ABUNDANCE AND MORPHOLOGICAL CHARACTERIZATION OF WEST AFRICAN FRESHWATER CRAB (*SUDANOUNTES AFRICANUS*) ALONG LOWER RIVER BENUE, MAKURDI, BENUE STATE NIGERIA

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ABSTRACT

The abundance and morphological characterization of freshwater crab (*Sudanountes africanus*) were determined in Makurdi along the Lower River Benue. 160 *Sudanountes africanus* were collected from August-November, 2016. The highest percentage (35.63%) *S. africanus* was obtained in August while the lowest (12.50%) was obtained November. The mean total length, body weight, carapace width, carapace length, length of the teeth, abdominal length, number of legs and diameter of the eye socket of male *S. africanus* were 3.38±0.03, 38.52±0.84, 4.67±0.83, 1.44±0.18, 3.51±0.06, 2.91±0.06, 8.00±0.00 and 0.69±0.01, respectively while the female counterpart had 3.40±0.07, 37.63±1.77, 4.71±0.10, 1.43±0.15, 3.26±0.08, 2.72±0.08, 8.00±0.00 and 0.64±0.01, respectively. There was no significant difference (p>0.05) between mean total length, body weight, carapace width, carapace length, abdominal length and the diameter of the eye socket. Female *S. africanus* had better "b" value (16.56) and mean condition factor (36.18±1.22) than the male with 7.13 "b" value and 7.16±4.77 condition factor. From the width-weight relationship, female *S. africanus* had better "b" value (11.22) and mean condition factor (9.20±2.09) than the male with 2.00 "b" value and 1.07±4.45 condition factor.

INTRODUCTION

Crabs are consumed as food in many countries of the world. The West African freshwater crab belonging to the family Potamonautidae, with over 88 species are present in all the streams and river system across Africa (Cumberlidge, 1999). True freshwater crabs are those that have adopted freshwater, semi-terrestrial or terrestrial modes of life, and are characterized by their ability to complete their life cycle outside the marine environment (Yeo *et al.,* 2008). Freshwater crabs are one of the most ecologically important macro-invertebrate groups in tropical inland waters worldwide (Dobson *et al.,* 2007; Yeo *et al.,* 2008; Cumberlidge *et al.,* 2009). They are excellent indicators of good water quality (Yeo *et al.,* 2008) and play an important role in nutrient cycling in tropical freshwater ecosystems (Dobson *et al.,* 2007).

Crabs, as the most free -living crustaceans, are ideal subjects for morphometric studies because of the ease of taking fast and precise measurements on their hard exoskeleton (Ledesma *et al.,* 2010). In studying crab species, measuring the length crab is often somewhat difficult, and during attempts to measure them, either the extremities of the crab can be broken or the investigator can be injured by the crab. It is therefore convenient to be able to convert into length (width), when only the weight is known or length-weight regression may be extensively used to estimate length from weight (Sangun *et al*., 2009; Oluwatoyin *et al.,* 2013).

In population studies, morphometric analysis provides a powerful complement to genetic and environmental stock identification approaches (Cadrin, 2000, Rufino *et al*., 2006, Konan *et al.* 2010, Silva *et al.,*2010, Srijaya *et al*., 2010, Bisaro *et al.,* 2013) and length-weight relationships allow the conversion of growth-in-length equations to growth--in-weight for use in a stock assessment model (Moutopoulos and Stergiou, 2002). Knowledge of these distinguishing characters and size relationships has particular importance in the study of valuable crustaceans. Such knowledge can be useful for further studies on the life history of species and in the development of resource management. Study of the length-weight relationship in aquatic animals has wide application in delineating the growth patterns during their developmental pathways (Bagenal, 1978). Information about individual body weight-length/ width relationships in populations is important for estimating the population size of a stock. Thee length-width/weight relationships are regarded as more suitable for evaluating crustacean populations (Gorce *et al.,* 2006; Fumis *et al.,* 2007; Sangun *et al*., 2009; Josilen, 2011; Sahoo *et al.,* 2011; Oluwatoyin *et al*., 2013; Safaie *et al.,* 2013).

