Length-Weight Relationship and Condition Factor of Five Fish Species from River Brass, Niger Delta

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ABSTRACT
This study evaluated the length-weight and condition factor of five species of fish from Brass River. The fish samples were obtained from the river using different fishing gears. The length-weight relationship and condition factor were determined using known biometric methods. Results obtained showed that length-weight regression trend of the five fish species exhibited negative allometric growth with length exponent (b) ranging from 0.971 (Polydactylus quadrifilis) to 1.743 (Mugil cephalus) for dry season and 0.661 (Mugil cephalus) to 1.054 (Micropogonias undulatus) for wet season. The mean condition factor for dry and wet season of fishes from Brass River was 0.58 and 0.65 respectively (Pomadasys Peroteti), 0.65 and 0.70 respectively (Micropogonias undulatus), 0.60 and 0.88 respectively (Mugil cephalus), 0.61 and 0.65 respectively (Polydactylus quadrifilis) and 0.49 and 0.68 respectively (Caranx latus). Hence, seasons affect condition factor of fish from Brass River.

KEY WORDS: Condition factor, Fisheries, Length-weigh relationship.

Introduction
Fish plays an important role in the development of a nation (Ndiaye et al., 2015). According to Atama et al. (2013), inland open water fishery resources play a significant role in the economy, culture, tradition and food habits of the people of a nation. As such information about the biology and ecology of fish are essential to improve fishery management and conservation (Atama et al., 2013). Fish are found in the aquatic ecosystem, which is frequently contaminated by anthropogenic peculiar to the region and to lower extent by natural effect (Izah and Angaye, 2016) including pesticides (Inyang et al., 2016a,b), effluents from oil palm processing (Izah et al., 2016), cassava processing, pharmaceutical and oil and gas industry. Typically the effluents are products of by-products of economic development and technological advancement (Chandel and Tank, 2016).

Environmental degradation has impact on the organism found in such environment. In aquatic ecosystem in could reduce growth rates and will cause a decrease in the average age of the fish (Samat et al., 2008), cause alteration in fish toxicological indices (Inyang et al., 2016a,b). Furthermore, the interactions between environmental changes and growth rates for of organisms are believed to be complex as such well difficult to explain (Samat et al., 2008).

Several indices are used in assessing the condition of a fish with regard to factors that affect their distribution and abundance, alteration in food, spawning and breeding grounds. Some common indices used to assess fish status is the length-weight, length-length relationship, growth factor and condition factor (King, 2007; Mahmood et al., 2012).
These indices require biometrics relationship to show the status of the fish life in a given ecosystem. Understanding the quantitative aspects such as length-weight relationship is vital in studying fish biology (Nehemia et al., 2012). According to Musa et al. (2016), Length in fish science is used to assess biomass from underwater length observations. It is also vital in parameterizing zing yield equations and in estimations of stock size (Musa et al., 2016). In length-weight relationship, fisheries can attain either isometric or allometric, which can either be positive or negative (Nehemia et al., 2012). Isometric growth is associated with no change of body shape as an organism (Nehemia et al., 2012).

Condition factor is essential in understanding the life cycle of fish species and it also contribute to adequate management of the species (Iyabo, 2015). Also condition factor reflect the interactions between biotic and abiotic factors in the physiological condition of the fishes (Lalrinsanga et al., 2012). Condition factor is also a useful index for monitoring of feeding intensity, age, and growth rates in fish (Musa et al., 2016). In fish, the condition factor reflects information on the physiological state of the fish in relation to its welfare (Atama et al., 2013). The condition factor which show the level of well-being of the fish in their habitat is expressed by ‘coefficient of condition’ also known as length – weight factor (Nehemia et al., 2012). When condition factor value is higher it means that the fish has attained a better condition (Nehemia et al., 2012).

Length-weight relationship of a fish is vital fishery management tool (Abowe, 2010; Lalrinsanga et al., 2012; Ndiaye et al., 2015; Mahmood et al., 2012). This is because a change in length and weight tells about the age of this fish, the data can be used to estimate the mortality rate, and assess the sustaining power of the fishery stock (Samat et al., 2008).

