

Size and Growth of *Cardiosoma armatum* and *Cardiosoma guanhumi* as Ecological Parameters for Mangrove Ecosystem

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Abstract

The Samples of *Cardiosoma armatum* and *Cardiosoma guanhumi* were collected from the Lagos Lagoon mangrove area of the University of Lagos. They were studied for their size composition and influence on growth pattern. A comparative analysis was done on both crabs. The carapace length of *Cardiosoma armatum* and *Cardiosoma guanhumi* examined ranges from 2.50 cm to 9.30 cm and 2.50 cm to 9.20 cm respectively. The carapace-width examined ranges from 2.70 cm to 9.40 cm and 2.80 cm to 9.40 cm respectively. The total weight of the *Cardiosoma armatum* ranges between 96.00 g and 290.00 g while *Cardiosoma guanhumi* ranges between 4.70 g and 295.00 g. The length- weight relationship of the two crabs showed low correlation value of 0.3378 and 0.2113 respectively. The Statistical T-test of the right and left chelipeds, the carapace length and carapace width of *Cardiosoma armatum* and *Cardiosoma guanhumi* showed that there were no statistical significances ($p > 0.05$) between carapace length of both crabs. There are statistical significance ($p < 0.05$) between carapace weight of both crabs collected in February, March, June and July. The statistical significance ($p < 0.05$) between the right and left chelipeds of both crabs are highly recognized. This research study indicates almost similar biological features for both species and evidently shows that both crabs are important spotlight for mangrove habitat.

Keywords: Crustacean; Size composition; Length-weight relationship; Mangrove ecosystem; Lagoon systems; Ecological values

Introduction

Crabs are decapods in the brachyuran infra order. The family comprises more than 14,750 species known for their ten legged creature (decapod). They are physiologically and structurally diverse across marine and freshwater environment. Their importance are diverse, this type of decapods are used as biological models and are highly edible for consumptions [1,2]. Crabs have flourish to be a predominant icon in the invertebrate fauna because of their ubiquitous in some part of the world including marine, freshwater and terrestrial environment [3]. The crab fisheries are also predominant in the marine, coastal, freshwater and lagoon fishery [4]. According to Geist et al., [5] crabs are known as ecosystem engineers due to their ability to burrow into sediment structures. These enhance sediment aeration and improve the biodiversity of surrounding vegetation associated to the mangrove environment. The size and growth of crabs are important ecological indicators, which can monitor the abundance of the crab species in the mangrove ecosystem. The ranges of their significant sizes expose the richness of the habitat with nutrient [6]. In Nigeria, *Geryon maritae* (Deep water crab), *Ocyroide africanus* (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 crab species found in brackish and marine environments [7]. The mangrove crabs have been found in mangrove habitat of the Lagos Lagoon. They have been subjected to reclamation by anthropogenic activities. However, this has played ecological role and significantly modify the mangrove ecosystem. The crabs have also been instrumental to clean up the environment by feeding on the fallen leaves [8]. Their environmental cleaning qualities are important with the omnivorous feeding attribute, depending on plant and animal [9]. According to Turner et al., [10] these mangrove land crabs developed burrows, which have strength for at least five years with temperature stability and high humid medium. The burrows are

great soil nutrient improvement agents and enhance plant seedlings production. *Cardiosoma* is a genus of Land crabs. Young individuals are often very colorful with a purple-blue Carapace and orange-red legs, exhibit color change as old age is reached [11]. There have been difficulties in the classification of these two crabs. Measurement of the size-frequency is one of most widely used method for growth pattern especially in the wild. This method gives more information about the ecological status of the species in the mangrove habitat [2]. The mangrove of the Lagos lagoon plays an important role on the diversity of the crab species, though various impacts have pose alarm on the environment which also affects the distribution of other important fauna and flora community of the ecosystem. The aim of this research is to provide baseline information on the relevance of using size and growth of *Cardiosoma armatum* and *Cardiosoma guanhumi* as ecological parameter of mangrove ecosystem and make comparison of the population differences based on morphological analyses of the two crab's species: *Cardiosoma armatum* and *Cardiosoma guanhumi*.

