POPULATION STRUCTURE AND BIOMETRIC RELATIONSHIPS OF *Callinectes amnicola* FROM THE CROSS RIVER ESTUARY, NIGERIA

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ABSTRACT

The population structure, carapace length-weight, carapace width- weight, carapace length-width parameters and condition indices of 262 specimens of Callinectes amnicola from the Cross River Estuary, Nigeria, were estimated for males, females and combined sexes. The results indicate that sex ratio was in favour of females (1:3.05, χ^2 = 67.26, 1df). Females were significantly heavier than males (χ^2 = 12.15, 1 df, P < 0.05) but not significantly longer. Weight was found to be isometric with carapace length (b = 2.37) while carapace width-weight was negatively allometric (b = 2.17), indicating that the crabs get thinner with increase in width. The carapace length - width relationship showed b is < 3.0, indicating negative allometric growth pattern. Mean values of condition factors were higher in males than females suggesting males had a better condition during the study period. Average growth rate of C. amnicola in the estuary was estimated as 3.0 - 7.5 mm CL/month (smaller crabs grew faster).

Keywords: isometry, population dynamics, Fulton's condition factor

INTRODUCTION

The variation in population characteristics of estuarine and marine crab populations is an annual phenomenon that is yet to be documented for the Cross River Estuary (CRE), and Southeast Nigeria. Generally, adult portunid crabs migrate in and out of the sea for growth and spawning. Nourishment and growth of juvenile crabs occurs in the estuaries, followed by seaward migration in adulthood.

Growth in crabs, characterized by changes in size (isometry) and in shape (allometry), result from gradual reduction in growth rate or differences in the rates of growth of different parts of the body. Growth of a part of a body (Y) relative to another part (X) are not uniform and may be expressed graphically or based on allometric relationships in the form $Y = aX^b$, where Y and X are dependent and independent variables (like carapace length and weight), respectively, and '***a***' and '***b***' are constant and coefficient, to be determined empirically. Such relationships are strong tools for studies of sexual dimorphism, distinction between hybrids and parental species, population ecology, among others (King, 1996; Udoidiong, 2005).

Biometric data such as Length - Weight Relationship (LWR) has both applied and basic uses (Pitcher and Hart, 1982) in the practical assessment of fish/crab stocks. It allows predictions of weight from (carapace) length in yield assessments, especially when the fish are landed in the market gutted, headless (or without elongated spines, as in crabs). It also allows prediction of mean weight of the crab for a given carapace length class, conversion of growth equation for carapace length into equation for weight, for morphological comparisons between population of same or different factor (Pauly, 1993).

Callinectes amnicola occurs in the West African coastline from Mauritania to Angola (Holthuis, 1981). *Callinectes* species are especially abundant and support very lucrative commercial and recreational fisheries in Chesapeake Bay and its tributaries in the United States of America and in countries located along the Atlantic Ocean such as the Gulf of Mexico, Australia, Canada, Japan, Philippines and Southeast Asia. It commands international trade valued of over US$ 3.5 million and over 1.7 million pounds. In addition, there is over one hundred year's catch and effort statistics available on record (Oersterling, 1996). Dankwa and Entsua-Mensah (1997) reported the widespread distribution of *C. amnicola* (= *C. latimanus*) among other fin-and shellfishes in forty lagoons and three estuaries in Ghana. Kwei (1978) reported on the occurrence, size composition, growth and sexual maturity of *C. amnicola* in two Ghanaian Lagoons while Durand *et al.* (1982) reported that 500 - 900 metric tonnes of *C. amnicola* are landed annually in Ivory Coast.

Little is known of crab fisheries in Nigeria. Most published works deal with their taxonomy and distribution (Powell, 1983, 1985; Jonathan and Powell, 1989), nutritional composition (Fineman-Kalio, 1987; Idoniboye-Obu and Ayinla, 1991; Alfred-Ockiya, 2000; Oduro *et al.*, 2001), ecology (Okafor, 1988; Lawal-Are and Kusemiju, 2000; Arimoro and Idoro, 2007), morphometrics (Anetekhai *et al.*, 2004; Akin-Oriola, 2005), and food and feeding (Chinda *et al.*, 2000; Lawal-Are and Kusemiju, 2000; Arimoro and Idoro, 2007).

