TROPHIC ECOLOGY OF *Pseudotolithus elongatus* (SCIAENIDAE: TELEOSTEI) IN THE CROSS RIVER ESTUARY, NIGERIA.

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ABSTRACT

Aspects of the trophic ecology of *Pseudotolithus elongatus* was studied in the Cross River Estuary. Three standard methods of stomach analysis were combined to obtain the Index of Relative Importance (IRI) for each food item. The IRI was further expressed as a percentage. The principal dietary compositions were of two classes namely: crustacean (shrimps) and Pisces (fish) with IRI 75.55% and 23.80% respectively while plant parts (IRI=0.65%) occurred incidentally. The food composition did not show any variation with sex and season except for the presence of plant materials observed only during the raining season. Feeding intensity based on the vacuity index was greater in the dry than the wet season and in females than males.The largest sized group(31-40 cm) exhibited the highest intensity of feeding. The significance of these and the dietary items are discussed

INTRODUCTION

The genus *Pseudotolithus* (Family Sciaenidae) commonly known as Croakers constitute an abundant and commercially important fish in Nigerian inshore waters (Anyanwu, 1983; Moses, 1981, 1987; Isangedighi, 2001). They occur throughout the Atlantic coast of West Africa (Bayagbona, 1963; Edwards *et al.,* 2001) and account for about 7.15% of the total marine fish landings of Akwa Ibom State (Nigerian) (Peters *et al.,* 1994); 42.90% by weight of the total average landings in the Nigerian coast (Emoepae, 1983) and 40% of the value of landings made by trawlers operating along the West coast of Africa (Etim *et at.,* 1994). The most economically important and dominant species in the Nigerian coastal waters are *Pseudotolithus elongatus*, *P. senegalensis* and *P. typus*, (Anyanwu, 1983) while the less prominent ones include *P. brachygnatus, P. epiperchus and P. moori* (Isangedighi, 2001).

The Croakers are commonly found on muddy deposits (Collington, 1960; Isangedighi, 2001) and are exploited by both industrial and artisanal fisheries. Spawning fish occur very close to inshore water, generally in untrawlable shallow waters. *P. senegalensis* and *P. typus* are mostly marine, forming an estimated 30% of the catch of the trawl fishery on the continental shelf, while *P. elongatus* occurs in the estuaries and saline creek systems. Out of the two open sea species, *P. typus* regularly penetrate into estuaries while *P. senegalensis* rarely does so (Ajayi, 1981). *P. elongatus* is widely distributed along the coast of tropical West Africa from Senegal to Angola and enters the estuary.

Prior to the pioneering report of Akpan and Isangedigh (2004), information on the trophic ecology of *Pseudotolithus* species in Southeastern Nigeria was generally lacking. The report which examined three species of the Sciaenidae depicted them as specialized feeders subsisting on similar food sources which were dominated by crustaceans (shrimps) and juvenile fish.The present report focuses specifically on the trophic ecology of *P. elongatus* of the Cross River estuary. It is meant to provide more information on the species as well as serve as baseline data for *P. elongatus* in the Ibaka (James Town) axis of the estuary which has been earmarked for the establishment of a deep sea port by the government of Akwa Ibom State, Nigeria

MATERIALS AND METHODS

STUDY AREA

The Cross River Estuary is the largest estuary in the Gulf of Guinea (Moses, 1987) occupying a total of 54,000 km^2 (Akpan and Ofem, 1991). It is a relatively high productive system in terms of fish catch (Moses, 1987) supporting a wide range of shell and fin fishes (Nawa, 1986). The mean annual fish catch from the artisanal fisheries of this system within Nigeria is 65,000 tones, making it one of the most productive of the medium size river systems in tropical Africa (Moses, 1987). The climate is tropical and consists of two seasons namely, the wet and dry seasons. The wet or rainy season which is of longer duration starts from March and last until October while the dry season extends from November to February. However, due to the effect of the hot humid moisturized air mass (attributable to the area's proximity to Guinea coast), rainfall is expected in every month of the year (Peters *et al.,* 1994). A short dry period of harmattan occurs between December and February (Moses, 1979)

