Original Research Article

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

ABSTRACT

The study examined the length-weight relationships (LWRs) and condition factor of *M. cephalus* and *E. fimbriata.* Mean total length of *M. cephalus* ranged from 23.80 ± 1.16cm (Okesiri) to 30.96 ± 0.56cm (Araromi) and weight ranged from 71.32 ± 18.12g (Okesiri) to 118.86 ± 9.36g (Araromi). *E. fimbriata* total length ranged from 13.96± 0.38cm (Okesiri) and 21.04 ± 0.74cm (Araromi) and weight ranged from 70.54 ± 5.76g (Okesiri) to 150.90 ± 1.14g (Araromi). The regression coefficient (b) revealed that both *M. cephalus* (1.97-2.19) and *E. fimbriata* (1.05-2.06) sampled in Araromi, Okesiri, Idiegbin and Obi respectively exhibited negative allometric growth. Condition factor range (1.50 - 2.41) recorded for *E. fimbriata* was higher than (0.45-0.50) range value recorded 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 (Abowei *et al.,* 2009). 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 (George *et al*., 2013).

Ethmalosa fimbriata, a pelagic clupeiformes is one of the most prevalent surface inshore fishes in West Africa (Fagade and Olaniyan, 1972). 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 (George *et al*., 2013). *Mugil cephalus* belongs to the order Perciformes and they are commercial food fish that helps sustain Nigeria

fishery resources (Asuquo *et al*., 2015). The mullets make up a significant portion of the catches by local fisher folks from lagoons and estuaries (Isangedighi *et al*., 2009).

Studies on the LWR and condition factors of fishes in Nigeria includes those of Bolarinwa and Popoola (2013) on some economic fishes of Ibeshe Waterside, Lagos Lagoon. Kolawole-daniels *et al*., (2017) on LWRs of *M. cephalus* and *L. falcipinnis* from Lagos Lagoon. Ajibare and Loto (2022) on LWRs and condition factor of *S. melanotheron* and *T. 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*., (2015), *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 (Jiboye *et al*., 2019). 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 (Jiboye *et al*., 2019). 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.

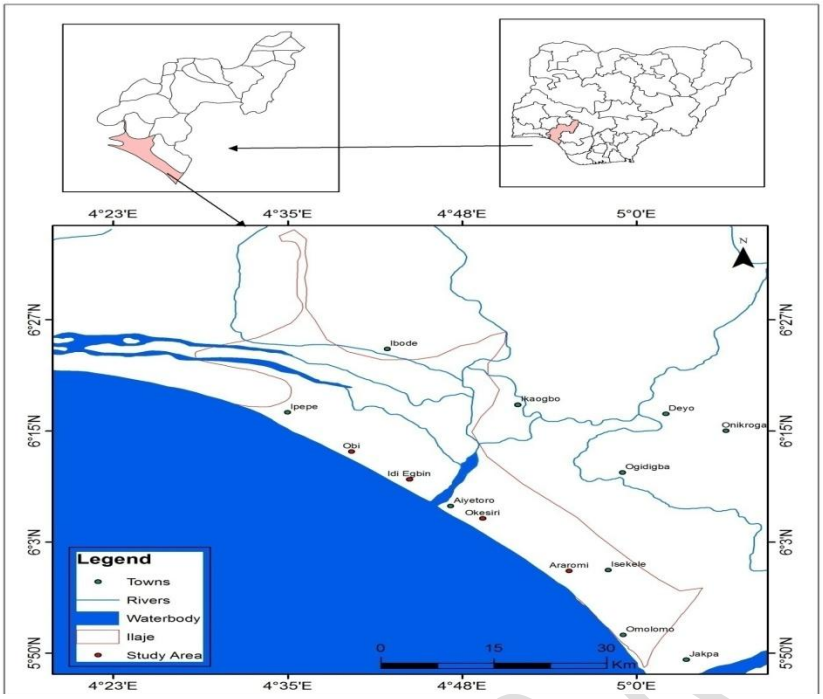

Figure 1: Map of Ilaje LGA showing the study areas

2.2. Collection and Identification of Samples

240 samples each of *Mugil cephalus* and *Ethmalosa 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 (2013).

