



## Growth pattern of three species of Mullet (Pisces: Mugilidae) in Sombreior River, Rivers State, Niger Delta, Nigeria

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### ABSTRACT

Length-weight relationships (LWRs) and condition factor are important biological information to assess the growth pattern and wellbeing of fish species influenced by numerous abiotic and biotic factors. To date, no data on the LWRs and condition of mullets in Sombreior River, Niger Delta. Hence, this research was conducted to determine abundance, length-weight relationship and Fulton's condition factor (K) of three species of fish belonging to family Mugilidae in Sombreior River, Nigeria. There were a total of 248 samples from five sampling stations for a period of months. Fish species were of various sizes ranging from  $24.66 \pm 0.40$  to  $26.35 \pm 0.26$  cm in length and  $141.41 \pm 6.30$  to  $161.56 \pm 5.87$  g in weight. For the three species, slope (b) values ranged from 2.18 to 2.68 indicating a negative allometric growth of all fish species. The mean condition factor ranged from  $0.89 \pm 0.03$  for six *Mugil cephalus* to  $0.93 \pm 0.03$  for *Parachanna grandisquamis* while the coefficients of determination ( $R^2$ ) of the LWR regressions ranged between 0.64 (*Neochelon falcipinnis*) and 0.79 (*Parachanna grandisquamis*). It was concluded that the mullets in the Sombreior River had a negative allometric growth pattern and the condition is showing the species were in good state of well-being since mean K values are greater than 1.

### Introduction

The Mugilidae family includes 17 genera and 72 valid species, which are found in freshwaters, estuaries, brackish water, hypersaline lagoons and coastal marine waters at shallow depths less than 20m. (Cardona, 2006). Species belonging to these genera are mostly benthic in their food habits (FAO, 1990). *Mugil* and *Liza*, are the two most important genera, which have 18 and 24 species respectively (Thomson, 1966; Nelson, 2006). In West Africa, mullets fish have high economic value (FAO, 2005) because they have high meat quality and very palatable taste (Asuquo *et al.*, 2015).

The biological information on fish are important and efficient approaches for their management and preservation. Biological data such as body length and weight constitute necessary data to assess population structure (Froese, 2006). Length-weight relationship is essential method for adequate use and control of

the abundance of the fish species (Anene, 2005). The association between total length and other body weight is helpful in maintaining the taxonomic characteristics of the species (Pervin and Mortuza, 2008). The regression-based isometric and allometric relationships are also useful for calculating the body composition of fish and other animals in the production sector (Dumas *et al.*, 2007). Condition factor is commonly used as a growth and feeding index (Fagade, 1979). Established assumption revealed that bigger fish of a given measurement are in healthier physiological state (Bagenal, 1978). Condition factor is likewise a valuable guide to track feeding strength, stage, and growth rates in fish (Oni *et al.*, 1983). This is highly affected by both biotic and abiotic conditions and can possibly serve as an index for determining the state of the aquatic environment of the fish (Anene, 2005). Condition factors of various tropical fish species were studied and stated

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for instance by Bakare (1970), Saliu (2001), Lizama *et al.* (2002), and Muchlisin *et al.* (2015). Studies on the LWRs and condition factors of mullets have been reported by several researchers, for instance; Yulianto *et al.* (2020) in Lambada Lhok waters in Aceh Besar, Indonesia; Dienye *et al.* (2019) in New Calabar River, Nigeria; Asuquo *et al.* (2015) in Cross River Estuary, Nigeria; Ali *et al.* (2016) in Eastern Coast of Libya; and Kumolu-Johnson and Ndimele, (2010) in Ologe Lagoon, Lagos, Nigeria. However, information on LWRs and condition factor of mulles in the Sombreior River, Nigeria was not available. Hence, the objective of this research was to estimate the abundance, length-weight relationship and condition factor for three important fish species belonging to family Mugilidae from the Somberior River.

