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Length frequency distribution, length-weight relationship and condition factor of *Eucinostomus melanopterus* (Bleeker, 1863) in the Saloum estuary (Senegal)

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ABSTRACT: This study on *Eucinostomus melanopterus* was conducted from September 2014 to June 2016 in the Saloum estuary. Samples were collected using gillnets (monofilament polyamide) with 28; 30; 32; 36 and 40 mm of mesh size (Knot to knot). The aim of this study was to provide information on length frequency distribution, length-weight relationship and condition factor for *E. melanopterus* in the Saloum estuary. Analysis of the size frequency distribution was bimodal with modes equal to 13 and 18 cm, respectively. The length-weight relationship showed positive allometric growth with b = 2.966. Values of condition the factor were greater than 1, indicating that individuals of *E. melanopterus* were in good physiological condition. The highest K value is obtained in the transition period between the hot and cold season (K = 1.327±0.059) and the lowest value in the transition period between the cold and hot season (k = 1.21±0.083).

KEYWORDS: Saloum estuary, condition factor, Fishery, Gerreidae.

1 INTRODUCTION

The family Gerreidae is mainly represented by medium to small sized estuarine coastal fish found on sandy or muddy bottoms [1], [2]. This family has about 44 species [3], including *Eucinostomus melanopterus* (Bleeker, 1863), which is distributed in the eastern Atlantic from Senegal to Angola [1], [2]. *E. melanopterus,* a marine species from the Estuary (ME) [4]. It is a coastal species which generally occupies sandy and sandy-muddy bottoms at depths between 0 and 25 m [5]. It occurs in brackish lagoons and estuarine environments and often invades mangroves [6].

E. melanopterus is not targeted by Senegalese marine fisheries. It is often caught accidentally by artisanal fishermen. However, it occupies, with *Gerres nigrii,* in the Saloum estuary, the second rank after the Clupeidae in terms of abundance [7]. Despite its importance in terms of abundance in the Sine-Saloum estuary waters, studies on the biology of this species are insufficient.

The aim of this study is to characterize the length frequency distribution, length-weight relationship (LWR) and condition factor of *E. melanopterus* in the Saloum Estuary.

2 MATERIEL AND METHODS

2.1 STUDY AREA

This study was conducted in the Saloum Estuary (13° 35’ et 14° 10’ Nord et 16° 50’ et 17° 00’ W) in southern Senegal. The Saloum Estuary belongs to the category of reverse estuaries [8], [9], [10]. This estuary no longer receives any inflow of fresh

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water. It is characterized by a predominance of seawater due to low slope, a positive upstream and downstream salinity gradient, and significant evaporative losses [11]. The Sine-Saloum presents a hyperhaline situation upstream, with extreme salinities reaching four times that of the sea [6].

