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Some Growth Characteristics of *Pellonula leonensis* from Luubara Creek, Niger Delta, Nigeria

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ABSTRACT: The Growth, mortality, population and yield parameters of the Clupeid *Pellonula leonensis* were studied based on the data collected from artisanal fishers during throughout 2020 along Luubara Creek, Niger Delta. The fish were caught using the Kara cane trap. Total specimen lengths ranged from 4.50-14.50cm and weighing from 0.50-50.00g. The growth pattern of *Pellonula leonensis* was estimated K (2.300) $L\infty$ (14. 22cm), t_o (2.140) and Ø (2.72). The value of K and Ø showed that *Pellonula leonensis* from the creek grows fast and regularly. The evaluation of mortality characteristics of *Pellonula leonensis* for twelve months showed that total mortality (Z) 7.08yr^{-1}, natural mortality (M) 3.97yr^{-1} and fishing mortality (F) 3.11yr^{-1} from the value of M and F, it is crystal clear that M is higher than F. Exploitation (E) of 0.439 obtained in the study showed that the species is under exploited as E was lower than 0.5. The ratio of length at first capture to asymptotic length (Lc/ $L\infty$) estimated showed that *Pellonula leonensis* with Lc (0.34cm) was caught at a small size. This scenario will lead to growth overfishing if adequate management and regulations are not put in place.

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KEYWORDS: *Pellunola leonensis*, Luubara Creek, exploitation rate, Mortality, growth characteristics.

INTRODUCTION

Fish belonging to the family Clupeidae are low-value small fish commonly consumed in Nigeria (Fakoya *et al*., 2019) and they occurr in a wide range of aquatic environments, constituting an affordable and important source of food and nutrition in many inland and coastal fishing communities of Nigeria (Fakoya *et al*., 2019). They are dried and exported to neighbouring countries such as Ghana (Fakoya *et al*., 2019). In the Niger Delta, clupeids including Pellonula are of high commercial importance in the Nigeria inshore waters (Ikomi 1993; Kunzel *et al*., 1985; Okon *et al.*, 2020) where they constitute important catch component of artisanal fisher folks in the Niger Delta (Okon *et al.*, 2020).

The fresh and brackish waters of tropical Africa boasts of about 20 species of clupeids and one of them is *Pellonula leonensis* (Nwafili and Eloho, 2023). *Pellonula leonensis* is a small-toothed, (Adeyemi-Ale *et al*., 2021; Nwafili and Eloho, 2023) herring-like fish belonging to the family Clupidae, and distributed in West African rivers and man-made lakes (Adeyemi-Ale *et al*., 2021). They are pelagic (Froese and Pauly, 2019). The Atlantic coastal waters of the Gulf of Guinea from Senegal to Zaire support a considerable stock of this shoaling pelagic-clupeid, *P. leonensis* (Okon *et al*., 2020) with wide spread distribution in both remote Sahelian and coastal basins (Gourene and Teugels, 2003). *P. leonensis* is an important in a riverine fish which also inhabit fast-flowing, calm, muddy habitats, lakes and creeks (Lowe-McConnell, 1987), near the shore (Nwafili and Eloho, 2023).

Considering the economic importance of small clupeids in terms of providing employment and rich protein source for rural coastal and riverine communities, and as affordable source of bait and ingredient for livestock feed manufacturing, it is surprising that only few workers have studied the biology of *P. leonensis* (Okon *et al*., 2020). Data on the biology of *Pellonula leonensis* are scarce in the rivers and coastal areas of the Niger Delta Region. However, Ikomi (1993), Nwafili and Eloho (2023), and Kingdom and Allison, (2009) have reported on aspects of the species' biology in the Niger Delta Region. Therefore, the objective of this study is to provide data on the growth and exploitation parameters of *P. leonensis* for its management and conservation in Luubara Creek.

