduction

Crabs are ecologically and economically important species, playing a vital role in coastal ecosystems and serving as a key resource for fisheries (Moruf & Ojetola, 2017). As a major part of estuarine and coastal ecosystems, crabs are often exposed to fluctuating environmental conditions, which can influence their growth and health. Evaluating their growth patterns and health status, therefore, is crucial for sustainable management and conservation. One way to assess these aspects is by determining the length-weight relationship and assessing the condition factor (K) of crabs.

The length-weight relationship provides description of how the weight of a crab varies with its length, offering insights into its growth patterns. This relationship which assesses whether the growth is isometric (b = 3) or allometric (b ≠ 3) is widely used in fisheries biology to assess the condition and growth performance of different species including crabs (Ayoade and Ikuala, 2007). The condition factor (K), on the other hand, is a numerical indicator of the health and fitness of crabs, reflecting their fat reserves and general well-being. High K values are typically associated with good environmental conditions and adequate food availability, while lower K values may signal poor habitat quality, disease, or environmental pollution.

The Elechi Creek in the upper in the upper Bonny Estuary of the Niger Delta, Nigeria, is a biodiversity hotspot that provides a variety of microhabitats for various species including fish, shellfish, birds and other aquatic organisms, with the creek serving as nursery ground and providing protection from predators for juvenile fish and crustaceans including the fiddler crab *Uca tangeri*. The creek also supports a wide range of human activities which are capable of modifying the environment, affecting the quality of the ecosystem and health of aquatic biota. Previous studies on the length-weight relationship and condition factor of crabs have demonstrated that these parameters can vary significantly across different environments and seasons, with crabs from polluted areas often exhibiting lower condition factors, reflecting the adverse effects contaminants on their health. Gesto *et al*. (2017) evaluated the length-weight relationship and condition factor of *Oreochromis niloticus* and *Clarias gariepinus* from Wudil River, Kano, Nigeria. Till date, there is very limited research and a dearth of information on the length-weight relationship and condition factor of fin-fish and shell-fish of the Elechi Creek. This study,

[*] Correspondence: ndbc_umesi@yahoo.com

therefore, seeks to fill this gap by evaluating the length-weight relationship and condition factor of the West African fiddler crab *Uca tangeri* from the Elechi Creek in the upper Bonny Estuary, Niger Delta, Nigeria.

II. Methodology

Study Area

The study area a 4.56 km stretch of the tidal Elechi Creek in the upper Bonny Estuary of the Niger Delta, Nigeria, running from the Rumueme area to Mgbuodohia axis in Rumuolumeni, and lies in latitudes 4.769157°N and 4.803468°N and longitudes 6.987985°E and 6.965151°E (Fig. 1 and Table 1). The area supports a wide range of human activities which are significant in the economies of local populations within and around the creek. It represents a hotspot for industrial activities involving the large scale storage of petroleum products in tank farms by companies (Masters Energy and NEPAS Group) operating within and around the banks. The Elechi Creek also supports a nearshore waste treatment (incinerator) facility (Frigate Upstream & Energy Services), facility for ship/barge repairs and maintenance, sprawling waterfront settlement, jetty of the Nigerian Agip Oil Company (now Oando), and a sewage treatment facility. The creek acts as a drain to these industrial activities, receiving varying concentrations of organic and inorganic wastes, some of which are capable of imposing environmental stress.

Field Sampling

Five (5) sampling units of the West African fiddler crab *Uca tangeri* were handpicked (Ibanga *et al*., 2021; Zhang *et al*., 2019) from the exposed mudflats from 5 sampling stations at low tide. A total of one hundred and fifty (150) individuals of *U. tangeri* were, therefore, collected across the sampling stations over a period of six (6) months on a bi-monthly basis from January – December, 2023. All samples were collected in ziploc bags, preserved in an ice chest at about 4°C and immediately transported to Anal Concept laboratory for biometric measurements.