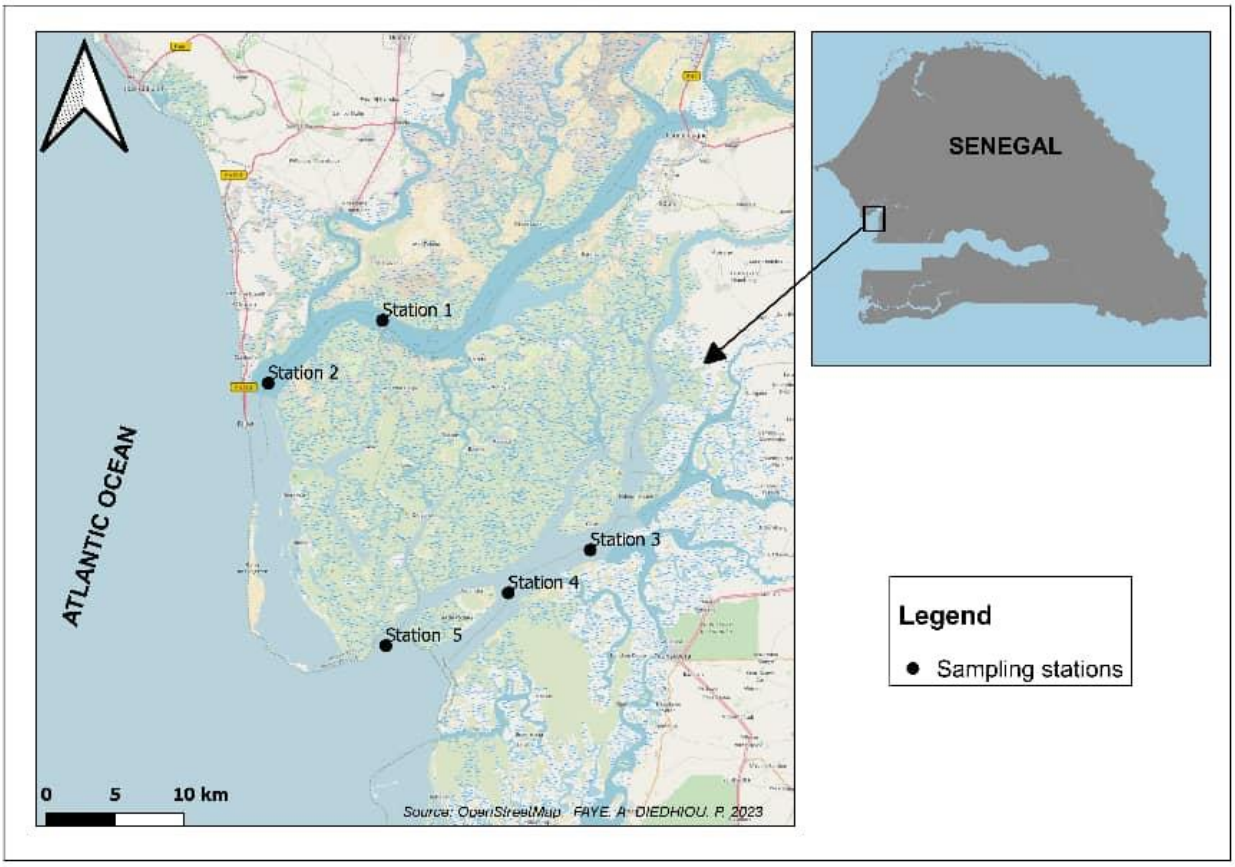

Fig. 1. Sampling station

2.2 SAMPLING PROTOCOL

The individuals of *E. melanopturus* used for this study were caught during experimental fishing conducted quarterly from September 2014 to June 2016. The purpose of this experiential fishing was to study the selectivity of gillnets used to capture *Ethmalosa fimbriata*. A gillnet with 28, 30, 32, 36, 40 and 46 mm side mesh was used. After each fishing operation, data on the total length (TL in cm), fork length (FL in cm) and weight (W in g) of each individual were measured.

2.3 LENGTH-FREQUENCY DISTRIBUTION

The total length measurements performed on specimens allowed to plot the length frequency distribution of *E. melanopturus*. The various measured lengths were grouped into 1 cm class intervals. The following formula was used to calculate the size frequencies:

$$Fi = Ni \times N \times 100$$

Where Fi = Frequency, Ni = Number of specimens for a given Length, N = Total number of specimens.

2.4 TOTAL LENGTH-FORK LENGTH RELATIONSHIPS

The relationships which link the total length and the length to the fork of *E. Melanopturus* is described by the following formulas:

$$TL = a \times FL + b$$

Where TL = Total Length of fish, a and b are regression constants of the equation

2.5 Length -Weight Relationship

The total length and body weight of fish were used for the length-weight relationship. The length weight relationship (LWR) of fish was expressed by the following equation [12]:

$$W = a \times TL^b$$

Where W = Weight of Fish (g), TL = Total Length of fish (cm), a = Constant (Intercept), b = Allometric coefficient (slope).

2.6 Condition Factor (K)

The condition factor has usually been represented by the letter K when the fish is measured and weighed in the metric system. The K value is calculated from the weight (g) and length (cm), and can be used to estimate changes in nutritional condition. The formula most often used is:

$$K = (W/TL3) \times 100$$

K= condition factor, W= Weight of fish (g) and TL= Total length of fish (cm).

2.7 Statistical Analysis

Statistical processing and graphics were performed with Microsoft Office Excel 2010 and R softwares.

3 Results

3.1 Length Frequency Distribution

A total of 151 specimens were used for this study. The length frequency distribution showed two modes (13 and 18 cm) corresponding to two different groups. The first group consists of individuals ranging in size from 10.5 to 15.9 cm, while the second group consists of individuals ranging in size from 16.3 to 24.5 cm (Figure 2).