The environment of aquaculture is multifaceted; as such management of the water and sediment quality is an important fisheries science. This is because the environment condition affects the fish body condition, growth performance and yield (Nehemia et al., 2012). Hence this study aimed as assessing the weight-length relationship of five commonly consumed fish from River Brass.

**Materials and Methods**

**Study Area**

The Brass River is one of major rivers in Brass River in Brass Local Government Area of Bayelsa State Nigeria. The river stretches from Nembe creek into the Atlantic Ocean and has many adjoining tributaries and creeks. The shore line of Brass River is characterized by soft-dark mud flats, usually exposed during low ride, mangrove swamps with mangrove trees.

**Fish Sampling**

Fish sampling was carried out during the month of March to September where different fish specimens were obtained from fishers using hook, gill nets, bonga driftnets, cast nets and various types of traps and stakes. And the fishes were conveyed in thermos cool boxes to the laboratory on each sampling day. Fish specimens were identified using monograph descriptions, checklists and keys (Boseman, 1963; Reed et. al., 1967; Holden and Reed, 1972; Poll, 1974; Whyte, 1975; Jiri, 1976; Reed & Sydenham, 1978; Otobo, 1981; Alfred Ockiya, 1983; Whitehead, 1984; Loveque et al., 1991). The total length of each fish was measured from the anterior tip of the fish to the caudal fin using the metre rule calibrated in centimeter. Fish weight was obtained after drilling water from the buccal cavity and blot drying with a dry piece of clean hand towel, weighing was done in a table top weighing balance to the nearest grams.

**Length – Weight Relationship**

The relationship between the length (L) and weight (W) of the various fish species were expressed by the exponential equation (Pauly, 1983):

\[ W = aL^b \]  

(Eqn. 1)

Where

- W = Weight of fish in (g)
- L = Total Lenght of fish in (cm)
- a = Constant (intercept)
- b = The Length exponent (Slope)

The “a” and “b” values were obtained from a linear regression of the length and weight of fish. When b is equal to three (3), isometric pattern of growth occurs but when b is not equal to 3, allometric pattern of growth occurs, which may be positive if >3 or negative if <3 (Nehemia et al., 2012). The correlation (r) that is the degree of association between the length and weight was computed from the linear regression analysis.
Condition Factor
The condition factor (K) of the experimental fish was estimated from the relationship:

\[ K = 100W/L^3 \]  
(Eqn. 2)

Where:
- \( W \) = Weight of Fish (g)
- \( L \) = Length of Fish (cm)

Analysis of Experimental Data
The following statistical tools were used to analyzed the data obtained; Regression and Correlation Analysis (RECA) for linear regression of length and weight of fish Microsoft Excel (2010) for computation of means and standard deviation; statistical package for social sciences (SPSS) and FISAT (Gayando and Pauly, 1997) for description statistics, length-weight relationship and condition factor of fish.

Results and Discussion
The length-weight relationship of various fish species in Brass River for both Dry and Wet Season is presented in Table 1. The length-weight relationship was determined following log-log transformation. The length-weight regression equation, correlation coefficient (r), coefficient of determination \( (r^2) \) and significance of correlation for various fish species for both Dry and Wet Seasons in Brass River are shown in Table 2. The regression trend indicated that in Brass River, all fish species exhibited negative allometric weight growth with length exponent \( (b) \) ranging from 0.971 \( (Polydactylus quadrifilis) \) to 1.743 \( (Mugil cephalus) \) for Dry season, and the length exponent \( "b" \) for Wet season ranges from 0.661 for \( (Mugil cephalus) \) to 1.054 for \( (Micropogonias undulatus) \). High correlation coefficient \( "b" \) value has also been reported by different authors in various fish species from different water bodies (Ginah, 2007; Hart and Abowei, 2007).

The mean condition factor for dry and wet season of some fishes from Brass river was 0.58 and 0.65 respectively \( (Pomadasys Peroteti) \), 0.65 and 0.70 respectively \( (Micropogonias undulatus) \), 0.60 and 0.88 respectively \( (Mugil cephalus) \), 0.61 and 0.65 respectively \( (Polydactylus quadrifilis) \) and 0.49 and 0.68 respectively \( (Caranx latus) \) (Table 3). The condition factor reported in this study is lower than the report of other authors in different fish species.

