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RACIAL STUDY OF *Macrobrachium macrobrachion* (Malacostraca : Palaemonidae) POPULATIONS FROM THREE TROPICAL LAGOONS, SOUTH-WESTERN, NIGERIA

*** AKINWUNMI Mosunmola Florence and LAWAL-ARE Aderonke Omolara**
Department of Marine Sciences, Faculty of Science, University of Lagos, Lagos, Nigeria.
*Corresponding author: mfakinwunmi@gmail.com**;** +234-80-3578-1878

ABSTRACT
Macrobrachium macrobrachion (Herklots 1851) is one of the largest species of the genus Macrobrachium in Nigerian waters. It is a decapod that has been widely identified in terms of its economic importance and possibility of recruitment into aquaculture. The racial study of brackish water prawn (M. macrobrachion) from Badagry, Lagos and Epe Lagoons was carried out to determine the variation among the populations from the three interconnecting lagoons. Eight morphometric and three meristic characters were studied. The results showed significant differences (P < 0.05) in total length, telson length, carapace length, carapace width, rostrum length, ventral rostrum teeth and the 3rd abdominal somite with no significant differences (P > 0.05) in the egg diameter of the prawns. The variations recorded could be an indication of genetically distinct populations from different water-bodies. It could also be as a result of isolation caused by differences in salinity gradients in the three lagoons.

Key words: *Macrobrachium macrobrachion*, lagoons, Nigeria, racial study, salinity.

INTRODUCTION
Macrobrachium macrobrachion (Herklots 1851) and *Macrobrachium vollenhovenii* (Herklots 1857) are the two largest and most economically important species of the genus *Macrobrachium* found in most Nigerian water-bodies. They are found in the freshwaters as well as the brackish waters (Marioghae, 1982). They are globally accepted as food items and support a substantial number of local fishery. The distribution, biology and artisanal fishery of *M. macrobrachion* in the Lagos Lagoon were studied by Marioghae (1982) by giving the appraisal on the cultivability of Nigerian Palaemonid prawns. The prawns were identified using morphological characters as reported by Holthius (1980) and Powell (1982). Both *M. macrobrachion* and *M. vollenhovenii* were recognisable by their large second cheliped which usually end in strong pincers. The chelipeds are stout and singular in *M. vollenhovenii* while they are slender

and the pincer is furry in *M. macrobrachion*. Morphometric and meristic parameters of a fish and shrimp species play a major role in ensuring whether there is any disparity between same species of different geographic region (Naeem *et al.,* 2012).

Also, Jimoh *et al*. (2012) reported that there were more teeth on the dorsal side of the rostrum than on the ventral side of *Macrobrachium* species. *M. macrobrachion* thrives only in tidal freshwaters and in low salinity brackish waters of a little above 10 ‰ (Marioghae and Ayinla, 1995).

Previous racial studies in Nigeria have been carried out by Kusemiju (1975) on *Chrysichthys nigrodigitatus,* Ajado *et al.* (2005) on *Chrysichthys nigrodigitatus,* Omoniyi and Agbon (2007) on *Sarotherodon melanotheron* and Lawal-Are (2009) on *Callinectes amnicola*. The objective of this study was to carry out a racial study on *M. macrobrachion* in the three interconnecting lagoons but ecologically different in salinity regimes using meristic and morphometric features in order to determine the variation among the populations.

MATERIALS AND METHODS

Description of Study Sites

The Badagry Lagoon (Fig. 1), with source in River Queme in the Republic of Benin to the west of Nigeria, is located in Lagos State and opens into the Atlantic Ocean via the Lagos harbour. It lies between longitudes 3°54″ and 4°13″E and latitudes 6°25″ and 6°35″N. The major ecological factors occurring in the Badagry Lagoon have been documented by Ezenwa and Kusemiju (1985) and Solarin (1998), the temperature ranged from 26 - 30°C. The authors also observed an increase in salinity from June to September (rainy season) in the Lagoon due to the intrusion of salt water from the Cotonou Lagoon in the Republic of Benin.

