Research Article

Stomach and gut content of Long Neck Croacker– *Pseudotolithus typus* (Bleeker,1863) from Lagos Lagoon, Nigera

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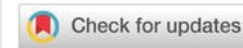Aquaculture and Fisheries Management, University of Ibadan, Nigeria

Abstract

Pseudotolithus typus has been considered to hold great promise for fish farming in Africa, the fish having a wide geographical spread, a high growth rate, resistance to handling stress and well appreciated in a wide number of African countries. Studying its feeding habit, which is an important aspect of its biology, is a crucial knowledge needed for its mass cultivation by fish farmers and also its implication for its management in the wild. The main objective of the study was to investigate the food items and feeding activities of *Pseudotolithus typus* in the Lagos lagoon, Nigeria.

A total of 93 specimens were collected and transported in ice-packed container to the wet laboratory of the Department of Biological Oceanography, Nigerian Institute for Oceanography and Marine Research (NIOMR) for further examination. These specimens were usually collected during early hour of the morning. Specimens were weighed with Camry model EK5350 of 5kg capacity to the nearest 0.10 g after blotting dry with filter paper Specimens were dissected and the gut were carefully removed with the aid of a forceps after dissection. Stomach and gut contents were examined and the individual food organisms sorted and counting the number of each food item present in the gut and stomach of the species and summing up these numbers to obtain the grand number of all food items in its guts. The number of non-empty guts divided by total number of guts examined, multiply by hundred was used to determine the guts repletion index. Index of fullness was measured as the ratio of food weight to body weight as an index of fullness. The sampling methods were season stratified.Data were subjected to one way analysis of variance (ANOVA) and significant differences accepted at $P < 0.05$ using statistical package (SPSS version 14).

The diet of *Pseudotolithus typus* was also analyzed. Frequency of occurrence, numerical abundance and Gut repletion index, stomach fullness were computed. The major dietary components of the species were shrimps. The food composition of *P. typus* shows seasonal variation with Bivalves conspicuously absent during the dry season. The frequency of occurrence of items in order of abundance revealed crustaceans (*Peaneus notialis, Parapenaeopsis longirostrics* and unidientified digested shrimps) followed undigested partly digested food items and less common items.

The diet composition of the *Pseudotolithus typhus* indicates they are specialised feeders depending on similar food sources with minimum number of dietary prey items. Shrimps and to some extent juvenile fishes constitute the important preys of *Pseudotolithus typhus*. Therefore the revolution of the abundance of food items must be assessed for their sustainable production and the extent of pollution in Lagos lagoon should be assessed due to the absence of bivalves(during the dry season) which are bio-indictors of pollutant to know what management strategies and control measures are to be taken.

Introduction

Feeding ecology is an important aspect of the life–history strategy of a species to understand the functional role of the fish within their ecosystems [1]. One of the most economically important and dominant species in the Nigerian coastal waters is *Pseudotolithus typus* .This species occurs in the estuaries and saline creek systems. *Pseudotolithus typus* is generally classified as omnivore or predator feeding mainly on aquatic insects, fish and plant debris. *Pseudotolithus typus* utilize various kinds of food resources available in their habitat [2].

The food and feeding habit of fish assemblage deals with their ability to have good nutritive foods which could improve

their growth within their environment. Therefore, the dietary analysis of *Pseudotolithus typus* in their natural habitat enhances the understanding of their growth, abundance, productivity and distribution and seasonal fluxes in the type and magnitude of food available as well as the season it occurs. This study was designed to have the broad knowledge of the different species of prey in order to understand the quantitative connection between fish and their food organisms . Furthermore, this study adopts an ecosystem approach by quantifying the food organisms based on seasonal variation. This study presents more information on the gut and stomach content of *Pseudotolithus typus* in Lagos Lagoon. Previous reports on the Croakers in Nigeria include [3,4] and [5,6], also worked on Food habits of two species of *Pseudotolithus* (Sciaenidae) off Benin (West Africa) nearshore waters and implications for management and [7] also worked on Biometric characteristics, Food and feeding Habit and Sex Dimorphism of the Long Neck Croacker(*Pseudotolithus typus*) from Lagos lagoon.

