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PRELIMINARY STUDY ON COMPARATIVE MORPHOMETRY OF *Cynothrissa mento* (Regan, 1917) FROM OLOGE, BADAGRY AND EPE LAGOONS, LAGOS, NIGERIA

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ABSTRACT

The morphometric characters of Cynothrissa mento from three major lagoons (Ologe, Badagry and Epe) in Lagos, Nigeria were compared to assess the possibility of this fish species from the three lagoons belonging to the same sub-population. The length-weight relationships (LWR), and condition factors (CF) of the fish were also described as well as the physico-chemical parameters of the three water bodies. The study was conducted between May, 2009 and April, 2010 and monthly sampling of fish and water was done in each sampling site. 7 physico-chemical parameters were assessed and these are; temperature, pH, salinity, turbidity, dissolved oxygen, total alkalinity and total hardness. A total of 294 specimens (Ologe 60, Badagry 174 and Epe 60) of C. mento were collected from the landings of the local fisher folks from the sampling sites. Seven morphometric characters; total length (TL), standard length (SL), body depth (BD), head length (HL), head depth (HD), eye diameter (ED) and interorbital width (IW) were measured. There was no significant difference ($p > 0.05$) in all the physico-chemical parameters measured among the sampling sites except pH. Coefficient of difference revealed that the C. mento from the three lagoons are uniform in all the morphometric parameters examined, which means that the specimens from the three sampling sites do not belong to different sub-populations. The growth coefficient/slope (b) values obtained for the fish species from the sampling sites ranged from 2.27 - 2.53, and differed significantly ($p < 0.05$) from 3, which indicates that most of the fish species have negative algometric growth.

Keywords: fish population, systematic,

INTRODUCTION

Comparing anatomical features of organisms has been a central element of biology for centuries (Verep *et al*., 2006). Both taxonomic classification of organisms, and understanding the diversity of biological life were historically based on descriptions of morphological forms (Dean *et al.*, 2003). In fish, morphometric characters represent one of the major keys for their systematics, growth variability, ontogenetic trajectories (Kováč and Copp, 1999) and/or various population parameters. However, investigation of morphometric variation in different fish species has in many cases disclosed a lack of homogeneity with respect to certain characters (Ajado *et al.*, 2004).

The morphometric relationships between length and weight can be used to assess the well-being of individuals and to determine possible differences between separate unit stocks of the same species (King, 2007). In

addition, length-weight relationships are also important in fisheries management for comparative growth studies (Moutopoulos and Stergiou, 2002). Pauly (1983) stated that length-weight relationship (LWR) provides valuable information on the habitat where the fish lives, while Kulbicki *et al.*(2005), stressed the importance of LWR in modeling aquatic ecosystems.

In fisheries science, the condition factor is used in order to compare the "condition", "fatness" or wellbeing of fish. It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition (Bagenal, 1978). Condition factor is also a useful index for monitoring of feeding intensity, age, and growth rates in fish (Oni *et al*., 1983). It is strongly influenced by both biotic and abiotic environmental conditions and can be used as an index to assess the status of the aquatic ecosystem in which fish live (Anene, 2005).

Cynothrissa mento (Regan, 1917), the Nigerian fang tooth pellonuline, belongs to the family Clupeidae. Other members of the family include herrings, shads, sardines and menhadens, most of which have been studied extensively (Soliman, 2006). However, *C. mento* have not been a subject of much research (except the work of Kumolu-Johnson *et al.* (2010), which investigated the Cu, Zn and Fe in *C. mento* from Ologe Lagoon) in spite of the fact that the fish is major protein source for riverine communities in Nigeria (Anetekhai *et al.*, 2003).

The objectives of the present study are to provide basic data on external morphology (selected morphometric characters) of *Cynothrissa mento* from Ologe, Badagry and Epe Lagoons; and to determine whether there are significant morphometric differences between sub-populations from these lagoons.

MATERIALS AND METHODS

Study Area

The study area is composed of three lagoons; Ologe, Badagry and Epe Lagoons (Fig. 1). Ologe Lagoon is a freshwater body with a surface area of 64.5 km^2. It lies between latitudes 6° 27' N and 6° 30' N; and longitudes 3° 02' E and 3° 07' E (Ndimele *et al*., 2009). Badagry Lagoon lies between latitudes 6° 22' N and 6° 42' N; and longitudes 2° 42' E and 3° 42' E while Epe Lagoon lies between latitudes 6° 29' N and 6° 38' N; and longitudes 3° 30' E and 4° 05' E (Agboola and Anetekhai, 2008).

