

BRIEF BIOLOGY OF *Sudanonautes africanus* (CRUSTACEA: BRACHYURA: EUBRACHYURA: POTAMOIDEA: POTAMONAUTIDAE: POTAMONAUTINAE), IN OSSIOMO RIVER, NIGER-DELTA, NIGERIA

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Abstract: The crab species *africanus* is a very notable detritivore, feeding on dead organic materials. It makes use of energy from the food and transfers it into the food chain trophic level, contributing to the gross ecosystem efficiency. However, their threat to human consumption and activities is gradually high in the sub-Sharan regions. There is a need to exploit alternative methods for traditional domestic cultivation to ensure food security. This study reported the length-weight relationship, condition factor, sex ratio, fecundity, and GSI (gonadosomatic index) of *Sudanonautes africanus* to prospect possible domestication. The result of the biomass of *Sudanonautes africanus* indicated a mean range of 52-180 g. A positive relationship existed between the weight and length relationship of the male and female crab with positive (+) allometry. There was no significant difference between both sexes. However, the fecundity estimates showed a ripe carapace full of bright red gonad materials (stage V) specifically in the female with eggs range of 2.56 to 8.95 g and GSI range of 11.28-41.44%; with the minimum (15) and maximum (27) fecundity at July and June 2016 respectively. It was concluded that the species could be domesticated via aquaculture because of its potentials to adapt to various feed substrate and water parameters.

Keywords: Cluster, Fecundity, Gonadosomatic, Morphometric, *Sudanonautes africanus*.

1. Introduction

Freshwater crabs mainly populate the sub-tropics and tropical regions of the aquatic biosphere. About 20% of the 1300 species of freshwater crabs belong to the infra-order brachyurans and section Eubrachyura (Tsang et al. 2014). Freshwater crabs consist of eight major families (Pseudothelphusidae, Trichodactylidae, Potamonautidae, Deckeniidae, Platythelphusidae, Potamidae, Gecarcinucidae, and Parathelphusidae),

which are found in various global ecological niche; Neotropics, Mexico, South and Central America, Madagascar and Africa, East Africa; Reed, North Africa, southern Europe, Asia, Seychelles, Australasia (Ng 1990; Collins and Williner, 2006; Reed and Cumberlidge 2006; Cumberlidge and Daniels 2008; Brandis et al. 2000; Wehrmann et al. 2010; Shih and Ng 2011).

Freshwater crab *Sudanonautes africanus* belongs to the family Potamonautidae which mainly dominates West Africa; Nigeria, Ghana, Togo, Cameroun, Congo, Zaire, and Gabon fresh watercourses (Arimoro and Orogun 2008). It is one of the major freshwater food delicacies in this region (Anani and Olomokoro 2018 and 2019). They are found in fast and slow streams, rivers, pools, stagnant ponds, and rice fields, the substratum of rocks, woods, and even foliage axils (Yeo et al. 2008). The land or terrestrial forms inhabit top trees and floor litters not too remote from permanent freshwater bodies. They get their food by osmotic or capillary uptake by recurrent soaking themselves in water (Yeo et al. 2008).

Sudanonautes africanus like other species of the same genus are well known as a carrier of parasitic infection and also play an intermediary role as a host of specific Trematodes fluke worms like *P. africanus* and *P. uterobilateralis*, which result in the sickness called paragonimiasis or lung fluke in human beings (Sachs and Cumberlidge 1991).

The genus *Sudanonautes* are well known for their progeny care, direct growth from eggs without forming larvae, and short-lived larvae (lecithotrophic) or eggs (Gross and Kaus 2005). The females tend to protect their progeny for three months, and may also be well adaptable to their immediate environment (Daniel, 2001; Arimoro and Orogun 2008). The genus is well distributed and diverse in the eco-zones they are found. Despite this diversity and distributional pattern of this genus, few species are well understood with a notable ecological role

in the ecosystem. This genus is also well known for their characteristics heterochely chelae where one of the claws is bigger than the other in both sexes and shows the propensity to the right-hand side of the body more, compared to the left-hand side, which is well used for defense and reproductive or courtship gesturing (Daniel, 2001; Arimoro and Orogun 2008).

There is a great scarcity of kinds of literature on the biology and ecology of *Sudano-nautes africanus* in this studied region. However, Arimoro and Orogun (2006), Olusoji et al. (2009), Dirat (2014), and Sodamola et al. (2016 and 2018), investigated some morphological and biological features of *Sudano-nautes africanus* and related species of the same genus in different water bodies. The crab species *africanus* is a very notable detritivore, feeding on dead organic materials. It makes use of energy from the food and transfers it into the food chain trophic level, contributing to the gross ecosystem efficiency. However, their threat to human consumption is gradually high in the sub-Sharan regions. There is a need to exploit alternative methods for traditional domestic cultivation to ensure food security. This study reported the length-weight relationship, condition factor, sex ratio, and fecundity of *Sudano-nautes africanus* to prospect possible domestication.

