
POPULATION, GROWTH PATTERN AND BIOMETRIC CHARACTERISTICS OF THE BONGA, *Ethmalosa fimbriata* (BOWDICH) FROM MARINE, BRACKISH AND FRESHWATERS OF SOUTH-WESTERN NIGERIA

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Abstract

The length-frequency distribution, length-weight relationship, condition factor and biometric features of *Ethmalosa fimbriata* (Bowdich) from Lagos coastal waters, Lagos Lagoon and Lekki Lagoon were investigated for 6 months (January-June). The major fishing methods employed for the collection of the specimens were cast-netting and gill-netting (mesh size 67 mm and 76 mm). The standard lengths ranged from 15.6 to 26.1 cm for the marine specimens; 3.5 to 15.3 cm for the brackish and 7.2 to 11.3 cm for the freshwater. The total body weights ranged from 97.7 to 540.0 g for the marine specimens; 3.6 to 77.8 g for the brackish water specimens and 5.00 to 19.85 g for the freshwater specimens. The fish exhibited positive allometric growth pattern in the marine, while the value of b was negative in the brackish and isometric in the freshwater specimens. The mean condition factors were 2.55, 1.82 and 1.88 in the marine, brackish and freshwaters respectively. There was a slight increase in the condition factor with increasing size of fish in the marine, while a decrease in K -value with increasing size of fish in the brackish and freshwaters occurred. There was an increase in the values of the morphometric and meristic features which were not statistically significant ($p > 0.05$) from the freshwater to the brackish and marine waters.

Keywords: *Ethmalosa fimbriata*, Lagos Coast, Lagoon, Lekki, morphometric, meristic.

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Introduction

Ethmalosa fimbriata (Bowdich, 1825) belongs to the herring family, Clupeidae. It is one of the most common inshore fishes in West Africa and has received the attention of a number of investigators (Olsen and Lefevre, 1969; Fagade and Olaniyan, 1972). *E. fimbriata* is pelagic-neritic; catadromous freshwater; brackish; marine, usually 0-50 m long, occurs in inshore waters, lagoons and more than 300 km up rivers e.g. Gambia River (Abowei, 2009). Moses (1988) and Kusemiju and Onadoko (1990) provided information on the populations of the species occurring in Nigerian

waters. The species is widely distributed throughout West African waters with openings into the sea. The adults penetrate the Lagos Lagoon during the dry season (December-May), and then migrate back to the sea in the wet season (June-November) to spawn (Fagade and Olaniyan, 1972).

Most of the information provided on the biology of *E. fimbriata* in Nigeria has been on the Lagos Lagoon population, a brackish water environment. For instance, Fagade and Olaniyan (1972) recognized three size groups of *E. fimbriata* in the Lagos Lagoon: fingerlings (total length < 7.0 cm), juveniles (total length 7.0-16.9



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cm) and adults (total length > 17.0 cm). Kusemiju (1981) did not record the occurrence of *E. fimbriata* in the adjacent Lekki Lagoon, a freshwater habitat. Recently, Soyinka and Kusemiju (2007) reported the growth pattern, food and feeding habits of young or juvenile bonga, *E. fimbriata*, landed by fisher-folks from Lekki Lagoon. In this study, a comparative study of the growth pattern of the bonga from Lagos Lagoon, Lekki Lagoon and Lagos coast was reported and the biometric features examined.

Materials and methods

Study area

The Lagos Lagoon (Figure 1) lies between Longitudes 3°20' and 3°40' E and Latitudes 6°15' and 6°40' N and has an area of nearly 208 km² (FAO, 1969). It is the largest of the nine coastal lagoons of south-western

Nigeria (others are Yewa, Badagry, Iyagbe, Ologe, Kuramo, Epe, Lekki and Mahin Lagoons, FAO, 1969). The Lagos Lagoon is surrounded by swamp forest and riparian forest consisting of mangrove vegetation: *Rhizophora racemosa*, *R. harrisonii*, *Aerosticum aureum*, *Paspalum orbiculare*, *Languncularia* sp and *Avicennia germinans*. The lagoon empties into the Atlantic Ocean off Lagos Coast via the Lagos Harbour (Ogunwenmo and Kusemiju, 2004).

