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Food and Feeding Habits of *Tilapia guineensis* (1862) in Rumuolumeni Creek, Niger Delta: Implications for Pisciculture

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ABSTRACT The paper investigated the food and feeding habit of a brackish water fish *Tilapia guineenisis* in the Rumuolumeni Creek of the Niger Delta, Nigeria. A total of 1,030 fish specimens were collected consisting of 565 juveniles and 465 adults and examined for stomach content. The 'points' and frequency of occurrence methods were used for the gut content analysis. In the 'points' method, a total of 100 points was given to all the stomach content and these points shared among them as the volume of each item was taken. Only stomachs that were more than half filled were used. The points obtained by each food item from all the stomachs observed were summed and then taken as a percentage of the total. The frequency of occurrence method involve recording the total number of guts in which each food item appeared and using this as a percentage of the total number of individuals examined. The results indicate that the juveniles of *Tilapia guineensis* feed mainly on zooplankton while the adult fish depend more on aquatic plants and invertebrates. It is opined that this mode of feeding could give an insight in feed formulation for intensive culture of *Tilapia guineensis.*

INTRODUCTION

Tilapias are members of the family Cichlidae and are among the most widely produced fishes in the world, second only in importance in aquaculture to the carps. *Tilapia guineensis* is a euryhaline species found along the West African coastline. Interest in this fish for aquaculture is increasing, especially in areas of high and variable salinities which characterize the estuaries and extensive lagoon systems in the Niger Delta region of Nigeria. Tilapia are important food fish in many Tropical and subtropical countries including Nigeria. More than 20 species of tilapia have been cultured in developing countries where animal protein is lacking. Tilapia is considered suitable for culture because of their high tolerance to diverse environmental conditions, their relative fast growth and the ease with which they can be bred.

In Nigeria aquaculture, is the least exploited for fish production. This is a country where aquaculture would have been a major means of flushing malnutrition, low income and unemployment having been endowed with 1,010,000 ha of perennial swamps and 741, 509 ha of brackish water giving a total of 1,751,509 ha suitable for fish farming.

Nigeria has a coastline of about 960 km bordering a coastal zone, with an extensive mangrove ecosystem comprising of lagoons, estuaries, wetlands and series of interconnecting creeks. The coastal zone covers an estimated one million hectares and offers considerable potential for commercial aquaculture. However, aquaculture practices are rare in this zone despite its potentials. Due to the inability of capture fishery to meet the demand of the teeming population (150 million Nigerians) to explore the aquaculture potentials of the coastal zones of the country becomes inevitable. This coupled with extensive freshwater, brackish water and marine sites that could be exploited profitably for aquaculture the need arises to evaluate the food and feeding habits of the fish fauna with a view to establishing brackish water aquaculture. The food and feeding habits of fish will continue to be studied because it forms the basis of a good aquaculture management system. (Oronsaye Nakpodia 2005). Various works have been done on the diets of Tilapia (Fagade 1971; Fagade Olaniyan 1972; Arawomo Fawole 1997; Kuton Ikusemiju 2000; Oso et al 2006; Oribhabor Adisa-Bolanta 2009; Agbabiaka 2010; Agbabiaka 2012). However no published work has been done on the biology of *Tilapia guineensis* in Rumuolumeni Creek of the New Calabar River, Niger Delta, Nigeria.

Objectives

Since feeding constitutes 60 to 65% of the aquaculture business, any species being considered for culture, must be evaluated for its food

and feeding habit with a view to determining the kinds of natural food to be encouraged to grow or artificial feed to be given in the pond or culture medium.

This work therefore serves as a preliminary investigation on the food and feeding habits of *Tilapia guineensis* of the Rumuolumeni Creek in the Niger Delta, Nigeria with a view to understanding the food and feeding habits of the fish thereby encouraging further research and eventual culture of the fish.

MATERIAL AND METHODS

Study Area

The Rumuolumeni Creek is situated South of Tombia and Ogbakiri towns and the northern parts of Rumuolumeni. The creek is an offshoot of the New Calabar River. The fringing forest vegetation include the red mangrove *Rhizophora racemasa* and the white mangrove *Avicennia Africana,* the water is brackish and tidal.

Sampling Procedure

Fish samples were obtained between May and October 2009 from artisanal fishermen. Fishing gear used includes cast nets; gill nets and cane traps. A total of 565 juveniles and 465 adults were examined. Samples were collected in ice chests containing ice blocks and transported to the Biology laboratory of the Rivers State University of Education for analysis. The fish were identified using fish identification guide by FAO (1992). Excess water was drained from the fish with filter paper and the fish weighed with a top loading balance to the nearest 0.lg. Standard length was measured in centimeters with a measuring board. Fish specimens were dissected and the gut was removed. The stomach content was emptied into a petridish after the stomach has been slit open to release the content. The petridish contained a little water to enable agitation and spreading out of the content for identification.

