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Length-Weight Relationships and Condition Factors of Twenty-One Fish Species in Ologe Lagoon, Lagos, Nigeria

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Abstract: This study describes the length-weight relationships (LWR) and condition factors of 21 fish species from 15 families of ecological and economic importance, found in Ologe Lagoon, Lagos, Nigeria. A total of 1353 specimens were caught by local fishing gears from January, 2007 to December, 2007. The slope (b) values obtained for the 21 fish species ranged from 2.012 to 2.991, and diferred significantly ($p<0.005$) from 3, which indicates that most of the fish species have negative allometric growth. *Liza falcipinnis* was the only species with isometric growth (b = 2.99). The condition factors (K) of the fish species ranged from 0.12 in *Polydactylus quadrifilis* to 16.29 in *Eutropius niloticus* and about 86% of these condition factors fall outside the range recommended as suitable for matured fresh water species in the tropics. This indicates that Ologe Lagoon may be unfavourable to fishes in the lagoon. 5 new records (*Hyperopisus bebe occidentalis*, *Eutropius niloticus*, *Bathygobius soporator*, *Trachinotus goreensis*, *Uranoscopus cadenati*) of length-weight relationships, which were not in FishBase was also reported.

Key words: Allometric growth, ecological importance, economic importance, isometric growth, length, Ologe Lagoon, weight

INTRODUCTION

Fish plays an important role in the development of a nation. Apart from being a cheap source of highly nutritive protein, it also contains other essential nutrients required by the body (Sikoki and Otobotekere, 1999). The length-weight relationship is very important for proper exploitation and management of the population of fish species (Anene, 2005). To obtain the relationship between total length and other body weight are also very much essential for stabilizing the taxonomic characters of the species (Pervin and Mortuza, 2008). Length and weight data are a useful and standard result of fish sampling programs. These data are needed to estimate growth rates, length and age structures, and other components of fish population dynamics (Kolher *et al*., 1995). Lengthweight relationships allow fisheries scientists to convert growth-in-length equations to growth-in-weight in stock assessment models (Morato *et al*., 2001; Stergiou and Moutopoulos, 2001), estimate biomass from length frequency distributions (Petrakis and Stergiou, 1995; Dulčić and Kraljević, 1996), compare life history and morphological aspects of populations inhabiting different regions (Stergiou and Moutopoulos, 2001) and calculate fish condition (Petrakis and Stergiou, 1995). The length-weight relationships of some fishes in Nigerian waters have been studied: Fafioye and Oluajo (2005) studied the length-weight relationships of five fish species (*Clarias gariepinus*, *Ilisha africana*, *Chrysichthys nigrodigitatus*, *Chrysichthys walker* and *Ethmalosa fimbriata*) in Epe Lagoon, Lagos, Nigeria while Agboola and Anetekhai (2008) studied the length-weight relationships of 35 fish species from Badagry creek, Lagos, Nigeria.

In fisheries science, the condition factor is used in order to compare the "condition", "fatness" or wellbeing of fish. It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition (Bagenal, 1978). Condition factor is also a useful index for monitoring of feeding intensity, age, and growth rates in fish (Oni *et al*., 1983). It is strongly influenced by both biotic and abiotic environmental conditions and can be used as an index to assess the status of the aquatic ecosystem in which fish live (Anene, 2005). Condition factors of different tropical fish species were investigated and reported by Bakare (1970), Saliu (2001) and Lizama *et al*. (2002).

Despite the usefulness of length-weight relationship and condition factor in fisheries science and the importance of the Ologe Lagoon to the fisheries of Lagos state, Nigeria, information about the length-weight relationships and condition factors of fish species in Ologe Lagoon is non-existent. The paucity of these

