Research Article
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Food and feeding habits, growth pattern and fecundity of *callinectes amnicola* in Lagos lagoon

Abstract

Crabs belong to the phylum Arthropoda together with other successful animals having exoskeletons. They are crustacean with broad, compact body and abdomen which is greatly reduced and tucked away underneath the cephalothoraxes. About 50 specimens, used for this study, were bought from Makoko market on June, 2011. They were caught by artisanal fishermen from Nigerian coastal waters. These specimens were examined for their growth pattern, food and feeding habit and reproductive biology of the shelf fish. The carapace length of the specimen ranged from 4.5 to 7.0. The correlation coefficient was 0.61 which showed a strong correlation between the standard length and weight. Out of the fifty shellfish specimens 24% has empty stomach. The condition factor ranged from 3.1 to 6.5 for the combined sexes. The result from chi-square test showed that the number of female was significantly more ($p>0.05$) than the number of males.

Keywords: *callinectesamnicola*, fecundity, condition factor

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Introduction

Crabs belong to the phylum Arthropoda with other successful animals with exoskeletons such as spiders and insects. It is a crustacean with broad, compact body and abdomen which is greatly reduced and tucked away underneath the cephalothoraxes. The crabs are so numerous with many families grouped into two broad categories: infra order Brachyura (true crabs) and infra order Anomuran (false crab). Brachyurans can be divided into the families Calappidae, Graspidea, Gecarcinidae, Geryonidae, Homolidae, Majidae, Ocypodidae, Xanthidae and Portunidae.[1]

Callinectesamnicola belong to family Potunidae. They are bottom dwelling aquatic crabs which are common constituents of tropical and subtropical estuarine system. *Callinectesamnicola* known as lagoon crabs are the most edible crab along the coastal habitats in the temperate, subtropical and tropical regions.[2]

Lagos Lagoon supports a major crab's fishery based on the abundance of the blue crab.[3] According to Lawal-Are,[4] the blue crab, *C. amnicolais* a very popular food item in the diet of coastal communities in West Africa. It is caught in the creeks, lagoons and adjacent inshore marine waters. It supports a major artisanal fishery in the Badagry, Lagos and Lekki Lagoons in south-west Nigeria where it is fished mainly by women.

Hartnoll[5] observed that growth is characterized by the change in size with time and change in shape resulting from differences in the rates of growth of different parts of the body. The growth due to changes in shape is referred to as relative growth. At puberty, the allometric growth of males becomes even more strongly positive while that of females continues to grow at prepuberty rate.[6]

In Nigeria, *Geryon maritae* (deep water crab), *Ocypode Africana* (ghost crab), *Goniopsis pelii* and *Sesarma* sp. (mangrove crabs), *Uca tangerii* (fiddler crabs), *Callinectes latimanus*, *C. amnicola, C. pallidus* and *C. marginatus* (swimming crabs), *Cardiosoma armatum* and *Gecarcinus weileri* (land crabs) are common species found in brackish and marine environments.[7,8]

Crab fisheries are carried out mostly by women and children (<16years) using traps made of basket, bicycle wheels and clay pots. Crabs attract the highest price in December when the females are berrying i.e. with eggs.[9]

In most West African countries, crabs are an important source of animal protein for coastal and riverine communities; hence most published works deal with their nutritional composition[10–12] and ecology,[13,14] Studied the size composition, growth pattern and feeding habits of the blue crab in the Badagry Lagos Lagoon Nigeria.

The objective of this study was to provide information on *Callinects amnicola* from the Lagos Lagoon with reference to the food and feeding habits, growth pattern, length–weight relationship, condition factor, sex ratio and the fecundity of the species.

Material and methods

The specimens used for this study were collected from Better-Life fish market of Makoko jetty in June, 2011. They were caught by artisanal fishermen who are mostly women from Lagos lagoon. Specimens were preserved in the freezer pending further analysis at the University of Lagos marine science laboratory to prevent spoilage.

Laboratory procedure

At the laboratory, the crab samples were thawed in the open air and body wiped dry. Measurements recorded for each specimen were carapace length (CL), carapace width (cw), carapace width without spine (cww), thoracic length, thoracic width, total weight. Sexes and food of the fish were determined.

Length measurement

The carapace length (CL), carapace width (cw), carapace width without spine (cww), thoracic length and thoracic width was measured using measuring tape to the neatest centimetre. This was done for all the specimens, snout to the posterior end of the mid lateral portion of the hypural (Plate 1). This measurement excludes the length of the caudal fin.