The Lekki Lagoon (Figure 1) lies between Longitudes 4°00' and 4°15' E and Latitudes 6°25' and 6°37' N and has a surface area of about 243 km² with a maximum depth of 6.4 m (FAO, 1969; Kusemiju, 1981). A greater part of the lagoon is however shallow and less than 3 m deep. The vegetation around the lagoon is characterized by stilt-rooted trees with a dense population of shrub, raphia palms (*Raphia sudanica*) and oil palm (*Elaeis guineensis*) (Kusemiju, 1981).

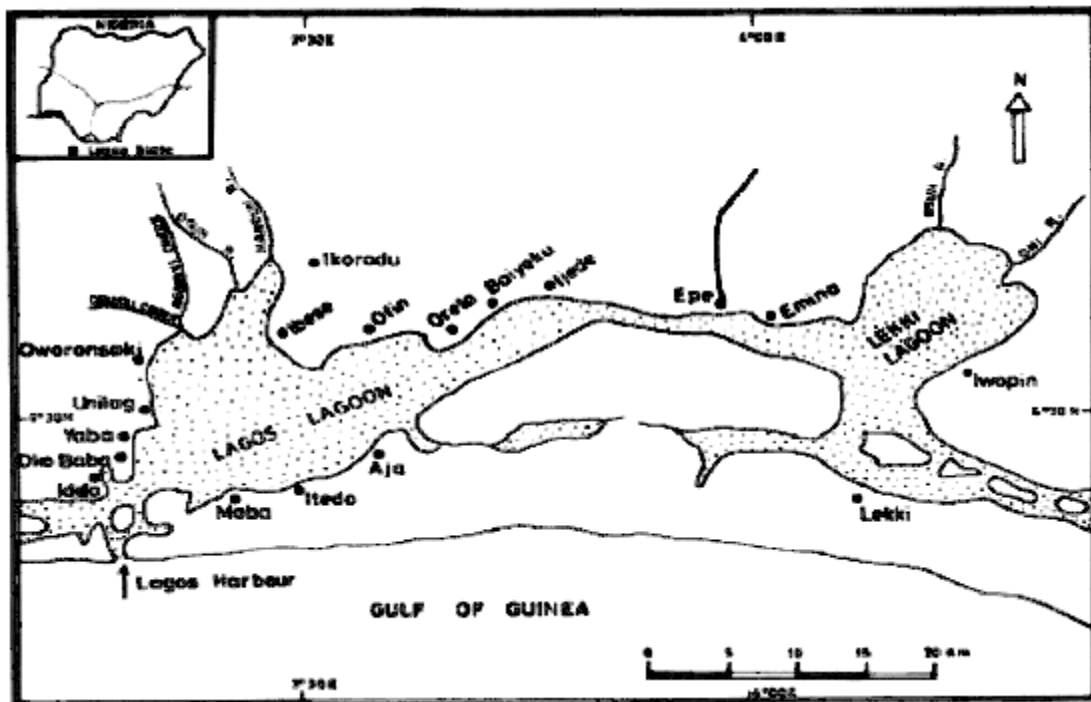


Figure 1: Map showing the Lagos Coast, Lagos Lagoon and Lekki Lagoon, with the map of Nigeria inserted.

Collection of specimens

The fish specimens were collected from the Lagos Coast (marinewater), Lagos Lagoon (brackish water) and Lekki Lagoon (freshwater). Number of specimens collected were: 106 (marine), 326 (brackish) and 90 (freshwater). For fishing, cast nets of small mesh sizes and gillnets (67 mm and 76 mm) were used for the specimens from the lagoons, while specimens from the

marine were collected from landings at the Ijora Jetty in Lagos. The specimens were preserved in a deep-freezer at -20°C) prior to laboratory examination.

Laboratory procedures

In the laboratory, data obtained for each specimen included length, using a measuring board; weight, using a sensitive 'Sartorius' top loading balance

(Model 1106). The counts of meristic characters (pectoral, pelvic, anal and dorsal fin rays and gill rakers) and morphometric characters (measurements of standard lengths, fork lengths, head lengths, etc.) were taken for the biometric features. Lengths were measured to the nearest 0.1 cm and total weight to the nearest 0.1 g.