## Materials and Methods

### Area of study

The river situated east of the Orashi river, the Sombreiro river comes from swamps in the Oguta-Ebocha region. It has its origins from the Niger River, flows into the Niger Delta basin's southern tip and drains into the Atlantic Ocean. The Sombreiro River's middle reach is brackish, and during the rainy season appears turbid. Studies were made on 5 locations of the Sombreior river in this middle section (Figure 1). The vegetation of this study area is characterized by red and white mangroves (*Rhizophora mangle* and *Avicenia* sp., respectively), *Nypa* palm (*Nypa fruticans*) and the aquatic weeds *Ipomoea aquatica*, *Nymphaea lotus*, *Mimosa pigra*, *Eichhornia natans*, among others. This river is economically important as numerous commercial activities take place within the study area. The area experiences two seasons: wet and dry seasons. It is one of the Niger Delta Rivers which discharges into the Atlantic Ocean. It flows southwards from its source to the Atlantic Ocean and is linked to other rivers through creeks in the coastal areas of the Niger Delta (Ezekiel *et al.*, 2002).

Fish specimen were collected twice a month from the Sombreior River fishermen's catches landed at the five fish landing sites with their coordinates namely Idama (4.799060, 6.763367), Ogonokom (4.816358, 6.731589), Ogbokuma (4.797754, 6.732589), Degema (4.771830, 6.761676) and Abonnema (4.728191, 6.767518) (Figure 1) between April and September 2018. These specimens were collected from the fishermen with different fishing gears, which includes cast nets, gillnets, beach seine, fyke nets, and scoop nets with mesh sizes ranging from 1.5 to 3cm. Samples were stored immediately in

an iced cooler box, and moved to a fisheries laboratory, Faculty of Agriculture at Port Harcourt University, Choba, to preserve samples in 4% formalin after labelling. Identification of the sampled specimens was carried out using appropriate texts from Adesulu and Sydenham (2007) and Fish base (Froese and Pauly, 2017). Total catch of the specimens was recorded.

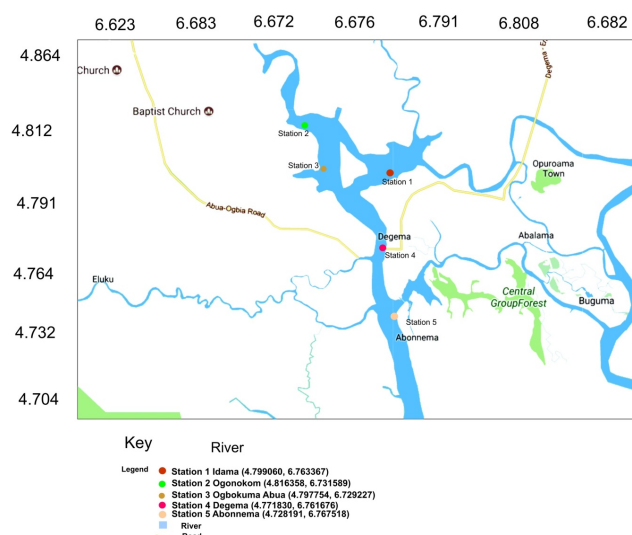


Figure 1. Map of Niger Delta showing the sampling site

### Sampling procedure

#### LWRs and condition factor analysis

Total Length (TL) and Standard Length (SL) of the specimens were taken with a calibrated measuring board in centimetre (cm), and the Body Weight (BW) were measured in grams (g). The Total Length (TL) of each fish was taken from the tip of the snout (mouth closed) to the extended tip of the caudal fin using a meter rule.

Relative species abundance (%) =  $(n/N) \times 100$ . The relative representative of a species was calculated by dividing the number of species (n) from each catch by the total number of species (N) from the total catch recovered

The length-weight relationship is stated by the formula  $W = aL^b$ , where W = body weight (g), and L = total length (cm) (Ricker, 1973). Parameters a and b were estimated by the logarithmic expression:  $\log(W) = \log(a) + b \log(L)$ , the factors a and b were estimated with 'a' as the intercept and 'b' the slope of the relationship. In order to institute LWRs with reverence to periodic differences that can affect b (Zargar *et al.*, 2012).