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.

2.4. Determination of Length-Weight Relationship and Condition Factor:

The Length-weight relationship of *Mugil cephalus* and *Ethmalosa fimbriata* were analyzed regardless of sex and year class using equation by Le Cren, (1951).

$$W = aL^b$$

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, (2006)

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

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 Table 1 and 2. The total length ranged from 23.80 ± 1.16cm (Okesiri) in November and 30.96 ± 0.56cm (Araromi) in April. 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 71.32 ± 18.12g (Okesiri) in November to 118.86 ± 9.36g (Araromi) in April. 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 13.96 ± 0.38cm (Okesiri) in November and 21.04 ± 0.74cm (Araromi) in April. The mean of the total weight of *E. fimbriata* ranged from 70.54 ± 5.76g (Okesiri) in November and 150.90 ± 1.14g (Araromi) in April.

The length-weight relationship and condition factor of *Ethmalosa fimbriata* and *Mugil cephalus* is presented in Table 3 and Figure 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* (1.97 in Araromi to 2.19 in Idiegbin) and *E. fimbriata* (1.05 in Obi to 2.06 in Idiegbin) 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* (1.50 to 2.41) and less than 1 for *M. cephalus* (0.45 to 0.50).

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}	99.40±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

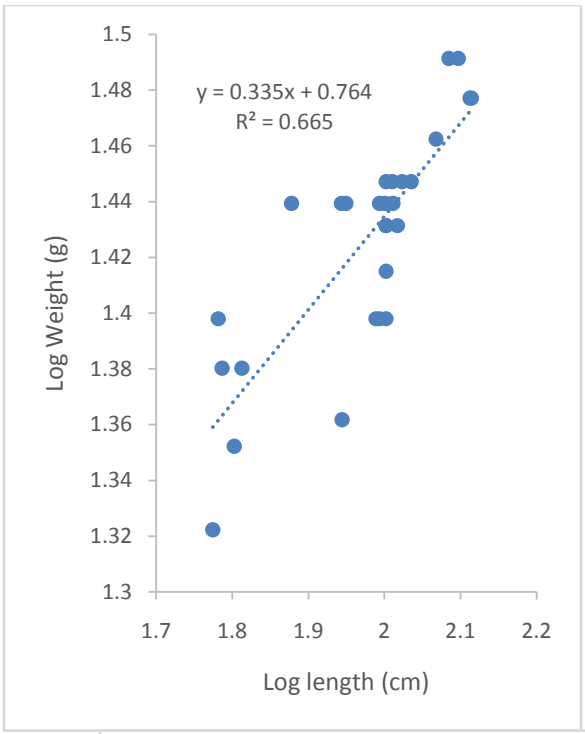

Figure 2: LWR of *M. cephalus* in Obi

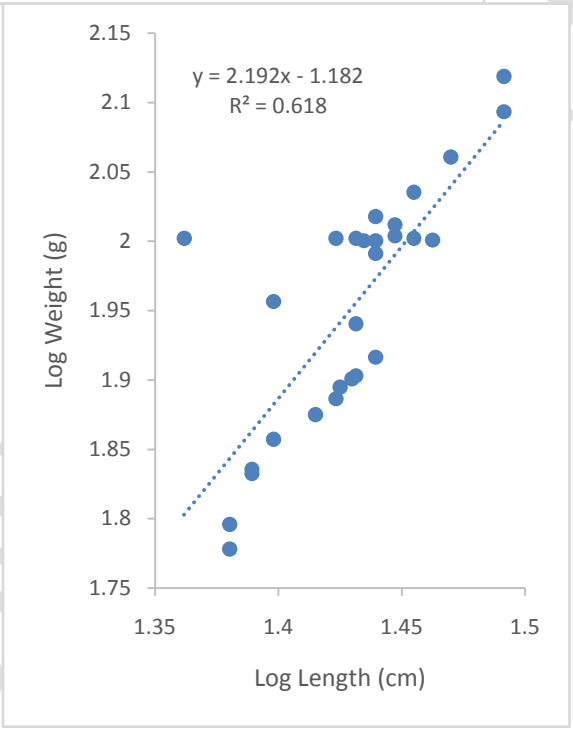

Figure 3: LWR of *M. cephalus* in Idiegbin

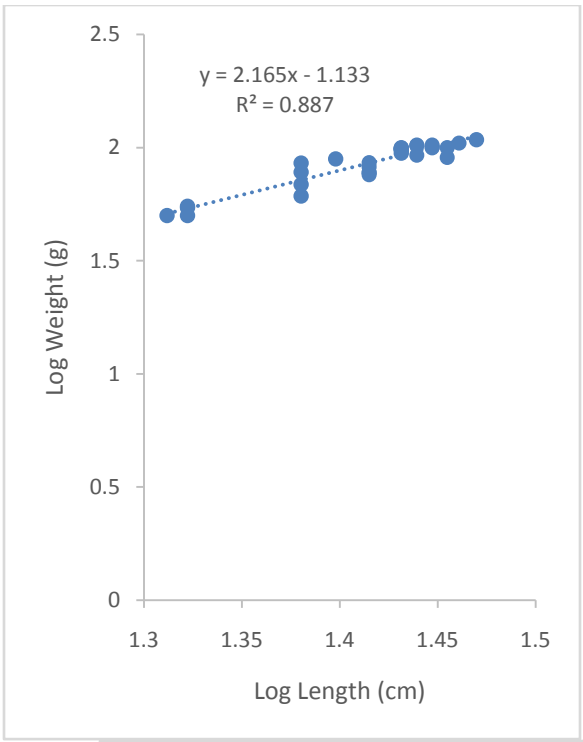

Figure 4: LWR of *M. cephalus* in Okesiri