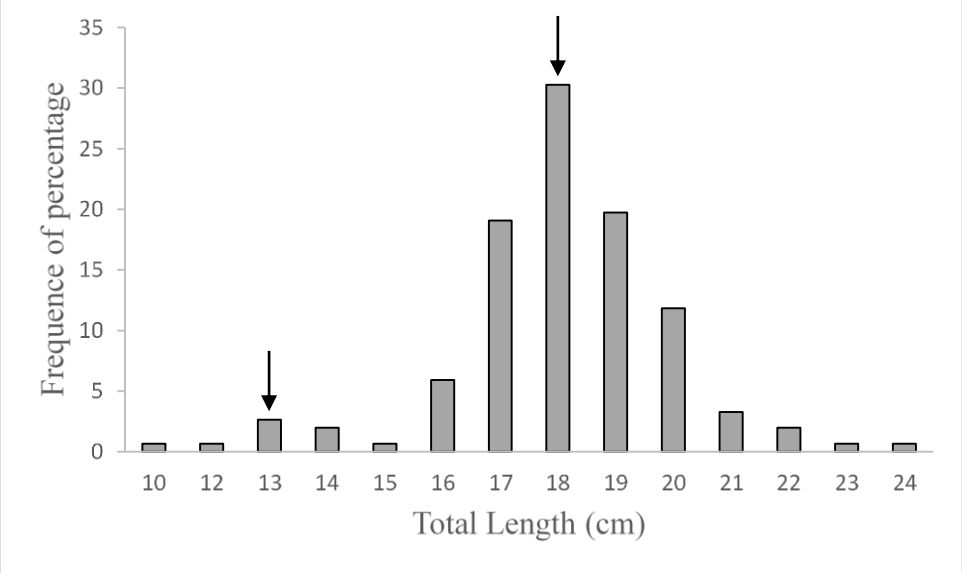

Fig. 2. Length frequency distribution of E. melanopturus

3.2 TOTAL LENGTH-FORK LENGTH RELATIONSHIPS

The relationship linking total length to length is shown in Figure 3 and is represented by the regression equation TL = 1.1431 FL + 0.7389. Analysis of this relationship shows a strong correlation (r2 = 0.9668) between total length and fork of *E. melanopturus* (Figure 3).

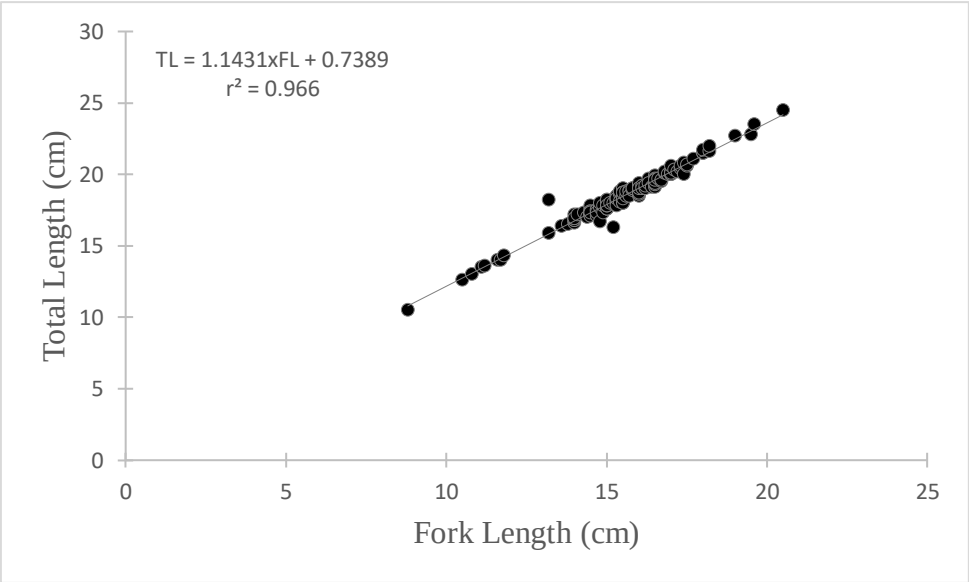

Fig. 3. Total Length-Fork Length relationship of E. melanopturus

3.3 LENGTH -WEIGHT RELATIONSHIP

Body weight of *E. melanopterus* varied from 14.8 g to 178.4 g (mean = 83.2±23.1 g) and total length varied from 10.5 to 24.5 cm (mean = 18.5±1.90 cm). The length-weight relationship of *E. melanopterus* is shown in Figure 4 and is represented by the following equation: W = 0.016×TL2.922. The allometric coefficient obtained was not significantly different from 3 indicating an isometric growth for *E. melanopterus*.