Materials and Methods

The study site for this project is the coastal and mangrove area of University of Lagos Lagoon front, located opposite the Lagos Lagoon, with the geographical platform of 6°26'N and 6°39'N and longitude 3°29'E and 3°50'E (Figure 1). The lagoon is the largest of the four lagoon

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Received March 04, 2015; Accepted July 10, 2015; Published July 15, 2015

Citation: Olalekan EI, Lawal-Are AO, Titilade PR (2015) Size and Growth of *Cardiosoma armatum* and *Cardiosoma guanhumi* as Ecological Parameters for Mangrove Ecosystem. J Marine Sci Res Dev 5: 164. doi:10.4172/2155-9910.1000164

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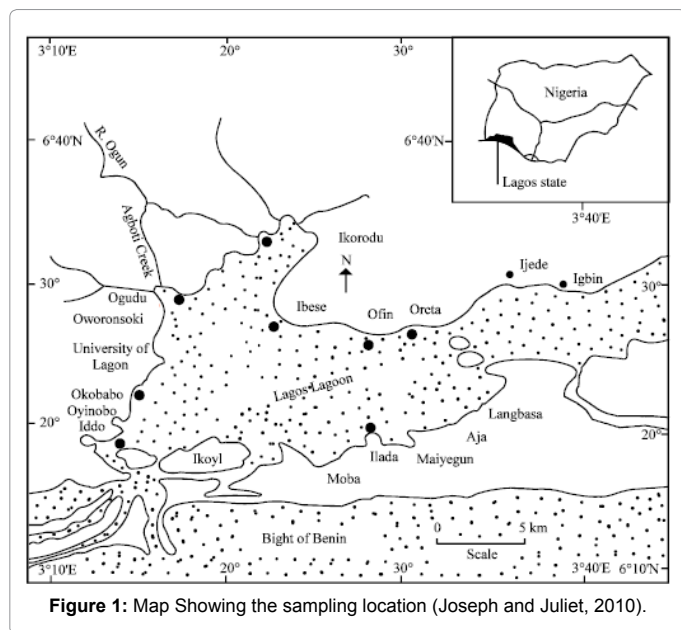


Figure 1: Map Showing the sampling location (Joseph and Juliet, 2010).

systems of the Gulf of Guinea and is located at South Western Nigeria. The mangrove swamp connects to the Lagos lagoon by tidal creek [12]. The Crab species (Plates 1 and 2) were collected at the mangrove part of the Lagos Lagoon along University of Lagos using the removal method [5]. They were caught between 7 pm and 11 pm. The collection was done randomly over a period of six months between February and July, 2012. The crabs were collected at two different stations within the mangrove swamp. A total of 858 crabs were collected from the site and were preserved immediately in a deep freezer in the laboratory prior to examination. The crabs were removed from the freezer and allowed to thaw. Excess water was removed from the specimens using filter paper. The carapace length and width of the two crabs was measured using a Simple vernier caliper. Total weight, weight of left and right chelipeds were measured to the nearest tenth of a gram using Sartorius Top Loading Balance (Model 1106); the results were recorded in a proformer for each specimen before dissection. The relationship between the carapace length-frequency distributions was established for each month and the cumulative (summary for the six months) worked out. Specimens were collected randomly in each of the six months. The crabs were examined to obtain their size composition and abundance. For the growth pattern, data of the length-weight relationship and width-weight relationship were compiled. The carapace length-weight relationship was expressed based on Rickter, [13] with the following equation:

$$W = aL^b$$

Where W=weight of crabs in grams.

L=length of the carapace in cm.

a=regression constant.

b=regression coefficient.

The equation was transformed to a linear relationship as

$$\text{Log Wt} = \text{Log } a + b \text{ Log } L$$

Scatter diagram of log weight – log length were plotted to illustrate these relationships.



Plate 1: *Cardiosoma armatum* (Self-Created).