C. amnicola constitutes about 3.27% by weight and 1.27% by number, of the annual landings in the shrimp beam trawl fishery off Lagos and the artisanal gillnet fishery off the Cross River estuary, Nigeria (Ambrose *et. al*., 2005; Holzlohner *et. al.,* 1998). The crab is fished at trawling depths of 30 – 70 m in the coastal deep sea waters of Nigeria with a mean catch of 49 – 70 kg (Tobor, 1991), and a declining annual production of 68 – 28 MT between 1988 and 1994 (FDF, 1995).

They constitute an important cheap dietary and food component to the coastal populations where animal protein is expensive. Preliminary report on the proximate and mineral composition of *C. amnicola* from an adjacent estuary, Qua Iboe River estuary, indicates that it contains 40 - 60% crude protein, 10 - 12% fat, 2 – 3% ash/minerals, and 7 – 15% moisture. *C. amnicola* also contains 26 – 32 mg $100g^{-1}$ vitamin A, 95 – 97 mg 100 g^{-1} Iron and 14 – 21 mg 100 g^{-1} Zinc which are considered adequate for all categories – infants children, adolescents, adults and the elderly (Udoh, unpublished).

This study is part of a series to understand the biometrics, ecophysiology, behavioural ecology and population dynamics of *Callinectes* species from the Cross, Qua Iboe and Imo River estuaries in southeastern Nigeria. The main aim of this paper is to provide the seminal information on the population structure, abundance, seasonality of occurrence, sex ratio, and size frequency, LWR, carapace length – width distribution and carapace width-weight relationships for *Callinectes amnicola* from the Cross River estuary, Nigeria. It is hoped that the biometric estimates generated could be incorporated into databases, such as fish base (Pauly and Froese, 1991) for easy access, retrieval and use by researchers and fisheries managers in understanding and managing the *Callinectes* fishery in Nigeria.

STUDY AREA

This study was conducted in the Cross River estuary (Fig.1) located between latitudes 4° 15' and 4° 45'N and longitudes 8°5' and 8° 35'E, in the tropical rainforest belt of Southeastern Nigeria. It exhibits marked seasonal changes in salinity from 0.5 ppt during the rainy season to 12 ppt in the dry season. The estuary receives seawater from the Atlantic Ocean and fresh water from the Great Kwa River and Calabar Rivers. Salinity changes are attributed to large volumes of water discharged (2,533 m^3 s^{-1}) in the wet season (879 m^3 s^{-1}in the dry season) which pushes salt water out of the estuary (Lowenberg and Kunzel, 1992).

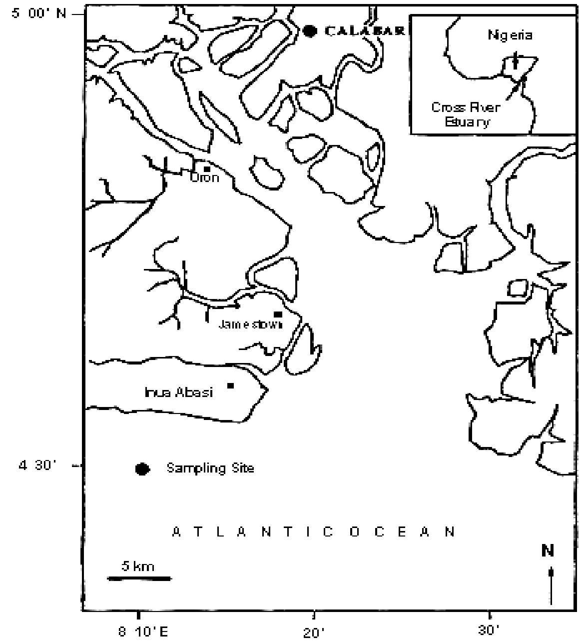

Fig. 1: The Cross River Estuary, Nigeria showing the sampling station – Calabar

MATERIALS AND METHODS

Two hundred and sixty-two samples of *Callinectes amnicola* were collected from the shrimp/crab fishers of the Cross River estuary landing on the beach of the Calabar River during the crab-fishing season (December to May). The flooding of the Cross River in the raining season, accompanied reduced salinity forces seaward migration of crabs (resulting in a natural closed season: June - November).