2. Materials and methods

2.1. Description of the study area

The study was conducted of about 5.0873 km stretch of Ossiomo River Ologbo axis, Benin City situated in the South West, Nigeria with the following geographical coordinates; Latitude 6° 03' .1'' N - Longitude 5° 40' 3'' E (Figure. 1) and sampling stations showing sampled points of Ossiomo River, Edo State, Nigeria.

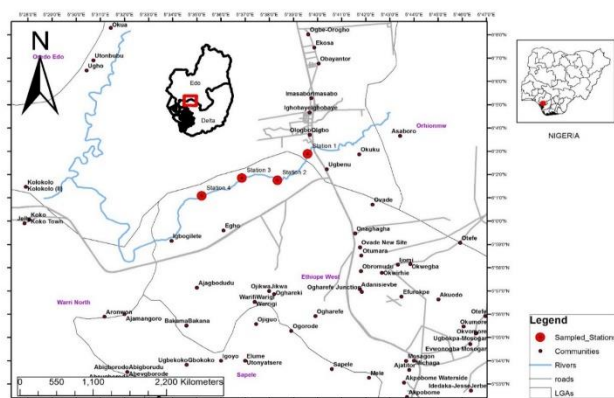


Figure 1. Map of the study area and sampling stations showing sampled points of Ossiomo River, Edo State, Nigeria.

2.2. Sampling

The sampling period spanned from March 2015 to August 2016, monthly. Samples of crabs were collected once every month between the hours of 09.00 and 12.00 hours on each sampling day, a long the stretch of the river, at four (4) sampled points.

2.3. Collection of freshwater crabs and Key features for the Identification of the crab species

The methods of Arimoro et al. (2007) and Ize-Iyamu et al. (2007) was used to sample the crustacean. Some key features of *Sudano-nautes africanus* such as the

mesobranchial and epibranchial areas, the cardiac and urogastric grooves, Figures 2 and 3, were used for the identification as confirmed by Professor Edema of the University of Benin, Benin City, Nigeria.



Figure 2. Measured ventral view of freshwater crab (*Sudano-nautes africanus*) – 4.0 cm (female)



Figure 3. Measured dorsal view of freshwater crab (*Sudano-nautes africanus*) – 3.8 cm (male)

2.4. Morphometric assessment and bio-data analysis of the specimen

The protocol of Arimoro and Orogun (2008) was used to assess the following morphometric parameters. The protocol of Bagenal and Braun (1978) was used in calculating the condition factor (k) of the crab. The methods of Sachs and Cumberlandidge (1991) were used in calculating the sex ratio of the crabs, while the modified protocol established by Daniel (2001), was used in the estimation of the various reproductive stages in the sampled specimen. More so, the protocol established by Bagenal and Braun (1978) was used to calculate the fecundity rates and GSI (gonad somatic index). The Chi-square test was used to determine the significant relationship between the sexes. All the statistical analysis was conducted with SPSS version 16.0 and Microsoft Excel version 2010.

3. Results

3.1. Measurements of carapace length, width, abdomen length, and weight of *Sudano-nautes africanus*

The linear length-weight relationship of *Sudano-nautes africanus* is as shown in Table 1. It was noticed that there was a positive relationship between the weight and length of the male and female crab ($y = 8.21x + 1.19$ and $y = 3.73x + 14.39$) respectively. The growth type for both sexes showed positive (+) allometry and the condition factors (K) for both sexes were considered good (41.10 and 17.14).

3.2. Sex ratio of *Sudanonautes africanus* (Milne-Edwards, 1869) in Ossiomo River

In this study, the sum of 171 crabs was collected, out of which 114 were males and 57 were females. The sex ratio ranged from 1:0.29 to 1:0.75 (Table 2). The relationship between both sexes was shown using Chi-square, the results indicated no significant difference ($p > 0.05$). However, the males were dominant over the females across the studied months.

Table 1. The length-weight relationship of *Sudanonautes africanus* caught in Ossiomo River

Species	N	Regression coefficient		Correlation coefficient R	Mean condition factor K	Other descriptive values			Growth type
		A	B			SE	Min	Max	
Male crab (<i>Sudanonautes africanus</i>)	114	8.21	1.19	0.79	41.10	0.11	6.07	126.25	Positive (+) allometry
Female crab (<i>Sudanonautes africanus</i>)	57	3.73	14.39	0.18	17.14	0.07	2.37	83.30	Positive (+) allometry

Table 2. Sex ratio of crab (*Sudanonautes africanus*) in Ossiomo River

	Male	Female	Male: Female	Chi-square	P-values	Significant
Mar-15	4	3	1:0.75	0.06	0.82	P>0.05
Apr-15	6	2	1:0.33			
May-15	7	2	1:0.29			
Jun-15	6	3	1:0.5			
Jul-15	8	3	1:0.38			
Aug-15	8	3	1:0.38			
Sep-15	6	4	1:0.67			
Oct-15	8	3	1:0.38			
Nov-15	4	2	1:0.5			
Dec-15	5	4	1:0.8			
Jan-16	6	3	1:0.5			
Feb-16	5	3	1:0.6			
Mar-16	6	4	1:0.67			
Apr-16	7	3	1:0.43			
May-16	8	4	1:0.5			
Jun-16	6	5	1:0.83			
Jul-16	8	3	1:0.38			
Aug-16	6	3	1:0.5			
Average	114	57				

3.3. Gonad development

Freshwater *Sudanonautes africanus* detected in the months of March 2015 and August 2016 had only gonad stages I and II correspondingly. Stage III only had a specimen of both sexes in the months of June-July 2016 (Table 3).