Lagos Lagoon (Fig. 1) is located between longitudes 3°23″ and 3°53″E and latitudes 6°26″ and 6°37″N. It is an open tidal estuary situated within the low-lying coastal zone of Nigeria. Lagos Lagoon has a seasonal fluctuation in salinity with high brackish variables during the dry season (December to May), while freshwater condition exists in the rainy season (June – November) (Ugwumba and Kusemiju, 1992; Solarin, 1998; Lawal-Are, 2006).

Epe Lagoon (Fig. 1) lies between latitudes 6º29″N and 6º38″N; and longitudes 3º30″E and 4º05″E and is fed by River Oshun (Agboola and Anetekhai, 2008).

With surface area of about 225 km^2 and a maximum depth of 6 m. A large area of the lagoon is relatively shallow with a minimum depth of 1m and the vegetation surrounding the lagoon is of the mangrove swampy type (Balogun, 1987). The lagoon opens into the Atlantic Ocean via the Lagos harbour (Kumolu-Johnson *et al*., 2010).

Physico-chemical parameters of the water samples.

The physico-chemical parameters such as the surface water temperature, salinity, pH, dissolved oxygen and transparency were collected in the month of June 2014 between the hours of 8.00 – 10.00 am for Badagry, Lagos and Epe Lagoons. The surface water temperature was measured using a Mercury-in-glass thermometer by dipping it into the water 15 cm below the water surface, salinity was determined using a refractometer (Model No: RHS-10), the pH value was measured using a Hanna pH meter (Model: HI 2210), the dissolved oxygen was determined using a Hanna DO meter (Model: HI 9146) while the water transparency was measured using a 20cm diameter black and white coloured secchi disc. All parameters were measured *in situ*.

Collection of specimens

Samples of *M. macrobrachion* were collected from Badagry, Lagos and Epe Lagoons on 5^{th}, 9^{th} and 12^{th} of June, 2014 respectively, using a basket trap (Plate 1). It was ensured that the samples were collected as close to the same period of the year as possible. The prawn samples were collected using a basket trap (Igun) which was set near the shore of the lagoons. The size range of *M. macrobrachion* used had a total length of 7.2 to 8.5 cm as these were likely to be of approximately the same age. The prawns were immediately preserved in an ice-chest for transportation to the laboratory of the Department of Marine Sciences and stored at -20 ^oC for further analysis.