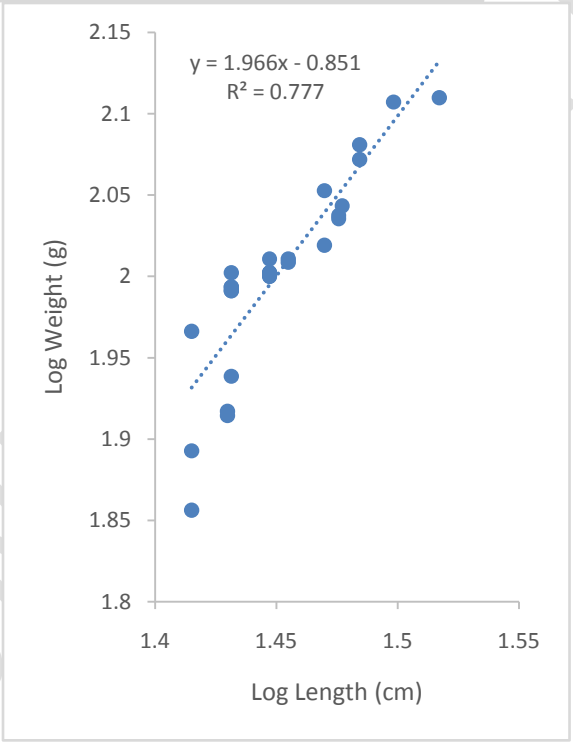

Figure 5: LWR of *M. cephalus* in Araromi

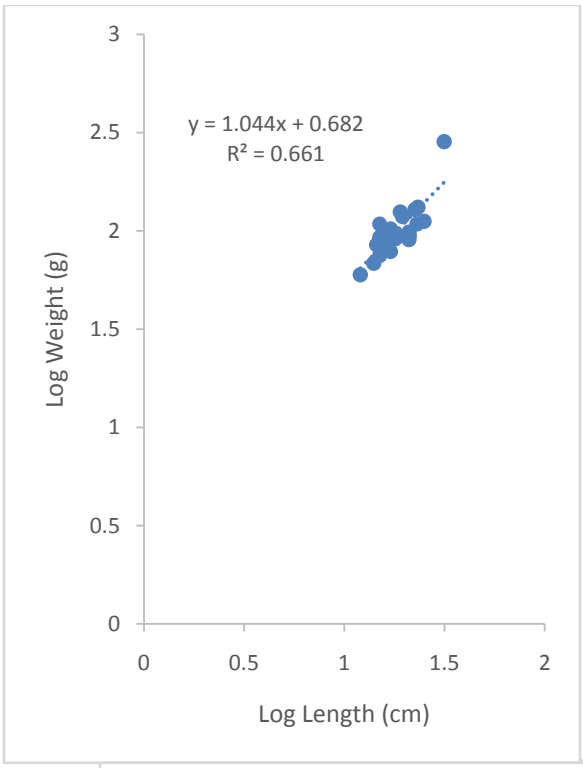

Figure 6: LWR of *E. fimbriata* in Obi

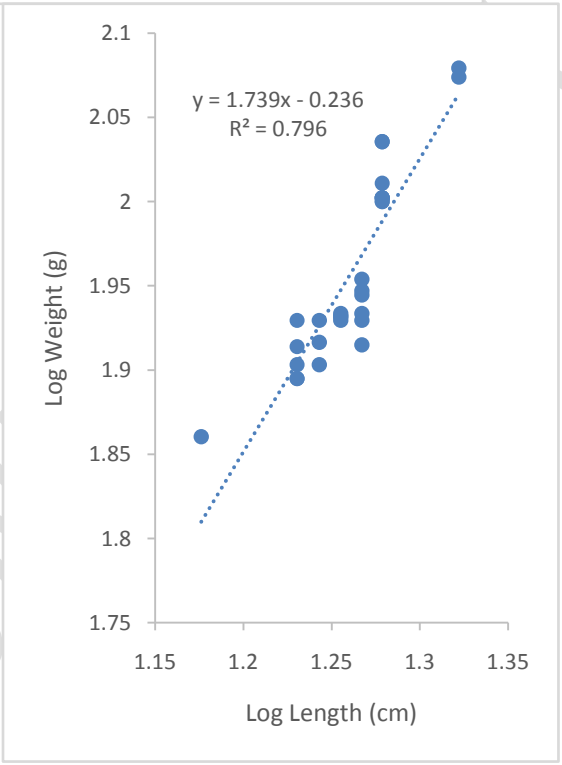

Figure 7: LWR of *E. fimbriata* in Idiegbin

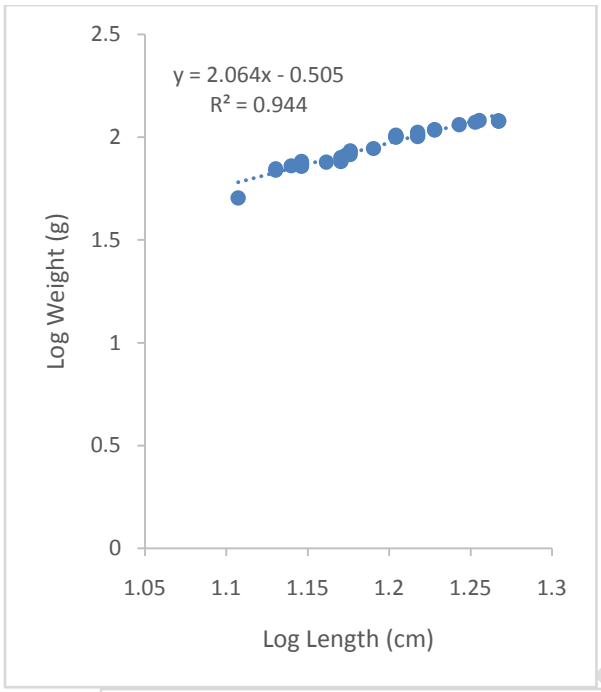

Figure 8: LWR of *E. fimbriata* in Okesiri

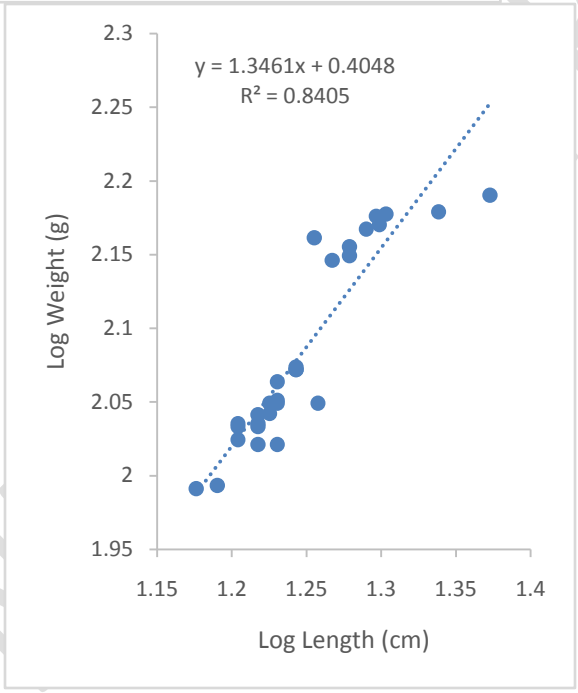

Figure 9: LWR of *E. fimbriata* in Araromi

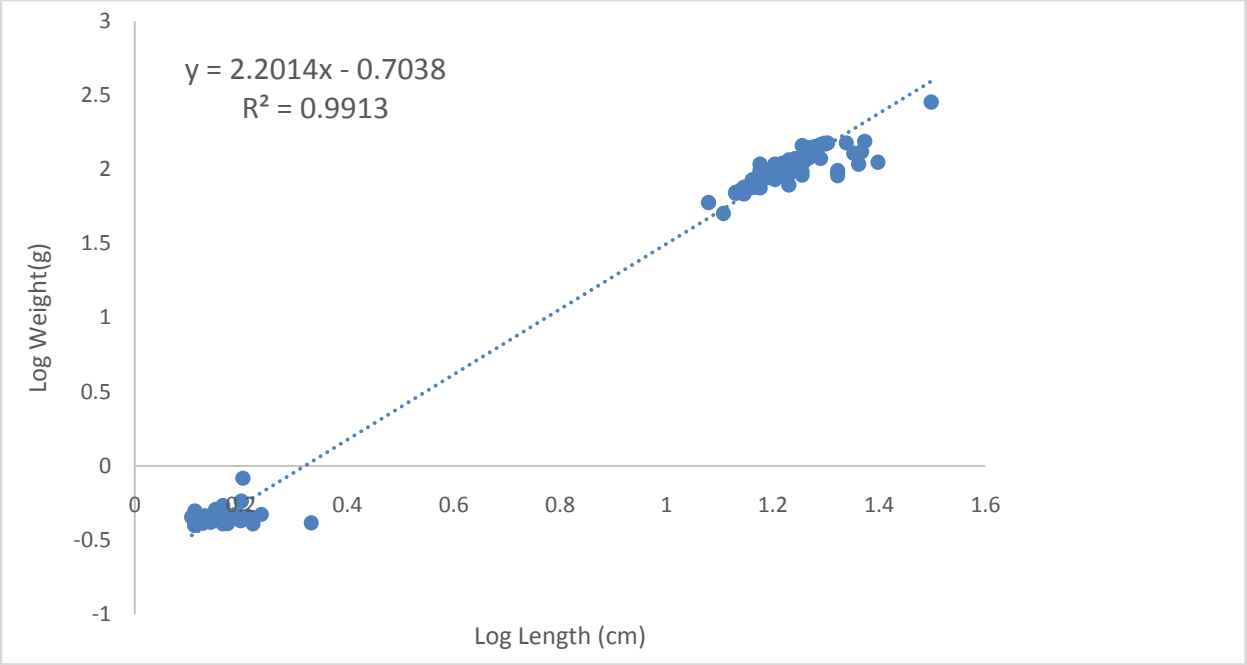

Fig. 10: Length-weight Relationship of *Ethmalosa fimbriata* in Coastal waters of Ondo State