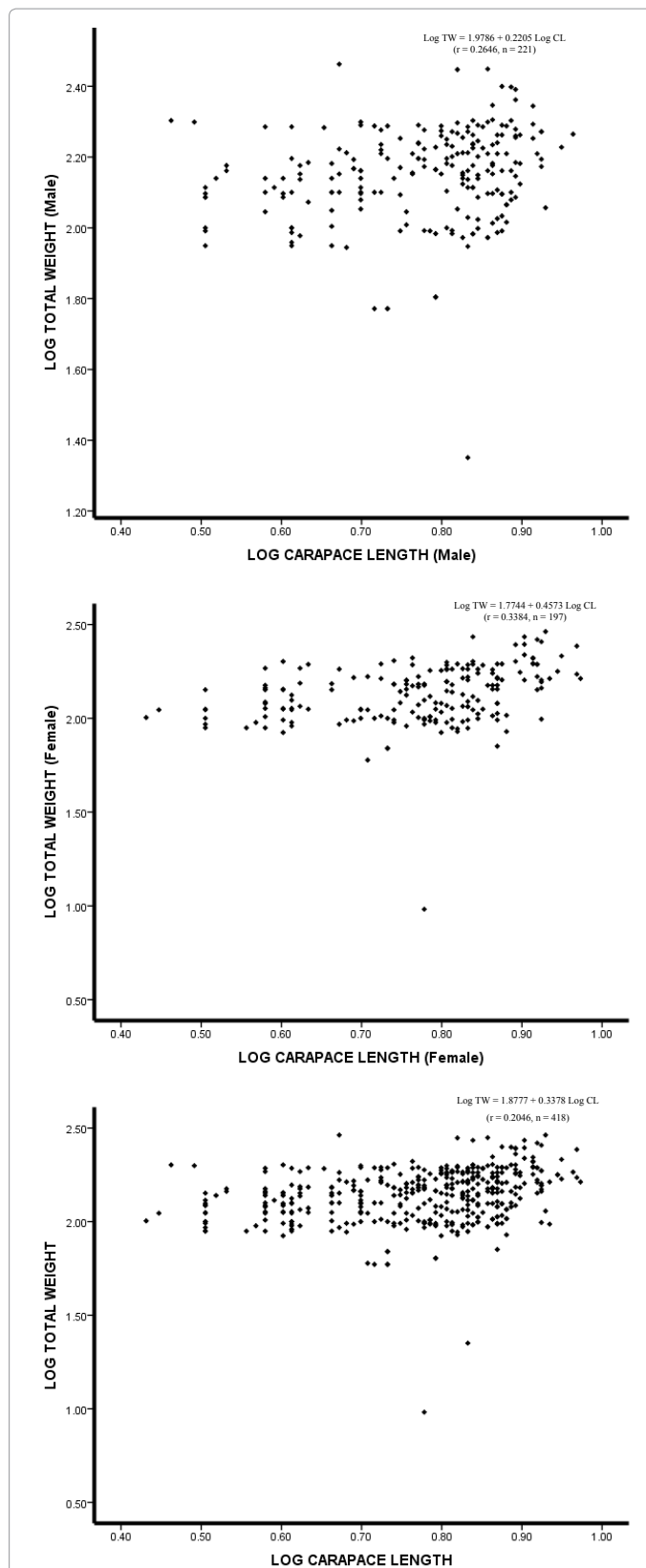
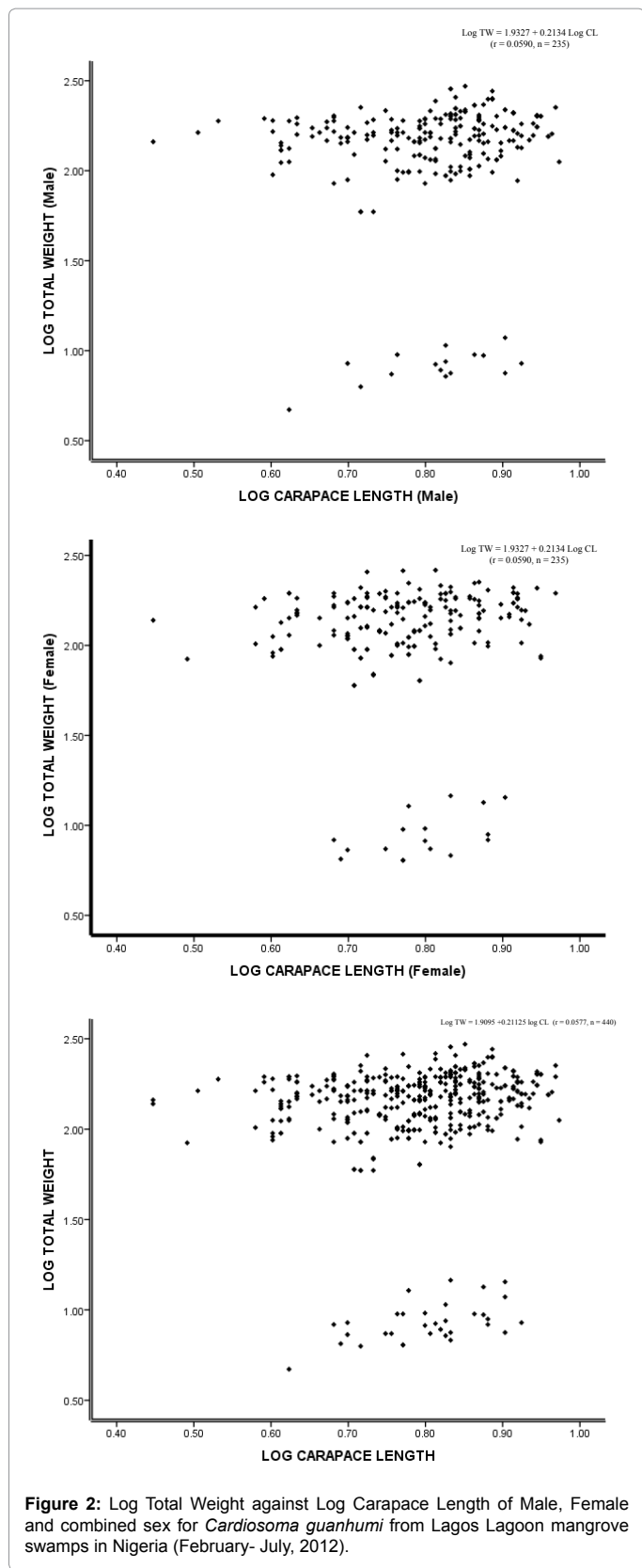