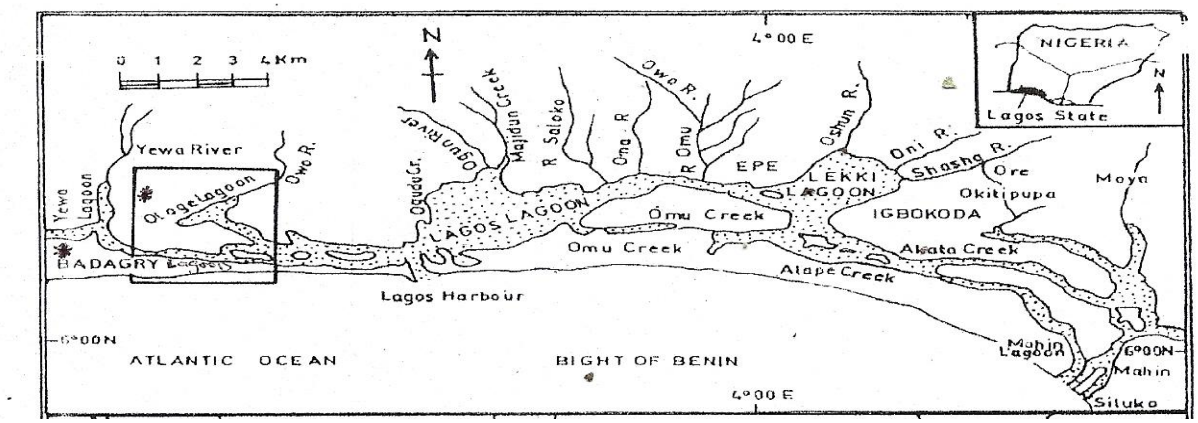

Fig. 1: Map of Lagos Lagoon complex showing the sampling sites (that is Ologe, Badagry and Epe Lagoons)

Physico-chemical parameters

Water samples were collected directly from each sampling site in 2-litre plastic containers washed with nitric acid to remove contaminants. Samples were stored immediately in a cooler, in order to

ensure that the physical properties of the water samples were maintained, and transported to the laboratory for analyses. Temperature and pH were determined *in situ* using a mercury-in-glass thermometer and pH meter (Jenway 3050 model) respectively while salinity, dissolved oxygen, total alkalinity and total hardness were determined by titration (Boyd, 1981). Turbidity was measured using nephelometer.

Specimens of *Cynothrissa mento* from the three lagoons (Ologe, Badagry and Epe) were collected from the landings of local fisher folks between May, 2009 and April, 2010. A total of 294 specimens from the three sampling sites were examined: Ologe Lagoon (n = 60), Badagry Lagoon (n = 174), and Epe Lagoon (n = 60). In the laboratory, 7 metric characters, including total length (TL), standard length (SL), body depth (BD), head length (HL), head depth (HD), eye diameter (ED) and interorbital width (IW), were measured to the nearest 0.1 cm. Body weight was measured to the nearest gram using a top loading Metler balance.

In this study for prospective inter-population comparisons, all metric characters except SL and TL were expressed in percent SL while SL was expressed as percent of TL, although, comparisons were also done with their raw metric values. In the between-lagoon comparisons, the coefficient of difference (C_{dif}) was used in each character:

$$C_{dif} = \frac{X_2 - X_1}{SD_2 + SD_1}$$

where X_1 and X_2 are the arithmetic means, and SD_1 and SD_2 are the standard deviations of the metric characters at the sites compared. Real difference in a metric character between 90 % of the population from two given sites existed when the absolute value was $C_{dif} > 1.28$ (Mayr *et al;* 1953).

Parameters of the length-weight relationship of identified fish species were estimated using the equation:

$$W = aL^b \quad \text{(Rickter, 1973)} \quad (1)$$

Where W = Weight of fish (g); L = Length of fish (cm); a = y-intercept or the initial growth coefficient;

b = Slope or the growth coefficient.