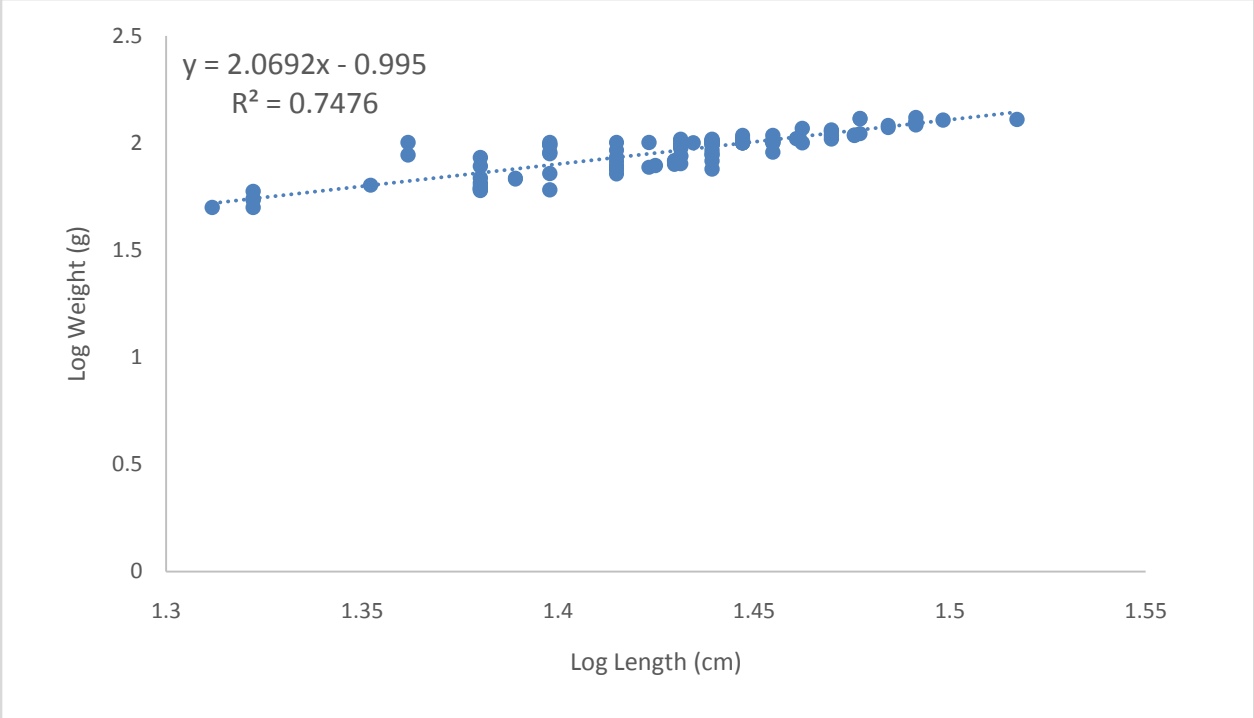

Fig. 11: Length-weight Relationship of *Mugil cephalus* in Coastal waters of Ondo State

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

(Abdul *et al*., 2016). The size range of *M. cephalus* and *E. fimbriata* observed corroborates the findings of Abidemi-Iromini, (2019) 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 *O. niloticus* collected from Lagos Lagoon. From the findings of Kolawole-Daniels *et al.* (2017), the total length and weight of *M. cephalus* varied from 12.5 to 28.7cm and 20.5 to 196.4g while *L. 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.,* (2010) reported negative allometric growth for *S. galilaeus* in Ogun State Coastal estuary. Also, Olawusi-Peters *et al*., (2015) reported negative allometric growth for *E. fimbriata* from Badagry Lagoon. Positive allometric growth patterns have been reported for *H. odoe* in Ogbomosho reservoir (Adedokun *et al*., 2013). The result of Abdul *et al*., (2016) was in contrary (positive allometric growth) to this study on *Mugil 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 (Hossain *et al*., 2009), sex and season (Hossain *et al.,* 2006), feeding rate, gonad development and growth phase (Hossain *et al*., 2011).

