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Length- weight Relationships and Relative Condition Factor (Kn) of Sciaenids, Pseudotolithus Senegalensis (Valenciennes, 1833) and Pteroscion peli (Bleek,1863), in Nigerian Coastal water

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Abstract

The length-weight relationship and condition factors were estimated for Psedotolithus senegalensis and Pteroscion peli of the family Sciaenidae trawled from Nigeria Coastal water in 2009. A total number of 1,612 specimens ranging from 6.0 – 50.0cm in total length and 1.7 – 900.0g in weight were analyzed. The length-weight relationships are shown by the following equations: LogW = -2.105 + 2.977 logL (P senegalensis) and LogW = -1.379 + 2.539 logL (P peli). The two species studied exhibited negative allometric growth (b < 3) with the mean b = 2.75 at p <0.001. The correlation coefficient (R) valves were 0.94 (P sengalensis) and 0.90 (P peli). The condition factor (K) obtained for P sengalensis and P peli was between 0.03 – 11.99 with mean value of 2.60 ± 0.89 and between 0.06 – 6.10 with mean value of 2.27 ± 0.94 respectively. The relative condition factor (Kn) were 3.57 ± 1.30 (P sengalensis) and 1.07 ± 0.35(P peli). The Kn increased progressively with increased length but reduced at 35cm – 39cm and 25cm - 29cm size groups for P senegalensis and P peli respectively. These size groups fell within their gonad development. The two species of sciaenidae studied are in good condition (K ≥ 0.5).

Keywords: Sciaenidae; Length-weight relationship; Relative condition factor; Coastal water; Nigeria.

Introduction

The most important genera in the tropical West African trawl fisheries belong to the family Sciaenidae (Longhurst ,1965). Sciaenidae is a family commonly called croakers, drums or hardheads for the repetitive throbbing or drumming sounds they make. The sounds are produced by the beating of abdominal muscles against the swim bladder .

This fish species group is primarily marine but also occurs seasonally in brackish water areas. Most of the mortality, growth and production (Beyer, 1987; Bolger and Connoly,1989; King, 1996a and b; Diaz et.al., 2000).

In addition, the data on length and weight can also provides important clues to climatic and environmental changes and the change in human consumption practices (Ecoutine et.al., 2005; Pauly, 1984). However, the size attained by the individual fish may also vary because of variation in food species inhabit sandy and muddy bottoms in coastal areas(Koranteng,1984).

The length – weight relationships (LWRs) is of great importance in fishery assessment (Garcia et.al.,1998; Haimovici and Velasco,2000). Its importance is pronounced in estimated the average weight at a given length group(Beyer,1987) and in assessing the relative well being of a fish population (Bolger and Connoly,1989).Length and weight measurement in conjunction with age data can give information on the stock composition, age at maturity, life span, supply, and these in turn may reflect variation in climatic parameters and in the supply of nutrient or in the degree of competition for food. Environment deterioration,

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for example, may reduce growth rates and will cause a decrease in the average age of the fish. The condition factor and the relative condition factor (Le Cren, 1951) are the quantitative parameters of the well being 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 an index of growth and feeding intensity (Fagade,1979). Condition factor decrease with increase in length (Bakare,1970;Fagade 1979) and also influences the reproductive cycle in fish (Welcome,1979). The objective here is to determine the length-weight relationships and the variations in the condition factor and relative condition factor among species and size groups of Sciaenids population in the Nigerian coastal water and to compare the different between previous reports of this family on the Gulf of Guinea with the present findings.

Materials and Methods

Study Area: The sampling areas started from Nigeria/Benin boarder to the Western part of Ondo State. Eleven transects were sampled with seven stations on each transect line. The seven stations selected were based on the depth ranges; 10, 20, 30, 40, 50, 70 and 100m. the distances between transects was 5 nautical miles (9.26km) apart and the total distance between first and last transect was 50 nautical miles (92.6km) (Figure 1).