The values of constants a and b were estimated after logarithmic transformation of equation (1) using least square linear regression (Zar, 1984) to give:

$$\log W = \log a + b \log L \quad (2)$$

In order to confirm whether b values obtained in the linear regressions were significantly different from the isometric value, t-test was applied as expressed by the equation according to Sokal and Rohlf (1987): $t_s = (b-3) / SE$,

where t_s is the t-test value, b the slope and SE the standard error of the slope (b). All the statistical analyses were considered at significance level of 5% ($p < 0.05$).

The condition factor was calculated by the formula:

$$\text{Condition Factor (K)} = \frac{100W}{L^b}$$

(Pauly, 1983)

Statistical analysis

Variations in physico-chemical properties among sampling sites were tested by one-way analysis of variance (ANOVA) and where there is significant variation; Fisher's Least Significant Difference (LSD) was used. Inter-population comparison of morphometric characters among the sampling stations was done using Coefficient of difference (C_{dif}) (Mayr *et al*, 1953). Regression analysis (Pearson's product-moment correlation) was used to examine the relationship among the morphometric characters in each sampling station. In all cases, the level of significance was set at $\alpha=0.05$, except in the regression analysis where $\alpha=0.01$.

RESULTS AND DISCUSSION

The results of the physico-chemical parameters showed that there was no

significant difference ($p > 0.05$) in these parameters among the sampling sites except pH (Table 1). The range of values of temperature (29.67 ± 0.33 - 30.33 ± 0.67 ^{o}C), pH (7.44 ± 0.07 – 7.63 ± 0.03), salinity (0.17 ± 0.07 – 0.23 ± 0.06 ppt), and dissolved oxygen (3.07 ± 0.70 – 4.20 ± 0.23 mg/l) (Table 1) recorded in the three sampling sites were within the range (temperature <40 ^{o}C, pH 6.5 – 9.5, salinity < 0.5 ppt for freshwater, and 3.0 - 5.0 mg/l) recommended by the Federal Environmental Protection Agency (FEPA, 2003). However, the concentrations of total alkalinity (86.63±30.25 – 144.30±17.01mg/l) and total hardness (103.73 ± 27.40 – 110.23 ± 45.71 mg/l) were above the values (total alkalinity 3.05 – 5.3 mg/l; and total hardness 0 – 75 mg/l) recommended by FEPA (2003) and the values of turbidity (23.33 ± 1.76 – 94.67 ± 14.68) recorded in this study is below the standard recommended by World Health Organisation (WHO, 1984).

The results of the morphometric characters (measured in cm) (Table 2) showed that there was significant difference ($p < 0.05$) in all these parameters among the three sampling sites. However, Yankova and Raykov (2006), reported that student t-test and analysis of variance (ANOVA) may not be appropriate tests for morphometric variability in fish species. These statistical tests do not explain the morphological differences in fish species, that is, very often they show differences in specimens that belong to one and the same subspecies. Therefore, coefficient of difference (Mayr *et al.*, 1953) was then used to evaluate differences between pairs of sub-populations. Values of coefficient of difference varied from 0.01 to 1.22, that is, all the coefficients of difference for the morphometric characters for the pairs of sampling sites compared in each case were below critical value of 1.28. This means that specimens from two samples do not belong to different sub-populations (Table 3), that is, specimens from the three sampling sites do not belong to different sub-populations.

Table 3 also shows the condition factors (CF), correlation coefficient (r) of body weight and standard length, and the growth coefficient (b) of *C. mento* from the three sampling sites. The values of the condition factors (5.84 ± 0.23 – 12.74 ± 0.41) recorded in the three lagoons are higher than the range (2.9 – 4.8) recommended as suitable for matured fresh water fish by Bagenal (1978). This could have been caused by adverse environmental factors (Anene, 2005) because the fish was not available all year round but comes with the influx of marine water into the lagoons, which indicates that *C. mento* may be a brackish water fish. The range of value of b (2.27 - 2.53) obtained in this study is similar to the values (2.607 - 3.254) recorded by Agboola and Anetekhai (2008), which studied the length-weight relationships of 35 fish species from Badagry Creek, Lagos. The values of b in the three sampling sites showed that the growth of *C. mento* in the sampling sites were negatively allometric. The correlation coefficients (r) between body weight and standard length for the fish species in the three sampling sites were high (Ologe $r = 0.93$, $n = 60$, $\alpha = 0.05$; Badagry $r = 0.81$, $n = 174$, $\alpha = 0.05$; Epe $r = 0.92$, $n = 60$, $\alpha = 0.05$)

Comparisons were also made between pairs of morphometric characters (Table 4) and the result revealed that there were strong ($r \geq 0.88$) and highly significant differences ($p < 0.01$) in all the comparisons except those ones that involved eye diameter (ED) and inter-orbital width (IW).

