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Length-Weight Relationship and Condition Factor of *Ethmalosa fimbriata* (Bowdish, 1825) and *Mugil cephalus* (Linnaeus, 1758) in Coastal Waters of Ondo State

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

The study aimed at examining the Length-Weight Relationships (LWRs) and Condition factor of *M. cephalus* and *E. fimbriata.* 240 fish specimens were collected from November 2021 to April 2022 from Obi, Idiegbin, Okesiri and Araromi following standard methodologies subjected to length-weight relationship and condition factor analysis. The results showed that the mean total length of *M. cephalus* ranged from 30.96 ± 0.56cm (Araromi) to 23.80 ± 1.16cm (Okesiri) and weight ranged from 118.86 ± 9.36g (Araromi) to 71.32 ± 18.12g (Okesiri). *E. fimbriata* total length ranged from 21.04 ± 0.74cm (Araromi) to 13.96± 0.38cm (Okesiri) and weight ranged from 150.90 ± 1.14g (Araromi) to 70.54 ± 5.76g (Okesiri). The regression coefficient (b) revealed that both *M. cephalus* (2.19-1.97) and *E. fimbriata* (2.06-1.05) sampled in Araromi, Okesiri, Idiegbin and Obi respectively exhibited negative allometric growth. Condition factor range (2.41-1.50) recorded for *E. fimbriata*

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was higher than (0.50-0.45) range value recorded for *M. cephalus*. The study concluded that the two species exhibited negative allometric growth pattern and the environment was for conducive for *E. fimbriata* than for *M. cephalus*. The variations in growth of the species could be attributed to prevailing ecological conditions of the environment. Therefore, sustainable fish stock management should be carried out.

Keywords: Ethmalosa fimbriata; Mugil cephalus; condition factor; length-weight relationship; Nigeria.

1. INTRODUCTION

"Since fish growth is continuous and dependent on both genetic and environmental factors, the study of the biology of fish species with preference to length-weight relationship (LWR) and condition factor (k) is crucial" (Rao and Babu, 2013). "Fisheries scientists can convert growth in length equations to growth-in-weight in stock assessment models by using The LWR (growth index) of fish, which is an important management tool" [1]. "The condition factor shows the degree of wellness of the fish in their habitat and variation in condition factor can be influenced by stress, sex, season, availability of feeds, and other water quality parameters" [2].

Ethmalosa fimbriata, a pelagic clupeiformes is one of the most prevalent surface inshore fishes in West Africa [3]. It inhabits both fresh water and brackish water environments. Clupeids are among the commercially exploited fishes for human consumption especially in Africa due to their cheap rate [2]. *Mugil cephalus* belongs to the order Perciformes and they are commercial food fish that helps sustain Nigeria fishery resources [4]. The mullets make up a significant portion of the catches by local fisher folks from lagoons and estuaries [5].

Studies on the LWR and condition factors of fishes in Nigeria includes those of Bolarinwa and Popoola [6] on some economic fishes of Ibeshe Waterside, Lagos Lagoon. Kolawole-Daniels *et al*., [7] on LWRs of *M. cephalus* and *Lisa falcipinnis* from Lagos Lagoon. Ajibare and Loto [8] on LWRs and condition factor of *Sarotherodon melanotheron* and *Tilapia guineensis* in Lagos Lagoon. Ajah and Asuquo (2017) on Sex Ratio, LWRs and Condition factor of *E. fimbriata* in the Cross River Estuary. According to Bolarinwa *et al*., [9], *M. cephalus* and *E. fimbriata* are of high economic viability and play essential role in the ecology of water bodies in Nigeria. For these reasons, they are abundant in the coastal waters of Nigeria, their length-weight parameters are sufficient indicators of the well-being of other fish stocks. This study was therefore designed to investigate growth pattern of *M. cephalus* and *E. fimbriata* in coastal waters of Ondo State, Nigeria with the aim of providing information on the condition of fishes inhabiting the waters.

2. MATERIALS AND METHODS

2.1 Study Area

The study areas (Obi, Idi-Egbin, Okesiri and Araromi) are located in Ilaje Local Government Area (Fig. 1), the coastal region of Ondo State which lies within latitude 6°10′ to 6°50′N and longitude 2°45′ to 6°09′E [10]. Ilaje is bounded in the west, east, north, and south by Ogun State, Ese-Odo LGA and Edo state, Irele LGA, Bight of Benin and the Atlantic Ocean, respectively. Nigeria's coastline stretches from Lagos to the Cross River (about 963 km), with over 20 million people living along the coastal area [10]. The southwestern coastal area of Nigeria extends from Nigeria/Benin Republic border and terminates at the Ondo-Edo border with Ilaje having the longest coastline in West Africa.