Fish Sampling: The length-weight relationships (LWRs) of two species of Sciaenidae was determined from individual collected from Nigeria coastal water . A total of 1,612 fish were analyzed, 835 for *Pseudotolithus sengalensis* (Cassava croaker) (Valenciennes,1833) and 777 for *Pteroscion peli* factor varies according to influences of physiological factors, fluctuating according to different stages of the development. Condition factor has been used as (Boe drum croaker) (Bleek,1863). They were collected with a trawl net (cod-end 20mm mesh size), trawled at different depth ranging from 10m-100m between May and June 2009.These species were abundant in 50m depth and above. The Total Length (cm) of the fish was measured from the tip of the snout or part of the mouth to the caudal fin using meter rule calibrated in centimeters. Fish was measured to the nearest centimeter. The weight of the fish was done with a table top weighing balance (Ohus Electronic) measured to the nearest gram. Fish weight was measured after blot drying with a piece of clean hand towel.

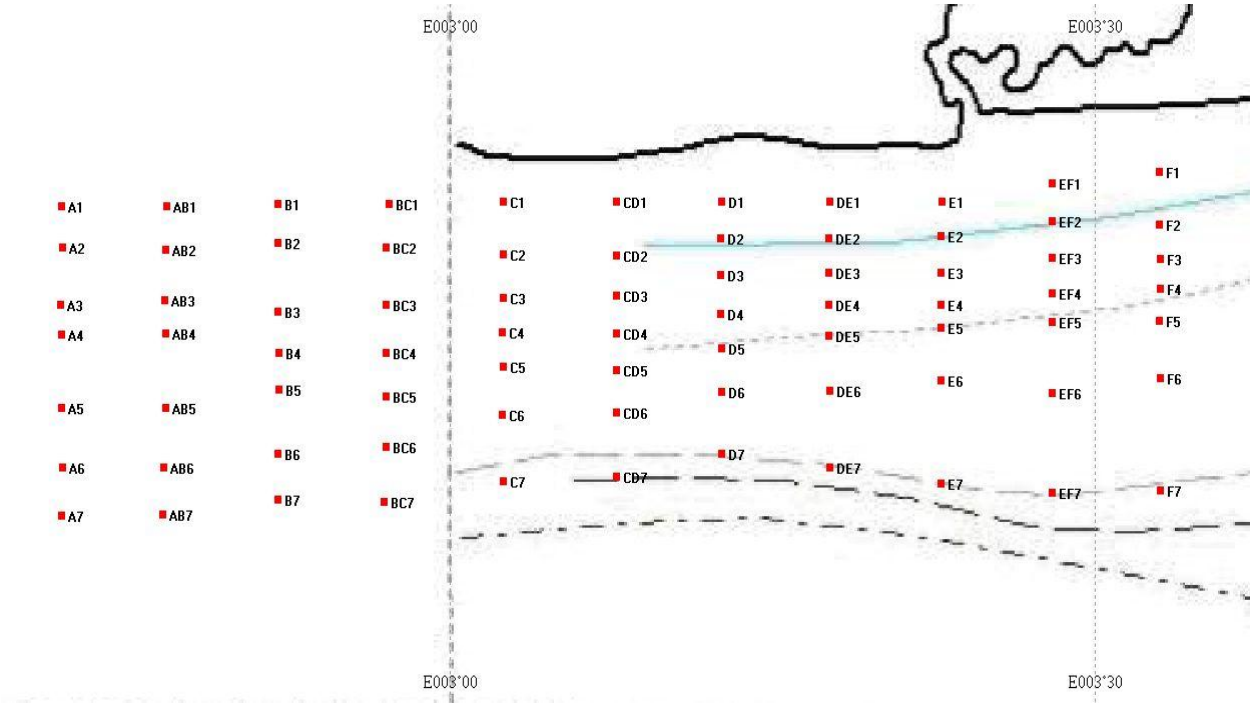

Figure 1: Map of Nigeria coastal water showing sampling stations

Length-weight Relationship: The relationship between the length(L) and weight (W) of the fish was expressed by equation (Pauly, 1983):

$W=aL^b$ (1a)

Linear transformation was made using natural logarithm at the observed lengths and weights proposed by Zar (Zar,1984). The expression of the relationship is represented by the following formula:

$\text{Log } W = b \log L + \log a$ (1b)

Where : W = the weight of the fish in grams.

