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Morphometric and Meristic Studies in Two Crabs: *Cardiosoma armatum* and *Callinectes pallidus*

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Abstract

Crabs are non-target species in artisanal and trawl fisheries in West Africa and are a common component of the invertebrate fauna. Information on morphometric, meristic and length-weight characteristics of crabs is required for assessment of the fishery. Maximum carapace length was 6.0 cm (4.38±0.04 cm) in *Cardiosoma armatum* and 7.0 cm (5.17±0.04 cm) in *Callinectes pallidus.* Mean body weights were 110.21±4.14 g and 126.27±4.01 g, respectively. All body proportions and counts except the right chelae diameter were significantly different ($p \leq 0.05$) in the two species. Heterochely was observed with both species. *C. armatum* showed a tendency towards left-handedness (53%) while *C. pallidus* was definitely right-handed (79%). Sexually dimorphic characters such as chelae diameter were higher in males of *C. armatum* than in males of *C. pallidus.* Conversely, body weight, chelae diameter and condition factor were significantly higher in males of *C. pallidus*. In the mixed population, length-weight relationships indicated positive allometric growth ($b < 3$) in *C. armatum* and a positive isometric growth pattern in *C. pallidus* ($b=3$).

Key Words: Body measurements, length-weight relationships, sexual differentiation, decapods.

Introduction

Crabs belong to a group of animals known as decapod crustaceans. They are one of the least-exploited crustaceans in artisanal and trawler fisheries in West Africa. In this region, the target species in shellfisheries are prawns and shrimps that have high export potential (Ajana, 1996; Awosika, 2002). Although all large species of crabs are edible, most marine crabs of commercial importance belong to three families: Portunidae (swimming crabs), Xanthidae (mud crabs) and Cancridae (cancer crabs). These species support a very lucrative crab fishery in the Chesapeake Bay area (USA), Canada, Japan, Philipines and other parts of Southeast Asia (Bardach *et al.*, 1972). Commercial harvests in a good year can yield close to 100 million pounds of crab annually (Oesterling, 1990).

In Nigeria, *Geryon maritae* (deep water crab), *Ocypode africana* (ghost crab), G*oniopsis 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 (Amadi, 1990; Ajayi, 1997). 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 (Ajana, 1996).

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 (Idoniboye-Obu and Ayinla, 1991; Alfred-Ockiya, 2000; and Oduro *et al.*, 2001) and ecology (Okafor, 1988; Lawal-Are and Kusemiju, 2000). Although this resource has been exploited locally, there are very few studies on their morphometrics (Anetekhai *et al.*, 1994). Thus the aim of this research is to provide baseline data on length-weight relationships, morphometric and meristic features of two common crab species: *Cardiosoma armatum* (Herklots, 1851) and *Callinectes pallidus* (De Rocheburne, 1883). Both species occur in the same geographical location but their habits differ – *C. armatum*, the African rainbow crab is a terrestrial species that ventures occasionally into water while *C. pallidus* is mainly aquatic. Information on morphometric and meristic features as well as length-weight patterns is necessary for assessment of the fishery to ensure sustainability and also form the basis for their inclusion in a regional food security programme.

Sampling Location

The Ojo creek in Badagry, Lagos State is an extension of Badagry creek, which is one of the marginal estuaries' characteristics of the West African coastline (Amadi, 1990). It is surrounded by many fishing villages and is a central point for the sales of fin- and shell- fish. During the off-season, mats, ropes, palm oil and coconuts brought from nearby villages are sold predominantly (Figure 1).