The stock status of *Sudanonautes africanus* is still unknown due to dearth of information on the population structure neither is there any detailed information about the biology of these crabs presently in Lower River Benue, Makurdi, Benue State, Nigeria. This study is therefore aimed at

determining the abundance and some aspects of biology, such as length-weight relationship, condition factors of *S. africanus* along Lower River Benue, Makurdi, Benue State.

MATERIALS AND METHOD

Study Area

This work was carried out in Makurdi, the capital of Benue State Nigeria, located at Longitude 7°43°N and Latitude 8°32°E. The town is divided into the North and the South bank by the River Benue which exists year round with its water volume fluctuating with season.

Sample collection

A total of one hundred and sixty (160) samples of *Sudanonautes africanus* comprising of 98 male and 62 female were collected along the Lower River Benue for the period of four months (August 2016 to November, 2016) using local hand hoe in digging the holes of the crabs, basket traps, traditional gear such as earthen clay pots, and surrounding net. The samples were transported to the Department of Fisheries and Aquaculture Laboratory, University of Agriculture, Makurdi in clean buckets with water for analysis. Identification of the crabs was carried out using an illustrated guide by Headstrom (1979). The location of the bigger cheliped and its percentage occurrence in each species was determined. In addition, the number of teeth on the bigger cheliped and the sex of each crab were determined. The male and female sexes were identified after Headstrom (1979).

Length-weight determination

Body weight of the crab samples was measured to the nearest 0.1 g using a Golden Mettler balance 'MEAS: 217*115*317 mm, USA while carapace length and chelae diameter were measured with a vernier caliper to the nearest 0.1 cm. The length-weight relationship was estimated using the equation:

$\mathbf{W} = aL^b$

where W is the weight, *a* is the intercept, L is carapace length and *b* is the slope. The parameters *a* (intercept) and *b* (slope) were estimated by linear regression based on logarithms:

$Log\ (W) = Log\ (a) + b\ Log\ (L)$

where W = weight (g) of the crabs, L = horizontal carapace length

Data Analysis

The significance of regression was carried out by analysis of variance (ANOVA). Width/length-weight relationships of *S. africanus* were calculated in relation to sex using the linear regression routine of Microsoft Office Excel in PC windows (2003). In order to test possible significant ($P > 0.01$) differences between the sexes, Student's t test was used for comparison of the two slopes. To determine the relations between different morphometric characters in males and females, regression equations were calculated assuming an allometric growth equation ($Y = a + bX$).

The values of the correlation coefficient (r) were calculated Microsoft Office Excel in PC windows (2003) to know the pattern of association between propodus/abdomen and carapace dimensions (Snedecor and Cochran, 1967), with the aim of laying a mathematical relationship between the variables.

The Fulton's condition factor (CF) was calculated according to Bagenal (1978) with the formula;

$K = 100W/L^3$

Where K is the condition factor (cf), W is the total body weight, L is the carapace length (CL).

RESULTS

Percentage abundance of *S. africanus* along Lower River Benue during the study period

Results of the percentage abundance of *S. africanus* collected along the Lower River Benue during the study period (August – November, 2016) are shown in figure 1. The highest percentage (35.63%) *S. africanus* was obtained in August while the lowest (12.50%) was obtained in November. In September and October, 23.75% and 28.13% were recorded respectively.
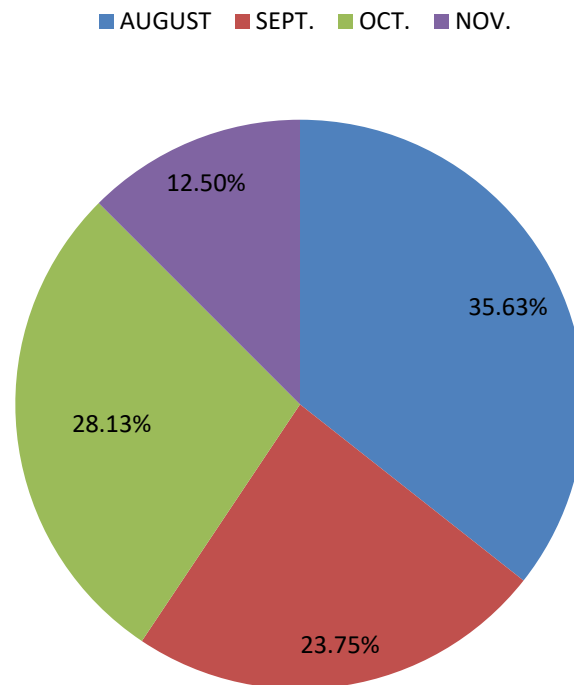
**Figure 1: Percentage abundance of *S. africanus* during the
study period (August 2016-Nov., 2016)**

