GROWTH PATTERN AND CONDITION FACTOR IN RELATION TO SALINITY OF THE GREY MULLET FROM LAGOS LAGOON

SOYINKA, O. O.
Department of Marine Sciences, University of Lagos, Nigeria.
soyinka.olufemi@gmail.com, +2348033808071

ABSTRACT
The length-weight relationship and condition factor in relation to the salinity, of Mugil cephalus from the Lagos Lagoon were investigated for 24 months (February 2004 – January 2006). The size of the 2661 specimens ranged from 1.7 – 29.5 cm standard length (total length: 1.9 – 39.0 cm); weight (0.02 to 450.00 g) indicating the suitability of the lagoon as nursery and feeding ground. The growth pattern showed a positive allometric growth for all sexes, with a significantly high b ($P < 0.05$) ranged between 3.21 – 3.60 ($r = 0.9003$ and 0.9784). The mean condition factor (K) values ranged from 1.39 to 2.30. Salinity, the principal hydro-meteorological force operating in the lagoon ranged from 0.0 to 23.5% (mean: 9.8 $\pm$ 9.13%) and the fish condition varied directly with salinity fluctuations in the lagoon, with higher condition factor in dry season than in wet season. The present utilization by the coastal communities needs to be improved upon to cater for a maximum sustainable yield of the species.
Keywords: salinity, growth dynamics, seasonal fluctuations

INTRODUCTION

Mullets (Mugilidae) are common fishes in the coastal waters of tropical and subtropical countries of the world. Sixteen species have so far been identified in West Africa (Fowler, 1936; Cadenat, 1954 and Blay, 1995), and these constitute an important proportion of the catches of commercial and subsistence fishermen in some countries in this area (Brulhet, 1975; Payne, 1976). The stripped mullet, *Mugil cephalus*, is perhaps the most widespread and abundant inshore teleost (Odum, 1970; Collins, 1985). Lifespan is reported to range somewhere between 4 and 16 years (Tzeng and Tsai, 1994). Size is generally more biologically relevant than age in fishes, due to several ecological and physiological factors that are more size-dependent than age-dependent. Variability in size has important implications for diverse aspects of fisheries science and population dynamics (Erzini, 1994).

Hamza (1999) highlighted some biological characteristics of *Mugil cephalus* in Bardawil Lake, Egypt; Ching (1977) found that the early life increase in weight of small grey mullet, *Lisa malinoptera* is slow in relation to length, but having attained a length of about 40mm, the weight gain is rapid. McDonough and Wenner (2003) obtained similar results in juvenile *M. cephalus.* Most works reported in West Africa sub-region were principally on food and feeding habits of the species (Fagade and Olaniyan, 1973; Brulhet, 1975; Payne, 1976; Blay, 1995; Soyinka, 2008). Although, *M. cephalus* constitutes an important source of protein in coastal states in Nigeria, studies on the ecology and population dynamics are insufficient. There is the need for more work on other aspects of the biology and culture potentials of the mullet species in Nigerian waters.

The present investigation is to examine the growth pattern and condition factor in relation to salinity, of *M. cephalus* in Lagos Lagoon to provide information on stock composition, life span, growth and mortality for fishery assessment purpose.

STUDY AREA

The Lagos Lagoon (Fig. 1) which lies between longitudes 3° 20´ and 3° 40´ E and latitudes 6° 15´ and 6° 40´ N has an area of 208 km^2 and is the largest of the lagoon systems of the West African sub-region. 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). It has supported decades of small scale fisheries which have shown sign of continuous decline (Solarin, 1998). The lagoon characterized with seasonal fluctuation in salinity – high brackish water during the dry season (December – May), while freshwater condition exist in the rainy season (June – November) (Fagade and Olaniyan,

1974; Kusemiju, 1975; Ugwumba, 1984 and Solarin, 1998). The lagoon is surrounded by swamp forest and riparian forest consisting of mangrove vegetation: *Rhizophora racemosa, R. harrisonii, Aerosticum aureum, Paspalum orbiculare, Langucularia* sp and *Avicennia germinans*. The lagoon empties into the Atlantic Ocean via the Lagos Harbour (Ogunwenmo and Kusemiju, 2004).