2.2 Collection and Identification of Samples

240 samples each of *M. cephalus* and *E. fimbriata* were procured monthly from fisher folks at the landing sites of the study areas from November 2021 to April, 2022. The fishes were identified using the keys provided by Olaosebikan and Raji [11].

2.3 Determination of Total Length (TL) and Weight (W)

The total lengths of fish samples were measured to the nearest 0.01cm using a standard measuring board and the corresponding weights were also measured after blot drying with a piece of clean hand towel, using Mettler Toledo electronic weighing balance (Model: PB8001) to the nearest 0.1g.

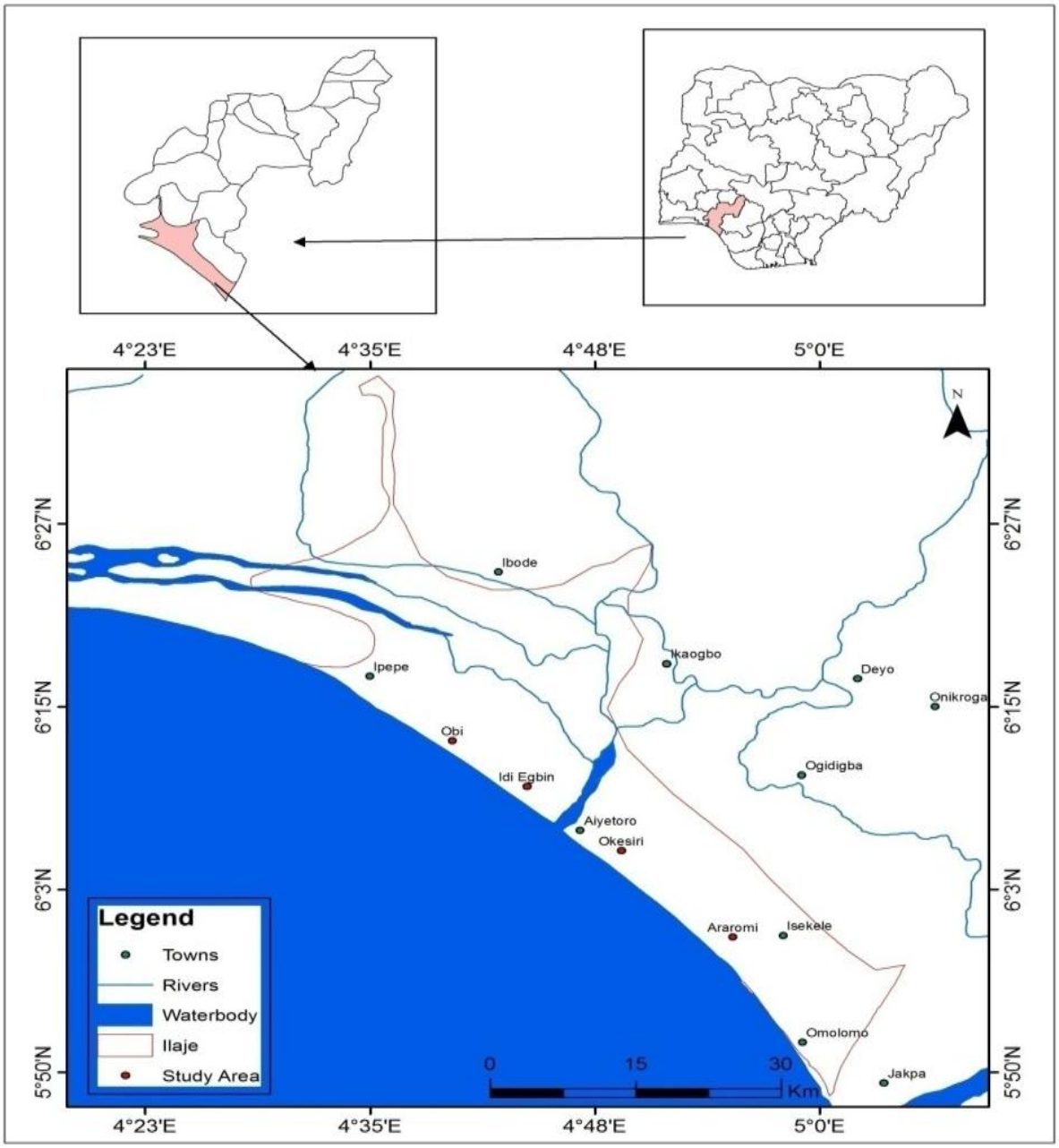

Fig. 1. Map of Ilaje LGA showing the study areas

2.4 Determination of Length-Weight Relationship and Condition Factor:

The Length-weight relationship of *M. cephalus* and *E. fimbriata* were analyzed regardless of sex and year class using equation by Le Cren, [12].

$$W = aL^b$$

Where, W = weight (g) of fish, L = length (cm) of fish, 'a' = intercept, b = slope (regression coefficient; while isometric (symmetric) growth is indicated at 3, and values other than 3 indicates allometric growth. i.e. values greater than 3 = positive allometric growth, and values less than 3 = negative allometric growth).