Length-Weight Relationship and Condition Factor

Prior to morphometric measurements of crabs, samples were first cleansed to remove mud and any debris, washed with distilled water, and gently blotting off excess water to get more accurate weight measurement. Carapace length is the straight-line distance from the eye socket to the posterior margin of the carapace, while carapace width is measured at the widest part of the shell. The carapace length and carapace width of crab samples were measured using a ruler with precision to at least 0.1 cm, and length recorded in centimeters (cm). The weight of crab, on the other hand, was recorded in grammes (g) by weighing on OHAUS Pro Balance (Model: Scout Pro SPU402). The length-weight relationship for the crabs was determined according to the method described in Patil and Patil (2012) as shown in the equation below.

$$W = aL^b$$

where:
W = total weight of the crab (g)
L = carapace length (cm)
a = intercept (constant)
b = slope (growth coefficient)

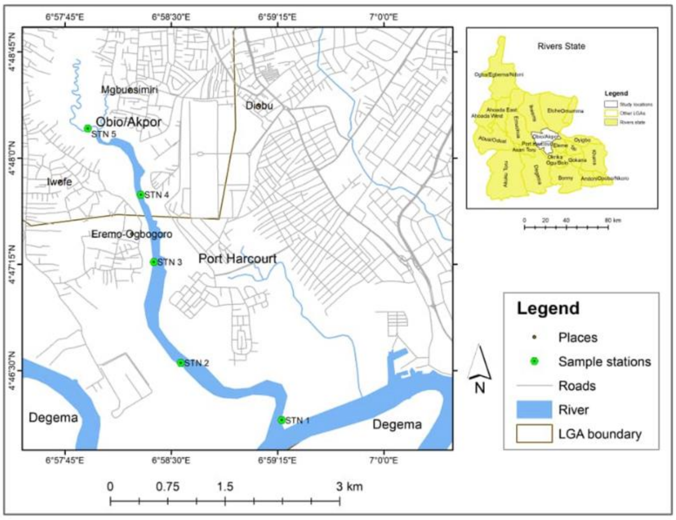

Fig. 1: Map of the Study Area Showing Sampling Stations

Table 1: Coordinates of the Sampling Stations

Sampling Station	Coordinates		Description of Sampling Station
	Northing	Easting	
STN 1	4.769157°	6.987985°	Masters Energy Oil and Gas
STN 2	4.775894°	6.976080°	Frigate Upstream and Energy Services Limited
STN 3	4.787768°	6.972935°	NEPAS Group Oil and Gas Company/Octopus
STN 4	4.795687°	6.971397°	Nigerian Agip Oil Company (NAOC)
STN 5	4.803468°	6.965151°	Control Station

The length-weight data were then log-transformed to linearize the length-weight relationship equation to make for easier application of linear regression to estimate the parameters *a* and *b* as shown in the equation.

$$\log(W) = \log(a) + blog(L)$$

The relative condition factor (K_n), on the other hand, was calculated according to Patil and Patil (2012) using the equation below.

$$K_n = \frac{W}{aL^b}$$

where:
K_n = relative condition factor
W = mean weight of crab (g)
L = mean length of crab (cm)
b = slope (growth rate)

Data Analysis

Data generated from the study were analysed using the Data Analysis Toolpak of the Microsoft Excel. Tables and charts were used to depict trends in the length and weight of the crab *Uca tangeri*. Linear regression on the log-transformed data was used to estimate the parameters *a* (additive constant) and *b* (slope). The significance of the slope was tested using the student's *t*-test at the 95% significance level. The relationship between carapace length and weight of crab was further evaluated using the Pearson product moment correlation (r) at $p = 0.05$, while the strength of the relationship was assessed using the coefficient of determination (r^2) as described in Fowler and Cohen (Fowler *et al*., 1998).

III. Results And Discussion

Fig. 2 below shows the means and standard deviations of carapace width, carapace length and weight of the fiddler crab *Uca tangeri* from the Elechi Creek. The mean carapace width, carapace length and weight of the crab ranged from 3.25 – 3.70 cm, 2.70 – 3.05 cm and 18.85 – 25.70 g respectively. Moruf and Ojetayo (2017) also reported a similar range of values for carapace length (1.2 -3.5 cm) and weight (1.8 – 20 g) of male *U. tangeri* from a mangrove wetland in Lagos, Nigeria. Results of the regression analysis for the length-weight relationship for *U. tangeri* are as presented in Table 2 below. The *b*s as shown in the table are the additive constant (0.2216) and the slope weight (0.6875) of the regression equation used to predict the dependent variable (log W) from the independent variable (log L). Accordingly, the regression equation is as follows:

$$log\,W = 0.6875\,log\,L + 0.2216$$

In this study, the slope weight indicated that longer carapace length predicted larger weight of *Uca tangeri*. The 95% confidence interval for the slope (0.594 - 0.781) was positive throughout the range of the interval (Table 2). This is fairly consistent with the range of 0.2211 – 1.1676 reported for the slope value (*b*) in fish samples (*Clarias gariepinus* and *Oreochromis niloticus*) from Wudil River, Kano, Nigeria (Gesto *et al*., 2017). Based on the magnitude of the correlation coefficient ($r = 0.767$), the study showed that carapace length is moderately related to weight of *U. tangeri* at the Elechi creek, with 59% ($r^2 = 0.588$) of the variance of crab body weight accounted for by carapace length.