The lagoon is shallow in depth and in most places a little more than 1.5 m depth (Solarin and Kusemiju, 2003).

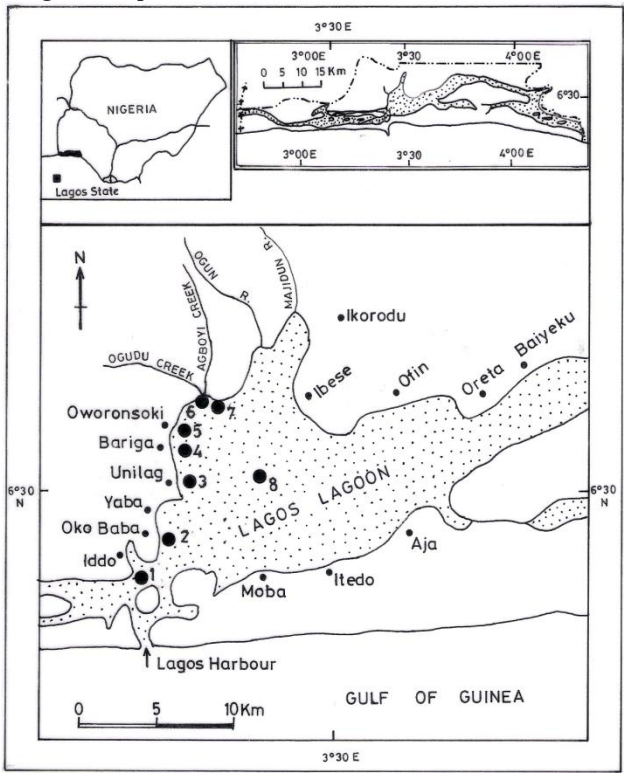


Fig. 1: Map of Lagos Lagoon, Nigeria showing the sampling stations (1 – 8)

MATERIALS AND METHODS

Field Studies

The salinity of the lagoon was determined *in-situ* twice a month between 8.00 – 11.00 a.m. for 24 months (February, 2004 – January, 2006) using a Refractometer (BIOMARINE, Aqua Fauna Model). Specimens of grey mullet, *Mugil cephalus* were collected by fisher-folks who used active fishing gears for fishing, at Lagos jetties. The collections were made fortnightly, and fish were placed in ice-chest on the field, but later transferred into a deep freezer at temperature of – 20 °C in the laboratory for further analysis.

Laboratory Procedures

The specimens were removed from the freezer and allowed to thaw before being examined. Excess water from the fish was drained away or by using the filter paper. The standard length (SL) and total length (TL) of the specimens were measured on a measuring board to the nearest 0.1 centimeter. The total weight of the fish was taken on a 'Sartorious' top loading balance (Model 1106 2608053) or a triple beam balance to the nearest tenth of a gram.

Length-weight relationship of *M. cephalus*

The data for the standard length – total weight relationship for the specimens was compiled. The linear relationship was expressed by the equation:

Log W = log a + b (log L) …….. (Tesch, 1968; Parsons, 1988)

Where: W = total weight of the fish in grams (g);
L = Standard length of the fish in

centimeters (cm); a = regression constant; b = regression coefficient

Condition Factor

The condition factor (K) of a fish, which indicates the state of overall well-being or how fat or lean a fish is was determined using the formula:

$$K = \frac{100W}{L^b}$$ …….. (Bannister, 1976)

Where: W = weight of fish in g;
L = Standard length of fish in cm
b = regression co-efficient.

The condition factor was determined for the specimens in relation to sex and size groups.