The condition factor (K) of the fish samples were estimated using the equation by Froese, [13].

$$K=\frac{100W}{L^3}$$

Where K = condition factor, W = weight (g), L = length (cm).

3. RESULTS

The length and weight of the species for the study period are presented in Tables 1 and 2. The total length ranged from 30.96 ± 0.56cm (Araromi) in April to 23.80 ± 1.16cm (Okesiri) in November. There was no significant difference between the total length of *M. cephalus* within the stations period while Araromi varied significantly in November, December, January and April at *P*>0.05. The results showed that the mean total weight ranged from 118.86 ± 9.36g (Araromi) in April to 71.32 ± 18.12g (Okesiri) in November. There was no significant difference between the weights of *M. cephalus* across the four stations throughout the study period, except for the month of January.

The results showed that the mean total length of *E. fimbriata* ranged from 21.04 ± 0.74cm (Araromi) in April to 13.96 ± 0.38cm (Okesiri) in November. The mean of the total weight of *E. fimbriata* ranged from 150.90 ± 1.14g (Araromi) in April to 70.54 ± 5.76g (Okesiri) in November.

The length-weight relationship and condition factor of *E. fimbriata* and *M. cephalus* is presented in Table 3 and Fig. 2. The growth coefficient "b" differed significantly from 3 at the level of sampled species, indicating that the two species had allometric growth (i.e., b values were lesser / greater than 3). The regression coefficient (b) of length and weight revealed that both *M. cephalus* (2.19 in Idiegbin to 1.97 in Araromi) and *E. fimbriata* (2.06 in Idiegbin to 1.05 in Obi) exhibited negative allometric growth pattern. This reveals that the rate of increase in body length is not proportional to the rate of increase in body weight. The condition factor which measures the wellbeing of fish was greater than 1 for *E. fimbriata* (2.41 to 1.50) and less than 1 for *M. cephalus* (0.50 to 0.45).

Table 1. Length and weight of *Mugil cephalus* from coastal waters of Ondo state

Parameters	Stations	November	December	January	February	March	April
Weight (g)	Obi	77.8±9.31^{a}	92.00±4.65^{a}	89.26±8.14^{ab}	93.56±8.17^{a}	110.30±5.35^{a}	115.92±6.33^{a}
	Idi-egbin	74.8±6.32^{a}	85.00±7.81^{a}	94.94±1.95^{b}	97.26±2.56^{a}	104.14±2.81^{a}	113.46±6.09^{a}
	Okesiri	71.32±8.11^{a}	74.36±8.75^{a}	76.92±6.99^{a}	90.56±4.47^{a}	100.30±0.64^{a}	103.16±1.73^{a}
	Araromi	90.28±6.37^{a}	94.58±4.20^{a}	100.60±0.80^{b}	98.30±1.49^{a}	104.40±6.66^{a}	118.86±4.18^{a}
Total length (cm)	Obi	24.30±1.20^{a}	25.1±0.71^{a}	26.80±0.56^{ab}	27.00±0.76^{a}	28.80±0.92^{a}	28.70±0.62^{a}
	Idi-egbin	25.50±0.95^{a}	26.22±0.34^{ab}	26.64±0.95^{ab}	27.80±0.49^{a}	27.80±0.49^{a}	29.10±0.81^{ab}
	Okesiri	23.80±1.16^{a}	24.30±1.11^{a}	25.00±1.35^{a}	26.60±0.24^{a}	27.90±0.24^{a}	28.08±0.48^{a}
	Araromi	25.66±0.34^{b}	26.68±0.50^{b}	27.90±0.24^{b}	27.20±0.37^{a}	28.76±0.76^{a}	30.96±0.56^{b}

Means with the same superscript are not significantly different at P>0.05

Table 2. Length and weight of *Ethmalosa fimbriata* from coastal waters of Ondo state