Stomach content analysis was done using a binocular microscope to observe the content of the petridish. The key to the identification of the food items was obtained from Gosner (1971) and Needham and Needham (1984). This method was appropriate because it brings about individual assessment and estimation of majority food items and feeding intensity were made in line with the size of each specimen and there was no problem of system of standards and adjustment for size of individuals. The results were recorded on a raw data sheet. For the fact that very tiny grained particles were found in the gut content the 'occurrence' and 'Points' methods were used for the estimation of food items.

In the frequency of occurrence method (Frost 1943; Hynes 1950) observations were made on each gut and items found were identified and recorded. The total number of gut in which each food item occurred was recorded and taken as a percentage of the total number of individuals examined. This method portrays the organism used as food but not on number or quantity.

In the 'points' method, stomachs that were more than half filled were used. A total of 100 points was given to all the stomach content and these points shared among them as the volume of each item was taken. The points obtained by each food item from all the stomachs observed were summed and taken as a percentage of the total number of points. This method was used by Fagade (1971).

RESULTS

The results of the gut-content analysis of juvenile *T. guineensis* using the points method is presented in Table 1.

Table 1: Gut content analysis of the juvenile *T. guineensis* using the 'points' method
Standard Length range (cm): 2.0 - 4.90
No. of fish examined. 250
No. of empty stomachs: 8

Food items	*Point gained*	*% of total*
Benthic diatoms	3,500	11.18
Decaying aquatic leaves	-	trace
Rotifers		
Brachionus spp	6,000	19.17
Limnia spp	4,500	14.38
Pholidina spp	5,000	15.97
Invertebrates	-	trace
Sand grains	200	0.64
Detritus/mud	3,000	9.58
Filamentous algae	1,000	3.19
Faecal matter	100	trace
Copepod nauplii	2,500	7.99
Nymphea spp	-	trace
Cyanobacteria	5,500	17.57
Total points	**31,300**	

The results of the gut-content analysis of adult *T. guineensis* using the points method is shown in Table 2.

Table 2: Gut content analysis of the adult *T. guineensis* using the 'points' method
Standard Length range (cm): 5.0 - 17.70
No. of fish examined. 200
No. of empty stomachs: 2

Food items	*Point gained*	*% of total*
Benthic diatoms	100	0.18
Decaying aquatic leaves	8,000	30.77
Rotifers		
Brachionus spp	4,000	1.54
Limnia spp	3,000	1.15
Pholidina spp	200	0.77
Invertebrates	4,500	17.30
Sand grains	4,000	15.38
Detritus/mud	5,000	19.23
Filamentous algae	500	1.92
Faecal matter	-	trace
Copepod nauplii	-	trace
Nymphea spp	1,000	3.85
Cyanobacteria	2,000	7.69
Total points	**26,000**	

The results of the gut-content analysis of juvenile *T. guineensis* using the frequency of occurrence method is given in Table 3.

Table 3: Gut content analysis of the juvenile *T. guineensis* using the frequency of occurrence method
Standard Length range (cm): 2.0 - 4.90
No. of fish examined. 300
No. of empty stomachs: 7

Food items	*No. of species in which food items occurred Point gained*	*% of total*
Benthic diatoms	240	80.0
Decaying aquatic leaves	-	trace
Rotifers	-	
Brachionus spp	252	84.0
Limnia spp	215	71.67
Pholidina spp	230	76.67
Invertebrates	10	3.33
Sand grains	8	2.67
Detritus/mud	220	73.33
Filamentous algae	170	56.67
Faecal matter	-	trace
Copepod nauplii	156	52.0
Nymphea spp	10	3.33
Cyanobacteria	264	88.0

Using the frequency of occurrence method (Table 3) the gut-content analysis of the juvenile *T. guineensis* showed the most prevalent food items as cyanobacteria 88%. benthic diatoms 80%; rotifers (*Brachionus spp, Limnia spp, Pholidina spp*) as having 84%, 71.67% and 76.67% respectively. Other food items of relative importance include detritus/mud 73.33% filamentous algae 56.67% and copepod nauplii 52%.

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The results of the gut-content analysis of adult *T. guineensis* using the frequency of occurrence method is given in Table 4.

Table 4: Gut content analysis of the adult *T. guineensis* using the frequency of occurrence method
Standard Length range (cm): 5.0 - 17.70
No. of fish examined. 260
No. of empty stomachs: 3

Food items	*No. of species in which food items occurred Point gained*	*% of total*
Benthic diatoms	47	18.07
Decaying aquatic leaves	206	79.23
Rotifers	-	
Brachionus spp	24	9.23
Limnia spp	16	6.15
Pholidina spp	19	7.31
Invertebrates	.233	89.62
Sand grains	.218	83.85
Detritus/mud	201	77.31
Filamentous algae	10	3.85
Faecal matter	6	2.31
Copepod nauplii	4	1.54
Nymphea spp	25	9.62
Cyanobacteria	36	13.85

The frequency of occurrence method (Table 4) further revealed the most conspicuous food items found in the gut of adult *T. guineensis* as invertebrates, decaying aquatic leaves, sand grains and detritus/mud with 89.62%; 79.23%; 83.85% and 77.31% occurrence respectively. Other minor food items include benthic diatoms 18.07% and cyanobacteria 13.85%.