Upon collection of crab samples, the carapace length with spines (CL) mm (from tip of frontal spine to margin of carapace), carapace width with spine (CW) mm (from tip of one lateral spine to tip of the other) were measured to 0.1mm using vernier calipers; and after draining out excess water from the body, the total weights, (TW), were taken to 0.1g using electronic balance. Specimens were sexed by means of abdominal widths (narrow in males, broad in females). The sex ratio was analyzed by the chi-square χ^2 tests (Sokal and Rohlf, 1981). The carapace length - weight and carapace width - weight relationships were established for males, females and combined sexes by least square regression analyses of the variables after logarithm transformation. The equation was of the form:

$$\mathbf{W = a + bL} \quad (1)$$

where W = log weight in grams, L = log carapace length or width in mm and a = constant, b = exponent of carapace width or length.

The carapace length - width relationship was determined by the method of least square regression analysis in the form: CW=a + b CL.

$$CW = a + b\ CL \qquad (2)$$

The exponents (b) of the regression analyses obtained were tested for departure from isometry (i.e., b = 3) using t - statistics given in Sachs (1974) as:

$$t = \frac{S_X|b-3|\sqrt{n-2}}{S_y\sqrt{1-r^2}} \qquad (3)$$

The correlation coefficients, r, were also tested for significance using the relationship:

$$t = \frac{r}{\frac{\sqrt{(1-r^2)}}{n-2}} \qquad (4)$$

where S_X, S_y are standard deviations of CL, W; CW, and CL, CW, respectively; r^2 is the coefficient of determination of the relationship.

The means of carapace length ($\overline{CL}$) and weight ($\overline{W}$) of crabs were used to calculate the Fulton's condition factor (K) following the relationship:

$$K = \overline{W} \times 100/\overline{CL^3} \quad \text{(Wooton,1992)} \qquad (5)$$

Population parameters determined included number of crabs caught per (mean) width, length and weight of males, female and combined sexes.

RESULTS

Sex Ratio

Two hundred and sixty two specimens of *Callinectes amnicola* were examined, out of which 65 (24.08%) were males and 197 (75.02%) females, giving an overall male-female ratio of 1:3.05 which is significantly different from unity (χ^2=3.841, 1df, P < 0.05) in favour of females and with size of crab (Fig. 2a-d and Tables 1 & 2). Sixty-five to ninety-seven percent of crabs sampled between December and May were females, except in March, when males dominated the catch (Table 1).

Population Size Distribution

The total weight, carapace length and carapace width distribution of *Callinectes amnicola* in the CRE is shown in Fig. 2. Two modes were identified for females in each size dimension; 60 mm and 70 mm CL, 130 mm and 120 mm CW and 80 and 100 g W. The corresponding values for males were 40mm and 60 mm CL, 130 mm CW and 30 g W. Females were present in all size classes while males occurred more in the mid-range sizes.

Two growth patterns were observed. Large crabs entered the fishery estuary in large numbers at 50 mm CL in December and grow to 65 mm CL in April and then undertake seaward migration for further growth and reproduction. Smaller crabs enter the estuary at 30 mm CL in February and grow up to 60 mm CL in May before also undertaking seaward migration. The average growth rate of *Callinectes* in the estuary is 3mm CL/month for large crabs and 7.5 mm CL/month for smaller crabs. Generally, abundance of crabs falls (24 - 12%) as dry season gives way to the rainy season and estuary water is diluted, prompting seaward migration of adult crabs.