Parameters	Stations	November	December	January	February	March	April
Weight (g)	Obi	101.70±3.60^{b}	9.40±12.41^{b}	138.50±37.30^{a}	99.16±5.62^{a}	82.12±5.94^{a}	87.48±5.87^{a}
	Idi-egbin	98.76±5.78^{b}	95.60±8.19^{ab}	94.90±7.25^{a}	86.14±3.66^{a}	90.34±4.17^{a}	83.28±2.04^{a}
	Okesiri	70.54±5.76^{a}	74.68±2.80^{a}	85.18±4.19^{a}	97.10±3.92^{a}	105.00±1.64^{b}	118.60±0.99^{b}
	Araromi	107.40±0.92^{b}	105.4±2.97^{b}	111.2±2.17^{a}	121.06±5.12^{b}	144.40±1.33^{c}	150.90±1.14^{c}
Total length (cm)	Obi	22.20±0.80^{d}	17.26±1.74^{ab}	21.40±2.86^{b}	16.80±0.93^{ab}	15.40±1.03^{a}	15.90±0.40^{a}
	Idi-egbin	19.20±0.46^{c}	18.10±0.78^{b}	18.60±0.70^{ab}	17.90±0.40^{b}	18.20±0.37^{bc}	17.70±0.25^{b}
	Okesiri	13.96±0.38^{a}	14.12±0.32^{a}	15.06±0.34^{a}	15.88±0.26^{a}	16.56±0.17^{ab}	18.08±0.19^{b}
	Araromi	16.36±0.16^{b}	16.32±0.53^{ab}	16.90±0.24^{ab}	17.56±0.39^{ab}	18.90±0.29^{c}	21.04±0.74^{c}

Means with the same superscript are not significantly difference P<0.05

Table 3. Condition factor of sampled species from coastal waters of Ondo state

Species	Obi	Idiegbin	Okesiri	Araromi	Combined
Mugil cephalus	0.50	0.47	0.49	0.45	0.48
Ethmalosa fimbriata	1.89	1.50	2.41	2.21	2.00