Materials and methods

Study area

Lagos State lies between longitude 3°21"24"E and latitude 6°35"8"N. It is located at the South-Western of Nigeria .Lagos State consists of twenty local governments. Ikeja currently serves as an administrative seat of the State and of a local government . The study area is Makoko, located in Lagos Mainland Local Government Area of Lagos State. Makoko is one of the many water and shoreline settlements in Lagos State. Makoko is a shanty settlement located in the centre of Lagos city, along the banks of the Lagos lagoon. Makoko lies within the south-eastern part of Lagos metropolis. It is bounded on the North by Iwaya and University of Lagos; at the West, by Ebute-Meta; South, by the Third Mainland Bridge; and East by the Lagos lagoon [8].

Fish samples collection

Samples of *Pseudotolithus typus* were randomly obtained from September 2018 to Febuary, 2019 from fishermen catches at Makoko landing point. The fish collection was done monthly for six consecutive months. A total of 93 specimens were collected and transported in ice-packed box to the wet laboratory of the Department of Biological Oceanography, Nigerian Institute for Oceanography and Marine Research (NIOMR) for further examination. These specimens were usually collected during early hour of morning.The sampling methods were season stratified. Seasonal stratification covered wet (September - November) and dry (December – February) seasons.

Laboratory procedure

The nomenclature of the fish samples taken to the laboratory for this study conformed to [9]. The fish specimens were treated individually to determine their biometric data. In the Laboratory, after blotting dry with filter paper Specimens were dissected and the gut were carefully removed with the aid of a forceps after dissection. The Stomach and the of dissected

specimens were slit open and the contents displayed in Petri dishes with a small drops of distilled water added to agitate them and examined under a stereo light microscope(magnification up to 100×) to identify the food items using appropriate taxonomic guide (FAO Marine Fish identification guide). Information on Total Length, Standard length, Weight and identified food items were recorded into a data sheet for data analysis.

Food composition determination

Two methods were used to assess the food composition of the fish. These methods included frequency of occurrence and numerical method [10].

Frequency of occurrence

Stomach contents were examined and the individual food organisms sorted and identified. The number of stomachs in which each item occurs were recorded and expressed as a percentage of the total number of stomachs examined.

Frequency of Occurrence = $J_i \div P$

Where, is number of fish containing prey i and P is the number of fish with food in their stomach. iJ

This method demonstrates what organisms are being fed upon, but it gives no information on quantities or numbers and does not take in to consideration the accumulation of food organisms resistant to digestion [11].

Numerical method

This involved counting the number of each food item present in the stomach of the species and summing up these numbers to obtain the grand number of all food items in its guts [12]. The number of each food was expressed as a percentage of the grand total number of food items. Usually expressed as:

$$\text{Percentage number of food} = \frac{\text{Total number of a particular food item}}{\text{Total number of all food items}} \times 100$$

This method expresses the numerical importance of different food items, and gives relative importance of each food item.

Index of fullness

This is measured as the ratio of food weight to body weight as an index of fullness. This index can be applied to the food in the stomach, or to that in the whole digestive tract. It is usually expressed as parts per 10,000 (or parts per decimals).

Gut contents were analyzed quantitatively. The various food items are identified. The food content found in the stomach was divided into three groups.

1. Full: Stomach was full with food

2. ½ Full: Stomach was ½ full

3. Empty: Stomach without food

Guts Repletion Index (GRI)

Guts repletion index is number of non-empty guts divided by total number of guts examined, multiply by 100.

Represented as:

$$GRI = \frac{Number\ of\ non-empty\ guts}{Total\ number\ of\ guts\ examined} \times 100$$

Statistical analysis

Data obtained from the study were subjected to descriptive statistics (mean and standard deviation) and presented in graphs, pie chart and bar chart. Data were subjected to one way analysis of variance (ANOVA) and significant differences accepted at $P < 0.05$ using statistical package (SPSS version 14). Relationship between variables (Length and Weight) was analysed using regression.