Generally, crabs whose lengths are longer than the mean, 55.06 mm CL populate the estuarine fishery. The smallest size categories (20 – 30 mm CL) occurred in the months of February and March, indicating short recruitment period. The modal length of the youngest brood in the catch samples (i.e., 32.5 mm CL) was used as the cut-off length in determining the index of recruitment (Enin, 1994) based on monthly percentage juveniles (≤ 32.5 mm CL) of which 75% of juveniles were males.

There was intersexual variation in total weight of C. *amnicola* as shown in Table 2. The females were significantly heavier in weight (g) than the males in the months of January, February and March while the males were significantly heavier in weight in the month of December and April - May. Female overall average weight (84.26 g) was significantly heavier by 12.15 g than that of males (72.11 g) (χ^2 = 12.15, 1df, P < 0.05). Total weight of the samples ranged between 4.50 and 195.00 g.

The male-female weight model in the crab fishery shows that as the mean weight of females increase, the reverse was observed in males (Fig. 2b). Details of the monthly mean variation in carapace length (CL mm) of *C. amnicola* are presented in Table 2. There was no significant difference in carapace length in this present study, except in the months of January and February when females exhibited significantly longer length than the males (P < 0.05). Average length of female was 59.55 mm. During the study, females were longer than males (CL = 50.62 mm) by 8.93 mm while the carapace length profile ranged between 23.00 and 84.9 mm.

Carapace widths of the samples obtained ranged from 37.00 to 180.00 mm. Average carapace width of males (124.40 mm) was greater than that of females (116.59) mm by 7.81 mm. No statistical difference was observed (χ^2 = 1.19, 1 df, P < 0.05). Intersexual variation in carapace width is shown in Table 3.

There were no significant variations in K (condition factor) values between males and females throughout the study period. The K values were low and ranged between 0.04 to 0.07 in males and 0.02 to 0.06 in females. The peak was in the month of February at 0.07 and was lowest in May at 0.04.