The Fulton's condition factor shows the degree of well being of the fish in their habitat which was estimated based on Muchlisin *et al.* (2010) :  $K = (W \times L)^{-3} \times 100$ , where, K is Fulton's condition factor, W is body weight of the fish sample (g), L is total

length of the same fish sample (cm),  $-3$  is a coefficient to confirm that the  $K$  value tends toward one. Based on Morton and Routledge (2006) the  $K$  value is separated into five classifications as follows: Very bad (0.8–1.0), Bad (1.0–1.2), Balance (1.2–1.4), Good (1.4–1.6) and Very good ( $> 1.6$ ).

## Results

A total of 248 specimens belonging to three species of the family Mugilidae were caught during the study as shown in Table 1 below. The most prevalent species was *Parachelon grandisquamis* (42.7%) followed by *Neochelon falcipinnis* (35.5%) while the least occurrence species was *Mugil cephalus* (21.8%).

The result of the size distribution presented in Table 2 showed that *M. cephalus* had the highest total

length (TL) and total weight (TW) values of  $26.35 \pm 0.26$  cm and  $161.56 \pm 5.87$  g followed by *P. grandisquamis* with TL  $25.30 \pm 0.31$  cm and TW  $152.54 \pm 5.89$  g and *N. falcipinnis* with least values of TL  $24.66 \pm 0.40$  cm and TW  $141.41 \pm 6.30$  g. Results of the LWR regressions are shown in Table 3 indicate the three species showed negative allometry. The mean  $b$  of *N. falcipinnis* was 2.679 (Figure 2a), 2.325 for *P. grandisquamis* (Figure 2b), and 2.177 for *M. cephalus* (Figure 2c). The coefficients of determination ( $R^2$ ) of the LWR regressions ranged between 0.64 (*N. falcipinnis*) and 0.79 (*P. grandisquamis*). The mean condition factor ranged from  $0.89 \pm 0.03$  recorded for *M. cephalus* to  $0.93 \pm 0.03$  recorded for *P. grandisquamis* (Table 3).

**Table 1.** Mean monthly catch of three species of fish of the family Mugilidae from Sombreior River.

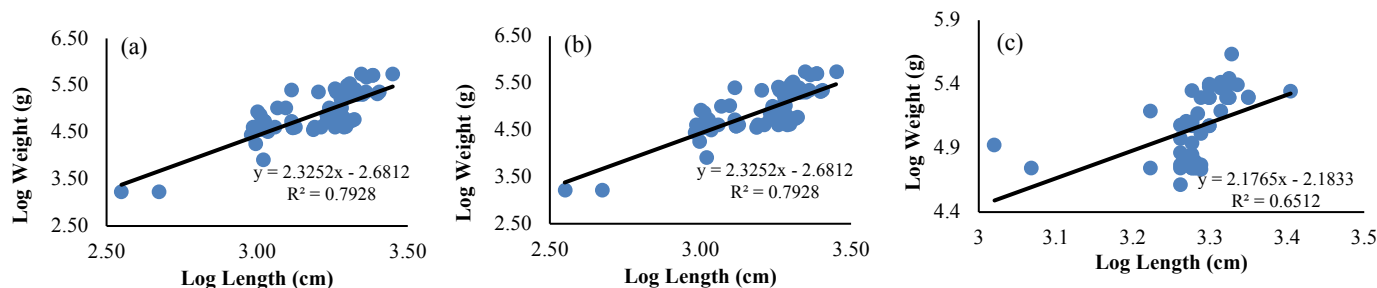
| Species                         | April            | May             | June             | July             | August           | September        | %    |
|---------------------------------|------------------|-----------------|------------------|------------------|------------------|------------------|------|
| <i>Neochelon falcipinnis</i>    | $16.00 \pm 2.00$ | $9.00 \pm 1.00$ | $31.00 \pm 1.00$ | $9.00 \pm 1.00$  | $9.00 \pm 1.00$  | $6.00 \pm 1.00$  | 35.5 |
| <i>Parachelon grandisquamis</i> | $22.00 \pm 0.00$ | $3.00 \pm 2.00$ | $21.00 \pm 1.00$ | $14.00 \pm 1.00$ | $19.00 \pm 1.00$ | $21.00 \pm 1.00$ | 42.7 |
| <i>Mugil cephalus</i>           | $10.00 \pm 1.00$ | $0.00 \pm 0.00$ | $14.00 \pm 1.00$ | $7.00 \pm 1.00$  | $7.00 \pm 1.00$  | $12.00 \pm 1.00$ | 21.8 |
| Total                           |                  |                 |                  |                  |                  |                  | 100  |