L = the total length of the fish in centimeter

a = exponent describing of the rate of change of weight with length (intercept)

b = weight at unit length (slope)

The correlation coefficient (r^2), that is the degree of association between the length and weight was computed from the linear regression analysis:

$$R = r^2 \quad (2)$$

Condition Factor: The degree of well-being or relative robustness of the fish is expressed by 'coefficient of condition' (also known as condition factor or length – weight factor). The condition factor as an indicator to fish welfare in their habitat was described (Gomiero and Braga, 2005). It is represented by letter K (formula 3) when the fish is measured and weighed ,as in the following equation (Pauly,1984).This 'k' value can be basically and directly interpreted as 'the higher the value , the better the condition of the fish.

$$K = \frac{100W}{L^b} \quad (3)$$

Where K = condition factor

W = the weight of the fish in gram

L = the total length of the fish in centimeters.

b = the value obtained from the length-weight equation. In this study, the exponent 'b' value that is in formula 1b was used to calculate the 'k' value.

Relative Condition Factor: The relative condition factor (Kn) was calculated by the formula of Le Cren(1951). This 'Kn' value is used to compare conditions between species and within their size classes (<5-9cm, 10-14cm, 15-19cm, 20-24cm, 25-29cm 30-34cm, 35-39cm, 40-44cm, 45-49, TL etc)

$$Kn = W/W' \quad (4)$$

Where: Kn = relative condition factor

W = the weight of fish in grams (observed weight)

$W' = aL^b$ (calculated weight)

The difference between K and Kn is that the former is measuring the deviation of an individual from a hypothetical fish while the later is measuring the deviation of an individual from average weight from length.

Results

A total number of 1,612 individuals of both species were analyzed of which 835 (51.79%) were *Pseudotolithus senegalensis* and 777 (48.20%) were *Pteroscion peli* (Table 2). The total length (TL) of 8.0cm (min) – 50.0cm (max) with mean value of 20.40±5.96cm for *Pseudotolithus senegalensis* and total length (TL) 0f 6.0cm (min) – 28.0cm (max) with mean value of 12.30cm for *Pteroscion peli* were recorded. Also the weight of 1.7g (min) – 900g (max) with mean value of 82.9±90.14g and 2.8g (min) – 179.1g (max) with mean value of 28.81±20.81g for *Pseudotolithus senegalensis* and *Pteriscion peli* respectively were recorded(Table 1). Figure 2 and 3 illustrate the length- weight relationships for *P senegalensis* and *P peli* respectively. Table 2 presents the Length-weight regression analysis for both species. Length weight relationships are shown by following equations: LogW = -2.105+2.977LogL (*P.senegalensis*), LogW = -1.379+2.539LogL *(Pteroscion peli*). All species studied exhibited negative allometric growth (b<3) with the mean b= 2.76 at p<0.001. The correlation co-efficient (r) were 0.94 and 0.90 for *P.senegalensis* and *Pteroscion peli* respectively (Table 1). In all the species the correlation coefficient found to be higher than 0.5, showing the length-weight relationship is positively correlated and vice versa.The condition factor (K) and relative condition factor (Kn) for both species are showed in figure 4. The sample size varied with fish species. The condition factor (k) ranged between 0.031 and 11.99 with mean value of 2.60 ± 0.89 for *P.senegalensis* and ranged between 0.55 and 6.10 with mean value of 2.27 ± 0.94 for *Pteroscion peli* while relative condition factor(Kn) were 3.57 ± 1.30 and 1.07 ± 0.37 for *P.senegalensis* and *Pteroscion peli* respectively. Figure 4 illustrates the variation in the mean K and Kn for theboth fish species. The 'k' value was high in *P peli* while 'Kn' value was high in *P senegalensis*. The relative condition factor (Kn) was estimated by dividing theobserved mean weight (W) by the calculated weight(W'). The Kn for all fish sampleswas determined from the average lengths and weights of 5cm interval of total size groups (Figure 5). The (Kn) values for size groups ranged between 0.7460 (25cm - 29cm) and 1.1645 (20cm - 24cm) for *P peli* and between 1.3495 (5cm – 9cm) and 5.4523 (45cm –49cm) for *P senegalensis*. The Kn increased progressively with increased length but reduced at 35cm - 39cm and 25cm - 29cm size groups for *P.senegalensis* and *P peli* respectively.

Figure 2: Length-weight relationship of *Pseudotolithus senegalensis* from Nigeria Coastal water.