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Table 1: Physico-chemical parameters of Ologe, Badagry and Epe Lagoons

PHYSICO-CHEMICAL PARAMETER	OLOGE	BADAGRY	EPE
TEMPERATURE (°C)	30.00± 0.58^{a}	29.67± 0.33^{a}	30.33± 0.67^{a}
pH	7.44± 0.07^{a}	7.63± 0.03^{b}	7.55± 0.05^{ab}
SALINITY (ppt)	0.17± 0.07^{a}	0.23± 0.06^{a}	0.20± 0.17^{a}
TURBIDITY (NTU)	94.67± 14.68^{a}	36.33± 6.12^{a}	23.33± 1.76^{a}
DISSOLVED OXYGEN (mg/l)	3.07± 0.70^{a}	3.90± 0.06^{a}	4.20± 0.23^{a}
TOTAL ALKALINITY (mg/l)	134.20± 33.64^{a}	144.30± 17.01^{a}	86.63± 30.25^{a}
TOTAL HARDNESS (mg/l)	103.73± 27.40^{a}	110.23± 45.71^{a}	109.50± 8.42^{a}

Figures in the same row and with the same superscript letters are not significantly (p > 0.05) different. All values are expressed as mean ± SE

Table 2: Morphometric characters and condition factors of *Cynothrissa mento* from Ologe, Badagry and Epe Lagoons

SAMPLING SITE	N	TL	SL	BD	HL	HD	ED	IW	CF	r	b
OLOGE	60	12.51^{a} ± 0.21	9.83^{a} ± 0.19	3.08^{a} ± 0.06	2.81^{a} ± 0.12	2.66^{a} ± 0.06	0.72^{a} ± 0.04	0.41^{a} ± 0.02	9.62^{a} ± 0.27	0.93	2.32
BADAGRY	174	11.93^{b} ± 0.13	9.32^{a} ± 0.13	2.85^{a} ± 0.05	2.66^{a} ± 0.05	2.46^{b} ± 0.03	0.76^{a} ± 0.02	0.66^{b} ± 0.04	5.84^{b} ± 0.23	0.81	2.53
EPE	60	16.74^{c} ± 0.32	12.98^{b} ± 0.29	4.68^{b} ± 0.15	4.06^{b} ± 0.09	3.94^{c} ± 0.14	0.94^{b} ± 0.03	0.50^{a} ± 0.01	12.74^{c} ± 0.41	0.92	2.27

Figures in the same column and with the same superscript letters are not significantly (p > 0.05) different. All values {except correlation coefficient (r) and growth coefficient (b)} are expressed as mean ± SE.

Table 3: Absolute values for the coefficients of difference (C_{dif}) between sub-populations of *Cynothrissa mento* from Ologe, Badagry and Epe Lagoons

LOCATION COMPARED	SL	BD	HL	HD	ED	IW
OLOGE/BADAGRY	0.01	0.30	0.02	0.16	0.31	0.94
OLOGE/EPE	0.23	0.13	0.57	0.74	0.02	0.28
BADAGRY/EPE	0.10	0.94	0.56	0.88	0.40	1.22

Table 4: Correlation matrix of morphometric characters of *Cynothrissa mento* from Ologe, Badagry and Epe Lagoons

	TL	SL	BD	HL	HD	ED	IW
TL	1						
SL	0.95**	1					
BD	0.94**	0.91**	1				
HL	0.93**	0.89**	0.89**	1			
HD	0.94**	0.92**	0.90**	0.88**	1		
ED	0.59**	0.58**	0.54**	0.51**	0.56**	1	
IW	-0.30*	-0.23	-0.28	-0.38**	-0.22	-0.32*	1

**** Correlation is significant at $\alpha = 0.01$ (two-tailed); * Correlation is significant at $\alpha = 0.05$ (two-tailed)**