The relationship between Standard Length (SL) and Total Weight (TW) was expressed by the linear equation:

$$\text{Log } TW = \text{Log } a + b \text{ Log } SL \dots\dots \text{ (Parsons, 1988)}$$

The condition factor, *K*, was calculated using the formula:

$$K = \frac{100 W}{L^3} \dots\dots\dots \text{ (Bannister, 1976)}$$

Where *W* = weight in grams (g);
L = length in centimeters (cm).

Regression equation was used to observe any correlation in the morphometric parameters used.

Results

Length frequency-distribution

The length-frequency distributions of *E. fimbriata* from the marine and brackish waters are presented in Figures 2 and 3.

Length-weight relationship

The length-weight relationship was based on 106 specimens from the marine, whose standard length ranged from 15.6 cm to 26.1 cm (total length 21.6-35.9 cm), 326 specimens from the brackish environment with standard length ranging from 3.5 cm to 15.3 cm (total length 4.8-19.9 cm) and 90 specimens from the freshwater with standard length ranging from 7.2 to 11.3 cm (total length: 8.9 to 13.5 cm). The weights of the marine specimens ranged between 97.7 and 540.0 g, while the range of the brackish specimens was 20.6 to 77.8 g and freshwater was 3.6 to 77.8 g. The Log standard length/Log total weight relationships for the specimens in the three environments are illustrated in Figures 4, 5 and 6. The values of *b* calculated are: 3.5086 for the marine, 2.7444 for the brackish water and 2.9744 for the freshwater specimens. The marine specimens exhibited a positive allometric growth pattern, the brackish specimens exhibited negative allometric growth pattern while the fresh water specimens had a *b* value close to 3, indicating that the fish grows isometrically.

Condition factor *K*

Values of *K* for *E. fimbriata* in the marine, brackish and freshwaters are presented in Tables 1, 2 and 3. Although the condition factors in the different environments were above 1, yet the best was in the marine waters where adult specimens are found. The least condition factor was recorded in specimens from the brackish water environment.

Biometric features

The means and differences between the means of the meristic and morphometric characters of *E. fimbriata*

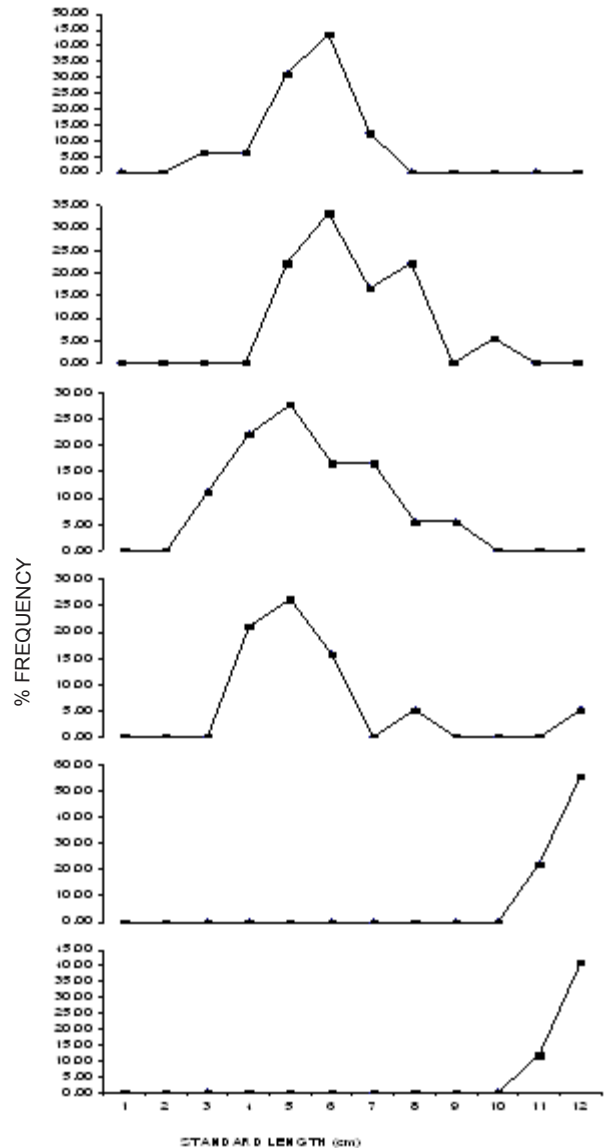


Figure 2: Standard length-frequency distribution of *Ethmalosa fimbriata* from the marine environment (January-June 2005).

from the three different environments are given in Table 4. The counts of meristic features were highest in marine specimens but least in the freshwater specimens. This followed the same trend in the morphometric characters measured for the specimens in the different environments.