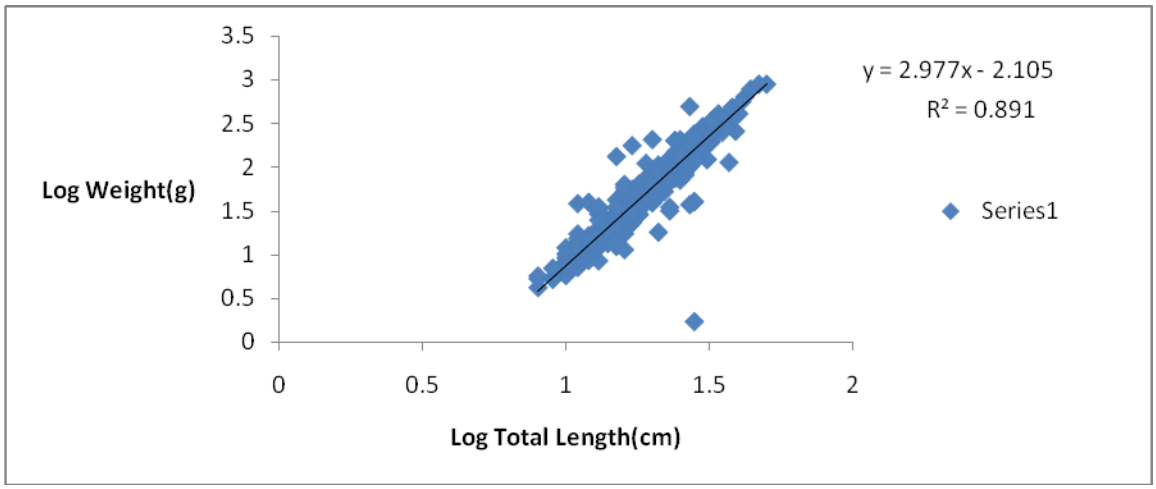

Figure 3: Length-weight relationship of *Pteroscion peli* from Nigerian Coastal water.

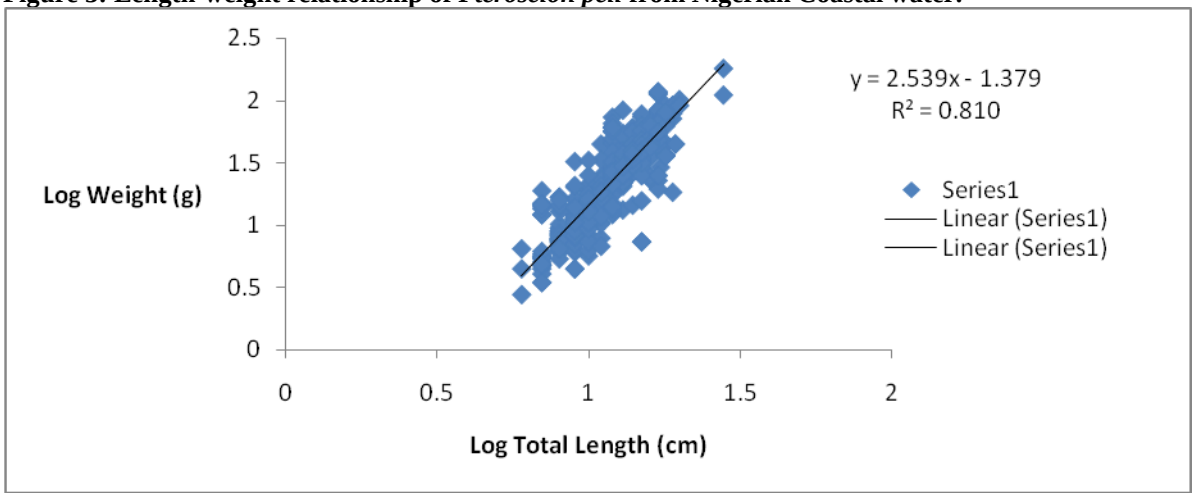

Table 1: Size ranges of *Pseudotolithus senegalensis* and *Pteroscion peli* from Nigeria Coastal water from Nigeria Coastal water

Fish Species	Average TL(cm)	TL range(cm) Max	Min	Average Wt(g)	Wt range(g) Max	Min
Pseudotoliths senegalensis	20.40	50.0	8.0	82.91	900.0	1.7
Pteroscion Peli	12.30	28.0	6.0	28.81	179.1	2.8