Samples Collection

Samples of *Pseudotolithus elongatus* were obtained from boat landings of artisanal fisherfolks at James Town fishing terminal for twelve consecutive months. Specimens were weighed to the nearest 0.1 g after blotting dry with filter paper and measured to the nearest 0.1cm (Total length, TL)

Determination of Feeding Intensity

The vacuity index was used to determine feeding intensity. This index is calculated by dividing the number of empty stomach by the total number of stomachs and multiplying the outcome by 100 (Labropoulou *et al.*, 1997). Thus, the higher the vacuity index, the lower the feeding intensity.

Analysis of Food Composition

Three methods were used to assess the food composition namely: the point, frequency of occurrence and numerical methods. The stomachs were removed, slit open, and the contents displayed in petri dishes with a few drops of distilled water added to agitate them and examined microscopically and macroscopically. Prey items were identified to the lowest possible taxonomic level. In the point method (Hyslop, 1980), each stomach was sorted out visually, categorized as empty, one quarter, half, three quarters and full and scored 0, 5, 10, 15 and 20 respectively with intermediate scores where necessary. These points were shared among the various contents, taking account of their relative proportion by volume. Points scored by each food item was calculated and expresses as percentage of grand total point scored by all stomach contents giving the percentage point (Cp). The percentage frequency of occurrence (F) was based on the number of stomachs in which a food item was found, expressed as a percentage of the total number of non-empty stomachs while percentage numerical abundance (Cn) was the number of each prey item in all non-empty stomachs in a sample, expressed as the percentage of the total number of food items in all stomachs (Hyslop, 1980). The principal food items were then identified using the IRI which is a modified version of Labropolou *et al.,* (1997), embracing the three methods as follows:

$$IRI = (Cn + Cp) \times F$$

Where IRI = Index of Relative Importance; Cn = Percentage Numerical Abundance; Cp = Percentage Point and F = Percentage Frequency of Occurency. The IRI was further expressed as percentage viz.:

$$\%IRI = \left[\frac{IRI}{\sum IRI}\right] X\ 100$$

Where ∑IRI refers to the sum of all IRI. The incorporation of the methods of stomach analysis in computing the % IRI is ,more representative (Windell, 1971; Hysop, 1980) and reduces to

the barest minimum, the bias associated with the independent interpretation of results from each analytical method and consequently gives a more accurate picture of dietary importance (Hyslop, 1980).

RESULT

Feeding Intensity

The overall vacuity index was 34.2%. Figure 1 shows the monthly variation in vacuity index of *P. elongatus* in the Cross river estuary. The highest vacuity index occurred in October (83.3%) while the lowest occurred in December (11.1%). Consequently, feeding activity in *P. elongatus* reached its peak on December and was lowest in October.

Ontogenic Variation In Feeding Intensity

Figure 2 shows the variation of vacuity index with size groups. The 21-30CM (TL) group had the highest vacuity index while the 31-40cm (TL) group had the lowest vacuity index. The vacuity index increased as the fish increased in size except in the largest size group in which the index decreased. Consequently, Feeding intensity was highest in the largest size group (31 – 40cm) followed by the smallest size group (1-10cm).

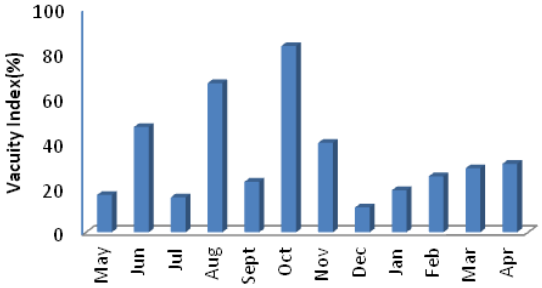

Figure 1: Monthly vacuity Index of *P. elongatus* in the Cross River Estuary, Nigeria

