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Length-weight relationship and condition factor of five fin fishes from Luubara Creek, Niger Delta, Nigeria

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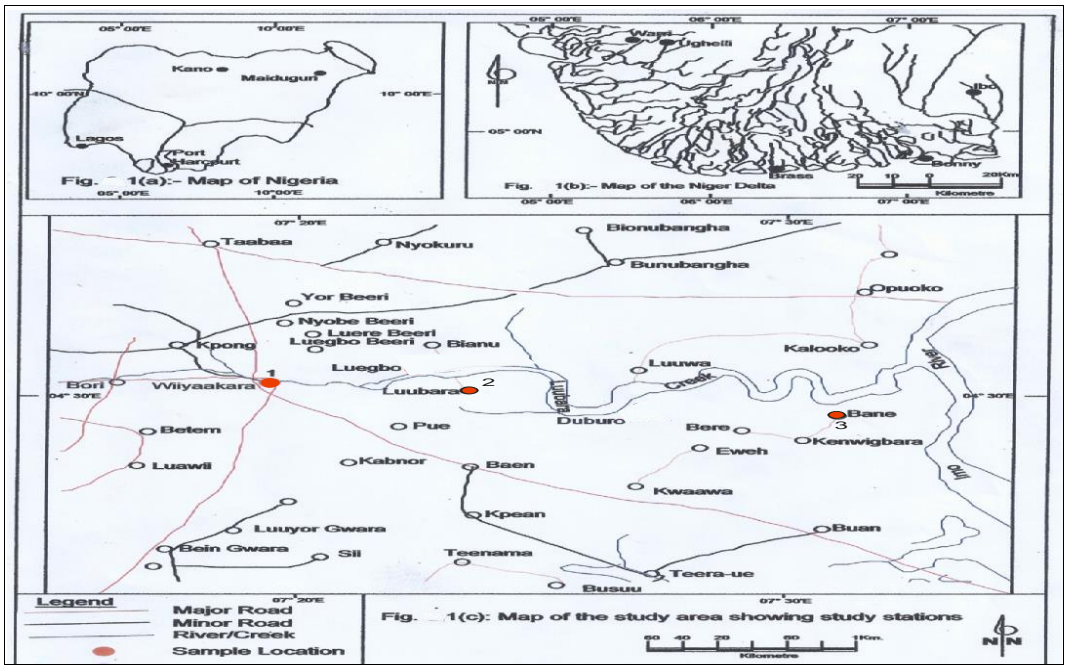
Abstract
The length-weight relationship and condition factor of some finfish species from Luubara creek: *Chrysichthys nigrodigitutus Ethmalosa fimbriata, Pseudotolithus elongatus Mugil cephalus and Pellonula leonensis* were studied for a period of one year. A total of 706 fish specimen of *C. nigrodigitatus* (97) *P. elongatus* (261), *M.cephalus* (71), *E. fimbriata* (193) and *P.leoneengis* (64) were measured for total length and weight. The fish samples which were caught during the study period using gillnet, castnet, trap (kara and metal drum traps) and longline. The length-weight regression statistics was obtained using FISAT (FAO-ICLARM stock assessment 7001s). The growth coefficient obtained for the five species ranged from 0.1307 to 2.3995 for *C. nigrodigitatus*, 0.0386 to 2.3985 for *E. fimbriata*, 0.428 to 3.6449 for *M. cephalus* 0.0730 to 3.0308 for *P.leoneensis*. Three species *C. nigrodigitatus, E. fimbriata and P. elongatus* have b-values of 2.3995, 2.3985 and 2.9908 respectively meaning that the values are less than 3(b<3): implying that they are negatively allometric in growth. *M. cephalus* had a b-value of 3.6449 (b>3) which indicates positive allometric growth pattern. *P. leonensis* had a b-value of 3.0308 which is equal to 3 (b=3) and indicating an isometric growth pattern. The condition factor (K) value ranges from 0.101-2.261 (mean K-0.7261) for *C. nigrodigitatus*, 0.721-0.949 (mean k=0.8726) for *E. fimbriata,* 0.337-0.923 (mean k=0.3925) *for M. cephalus,* 0.7-0.912 (mean K=0.7377) for *P. Elongates* and 0.504-0.990 (mean k = 0.8233 for *P. leoneensis.* The condition factor for four of the species were in suitable range that guarantee good condition.