Wt = weight; TL = total length; parentheses = range value

Table 2: Length-weight relationship parametes for *Pseudotolithus senegalensis* and *Pteroscion peli* from Nigeria coastal water

Fish Species	N	b±s.d	Logarithmic equation	R
Pseudotolithus senegalensis	835	2.98±0.37	LogW=-2.105+2.977logL	0.94
Pteriscion peli	777	2.54±0.28	LogW=-1.379+2.539logL	0.90

N = number of fish; b = regression co-efficient; r = correlation co-efficient

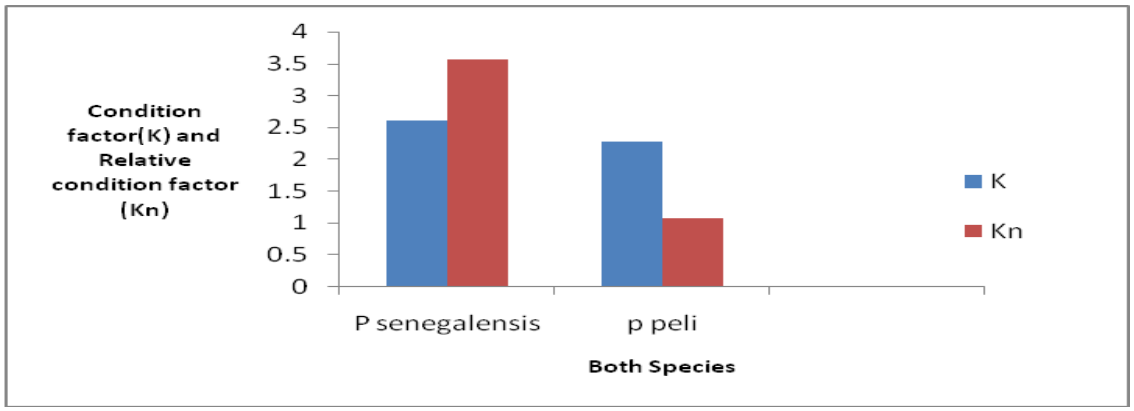

Figure 4: Condition factor (K) and relative condition factor (Kn) for *Pseudotolithus senegalensis* and *Pteroscion peli* from Nigeria Coastal water.

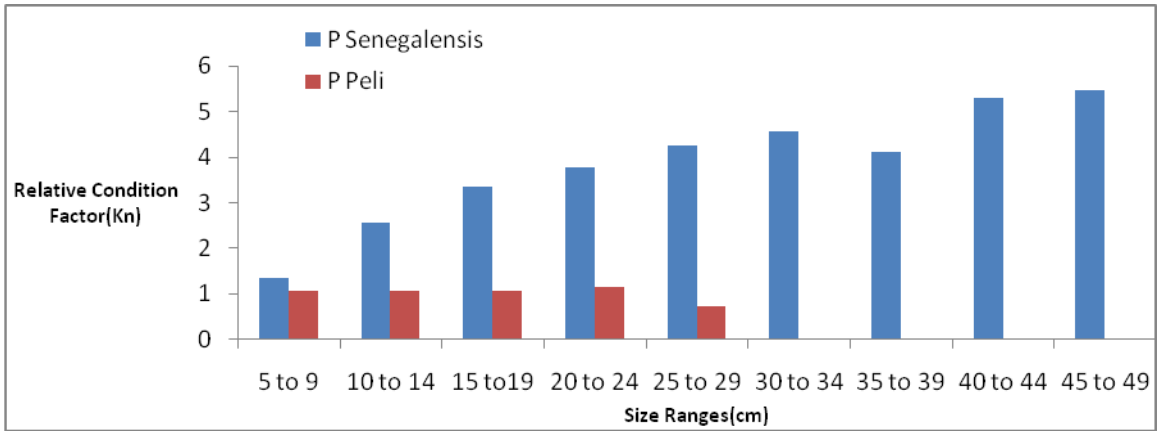

Figure 5: Size wise relative condition factor (Kn) for *Pseudotolithus senegalensis* and *Pteroscion peli* from Nigeria Coastal water

Discussion

Length-weight relationships: Length-weight relationships give information on the condition and growth patterns of fish (Bagenal and Tesch, 1978). Fish are said to exhibit isometric growth when length increases in equal proportions with body weight from constant specific gravity. The regression co-efficient (b) for isometric growth is '3' and a value lesser than '3'indicates negative allometric growth which shows that fish becomes smaller while a value greater than '3' indicates positive allometric growth which indicates that fish becomes heavier for a particular length as it increases in size (Gayando and Pauly, 1997; Wotton, 1998; Zafar et al., 2003).