The observed condition factor ranged from 0.45 to 2.41 which falls within the observations of Kumolu-Johnson and Ndimele (2010) for fishes (0.91 to 8.46) from Ologe lagoon, in Lagos; Oso and Iwalaye, (2016) 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 (Getso *et al*., 2017). According to Uneke (2017), 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*., (2015) and Getso *et al*., (2017) 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 *Ethmalosa fimbriata* than *Mugil cephalus*.

CONCLUSION

Effective and sustainable fish stock management should be carried out to support fish growth in the fishery.

REFERENCES

Abdul, W. O., Omoniyi, I. T., Adekoya, E. O., Adeosun, F. I., Odulate, O. O., Idowu, A. A., Olajide, A. E. and Olowe, O. S. (2016). Length-Weight Relationship and Condition Factor of some commercial fish species in Ogun State Coastal Estuary, Nigeria. Ife Journal of Agriculture, 28 (**1**): 1-10.

Abdul, W. O., Omoniyi, I. T., Akegbejo-Samson Y., Agbon, A. O. and Idowu, A. A. (2010). Length-weight relationship and condition factor of cichlid tilapia, *Sarotherodon galilaeus* in the freshwater ecotype of Ogun State coastal estuary, Ogun State, Nigeria. *International Journal of Biological and Chemical Sciences* 4(4): 1153-1162.

Abidemi-Iromini, A. O. (2019). Assessment of stomach contents of *Oreochromis niloticus* from the Lagos Lagoon, Nigeria. *International Journal of Fisheries and Aquaculture*. 11(1): 1-6.

Abowei, J. F. N., Davies, O. and Eli, A. A. (2009). Study of the length-weight relationship and condition factor of five fish species from Nkoro River, Niger Delta, Nigeria. *Current Research Journal of Biological Sciences*, 1: 94 -98.

Adedokun, M. A., Fawole, O. O. and Ayandiran, T. A. (2013). Allometry and condition factors of African pike "*Hepsetus odoe*" actinopterygii in a lake. *African Journal of Agricultural Research*, 8 (**25**): 3281-3284.

Ajah, P. O. and Asuquo P. E. (2017). Sex Ratio, Length-Weight Relationship And Condition Factor Of Ethmalosa Fimbriata In The Cross River Estuary, Nigeria. *IOSR Journal of Biotechnology and Biochemistry* 3(2): 46-55.

Ajibare, A. O. and Loto, O. O. (2022). Length-Weight Relationship and Condition factor of *Sarotherodon melanotheron* and *Tilapia guineensis* in Lagos Lagoon, Nigeria. *Agrosearch* 21(1&2):57-66.

Asuquo, P. E., Eyo, V. O., Ikechukwu, C. C. (2015). Feeding ecology, Length-weight relationship and condition factor of *Mugil cephalus* (Pisces: Mugilidae; Linnaeus, 1758) from Cross River Estuary, Nigeria. *European Academic Research*. 11(**12**): 15276-15294.

Bolarinwa, J. B. and Popoola Q. (2013). Length-Weight Relationships of Some Economic Fishes of IbesheWaterside, Lagos Lagoon, Nigeria. *Journal of Aquaculture Research Development*, 5 (**1**): 40-47.

Bolarinwa, J. B., Fasakin, E. A. and Fagbenro, O. A. (2015). Species Composition and Diversity of the Coastal Waters of Ondo State, Nigeria. *International Journal of Research in Agriculture and Forestry*, 2 (**3**): 51-58.

Fagade, S. O. and Olaniyan, C. I. (1972). The biology of the West African shad *Ethmalosa fimbriata* (Bodwich, 1825) in the Lagos Lagoon, Nigeria. *Journal of Fish Biology*. 4 (**4**): 519-533.

Froese, R. C. (2006). Condition factor and weight-length relationships: history, meta-analysis and recommendations. *Journal of Applied Ichthyology*, 22 (**4**): 241-253.

George, U. U., Idung, J. U., Andem, A. B., Okorafor, K. A. and Mowang, D. (2013). Diet Composition and Condition factor of *Ethmalosa fimbriata* in the Cross River Estuary. *Greener Journal of Biological Sciences*, 3 (**6**): 244-252.