Plate 1 Picture of a *Callinectes amnicola.*

Weight measurement

An electric weighing balance (Sartorious) was used in measuring the weight of the samples, as well as the weight of their egg to nearest gram. This is done after draining water from the bucal cavity and blotting and excess water on the crab body.

Growth pattern

To determine growth pattern in the species carapace length – weight relationship for male, female and both were estimated using the equation:

$W=a1b$[15]

Length–weightrelationship

$W=aLb=a+bL$

Where

W=body weight of fish (g)

L=carapace length of crab (cm)

a=proportionality constant or intercept

b=regression coefficient

The corresponding log transformation values of carapace length and weight gives the linear expression $\log_{10} w = \log_{10} a + b \log_{10} cL$ via least square linear equation.[16]

In general, b less than 3.0 represents fish that become less rotund as length increase and b greater than 3.0, growth is isometric, this means that the shape does not change as fish grow.

Condition factor

In fisheries science, the condition factor is fatness or well being of fishes.

The condition factor was calculated for the males, females and combined sexes using the condition factor method of.[17,18]

Condition factor $K=100W/L3$

Where: K=condition factor

Weight in gram (g)

L=Length in centimetre (cm)

Reproductive biology

The crab samples were sorted out and sexed using their gonopod and the gonophore for female and male, respectively. They were dissected by opening the abdominal ventral cavity.

The gonad was used to determine the sex for each specimen. The shape of the abdomen is also used in differentiating sexes and stages of development in females.

The gonad sac for ripe samples was weighed and their fecundity was estimated. The gonadotropic index (Table 1) as well as sex ratio was estimated.

Table 1 Gonadotropic index of *C. Amnicola*

Specimen	Fish weight (g)	Ovary weight (g)	% G I
5	111.05	5572	6.40
41	130.0	5604	5.42
37	109.34	6342	6.62
19	83.93	2402	6.31
24	106.95	4807	6.36
35	95.40	3541	8.18

The gonadotropic index (GI) was calculated using the formula: *G.I=Ovary weight Fish weightX*100

A General development stage includes

i. Immature–White.

ii. Developing–pink.

iii. Ripe–orange in colour.

iv. Ripe running–Brown.

The fecundity was estimated from the ripe ovaries. (Stage iii)

Fecundity–the number of ripe eggs in the female fish prior to the next spawning.

The length–fecundity, weight-fecundity relationship were estimated by plotting the equation in a graph $Y=a+bx$

Where y=Fecundity

a=constant

b=constant

x=length or weight

Stomach content analysisincludes

The stomach contents were analyzed to establish the food habits of the fish. Since the fish were not frozen immediately after catching their stomach contents were not all represented. Food items were quantified by two methods, the numerical and frequency of occurrence methods.[19,20] A scatter diagram of the relationship is shown in (Figure 1). In the numerical method the number of each food item was expressed as the percentage of the total number of food items found in the stomachs while in the frequency of occurrence method, the occurrence of food items was expressed as the percentage of the total number of stomach containing food.

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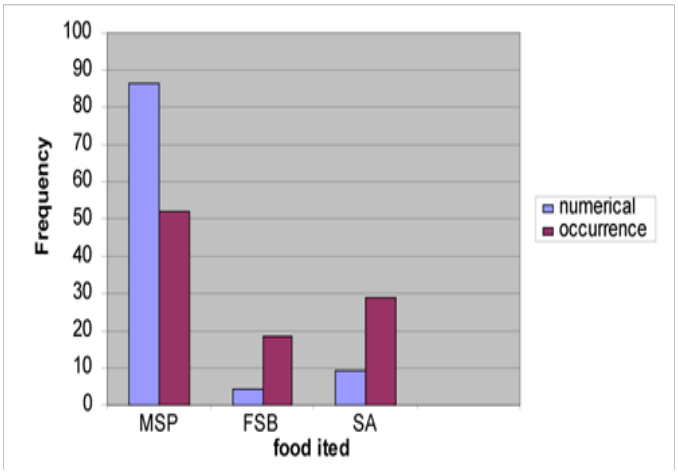

Figure 1 Stomach content of *Callinectes amnicola* from lagos lagoon.

Results

Size composition of *Callinectes amnicola*

Twenty-five Specimens of *Callinectes amnicola* were studied for length-frequency distributions. Summary is illustrated in (Table 2 & Table 3) and (Figure 2 & Figure 3), which showed that the population obtained contained large number of crabs measuring between 6.0 and 6.4 as the majority were female crabs.