Plate 2: *Cardiosoma guanhumi* (Self-Created).

Result

Size composition of *Cardiosoma armatum* and *Cardiosoma guanhumi*

418 and 440 specimens of *Cardiosoma armatum* (Plate 1) and *Cardiosoma guanhumi* (Plate 2) were studied respectively making a total of 858 species of crabs collected and studied. The specimens were studied for the length and width frequency distributions between the months of February to July, 2012 (Figures 2 and 3). The carapace length of *Cardiosoma armatum* and *Cardiosoma guanhumi* examined ranged from 2.50 cm to 9.30 cm and 2.50 cm to 9.20 cm respectively while their carapace width were examined ranging from 2.70 cm to 9.40 cm and 2.80 cm to 9.40 cm respectively. The largest specimen of *Cardiosoma armatum* and *Cardiosoma guanhumi* weighed 290.00 g and 295.00 g respectively. The smallest size range collected in the same month weighed 9.60 g and 4.70 g. The two crabs were studied for length and width frequency distributions between February-July, 2012 (Tables 1 and 2). The carapace length frequency polygon of *Cardiosoma armatum*



Month	Number Collected					
	<i>Cardiosoma armatum</i>			<i>Cardiosoma guanhumi</i>		
	Female	Male	Total	Female	Male	Total
February	26	30	56	24	36	60
March	29	33	62	34	41	75
April	33	37	70	27	34	61
May	31	38	69	41	37	78
June	39	39	78	40	40	80
July	39	44	83	39	47	86
Total	197	221	418	205	235	440

Table 1: Monthly collection of *Cardiosoma armatum* and *Cardiosoma guanhumi* from Lagos Lagoon mangrove swamp in Nigeria (February- July, 2012).

Carace length	Length				Width			
	<i>Cardiosoma armatum</i>		<i>Cardiosoma guanhumi</i>		<i>Cardiosoma armatum</i>		<i>Cardiosoma guanhumi</i>	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
2.5-3.4	20	4.8	5	1.1	43	10.3	12	2.7
3.5-4.4	51	12.2	34	7.7	49	11.7	39	8.9
4.5-5.4	59	14.1	78	17.7	55	13.2	87	19.8
5.5-6.4	93	22.2	115	26.1	111	26.6	126	28.6
6.5-7.4	120	28.7	118	26.8	108	25.8	110	25.0
7.5-8.4	63	15.1	68	15.5	44	10.5	48	10.9
8.5-9.4	12	2.9	22	5.0	8	1.9	18	4.1
Total	418	100.0	440	100.0	418	100.0	440	100.0

Table 2: The frequency distribution of Carapace length and width of *Cardiosoma armatum* and *Cardiosoma guanhumi* from Lagos lagoon mangrove swamps in Nigeria (February to July, 2012).

and *Cardiosoma guanhumi* showed distinct size groups. The size group 6.5-7.4 cm was abundant with 25% and 28.7% for *Cardiosoma armatum* and *Cardiosoma guanhumi* respectively.