Results of the minimum, maximum and mean morphological characterization of *S. africanus* during the study period are shown in Table 1 while Table 2 shows the results of mean morphological variation of male and female *S. africanus* during the study period.

From Table 1, the minimum total length, body weight, carapace width, carapace length, length of the teeth, abdominal length, number of legs and diameter of the eye socket of *S. africanus* were 2.50, 20.00, 0.40, 0.40, 2.10, 2.10, 8.00 and 0.40, respectively while the maximum total length, body weight, carapace width, carapace length, length of the teeth, abdominal length, number of legs and diameter of the eye socket were 4.50, 71.20, 6.00, 6.00, 5.00, 4.70, 8.00 and 0.80, respectively with the corresponding means of 3.39±0.04, 38.17±0.85, 4.68±0.06,3.41±0.05, 2.84±0.05, 8.00±0.00 and 0.67±0.01, respectively.

From Table 2, the mean total length, body weight, carapace width, carapace length, length of the teeth, abdominal length, number of legs and diameter of the eye socket of male *S. africanus* were 3.38±0.03, 38.52±0.84, 4.67±0.83, 1.44±0.18, 3.51±0.06, 2.91±0.06, 8.00±0.00 and 0.69±0.01, respectively while the female counterpart had 3.40±0.07, 37.63±1.77, 4.71±0.10, 1.43±0.15, 3.26±0.08, 2.72±0.08, 8.00±0.00 and 0.64±0.01, respectively as mean total length,

body weight, carapace width, carapace length, length of the teeth, abdominal length, number of legs and diameter of the eye socket. There was no significant difference ($p>0.05$) between mean total length, body weight, carapace width, carapace length, abdominal length and the diameter of the eye socket.

Table 1: Minimum, Maximum and Mean morphological characterization of *S. africanus* during the study period

MORPHOLOGICAL CHARACTERS	MINIMUM	MAXIMUM	MEAN±SEM
Total length	2.50	4.50	3.39±0.04
Body weight	20.00	71.20	38.17±0.85
Carapace width	0.40	6.00	4.68±0.06
Carapace length	0.40	6.00	4.68±0.06
Length of the teeth	2.10	5.00	3.41±0.05
Abdominal length	2.10	4.70	2.84±0.05
No. of legs	8.00	8.00	8.00±0.00
Diameter of eye socket	0.40	0.80	0.67±0.01

Table 2: Mean morphological variation of male and female *S. africanus* during the study period

MORPHOLOGICAL CHARACTERS	SEX		P-value
	MALE	FEMALE	
Total length	3.38±0.03	3.40±0.07	0.82[ns]
Body weight	38.52±0.84	37.63±1.77	0.62[ns]
Carapace width	4.67±0.83	4.71±0.10	0.76[ns]
Carapace length	1.44±0.18	1.43±0.15	0.96[ns]
Length of the teeth	3.51±0.06	3.26±0.08	0.01
Abdominal length	2.91±0.06	2.72±0.08	0.06[ns]
No. of legs	8.00±0.00	8.00±0.00	0.00
Diameter of eye socket	0.69±0.01	0.64±0.01	0.86[ns]

