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 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, Geryoniidae, Homolidae, Majidae, Ocypodidae, Xanthidae and Portunidae [1].

*Callinectes amnicola* belong to family Potunidae. They are bottom dwelling aquatic crabs which are common constituents of tropical and subtropical estuarine system. *Callinectes amnicola* 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. amnicola* is 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 (< 16 years) 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.

**Materials 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 nearest 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.

**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:

\[ W = aL^b \quad \text{[15]} \]

**Length – weight relationship**

\[ W = aL^b = a + bL \]

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].

\[ \text{Condition factor } K = \frac{100W}{L^2} \]

Where: 
- \( K \) = condition factor
- \( W \) = 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.

**Gonadotropic index (GI)**

The gonadotropic index (GI) was calculated using the formula:

\[ GI = \frac{\text{Ovary weight}}{\text{Fish weight}} \times 100 \]

**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.

**Table 1: Gonadotropic Index of *C. Amnicola*.

| Specimen | Fish weight (g) | Ovary weight (g) | % GI |
|----------|----------------|-----------------|------|
| 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 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 analysis**

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.

**Results**

**Size composition of Callinectes amnicola**

Twenty-five Specimens of Callinectes amnicola were studied for length-frequency distributions. Summary is illustrated in (Table 2 and 3) and (Figure 2 and 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.

**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 and 5).

From the equation

\[ \log w = \log a + b \log L \]

\[ \log Wt = \log 1.005 + 1.2375 \log CL \]

\[ a = 1.005 \]

\[ b = 1.2375 \]

\[ n = 50 \]

\[ r = 0.612 \]

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

**Table 2: Summary of carapace length-frequency distribution of Callinectes amnicola in Lagos Lagoon.**

| Carapace length Range (cm) | Mid class (cm) | Frequency | % Frequency | Male | Female | % Frequency Male | % Frequency Female |
|----------------------------|----------------|-----------|-------------|------|---------|------------------|-------------------|
| 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 carapace length-frequency distribution of Callinectes amnicola in Lagos Lagoon by Sexes.**

| 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 1:** Stomach content of Callinectes amnicola from Lagos Lagoon.

**Figure 2:** Carapace length frequency distribution of C. amnicola in Lagos Lagoon.

**Figure 3:** Carapace length frequency distribution of C. amnicola in Lagos Lagoon by Sexes.
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 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.

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 Callinectes 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 C. amnicola is more significance than the number of males. (Table 6) given rise to the ratio of 1: 0.2

\[ X^2 = \frac{(observed – expected)^2}{expected} \]

\[ (X)^2 = \frac{(9 – 25)^2}{25} + \frac{(41 – 25)^2}{25} \]

\[ (X)^2 = \frac{(-16)^2}{25} + \frac{(16)^2}{25} \]

\[ (X)^2 = \frac{256}{25} + \frac{256}{25} \]

\[ = 20.48* \]

Table X^2 1df at 5% = 3.84

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

* Significance

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.

The relationship between Log carapace length and Log

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

| Size group (cm) | 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/L^3

Table 5: Summary of the stomach content of C. Amnicola in Lagos Lagoon.

| 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 | 18.5 |
| Shrimp Appendages | 140 | 9.2 | 8 | 29 |
| Total | 1519 | 100 | 27 | 100 |

Table 6: Test Calculation on Sex Ratio of C. Amnicola.

| Sex | Observed | Expected |
|-----|----------|----------|
| Male | 9 | 25 |
| Female | 41 | 25 |
| Total | 50 | 50 |

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 |

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 Logweight

a = 0.7085
b = 2.5156
r = 0.877

Discussion
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.

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].

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