Table 2 Summary of carapace length-frequency distribution of *Callinectes amnicola* in lagos lagoon

Carapace length range (g)	Mid class (cm)	Frequency	% Frequency
4.5- 4.9	4.6	3	6
5.0- 5.4		-	-
5.5- 5.9	5.8	10	20
6.0- 6.4	6.1	21	42
6.5- 6.9	6.7	14	28
7.0- 7.4	7.0	2	4
TOTAL		**25**	**100**

Table 3 Summary of carapace length-frequency distribution of *Callinectes amnicola* in lagos lagoon

Carapace length range (cm)	Male	Female	% Frequency male	% Frequency female
4.5- 4.9	1	2	2	4
5.0- 5.4	-	-	-	-
5.5- 5.9	3	7	6	14
6.0- 6.4	5	16	10	32
6.5- 6.9	-	14	-	28
7.0- 7.4	-	2	-	4

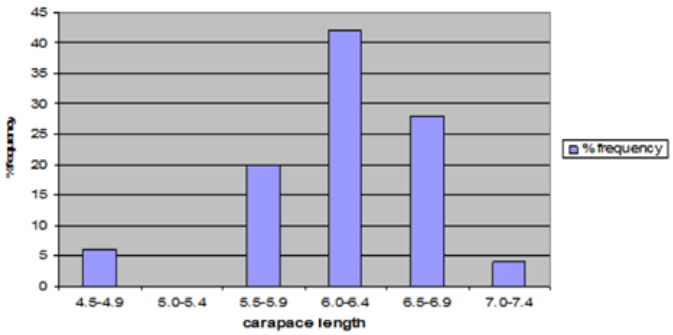

Figure 2 Carapace length frequency distribution of *C. amnicola* in lagos lagoon.

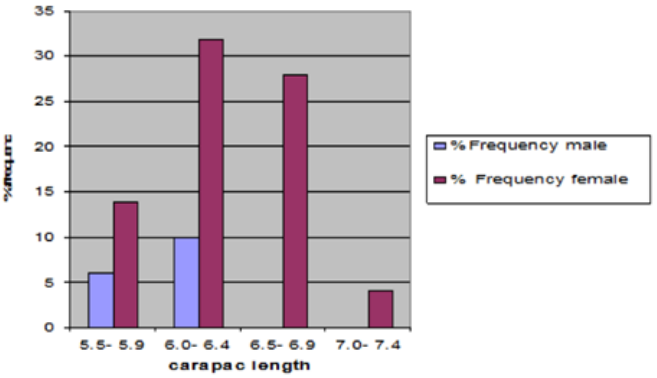

Figure 3 Carapace length frequency of male and female of *C. amnicola.*

Growth pattern

The total weights of *Callinectes amnicola* ranged from 6.5 to 136.36 and the carapace length ranged from 4.5 to 7.0. This showed increase in length with increase in weight.

The carapace length total weight was transformed into the logarithm form. The log carapace length- logweight relationship showed a linear relationship. The scatter diagram showing log length and log weight relationship is illustrated in (Figure 4 & Figure 5).

From the equation

Logw=Loga+bLogL

LogWt=log1.005+1.2375logCL

a=1.005

b=1.2375

n=50

r =0.612

The value of 'b' obtained for the crab was less than 3. This indicates that *Callinectes amnicola* from the Lagos lagoon exhibited a negative allometric growth. The correlated coefficient 'r' was 0.612 shows a strong correlation between the standard length of *Callinectes amnicola* and total weight.

Condition factor (k)

The summary of condition factor by size of *Callinectes amnicola* is presented in (Table 4). The k-values ranged from 2.22 to 2.78, 2.5-3.0 and 2.30-2.89 for males, females and combined sexes, respectively. The highest k value was recorded for males in size 5.5–5.9.

Generally 'K' value decreases as length and weight increase. The

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males in each group had a higher 'k' value than the females with the exception of the females in the size group of 4.5–4.9.

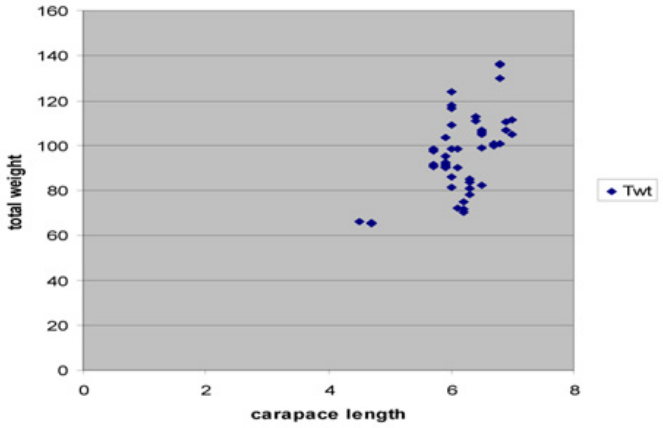

Figure 4 Carapace length–total weight relationship of *C. amnicola* from Lagos Lagoon.