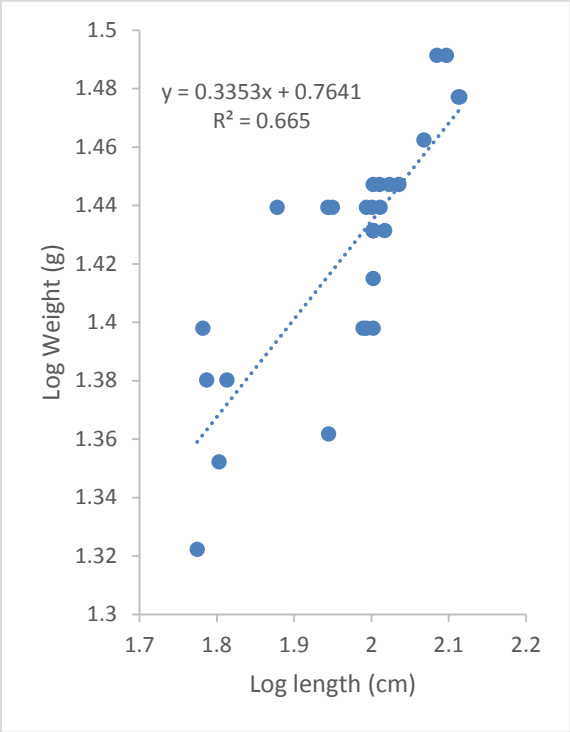

Fig. 2. LWR of *M. cephalus* in Obi

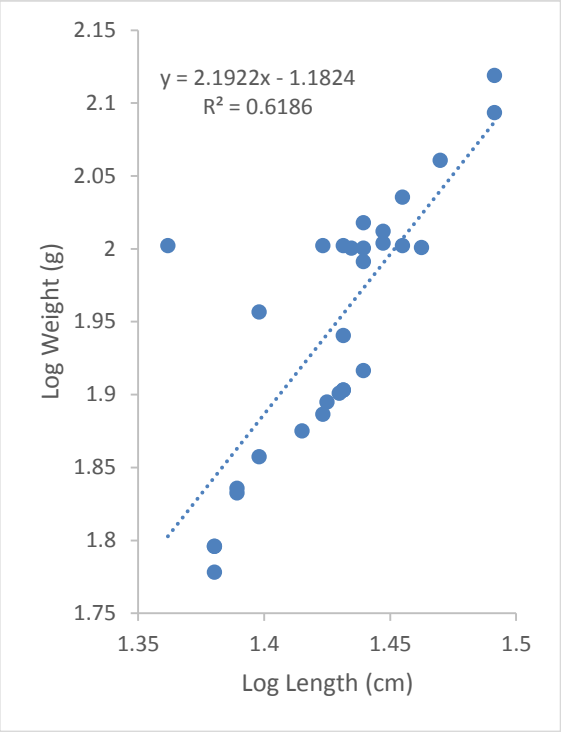

Fig. 3. LWR of *M. cephalus* in Idiegbin

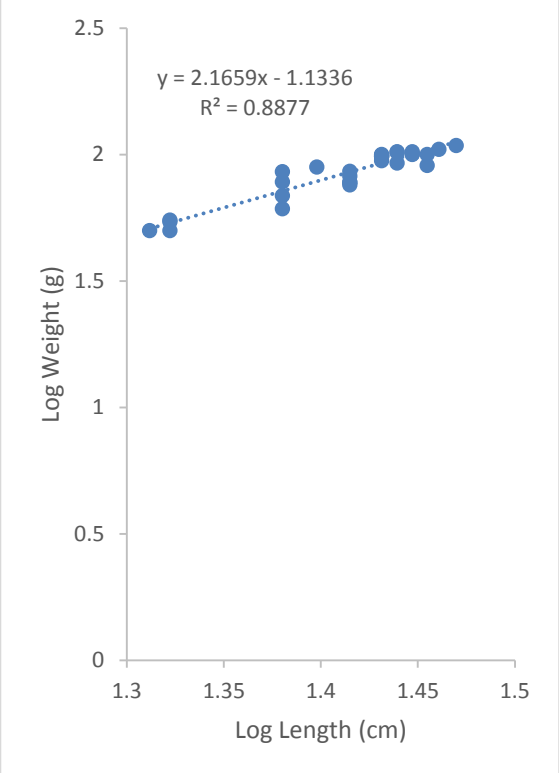

Fig. 4. LWR of *M. cephalus* in Okesiri