DISCUSSION

The result of the findings in this study indicate that the dominant food items for *Tilapia*

guineensis juveniles at the Rumuolumeni Creek, Niger Delta, Nigeria are rotifers (*Brachuoius spp, Limnia spp, and Pholidina spp*), 19.17, 14.38, 15.97 percent respectively. Cyannobacteria and benthic diatoms 17.57% and 11.18% respectively are also important. Other food items of some relevance include detritus/mud 9.58% and copepod nauplii 7.99% using the 'points' method (Table 1). The gut-content analysis of the adult *T. guineensis* using the 'points method revealed the dominant food item as decaying aquatic leaves 30.77% and detritus/mud 19.23% (Table 2).

Thus from both the 'point' and frequency of occurrence methods, the most important food items for the juvenile *T. guinessnsis* as revealed by this work are similar (rotifers, benthic diatoms, cyanobacteria) with detritus/mud and copepod nauphii as minors. These findings agree with the work of Mahatane, (1986). In general the juvenile *T. guineensis* of the Rumuolumeni creek are zooplankton feeders.

In the case of the adult *T. guineensis* the result of the present investigation suggest the most dominant food items from both the 'point' and frequency of occurrence methods as decaying aquatic leaves, invertebrates, sand grains and detritus/mud. The feeding habits of the adult *T. guineensis* also agree with the findings of Fagade (1971) who reported the fish to be feeding on algae, detritus, sand and invertebrates in the Lagos Lagoon. Campbell (1987) described it as the only true estuarine leaf chewer. Cisse (1985) and Mahatane (1986) considered it as macrophagous and a benthic grazer. The finding in this work is further corroborated by that of Oribhabor and Adisa-Balanta (2009) and Agbabiaka (2012). Generally, one can only infer that *T. guineensis* in the Rumuolumeni Creek; Niger Delta, are opportunistic feeders that are able to consume and digest quite a variety of food items available in the environment, switching from mainly zooplankton diets at the juvenile stage to aquatic macrophytes and invertebrates in adulthood.

IMPLICATIONS FOR PISCICULTURE

Fishes as all other animals require adequate nutrition in order to grow and survive. Through observations in the field and the examination of the contents of digestive tracts, a lot has been learnt concerning the feeding behaviour and the kinds of organisms that are eaten by fish.

It is to be expected that a group as widely adapted to a variety of foods, some fishes feed exclusively on plants, others feed only on animals where as a third and large group derives its proteins, carbohydrates and fats, as well as vitamins and most minerals necessary for growth and upkeep from both plant and animal sources.

Due to natural fluctuations in abundance, any one-food organism is not of constant numerical availability to fishes. Such fluctuation of forage organisms are often cyclic and due to environmental factors, life histories or climatic.

Abundance of a potential feed species often determine whether or not it will be eaten by fishes in the wild, for indeed availability is a factor in determining what a fish will eat. Most fishes are highly adaptable in their feeding habits and utilize the most readily available foods.

The type of food a fish feeds on in the wild is an indicator to its feeding habits and this gives an insight in aquaculture to the type of feed formulated.

The cost of feeding has long been recognized as the major cost in aquaculture (De-Silva 1989; Tacon 1993; Anupama 2000; Sogbesan et al. 2004). It has been documented Falaye (1992) that feed cost claims about 60% of the recurrent cost of the fish farming ventures.

The zooplankton diets of the juveniles suggest that at this stage of development the fish could accept crumbles from a protein source such as blood meal to prepare a balanced protein diet. The feeding habits of the adult fish also suggest that it could readily accept pelleted feeds made from edible plant leaves and other inexpensive agricultural by-product. It is hoped that the findings in this work will give fish culturist, fish nutritionists and feed technologists an insight in the choice of feed ingredients to use in compounding artificial diets for the juvenile and adult *T. guineensis* respectively under intensive culture system. Further research is needed in this area.

CONCLUSION

The kinds of food a fish feeds on in the wild gives an insight into its feeding habits as an aquaculture species. The switch from Zooplankton diet as juveniles to aquatic macrophytes and invertebrates as adults *T.guineensis* could suggest higher protein needs of the juveniles than

the adults. It is also an indication that as the fish grows older the size of food increases.

From the following, *T.guineensis* is a feasible candidate for aquaculture in the brackish water or estuarine habitats of the Niger Delta region of Nigeria. If adequate care is taken of the food and feeding by encouraging the growth of natural food organisms and or supplemented with artificial feed. This study will further stimulate research in this area.

RECOMMENDATIONS

Fish farmers in this country should be encouraged to harness the vast fisheries potentials of the Niger Delta region with an extensive mangrove ecosystem consisting of Lagoons, estuaries, wetlands and a series of interconnecting creeks. Government and other corporate organizations like the oil companies should assist in this regard to develop brackish water pisciculture since capture fisheries has not been able to satisfy the fishery needs of the people.

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