RESULTS

(a) Length-weight relationship of *M. cephalus.*

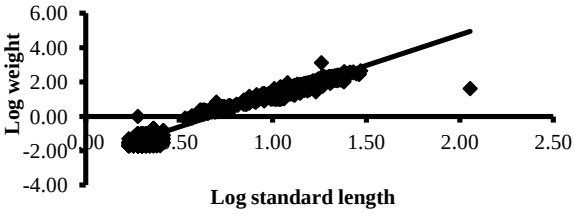
The relationship between Log standard length and Log weight of *M. cephalus* is illustrated in Fig. 2 (A – D) for the combined, immature, male and female sexes respectively. The relationship between Log standard length and Log weight of *M. cephalus* from the Lagos Lagoon is presented in the regression equations shown below:

Immature: Log W = -2.4088 + 3.5896 Log SL
(n = 2011, r = 0.9784)

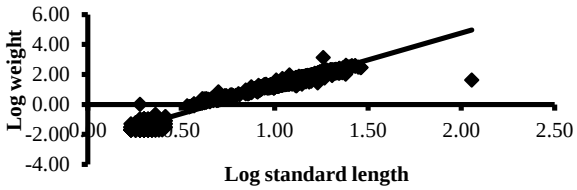
Male sexes: Log W = -1.995 + 3.2118 Log SL
(n = 426, r = 0.9003)

Female sexes: Log W = -2.4955 + 3.5971 Log SL
(n = 224, r = 0.9548)

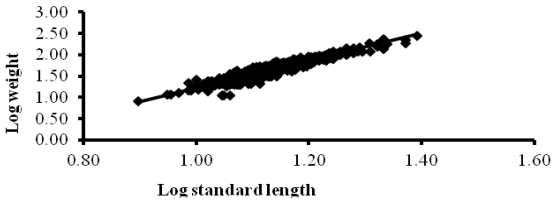
Combined sexes: Log W = -2.3995 + 3.5717 Log SL
(n = 2661, r = 0.9779)



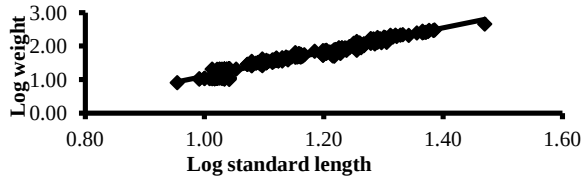
A



B



C



D

Fig. 2: Log standard length / Log weight relationship of *M. cephalus* from Lagos Lagoon (February 2004 – January 2006)

Key: A = combined sexes; B = immature; C = male sexes; D = female sexes

(b) Condition factor (K) of *M. cephalus*.

The summary of the variations in condition factor by size and sex of *M. cephalus* from the Lagos Lagoon are presented in Table 1. The K-values ranged from 2.01 – 2.41 (male); 1.68 – 1.90 (female) and 1.96 – 2.01 (combined sexes). The highest K-values were recorded for the small size groups in the males and combined sexes, while the highest K-value for the females was recorded for the medium size group. The monthly variations in the condition factor of *M. cephalus* from the Lagos Lagoon are illustrated in Fig. 3. The relationship between condition factor of *M. cephalus* and the salinity fluctuations in the lagoon is illustrated in Fig. 4. It could be seen

generally, that the males had a slightly higher condition factor than the females in the lagoon, while the females had a better condition factor in the high brackish condition than in low brackish condition.

Table 1: Condition factor (K) by sex and size group of *Mugil cephalus* from the Lagos Lagoon (February 2004 – January 2006)

Standard	MALE				FEMALE				COMBINED SEXES			
Length (cm)	N	SL (cm)	W (g)	K	N	SL (cm)	W (g)	K	N	SL (cm)	W (g)	K
4.5 – 12.4	3	11.8	39.63	2.41	2	11.9	28.25	1.68	5	11.9	33.94	2.01
12.5 – 20.4	342	16.4	88.45	2.01	155	16.7	88.37	1.90	497	16.6	88.41	1.96
20.5 – 29.4	44	22.3	230.25	2.08	5	21.2	177.47	1.86	49	21.8	203.86	1.97
TOTAL	**389**				**162**				**551**			

KEY: N = Number; SL = Average Standard length (cm); W = Average Weight (g); K = Condition factor