The 'b' values for *Pseudotolithus senegalensi* and *Pterscion peli* show a negative allometric growth (Table 2). According to Hile (1936) and Martin (1949) the valves of exponents 'b' usually ranges between 2.5 and 4. Several authors have both reported isometric and allometric growth for different fish species from various water bodies. Pauly and Gayando (1997) reported that b values may ranged from 2.5 to 3.5 which . Da Costa and Araujo (2003) recorded 'b' value of 2.9 for *Micropogonias furnieri* which of the same family with this present studies. King (1996) reported isometric growth for *Pseudotolithus elongatus* from Qua Ibeo Estuary. Garcia et al.(1997) reported b values ranged between 2.8 and 3.0 for family sciaenidae in the Gulf of Salamanca which support the result of this study. Nieto-Navarro et al., (2007) also reported the value ranged between 2.8 (*Cynoscion phoxocephalus*) and 3.5 (*Paralonchurus goodie*) for sciaenids from the Gulf of California.

In the present study, for the length-weight relationships of sciaenids, weight increased proportionately to an increase in length in all the species. Correlation coefficients (r) were very high and highly significant (Table 2) an indication that changes in total length and weight of these fish species were directly proportional.The length-weight relationship in fishes is affected by a number of factors including season, habitat, gonad maturity, sex, diet and stomach fullness, health and preservation techniques (Tesch.1971) which are not reported in this study.

The condition factor (K) and relative condition factor (Kn): Individual fish species conditions are determined

based on the analysis of length-weight data reflected that the heavier fish at a given length is in better condition. It also indicates the conducive
environmental condition(Borgal and connolly,1989). K also gives information when comparing two populations living in certain feeding ,density, climate and other conditions (Bagenal and Tesch 1978). The mean condition factor obtained for both species were above 2 which support results from other studies. Fafioye and Oluajo (2005) reported 'k' value between 0.64 and 1.99 for five fish species at Epe Lagoon, Nigeria. The 'K' values that ranged between 1.12 and 8.80 were recorded for *Pterygoplichthys pardalis* in Langart River (Samat et al .,2008). The values obtained from this study showed that the two species studied were in good condition. Braga (1986) showed that the values of the condition factor vary according to seasons and are influenced by environmental condition. The same may be occurring in the environment under this study since Nigeria coast is influenced by many biotic and abiotic factors which favor the equilibrium of all the species in an ecosystem. Nikosky (1963) reported that the largerthe condition factors the better the well being of thefish. In this study, *P senegalensis* with higher 'K'value was in a better condition than *P peli* with lower'K' value (figure 4). Figure 4 showed *Pteroscion peli* with higher condition factor while highest relative condition factor was revealed for *Pseudotolithus senegalensis*. 'Kn' value in *P senegalensis* revealed that this fish specie was more robust and in a betterstate of well being rather than 'K' value. It istherefore necessary to calculate the Kn, which compensates for changes in form or condition with increase in length, and thus measures the deviation ofan individual from the average weight for length inthe respective samples. The Kn increased progressively with increased length i.e as they move from juvenile to
adult stage but reduced at 35cm –39cm and 25cm – 29cm size groups for *P senegalensis* and *P peli* respectively (figure 5). This result suggested that their growth from juvenile to adult stage was not affect by any extrinsic factors. This also assumed that their gonad developed gradually until their maturity stage. Samat et al;(2008) reported lower 'Kn' value for *Pterygoplichthy pardalis* from Langart River at full grown gonadal stage. Mgbenka and Eyo (1992) and Fawole (2002) attributed the differences in condition factor to the deposition of materials for gonad formation, which led to increase in weight and actual spawning which lead to reduction in fish weight respectively. In addition. Vazzoler (1996) confirmed that lowest 'k' values during the more developed gonadal stages might mean resource transfer to the gonads during the reproductive period.

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