Results

Stomach fullness

Figure 1-3 shows the degree of stomach fullness of *Pseudotolithus typus* samples during the wet season, degree of stomach fullness of *Pseudotolithus typus* samples during the dry season and degree of Stomach fullness of *Pseudotolithus typus* samples during wet and dry season.

Table 1 shows the gut repletion indices of *Pseudotolithus typus* samples from Lagos Lagoon during the wet and dry season. The gut repletion index was lower during the wet season with a mean value of 71.11 and higher during the dry season with a mean of 79.26.The maximum gut repletion index of 80.00 was obtained during the wet and dry season while the minimum of 60.00 was obtained during the wet season.

Table 2 shows the gut repletion index *Pseudotolithus typus* samples for the combined sampling period of six month and has a maximum value of 80.00 with the minimum of 60.00. The gut repletion index of *Pseudotolithus typus* samples from Lagos lagoon has a mean of 75.18 for both season. Figure 4 shows the gut repletion index of *Pseudotolithus typus* samples
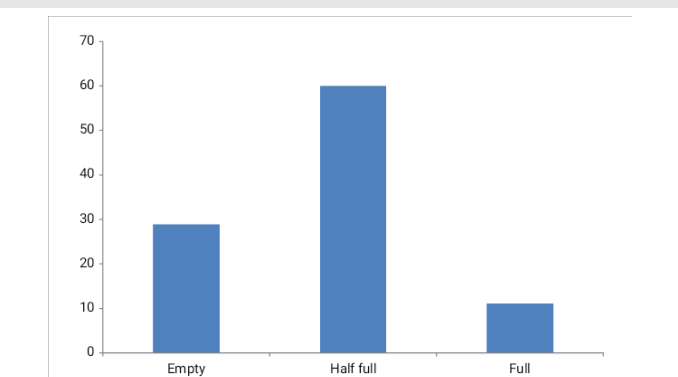

Figure 2: Degree of stomach fullness of *Pseudotolithus typus* samples during the dry season.
Scale: 1unit represent 10units of stomach found to be Empty, Half full and full while the Y-axis represents the stomach fullness degree are represented on the x-axis during the dry season.
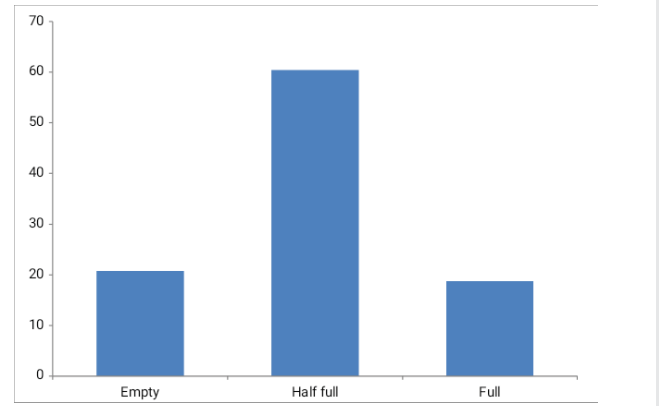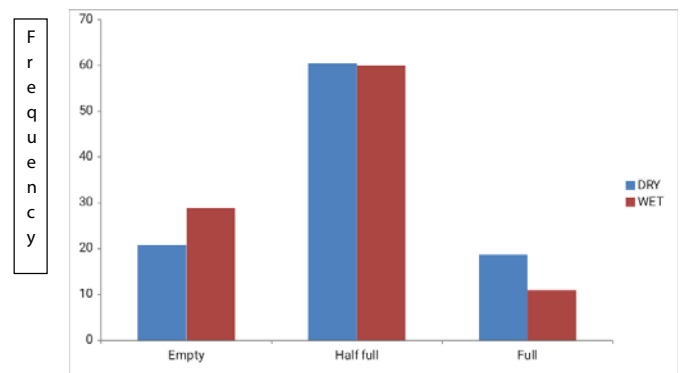

Figure 3: Degree of Stomach fullness of *Pseudotolithus typus* samples during wet and dry.
Scale: 1unit represent 10percent of frequency of occurrence and Numerical Dietary Composition of *Pseudotolithus typus* on Y-axis while the stomach fullness degree are represented on the x-axis.