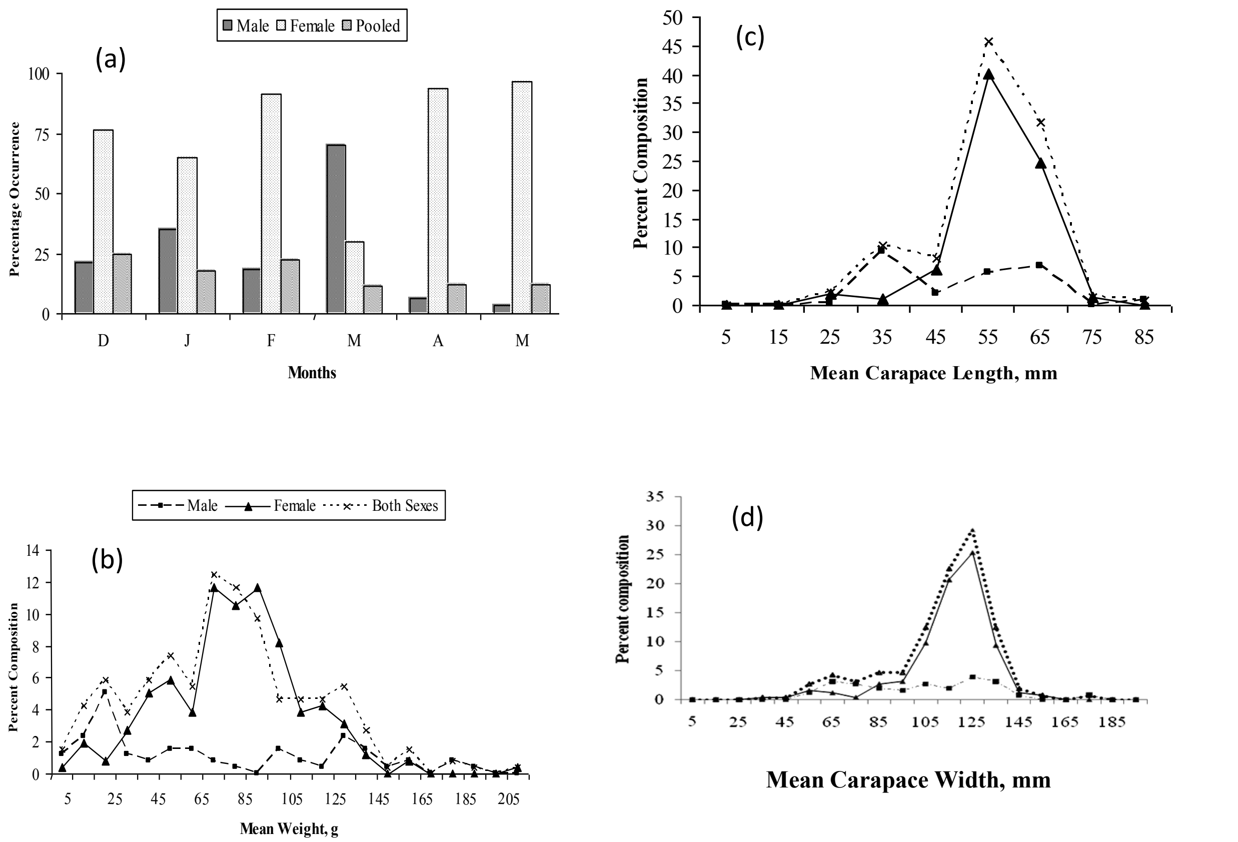

Fig. 2a-d: Distribution of population, total weight, carapace length, width and condition factor of *C. amnicola* in the Cross River estuary, Nigeria

Table 1: Population Structure of *Callinectes amnicola* from Cross River Estuary, Nigeria

Carapace Length (mm)	Dec. ♂	Dec. ♀	January ♂	January ♀	February ♂	February ♀	March ♂	March ♀	April ♂	April ♀	May ♂	May ♀	Freq. ♂	Freq. ♀
20.1 - 25.0					0	1							0	1
25.1 - 30.0					0	2	1	2					1	4
30.1 - 35.0			5	0	5	1	4	0					14	1
35.1 - 40.0			3	2	2	0	5	0					10	2
40.1 - 45.0			0	0	1	5	2	2	0	2	0	1	3	10
45.1 - 50.0	0	1	0	1	1	1	1	0	0	2	0	1	2	6
50.1 - 55.0	2	11	3	2	1	4	0	0	1	6	1	8	8	31
55.1 - 60.0	3	27	2	6	1	18	1	1	0	11	0	11	7	71
60.1 - 65.0	6	10	3	11	0	15	6	1	1	5	0	10	16	52
65.1 - 70.0	1	2	0	6	0	1	1	1	0	3			2	13
70.1 - 75.0			0	2			0	1					0	3
75.1 - 80.0							0	1					0	1
80.1 - 85.0	2	0											2	0
∑	14	51	16	30	11	48	21	9	2	31	1	31	65	197
Sample No.	65		46		59		30		33		32		262	
♂:♀	1:3.64		1:1.875		1:4.36		1:0.43		1:15.5		1:31		1:3.05	
χ^2, df = 1	21.16***		4.26*		23.20***		4.8**		17.64***		28.13*		67.26***	

*, *** means significant at P<0.05 and P<0.001 level, respectively; ♂ = male; ♀= female
(χ^2 = 3.841, df = 1, 5% level; χ^2 = 10.83, df = 1, 0.1% level)

Table 2: Monthly intersexual mean variation in carapace length (mm) and total weight (g)

	Carapace Length				Total Weight			
Month	Male	Female	Pooled	χ^2 test	Male	Female	Pooled	χ^2 test
December	64.28	58.28	59.58	0.29	137.68	98.93	107.28	86.79***
January	49.49	77.90	66.94	6.34*	47.89	81.80	68.96	8.93 *
February	41.66	54.20	51.65	7.97*	47.47	87.97	79.68	13.87***
March	46.66	52.6	48.45	0.35	58.30	81.40	65.23	4.75 *
April	58.45	56.23	56.38	0.04	92.90	73.24	74.55	4.54 *
May	52.10	57.01	56.85	0.22	85.60	67.74	67.62	4.78 *
∑	50.62	59.55	255.06	0.72	72.11	84.26	81.24	12.15 *

*, *** represent significance at 5% and 0.1% levels, respectively.