The hypothesis test of interest evaluated whether the *b* value was equal to 3, indicating isometric growth. The *t* test associated with the coefficient of log*L* (independent variable) was significant, $t(147) = 14.476$, $p < 0.05$ (Table 2). In addition, the 95% confidence interval for the slope which did not reflect the value of zero was also indicative that *b* is not equal to 3 at the 0.05 level. The calculated *b* value for *U. tangeri* in this study was < 3 and showed negative allometric growth in crabs from the Elechi Creek (Bagenal and Tesch, 1978). Patil and Patil (2012) also reported *b* values < 1 which indicated negative allometric growth in the freshwater crab *Barytelphusa gurini* from Kham River, near Aurangabad region. In samples of *Barytelphusa gurini* from Badagry, Lagos and

Lekki Lagoon in Nigeria, Lawal-Are & Kusemiju (2000) also recorded *b* value < 3 which suggested negative allometric growth. Similar findings have been reported *Callinectes sapidus* from Georgia (Stickney, 1972) and the blue swimming crab *Callinectes amnicola* from Okpoka Creek in the Niger Delta, Nigeria (Abowei and George, 2009). Estimates of the allometric coefficients(*b*) for *Clarias gariepinus* and *Oreochromis niloticus* from Wudil River, Kano, Nigeria, ranged from 0.1173 – 0.5457 and 0.1441 – 0.8058 respectively (Gesto *et al*., 2017) which are comparable with the value obtained in this study and differed significantly from 3, indicating negative allometric growth.

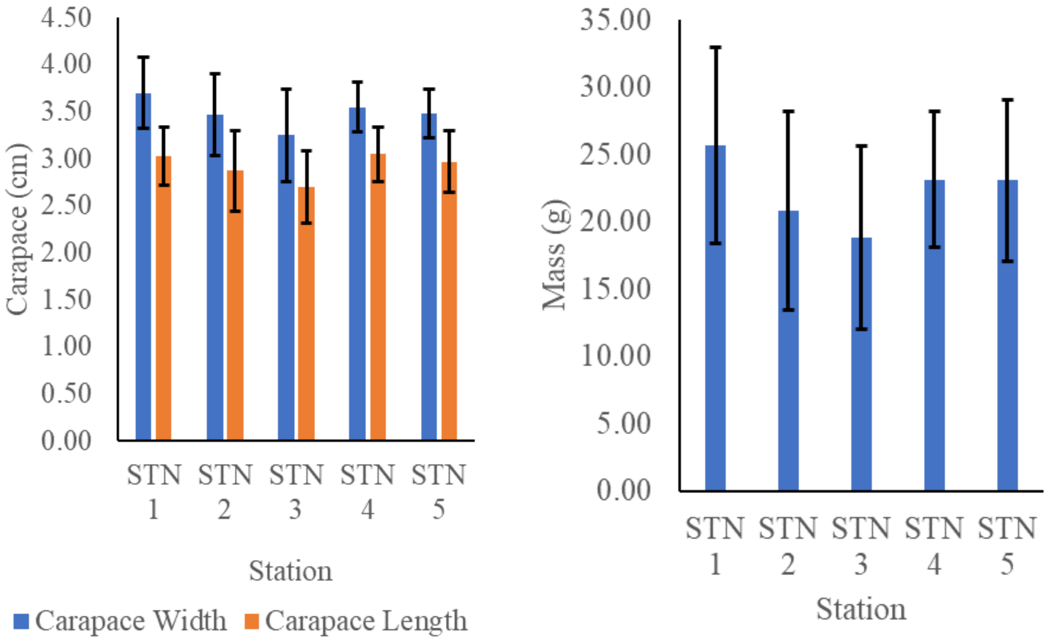

Fig. 2: Spatial Variations in Mean Carapace Width, Length and Weight of *Uca. tangeri*.

Table 2: Length-Weight Relationship of the Fiddler Crab *Uca tangeri* (N=149).