MATERIALS AND METHODS

Study Area

The study was carried out in Luubara creek in Khana Local Government Area of Rivers State, Nigeria for a period of one year from September, 2018 to August, 2019 (Fig. 1). The creek is located 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, 2009; Gbarakoro *et al*., 2014).The Luubara creek has climatic rotation of wet and dry seasons. The wet season has a total annual rainfall of between 160mm and 298mm. while the dry season has an occasional precipitation in the month of November (Gbarakoro *et al*., 2014). This phenomenon shows that the area is in the humid tropical zone (Gbarakoro *et al*., 2014). More descriptions of the study area were given by (Gbarakoro *et al*., 2014)

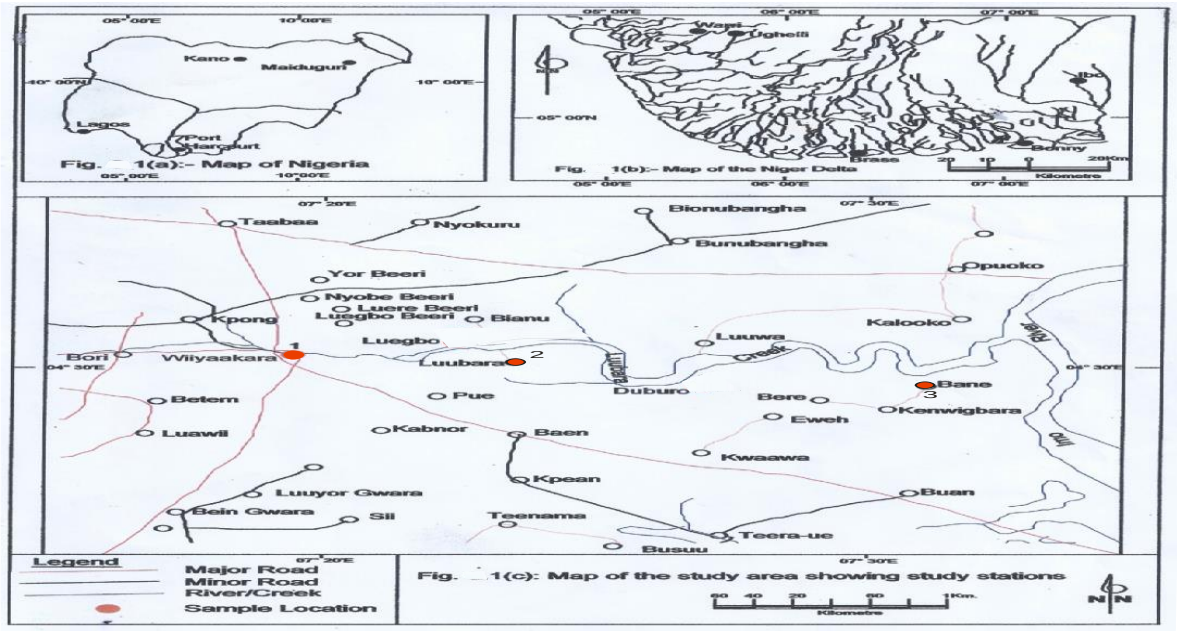

Fig.1: **Map of Luubara creek showing study stations.**
Source: Deekae, 2009

Collection of Samples

P. leonensis were collected twice a month from three stations (Wiiyaakara, Bane and Luubara; Fig. 1) by assessing the artisanal fisher folks catches from traditional fishing operations using Kara cane trap (Plate 1) for the period covering 2020. Specimens were measured to the nearest 0.1 cm total length and weighed to the nearest 0.1 g total weigh. Total length (cm) of *Pellonula leonensis* was taken by measuring from the tip of the mouth to the end of the caudal fin using measuring board and the weight (g) was taken by placing the on an electronic kitchen scale using model (S.F-400 model).

Fig. 2: Kara trap used in fishing *Pellonula leonensis* in Luubara creek

Data analysis

Growth Parameters

The annual growth parameters (L_∞, K and t_0) of *Pellonula leonensis* was determined using Von-Bertalanffy's (Pauly and Munro, 1984) growth Function (VBGF). The growth parameters were estimated from the equation:

$$\mathbf{L_t = L_\infty\ (1\text{-}e^{-k\ (t\text{-}to)})}.$$

The growth performance index (Ø) of the *Pellonula leonensis* was estimated from the parameters of the Von Bertallanffy's Growth Model (VBGM) (Pauly and Munro, 1984) and incorporated into the scan of k-value routine as:

$$\mathbf{Ø = Log_{10}\,K + 2\ Log_{10}\,L_\infty}$$

The total mortality coefficient (z) was estimated by the length-converted catch curve procedure of ELEFAN II (Gayanilio *et al.*, 2002)). In this analysis the percentage of samples in length groups were pooled to simulate a steady- state population. The data for the catch curve was obtained by pooling all the monthly length-frequencies. The principle applied in the catch curve analysis involved the use of the natural logarithm of the number of fish caught in each age group (N) plotted against their corresponding relative age (t) (Pauly, 1985). The relative ages were calculated from L_∞ and K values of the VBGF. The total mortality (Z) was obtained from the slope (b) of the descending limb of the catch curve.