The surrounding vegetation is composed of

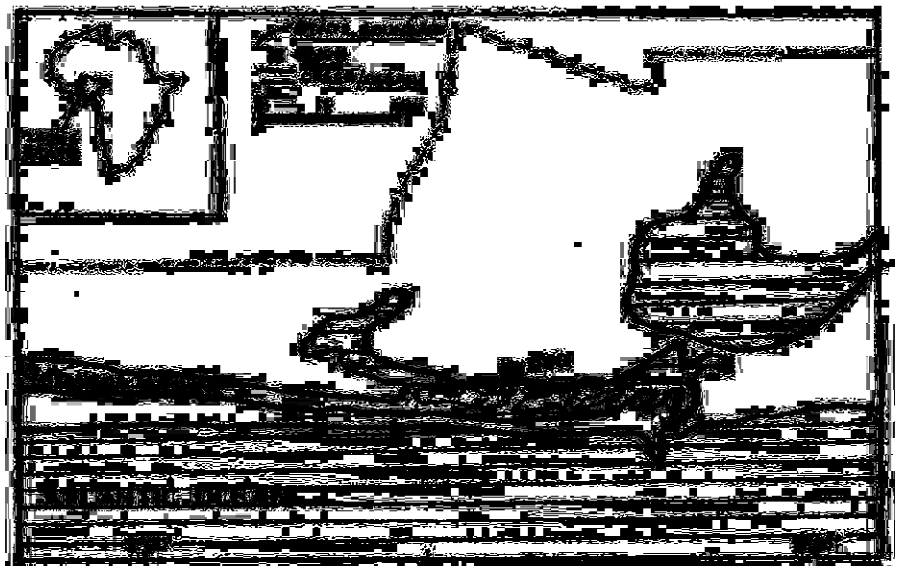


Figure 1. Sampling location - Ojo creek, Lagos, Nigeria.

mainly herbs and shrub plants dotted by raffia palm (*Raphia sudanica*), oil palm (*Elaeis guineensis*) and coconut palms (*Cocus nucifera*). Floating plants such as the water lettuce (*Pistia stratoites*), duckweed (*Lemna* sp.) and water hyacinth (*Eichhornia* sp.) often cover some parts of the water surface.

There is a distinct two-season climate regime: The dry season (November – March) with maximum temperatures above 30^{o}C, low rainfall and low relative humidity and the wet season (April – October) with reduced temperatures, higher precipitation and relative humidity.

Materials and Methods

Crabs used in this study were purchased monthly from fishmongers in Ojo beach, Lagos between April 2001 – March 2002. A total of two hundred and thirty crab specimens were examined. The crabs were caught with traditional gear such as earthen clay pots, basket traps and surrounding net. Live crabs were transported to the laboratory in clean cooler boxes with some water. Identification was carried out using an illustrated guide (Schneider, 1992). Body weight was measured using a Mettler balance (PM400) while carapace length and chelae diameter were measured with a vernier caliper. The position of the bigger cheliped and its percentage occurrence in each species was determined. Also the number of teeth on the bigger cheliped and the sex of each crab were determined.

The length-weight relationship is represented by:

$$W = a L^{b}$$ (Bagenal and Tesch, 1978)

where W is total body weight of crab (g) and L is carapace length (cm).

Fulton's condition factor (K) was calculated from:

$$K = 100 (W / L^{3})$$

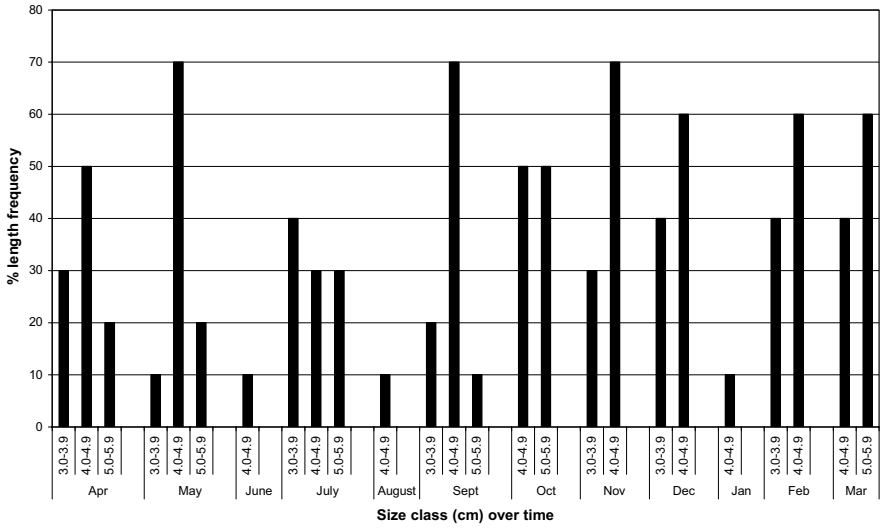
The data was analysed for significant differences between groups by the two sample t-test.