Growth pattern of *Cardiosoma armatum* and *Cardiosoma guanhumi*

The total weight of the *Cardiosoma armatum* ranged between 96.00 g and 290.00 g while *Cardiosoma guanhumi* 4.70 g and 295.00 g were for the combined sex. The carapace length of *Cardiosoma guanhumi* ranges between 2.80 cm to 9.40 cm and carapace length of the *Cardiosoma armatum* ranges from 2.70 cm and 9.40 cm for the combined sex. This result showed increase in length with increase in weight (Figures 4 and 5). The carapace length-total weight of the two crabs was transformed into a logarithmic form. The Log length-weight relationship showed a linear relationship between length and weight of the crab. The carapace length-weight relationship was determined using the formula below:

$$\text{Log TW} = a + b \text{ Log CL}$$

Where, W=Total weight of crab in grams (g)

CL=Carapace length of crab in grams (cm)

a=regression constant

b=regression coefficient

The value of length-weight relationship for *C. armatum* and *C. guanhumi* are given as follows;

The Total length-weight relationship for *Cardiosoma armatum* of the least square common fit of the transformed data got the following linear equation.

$$\text{Female: Log TW} = 1.7744 + 0.4573 \text{ Log CL} \quad (r = 0.3384, n = 197)$$

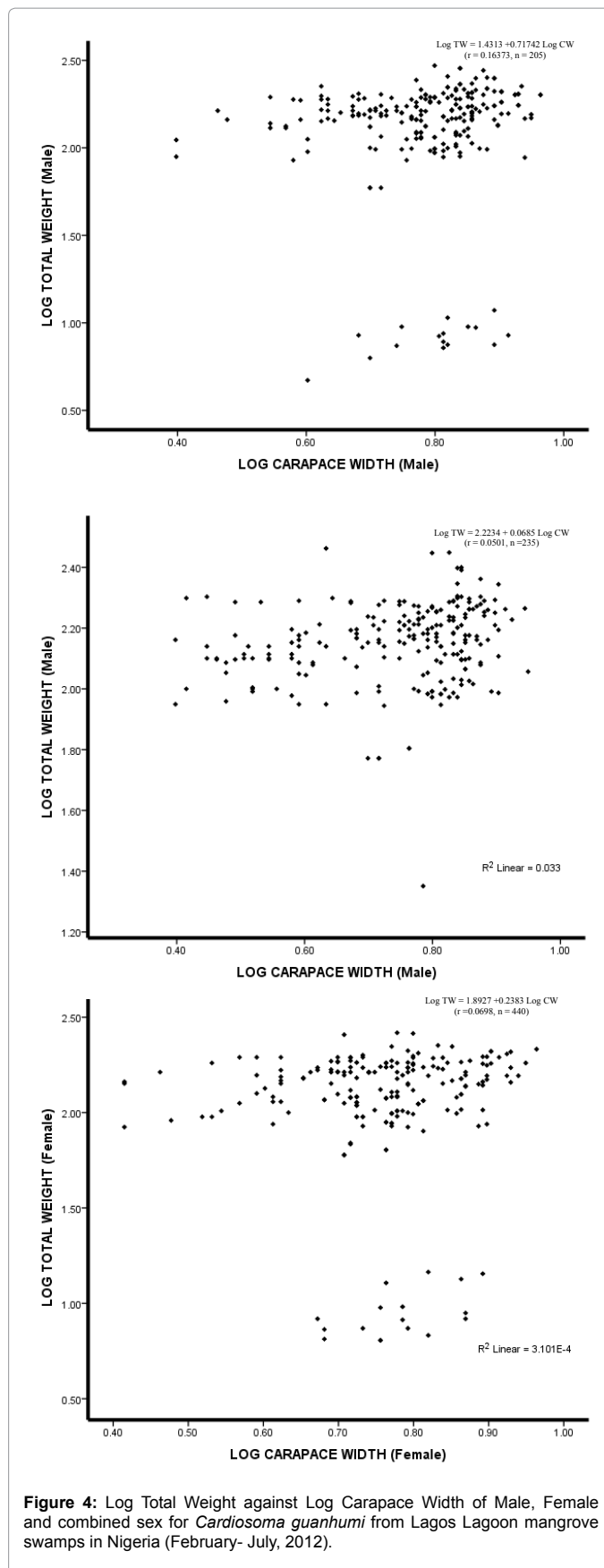
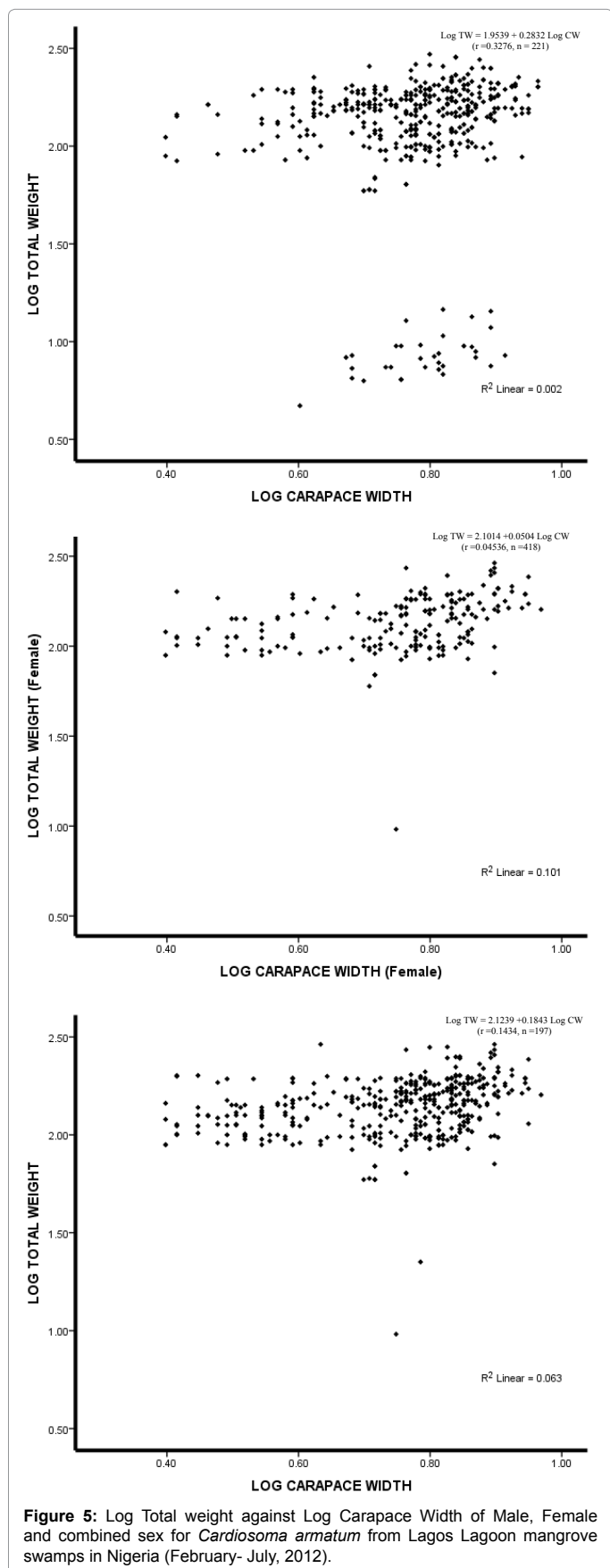


Figure 4: Log Total Weight against Log Carapace Width of Male, Female and combined sex for *Cardiosoma guanhumi* from Lagos Lagoon mangrove swamps in Nigeria (February- July, 2012).



Male: $\text{Log TW} = 1.9786 + 0.2205 \text{ Log CL}$ ($r = 0.2646, n = 221$)

Combined (sex): $\text{Log TW} = 1.8777 + 0.3378 \text{ Log CL}$ ($r = 0.2046, n = 418$)

The values of b were less than 3 in both sexes of *Cardiosoma armatum* which also indicated a positive isometric growth. The values were 0.4573, 0.2205 and 0.3378 for male, females and combined sexes respectively.