Exploitation parameters: The instantaneous natural mortality (M) was estimated by Pauly's (1983) empirical formula: $\mathbf{Log10M = O.0066 - 0.279Log_{10}L_\infty + 0.654Log_{10}K + 0.4634Log_{10}T.}$

L and K were taken from VBGF while T was the mean environmental temperature estimated as 29.5°C for the study area. Fishing mortality (F) was calculated from F= Z-M. The state of exploitation of the fish species were calculated from the ratio of E/Z.

The relative yield-per-recruitment (Y/R) and relative biomass-per-recruitment of *P. leonensis* was determined by the knife-edge recruitment approach which is identified by Beverton and Holt (1959) as yield per-recruit model and incorporated into the recruitment routine in FISAT (Pauly. 1983).

Data collected was analyzed through the use of FAO- ICLARM Stock Assessment Tools (FISAT11) 2007 software.

RESULTS

The TL of *P. leonensis* was found to range from 4.50-14.50cm and the weight range was 0.50 -50.00g. The nature of the trap and Covid-19 hindered fishing operations, resulting in capture of limited number of individuals (120).

Growth parameters

The results of estimated growth characteristics of *P. lenensis* showed the asymptotic length ($L\infty$) was 14.22 cm with a growth rate (K) of 0.48 per year and the growth performance index (Φ) was 2.72. The theoretical age for which the fish has zero length (t_0) was estimated as 0.35 year. Fig. 1 and 2 showed the K-scan and length-converted catch curve of *Pellonula leonensis* respectively. The von Bertalanffy growth model for *P. leonensis* in Luubara Creek is described as Lt = Lt = $14.22\ (1 - e^{(-0.48\ (t - to))})$.

Mortality

The catch curve (Fig. 2) showed an estimated coefficient of total mortality, $Z = 7.08yr^{-1}$. From Pauly's empirical formula, natural mortality (M) was estimated as, $M = 3.97yr^{-1}$ at an average annual sea surface temperature of 29.5^0C. The fishing mortality, F (Z-M) = $3.11yr^{-1}$ was obtained. From the values of M and F, it is clear that M is greater than F and exploitation rate (E) was 0.44. The state of exploitation of *P. leonensis* is optimal when E = 0.50 or F = M. It is under-exploited when E < 0.5 and over-exploited when E > 0.5 (Gulland, 1971).

Yield per Recruit and Biomass per Recruit

The ELEFAN I procedure was used to compute the relative yield per recruit and relative biomass per recruit (Fig. 3). The following results were obtained: $E_{max} = 0.562$, $E_{10} = 0.468$ and $E_{50} = 0.316$. The ratio of length at first capture to asymptotic length ($Lc/ L\infty$) estimated showed that *Pellonula leonensis* with Lc (0.34cm) was caught at a small size. The L_{50} or L_C is the size at which 50% of the fish are vulnerable to capture.