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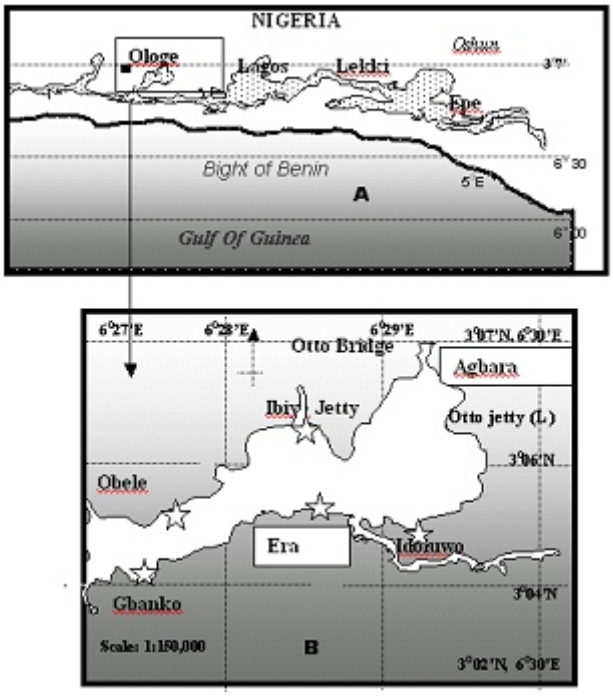

Fig. 1: Location of study site. A: Map of Lagos Lagoon complex - inset: Ologe Lagoon; B: Map of Ologe Lagoon = Areas of fishing operations. L = Fish Landing Site

information propelled this study, which is aimed at bridging this gap and also provide useful information for the management of Ologe Lagoon fisheries.

MATERIALS AND METHODS

The study area is the Ologe Lagoon (Fig. 1) situated in South-west Nigeria between longitude 3º02′E to 3º07′E and latitude 6º27′N to 6º30′N, and has a surface area of 9.4 km^2 (Kumolu-Johnson *et al.*, 2010). The study was conducted in the Laboratory of the Department of Fisheries, Faculty of Science, Lagos State University, Ojo, Lagos, Nigeria in 2007 as part of a series of study (Ndimele *et al.*, 2009; Kumolu-Johnson *et al.*, 2010) to investigate the physico-chemistry and biota of Ologe Lagoon. This lagoon forms part of the continuous lagoon that stretches from Lake Nokoue in Benin Republic to Lagos, emptying into the Atlantic Ocean (Agboola and Anetekhai, 2008).

A total of 1,353 fish samples belonging to 15 families (Polynemidae, elopidae, mormyridae, mugilidae, clupeidae, schilbeidae, sphyraenidae, gobiidae, monodactylidae, carangidae, channidae, citharinidae, lutjanidae, drepanidae and uranoscopidae) were collected randomly from Otto Jetty (fish landing site) (Fig. 1) between January, 2007 and December, 2007. The fisher folks operating in this lagoon deploy surface and bottom-set gillnets, cast nets, ring nets, drift net and fishing baskets for their catches. Fish samples were immediately immersed in 10% formalin and transported to the laboratory where the species identifications were performed by using keys provided by Boulenger (1909), Pellegrin (1912), Reed *et al.* (1967) and Leveque *et al.* (1990).

Total length (cm) of each fish was taken from the tip of the snout (mouth closed) to the extended tip of the caudal fin using a measuring board. Body weight was measured to the nearest gram using a top loading Metler balance (Fafioye and Oluajo, 2005).

Parameters of the length-weight relationship of identified fish species were estimated using the equation:

$$W = aL^b \text{ (Rickter, 1973)} \quad (1)$$

where,

W = Weight of fish (g)
L = Length of fish (cm)
a = y-intercept or the initial growth coefficient
b = Slope or the growth coefficient.

The values of constants a and b were estimated after logarithmic transformation of Eq. (1) using least square linear regression (Zar, 1984) to give:

$$\log W = \log a + b \log L \quad (2)$$

Prior to regression analysis of logW on logL, log-log plots of length and weight values were performed for visual inspection of outliers (Froese, 2006). Only extreme outliers attributed to data error were omitted from analyses. The 95% confidence interval, CI of b was computed using the equation:

$$CI = b \pm (1.96 \times SE)$$

Where SE is the standard error of b.