Iyabo (2015) reported overall mean condition factor of 0.65 and 0.70 respectively. (2008), (2013), (2013) reported his study, 0.61 and 0.65 respectively from Brass River, all fish species exhibited negative allometric weight growth with length exponent \( (b) \) ranging from 0.971 \( (Polydactylus quadrifilis) \) to 1.743 \( (Mugil cephalus) \) for Dry season, and the length exponent \( "b" \) for Wet season ranges from 0.661 for \( (Mugil cephalus) \) to 1.054 for \( (Micropogonias undulatus) \). High correlation coefficient \( "b" \) value has also been reported by different authors in various fish species from different water bodies (Ginah, 2007; Hart and Abowei, 2007).

The mean condition factor for dry and wet season of some fishes from Brass river was 0.58 and 0.65 respectively \( (Pomadasys Peroteti) \), 0.65 and 0.70 respectively \( (Micropogonias undulatus) \), 0.60 and 0.88 respectively \( (Mugil cephalus) \), 0.61 and 0.65 respectively \( (Polydactylus quadrifilis) \) and 0.49 and 0.68 respectively \( (Caranx latus) \) (Table 3). The condition factor reported in this study is lower than the report of other authors in different fish species.

The condition factor reported in this study is lower than the report of other authors in different fish species including Polydactylus quadrifilis (1.75), Tilapia zillii (2.47), Hemichromis fasciatus (1.79), Tilapia mariae (1.76), and Oreochromis niloticus (1.93) inhabiting River Anambra. But higher than the condition factor of 0.043 – 0.081 for male and 0.0021 – 0.119 for female Oreochromis niloticus from Shirmu lake, Hungu, Kano state, Nigeria.

The correlation factor in this study is close to 0.930 reported by Iyabo (2015). High positive correlation coefficient and significant \( (p <0.05) \) suggests that the species lengths and weights were growing proportionally (Iyabo, 2015). The fish samples showed negative allometric. The trend have been reported in fish samples from different surface water in Nigeria including river Anambra (Atama et al., 2013), Nkoro River (Abowei, 2010), river Igbedi (Seiyaboh et al., 2013).

The variation in condition factor of fisheries in different location among different species could be attributed to the sediment and water quality. The quality of a river depends on the drainage structure and are affected by runoff resulted from precipitation and wastes discharged into the water especially in communities aligning surface water in the Niger Delta. Thus, variation in river quality (water and sediment) could affect migration and feeding pattern in fisheries. Abowei (2010) reported that variation in condition factor of a fish between two or more location of same species could be associated to differences in fishing and industrial activities in the different rivers. According to Atama et al. (2013), temporal variations in condition factor recorded this study was influenced by many biotic and abiotic factors such as phytoplankton abundance, predation, water temperature and dissolve oxygen concentrations among others which may not favour the survival of all the species in the ecosystem. Furthermore, Samat et al. (2008) reported that the size attained by the individual fish may also vary because of variations in food supply, and these in turn may reflect variations in climatic parameters and in the supply of nutrients or in the degree of competition for food.
### Table 1: Length-Weight Relationship of Various Fish Species in Brass River