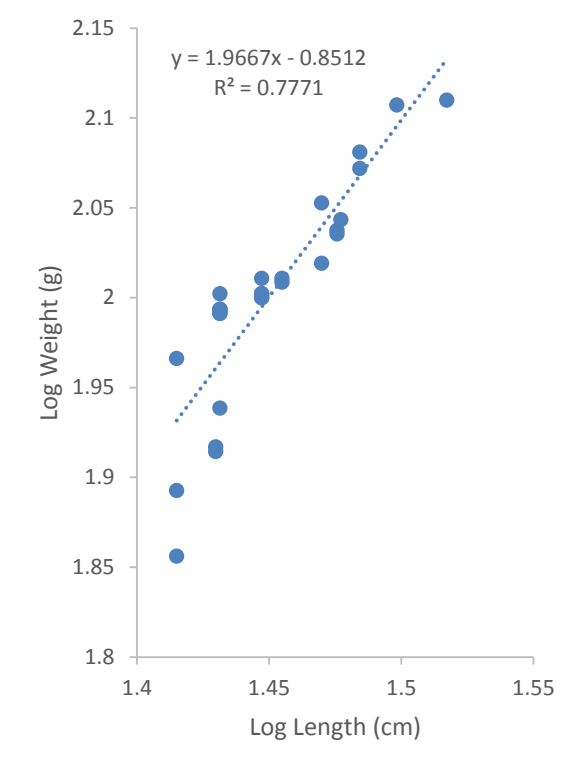

Fig. 5. LWR of *M. cephalus* in Araromi

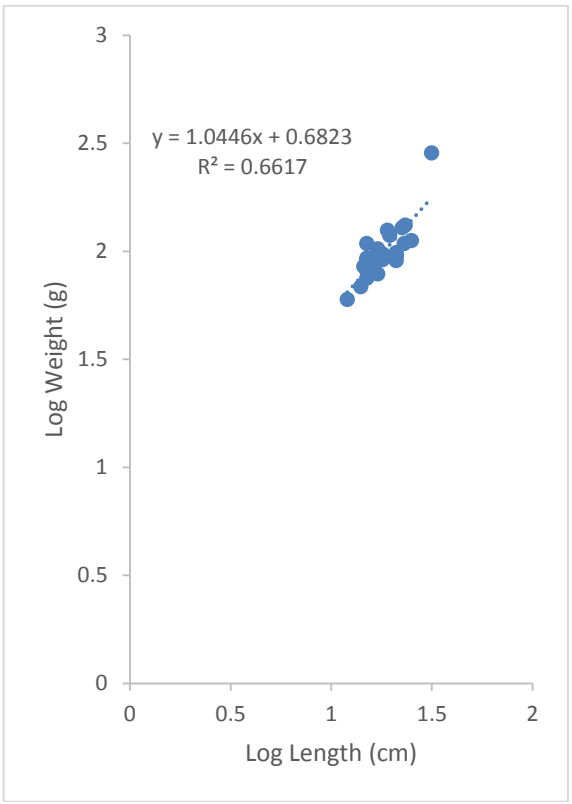

Fig. 6. LWR of *E. fimbriata* in Obi

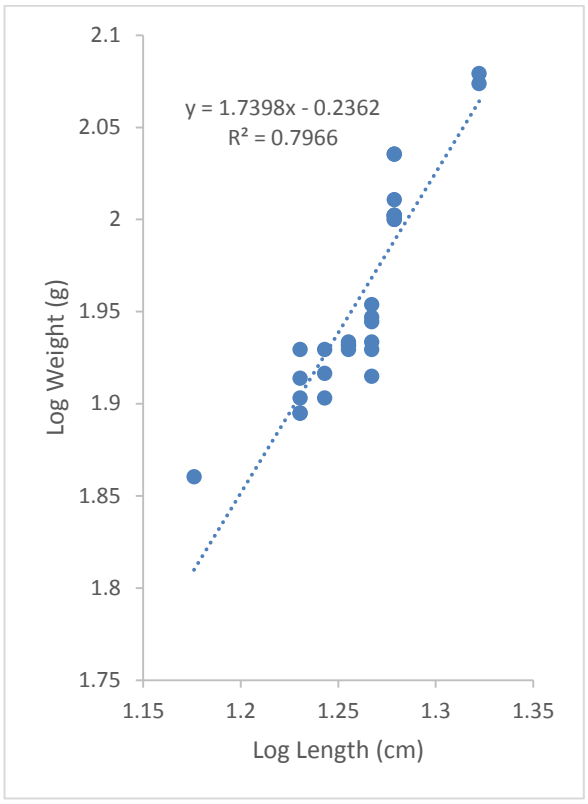

Fig. 7. LWR of *E. fimbriata* in Idiegbin

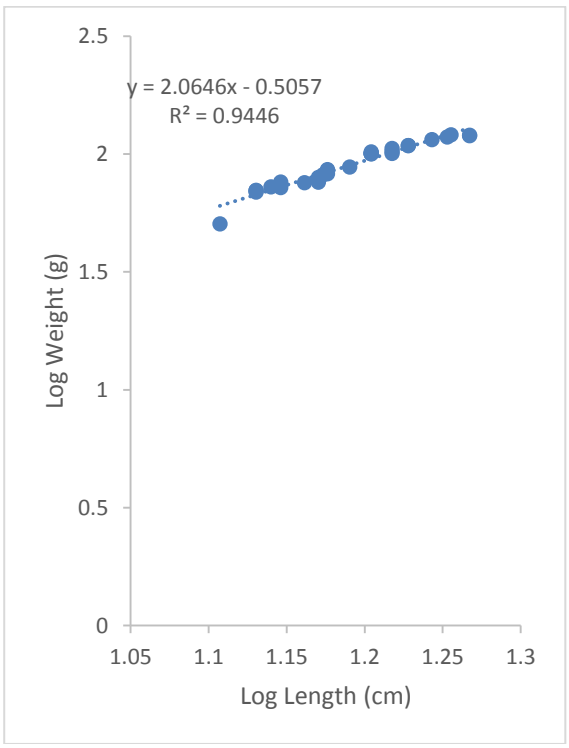