Table 3: Monthly intersexual mean variations in carapace width (mm)

Month	Male	Female	Pooled	χ^2 test
December	133.21	119.00	122.11	1.09
January	91.19	121.85	111.41	4.65*
February	82.29	113.38	106.95	6.07*
March	102.23	109.89	104.88	0.31
April	136.86	111.86	112.67	4.88*
May	117.1	118.59	118.55	0.02
∑	124.4	116.59	113.29	1.19

(χ^2 = 3.841, 5% level, df = 1), * indicates significant at 5% levels.

Carapace Length – Weight Relationship

Carapace length and total weight were significantly correlated in C. *amnicola* in Cross River estuary (r = 0.863, 194 df, P < 0.05). About 74.40% of the variations in body weight were explained by changes in carapace length. Table 4 presents the carapace length - weight relationships obtained for *C. amnicola.* The values of the exponent, ***b***, for males and females were significantly (P < 0.05, t - Test) lower than 3.0, indicating that individual weight growth of male and female *C. amnicola* departs significantly from isometry. The ***b*** value for the pooled sample was not significantly lower than 3.0 (P > 0.05, t - Test, t = 1.05) indicating an isometric condition.

Carapace Width - Weight Relationship

The carapace width - weight relationships obtained for *C. amnicola* correlated significantly and had the forms:

Male: Log W = -3.84695 + 2.7806 Log CW
(r^2 = 0.787, t - Test, P < 0.05, df = 61).

Female: Log W = -1.5089 + 1.6476 Log CW
(r^2 = 0.496, t - Test, P < 0.05, df = 188).

Combined Sexes: Log W = -2.59306 + 2.1688 Log CW (r^2 = 0.640, t - Test, P < 0.05, df = 250).

t - Test analyses of the exponent, ***b***, reveal isometric condition in males where ***b*** is not significantly different (P > 0.05), t = 1.1833, df = 61) from 3. The ***b*** values for females and combined sexes were significantly lower than 3 in each case (P < 0.05, t - Test) indicating negative allometric growth, which means they tend to become thinner as they grow larger.

Carapace Length - Width Relationship

Table 4 shows the relationship between carapace length (X) and width (Y) in *C. amnicola.* The regression equations derived for males, females, and combined sexes are indicated. The overall regression analyses for combined sexes indicated significant correlations ($r^2 = 0.818$, t – Test, $P < 0.05$, df = 254) between the variables giving the equation: CW = 2.3277+2.01CL. The exponent, ***b***, was significantly lower than 3, indicating negative allometry. Similarly, carapace length - width relationships for males and females were negatively allometric and are described by the equations:

Male: CW = -2.4824 + 2.09CL, $r^2 = 0.96$

Female: CW=41.6083 + 1.33CL, $r^2 = 0.38$

DISCUSSION

The absence of crabs of less than 37.00 mm CW or 23.00 mm CL indicates bias in the sampling methods in favor of large crabs of market value. Crabs (<37 mm CW) are usually discarded by the fishers before landing. The sex-wise distribution of crabs during the six months crab season showed females to be significantly more than males all through the study period, except in March. Devi (1985) made similar observations. He observed a dominance of females over males in *Scylla serrata* crab in Kakinada Region of India and attributed it to schooling according to sex. Considering that samples for this study were obtained from shrimpers, who fish on the bottom and fringes of the estuary, the female dominance could be due to spatial preference of females for deeper waters, efficiency of fishing gear and market preference for large crabs as suggested by Archambault *et al.* (1990).