<table>
<thead>
<tr>
<th>Species</th>
<th>Season</th>
<th>Tot.</th>
<th>Range</th>
<th>Min.</th>
<th>Max.</th>
<th>Mean±S.E</th>
<th>Range</th>
<th>Min.</th>
<th>Max.</th>
<th>Mean±S.E</th>
<th>'a'</th>
<th>b</th>
<th>r</th>
<th>r²</th>
<th>Growth Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pomadasys Peroteti</td>
<td>Dry</td>
<td>100</td>
<td>21.00</td>
<td>11.00</td>
<td>32.00</td>
<td>17.19±0.49</td>
<td>32.00</td>
<td>12.00</td>
<td>44.00</td>
<td>24.24±0.74</td>
<td>0.146</td>
<td>0.999</td>
<td>0.874</td>
<td>0.764</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>100</td>
<td>22.00</td>
<td>10.00</td>
<td>32.00</td>
<td>17.54±0.53</td>
<td>32.00</td>
<td>13.00</td>
<td>45.00</td>
<td>27.40±0.89</td>
<td>0.186</td>
<td>1.002</td>
<td>0.871</td>
<td>0.759</td>
<td>NA</td>
</tr>
<tr>
<td>Micropogonias undulatus</td>
<td>Dry</td>
<td>100</td>
<td>10.50</td>
<td>10.00</td>
<td>20.50</td>
<td>15.28±0.26</td>
<td>18.00</td>
<td>12.00</td>
<td>30.00</td>
<td>20.84±0.39</td>
<td>0.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>100</td>
<td>15.00</td>
<td>10.00</td>
<td>25.00</td>
<td>16.38±0.46</td>
<td>27.00</td>
<td>15.00</td>
<td>42.00</td>
<td>24.92±0.82</td>
<td>0.111</td>
<td>1.054</td>
<td>0.895</td>
<td>0.800</td>
<td>NA</td>
</tr>
<tr>
<td>Mugil cephalus</td>
<td>Dry</td>
<td>100</td>
<td>10.00</td>
<td>10.00</td>
<td>20.00</td>
<td>14.96±0.29</td>
<td>26.00</td>
<td>6.00</td>
<td>32.00</td>
<td>19.12±0.62</td>
<td>0.779</td>
<td>1.743</td>
<td>0.926</td>
<td>0.858</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>100</td>
<td>17.00</td>
<td>10.00</td>
<td>27.00</td>
<td>16.06±0.41</td>
<td>22.00</td>
<td>20.00</td>
<td>42.00</td>
<td>27.88±0.59</td>
<td>0.647</td>
<td>0.661</td>
<td>0.799</td>
<td>0.638</td>
<td>NA</td>
</tr>
<tr>
<td>Polydactylus quadrifilis</td>
<td>Dry</td>
<td>100</td>
<td>10.30</td>
<td>10.00</td>
<td>20.30</td>
<td>15.71±0.33</td>
<td>19.00</td>
<td>11.00</td>
<td>30.00</td>
<td>20.16±0.53</td>
<td>0.138</td>
<td>0.971</td>
<td>0.834</td>
<td>0.696</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>100</td>
<td>14.00</td>
<td>11.00</td>
<td>25.00</td>
<td>17.16±0.32</td>
<td>20.00</td>
<td>20.00</td>
<td>40.00</td>
<td>29.58±0.62</td>
<td>0.276</td>
<td>0.966</td>
<td>0.848</td>
<td>0.719</td>
<td>NA</td>
</tr>
<tr>
<td>Caranx latus</td>
<td>Dry</td>
<td>100</td>
<td>18.00</td>
<td>10.00</td>
<td>28.00</td>
<td>16.81±0.41</td>
<td>27.00</td>
<td>7.00</td>
<td>34.00</td>
<td>20.24±0.60</td>
<td>0.118</td>
<td>1.157</td>
<td>0.858</td>
<td>0.735</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>100</td>
<td>15.00</td>
<td>10.00</td>
<td>25.00</td>
<td>17.10±0.40</td>
<td>27.00</td>
<td>18.00</td>
<td>45.00</td>
<td>28.04±0.66</td>
<td>0.422</td>
<td>0.830</td>
<td>0.825</td>
<td>0.681</td>
<td>NA</td>
</tr>
</tbody>
</table>
### Table 2: Length – Weight Regression Equation, Correlation Coefficient (r), Coefficient of Determination ($r^2$) and Significance of Correlation for Various Fish Species in Brass River