Keywords: Fin-fish, length-weight relationship, condition factor, luubara

Introduction
Fish is a high-quality food which contains vital nutrients such as protein, fat vitamin and mineral and individual that consumed fishes derived a lot of health benefit (Dan-Kishlya, 2013; Bolarinwa, 2013, Balogun, 2015; Ekpo and Effang, 2018; Salaudeen *et al.,* 2021) [12, 13, 15, 21, 38]. Fish is important and make significant contribution to the health and well-being of greater portion of the population of the people of Niger delta and Nigerians at large (Ahmed and Krishen, 2007; Razo *et al*.,2014) [8]. Fish in general possess omega 3 fatty, acids that help to prevent cardiovascular disease, hypertension and arteriosclerosis (Gaskin, 2008; Adewunwi and Fagberio, 2009). Length-weight relationship is a vital fisheries management tool mostly use in estimating the average weight of fish at a given length group to predict the growth pattern of fish (Oribhabor *et al*., 2009; Ekpo, 2020; Kefas *et al*., 2020) [20, 27]. Study of the relationship helps in determining the age and year class of fin fish and shell fish and in assessing the relative well-being of a fish population (Abowei, 2006; oribhbalor *et al*., 2011) [4].
The condition factor explains the welfare of fish in their habitat or compares the well-being of fish (Gomfero and Brag 2009). The condition factor is based on the assumption heavier fish of a given length are in better condition than less weighty fish (Abowei and Hart, 2008; Ogamba *et al*.,2014, Aba and Agarin, 2016; Agorua *et al*., 2021) [3, 7, 30]. The condition factor is a measure of different ecological and biological factors such as fitness, gonad development and suitability of the aquatic environment with regard to feed condition (Abowei, 2009) [2]. This study is therefore, making an attempt to estimate a first class information the well-being *of C.nigrodigitatus, E. fimbriata, M.cephalus, P. elongatus* and *P.leoneensis* in Luubara Creek to given crucial baseline data on the well-being of these fishes of the creek.

Material and Methods.
The study was carried out in Luubara creek in Khana Local Government Area of Rivers State of Nigeria for a period of one year from September, 2018 to August, 2019 (Figure1). The creek is found between longitudes $7^{0}15^{/\!/}$E —$7^{0}32^{/\!/}$E and latitudes 4°321-4°37$^{/\!/}$N in the eastern part of the Niger Delta (Deekae, *et al*., 2010a, 2010b; Gbarakoro *et al*., 2014) [17, 18, 25]. The creek is constituting of two distinct parts which include brackish water and freshwater. The brackish water is found between Bane and Kalooko while the freshwater stretch extensively from Bane to Bori. In the fresh water zone, the vegetation consists of floating plants which include: duck weed, wolfia, and rooted plants like Raffia palms, Palm trees and Coconut trees etc. Also, there is *Nympea loties, Criniem natans* etc. At low tide some places show peak banks and mud banks with plant vegetation. The brackish water area has the normal mangrove vegetation comprising of trees made of *Rhizophora racemosa, Avicennia germinans Leguncularia racemosa* (Stern-PIrlot and Wolff, 2006;Deekae, 2009; Deekae *et al., 2010;* Zabbey and Malaquias, 2013) [16, 17, 18, 40, 41].

Collection of fish samples
Samples of *C.nigrodigitatus, M.cephalus E. fimbriata, P. leoneensis and P. elongatus*were collected twice a month across the major settlement Wiiyaakara, Luubara and Bane (Fig.1) for one year from September, 2018 to August, 2019. The length and weight of fishes was taken and recorded to the nearest centimetre (cm) and weight in grams (g). the total length (measured from the anterior part of the snout to the tip of the caudal fin) was taken using a measuring board. The weight of the fishes was taken using a sensitive weighing balance (S.F-400 model).



Source: Deekae, 2009 [16]; Deekae *et al*. 2020

Fig 1: Map of Luubara creek showing study stations

Collection of fish samples

Samples of *C.nigrodigitatus, M.cephalus E. fimbriata, P. leoneensis and P. elongatus*were collected twice a month across the major settlement Wiiyaakara, Luubara and Bane (Fig.1) for one year from September, 2018 to August, 2019. The length and weight of fishes was taken and recorded to the nearest centimetre (cm) and weight in grams (g). the total length (measured from the anterior part of the snout to the tip of the caudal fin) was taken using a measuring board. The weight of the fishes was taken using a sensitive weighing balance (S.F-400 model).