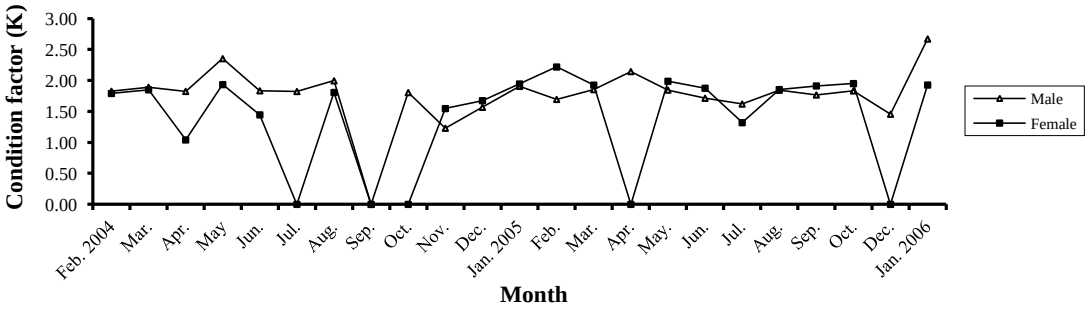


Fig. 3: Monthly condition factor (K) by sex of *Mugil cephalus* from the Lagos Lagoon (February 2004 – January 2006)

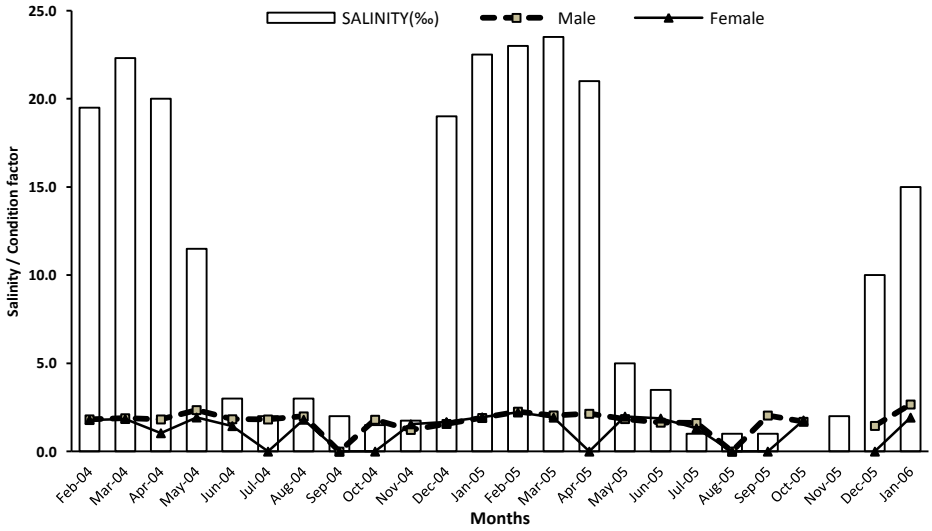


Fig. 4: Relationship between condition factor for male and female *M. cephalus* with salinity of the Lagos Lagoon (February 2004 – January 2006)

DISCUSSION

The grey mullet, *M. cephalus* was caught throughout the year in the Lagos Lagoon during this investigation and this agreed with the work of McDonough and Wenner (2003). Fagade and Olaniyan (1974) however reported the species in dry season (December to May).

The Log standard length – Log total weight relationship of the grey mullet from the Lagos Lagoon showed a positive allometric growth for all sexes and immature specimens. This is indicative that as the fish elongates horizontally, there is a corresponding increase in weight. The regression coefficient *b* ranged between 3.21 and 3.60, which was closely linked to the range of 2.54 – 3.58 recorded on 'fishbase'. The report in the present study used standard length and fish size of 1.7 – 29.5 cm, while the report on 'fishbase' consisted of total length, standard length and fork length. There existed a high correlation between the size and weight of fish in the present finding. The fish growth could be described by the relationship: Total weight (g) = -2.3995(standard length)$^{3.5717}$ (r = 0.9779). McDonough and Wenner (2003) reported that juvenile growth after recruitment into the estuary can be described by the relationship: Total length (mm) = 0.341(Age)$^{1.04}$ (r^2 = 0.741, P = 0.001). Ching (1977) found that the early life increase in weight of small grey mullet, *Lisa malinoptera* is slow in relation to length, but having attained a length of about 40mm, the weight gain is rapid. Growth after the 80mm mark occurs more by increase in weights than increase in length, probably after maturity is reached. McDonough and Wenner (2003) reported that the greatest increase in growth for *M. cephalus* juveniles came after a mean size of 40 mm (4.0 cm) was reached and during the months when mean monthly temperatures were higher. In the present investigation, similar observations were made in addition that the value of the weight began to exceed that of the length at a size of 10.3 cm (103 mm). The LWR parameters (*a, b*) of the fish are affected by a series of factors such as season, habitat, gonad maturity, sex, diet, stomach fullness, health, preservation techniques and annual differences in environmental conditions (Bagenal and Tesch, 1978; Froese, 2006). Such differences in values *b* can be ascribed to one or a combination of most of the factors including differences in the number of specimens examined, area/season effects and distinctions in the observed length ranges of the specimens caught, to which duration of sample collection can be added as well (Moutopoulos and Stergiou, 2002).