The predominance of female over males largely influences the male-female weight profile, illustrated in Fig. 2a and Table 2. The males were heavier than females as also observed by Pullen and Trent (1970), Abbe (1983), Olmi and Bishop (1983) and Nlewadim *et al.* (2009) which indicate that males of a given carapace width (CW) are heavier than females of the same CW. Mature males weighed more than similar-sized immature males; in contrast mature females weighed less than immature females of equal size. Crabs with short lateral spines were heavier than those of same sex and width with long spines. Sexual differences in growth rates become evident after puberty. Mature males are generally larger than mature females since females devote part of their energy to gonadal development while males devote their energy to somatic development alone. The mean lengths and widths of crabs in this study did not show significant monthly variation. This suggests small-scale recruitment and/or high fishing pressure, which do not allow room for increase in sizes. The abundance of larger-sized crabs (≥150 mm CL) peaked in December and declined steadily (Table 1); with change in salinity. The moderate peak observed in May reflected migrating females as they withdrew from the estuary to water of higher salinity in the outer estuary, for eventual spawning (Fig. 3). The percent of male was highest in March and dropped steadily as salinity decreased. Nlewadim *et al.* (2009) and Abowei and George (2010) also reported a mass catch of *C. amnicola* between December and January at Imo River estuary and Okpoka creek of the Niger delta, respectively.

Akin - Oriola *et al.* (2005) observed that sexually dimorphic characters such as body weight and condition factor were higher in males than females of *Cardiosoma armatum* and *Callinectes pallidus* from Ojo Creek, in Badagry, Lagos, Nigeria. *Cardiosoma armatum* showed higher variation than *Callinectes pallidus*. Lawal-Are and Kusemiju (2000) and Arimoro and Idoro (2007) observed that the carapace length (CL) frequency distribution of *C. amnicola* in Badagry, Lagos showed unimodal distribution. The CL ranged from 7.5 to 11.45cm (with a mode of 8.5 – 9.4) and CW of 3.5 – 7.5cm (and mode of 4.5 – 5.4 cm). Carapace length and width distribution of *C. amnicola* in the Cross River Estuary, Nigeria (this study) exhibited two modes for females (60 mm and 70 mm CL; 130 mm and 120 mm CW) and for males (40 mm and 60 mm CL; 130 mm CW).

Table 4: Carapace length – weight and Carapace length – width relationships of *Callinectes amnicola* from the Cross River Estuary, Nigeria

	Carapace length–weight relationship				Carapace length – width relationship			
Month	n	a	b	r^2	n	a	b	r^2
December	65	- 1.953	1.59	0.833	64	- 3.490	2.11	0.787
January	44	- 4.488	3.59	0.891	47	- 7.488	2.15	0.940
February	60	- 2.426	2.49	0.865	58	- 4.061	2.15	0.871
March	29	- 1.547	1.91	0.797	26	10.286	1.89	0.987
April	30	- 1.022	1.64	0.241	30	69.406	0.78	0.137
May	32	- 2.456	2.44	0.724	32	35.683	1.46	0.678
Male	51	- 2.040	2.18*	0.647*	60	- 2.482	2.09*	0.955*
Female	144	- 2.213	2.33*	0.762*	196	41.608	1.33*	0.383*
Both sexes	195	- 2.305	2.37	0.744	256	- 2.328	2.01*	0.818*

* indicates significant at 5% levels.

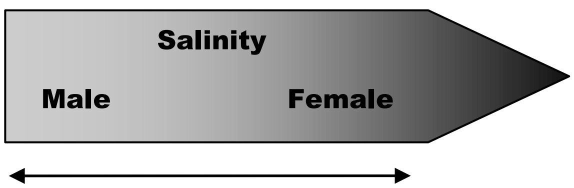

Fig. 3: ***Callinectes*** **species exhibit differentiated distribution along salinity gradient with male dominance at much lower salinities and females in higher numbers in more saline environments**

Females were present in all size classes while males occurred more in the mid-range sizes. About 75% of juveniles were males.