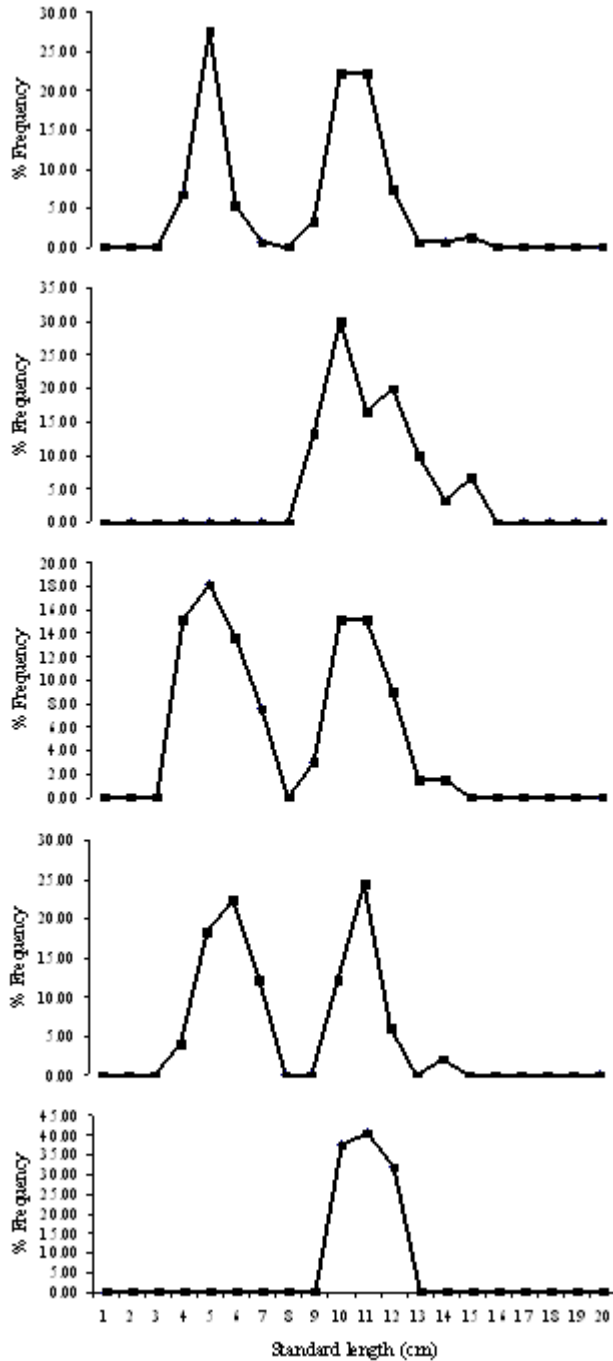


Figure 3: Standard length-frequency distribution of *Ethmalosa fimbriata* from the brackish water environment (January-June 2005).

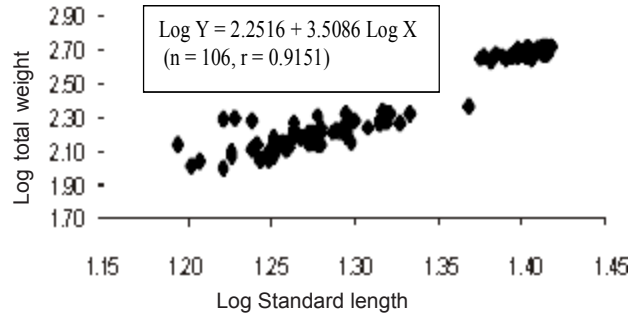


Figure 4: Log standard length/log total weight relationship of *Ethmalosa fimbriata* from the marine environment (January-June 2005).