The K-value was assessed based on size, sex and season. The highest K-values were recorded for the small size group in the males (2.41), while the least was the small size group in the females (1.68). According to Lagler (1978), a fish is said to be in a good condition when the K-value is greater that one (1). Although all the groups in this investigation are in good condition, yet the highest K-value of the small size group is indicative of active growth process of this stage. Between the sexes, generally, the condition factor during high salinity in dry season was higher than during low salinity in wet season. This was more remarkable among the female *M. cephalus*. The relatively high condition factors recorded in the present study is indicative of a productive ecosystem. Major food organisms of the species could be more abundant during the dry season and thus encourage a more active feeding. However, the slight variations in the condition factor from dry season to wet season could probably be as a result of fluctuations in environmental factors particularly, salinity. Freshwater species of food items are not probably occurring in the lagoon at dry season when salinity is high. The species richness affected by seasonality will probably create a variation in the fish condition factor. This agreed with the report by Bagenal (1978), Braga (1986) and Ekanem (2004) that environmental factors play a great account for spatial and temporal differences in condition factor of fish.

CONCLUSION

It is implied from the present study that the Lagos Lagoon ecosystem is viable to sustain a good fishery for the grey mullet, *M. cephalus*, as recorded in the range in sizes from fry to adult. The present utilization by the coastal communities needs to be improved upon to cater for a maximum sustainable yield of the species. Measures such as mesh size regulation, and target of adult sizes of the species during dry season should be encouraged and adopted for artisanal fishers.

ACKNOWLEDGEMENT

The unrelenting effort of Professor K. Kusemiju of the department of Marine Sciences,

University of Lagos during the conduct of this research is greatly appreciated.

REFERENCES

Bagenal, T.B. (1978). Aspects of fish fecundity. *In*: S.D. Gerking (Ed) *Ecology of Freshwater fish Production.* Blackwell Scientific Publications, Oxford: 75-101.

Bagenal, T.B. and Tesch, F.W. (1978). Age and growth. *In*: T. Bagenal (Ed.), *Methods for assessment of fish production in fresh waters*, 3rd Edition. IBP Handbook No. 3, Blackwell Science Publications, Oxford, 101- 136.

Bannister, J.V. (1976). The length-weight relationship, condition factor and gut contents of the Dolphin fish, *Coryphaena hippurus* (L) in the Mediterranean. *Journal of Fish Biology* 9: 335 – 338.

Blay, J. (1995). Food and feeding habits of four species of juvenile mullet (Mugilidae) in a tidal lagoon in Ghana. *Journal of Fish Biology* 46, 134 – 141.

Braga, F.M.S. (1986). Estudo entre o fator de condição e relação peso/comprimento para alguns peixes marinhos. *Rev. Brasil. Biol.*, 46(2): 339-346.

Brulhet, J. (1975). Observations on the biology of *Mugil cephalus ashanteensis* and the possibility of its aquaculture in the Mauritanean coast. *Aquaculture* 5, 271 – 281.

Cadenat, J. (1954). Note d'ichthyologie oust-africain 8. Regime alimentaire sur les mullets de la cote occidental d'Afrique. *Bulletin de I'Institute francais d'Afrique noire (ser. A)* 16, 584 – 591.