The carapace length-weight relationship for *Cardiosoma guanhumi* of the least square common fit of the transformed data gave the following linear equation;

Female: $\text{Log TW} = 1.9999 + 0.1038 \text{ log CL}$ ($r = 0.0266, n = 205$)

Male: $\text{Log TW} = 1.9327 + 0.2134 \text{ log CL}$ ($r = 0.0590, n = 235$)

Combined sex: $\text{Log TW} = 1.9095 + 0.21125 \text{ log CL}$ ($r = 0.0577, n = 440$)

Statistical analysis of *Cardiosoma armatum* and *Cardiosoma guanhumi*

T-test statistical analysis was conducted; there is no statistical significance for carapace weight of *Cardiosoma armatum* and *Cardiosoma guanhumi* collected in April and May respectively (Tables 3 and 4). No statistical significance was observed for the left chelae of *Cardiosoma armatum* and *Cardiosoma guanhumi* for the month of February. The statistical T-test analysis of the right chelae of *Cardiosoma armatum* and *Cardiosoma guanhumi* for the month of March and May do not show statistical significant.

Discussions

The assessment of the size and growth pattern of the Hairy Mangrove Crab, *Sersema huzardii* was examined by Lawal-Are and Nwankwo [4] in the Lagos Lagoon mangrove area. The length of the

Month	Weight		Length of Carapace	
	<i>Cardiosoma Guanhumi</i>	<i>Cardiosoma armatum</i>	<i>Cardiosoma armatum</i>	<i>Cardiosoma guanhumi</i>
Feb	159.34 ± 7.65 ^a	141.58 ± 6.12 ^b	3.16 ± 0.17 ^a	3.06 ± 0.26 ^a
Mar	153.76 ± 5.96 ^a	118.58 ± 5.60 ^b	4.01 ± 0.18 ^a	4.12 ± 0.16 ^a
April	155.48 ± 4.42 ^a	149.19 ± 5.83 ^a	4.98 ± 0.28 ^a	5.05 ± 0.24 ^a
May	161.83 ± 3.39 ^a	167.53 ± 4.44 ^a	6.01 ± 0.29 ^a	5.99 ± 0.26 ^a
June	97.22 ± 8.81 ^a	164.56 ± 3.46 ^b	6.96 ± 0.29 ^a	6.94 ± 0.29 ^a
July	141.96 ± 4.78 ^a	124.79 ± 3.33 ^b	7.92 ± 0.32 ^a	7.96 ± 0.31 ^a

In each row, means with a common letter are not significantly different ($P > 0.05$).
Table 3: T-test of weight *Cardiosoma armatum* and *Cardiosoma guanhumi* and length of Carapace of *Cardiosoma armatum* and *Cardiosoma guanhumi* from the Lagos Lagoon mangrove swamps (February- July, 2012).

Period	Right Chelae		Left Chelae	
	<i>Cardiosoma Guanhumi</i>	<i>Cardiosoma armatum</i>	<i>Cardiosoma guanhumi</i>	<i>Cardiosoma armatum</i>
Feb	9.84 ± 0.18 ^a	9.91 ± 0.21 ^b	10.22 ± 0.24 ^a	9.35 ± 6.08 ^b
Mar	9.80 ± 0.22 ^a	9.76 ± 0.28 ^a	10.45 ± 0.311 ^a	10.32 ± 0.28 ^a
April	7.94 ± 0.035 ^a	10.28 ± 0.29 ^b	9.21 ± 0.32 ^a	9.73 ± 0.31 ^a
May	6.98 ± 0.23 ^a	7.17 ± 0.23 ^a	8.32 ± 0.23 ^a	8.22 ± 0.24 ^a
June	7.04 ± 0.26 ^a	8.19 ± 0.25 ^b	8.75 ± 0.24 ^a	9.20 ± 0.22 ^a
July	8.39 ± 0.25 ^a	10.13 ± 0.21 ^b	9.15 ± 0.26 ^a	9.24 ± 0.05 ^a

Table 4: T-test of Right and Left Chelae for *Cardiosoma armatum* and *Cardiosoma guanhumi* from the Lagos Lagoon mangrove swamps in Nigeria (February- July, 2012).