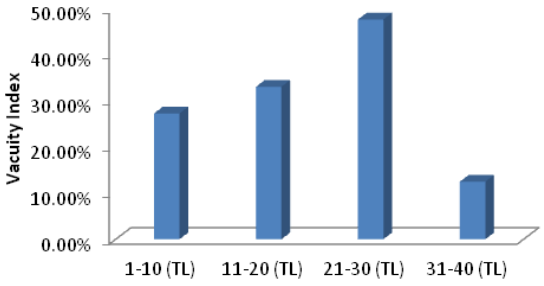

Figure 2: Variation of vacuity index with size groups of *P.elongatus* in the Cross River Estuary, Nigeria

Seasonal and Sexual Variation In Feeding Intensity

Wet season samples of *P. elongatus* had higher vacuity index (39.5%) than dry season samples (23.1%) (Fig. 3). This indicates that feeding was more intense during the dry season than during the rainy season. On the other hand, feeding intensity was higher in female (VI = 15.79%) than male (VI = 56.25%), Fig. 4

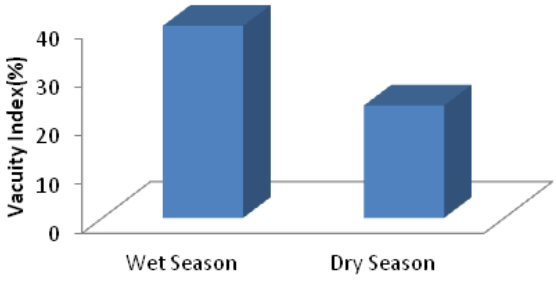

Figure 3: Seasonal Variation in Vacuity Index of *P.elongatus* in the Cross River Estuary, Nigeria

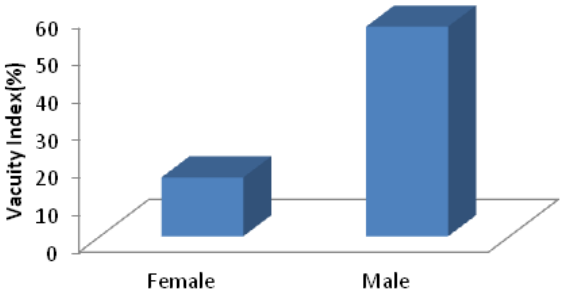

Figure 4: Sexual Variation in Vacuity Index of *P.elongatus* in the Cross River Estuary, Nigeria

Diet Composition

The diet of *P. elongatus* in the Cross River Estuary consisted of crustaceans (shrimps), Pisces (fishes) and plant materials. The relative importance of the different prey groups and species are shown in Table 1. Crustaceans constituted the most important prey group making up

75.55% of the total IRI. Among the crustaceans, shrimp parts had the highest %IRI (59.26%) while *Penaeus notialis* had the lowest % IRI (0.17%). Pisces (fishes) contributed the second highest dietary materials making up 23.80% of the IRI. *Pseudotolithus typus* (% IRI = 10.17) and unidentified partially digested fish (IRI =13.38 %) had the greatest percentage IRI while *Ilisha africana* (% IRI = 0.17), fish scale (% IRI = 0.07) had very low % IRI. Plant materials had the lowest % IRI (0.65%) among the food categories. No difference in food composition between the sexes was observed but plant materials occurred in the stomach only during the rainy season.

DISCUSSION

Vacuity index of 34.2% in this study is close to that reported for same species in the Lagos lagoon (Fagade and Olaniyan,1973) which was 32%. The present results show that feeding intensity in *P.elongatus* decreased as the fish got bigger and then increased again in very large fishes. The largest group obtainable (31-40 cm) exhibited the greatest feeding intensity. Higher feeding activity in small individuals could be attributed to the fact that small prey items are digested much more rapidly than larger ones found in the stomach of the larger fish (Labropoulou *et al*.,1997) while increased feeding activity in very large fish may be due to increased physiological demand linked with reproductive investment as well as increased mouth gape. Large fish are also less vulnerable to predators during feeding and therefore indulge in greater feeding activity (Isangedighi, 2001; Akpan and Isangedighi, 2004).Bigger fish are faster and better able to handle prey (Plattel and Potter, 1998)