<table>
<thead>
<tr>
<th>Fish Species</th>
<th>Season</th>
<th>Regression Equation</th>
<th>$r$</th>
<th>$r^2$</th>
<th>Significance of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pomadasys peroteti</td>
<td>Dry</td>
<td>LogW=0.146+0.999LogL</td>
<td>0.874</td>
<td>0.764</td>
<td>$P&lt;0.05; t=17.80$, df=99</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>LogW=0.186+1.002LogL</td>
<td>0.871</td>
<td>0.759</td>
<td>$P&lt;0.05; t=17.56$, df=99</td>
</tr>
<tr>
<td>Micropogonias undulates</td>
<td>Dry</td>
<td>LogW=0.000+1.000LogL</td>
<td>1.000</td>
<td>1.000</td>
<td>$P&lt;0.05; t=0.00$, df=99</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>LogW=0.111+1.054LogL</td>
<td>0.895</td>
<td>0.800</td>
<td>$P&lt;0.05; t=19.82$, df=99</td>
</tr>
<tr>
<td>Mugil cephalus</td>
<td>Dry</td>
<td>LogW=0.0.779+1.743LogL</td>
<td>0.926</td>
<td>0.858</td>
<td>$P&lt;0.05; t=24.35$, df=99</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>LogW=0.647+0.661LogL</td>
<td>0.799</td>
<td>0.638</td>
<td>$P&lt;0.05; t=13.14$, df=99</td>
</tr>
<tr>
<td>Polydactylus quadrifilis</td>
<td>Dry</td>
<td>LogW=0.138+0.971LogL</td>
<td>0.834</td>
<td>0.696</td>
<td>$P&lt;0.05; t=14.91$, df=99</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>LogW=0.276+0.966LogL</td>
<td>0.848</td>
<td>0.719</td>
<td>$P&lt;0.05; t=15.85$, df=99</td>
</tr>
<tr>
<td>Caranx latus</td>
<td>Dry</td>
<td>LogW=0.118+1.157LogL</td>
<td>0.858</td>
<td>0.735</td>
<td>$P&lt;0.05; t=18.50$, df=99</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>LogW=0.422+0.830LogL</td>
<td>0.825</td>
<td>0.681</td>
<td>$P&lt;0.05; t=1447$, df=99</td>
</tr>
</tbody>
</table>

### Table 3: Condition Factor of Various Fish Species in Brass River

<table>
<thead>
<tr>
<th>Species</th>
<th>Season</th>
<th>Total No</th>
<th>Range</th>
<th>Min.</th>
<th>Max.</th>
<th>Mean±S.E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pomadasys Peroteti</td>
<td>Dry</td>
<td>100</td>
<td>1.04</td>
<td>0.13</td>
<td>1.18</td>
<td>0.58±0.03</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>100</td>
<td>1.59</td>
<td>0.14</td>
<td>1.73</td>
<td>0.65±0.04</td>
</tr>
<tr>
<td>Micropogonias undulates</td>
<td>Dry</td>
<td>100</td>
<td>1.16</td>
<td>0.34</td>
<td>1.50</td>
<td>0.65±0.03</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>100</td>
<td>1.50</td>
<td>0.20</td>
<td>1.70</td>
<td>0.70±0.04</td>
</tr>
<tr>
<td>Mugil cephalus</td>
<td>Dry</td>
<td>100</td>
<td>0.82</td>
<td>0.38</td>
<td>1.20</td>
<td>0.60±0.02</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>100</td>
<td>1.96</td>
<td>0.21</td>
<td>2.16</td>
<td>0.88±0.06</td>
</tr>
<tr>
<td>Polydactylus quadrifilis</td>
<td>Dry</td>
<td>100</td>
<td>1.24</td>
<td>0.26</td>
<td>1.50</td>
<td>0.61±0.03</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>100</td>
<td>1.28</td>
<td>0.22</td>
<td>1.50</td>
<td>0.65±0.03</td>
</tr>
<tr>
<td>Caranx latus</td>
<td>Dry</td>
<td>100</td>
<td>0.70</td>
<td>0.15</td>
<td>0.85</td>
<td>0.49±0.02</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>100</td>
<td>1.78</td>
<td>0.22</td>
<td>2.00</td>
<td>0.68±0.04</td>
</tr>
</tbody>
</table>

### Conclusion

This study investigated the length–weight relationship and condition factor of five fish species from Brass river, Niger Delta, Nigeria. The study found that Pomadasys peroteti, Micropogonias undulates, Mugil cephalus, Polydactylus quadrifilis and Caranx latus have negative allometric pattern of growth. The condition factor were in the ranged of 0.49 – 0.65 and 0.65 – 0.88 for dry and wet season respectively. As such season could affect the condition factor and weight-length relationship of a fish.

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