Fig. 8. LWR of *E. fimbriata* in Okesiri

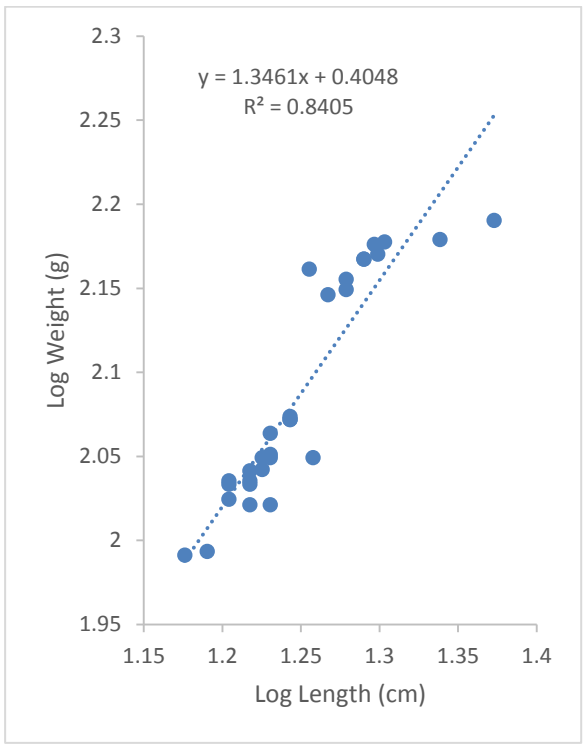

Fig. 9. LWR of *E. fimbriata* in Araromi

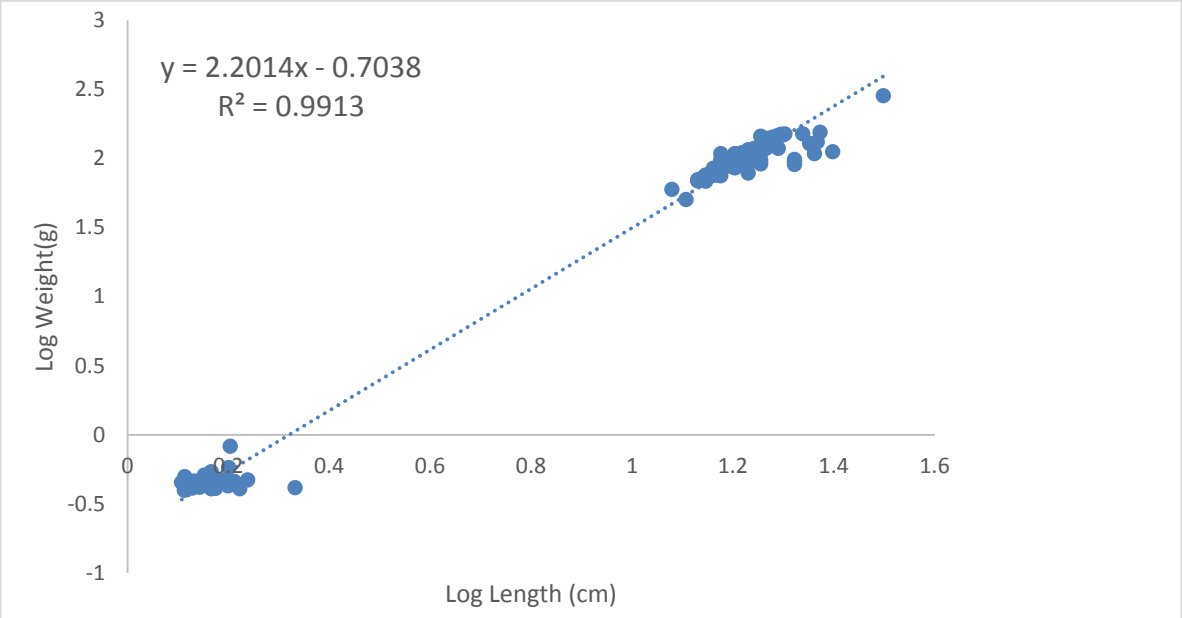

Fig. 10. Length-weight relationship of *Ethmalosa fimbriata* in coastal waters of Ondo State