ns = No significant difference

Parameters of the relationship (W = a L^b) between Weight -Carapace length (CL), Weight-Carapace width (CW) and Condition factor (K) for *S. africanus* are shown in Table 3. From the length-weight relationship of *S. africanus,* the "b" values for male, female and combined sexes were 7.13, 16.56 and 10.44 with mean condition factors of 7.16±4.77, 36.18±1.22 and 4.52±2.92, respectively. Female *S. africanus* had better "b" value (16.56) and mean condition factor (36.18±1.22) than the male counterpart (7.13 "b" value and 7.16±4.77 condition factor). In addition, from the width-weight relationship, the "b" values for male, female and combined sexes were 2.00, 11.22 and 3.95 with mean condition factors of 1.07±4.45, 9.20±2.09 and 4.21±2.84, respectively. Female *S. africanus* had better "b" value (11.22) and mean condition factor (9.20±2.09) than the male counterpart (2.00 "b" value and 1.07±4.45 condition factor).

Table 3: Length-weight, Width-weight relationship parameters and mean condition factor of *S. africanus* during the study period

SEX	Length -weight relationship parameters				Width-weight relationship parameters			
	A	B	r^2	Mean K ⌈K = (W*100)/CW^3⌋	A	B	r^2	Mean K ⌈K = (W*100)/CL^3⌋
Male	5.22	7.13	0.50	7.16±4.77	35.63	2.00	0.18	1.07±4.45
Female	-40.35	16.56	0.82	36.18±1.22	21.61	11.22	0.85	9.20±2.09
Combined	-10.72	10.44	0.59	4.52±2.93	32.49	3.95	0.32	4.21±2.84

a = Intercept, b = Slope, r^2 = Regression coefficient, K = condition factor, W = Weight, CW = Carapace width and Cl = Carapace length.

Results of the correlation analysis of *S. africanus* during the study period are shown in Table 4. Strong correlation existed among the morphological characters of *S. africanus* except for the number of legs which could not be computed because at least one of the variables was constant. There was no significant difference (p>0.05) among these parameters.

Table 4: Correlation Analysis of *S. africanus* during the study period

PARAMETER	TL	WT	CL	CW	TEETL	ABD	NOL	ES
TL	1							
WT	0.827**	1						
CL	0.659**	0.770**	1					
CW	0.659**	0.770**	1.00	1				
TEETL	0.475**	0.582**	0.453**	0.453**	1			
ABD	0.380**	0.624**	0.477*	0.477**	0.665**	1		
NOL	.a	.a	.a	.a	.a	.a	.a	
ES	0.367**	0.359**	0.349**	0.349	0.292**	0.233**	.a	1

**Correlation is not significant at the 0.05 level (2-tailed).

.a Cannot be computed because at least one of the variables was constant

Note:

TL = Total length, WT = Weight, CL = Carapace length, CW = Carapace width, TEETL = Teeth length, ABD = Abdominal width, NOL = No. of legs and ES = Diameter of Eye socket

DISCUSSION

Measuring the length of freshwater crab species such as the *S. africauns* is often somewhat difficult and in studying them and in attempts to measure them, either the extremities of the crab can be broken or the investigator can be injured by the crab. It is therefore convenient to be able to convert into length (width) when only the weight is known or length-weight regression may be extensively used to estimate length from weight (Oluwatoyin, *et al.,* 2013).

The exponential values (b) of the length-weight relationship of male and female were 7.13 and 16.56 whereas in width-weight relationship of male and female crabs was 2.00 and 11.22, respectively indicating an allometric pattern of growth. Length-weight relationship parameters (a and b) are affected by a series of factors such as season, habitat, gonad maturity, sex, diet, stomach fullness, health, preservation techniques and annual differences in environmental conditions (Bagenal and Tech, 1978). Differences in value 'b' could be ascribed to one or a combination of most of the factors including differences in the number of specimens examined, area/season effects and distinctions in the observed length ranges of the specimens caught, to which duration of sample collection can be added as well (Moutopoulos and Stergio, 2002).

