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Stomach ContentAnalyses of Cassava Croaker *Pseudotolithus senegalensis* (Valenciennes, 1833) in Forcados River Estuary, Delta State, Nigeria

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Abstract - *Pseudotolithus senegalensis* is one fish species caught in large numbers in Forcados river estuary. Regardless of it's abundance, published information about the biology of this unique species in this water body is scare.This research study would fill the knowledge gaps by providing information for further studies.Atotal of 1120 samples of *P. senegalensis* were collected from artisanal fishermen from Forcados river estuary from April 2017 to March 2019. The stomachs of the fish were slit opened and food content were identified and analysed using the frequency of occurrence and volumetric methods. Ivlev index was used to estimate food selectivity.About 96.66% of the stomachs studied had food items. Small fish species recorded 30.39% (highest percentage) by frequency of occurrence analysis and 41.22 % volumetric analysis method. The order of preponderance index from the most important food item revealed the following trend - small fish (56.15 %); shrimps (24.05 %); snails (gastropod) (13.66%), fish scales (4.66 %) and fish bone (1.48 %). The Ivlev index indicated that shrimps were positively selected by the fish. This study provides baseline information on an aspect of biology of cassava croaker. However, more studies on this species are recommended for better understanding of its ecology and possible data comparisons in the future.

Keywords- Food and feeding pattern, Sciaenids, Monthly, Fish, Tropics.

Introduction

The Sciaenids comprise a large group of fishes that are related to the species found in the Lutjanidae family. However, they are easily identified by the possession of a spinous dorsal fin that is shorter [1]. This family comprises weakfishes, meagres, drums, and croakers. The fish group croakers, have been found in large quantities along the coastal regions of West Africa [2] and are exploited by industrial and artisanal fishermen [4].

Pseudotolithus is recognized by the presence of a ray-finned in the family *Sciaenidae* [1]. *Pseudotolithus senegalensis,* also known as cassava croaker, is an economically significant bottom-dwelling fish, widely distributed on the West African coastline [1, 5, 6]. They are found in brackish waters, mainly during the dry season but are marine in nature. Their diet includes; shrimps, cephalopods, crabs, and small fish [7] and are reported to have high market demands [6]. The stomach content analyses of fish species enable fish biologists to understand its abundance, distribution, growth, and productivity[8].

These ecological studies provide essential information on fish and allow a better understanding of the appropriate management of their fishery [9]. Ample knowledge of aspects of feeding habits including diets, degree of diet overlaps, and feeding strategies, of a fish population in the wild is important to comprehend their productive capacity and ecological role [10]. Such information is critical to the development of sustainable managementplansandconservation.

Research works on the biology and management of sciaenids includes works of [5, 7, 11,12 13]. Other works include those of [14] who reported aspects of feeding habits of some species of Pseudotolithus in southeastern Nigeria. [15] worked on the feeding habits of this species from Qua Iboe River of the Estuary, Nigeria, [16] reported on aspects of biology on *P. senegalensis* in Ivorian continental waters. [6] studied some aspects of the biology of *Pseudotolithus*

senegalensis and *Pseudotolithus typus* in Lagos Lagoon, Nigeria.

Published information on the diets of this species is scarce in the Niger Delta region in general and the Forcados river estuary in particular. In 2018, [17] compared studies of the growth characteristics of *Macrobrachium macrobrachion* and *Macrobrachium vollenhovenii* in the Forcados river estuary of Nigeria in an earlier study. Due to the economic value of this fish species and scarce biological information in the Forcados river estuary, it was necessary to examine its stomach content to fill some research gaps.

Methodology

The study area

The study area is in the Forcados River estuary in Delta State, Nigeria and lies between latitudes 5º 21' - 5º35' N and longitudes 5º 31' - 5º51' E. The area is characterized by two seasons (rainy and dry). The dry season is usually from November to April while the rainy season starts from May to October [18]. The vegetation cover includes; *Eichhornia crassippes, Pennisetum purpureum, Trapa spp, Pistia,* and *Ceratophyllum spp.* Anthropogenic activities carried out in the study locations include; jetty operations, washing of boats, laundering, swimming, and dumping of both inorganic and organic waste.

ExperimentalProcedure

From April 2017 to March 2019, a total of 1120 fish samples were collected monthly from fishermen and the gut contents were analyzed. The fish were identified using the identification keys of Fisher *et al* [2,] and Idodo-Umeh19].

Gut contentanalysis

The abdomen of each fish was cut open with the aid of a forcep and the content carefully emptied by adding small drops of distilled water. The aggregate of food items was examined under a microscope (10 - 100x).The food items were grouped into major categories for comparison [9] and content were analysed using the occurrence frequency (Fi) method and volumetric analysis index [20, 21, 22, 23, 24, 25].