Table 1: Gut repletion index of *Pseudotolithus typus* in Makoko, Lagos Lagoon for individual season.

Season	Gut repletion index		
	Mean±SD	Min.	Max.
WET	71.11±10.18	60.00	80.00
DRY	79.26±1.29	77.77	80.00

Table 2: Gut repletion index of *Pseudotolithus typus in* Makoko, Lagos lagoon for combined season.

Season	Gut repletion index		
	Mean±SD	Min.	Max.
Both	75.18±7.88	60.00	80.00

for each month samples from Lagos lagoon (September, 2018 – February, 2019) respectively.

Diet composition

The diet of *Pseudotolithus typus* samples from Lagos lagoon consisted mainly of crustaceans (shrimps) and Pisces (fishes). Other food items were unidentified partially digested fish, Unidientified partially digested Crabs, Cephalopods

Figure 1: Degree of stomach fullness of *Pseudotolithus typus* samples during the wet season.
Scale: 1unit represent 10units of stomach found to be Empty, Half full and full while the Y-axis represents the stomach fullness degree are represented on the x-axis during the wet season.

and Bivalves. Crustaceans constituted the most important prey group in samples and have a frequency of occurrence of 55.71%. *Parapenaeopsis longirostrics* had 5.71% while *Paeneus notialis* has the highest frequency of occurrence of 48.57%. Figure 4 shows the frequency of occurrence dietary composition of *Pseudotolithus typus* samples from Lagos lagoon, Nigeria (September, 2018 – February, 2019), while Figure 5 shows the numerical dietary composition of *Pseudolithus typus* samples within the specified sampling period. Figure 6, shows comparison between the frequency of occurrence and numerical dietary composition of *Pseudotolithus typus* in Makoko Lagos lagoon, Nigeria (September–February) respectively.

Figure 7 Comparison between Frequency of Occurrence and Numerical dietary Composition of *Pseudotolithus typus* samples from Lagos lagoon, Nigeria during wet season while.

Discussion

Gut repletion index of *Pseudotolithus typus*

Gut repletion index mean of 75.18% with minimum of 60% and maximum of 80% was observed during the combined
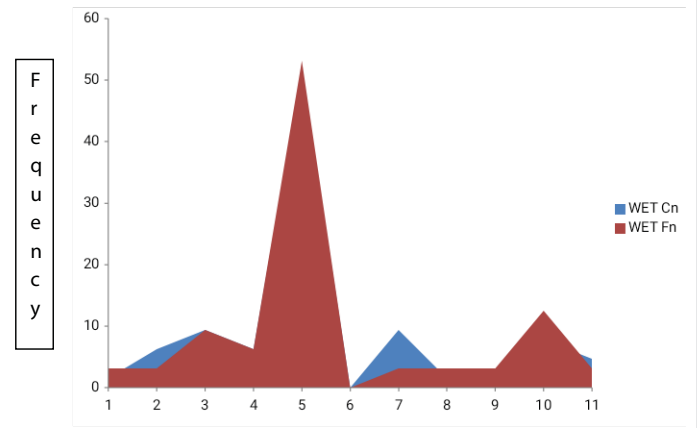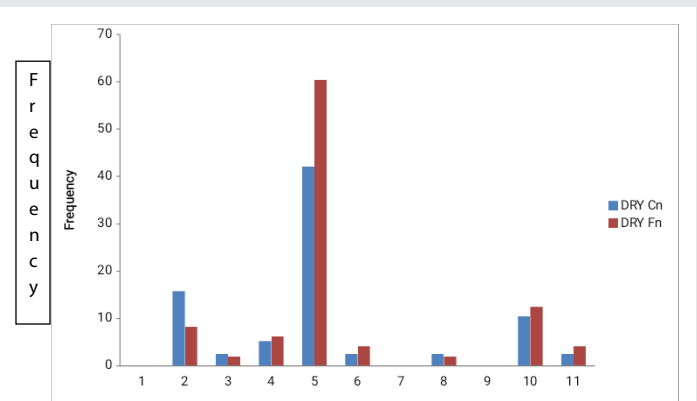