The variations of K-values in the male and female *S. africauns* could be an indication of food abundance, adaptation to the environment and gonad development. This agrees with the reported findings of Soyinka and Adekoya (2011), Frota *et al.,* (2004) and King (1996) who reported that variations of K may be indicative of food abundance, adaptation to the environment and egg/gonad development in fish.

The important of Length/width-weight relationships in this present study is to enable crab biologists derive length estimates for are *S. africauns* that are weighed but not measured. In the study, the sex ratio (1:1.58) of the crabs was in favour of the males than the female counterpart, implying that males were found mostly roaming in search of food and mating due to their reproductive period which is usually at the beginning of rainfall. The length-weight relationship showed that the crab's growth was allometric, indicating that, as the length of the crab increased so was the weight. The length-weight relationship showed that *S. africauns* is a good candidate for aquaculture though other factors need to be considered apart from reproductive biology. It is also essential for proper assessment and management of resources in the West African freshwaters. The crab, *S. africauns,* can be bred in captivity, which means that selective breeding can take place to forestall extinction of the population in the near future.

REFRENCES

[1] Bagenal, T., (1978). Method for Assessment of Fish Production in Fresh Waters (3rd ed.). (IBP Handbook, 3. Blackwell Scientific Publications, Oxford), 365P.

[2] Bissaro, F.G., Gomes, J.L., Madeira di Benedito, A.P. (2013). Morphometric variation in the shape of the cephalothorax of shrimp *Xiphopenaeus kroyeri* on the east coast of Brazil. Journal of the Marine Biological Association of the United Kingdom 93(3): 683–691. doi: 10.1017/ S0025315412000409

[3] Cadrin, S. X. (2000). Advances in morphometric identification of fishery stocks. Reviews in Fish Biology and Fisheries. 10: 91-112.

[4] Cumberlidge, N. (1999). Modification of the freshwater crabs of West Africa.*Family Potamonautidae.*

[5] Cumberlidge, N., K.L. Ng, P., C.J. Yeo, D., Magalhes,C., R. Campos, M., Alvarez , F., Naruse, T., R. Daniels, S.,J. Esser, L., Y.K. Attipoe, F., Lara, Dudgeon, D., Arthington, A.H., Gessner, M.O., Zen- Ichiro Kawabata, Z.-I., Knowler, D.J., Leveque, C., Naiman, R.J., Prieur-Richard, A.-H. and Soto, D. (2009). Freshwater crabs and the biodiversity crisis: Importance, threats, status, and conservation challenges. Biological Conservation. 142: 1665-1673.

[6] Dobson, M. K., Magana, A. M., Lancaster, J. And Mathooko, J. M. (2007). Aseasonality in the abundance and life history of an ecologically dominant freshwater crab in the Rift Valley, Kenya. Freshwater Biology. 52: 215–225.

[7] Frota L.O., Costa, P.A.S. and Braga, A.C. (2004).length-weight relationship of marine fishes from the central Brazilian cost. *Naga, ICLARM. Qrt.* 27: 20-26.

[8] Fumis, P. B., Fransozo, A., Bertini, G. and Braga, A. A. (2007). Morphometry of the crab *Hexapanopeusschmitti* (Decapoda: Xanthoidea) on the northern coast of the state of São Paulo, Brazil. Revista de Biología Tropical. 55: 163-170.

[9] Gorce, G., Erguden, D., Sangun, L., cekic, M. And Alagoz, S. (2006). Width/length and relationships of the blue crab (Callinectes sapidus Rathbun, 1986) population living in Camlik Lagoon Lake (Yumurtalik). Pakistan Journal of Biological Sciences. 9:1460-1464.

[10] Headstrom, R. (1979). Lobsters, Crabs, Shrimps, and Their Relatives. New York: A.S. Barnes and Co., Inc.

[11] Josileen, J. (2011). Morphometrics and length-weight relationship in the blue swimmer crab *Portunus pelagicus* (Linnaeus, 1758) (Decapoda, Brachyura) from the Mandapam coast, India. Crustaceana. 84 : 1665-1681.

