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Length-Weight Relationship and Seasonal Variation of the Condition Factor of *Dentex angolensis* (Pisce, Poll And Maul, 1953) In Beninese Coastal Waters

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Abstract

The length weight relationship and fish condition factors were studied between June 2013 and May 2014. Length-weight relationship of *Dentex angolensis* did not differ significantly between the sexes and combined equation is given by $We = 0.0306SL^{2.998}$. *D. angolensis* exhibited isometric growth. The highest condition factor (Kc) value in females was registered in July (3.232±0.07) and the lowest in September (2.826±0.08). Similarly, the highest Kc value in males was in April (3.242±0.05) and the lowest in September (2.946±0.03). The high values of Kc in males were noted during the major warm season (February to May) and at the end of the major cold season (October) which may be related to feeding activity and post-spawning recovery of the fish. The higher Kc values registered for females in July (major cold season) and from October to November (at the end of the major cold season and during the minor warm season) almost coincide with the months of occurrence of higher values of Gonado Somatic Index. In both males and females, the Kc value was highest in April during the major hydrological warm season. Based on these results, it can be concluded that the variation in the condition of *D. angolensis* may be related to sexual cycle or feeding intensity and perhaps to several other unknown factors generated by seasons.

Keywords: *Dentex angolensis*, Length-weight relationship, isometric growth, condition factor, coastal water, Benin

1. Introduction

Family Sparidae include small to medium sized fishes all below 43cm in total length (Anato, 1999)are common on African and South European coasts (Marshall, 1971). They inhabit various types of bottoms on the continental shelf and upper slope; down to at least 200 m. large adults tend to be solitary and occur in deeper water, the smaller species and young form aggregations and are often found in estuaries (Randall *et al*., 1997). The Angola dentex, *Dentex angolensis* is typically African species and is widely distributed from Angola to Guinea (Amadi, 1982). In Benin as well in Nigeria, this commercial species is commonly caught at depth 50 to 200m (Amadi, 1982, Anato 1999).

The length-weight relationship is of great importance in fishery assessment (Garcia *et al*., 1998; Haimovici and Velasco, 2000). Its importance is pronounced in estimating the average weight at a given length group (Beyer, 1987) and in assessing the relative wellbeing of a fish population (Bolger and Connoly, 1989).

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Length and weight measurement in conjunction with age data can give information on the stock composition, age at maturity, life span, mortality, growth and production (Beyer, 1989; Bolger and Connoly, 1989; King, 1996; Diaz *et al*., 2000).

In addition, the data on length and weight can also provide important clues to climatic and environmental changes and the change in human consumption practices (Ecoutine *et al*., 2005; Pauly, 1984). The condition factor and the relative condition factor (Le Cren, 1951) are the quantitative parameters of the wellbeing state of the fish and reflect recent feeding condition of the fish. It is based on the hypothesis that heavier fish of a given length are in better condition (Bagenal and Tesch, 1978).This factor varies according to influences of physiological factors, fluctuating according to different stages of the development. Condition factor has been used as an index of growth and feeding intensity (Fagade, 1979).

The present paper attempts to provide information on the length-weight relationship and relative condition factors of *Dentex angolensis* from Beninese coastal waters and to compare the differences between previous reports of this species with the present findings for management and conservation measures.

2. Materials and Methods

The study was carried out between June 2013 and May 2014 based on samples collected from commercial catches landed at the artisanal fishing port of Cotonou (Benin, West Africa). A total of 1,581 specimens (650 males, 851 females and 80 unsexed) were used. In the laboratory the standard length (SL, mm) and gutted weight (We, g) were noted. The length-weight relationship of *D. angolensis* was calculated by using the formula $We = a\,SL^b$(Ricker, 1975)which is logarithmically transformed into log We = log a + b log SL where a and b are constants. Analysis of covariance was used to test significant difference in the estimates of b between the sexes. The pattern of growth was tested by t-test using the formula t = b-3/sb. The condition factor Kc was calculated for individual fish by using the formula $Kc = 100^* We/SL^b$ (Chakroun *et al*., 2003). It's measuring the deviation of an individual from a hypothetical fish.