Data analysis

The length weight relationship was determine using the equation; linear regression (Pauly, 1984) [35]. Linear regression which was incorporated into FISAT (FAO-ICLARM stock assessment tool).

$Log_{10}W=a+blog_{10}L$

Where

W= total weight total wet weight of fish

L = total length of fish 9cm

A = constant intercept

B = the length exponent (slope)

Log_{10} w =y

$Log_{10}L$= x

The regression statistics was estimated by software known as FISAT

Fulton condition factor (K)

The condition factor of the five fish species was calculated using the formula according to Hile (1936)

$$K \frac{W}{L_3} x100$$

Where

K = Fulton condition factor

W = wet weight of fish

L = total length of fish

Results

The components of the length-weight relationship of *Chrysichthys nigrodigitatus, Ethmalosa finbriata, Mugil cephalus, Pseudotolithus elongatus* and *Pellonula leoneensis* observed in Luubara creek is given in (Table 1).The value intercept (a) slope (b) correlation coefficient (r) and coefficient of determination (r^2) for each of the five species are shown in Table 1 below. Three species *C. nigrodigitatus, E. fimbriata and P. elongatus* have b-values of 2.3995, 2.3985 and 2.9908 respectively which means that the values are less than 3(b<3); implying that they are negatively allometric in growth.When the b-value is less than 3, it means that the fish will be slender in shape.

M. cephalus had a b-value of 3.6449 (b>3) which indicates positive allometric. This means that the fish (*M. cephalus*) is stouter or fatter. *P. leonensis* had a b-value of 3.0308 which is equal to 3 (b=3) and indicating an isometric growth pattern. When the growth pattern is isometric it then means that there was proportional increase or growth in length and weight of the fish (*P. leoneensis*).

The monthly condition factor,(k) for the 706 fishes sampled for the five species were calculated given in Table 2. *C. Nigrodigitatus* have the highest condition factor in the month of August (2.261) the least in the month of September (0.101), *E. fimbriata* have the highest in the month of July (0.949 and the least in the month of September (0.721), *M. cephalus* have the highest in June (0.923) and the least in November (0.054),*P. elongatus* have the highest in the month of September (0.912) and the least in January (0.504)and *P. leonensis* have the highest condition factor in the month of September (1.085) and the least in November (0.516).

Table 1: Length –weight relationship of *C.nigrodigitatus, E.fimbriata, M.cephalus, P. Elongates and P.leonensis from* Luubara creek

Species	a	b	r	r^2
C. nigrodigitatus	1.6139	2.3995	0.6736	0.4538
E. fimbriata	0.2496	2.3985	0.7405	0.5483
M. cephalus	3.4061	3.6449	0.5977	0.3572
P. elongatus	2.1459	2.9008	0.9562	0.9142
P. leonensis	2.1353	3.0308	0.9139	0.8352

Table 2: Condition factor of C.*nigrodigitatus*, E.fimbriata, M.cephalus, P. elongatus and P.leonensis from creek Luubara

Month	*C.nigrodigitatus* Mean SD	*E. fimbriata* Mean SD	*M.cephalus* Mean SD	*P. elongatus* Mean SD	*P. leonensis* Mean SD
September 2018	0.101 ± 0.026	0.721 ± 0.255	0.337 ± 0.454	0.912 ± 0.554	1.085 ± 0.378
October	0.284 ± 0.103	0.811 ± 0.074	0.509 ± 0.092	0.721 ± 0.11	0.985 ± 0.875
November	0.718 ± 0.235	0.869 ± 0.035	0.054 ± 0.013	0.504 ± 0.93	0.516 ± 0.173
December	0.905 ± 0.13	0.921 ± 0.192	387 ± 0.366	0.673 ± 0.136	0.83 ± 0.073
January 2019	0.633 ± 0.165	0.871 ± 0.051	0.067 ± 0.062	0.504 ± 0.017	0.864 ± 0.28
February	0.472 ± 0.151	0.874 ± 0.045	0.667 ± 0.0354	0.673 ± 0.136	0.868 ± 0.093
March	1.055 ± 0.171	0.928 ± 0.054	0.055 ± 0.03	0.693 ± 0.085	0.673 ± 0.085
April	0.127 ± 0.008	0.888 ± 0.105	0.050 ± 0.009	0.7 ± 0.058	0.747 ± 0.07
May	0.096 ± 0.032	0.866 ± 0.097	0.621 ± 0.443	0.699 ± 0.165	0.89 ± 0.086
June	0.501 ± 0.019	0.848 ± 0.227	0.923 ± 0.145	0.865 ± 0.101	0.681 ± 0.154
July	1.561 ± 0.588	0.949 ± 0.721	0.844 ± 0.152	0.711 ± 0.933	0.999 ± 0.534
August	2.261 ± 0.571	0.925 ± 0.502	0.797 ± 0.0003	0.908 ± 0.196	0.762 ± 0.353
Mean	0.7261 ± 0.749	0.8726 ± 0.1896	0.3925 ± 0.1510	0.7377 ± 0.1584	0.8233 ± 0.2631