carapace ranged from 1.5 cm to 4.7 cm which is low when compared to 2.5 to 9.5 cm of the present study for both species under consideration. Both *Sersema* spp and *Cardiosoma* spp are both mangrove crabs; however *Sersema* spp are smaller in size than *Cardiosoma* spp. The biology and distribution of some Mangrove Crabs in the Wouri River Estuary of Douala in Cameroon was studied by Ngo-Massou et al., [14] some *Cardiosoma* species were also studied, carapace length and width ranges from 3.6 -9.79 cm and 4.49 -13.13 cm respectively. These values are smaller than the *Cardiosoma* spp studied in this research, which is due to the abundance of trees and the richness of the mangrove ecosystem of University of Lagos Lagoon front of the Lagos Lagoon. The two crabs show high chela weight, which is in accordance with the body weight. This is in relation to Sneddon, Huntingford and Taylor, [15] that there is a great relationship between the chela size and the body weight, the chelae influences the contest between crabs in the same habitat. Akin-oriola et al. [3] also reported the maximum carapace length of 6.0 cm for *Cardiosoma armatum* and 7.0 cm for *Callinectes pallidus* respectively from Badagry creek. There was only one predominant generation of crabs sampled and they belong to the same year of class in their first year of life. It was observed that there was very low distribution in the 8.5-9.4 cm (1.9%) of *Cardiosoma armatum*, which is in contrast to Hartnoll et al. [16] of the mangrove crab of *Johngarthria lagostoma* with the size 90-80 cm size group. The ranges in the data obtained were due to the collection methods of the crabs, differences in the habitat terrain and topography of the area. The monthly distribution of the two crabs *Cardiosoma armatum* and *Cardiosoma guanhumi* for the month of July showed greater distribution pattern of 83 in July, 2012 for *Cardiosoma armatum* and 86 in July, 2012 for *Cardiosoma armatum* respectively. These values are in conformity with the research of Akin-oriola et al. [3] which showed the increase in the number of crabs caught in June and July including the size group of 4.0-4.9 cm showed the highest distribution pattern in May, September and November. *Cardiosoma armatum* in the Gulf of Guinea showed a maximum carapace length of 9.5 cm, Akin-oriola et al. [3] this is in agreement with the present study which also conform with the work of Atar and Secer, [17] and Lawal-Are and Nwankwo [4]. The logarithmic form of length-weight relationship of both crab species show low b value. *Cardiosoma armatum* shows a positive isometric growth with values 0.4573, 0.2205 and 0.3378 for male, female and combined sexes respectively. The length-weight relationship for *Cardiosoma guanhumi* was 0.1038, 0.2134 and 0.2113 for male, female and combined sexes respectively, this value are supported by Turner et al. [10]. However, females of both crabs showed a lower b value of 0.2205 and 0.2113 for *Cardiosoma armatum* and *Cardiosoma guanhumi* respectively, Which is scientifically attributed to the slow rate of growth of female crabs and the great amount of energy invested in the reproductive process at the expenses of growth by females [10]. Observations of higher b value of *Cardiosoma guanhumi* over *Cardiosoma armatum* were linked to the higher population and standing stock biomass and condition indices [17]. The overall low symmetrical or isometric growth of b values was less than 3 and this is due to the recruitment stock in biomass. Which is due to the peculiarity of coastal dwelling land crabs to show irregular recruitment pattern with uncertainty of returning to a small land mass after the planktonic laval phase [18]. T-test statistical analysis between the two crabs *Cardiosoma armatum* and *Callinectes pallidus* for carapace length, weight and chelae were reported by Akin-oriola et al. [3] the result shows concurrence with the present research.

Conclusion

The analysis of the two crabs, *Cardiosoma armatum* and *Cardiosoma*

guanhumi for the Size and growth parameter indicate the ecological richness of the mangrove ecosystem. The significant amount of size and the abundance including the frequency of the two crabs greatly expose that the crabs have influenced the vegetation which is attributed to the lagoon ecosystem. This research has served as a baseline for the use of crustaceans to monitor the ecological significance of the lagos lagoon habitat.

Acknowledgements

This study was a research to contribute to the scholarly attribute of the mangrove area of the Lagos Lagoon around the University of Lagos. We appreciate the support and contributions of the Department of Marine Sciences, University of Lagos, Akoka, Lagos, most especially for the permission to use their facilities. We also thank the people who assisted with the fieldwork, laboratory activities and the data analysis.

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