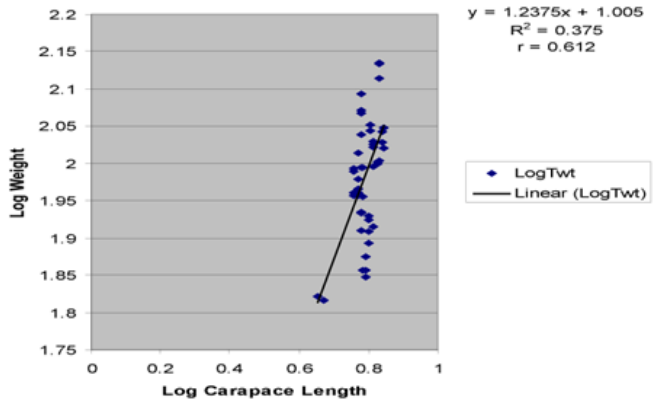

Figure 5 Diagram of log length–log weight relationship of the combined sexes of the *Callinectes amnicola.*

Food and feeding habits

Stomach analysis: The stomach content of twenty-five specimen of C. Amnicola was examined for food. Eight (16%) of the crab had empty stomachs.

Food item of *Callincetes amnicola*: The crab samples were left for some time after being bought before putting in the freeze, thus most of the food in their stomach would have being digested.

The summary of stomach contents of C. amnicola is represented in Table 5. The food items found mostly include mollusc shell parts, fish scales and bones and shrimp appendages. Mollusc shell parts constituted the most important by both occurrence method (51.9%) and numerical method (86.4%).

Sex ratio

Out of the twenty-five specimens of *Callinectes amnicola* studied, only nine males were found. The result of chi-square test showed that the number of female *Callinectes amnicola* is more significance than the number of males. (Table 6) given rise to the ratio of 1: 0.2

X^2=(*observed–expected*)2*expected*

$(X)^2=(9-25)225+(41-25)225$

$(X)^2=(-16)225+(16)225$

$(X)^2=25625+25625=20.48*$

Table X^2 1df at 5%=3.84

Hence calculate $X^2>3.84$ (table X^2)

Therefore the number of female was more significant than the number of male.

Fecundity

The relationship between carapace length and fecundity was determined in Table 7. A scatter diagram of the relationship is shown in Figure 6. Variability in the number of eggs for crabs of the same carapace length was observed.

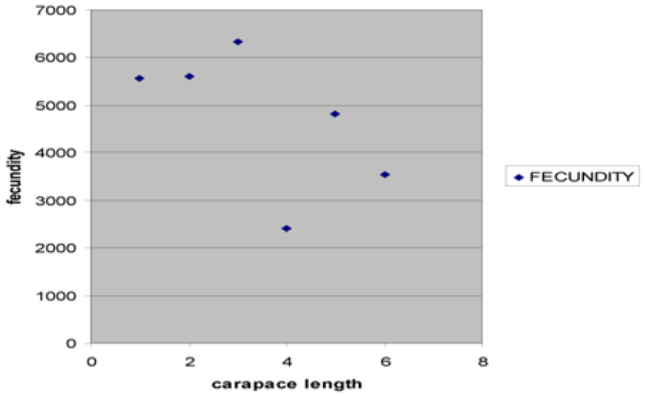

Figure 6 Carapace length- fecundity relationship of *C. Amnicola* from Lagos Lagoon.

The relationship between Log carapace length and Log fecundity was determined in Table 7. A scatter diagram of the relationship is shown in Figure 7.

The relationship between weight and fecundity was also examined. A scatter diagram of the relationship is shown in Figure 8.

The relationship between Log total weight- log fecundity was also examined. A scatter diagram of the relationship is shown in Figure 9.

Log fecundity= -Log 0.7085+2.1562 Log weight

a=-0.7085

b=2.5156

r=0.877

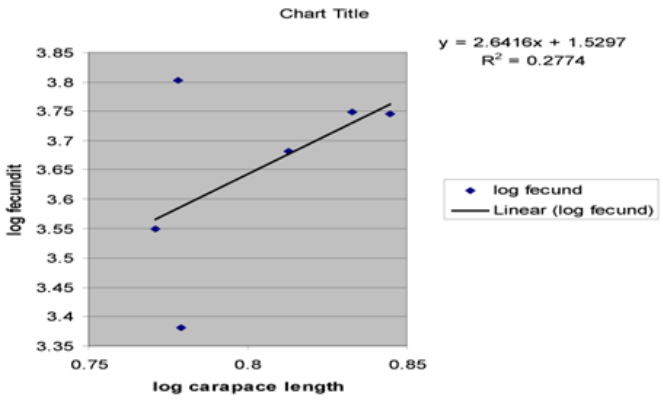

Figure 7 Log carapace length- log fecundity relationship of *C. Amnicola* from Lagos Lagoon.