Discussion

The study revealed three different "b" values of negative allometric growth, positive allometric growth and isometric growth pattern. Khairnizam and Norma-Rahsid (2002) postulated that when the b-value of fish is less than 3, the fish has a negative allometric growth pattern and when it is greater than 3, it has a positive allometric growth while when it is equal to 3, it has isometric growth pattern. In this study, *C. nigrodigitatus*, *E. fimbriata*and P. *enlongatus* all have negative allometric growth. This is in agreement with the findings made by oribhobor *et al.* (2007) for *T. guineensis* from Buguma creek in Azaria-Toru Local Government Area of Rivers State and Chucker and Deekae (2004) who reported b-value of 2.73 for *periphthamus barbarous* from new Calabar River all from Niger Delta, Francis and Elenwu, (2012) [23] and Abu and Agarin (2016) [5] who both also reported negative allometric from Ne Calabar River and Omotaya *et al*. (2018) [33] and Omatsuli *et al*. (2021) [32]. Abu and Agarin (2016) [5] stated that when the growth pattern is negative allometric it means that such fish species does not grow equally in length and body weight. That is to say that the fish grow faster in weight than in body.

M. cephalus had a b- value greater than 3 (positive allometric) and *P. leonensis* had a b- value equal to 3(isometric growth). Similar observations were made by Abowel *et al*. (2009) in Nun River, Niger Delta. The differences in b-values of fish species witness in this study and other documented studies could be linked or associated with change in habitat, sex, stage of maturity time of the year, stomach content, food abundance, fishing pressure, environmental degradation, habitat and diet of the species (Abowei, 2006 and Abu and Agarin, 2016) [4, 5]. Froese (2006) [24] reiterated that variation in b- values could be associated with a combination of the difference in the number of species, geographical location, size of species, and season, while Abu and Agarin (2016) [5] cited Ricker (1975) disclosed thatlength-weight relationship of fish is influenced by factors like: population, variability, sampling (sample size, length distribution in sample, and type of length measurement) and estimation method and nutritional condition.

Four species *C. nigrodigitatus, E. fimbriata, P. elongatus and P. leonensis* from the sampling stations had condition factors approximately one exception of *M. cephalus* that showed a mean value less than one. These four species fall within the normal range recommended by Ujania (2012) and Geto *et al*. (2017) [26] who pointed out that when the condition factor is greater than one or equal to one then the fish is in good condition.This present study of k-values is similar to the report ofAgude and Ikulala (2007) in Cichlids from Elelyell Lake, south West Nigeria and Abowei *et al.* (2009) [2], Anene (2005) [9] and Abowei (2009) [2] on Nun River, Niger Delta) all in Niger Delta and the report from Agorua *et al*. (2021) [7]. They foregoing researchers explained that the condition factor of fish in any aquatic environment can basically be influenced by the type of food consumed age, sex and season. The k- value of *M. cephalus* fall below the recommended value.

Conclusion

The variation in the condition factor and length-weight relationship of *P. elongatus, P. leonensis, M. cephalus, E. fimbriata and C. nigrodigitatus* may be as result of the differences in the stage of maturity, sex, state of the stomach fullness, difference in stock population and seasonal

variation. TheFulton condition factor revealed the well-being of the five fish species of the creek. The Luubara Creek appear to be well suitable for *E. fimbriata, P. leonensis, P. elongatus* and *C. nigrodigitatus* except *M. cephalus* that the k-value was less than 1.0. the higher the k-value the better condition of fish. The k-values of the speciesstudy in the creek was approximately one. Therefore, the condition of fish in Niger Delta are gradually deteriorating due to crude oil pollution, so therefore, measures should be taken in monitoring the water bodies so as to reduce fish mortality and improve the fishery.

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