Results

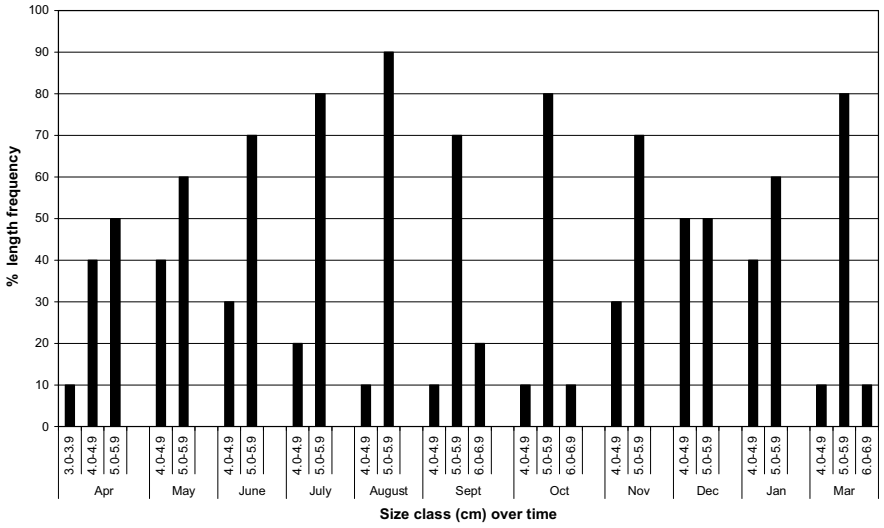
The length composition of crabs is shown in Figure 2. The optimum length reached by *C. armatum* and *C. pallidus* in Ojo Lagoon were 4.9 and 5.9 cm, respectively.

Both crabs showed conspicuous differences in external morphology. Carapace in *C. armatum* is apple-shaped and smooth with no antero-lateral teeth whereas that in *C. pallidus* is rhombic with broad anterior and posterior edges and a rough surface. The sides of the carapace are elongated to form a lateral spine and antero-lateral teeth are present. In addition, the fourth pair of walking legs in *C. pallidus* is broad and flattened to form a paddle, which helps in swimming.

The morphometric and meristic features examined in both crabs are listed in Table 1. Carapace length and body weight were greater in *C. pallidus*. The left and right chelae in *C. pallidus* had the same range in diameter but for *C. armatum*, a difference in diameter range was recorded. Crabs exhibit heterochely - one cheliped being larger than the other and this was observed in both species of crabs irrespective of sex. The larger cheliped can be located on the left or right side of the body. This study showed that heterochely in *C. armatum* resulted in a slight tendency towards left-handedness (53 %) although in *C. pallidus,* the tendency was definitely



(a)



(b)

Figure 2. Length-frequency distribution for (a) *C. armatum* and (b) *C. pallidus* in Ojo Lagoon, Lagos.

Table 1. Morphometric and meristic features of *C. armatum* and *C. pallidus*

Variable	*Cardiosoma armatum*	*Callinectes pallidus*
Carapace length (mean±SE) (cm)	4.38±0.04 ^{y}	5.17±0.04 ^{z}
	3.20 – 5.80	3.80 – 6.50
	n = 120	n = 110
Body weight (mean±SE) (g)	110.21±4.14 ^{y}	126.27±4.01^{z}
	38.07 – 214.60	10.70 – 220.20
Left Chelae diameter (mean±SE) (cm)	1.72±0.06 ^{z}	1.28±0.03 ^{y}
	0.7 – 3.6	0.8 – 2.4
Right Chelae diameter (mean±SE) (cm)	1.65±0.07 ^{z}	1.62±0.03 ^{z}
	0.8 – 4.6	0.8 – 2.4
Number of teeth on big chelae (mean±SE)	12.87±0.27 ^{y}	15.3 ± 0.27 ^{z}
	7 – 24	7 – 20
Heterochely		
Crabs with bigger left chelae	64 (53%)	19 (17%)
Crabs with bigger right chelae	56 (47%)	87 (79%)
Crabs with one chelae cut off		4 (3.6%)
Sex ratio (m : f)	55 : 65	51 : 59
	1 : 1.18	1 : 1.16

In each row, means with a common letter are not significantly different (P > 0.05).

towards right-handedness (79 %). Four specimens of *C. pallidus* had one cheliped cut off. Hence it was not possible to determine its length. The mean monthly sex ratio was 1: 1.18 in *C. armatum* and 1: 1.16 in *C. pallidus* in favour of the females.

The t-test showed that all morphometric and meristic features except the right chelae diameter were significantly different between *C. armatum* and *C. pallidus* (Table 1).