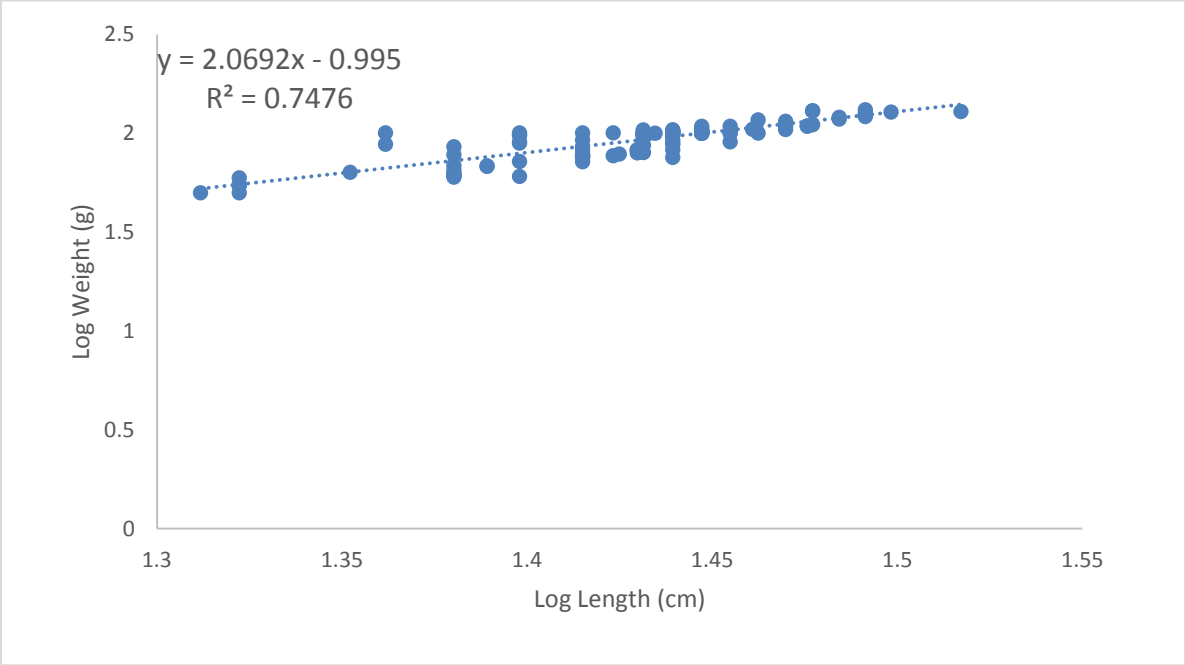

Fig. 11. Length-weight relationship of *Mugil cephalus* in coastal waters of Ondo State

4. DISCUSSION

"In fisheries sciences, particularly in fish biology, physiology, ecology, population dynamics and stock assessment, the length-weight relationship is widely acknowledged as an essential tool" [14]. The size range of *M. cephalus* and *E. fimbriata* observed corroborates the findings of Abidemi-Iromini, [15] who reported that standard length ranged from 13.72 to 18.45cm with a mean of 14.67 ± 1.56cm while weight ranged from 83.32 to 140.68g with a mean weight of 135.40 ± 31.46g for the samples of *Oreochromis. niloticus* collected from Lagos Lagoon. From the findings of Kolawole-Daniels *et al.* [7], the total length and weight of *M. cephalus* varied from 12.5 to 28.7cm and 20.5 to 196.4g while *Lisa falcipinnis* ranged within 12.5 to 21.5cm and 20.1g to 180g.

The b values estimated from this study for *M. cephalus* and *E. fimbriata* depicts a negative allometric growth pattern and this echoes what other authors have reported for different fish species from different water bodies. Abdul *et al.* [16] reported negative allometric growth for *Sarotherodon galilaeus* in Ogun State Coastal estuary. Also, Olawusi-Peters *et al*. [17] reported negative allometric growth for *E. fimbriata* from Badagry Lagoon. Positive allometric growth patterns have been reported for *Hepsetus odoe* in Ogbomosho reservoir [18]. The result of Abdul *et al*. [14] was in contrary (positive allometric growth) to this study on *M. cephalus* in Ogun State Coastal estuary; perhaps because of growth pattern of fish is ecosystem invariant. Variation in b values of LWRs may be attributed to ecological conditions of the habitat or in the physiology of fish or both [19], sex and season [20], feeding rate, gonad development and growth phase [21].

The observed condition factor ranged from 0.45 to 2.41 which falls within the observations of Kumolu-Johnson and Ndimele [22] for fishes (0.91 to 8.46) from Ologe lagoon, in Lagos; Oso and Iwalaye, [23] for four cichlids (0.99 to 4.35) from Ero dam, Ekiti State Nigeria. The variation in the values obtained in the above-mentioned studies may be attributed to several factors such as the sizes, ages, sexes, feeding intensity/fullness of the gut, degree of muscular development, the amount of reserved fat and life history, variations in the stage of maturity, stress, season, mutagens from human interference and other water quality parameters [24]. According to Uneke [25], the condition factor of fish is affected by strain, species, stress, sexes, availability of feeds, water quality, etc. Hence, this could justify the differences between the observation of the present study and those of previous studies on different fishes under different experimental conditions. Higher values (i.e. $K \geq 1$), observed in *E. fimbriata* showed that the condition factors estimated in the four waters were within the normal range recommended (as suitable for matured fish) by Olawusi-Peters *et al*. [17] and Getso *et al*. [24] who stated that condition factor greater or equal to one ($K \geq 1$) implied that the fish are in good physiological condition with their habitat. It may also indicate adequate nutrition and positive environmental conditions. Based on this, it could be said that all the sampled *E. fimbriata* are in good condition of well-being. The results suggest that the four stations were more conducive for *E. fimbriata* than *M. cephalus* [26].

5. CONCLUSION

The study concluded that the two species exhibited negative allometric growth pattern and the environment was for conducive for *E. fimbriata* than for *M. cephalus*. The variations in growth of the species could be attributed to prevailing ecological conditions of the environment. Therefore, sustainable fish stock management should be carried out.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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