Table 3. Monthly occurrence of different stages of the gonad in *Sudanonautes africanus*

Months	Sex	I	II	III	IV	V	Total observed
Mar-15	M	2	2	-	-	-	4
	F	2	1	-	-	-	3
Apr-15	M	4	2	-	-	-	6
	F	1	1	-	-	-	2

May-15	M	4	3	-	-	-	7
	F	1	1	-	-	-	2
Jun-15	M	3	3	-	-	-	6
	F	2	1	-	-	-	3
Jul-15	M	3	5	-	-	-	8
	F	2	1	-	-	-	3
Aug-15	M	4	4	-	-	-	8
	F	2	1	-	-	-	3
Sep-15	M	3	3	-	-	-	6
	F	2	2	-	-	-	4
Oct-15	M	6	2	-	-	-	8
	F	2	1	-	-	-	3
Nov-15	M	3	1	-	-	-	4
	F	1	1	-	-	-	2
Dec-15	M	3	2	-	-	-	5
	F	2	2	-	-	-	4
Jan-16	M	4	2	-	-	-	6
	F	2	1	-	-	-	3
Feb-16	M	4	1	-	-	-	5
	F	2	1	-	-	-	3
Mar-16	M	4	2	-	-	-	6
	F	2	2	-	-	-	4
Apr-16	M	4	3	-	-	-	7
	F	2	1	-	-	-	3
May-16	M	4	2	-	-	2	8
	F	1	1	-	-	2	4
Jun-16	M	4	1	1	-	-	6
	F	1	1	-	-	3	5
Jul-16	M	8	-	-	-	-	8
	F	1	-	1	-	1	3
Aug-16	M	4	2	-	-	-	6
	F	2	-	-	-	1	3

3.3. Fecundity and gonadosomatic index (GSI)

Table 4 showed the fecundity and GSI evaluation for *Sudanonautes africanus*. The length of the carapace of ripened females ranged from 3.12 to 11.2 cm. The range of values of the body weight was 18.97-33.33 g. The rate of the estimate of fecundity ranged from 11-35 eggs. The weight of the eggs ranged from 2.56 to 8.95 g. While the range of the GSI of *Sudanonautes africanus* (Milne-Edwards, 1869) was 11.28-41.44%, in July and June 2016.

Table 4: Fecundity estimates and GSI of selected female *Sudanonautes africanus* (Milne-Edwards, 1869)

Months	Number of female crabs	Carapace length (cm)	Weight (g)	Egg weight (g)	Absolute fecundity
May-16	4	11.2	33.3	8.95	35
Jun-16	5	7.8	19.23	5.63	27
Jul-16	3	3.12	25.3	2.56	15
Aug-16	3	6	18.97	4.13	23

4. Discussion

The condition factor obtained from this study revealed that *S. africanus* expressed a perfect degree of well-being, relative plumpness, or fatness in numerical terms. However, certain factors like age, sex, state of maturity, state of stomach fullness, sampling methods, and environmental conditions might have some limitations in some species sampled.

In this study, the sex ratio showed that the male *S. africanus* dominated the female *S. africanus*. The finding of this study was not similar to what was obtained by Arimoro and Orogun (2006) and Sodamola et al. (2016 and 2018).

The results of the fecundity of *S. africanus* showed that the sexually matured individual (females), were mainly in stage V. While those showing gonads development were mainly in stages I and II respectively. There were no individuals recorded in stage IV. The results obtained here are similar to what was obtained by Arimoro and Orogun (2006), Olusoji et al. (2009), and Sodamola et al. (2016). The findings of this study indicated that there was an association between the egg size with the weight and length of the carapace of the crab. That the crab species has the faculty to reproduce many eggs if the growth length is proportional to its weight. The results of GSI showed that the female *S. africanus* had more sexually matured gonads compared to the male *S. africanus*. This finding also correlates with the weight of the female which is evidence of ripened gonads; for the production of eggs.

5. Conclusion

This study has shown the biology of *S. africanus* in terms of its growth, reproduction, and body morphology. Evidence of these characteristic features has distinguished it from another genus. This species can be domesticated via aquaculture and can serve as an economic hub for future fishery business. More so, these species are widely common in the tropics especially the Ossiomu River. Conservation strategy should be employed to avoid environmental stressors in displacing it from its microhabitat.

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