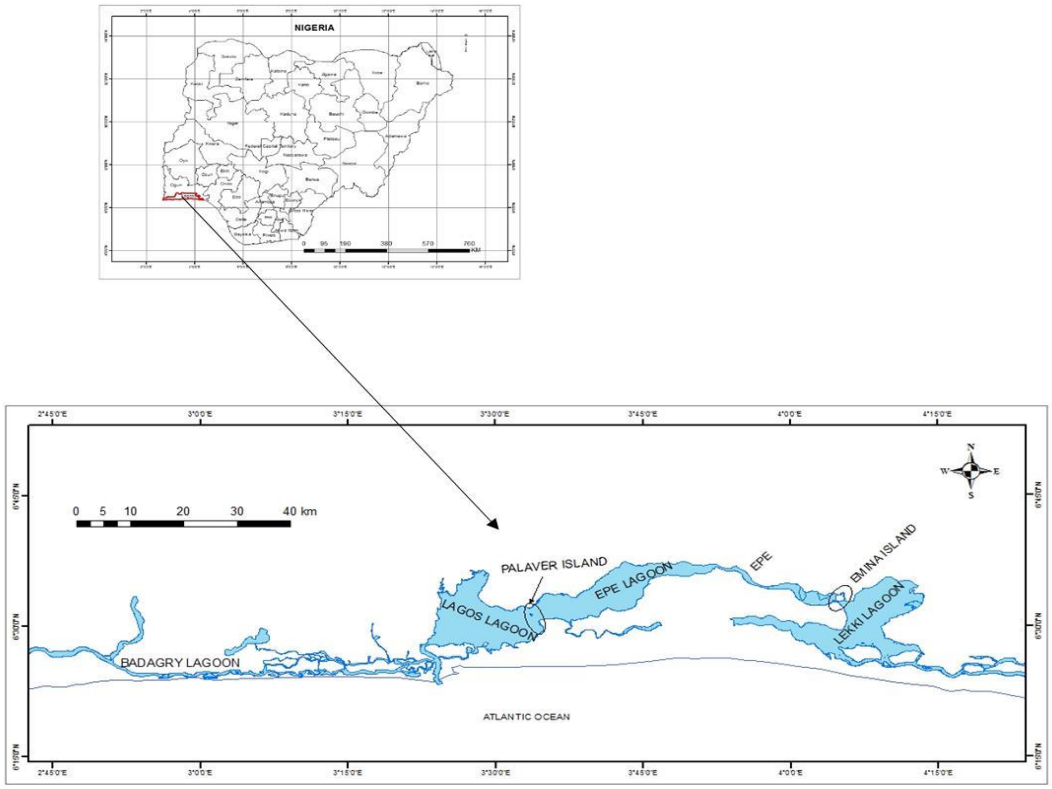


Fig. 1: Map showing Badagry, Lagos and Epe Lagoons.

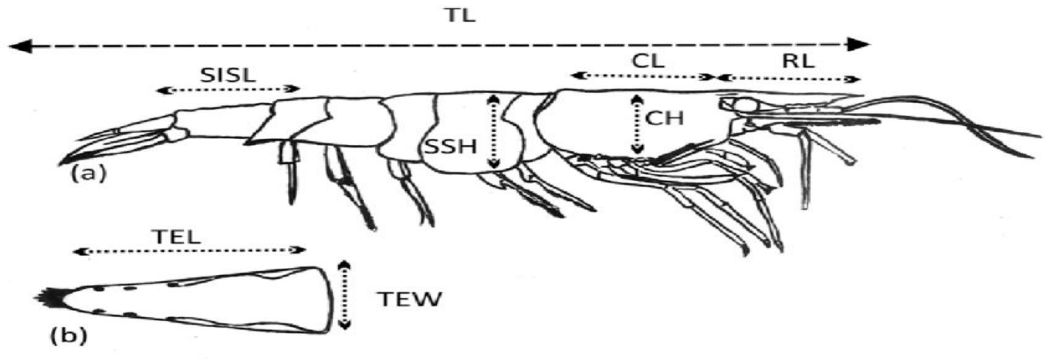
Plate 1: Trap (Igun) used in the collection of the prawn species

Laboratory analysis

The prawns were removed from the freezer and allowed to thaw (Plate 2). Excess water was removed from the specimens through mopping on a pile of filter papers. The meristic characters observed were the rostrum teeth (dorsal and ventral) and the morphometric characters such as total length, telson length, carapace length, carapace width, rostrum length, 3rd abdominal segments, left cheliped length, right cheliped length and egg diameter were investigated (Fig. 2). The meristic characters were determined by counting the number of teeth on the dorsal and ventral side of the rostrum. The total length involved measuring the prawns from the tip of the rostrum to the end of the telson. The carapace length was determined by measuring the prawn from the eye socket to posterior end of the carapace. The length of the telson, rostrum, 3rd abdominal segment, left cheliped and right cheliped were also measured (Naiyanetr, 2001; Murphy and Austin, 2005).

The egg diameter was measured with a graduated occular micrometer mounted in the eye piece of a binocular microscope.

Plate 2: The dorsal view of *Macrobrachium macrobrachion* (Mag. x 0.6)



telson. TL: total length, CL: carapace length, CH: carapace height, RL: rostral length, SSH: second pleon segment height, SISL: sixth pleon segment length, TEL: telson length and TEW: telson width.

Fig. 2: The morphometric and meristic features of *Macrobrachium macrobrachion*
(Dineshbabu, 2014)

STATISTICAL ANALYSIS

All data were subjected to One-way analysis of variance (ANOVA) and post-hoc (DMRT) was used to determine significant differences ($P < 0.05$) of the means from the three lagoons. The data from the egg diameter were tested for significant differences ($P < 0.05$) using the paired t-test.