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Table 4 Condition factor k by sex and size of *C. Amnicola*

Size group	Male				Female				Combined sexes			
Standard length (cm)	F	CL	WT	K	F	CL	WT	K	F	CL	WT	K
4.5 – 4.9	1	4.7	6.5	6.3	2	4.6	65.84	6.7	3	4.65	65.65	6.5
5.0 – 5.4	-	-	-	-	-	-	-	-	-	-	-	-
5.5 – 5.9	3	5.8	97.76	5.0	7	5.8	92.59	4.7	10	5.8	95.18	4.8
6.0 -.6.4	5	6.0	111.58	5.1	16	6.1	87.53	3.8	21	6.05	99.56	4.4
6.5 – 6.9	-	-	-	-	14	6.7	111.16	3.6	14	6.7	111.16	3.6
7.0 – 7.4	-	-	-	-	2	7.0	107.96	3.1	2	7.0	107.96	3.1

F, frequency, CL, mean carapace length, Wt, mean total weight, k, condition factor, k=100w/L3

Table 5 Summary of the stomach content of *Callinectes amnicola* in Lagos Lagoon

	Numerical method		Occurrence method	
Food items	Numerical value	Percentage (%)	Frequency	Percentage (%)
Mollusc shell Parts	1,312	86.4	14	51.9
Fish scales and bones	67	4.4	75	18.51
Shrimp Appendages	140	9.2	8	29
Total	**1519**	**100**	**27**	**100**

CL, mean carapace length, Wt, mean total weight

Table 6 Test calculation on sex ratio of *Callinectes amnicola*

Sex	Observed	Expected
Male	9	25
Female	41	25
Total	**50**	**50**

*Significance

Table 7 Fecundity data

Specimen	CL (cm)	WT (g)	Log CL	Log WT	Fecundity	Log fecundity
5	7.0	111.05	0.845	2.046	5572	3.746
41	6.8	130.0	0.833	2.114	5604	3.748
37	6.0	109.34	0.778	2.039	6342	3.802
19	6.3	83.93	0.779	1.924	2402	3.381
24	6.5	106.95	0.813	2.029	4807	3.682
35	5.9	95.40	0.771	1.980	3541	3.549

Discussion

The males of C. amnicola, studied, were generally larger than the females. This is in conformity with the observation of[21] who indicated that the true crab males are generally larger than females. The carapace length frequency histogram showed distinct size groups. The carapace length ranged from 4.5cm to 7cm and has its highest frequency of 21 in the size range of 6.0-6.4, thus, size group 6.0-6.4 was most abundant. The linear relationship between carapace length and total weight of crab reflecting the increase in weight with the increase in length was similar to the results obtained by Lawal-Are.[22] This relationship exhibited a cluster pattern which indicated that the species were from the same age rank.

The length-weight relationship of C. amnicola from Lagos Lagoon showed negative allometric growth. This was in line with the findings of Lawal-are.[23] The value of 'b' obtained for the crab was less than 3. This indicated that *Callinectes amnicola* from the Lagos lagoon exhibited a negative allometric growth. The correlation coefficient 'r' was 0.612 which shows a strong correlation between the standard length of *Callinectes amnicola* and total weight.

The mean condition factor for different sizes ranges from 3.1 to 6.5. It changes with increase in length. It could be concluded that k-condition factor decreases as the crab becomes larger. The condition factor (k) which is used to determine the condition of the habitat and overall well being of crab varied by size for C. amnicola from Lagos Lagoon. A crab is said to be in good condition when 'k' is high. From the data obtained, 'k' decreases with increase in carapace length.

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Stomach analysis carried out on *Callinectes amnicola* indicated that the fishes are scavengers and carnivores. The diet constituted mainly crayfish, fish, molluscs and crab. These are active sedentary benthic organisms showing that the species is a bottom carnivores. This conformed to the finding of;[24] who stated that *Callinectes amnicola* benthic animals that fed on other crustaceans, fish, bivalves. This study showed that number of *Callinectes amnicola* females were significantly more than the number of males from the expected 1:1 ratio to 1:0.2. The crab samples with the same length or weight had variable fecundity is also in line with Kusemiju and Osibona.[25]

Acknowledgements

None.

Conflict of interest

The author declares no conflict of interest.

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