In order to confirm whether b values obtained in the linear regressions were significantly different from the isometric value of ±95% CI of b at $\alpha = 0.05$, t-test was applied as expressed by the equation according to Sokal and Rohlf (1987):

$$t_s = (b-3) / SE,$$

where t_s is the t-test value, b the slope and SE the standard error of the slope (b). All the statistical analyses were considered at significance level of 5% ($p<0.05$). The condition factor was calculated by the formula:

$$\text{Condition Factor (K)} = \frac{100W}{L^3} \text{ (Pauly, 1983)}$$

RESULTS

A total of 1,353 individuals belonging to 15 families and 21 genera were analysed in this study. The family with the highest number of species was Clupeidae, which had 3 species (*Sardinella maderensis*, *Ethmalosa fimbriata* and *Cynothrissa mento*) while 2 species were recorded by mormyridae (*Hyperopisus bebe occidentalis, Gnathonamus niger*), mugilidae (*Liza falcipinnis*, *Mugil cephalus*), Schilbeidae (*Eutropius niloticus*, *Schilbe mystus*) and Gobiidae (*Bathygobius soporator*, *Gobioides ansorgii*). The other families had one species each. The species, number of specimens, length-weight relationship parameters a and b, 95% confidence interval for b, correlation coefficient (r), condition factor, mean length of fish species, mean weight of fish species and growth type (allometric or isometric) are presented in Table 1.

The sample size for the fish species varied from 35 in *Mugil cephalus* (Mugilidae) to 256 in *Liza falcipinnis* (Mugilidae) while the value of b ranged from 2.012 in *Eutropius niloticus* (Schilbeidae) to 2.991 in *Liza falcipinnis* (Mugilidae). The lowest condition factor (K) (0.12) was recorded in *Polydactylus quadrifilis* (Polynemidae) while the highest value (16.29) was observed in *Eutropius niloticus* (Schilbeidae). The values of correlation coefficient (r) varied from 0.64 in *Trachinotus goreensis* (Carangidae) to 0.98 in *Liza falcipinnis* (Mugilidae). 14.29% of the species had r>0.90, 57.14% had r values between 0.80 - 0.90 while 28.57% had r values lower than 0.80.

The t-test showed that all the fish species had negative allometric growth except *Liza falcipinnis* (Mugilidae), which had isometric growth.

DISCUSSION

This study provides new information on the length-weight relationships of some fish species. A comparison of the result of this study and the information in the electronic database, FishBase (www.fishbase.org, as at May, 2010) showed that five (*Hyperopisus bebe occidentalis*, *Eutropius niloticus*, *Bathygobius soporator*, *Trachinotus goreensis*, *Uranoscopus cadenati*) of the fish species have no previous data on length-weight relationships in FishBase (Froese and Pauly, 2010) nor is there any previous data on their length-weight relationships in Nigeria.

The range of value of b (2.012 - 2.991) obtained in this study is similar to the values (2.607-3.254) recorded by Agboola and Anetekhai (2008), which studied the length-weight relationships of 35 fish species from Badagry Creek, Lagos. It is also similar to the b values (2.790-3.210) obtained in Fafioye and Oluajo (2005), which studied the length-weight relationships of five fish species in Epe Lagoon, Lagos. The 95% confidence interval of b for about 76.19% of the fish species ranged from 2.6 to 3.4. This is within the expected range of $2.5<b<3.5$ (Carlander, 1969). The value of b for *Ethmalosa fimbriata*, *Hyperopisus bebe occidentalis*, *Mugil cephalus*, *Elops lacerta*, *Lutjanus agennes*, *Drepane africana* and *Polydactylus quadrifilis* reported in this study is different from those reported by Agboola and Anetekhai (2008) for Badagry Creek, which is directly connected to Ologe Lagoon. It is likely that this discrepancy is due to seasonal variability of the environment, food availability (Mommsen, 1998; Henderson, 2005), sampling size and the length interval within different areas (Morey *et al.*, 2003) or habitat suitability (Nieto-Navarro *et al.*, 2010).

The condition factor (K) reflects, through its variations, information on the physiological state of the fish in relation to its welfare. From a nutritional point of view, there is the accumulation of fat and gonad development (Le Cren, 1951). From a reproductive point of view, the highest K values are reached in some species (Angelescu *et al.*, 1958). K also gives information when comparing two populations living in certain feeding, density, climate, and other conditions; when determining the period of gonad maturation; and when following up the degree of feeding activity of a species to verify whether it is making good use of its feeding source (Weatherley, 1972). The condition factors (K) of the 21

Table 1: Length - weight relationships of twenty-one fish species collected from Ologe Lagoon, Lagos, Nigeria