RESULTS

The physico-chemical parameters of the different lagoons sampled are presented in Table 1. The morphometric and meristic characteristics of *M. macrobrachion* in Badagry, Lagos and Epe Lagoons had total length (TL), telson length (Tel-L), carapace length without rostrum (CL), carapace width (CW), rostrum length (RL), dorsal rostrum teeth (RT dorsal), ventral rostrum teeth (RT ventral), 3rd abdominal somite (3rd - S), left cheliped length (LCL), right cheliped length (RCL) and the egg diameter are shown in Tables 2, 3 and 4 with their varied levels of significance.

There were significant differences ($P < 0.05$) in the TL, Tel-L, CL, CW, RL, RT ventral and the 3rd abdominal somite from the three lagoons except the RT dorsal, LCL, RCL and egg diameter which showed no significant difference ($P > 0.05$).

Table 1: Physico-chemical parameters of Badagry, Lagos and Epe Lagoons in June, 2014

	Surface water temp. (ºC)	**Salinity (‰)**	**pH**	**Dissolved oxygen content (mg/l)**	**Transparency (cm)**
Badagry Lagoon	28.2	2.20	7.5	7.2	62
Lagos Lagoon	25.0	2.00	7.4	6.1	58
Epe Lagoon	25.0	0.20	7.2	7.0	69

Table 2: Mean values on meristic characters of *Macrobrachium macrobrachion* from Badagry, Lagos and Epe Lagoons

MERISTIC CHARACTERS	**BADAGRY LAGOON**	**LAGOS LAGOON**	**EPE LAGOON**
Rostrum Teeth (Dorsal)	10.5 ± 0.08^{a} (9 - 12)	10.2 ± 0.07^{a} (8 - 14)	10.3 ± 0.15^{a} (9 - 13)
Rostrum Teeth (Ventral)	5.9 ± 0.09^{b} (4 – 8)	5.5 ± 0.05^{a} (3 - 7)	5.5 ± 0.11^{a} (4 - 7)

Range in brackets

Means with the same superscripts along the row were not significantly different ($P > 0.05$)

Table 3: Mean values on morphometric features of *Macrobrachium macrobrachion* from Badagry, Lagos and Epe Lagoons

MORPHOMETRIC MEASUREMENTS (cm)	BADAGRY LAGOON	LAGOS LAGOON	EPE LAGOON
Total Length	8.0 ± 0.10^{b} (6.1 - 9.8)	7.2 ± 0.08^{a} (4.3 - 9.0)	8.5 ± 0.10^{c} (7.5 - 9.7)
Telson Length	1.0 ± 0.01^{b} (0.8 - 1.3)	0.9 ± 0.01^{a} (0.6 - 1.2)	1.1 ± 0.01^{c} (0.9 - 1.3)
Carapace Length without rostrum	2.2 ± 0.03^{b} (1.6 - 2.7)	1.9 ± 0.02^{a} (1.3 - 2.5)	2.3 ± 0.03^{c} (1.9 - 2.6)
Carapace width	3.3 ± 0.04^{b} (2.5 - 4.1)	2.0 ± 0.04^{a} (2.1 - 5.4)	3.5 ± 0.05^{c} (3.0 - 4.0)
Rostrum Length	2.3 ± 0.03^{b} (1.9 - 3.0)	2.1 ± 0.02^{a} (1.2 - 2.8)	2.5 ± 0.04^{c} (1.9 - 2.9)
Third Abdominal segment	0.9 ± 0.01^{b} (0.6 - 1.2)	0.7 ± 0.01^{a} (0.5 - 1.1)	1.0 ± 0.02^{c} (0.6 - 1.2)
Left Cheliped Length	5.3 ± 0.30 (2.8 - 15.4)	4.4 ± 0.19 (1.7 - 15.1)	5.2 ± 0.33 (3.0 - 12.7)
Right Cheliped Length	5.3 ± 0.28 (2.8 - 15.1)	4.5 ± 0.20 (1.7 - 17.8)	5.2 ± 0.32 (3.0 - 12.8)