**Table 2.** Range of length and weight of the sampled mullets fish in Sombreior River

| Species                         | N   | Total weight (g)  |           | Total Length (cm) |             | Standard Length  |             |
|---------------------------------|-----|-------------------|-----------|-------------------|-------------|------------------|-------------|
|                                 |     | Mean $\pm$ SE     | Range     | Mean $\pm$ SE     | Range       | Mean $\pm$ SE    | Range       |
| <i>Neochelon falcipinnis</i>    | 88  | $141.41 \pm 6.30$ | 15 – 260  | $24.66 \pm 0.40$  | 10.1 – 29.8 | $20.59 \pm 0.39$ | 8.1 – 25.5  |
| <i>Parachelon grandisquamis</i> | 106 | $152.54 \pm 5.89$ | 25 – 311  | $25.30 \pm 0.31$  | 12.8 – 31.5 | $21.17 \pm 0.31$ | 8.8 – 27.5  |
| <i>Mugil cephalus</i>           | 54  | $161.56 \pm 5.87$ | 101 – 280 | $26.35 \pm 0.26$  | 20.4 – 30.1 | $22.17 \pm 0.28$ | 15.4 – 26.6 |

**Table 3.** Overall condition factors and the growth pattern of the sampled mullets fish in Sombreior River

| Species                         | K               |             | a     | b    | $r^2$ | Growth pattern     |
|---------------------------------|-----------------|-------------|-------|------|-------|--------------------|
|                                 | Mean            | Range       |       |      |       |                    |
| <i>Neochelon falcipinnis</i>    | $0.90 \pm 0.03$ | 0.57 – 1.94 | -1.92 | 2.17 | 0.64  | Negative allometry |
| <i>Parachelon grandisquamis</i> | $0.93 \pm 0.03$ | 0.51 – 1.94 | -3.71 | 2.68 | 0.79  | Negative allometry |
| <i>Mugil cephalus</i>           | $0.89 \pm 0.03$ | 0.57 – 1.60 | -2.08 | 2.18 | 0.65  | Negative allometry |



**Figure 2.** Length-weight relationship of (a) *Neochelon falcipinnis*; (b) of *Parachelon grandisquamis*; (c) *Mugil cephalus* in Sombreior River.

## Discussion

The study provides a data on the abundance and length-weight relationships of three fish species belonging to the family Mugilidae from the Sombreior River. The species recorded in the current study included *P. grandisquamis*, *N. falcipinnis* and *M. cephalus*. These three species are also available in the New Calabar River (Dienye *et al.*, 2018). This is different from the report of Ibim and Bongilli (2018) who recovered only two species (*N. falcipinnis* and *M. cephalus*) from the middle reach of the same river. The species recorded in the present study appear to be more susceptible to artisanal fishing gear used by local fishers in the Sombreior River. Differences in sampling and sampling processes and abundance of fish may differ accordingly (Olopade and Rufai, 2014). In this study, three species of the family Mugilidae sampled, were relatively small fishes with sizes ranging from  $24.66 \pm 0.40$  to  $26.35 \pm 0.26$  cm in length and  $141.41 \pm 6.30$  to  $161.56 \pm 5.87$  g in weight. This indicated that middle sized species were better exploited. In general, middle size group of fishes in riverine/natural stocks are more exploited than other size groups (Nikolskii, 1980). This may be attributed to selectivity of the fishing gear deployed in the river and human effects, particularly the fishing pressure and habitat damage. The common indicator of unmanageable fishing is the decline in the mean fish size of the catch.