3. Results and Discussion

3.1. Length- Weight relationship

The length weight relationship of *D. angolensis* was estimated as reported in Table 1.

Table 1 Length-Weight relationship parameters of *D. angolensis*

	Regression equations	Statistic parameters				Min – Max values	
Sex	$We = aSL^b$	N	r	STDy	STDx	SL (mm)	We (g)
M	$We = 0.0417LS^{2.895}$	650	0.9931	0.0165	0.0057	138.0-203.3	84-261.75
F	$We = 0.0494SL^{2.829}$	851	0.9952	0.0229	0.0081	103.5-215.9	36-281.51
M + F	$We = 0.0306SL^{2.998}$	1,501	0.9980	0.0222	0.0074	109.5-209.6	38-271.64

N = number of fish specimen, r = correlation coefficient, STD = standard deviation, Min = minimum, Max = maximum

The regression equation of males and females did not differ significantly and a common equation was calculated as $We = 0.0306SL^{2.998}$. In the present study, the length-weight relationship of *D. angolensis* showed that the weight of the fish increased almost at the cube of length as the value of exponential was found to be 2.998. This was found to be not significantly different from the hypothetical 3.00 ($p < 0.05$) of an ideal fish. While discussing the merits of allometric formula in contrast to cube formula in expressing the length-weight relationship, Beaverton and Holt (1957) stated that the values of "a" and "b" may vary within the wide limits for very similar data and instance of important deviations from isometric growth in adult fishes are rare. From the above results, it is obvious that growth does not depart significantly from the isometric growth of *D. angolensis*. The length-weight relationship of *D. angolensis* showed an isometric growth as expressed by the common regression equation,

Log We = 2.998LogSL - 1.5153. Isometric growth was previously reported for some species from the near shore waters of Benin (Sossoukpe *et al*., 2013 and 2016). Omogoriola *et al*. (2011) reported a negative allometric growth of this species in Nigerian coastal waters as expressed in the following equation, Log W = 2.776LogL -1.558.

The analysis of covariance shows that there is no significant difference (F=1.0135) in the length-weight relationship between males and females. Hence, a common relationship irrespective of sex is obtained. The corresponding parabolic equation was represented by $We = 0.0306SL^{2.998}$. Hence cubic formula $W= aL^3$ can well represent the length-weight relationship in this species.

3.2. Condition Factor

The condition factor expresses the general wellbeing of the fish. It also gives clues regarding food supply, timing, and duration of the breeding cycle. In this study, the condition factor ranged between 2.363 and 3.232 for females, 2.946 and 3.242 for males, 2.886 and 3.202 for pooled individuals. Omogoriola *et al*. reported a condition factor ranged 2.06 and 6.13 with mean value of2.79 ± 0.42 for *D. angolensis* in Nigerian coastal waters. In females, Kc values were high in April, June, July, October, and November. The values of Kc were low in February and August. The highest Kc values in female were in July (3.232±0.07) and lowest in February (2.363±0.06) (Table 2). In males, the Kc values were high throughout the year with slight decrease in September and December. The highest Kc values were in April (3.242±0.05) and lowest in September (2.946±0.03) (Table 2).

Table 2: Monthly variation of the condition factor

	Males		**Females**		**Males + Females**	
Months	Kc	STD (±)	Kc	STD (±)	Kc	STD (±)
Jun	3.071	0.06	3.041	0.05	3.056	0.07
Jul	3.104	0.06	3.232	0.07	3.118	0.04
Aug	3.077	0.05	2.948	0.04	3.013	0.07
Sep	2.946	0.03	2.826	0.08	2.886	0.03
Oct	3.126	0.04	3.156	0.04	3.141	0.04
Nov	3.049	0.04	3.196	0.05	3.123	0.04
Dec	2.973	0.07	3.012	0.07	2.993	0.03
Jan	3.079	0.07	3.086	0.03	3.083	0.06
Feb	3.131	0.07	2.363	0.06	2.747	0.04
Mar	3.138	0.03	2.99	0.04	3.064	0.07
Apr	3.242	0.05	3.161	0.05	3.202	0.05
May	3.047	0.07	2.99	0.03	3.019	0.04