Figure 4: Monthly Gut repletion index of *Pseudotolithus typus* samples from Lagos lagoon (September, 2018 – February, 2019) for both dry and wet season.
Scale: 1unit represent 10percent of frequency of occurrence and Numerical Dietary Composition of *Pseudotolithus typus* on Y-axis while the sampling months are represented on the x-axis

Figure 5: Frequency of Occurrence Dietary Composition of *Pseudotolithus typus* samples from Lagos lagoon, Nigeria (September, 2018 – February, 2019).

Scale: Each number represents the dietary composition on the x-axis:1=Sphyraena barracuda (juvenile), 2=Unidentified partially digested fish, 3=Unidentified partially digested Cephalopods, 4=*Parapenaeopsis longirostrics, 5= Paeneus notialis,* 6=Unidentified partially digested whole shrimp, 7=Unidentified bivalve, 8= *Callinctes Amnicola,*9=Unidentified Crab larva,10= Undigested food item 11=Polychaete
1unit represent 10percent of frequency of occurrence and Numerical Dietary Composition of *Pseudotolithus typus* on Y-axis.

Figure 6: Comparison between Frequency of Occurrence and Numerical dietary Composition of *Pseudotolithus typus* samples from Lagos lagoon, Nigeria during wet season.

Scale: Each number represents the dietary composition on the x-axis:1=Sphyraena barracuda (juvenile), 2=Unidientified partially digested fish, 3=Unidentified partially digested Cephalopods, 4=*Parapenaeopsis longirostrics, 5= Paeneus notialis,* 6=Unidentified partially digested whole shrimp, 7=Unidentified bivalve, 8= *Callinctes Amnicola,* 9=Unidentified Crab larva,10= Undigested food item 11=Polychaete
1unit represent 10percent of frequency of occurrence and Numerical Dietary Composition of *Pseudotolithus typus* on Y-axis.

Figure 7: Comparison between Frequency of Occurrence and Numerical dietary Composition of *Pseudotolithus typus* samples from Lagos lagoon, Nigeria during dry season.

Scale: Each number represents the dietary composition on the x-axis: 1=Sphyraena barracuda (juvenile), 2=Unidientified partially digested fish, 3=Unidentified partially digested Cephalopods, 4=*Parapenaeopsis longirostrics, 5= Paeneus notialis,* 6=Unidentified partially digested whole shrimp, 7=Unidentified bivalve, 8= *Callinctes Amnicola,*9=Unidentified Crab larva,10= Undigested food item 11=Polychaete.
1unit represent 10percent of frequency of occurrence and Numerical Dietary Composition of *Pseudotolithus typus* on Y-axis

sampling period. The observed mean gut repletion index for wet (71.11%) and dry (79.26%) season is an indication of high feeding intensity. The present information is not in agreement with reports of [13] who observed the 100% GRI in *C. Auratus* in Cross river estuary of Nigeria. The high % GRI exhibited by *P.typus* might be due to their ability to switch diets due to high abundance of food items.