Species	N	a	b	95% CI for b	r	K	Mean L (cm)	Mean W (g)	GT
Polynemidae									
Polydactylus quadrifilis (Cuvier, 1829)	47	0.013	2.864	2.851-2.877	0.82	0.12	24.64	11.23	-
Elopidae									
Elops lacerta (Valenciennes, 1847)	43	0.014	2.943	2.898-2.988	0.82	1.67	18.43	87.24	-
Mormyridae									
*Hyperopisus bebe occidentalis** (Günther, 1866)	113	0.020	2.722	2.719-2.725	0.79	2.54	24.83	157.41	-
Gnathonemus niger (Günther, 1866)	81	0.012	2.784	2.773-2.795	0.72	2.62	16.45	62.46	-
Mugilidae									
Liza falcipinnis (Valenciennes, 1836)	256	0.016	2.991	2.979-3.003	0.98	1.43	17.76	76.88	I
Mugil cephalus (Linnaeus, 1758)	35	0.015	2.823	2.800-2.845	0.94	2.71	16.37	71.19	-
Clupeidae									
Sardinella maderensis (Lowe, 1838)	53	0.028	2.663	2.543-2.783	0.89	4.10	12.97	36.96	-
Ethmalosa fimbriata (Bowdich, 1825)	41	0.032	2.801	2.787-2.815	0.85	2.06	14.36	35.38	-
Cynothrissa mento (Regan, 1917)	61	0.020	2.553	2.533-2.573	0.86	6.48	13.24	46.78	-
Schilbeidae									
*Eutropius niloticus** (Rüppell, 1829)	57	0.105	2.012	1.978-2.046	0.91	16.29	12.55	26.18	-
Schilbe mystus (Linnaeus, 1758)	43	0.019	2.461	2.427-2.495	0.81	6.22	17.24	68.14	-
Sphyraenidae									
Sphyraena piscatorum (Cadenat, 1964)	42	0.015	2.821	2.767-2.875	0.72	1.92	27.13	210.56	-
Gobiidae									
*Bathygobius soporator** (Valenciennes, 1837)	41	0.019	2.744	2.731-2.757	0.81	4.94	13.17	56.93	-
Gobioides ansorgii (Boulenger, 1909)	59	0.017	2.782	2.766-2.798	0.81	4.28	13.17	53.56	-
Monodactylidae									
Psettias sebae (Cuvier, 1829)	62	0.025	2.832	2.758-2.906	0.89	3.44	11.87	37.26	-
Carangidae									
*Trachinotus goreensis** (Cuvier, 1832)	49	0.021	2.133	2.060-2.206	0.64	11.51	12.19	23.38	-
Channidae									
Channa obscura (Günther, 1861)	49	0.016	2.663	2.617-2.709	0.84	5.23	16.75	93.66	-
Citharinidae									
Citharinus citharius (Geoffroy Saint-Hilaire, 1809)	51	0.025	2.284	2.259-2.309	0.85	9.99	10.73	22.29	-
Lutjanidae									
Lutjanus agennes (Bleeker, 1863)	49	0.013	2.612	2.592-2.632	0.77	6.94	14.14	69.36	-
Drepanidae									
Drepane africana (Osório, 1892)	65	0.016	2.433	2.418-2.448	0.79	10.81	12.67	51.16	-
Uranoscopidae									
*Uranoscopus cadenati** (Poll, 1959)	56	0.019	2.713	2.710-2.716	0.81	5.63	13.48	63.89	-

N = Sample size; a and b = regression coefficient; CI = confidence interval; r = correlation coefficient; K = condition factor; L = total length; W = weight; Growth Type (GT): +: Positive allometric, -: Negative allometric, I: Isometric; *: Species without length-weight relationship in fishbase

fish species ranged between 0.12 and 16.29. A closer examination of the condition factors revealed that 86% (18 out of 21 fish species) of the fish species had their K values outside the range (2.9-4.8) recommended as suitable for matured fresh water fish by Bagenal and Tesch (1978). This could have been caused by adverse environmental factors (Anene, 2005). This suggests that the condition of Ologe Lagoon in comparison to fresh water bodies may be unfavourable to fishes in the lagoon. Therefore, there would be need for more studies on the physico-chemical properties and the condition factors of other fish species in Ologe Lagoon to be able to establish the suitability of the lagoon for fish survival.

CONCLUSION

An important contribution of this study is the provision of base line data on the length-weight

relationships and condition factors of some fish species in Ologe Lagoon and the new records of length-weight relationships for 5 fish species, which was not in FishBase.

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