The slope (b) values reported for the three species ranged from 2.17 to 2.68 which indicated a negative allometric growth. By negative allometry ( $b < 3$ ), the fish is said to be “lighter for its length” as it grows (Froese, 2006). Allometry values of the same species have been noted to vary in relation to place and time. Kolawole-Daniels *et al.* (2017) also reported negative allometric growth in *M. cephalus* and *N. falcipinnis* from Lagos Lagoon. Dienye *et al.* (2019) reported *N. falcipinnis*, *P. grandisquamis* and *M. cephalus* revealed isometric, negative allometric and isometric growth pattern with “b” values of 3.0, 2.895 and 2.964, correspondingly in the New Calabar River. Borges *et al.* (2003) reported that *Liza aurata* in Algarve, South of Portugal exhibited positive allometry with the parameter  $b = 3.154$ . However, Andrea-Soler *et al.* (2006) reported isometric growth for the same species collected from Segura River, South-eastern Spain with  $b = 3.006$ . The coefficient of determination  $R^2$  values reported in this study substantiate the value (0.93) reported by Shahabuddin, (2015) and those (0.60 - 0.98) reported by Christina *et al.* (2016) indicating strong length weight relationships. Variations in b value in this study were attributed to sample size differences of

the species sampled. Regardless of the variation in b values, the significance of length and weight relationships is its usefulness in fish stock assessment where it is easier, faster, and more accurate to measure fish length than weighing it.

The Fulton's Condition Factor (K) mean values for the three mullet species ranged from  $0.89 \pm 0.03$  to  $0.93 \pm 0.03$ . These values generally indicate that the fish species were in the “slimmer” side of the condition factor scale. The variation in K values may possibly be credited to changes in the environment, food accessibility, gonad growth and sex of the fish (Quilang *et al.*, 2007; Zhu *et al.*, 2008; Hussain *et al.*, 2010; Ndome and Eteng, 2010). Soyinka (2010) reported a high K value (1.96-2.01) for *M. cephalus* in Lagos Lagoon while Lawson *et al.* (2010) reported very low K value (0.0079) for *L. falcipinnis* in the Badagry creek. The same factors are attributed to the variations in the regression coefficient b which indicates growth pattern of the fish. Additional features affecting the condition factor of a fish comprise the quantity of fish studied, period and area, breeding, level of stomach fullness, healthy or unhealthy state, modifications of fishing gear and/or mesh size, preservation methods adopted, and variation in the length ranges of the fish sampled (Borges *et al.*, 2003; Andrea-Soler *et al.*, 2006; Verdiell-Cubedo *et al.*, 2006). Environmental parameters such as temperature, trophic level and food availability among others in the sampling sites vary as well which influence over-all fish growth.

## Conclusions

The finding of this research showed that *N. falcipinnis*, *P. grandisquamis* and *M. cephalus* revealed negative allometric growth pattern with “b” values of 2.17, 2.68 and 2.18, individually. The condition factors of the species ranged between 0.57–1.94, 0.51–1.94 and 0.57–1.60 showing the species were in good state of well-being since K value is greater than 1. The findings of this research could possibly be an active means to improving management approaches for Mullet species and this will be of great use in the exploitation and management of mullet fishery in the Sombreior River with critical purpose of managing healthy mullet fishery.

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## Declarations of interest

The authors declare no conflicts of interest.

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