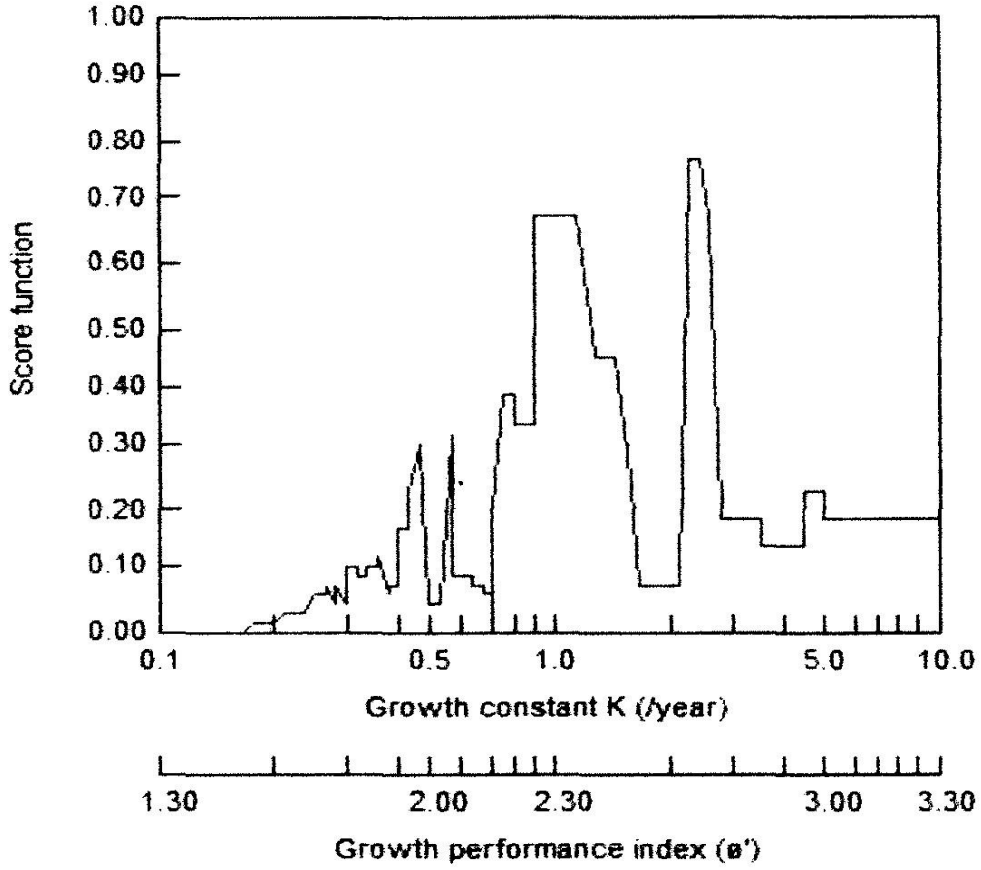

Fig. 1: K- Scan of *P. leonensis* from Luubara creek

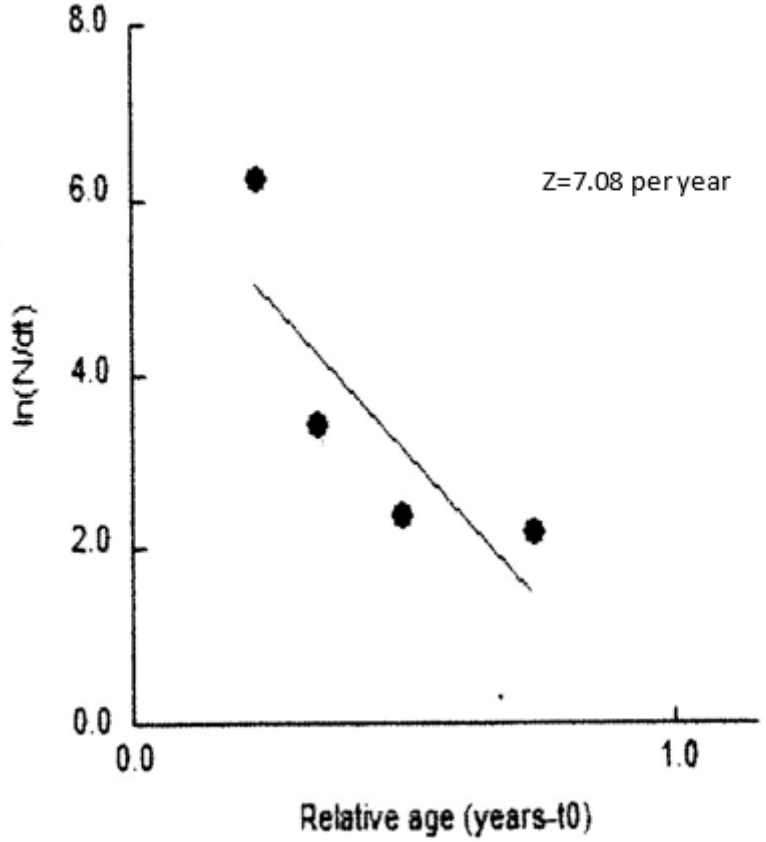

Fig. 2: Length converted catch curve *P. leonensis* from Luubara creek

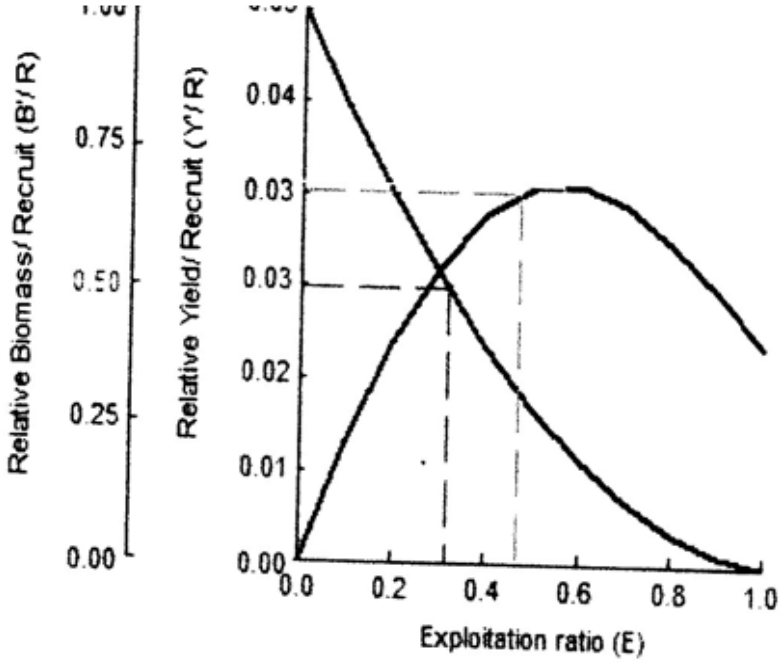

Fig. 3: Relative yield per Recruit and relative Biomas-per Recruit of *P. leonensis* from Luubara creek

DISCUSSION

The value of K and Ø showed that *Pellonula leonensis* from the creek grows fast. Sparre and Venema (1998) stated that fish with K value ≥ 0.5 is typical for rapid growth pattern; the higher the growth coefficient the faster they reach the asymptotic length. The growth performance index in this study is very close to the growth performance index (Φ') obtained for the same species (Uneke *et al*., 2010; Assi *et al.,* 2019; Okon *et al.,* 2020) and other clupeids such as *Sardinella maderensis* (Djama *et al.,* 1989). The growth performance indices (Ø′) are typically species specific, indicating that their values are often similar within closely related taxa and exhibit limited variability. According to Sparre and Venema (1992), a growth performance index (K) of 1.0, 0.5 and 0.2 indicates rapid, moderate and slow growth, respectively.

The state of exploitation of *P. leonensis* is less than the E_{opt} = 0.5. Thus, *P. leonesis* in Luubara creek is under exploited as E was lower than E_{opt} = 0.5. Uneke et al. (2010) also reported E (0.31) for *P. leonensis*. The Lc estimated in this study pointed out that *P. leonensis* is harvested most at a small size. Olopade *et al.