Getso, B.U., Abdullahi, J. M. and Yola, I.A. (2017). Length-Weight Relationship and Condition Factor of *Clarias gariepinus* and *Oreochromis niloticus* of Wudil River, Kano, Nigeria. *Agro-Science Journal of Tropical Agriculture, Food, Environment and Extension*, 16 (**1**), 1 – 4.

Hossain, M. Y., Ahmed, Z. F., Leunda, P. M., Jasmine, S., Oscoz, J. and Miranda, R. O. (2006). Condition, length-weight and length-length relationships of the Asian striped catfish *Mystus vittatus* (Bloch, 1794) (Siluriformes: Bagridae) in the Mathabhanga River, Southwestern Bangladesh. *Applied Ichthyology*, 22 (**4**): 304-307.

Hossain, M. Y., Jasmine, S., Ibrahim, A. H. M., Ahmed, Z. F., Rahman, M. M. and Ohtomi, J. (2009). Length-weight and length-length relationships of small fish species from the Ganges, Bangladesh. *Applied Ichthyology* 25(**1**): 117-119.

Hossain, M. Y., Rahman, M. M., Fulanda, B., Jewel, M. A. S., Ahamed, F. and Ohtomi, J. (2011). Length-weight and length-length relationships of five threatened fish species from the Jamuna (Brahmaputra River tributary) River, northern Bangladesh. *Journal of Applied Ichthyology*, 363p.

Isangedighi, I. A., Udo, P. J. and Ekpo, I. E. (2009). Diet composition of *Mugil cephalus* (Pisces: Mugilidae) in the Cross River Estuary, Niger Delta, Nigeria. *Nigerian Journal of Agriculture, food and Environment*. 5(**2-4**):10-15.

Jiboye, J. O., Ikporukpo, C. O., and Olatubara, C. O. (2019). Causes of environmental degradation in the coastal areas of Southwest, Nigeria. *European Journal of Sustainable Development Research*, 3 (**2**): 79.

Kolawole-Daniels, A. O., Fola-Mathews, O. O. and Nicholas E. (2017). Comparative study on length-weight relationship of the grey mullet *Mugil cephalus* (Linnaeus 1758) and sickle fin *Liza falcipinnis* (Valenciennes, 1836) from Lagos Lagoon, Nigeria. *International Journal of Fisheries and Aquatic Studies* 5(5):17-20.

Kumolu-Johnson, C. A., and Ndimele, P. E. (2010). Length-weight relationships of nine fish species from Ologe lagoon, Lagos, Nigeria. *African Journal of Biotechnology*, 10(**2**), 241-243.

Kurma Rao, R. and Ramesh Babu K. (2013). Studies on length-weight relationship of *Mugil cephalus* (Linnaeus, 1758), east coast of Andhra Pradesh. *India Advances in Applied Science Research* 4(3):172-176.

Le Cren, E. D. (1951). The length–weight relationships and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *Journal of Animal Ecology,* 20: 201-219.

Olaosebikan, B. D. and Raji, A. (2013). *Field guide to Nigeria freshwater fishes*. (Revised Edition), University of Ilorin Press, Nigeria, pp 1-89.

Olawusi-Peters, O. O., Ajibare, A. O. and Olowoyeye, I. M. (2015). Gut content analysis and condition factor of *Ethmalosa fimbriata* (Bowdish, 1825) from Badagry Lagoon, Nigeria. Proceedings of the 8th Annual Conference School of Agriculture and Agricultural Technology. Federal University of Technology, Akure. Pp 185-190.

Oso, J. A., and Iwalaye, A. O. (2016). Growth pattern and condition factor (K) of four dominant fish species in Ero dam in Ekiti State. *British Journal of Applied Research*, 1(**2**), 8-10.

Uneke, B.I. (2017). Food and Feeding Habit and Condition Factor of Tilapia Species in Ebonyi River, Southeastern Nigeria. *American Association of Science and Technology Communications*, 3(**6**), 248-253.