Occurrence Frequency (Fi) Method

The number of stomachs where each food item occurred was taken note of and expressed as a percentage and examined. This method gives the proportion of the population of fish that feeds on a particular food item.

$$F_i = \frac{100\ ni}{n} \qquad \text{(Eq.1)}$$

Where; *Fi* is the occurrence frequency of food i *ni* represents the number of food i

and *n* is the total number of a digestive tract having food items

VolumetricAnalysis Index uses the formula:

$$MiVi25 = \qquad \text{(Eq.2)}$$

Description: *Vi* represents the volumetric analysis index of the *i* food item;25is multiplication constant used to obtain the percentage; *Mi*represents the mean points ascribed to the*i* food items.

Index of Preponderance was determined by using the descriptions of [25] as follows;

$$IP = \frac{Vi \times Oi}{\Sigma (Vi \times Oi)} \times 100 \qquad \text{(Eq.3)}$$

Where;

Vi is the percent volume of food *i*

*oi*represents the percent occurrence frequency of food i

$\Sigma(Vi\,x\,Oi)$ is the total of Vi x Oi of all food items

The Ivlev, 1961 index was used for selectivity estimations.

$$I = \frac{Ei-Bi}{Ei+Bi} \qquad \text{(Eq.4)}$$

Where;

Ei represents the percentage by the number of taxa i in the stomach contents, while Bi is the percentage by the number of taxa**i** in the benthos.

Results

The result of 1120 stomachs of *P. senegalensis* analysed are presented below. About 1081 (96.66%) of these stomachs contained food items while 39 (3.34%) had empty stomachs. Table 1 shows that small fish had the highest percentage (30.39%) by percent occurrence frequency of food and percent volume of food (41.22 %). The order of preponderance index from the most important food item followed this order - small Fish (56.15 %); shrimps (24.05 %); snails (gastropod) (13.66%),fish scales (4.66 %) and fish bone (1.48 %).

Table 1. Food items (summary) consumed by *P. senegalensis*during the study period

	Percent occurrence frequency of food *(%Oi)*	Percent volume of food *i* (%Vi)	*Vi x Oi*	Index of Prepond-erance -% *(IP)*
Crustaceans				
Shrimps	27.64	19.42	536.77	24.05
Mollusca				
Snails (gastropoda)	9.90	30.8	304.92	13.66
Fish				
Small Fish	30.39	41.22	1252.68	56.14
Fish scales	15.99	6.5	103.94	4.67
Fish bone	16.08	2.06	33.12	1.48
Σ (Vi x Oi)			2231.43	

Variations in feeding habits of P. senegalensis

Fig. 1 shows the monthly trends in the feeding habits of *P. senegalensis.* Fish, gastropods, and crustaceans were regularly fed during the dry and rainy season months and may be attributed to their preponderance during the study period. Crustaceans were consumed more during the dry season with their highest consumption in January 2018. The abundance of crustaceans during the dry season could be as a result of better environmental conditions during this season. The consumption of fish and gastropods was irregular and did not follow any seasonalpattern.

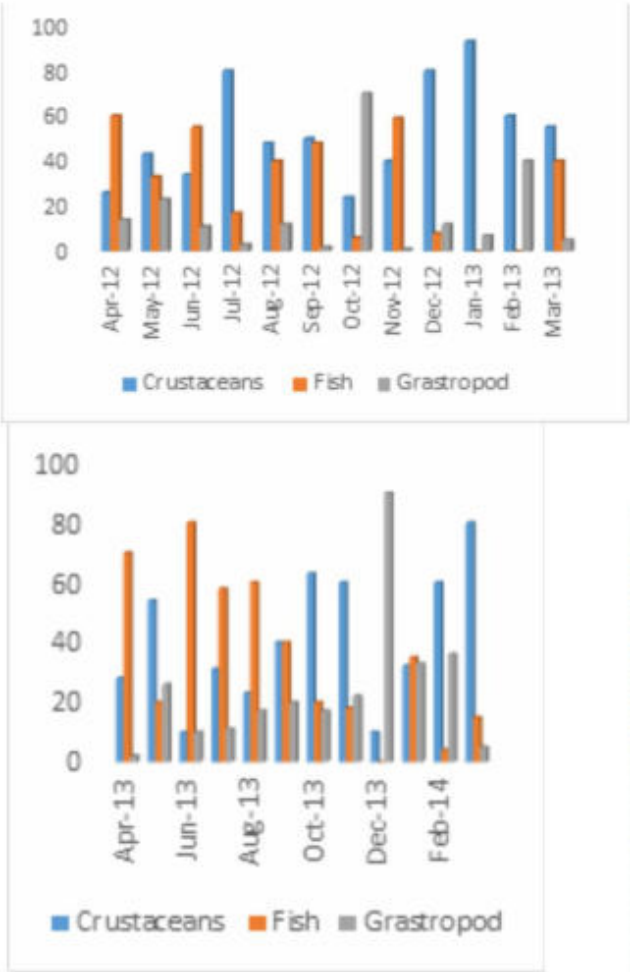

Figure 1. Variations in feeding habits of P. senegalensis throughout the study period

Feeding Intensity of P. senegalensis

Variations in the number of the empty stomach of *P. senegalensis* are presented in *Fig. 2*. There were no empty stomachs in October 2018. The highest number of stomachs without food content was encountered in May 2017 and the least in September 2017 and December 2013. The number of empty stomachs did not follow a regularseasonalpattern.