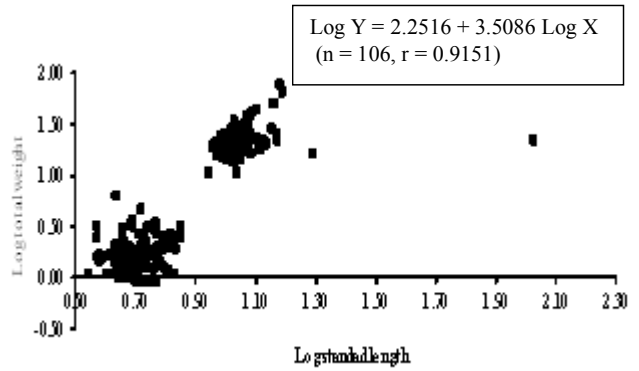


Figure 5: Log standard length/log total weight relationship of *Ethmalosa fimbriata* from the brackish water environment (January to June 2005).

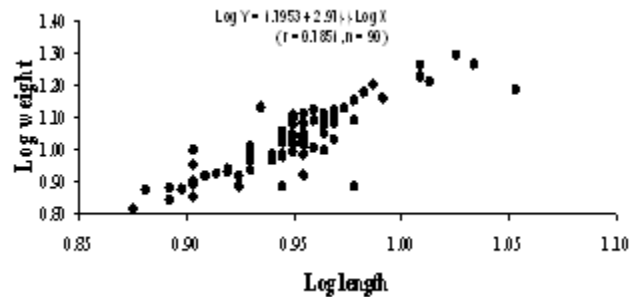


Figure 6: Log length-log weight relationship of *Ethmalosa fimbriata* from freshwater environment.

Table 1: Condition factor for *E. fimbriata* from marine waters off Lagos Coast.

Size Group	Number	Mean SL (cm)	Mean TW (g)	K	Mean K
15.6-19.5	50	17.6	151.3	2.78	2.55
19.6-23.5	16	21.6	194.2	1.93	
23.6-27.5	40	25.6	495.0	2.95	

Table 2: Condition factor for *E. fimbriata* from brackish waters of Lagos Lagoon.

Size Group	Number	Mean SL (cm)	Mean TW (g)	K	Mean K
3.5-9.5	137	9.2	21.1	2.71	1.82
9.6-15.5	189	14.9	30.5	0.92	

Table 3: Condition factor for *E. fimbriata* from the freshwaters of Lekki Lagoon.

Size Group	Number	Mean SL (cm)	Mean TW (g)	K
7.0-11.5	90	8.7	12.5	1.88

Key:

SL = Standard length (cm); TW = Total weight (g); K = Condition factor.

Table 4: The means and differences between the means for meristic characters of *E. fimbriata* from marine, brackish and freshwater environments.