Table 1. Dietary composition of *P.elongatus* In The Cross River Estuary, Nigeria

Food Item	*Cn*	*Cp*	*F*	*IRI*	*%IRI*
PISCES					
Pseudotolithus typus	8.0	19.1	14.8	401.08	10.18
Ilisha Africana	0.8	2.9	1.85	6.85	0.17
Undentified partially digested fish	7.2	28.4	14.81	527.24	13.38
Fish parts	0.8	0.6	1.85	2.59	0.07
Total	17.6	51.6	35.16	937.76	23.80
CRUSTACEA (SHRIMP)					
Nematopalaemon hastatus	9.6	8.6	9.26	168.53	4.28
Parapenaeopsis atlantica	7.2	11.3	16.67	308.40	7.82
Unidentified partially digested whole shrimp	4.0	17.4	7.41	158.57	4.02
Shrimp parts	56.8	17.4	31.48	2335.80	59.26
Penaeus notialis	0.8	2.9	1.85	6.85	0.17
Total	78.4	57.8	66.67	2978.15	75.55
OTHERS					
Plant material (leaf/leaf stalk)	4	2.9	3.70	25.53	0.65
Number of stomachs examined	410				
Number of empty stomachs	140				
Vacuity index	34.2				

Cn = percentage numerical abundance, *Cp* = percentage point, *F*= percentage frequency of occurrence. *IRI*= Index of Relative Importance

Seasonal variation in vacuity index showed a higher feeding activity in the dry season than during the rainy season. Similar trend has been reported for *Brienomyrus brachyistus* (King, 1989) and *Ilisha africana* (King *et. al.*, 1991).This is probably an adaptation towards ensuring the availability of energy for the dry season breeding activity of *P. elongatus* (Isangedighi, 2001). Higher foraging activity in the dry season may also be attributed to higher temperature associated with the season (Moore and Moore, 1976, Lowe-McConnel,1975) with its attendant increase in metabolic activities. Thus, the species fed more in the dry season to meet up with the increased metabolic demand linked with elevated temperature.

The overall food composition of *P. elongatus* was principally carnivorous. The major dietary items were shrimps (Crustaceans) and juvenile fish (Pisces) perhaps a reflection of their abundance in the estuary (Lagler *et. al.*, 1977) and nutritional profitability. Besides being abundant, the crustaceans are also easy to capture (Marioghae, 1980). They attract a lot of predatory fish, some of which are in turn fed upon by Sciaenids in general and by *P. elongatus* in particular as seen in this investigation.The high trophic specialization observed in *P. elongatus* may be attributed to the fact that the dietary sources are largely autochthonous. The disadvantage of such specialized foraging is that the fish is increasingly exposed to competition for food between conspecifics and congeners occupying the same biotope.

However, the occurrence of plant materials, though incidental (due to their low quantity) may attest to the inherent ability of *P. elongatus* to expand its dietary spectrum should the need arise. The occurrence of plant materials in the stomach of *P. elongatus* only during the rainy season may be regarded as allocthonous food materials brought in as a result of the expanded habitat of fish (Moses, 1987). Although the nutritional value of plant materials are less than those of animal preys, their presence in the stomach provide satiation as well as increasing gastric evacuation rates which compensate for their low assimilation efficiency (Magalhaes, 1992). This investigation shows that *P. elongatus* of Cross River estuary is a predator feeding on shrimps and juvenile fish which occur abundantly in a biotope that is highly productive (Moses,1987).

CONCLUSION

The abundance of this species, for now, may not be limited by food resources. However it is hoped that the imminent coastal development and pollution that is bound to accompany the establishment of an industrial estate in the study area will be such that will not constitute a threat to the shrimp fishery as this will negatively affect the Croakers and other species of fish dependent on them for food.

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