Range in brackets
Means with the same superscripts along the row were not significantly different ($P > 0.05$)

Table 4: Ranges and Mean egg diameter (µm) of *Macrobrachium macrobrachion* from Badagry, Lagos and Epe Lagoons

	BADAGRY LAGOON	LAGOS LAGOON	EPE LAGOON
Range (µm)	258 - 450	258 – 450	258 – 410
Mean (µm)	351.90 ± 4.44	348.88 ± 2.88	348.14 ± 5.26

Means with the same superscripts along the row were not significantly different ($P > 0.05$)

DISCUSSION

Morphometric and meristic characters were used to describe the variations in *M. macrobrachion* from Badagry, Lagos and Epe Lagoons. According to Kinsey *et al*. (1994) morphometric variability can be used to determine variations among geographically and distinct populations. It can also be used to classify distinct

genetic structures or environmental factors to each geographic area. In the current study, the physico-chemical parameters such as temperature, pH, dissolved oxygen, salinity and transparency were found to be similar among the three lagoons studied except salinity. The salinity values obtained were 2.20 ‰, 2.00 ‰ and 0.20 ‰ for Badagry, Lagos and Epe Lagoons respectively.

The salinity of Badagry Lagoon was higher even in the wet months which conformed to the findings of Ezenwa and Kusemiju (1985). They observed an increase in salinity from July to September (rainy season) in the Badagry Lagoon due to the intrusion of salt water from the Cotonou Lagoon in the Republic of Benin. The salinity recorded for Lagos Lagoon might be due to seasonal variation in rainfall which makes the environment to be low saline during the rainy season. Solarin (1998) and Lawson (2001) reported that the salinity of the Lagos Lagoon was very low during the rainy season due to the fact that, River Ogun its major source of water discharges a large volume of water into the lagoon. Also, Lagos Lagoon receives freshwater from Lekki Lagoon via Epe Lagoon in the North-east (Lawal-Are and Nwankwo, 2011). According to Kusemiju (1975), Ugwumba and Kusemiju (1992), Solarin (1998) and Lawal-Are (2006), Lagos Lagoon has a seasonal fluctuation in salinity, high brackish water during the dry season (December - May) and freshwater condition exists in the rainy season (June – November). The salinity of Epe Lagoon was attributed to River Oshun which empties into it as observed also by Ndimele and Kumolu-Johnson (2011). Soyinka and Ebigbo (2012) reported that the freshness could be due to the close connection to two fresh water bodies (Lekki Lagoon and River Oshun), which over-rides the effect of further distant brackish water (Lagos Lagoon). Thus, it could be concluded from the result of the physico-chemical parameters that Badagry Lagoon was a low brackish environment, Lagos Lagoon was highly brackish (but low brackish during the rainy season) while Epe was a freshwater environment. This environmental differences in salinity could be responsible for the varied meristic and morphometric characters and this is in congruent with the report of Omoniyi and Agbon (2007) and Ajado *et al.* (2005) on the morphometric and comparative studies of *Sarotherodon melanotheron* and *Chrysichthys nigrodigitatus* respectively.

Considering the rostrum teeth, it was observed that there were more spines on the dorsal side than on the ventral side of *M. macrobrachion* from the three lagoons. The average number of spines on the dorsal side is 10 with an average of 6 on the ventral side. This is different from the values reported by Jimoh *et al*. (2012) in

Ologe Lagoon, a completely fresh water environment. They recorded 5 and 9 spines as the highest frequency of occurrence on the ventral and dorsal side of *M. macrobrachion* respectively. The variations in meristic and morphometric features could be an indication of genetically distinct populations from different water-bodies. Variation might have also occurred as a result of isolation caused by differences in salinity gradients in the three lagoons.

This study would therefore, serve as a basis upon which further researches on the morphological identification and/or taxonomy of *M. macrobrachion* could be based. However, the major ecological variations in the three lagoons is salinity. Thus, salinity fluctuations could be a factor responsible for the variations in the morphometry of the prawns in the lagoons.

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