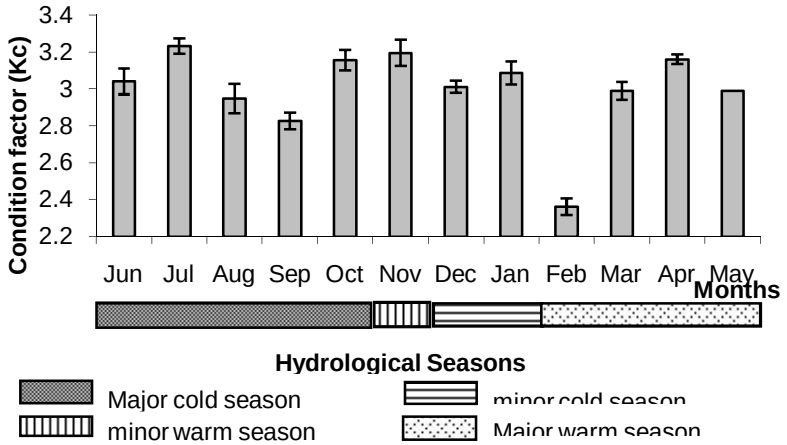

Figure 1: Condition factor of females of *D. angolensis*

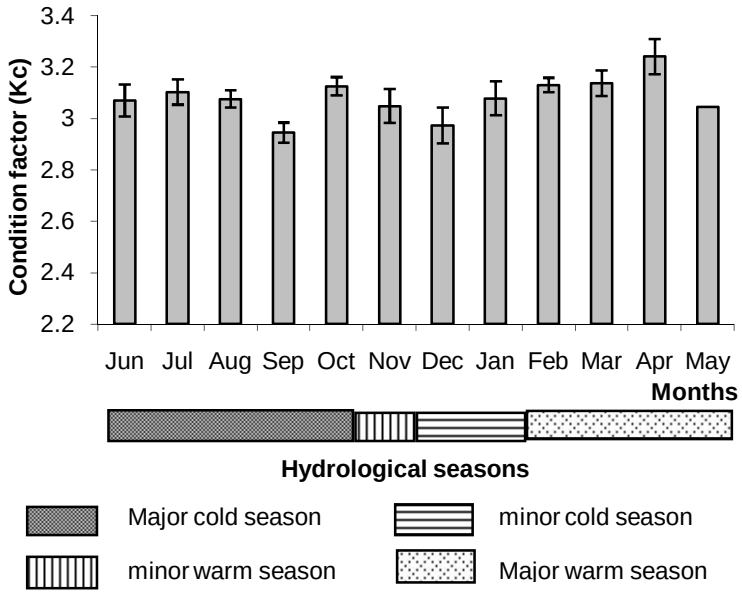

Figure 2: Condition factor of males of *D. angolensis*

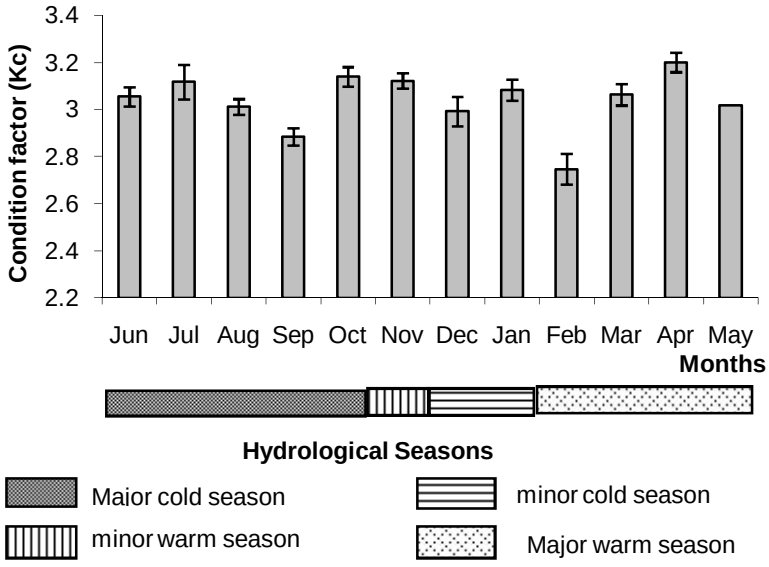

Figure 3: Condition factor of both males and females of *D. angolensis*

The present study on the seasonal variation in the condition of males and females (Figs 1 and 2) showed that the Kc values were not similar in both the sexes, thus indicating unequal metabolic activity during hydrological seasons. The high values of males were noted during the major warm season (February to May) and at the end of the major cold season (October) which may be related to feeding activity and post-spawning recovery of the fish (Fig 4). The higher Kc values registered for females in July (major cold season) and from October to November (at the end of the major cold season and during the minor warm season) almost coincide with the months of occurrence of higher values of Gonado Somatic Index. The months with lower Kc values were similar to those with lower Gonado-Somatic Index (Fig 3). There seems to be some relation between condition and reproductive activities. April, May, June, July and December, January were periods of intensive reproductive seasons when the condition values were also

high in both the sexes. The values obtained from this study showed that the species studied were in good condition. Braga (1989) showed that the values of the condition factor vary according to seasons and are influenced by environmental conditions.

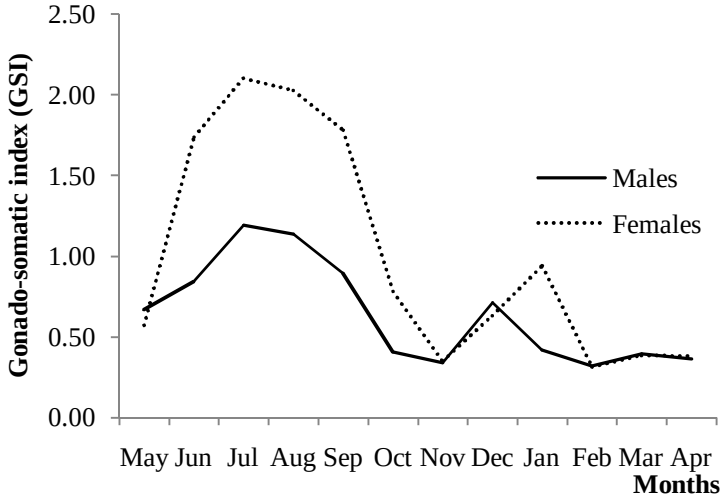