Fish are capable of changing their gut morphology in response to available food resources and demonstrate high degree of plasticity. However, contrary to the report of high gut
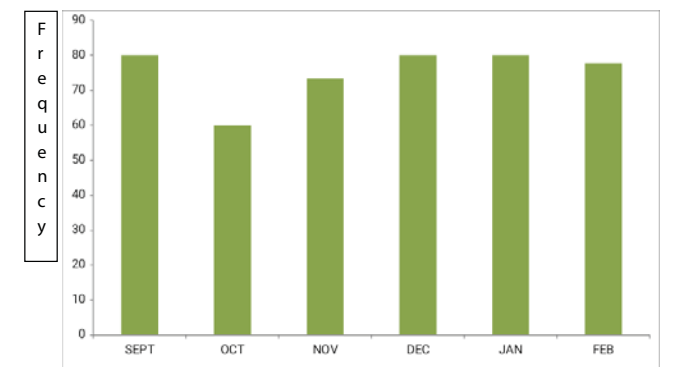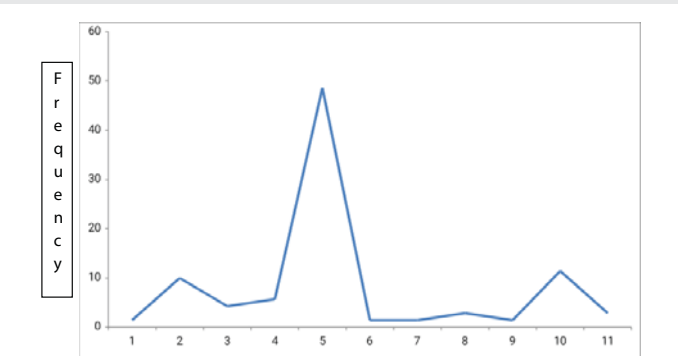
repletion index in this study [14], reported a low GRI in *T. teraia* (4.35%), *E. aeneus* (20.00%).Based on their feeding intensity observed in this study, *Pseudotolithus typus* from Lagos lagoon, Nigeria were considered active feeders.

Dietary composition of *Pseudotolithus typus*

The diet composition of *Pseudotolithus typus* shows to be a specialized feeders depending on same food sources with streamlined number of food items. The major food materials reported by the current study were shrimps (Crustaceans). These results confirmed those of [15] who observed and reported that four stomachs out of five contained shrimps [16]. also reported the importance of shrimps in the food regime of *P. Typus* [17]. obtained the similar results while studying the community of Sciaenidae off the Guinean coasts [18]. noted that *P. typus* feeds mostly (80%) on shrimps.Similar results have been reported in previous studies in Nigeria [19].

The present study revealed that *Paeneus notialis* was the most important shrimps species fed on by *P. typus* in Lagoon during the sampling period [18]. reported similar results for these two Sciaenid fish species off Cameroon. This importance of shrimps in diet composition may be due to their abundance [20] and nutritional benefits. The observed high diet specialization can be attributed to the fact that the dietary sources are largely autochthonous. This could however lead to intra and inter-competition. However, the presence in *P. typus* attests to the inherent ability of the specie to expand their food items, options should there be any dramatic negative alteration in the availability of the favoured food item.

Seasonal variation in Dietary Composition of *Pseudotolithus typus* from Lagos lagoon, Nigeria

In this study, it was observed that there was a variation in diets fed on by *P.typus* during the wet and dry season. There was an obvious absence of *Sphyraena barracuda* and Bivalves during the dry season while they are present during the wet season. Bivalve molluscs are largely used as bioindicators to monitor the health of aquatic environments in both fresh water and the marine environments [21]. reported that a definite pattern of seasonal variations in pollution could not be established for Lagos lagoon.The presence of bivalves during in the dry season indicates there is a certain level of pollution in Lagos lagoon which contradicts the report by [12]. Bivalves population status or structure, physiology, behavior or the level of contamination with elements or compounds can indicate the state of contamination status of the ecosystem. They are particularly useful since they are sessile so that they are representative of the environment where they are sampled or placed according to U.S. Mussel Watch Programme [22].

Conclusion and recommendation

The stomach and gut content of *Pseudotolithus typus* from Lagos lagoon show a great autochthonous pattern and have been grouped into predatory or carnivores feeder. An overlap does not exist in the diet which increases competition among the fish and ensures a narrow spectrum of dietaries. From the

study, it can be concluded that *Pseudotolithus typus* in Lagos lagoon utilize more than one source of food.

My recommendation is that the research should be intensified in other area of *pseudotolithus typus* nutrition and microbial gut content in other to be able to determine the nutritional technicality of rearing the fish in a cultured environment. Also the pollution level of Lagos lagoon should be determined especially during the dry season(when the water level is low) to be able to determine the remediation methods to use in controlling such.

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