Ching, C. V. (1977). Studies on the small grey mullet, *Liza malinoptera* (Valenciennes). *Journal of Fish Biology*, 11, 293 – 308.

Collins, M. R. (1985). *Species profiles*: *Life histories and environmental requirements of coastal fishes and invertebrates (South Florida) – striped mullet*. U.S. Army Corps of Engineers, TR EL – 82.4 11pp.

Ekanem, S.B. (2004). The biology and culture of the silver catfish (Chrysichthys nigrodigitatus). *Journal of Sustainable Tropical Agricultural Research*, 10, 1-7.

Erzini, K. (1994). An empirical study of variability in length and age of marine fishes. *Journal of Applied Ichthyology* 10, 17 – 41.

Fagade, S.O. and Olaniyan, C.I.O. (1973). The food and feeding interrelationship of the fishes in the Lagos Lagoon. *Journal of Fish Biology* 5, 205 – 225.

Fagade, S.O. and Olaniyan, C.I.O. (1974). Seasonal distribution of the fish fauna of the Lagos lagoon. *Bull de l' I.F.A.N. A*. 36(1): 244 – 452.

FAO. (1969). Fisheries survey in the western and mid-western regions of Nigeria. FAO/SF74/NIR6.

Fowler, H. W. (1936). The marine fishes of West Africa. *Bulletin of the American Museum of Natural History* 70, 1– 605.

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

Hamza, A. K. (1999). A study on some biological characteristics of *Mugil cephalus* (L.) in Bardawil Lake, Egypt. *Journal of Applied Ichthyology* 15 (3): 135–139.

Kusemiju, K. (1975). The bionomics and distribution of the pink shrimp, *Penaeus duorarum* (Burkenroad) off Lagos coast, Nigeria. *Bull de I' I.F.A.N. A.* 37(4): 775 – 783.

Lagler, K. F. (1978) *Freshwater Fisheries Biology*. C. Brown Company Ltd. 421pp.

McDonough, C. J. and Wenner, C. A. (2003). Growth, recruitment and abundance of juvenile *Mugil cephalus* in South Carolina estuaries. *Fisheries Bulletin* 101, 343 – 357.

Moutopoulos, D.K. and Stergiou, K.I. (2002). Length-weight and length-length relationships of fish species from the Aegean Sea (Greece). *Journal of Applied Ichthyology*, 18, 200-203.

Odum, W. E. (1970). Utilization of the direct grazing and plant detritus food chains by the striped mullet, *Mugil cephalus*, pp 222 – 240, In: J. J. Steele (ed.) Marine food chains. Oliver and Boyd, Ltd, Edinburgh, Scotland.

Ogunwenmo, C.A. and Kusemiju, K. (2004). Annelids of a West African estuarine system. *Journal of Environmental Biology* 25 (2): 227 – 237.

Parsons, R. (1988). *Statistical analysis: A decision making approach.* Second edition. Harper and Rao Publishers. New York. 791pp.

Payne, A. L. (1976). The relative abundance and feeding habits of the grey mullet species occurring in an estuary in Sierra Leone, West Africa. *Marine Biology* 35, 277 – 286.

Solarin, B.B. (1998). The hydrobiology, fishes and fisheries of the Lagos Lagoon, Nigeria. Ph.D Thesis, University of Lagos. 235pp.

Solarin B.B. and Kusemiju, K. (2003). An appraisal of gender participation in trap and liftnet fisheries in Lagos lagoon Nigeria. *African Journal of Applied Zoology and Environmental Biology* 5: 75- 81.

Soyinka, O.O. (2008). The feeding ecology of *Mugil cephalus* (Linnaeus) from a high brackish tropical lagoon in south-west Nigeria. *African Journal of Biotechnology* 7 (22): 4192 – 4198.

Tesch, F.W. (1968). Age and growth. *In*: *Methods for Assessment of fish production in freshwater* (Ricker, W.E. ed.) Blackwell Scientific Publication, Oxford. 93 – 123.

Ugwumba, O. A. (1984). The biology of the ten pounder, *Elops lacerta* (Val.) in the freshwater, estuarine and marine environments. Ph.D Thesis, University of Lagos. 297pp.