	Coefficients	Standard Error	*t* Stat	*P*-value	Lower 95%	Upper 95%
Intercept	0.2216	0.0221	10.0142	$p < 0.05$	0.1779	0.2654
logL	0.6875	0.0475	14.4778	$p < 0.05$	0.5937	0.7814

The scatterplot for the two variables, as shown in Fig. 3, indicates that carapace length and weight of *Uca tangeri* at the Elechi Creek are linearly related such that as carapace length increases, the crab weight increases as well. The accuracy in predicting the mass of crab was moderate. The correlation between the carapace length (log L) and crab mass (logW) was 0.767, with approximately 59% of the variance of the weight of crab accounted for by its linear relationship with carapace length. This similar to Patil and Patil (2012) who also reported very strong correlations between carapace length and mass in the male and female crab *Barytelphusa gurini* from Kham River with coefficients of determination of $r^2 = 0.978$, $r^2 = 0.986$ and $r^2 = 0.937$ for the male, female and combined crabs respectively. In a similar study conducted in Wudil River, East-Central Kano, Nigeria, Gesto *et al*. (2017) found r^2 values ranging from 0.1421 - 0.9087 for *Clarias gariepinus* which were higher than that obtained for *Uca tangeri* in the current study. The *t* values for b of 6.92, 8.83 and 11.5 reported for male, female and combined crab *Barytelphusa gurini* respectively by Patil and Patil (2012) were significant at $p = 0.05$ and also comparable to the *t* value (14.476) obtained for *Uca tangeri* in the present study.

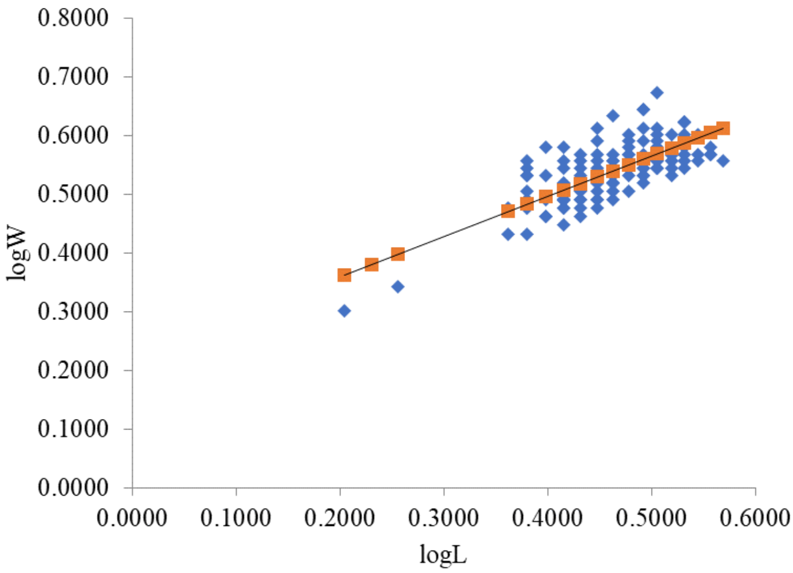

Fig. 3: Scatter Plot Showing Length-Weight Relationship of *Uca tangeri* in Elechi Creek.

Higher condition factor (K > 1) indicates crabs are in good physical condition, with sufficient fat reserves and overall better health. On the other hand, a lower K value (K < 1) is suggestive of malnutrition, poor environmental condition or disease. According to Perry *et al*. (1996), fishes with a low condition index are presumably believed to have experienced adverse physical environment or insufficient nutrition. The condition factor (K_n) value of 1.0031 calculated for the crab *Uca tangeri* in Elechi Creek in this study was > 1 and indicated that crab in the study area had good level of feeding and proper environmental condition (Ujjania *et al*., 2012). This agrees with the highest K value of 1.809 reported for *Oreochromis niloticus* but higher compared to the K value of 0.516 observed for *C. gariepinus* in Wudil River by Gesto *et al*. (2017). Patil and Patil (2012) reported K values of 0.000802, 0.000669 and 0.000214 for male, female and combined *Barytelphusa gurini* respectively which were lower that the value obtained in this study. Bagenal and Tesch (1978) recommended K value range of 2.9 – 4.8 as suitable for natural freshwater fish which is higher compared to the finding of this study.