Characters/Parameter	Marine			Brackish			Freshwater		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
Meristic									
1 Pelvic fin rays (PFR)	9	7	7.97 ± 1.41	8	8	8 ± 0.00	8	8	8 ± 0.00
2 Dorsal fin rays (DfR)	18	16	16.81 ± 1.41	17	15	16.9 ± 1.41	17	15	15.64 ± 1.41
3 Anal fin rays (AfR)	23	18	19.68 ± 3.54	22	19	20.15 ± 2.12	21	19	20.36 ± 1.41
4 Pectoral fin rays (PFR)	16	14	14.19 ± 1.41	16	14	14.03 ± 1.41	16	15	15.40 ± 0.71
5 Right gill rakers (RgR)	117	83	96.22 ± 24.04	80	63	72.52 ± 12.02	78	55	65.24 ± 16.26
6 Lateral line scales (LIS)	38	43	40.5 ± 1.12	46	37	41.4 ± 2.72	44	40	42.1 ± 1.21
7 Pre-dorsal scales (PdS)	21	20	20.3 ± 0.12	20	14	17.16 ± 2.27	20	22	21.2 ± 0.25
8 Caudal fin rays (CfR)	22	22	22 ± 0.00	23	18	19.20 ± 1.85	23	22	22.2 ± 0.34
Morphometric									
1 Total length (TL)	35.7	21.5		18.0	17.0	17.28 ± 3.42	14.2	9.5	12.2 ± 3.42
2 Standard length (SL)	26.1	15.6	20.9 ± 7.42	14.0	13.0	13.46 ± 0.25	11	7.8	8.94 ± 2.26
3 Fork length (FL)	28.9	18.6	23.3 ± 7.28	15.5	14.0	14.58 ± 0.40	11.6	8.2	10.1 ± 3.31
4 Head length (HL)	6.5	4.8	5.62 ± 3.21	4.5	4.0	4.12 ± 0.22	3.9	2.6	2.94 ± 0.92
5 Orbit diameter (OrDw)	1.5	1.2	1.41 ± 0.32	1.1	0.9	0.99 ± 0.06	0.8	0.6	0.68 ± 1.26
6 Snout length (SnL)	1.5	1.2	1.33 ± 2.11	1.1	0.9	1.04 ± 0.08	0.9	0.5	0.7 ± 11.3
7 Mandible length (ML)	3.2	3.0	2.94 ± 1.42	1.6	1.4	1.43 ± 0.06	1.9	1.3	1.58 ± 1.45
8 Postorbital head length (PoHL)	3.7	3.0	3.4 ± 1.18	2.8	2.3	2.47 ± 0.15	2.0	1.3	1.65 ± 2.45
9 Caudal peduncle length (CpL)	4.6	1.8	3.5 ± 12.5	1.5	1.3	1.33 ± 0.06	2.9	2.0	2.48 ± 0.17
10 Anal fin length of base (AfbL)	3.0	3.0	3.0 ± 0.00	0.8	0.3	0.60 ± 0.15	1.9	0.8	1.51 ± 1.22
11 Pre-dorsal fin length (PdL)	13.5	9.0	11.2 ± 1.87	7.0	6.5	6.74 ± 0.16	5.1	3.3	4.5 ± 3.21
12 Pre-pelvic length (PpL)	13.3	8.0	10.7 ± 2.21	1.8	1.4	1.53 ± 0.10	5.6	3.7	4.81 ± 1.84
13 Pelvic fin length of base (PfbL)	1.7	1.5	1.58 ± 1.61	0.8	0.5	0.62 ± 0.10	0.4	0.2	0.32 ± 2.11
14 Body depth (BD)	6.2	5.9	6.1 ± 1.22	5.8	5.3	5.56 ± 0.20	3.5	2.5	3.0 ± 1.22
15 Caudal peduncle length least depth (LdCP)	1.0	0.8	0.84 ± 1.54	0.5	0.3	0.45 ± 0.09	0.9	0.7	0.8 ± 0.23
16 Anal fin height (AfH)	3.0	2.3	2.7 ± 2.34	1.0	0.9	0.98 ± 0.04	0.9	0.6	0.72 ± 1.12
17 Pectoral fin height (Pfh)	2.7	2.4	2.2 ± 1.34	2.6	2.3	2.48 ± 0.13	2.3	1.2	1.69 ± 0.67
18 Dorsal fin height (DfH)	2.3	2.2	2.45 ± 3.1	2.5	1.7	2.14 ± 0.26	1.8	1.3	1.52 ± 1.23