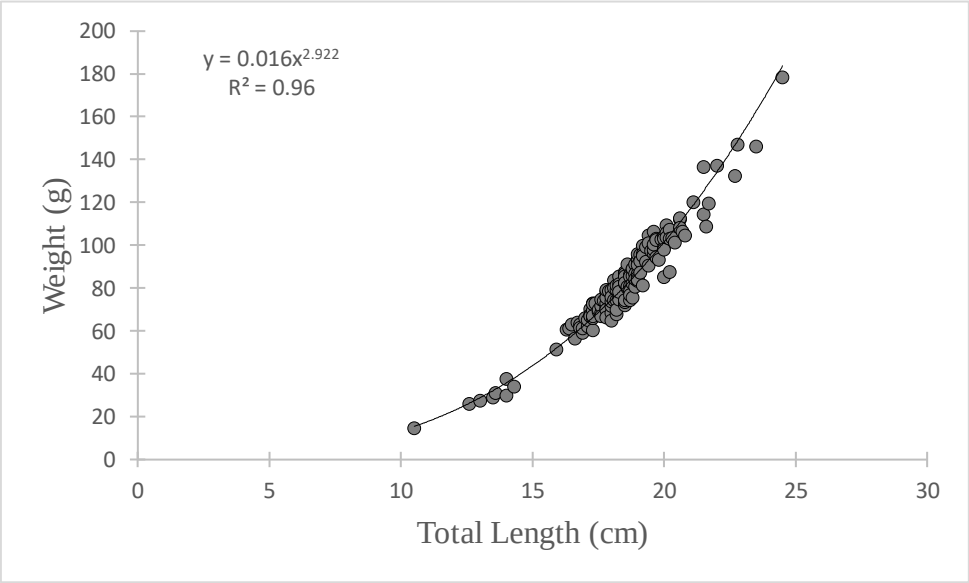

Fig. 4. Length-weight relationship of E. melanopturus

3.4 CONDITION FACTOR (K)

Boxplot diagrams were used to show the variation in condition factor (K) for *E. melanopturus*. All seasonal values of K are greater than 1 (Figure 5). The highest K value is recorded during the hot season (1.28±0.000) and the transition period between the hot season and the cold season (1,327±0.059). Then, the condition factor gradually decreases through the cold season (1.24±0.085) and the transition period between the cold season and the hot season (1.21±0.083).