The logarithmic carapace length – weight relationship of *Callinectes amnicola* in Nigeria show a linear relationship as follows:

Male: Log W = - 2.0396 + 2.18 Log CL
(r^2 = 0.647, t - Test, P<0.05, df = 50; (this study)
Log W = - 23.3153 + 3.4050 Log CL
(r = 0.4757, n=112; (Arimoro and Idoro, 2007)
Log W = 3.52 Log CL – 0.92 (*C. pallidus*)
(r^2 = 0.36; (Akin-Oriola *et. al*., 2005)

Female: Log W = - 2.2129 + 2.33 Log CL
(r^2 = 0.762, t - Test, P<0.05, df = 143; (this study)
Log W = Log 53.3861 + 2.2852 Log CL
(r = 0.216, n=128; (Arimoro and Idoro, 2007)
Log W = 2.53 Log CL + 0.51 (*C. pallidus*)
(r^2 = 0.42; (Akin-Oriola *et. al*., 2005)

Combined Sexes: Log W = - 2.3047 + 2.37 Log CL
(r^2 = 0.744, t - Test, P<0.05, df = 195; (this study)
Log W = Log 52.3483 + 2.4137 Log CL
(r = 0.1279, n=240; (Arimoro and Idoro, 2007)
Log W = 3.01 Log CL – 0.18 (*C. pallidus*)
(r^2 = 0.35; (Akin-Oriola *et. al*., 2005)

The exponent, ***b***, reveal isometric condition in males where ***b*** is not significantly different (P > 0.05) from three (3). The ***b*** values for females and combine sexes were significantly lower than three in each case (P < 0.05, t - Test) indicating negative allometric growth, which means they tend to become thinner as they grow larger. Lawal-Are and Kusemiju (2000) and Arimoro and Idoro (2007) made similar observations on *C. amnicola* in Badagry, Lagos and Warri River, Niger Delta, respectively; and Neville (1979) and Oyenekan (1995) on other species of brachyuran crabs. Akin-Oriola *et al.* (2005) observed positive allometry for both sexes in *C. pallidus* from Ojo Creek in Badagry, Lagos. King (1996) showed that generally, vast majorities of fish species do not obey the cube law isometric growth in Length-Weight Relationship (LWR). Udoidiong (2005), also reported that the ***b*** values for most intertidal macro-benthos in Southeast Nigeria were markedly less than three.

Anetekhai *et al.* (2004) and Akin-Oriola *et al*. (2005) recommend the use of carapace width in estimating the weight of *Cardiosoma armatum* and *Callinectes pallidus* from the Badagry area of Lagos, Nigeria. They based their recommendations on the recommendations on the low R^2 values in LWR relationships. However, we recommend the use of carapace length - weight relationship (LWR) in analyzing the population dynamics of *C. amnicola* in the Cross River Estuary, Nigeria using conventional models, since the exponent, ***b***, in the carapace length - weight relationship of *Callinectes amnicola* was not significantly different from 3 indicating that the crab approximates an isometric weight growth (Bagenal and Tesch, 1978). The reverse is the case in ***b*** of the carapace width - weight relationship. Analyses of population dynamics usually assume isometry in fish and invertebrate growth (Pauly, 1984; Enin, 1994).

CONCLUSION

The exponent, ***b***, is an important data in fish biometrics. If ***b*** is different from three (3) the growth function is said to be allometric with changes in shape as the crab grows larger. If ***b < 3***. Growth is negative; the crab gets relatively thinner as it grows larger. If *b* > ***3***, growth is positive and the crab gets plumber as it grows larger. This study reveals that as the carapace width increase, the weight reduces. Similarly, as the carapace length increases, the width reduces. Another important function of the exponent in fish biometrics is that it can be used to predict condition factor. When ***b*** = 3, K = a.100 (Pauly, 1984). Pauly's derivation for K does not apply in this study. Differences were detected for all population sex ratio and intersexual variation in length, width and weight, varied over time.

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