[12] King, R.P. (1996). Length-weight relationships and related statistics of 73 populations of fish occurring in inland waters of Nigeria. Naga ICLARMQ. 19: PP 49-52.

[13] Konan, K.M., Adépo-Gourène, A.B., Ouattaraa, A. Nyingy, W.D. and Gourène, G. (2010) Morphometric variation among male populations of freshwater shrimp *Macrobrachium vollenhovenii*

[14] Ledesma, F. M., Molen, V. and Barón, P. J., (2010). Sex identification of Carcinus maenasby analysis of carapace geometrical morphometry. Journal of Sea Research. 63: 213–216.

[15] Moutopoulos ,D. K. and Stergiou, K. I. (2002). Weight-length and length-length relationships for 40 fish species of the Aegean Sea (Hellas). Journal of applied Ichthyology. 18: 200-203.

[16] Oluwatoyin, A., Akintade, A., Edwin, C. and Victor k. (2013). A Study of Length-Weight Relationship and Condition Factor of West African Blue Crab (Callinectes pallidus) from Ojo Creek, Lagos, Nigeria. American Journal of Research Communication. 1: 102-114.

[17] Rufino, M. Abelló, P., Yule, A.B. (2006). Geographic and gender shape differences in the carapace of *Liocarcinus depurator* (Brachyura: Portunidae) using geometric morphometrics and the influence of a digitizing method. Journal of Zoology 269: 458–465. doi: 10.1111/j.1469- 7998.2006.00086.x

[18]   Safaie, M., Kiabi, B., Pazooki, J. and Shokri, M. R. (2013). Growth parameters and mortality rates of the blue swimming crab, *Portunus segnis* (Forskal, 1775) in coastal waters of Persian Gulf and Gulf of Oman, Iran. Indian journal of Fisheries. 60: 9-13.

[19]   Sahoo, D., Panda, S. and Guru, B.C. (2011). Studies on reproductive biology and ecology of blue swimming crab *Portunus pelagicus* from Chilika Lagoon, Orissa, India. Journal of the Marine Biological Association of the United Kingdom. 91: 257-264.

[20]   Sangun, L., Tureli, C., Kamca, E., and Duysak, O. (2009). Width/length-weight and width length relationships for 8 crab species from north- Mediterranean coast of Turkey. Journal of Animal and Veterinary Advances. 8: 75-79.

[21]   Silva, I.C, Alves, M.J., Paula, J. And Hawkins, S.J. (2010). Population differentiation of the shore crab *Carcinus maenas* (Brachyura: Portunidae) on the southwest English coast based on genetic and morphometric analyses. Scientia Marina 74: 435–444.

[22]   Snedecor, G. W. and Cochran W. G. (1967). Statistical methods applied to experiments in agriculture and biology: 1-534. (The Iowa State College Press, Ames, Iowa).

[23]   Soyinka, O.O. and Adekoya, O.Y. (2011). Occurrence, age, Growth and sex ratio of Mullets species in Lagos Lagoon. *Nigerian journal of Fisheries.* 8(2), Pp 322-329.

[24]   Srijaya, T.C., Pradeep, P.J., Mithun, S., Hassan, A., Shaharom, F. and Chatterji, A. (2010). New record on the morphometric variations in the populations of horseshoe crab (*Carcinoscorpius rotundicauda* Latreille) obtained from two different ecological habitats of Peninsular Malaysia. Our Nature 8: 204–211. Technical Paper (234) 52P.

[25]   Yeo, D. C. J., Ng, P. K. L., Cumberlidge, N., Magalhães, C., Daniels, S. R. and Campos, M. R., (2008). A global assessment of freshwater crab diversity (Crustacea: Decapoda: Brachyura). In: Balian, E.V., Lévequè, C., Segers, H., Martens, M. (Eds.), Freshwater Animal Diversity Assessment. Hydrobiologia. 595: 275–286.