Discussion

Based on length-frequency distribution of *E. fimbriata* caught in Lagos Coast, Nigeria, two size groups were identified, with standard lengths ranging between 15.0-22.9 cm and 23.0-26.1 cm (total lengths, 24.2 and 28.1 cm and 28.2-35.9 cm respectively). Kusemiju and Onadeko (1990) also identified two size groups (15.0 and 24.4 cm and from 24.5 to 31.5 cm) for *E. fimbriata* obtained off Aiyetoro Coast, Nigeria. Three age-groups were identified from January to April which were dry months; two age-groups in May, and this is probably a transition to the one age-group of larger sized specimens obtained in June, which marked wet month and when salinity of coastal waters was low due to high precipitation. The length-weight relationship reflected two major populations of *E. fimbriata* in the sample collected off Lagos Coast. In this investigation, the specimens were relatively of similar size range but being slightly smaller than sizes reported by Kusemiju and Onadeko (1990). It is clear that the size distribution of *E. fimbriata* in the marine waters off Lagos Coast has not changed remarkably. In this study, the marine specimens of *E. fimbriata* had a positive allometric growth. Of the specimens from the Lagos Lagoon investigated in January-June 2005, two size groups of standard lengths 3.0-8.0 cm and 8.1-16.0 cm (total lengths 4.7-8.7 cm and 8.8-19.9 cm) were identified. The standard length/weight relationship reflected the two size groups in the Lagos Lagoon specimens. Fagade and Olaniyan (1972) identified three age-groups of *E. fimbriata* from the Lagos Lagoon with sizes of 3.5-6.9 cm, 7.0-16.9 cm and 17.0 cm and above using the length-frequency distribution method. The authors recorded the size-group of 17.0 cm and above due to their 24-months sampling. However, only very few quantities of size 17.0 cm and above were caught by Fagade and Olaniyan (1972) in the rainy months (June-November). Two modes were recognizable in the dry months (Jan-May) while only one age-group was identified for the wet month (June). This may be due to a downstream migration to the coastal waters where salinity was higher than that of the lagoon, and where maturity to adult size was attained in this species. The specimens caught in the wet month (June) were also of the larger size group. Fagade and Olaniyan (1972) did not observe any immature fish (total length, 3.5-7.0 cm) but medium to larger sized group in the wet months (June-November). From the value of regression coefficient b obtained, the brackish water specimens experienced a negative allometric growth. This agreed with the report by Soyinka and Kusemiju (2007) in which *E. fimbriata* from the brackish Lagos Lagoon had a

negative allometric growth pattern. The length-weight relationship showed the general increase in weight with length of the young bonga in Lekki Lagoon. The value of b was nearly 3 in the Lekki Lagoon, suggesting that the fish grows isometrically. This is in consonance with the report by Soyinka and Kusemiju (2007) who also obtained a b value very close to 3 in *E. fimbriata* from same lagoon.

The mean condition factor increased with the increase of the fish length except for the slight variation in sizes 9.6 to 15.5 cm in the brackish water and 19.6 to 23.5 cm in the marine environment. Salzen (1958) cited by Fagade and Olaniyan (1972) recorded a condition factor of 1.0 for *Awefu* (maximal length 15.0 cm) which corresponds to the *Efolo* reported by Fagade and Olaniyan (1972) with a K -value range of 1.50-2.39. This variation in the condition of *E. fimbriata* from the brackish water could be as a result of adverse human impact such as sewage disposal, refuse disposal and oil pollution in the Lagos Lagoon (Amund, 2000; Akpata, 2002). However, the increase in the mean condition factor from the brackish water to the marine habitat indicated an improvement in the fish condition as it moved seawards. This could probably be as a result of available food organisms for the species and the maturing as it moved seawards.

The morphometric and meristic characteristics in *E. fimbriata* from the Lagos Coast, Lagos Lagoon and Lekki Lagoon revealed slight variations. The regression analysis gave a close correlation between the parameters (fork length and standard length) used for the marine and brackish water populations of *E. fimbriata* and the graphical representations showed that the brackish species were juvenile stages that migrated into the waters of the Lagos Coast to mature into adults. There was a very low correlation between the parameters (head length and standard length) for the Lekki Lagoon population. Kusemiju (1975) attributed the differences in the counts and rays to environmental factors such as temperature and salinity. The meristic characters of the species from the Lagos and Lekki Lagoons did not show any significant difference ($p > 0.05$) though the standard lengths of those from the Lagos Lagoon had a significant ($p < 0.05$) larger mean size than those from the Lekki Lagoon. There is a possibility of common origin from the Lagos Coast, for the species of *E. fimbriata* in both lagoons. The species of *E. fimbriata* using the Lagos Lagoon as nursery ground may likely be the same that migrated into the Lekki Lagoon over such a long distance, considering its life history and species that are diadromous which undertake long distances for reproduction or feeding. Also, due to the man-made links by dredging activities

in the Lekki Lagoon, there are channels through which fries of *E. fimbriata* migrate directly from the Lagos coastal waters into the Lekki Lagoon.

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