The highest IP was recorded in mud (46.81 %) followed by detritus (17.59 %), plant materials (8.67 %), desmids (7.6 %), bony fish (6.33 %), crustacean (5.02 %), closterium (2.06 %), diatoms (2.31 %) and rivularia (1.05 %).

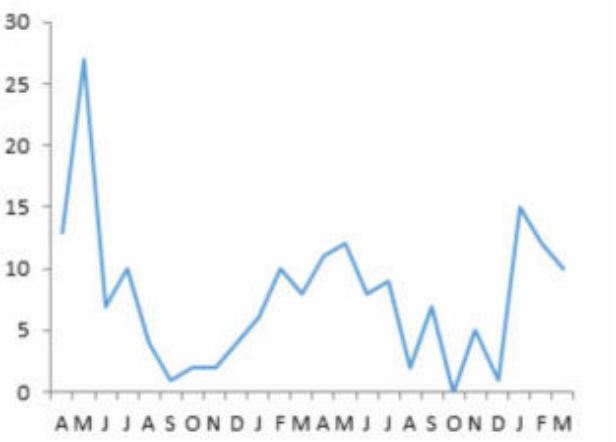

Figure 2: Monthly variation in the empty stomach of P. senegalensisApril2018 – March 2019 selectivity

Table 2. shows food selectivity for macroinvertebrate species taken by *P. senegalensis.* The Ivlev index indicated two macrobenthos as being selected by the fish; shrimp and snails (Gastropoda) with an Ivev index of 0.28 and -0.66 respectively.

Table: 2. Macroinvertebrate selectivity by *P. senegalensis*during the study period

	Stomach %	Macroinvertebrate %	Ivev Index
Crustaceans			
Shrimps	27.64	14.25	0.28
Mollusca			
Snails (gastropoda)	9.90	47.61	-0.66

Discussion

Information on the niche, trophic dynamics, and food chains of a species is often obtained from the analysis of stomach contents [9]. The high percentage (96.66%) of the stomach that had food items indicates that these species were active feeders with plenty of food available in the study area during the period of study. The primary dietary composition of *P. senegalensis* in this study was fish indicating that the species is piscivorous. This was also confirmed by the high preponderance index for small fish. This finding is in agreement with reports from Qua Iboe River estuary by [7, 15] but at variance with reports by [5; 26].

The order of preponderance index from the most important food item indicated that shrimps with 24.05 % were the second most important food item recorded in this study. This might be as a result of their abundance and nutritional value [27, 7]. *P. senegalensis* feeding more on small Fish (56.15 %); shrimps (24.05 %) in this study is in line with earlier reports by [7, 11, 12] in their various studies. The cassava croaker is a benthic and coastal species that feeds mainly on benthic organisms [9]. The data presented here suggest that the cassava

croaker feed on mostly demersal species (epibenthic crustacean, principally penaeids and fish), which is congruent with the assumptions of [5, 7, 13, 26].

The composition of the food items recorded during this study did not show any major seasonal preference and also portrays this species as specialized feeders that depend on a low number of dietary prey items. Thus, feeding well both in the dry season and in the rainy season. This is in line with reports from Qua Iboe River [15]. However, this report is contrary to observation off Benin (West Africa) near shore waters [7] and from the Senegalese coast [9] . Some species have been implicated to shift their diet across seasons and locations due to connectivity to floodplain habitats. Variation in the diet of *P. senegalensis* with the season in both study sites agrees with the observations of several workers in different fish species [7]. The present study revealed seasonal variation in the feeding activity of the cassava croaker indicating the highest amounts of food in the warm season on the Senegalese coast. Seasonal differences in diet presumably reflect the seasonal migration of predators or their prey. This is consistent with the observations of [7], who established that feeding of *P. senegalensis* and its congener *P. typus* was more intense during the major warm season than during any other season on the coasts of Benin. The present data are also consistent with the suggestions of [28], who suggested that fish feeding rates decrease as water temperature drops.

For food selectivity calculations, the macroinvertebrate positively selected indicates that the fish took great advantage of the abundance of shrimps found in the water body. These findings also established the fact that *P. senegalensis* in the study area were benthic feeders.

For a better understanding of this species in the study location, more research needs to be carried out for the sustainable management of this economic fish.

Conclusion

This study provided first-time information on the feeding habits of *P. senegalensis* in the Forcados River estuary. The research findings revealed that during the study periods, *P. senegalensis* were active feeder feeding mainly on small fish. Proper documentation of fishing gear used would help for better comparative studies in the future.

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