The length-weight relationship for *C. armatum* gave a positive value of b that is less than 3 for both sexes and the mixed population while for *C. pallidus*, the value of b was 3 for the mixed population, 3.52 and 2.53, respectively for male and female populations (Table 2).

Sex differentiating characters were observed in morphometrics and meristics of both crab species. Male crabs of both species have an 'inverted T' shape abdomen while immature females have an 'inverted V' shape abdomen and mature females an 'inverted U' shape abdomen. In *C. armatum*, the right chelae diameter of males were significantly bigger ($p \leq 0.05$) than that of females (Table 3). On the other hand, body weight, chelae diameter and condition factor of male *C. pallidus* were significantly higher than those of females.

Discussion

Crabs are a neglected component of aquatic systems despite their great diversity, wide distribution and high food value. They form a substantial proportion of the diet of communities along the coast and river basins in Benin, Ghana, Togo, Ivory Coast and Nigeria (Bertrand, 1979; Okafor, 1988) and have a high ash, mineral and crude fibre content (Oduro *et al.*, 2001). As a source of minerals, they are consumed either wholly or in part by sick folks and pregnant women. Few studies are available on their morphometric and meristic features in West Africa despite their food value. This work therefore presents the information needed for effective management and utilization of this resource.

In the Gulf of Guinea, records indicate that maximum carapace length was 9.5 and 4.5 cm for *C. armatum* and *C. pallidus,* respectively (Fischer *et al*., 1981) as against 6.0 and 7.0 cm recorded in the present study. The difference in diameter range observed for *C. armatum* was due to a solitary male specimen with a right chelae diameter of 4.6 cm.

C. armatum exhibited positive allometric growth i.e. body proportions change with growth while in *C. pallidus,* growth is isometric for the mixed population i.e. body proportions do not change as the organism grows but positively allometric for each sex. Carapace length in both crab species accounts for less than 43% of the variability observed in body weight as indicated by the R^2 value. Hence it may not be an ideal parameter for weight estimation. Rather carapace diameter has been shown to be a more appropriate index of body weight (Anetekhai *et al.*, 1994).

The significance of heterochely in crabs is unclear, but according to Daniels (2001) it may be related to sexual signalling and defence. Large claws are important in offence and defence and in females may indicate reproductive vigour as well as the ability to take care of and protect their brood.

There are two main types of sex characters – primary sexual characters which are directly associated with reproduction and secondary characters. In crabs, apart from the shape of the abdomen, secondary sex differentiating characters have not been reported. The occurrence of sexual differentiation in characters such as body weight and

Table 2. Length-weight relationships in both sexes of *C. armatum* and *C. pallidus*

	C. armatum	*C. pallidus*
Males	LogW = 0.96 LogL + 3.23 $R^2 = 0.07$	LogW = 3.52 LogL – 0.92 $R^2 = 0.36$
Females	LogW = 1.75 LogL + 2.05 $R^2 = 0.26$	LogW = 2.53 LogL + 0.51 $R^2 = 0.42$
Population (mixed)	LogW = 1.50 LogL + 2.42 $R^2 = 0.19$	LogW = 3.01 LogL – 0.18 $R^2 = 0.35$
Condition factor (K)	134.79 ± 5.92	89.91 ± 2.38

Table 3. T-test to show sexually dimorphic features in *C. armatum* and *C. pallidus* (mean±SE)

Variable	*C. armatum*		*C. pallidus*	
	Male	Female	Male	Female
Carapace length	4.4±0.06	4.3±0.07	5.2 ±0.05	5.2±0.07
Body weight	111.2±5.63	109.4±6.01	139.5±5.69	110.9±4.82*
Left chelae diameter	1.7±0.10	1.8±0.08	1.4±0.04	1.1±0.05*
Right chelae diameter	1.8±0.11	1.5±0.08*	1.7±0.04	1.5±0.05*
Number of teeth	13.0±0.36	12.7±0.40	15.0±0.30	15.7±0.46
Condition factor (K)	133.0±9.22	136.3±7.71	99.1±3.37	79.3±2.69*

*: Indicates significant difference at $p \leq 0.05$ between sexes.

chelae diameter may help to curb aggression in females and protect males during periods of courtship and reproduction since crabs are known to be cannibalistic in habit. Moreover their monogamous life style may be an adaptation to prevent excessive predation on weaker members of the community.

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