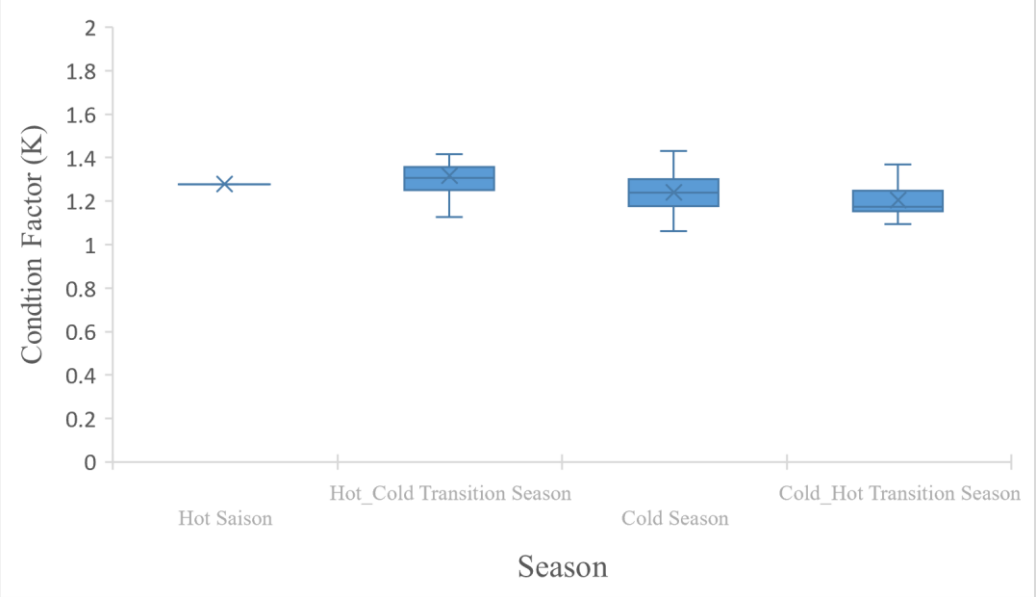

Fig. 5. Condition factor (K) of E. melanopturus

4 DISCUSSION

Size structure analysis is one of the most commonly used tools to assess fisheries. Thus, length frequency data provide valuable information about the dynamics of fish populations and help to identify problems such as inconsistent staffing of age groups, slow growth or excessive mortality [13].

For the present study, the length frequency distribution showed two distinct groups of individuals of *E. melanopturus* with two modes equal to 13 and 18 cm, respectively. The first group would correspond to immature individuals while the second would consist of adults. The appearance of these two groups in the catches is due to the use of the different mesh sizes of the net (28; 30; 32; 36 and 40 mm of mesh size).

Knowledge of the length-weight relationship (LWR) is used in fish biology and assessment of fish stocks [14]. length-weight relationship allows conversion of length growth to weight to weight in models evaluating biomass stocks from length frequency distributions and assessment of fish status [15], [16]. The results on the length-weight relationship of this study showed that the value of the allometric coefficient is close to the cubic law (b = 2.922) demonstrating an isometric growth for E. melanopterus from the Saloum Estuary. This result is similar to those of [17] and [18] in Ivory, [19], [20], [21] and [22] in Brazil, [23] in Nigeria and [24] in Guadeloupe who found isometric growth for *E. melanopterus* (Table 1). However, [25] and [26] for *E. melanopterus* obsessed with a positive allometric growth in Mexican waters. Several biological factors are known to affect LWR of fish. In other studies, the differences in the allometric coefficient have been attributed to several factors: sex, gonad maturity, growth phase, health, food availability, stomach fullness, season, water temperature or salinity [27], [28], [29], [30] and [31].

Table 1. Parameters of length-weight relationship of E. melanopterus compared with other results

Country	a	b	r^2	Number	Type of length	Auteurs
Ivory Coast	0.01500	2.840	0.959	18	SL	[17]
Brazil	0.00970	2.840	0.960	899	TL	[22]
Nigeria	0.01280	2.910	0.976	25	TL	[23]
Brazil	0.01620	2.920	0.983	104	TL	[19]
Senegal	0.016	2.922	0.96	151	TL	Present study
Brazil	0.01090	3.030	0.993	85	TL	[21]
Guadeloupe	0.01110	3.034	0.972	29	TL	[24]
Brazil	0.01080	3.042	0.970	158	TL	[20]
Ivory Coast	0.0086	3.079	0.923	210	SL	[18]
Mexico	0.01490	3.349	0.907	168 65	SL	[25]
Mexico	0.00600	3.620	0.950	41	TL	[26]

The results of this study showed seasonal fluctuations variations in the K values of *E. melanopterus*. The seasonal variation of K is influenced by gonad development, feeding activity and several other factors [32]. The low K values during the cold season and the transition period between cold and hot seasons could be attributed to reproduction or food availability. In fact, the condition factor indicates the stages of parental physiological development for weight gain and gonad maturation [33]. Its temporary development leads to weight loss or gain. Mushing or weight loss in fish may coincide with the active breeding season, and its increase results in weight gain consistent with the oocyte maturation phase in the gonads [34], [35]. Condition and feeding activity decrease during the breeding season [36]. According to [37], the lowest K values in more developed gonad stages may indicate resource transfer to the gonads during the breeding season.

5 CONCLUSION

Knowledge of the length-weight relationship and the condition factor of fish is an important tool in fisheries management. The present study provides the basic initial information on the parameters of the length-weight relationship and the condition factor of *E. melanopterus* in the Saloum Estuary. The results on the length frequency distribution of *E. melanopterus* showed a bimodal distribution with two groups of different individuals. The study also showed that *E. melanopterus* exhibited an isometric growth. The highest condition factor values were recorded during the hot season. The results obtained in this study could be used as basic parameters for population dynamic studies of this species.

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