IV. Conclusion

This study has provided valuable insights into the length-weight relationship and condition factor of *Uca tangeri* from the Elechi Creek in the Upper Bonny Estuary of the Niger Delta, Nigeria, highlighting critical aspects of the species' growth patterns and overall health. The length-weight analysis revealed a negative allometric growth pattern, suggesting that crabs in the study area gets thinner with increase in carapace length. However, the condition factor assessment indicates a generally healthy population of *U. tangeri* at the Elechi Creek. These findings underscore the importance of monitoring populations of *U. tangeri* as a bioindicator of estuarine health, especially in areas such as the Elechi Creek which has become a hotspot for industrial activities and has come under moderate anthropogenic influence due to varying degrees of industrial activities. Future studies should explore the influence of specific environmental parameters (heavy metal concentrations, organic pollution, salinity, and organic matter) which could account for the negative allometric growth observed in *U. tangeri* in the present study.

References

[1] Abowei, J. F. K. & George, A. D. I. (2009). A Study Of The Length -Weight Relationship And Condition Factor Of Callinectes Amicola (De Rochebrune, 1883) From Okpoka Creek, Niger Delta, Nigeria. International. Journal Of Animal And Veterinary Advances, 1(2): 66-72.

[2] Ayoade, A. A. & Ikulala, A. O. (2007). Length Weight Relationship, Condition Factor And Stomarch Contents Of Hemichromis Bimaculatus, Serotherodon Melanotheron And Tilapia Guetheri (Perciformes: Cichilidae) In Eleiyele Lake, Southwestern Nigeria. Int. Journal Of Tropical Biology, 55 (3-4), 969-977.

[3] Bagenal, T. B. & Tesch, F. W. (1978). Methods Of Assessment Of Fish Production In Fresh Waters. Ibp Handbook No. 3, 3rd Ed. Oxford Blackwell Scientific Publication, London. Pp. 101-136.

[4] Fowler, J., Cohen, L. And Jarvis, P. (1998). Practical Statistics For Field Biology (Second Edition). John Wiley & Sons, England, Pp 179-209.

[5] Getso, B. U., Abdullahi, J. M. & Yola, I. A. (2017). Length-Weight Relationship And Condition Factor Of Clarias Gariepinus And Oreochromis Niloticus Of Wudil River, Kano, Nigeria. Journal Of Tropical Agriculture, Food, Environment And Extension, 16(1): 1-4.

[6] Ibanga, L., Nkwoji, J. A., Usese, A., Onyema, I. And Chukwu, O. (2021). Macrobenthic Invertebrate Community Structure And Heavy Metals Concentrations In The Crab Uca Tangeri In A Tidal Creek, Niger Delta, Nigeria. Songklanakarin J. Sci. Technol., 43(2): 318-325.

[7] Lawal-Are, A. O. & Kusemiju, K. (2000). Size Composition, Growth Pattern And Feeding Haibits Of The Blue Crabs, Callinectes Amnicola (De Rocherburne) In The Badagry Lagoon, Nigeria. Journal Of Scientific Research And Development, 5: 169-176.

[8] Moruf, R. O. And Ojetayo, T. A. (2017). Biology Of The West African Fiddler Crab, Uca Tangeri (Eydoux,1835) (Decapoda: Ocypodidae) From A Mangrove Wetland In Lagos, Nigeria. Int. J. Aquat. Biol., 5(4): 263-267.

[9] Patil, K. M., And Patil, M. U. (2012). Length-Weight Relationship And Condition Factor Of Freshwater Crab Barytelphusa Gurini (Decapoda, Brachyura). Journal Of Experimental Sciences, 3(5):13-15.

[10] Perry, R. I., Hargreaves, N. B., Waddell, B. J. & Mackas, L. (1996). Spatial Variations In Feeding And Condition Of Juvenile Pink And Chum Salmon Off Vancouver Island, British Columbia. Fish Oceanogr., 5 (2), 73-88.

[11] Ujjania, N. C., Kohli, M. P. S. & Sharma, L. L. (2012). Length-Weight Relationship And Condition Factors Of Indian Major Carps (C. Catla, L. Rohita And C. Mrigala) In Mahi Bajaj Sagar, India. Research Journal Of Biology, 2 (1), 30-36.

[12] Zhang, Z., Fang, Z., Li, J., Sui, T., Lin, L. And Xu, X. (2019). Copper, Zinc, Manganese, Cadmium And Chromium In Crabs From The Mangrove Wetlands In Qi'ao Island, South China: Levels, Bioaccumulation And Dietary Exposure. Watershed Ecology And The Environment, 1: 26-32.