Figure 4: Monthly variation of Gonado-somatic index of *D. angolensis*

3.3. Condition Factor in Relation to size of Fish

Fluctuation in the condition with the length of fish is not regular. The values of Kc were highest in the size range of 100-110 mm. Further, there was gradual decrease in Kc values till 140-150 mm. Again the Kc values attained a peak in the next size group 150- 160 mm which might be due to the building up of gonads and sudden fall in the size group of 160-170 mm could be due to the spawning stress on the fish which is very close to 50% attainment of maturity length at 163 mm (Anato, 1999). The values show peaks at 170-180 mm, 190-200 mm and 210-220 mm and troughs at180-190 mm and 200-210 mm. This may be associated with subsequent maturation and spawning cycle (Anato, 1999).The Kc values for females showed that the size groups of 100-110mm exhibited high Kc followed by sudden decrease in the next successive size groups of 110-120 mm and 120-130 mm. There was gradual increase in the Kc values till 150-160 mm after which it falls in 160-170 mm size groups only to rise in the size class of 180-190 mm. The highest values in150 to 160 mm might be due to the accumulation of fat prior to spawning, building up of gonads and drop in the 160-170 mm and 170-180 mm size groups could be due to the spawning activity of the fish. Hence, based on the results obtained during the present study it can be concluded that the variation in the condition of *D. angolensis* may be related to sexual cycle or feeding intensity and perhaps to several other unknown factors.

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