* (2019) stated that when undersize fish is harvested then growth overfishing will set in and when it continues without regulation on the long-run, overfishing will be experienced in the fishery. In proffering management measure, Olopade *et al*. (2019) advised that 0.4 should be maintained in any fishery to ensure sustainability. The prevalence of small-sized specimens in the samples suggests the need for management actions, such as implementing size-limit regulations through a gradual enlargement of fishing gear mesh size.

The M value in this study is greater than F indicating that the mortality of *P. leonensis* was caused more by natural events. This is similar to the report of Uneke *et al*. (2010) on *P. leonensis* from river port Otuocha in Anambra, Nigeria. Anthropogenic activities emanating from dredging, urbanization, oil spill and water transportation could be a major of source of M. In Qua-Iboe Estuary, Okon *et al.* (2020) reported F as greater than M. The low ratio of F to M of 0.78 obtained in this study correspond with that of Uneke *et al*. (2010).

CONCLUSION

The study describes the growth pattern, growth parameters, mortality, recruitment and exploitation rate of P. leonensis captured from Luubara Creek.The fishery of *P. leonensis is* under exploitated with juveniles dominating the catch. This scenario suggests the need for management actions, such as implementing size-limit regulations through a gradual enlargement of fishing gear mesh size due to prevalence of small sized individuals. Although the mortality rate and exploitation not under human pressure, there is still the need to institute management guideline in order to conserve and sustain *P. leonensis* fishery as well as protecting the aquatic environment from the causes of natural mortality.

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