TROPHIC STATUS OF THE RIBBONFISH (*Trichiurus lepturus*, LINNAEUS 1758) (PISCES: TRICHIURIDAE) FROM THE DISTANT WATERS OFF QUA IBOE RIVER ESTUARY, NIGERIA.

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ABSTRACT

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Literature on the biology of the ribbonfish, Trichiurus lepturus in Nigerian coastal waters is scanty. The present study therefore examines aspects of the trophic biology of the species for a 12-month duration. The ribbonfish is a piscivore-invertivore in feeding habits with a narrow trophic spectrum. Its major dietary groupings comprised Pisces (Sepia elegans, juveniles of Trichiurus lepturus, unidentified juvenile fish and fish remains), Crustacea (Macrobrachium species, Penaeus notialis, unidentified shrimp remains and Squilla aculeata calmani), Algae, plant matter and abiogenic sand. Variations in stomach fullness indices showed that feeding intensity of the ribbonfish increased with months. Save for September, there was similarity in the monthly pattern of the unadjusted food richness (UFR) and adjusted food richness (AFR). Intersexual variation in dietaries revealed that while the male fishes did not consume Algae, Squilla aculeata calmani and plant matter, the complete array of the food items reported in this study were ingested by the females. The females ingested more dietaries and were higher also in feeding intensity vis-a-vis the males. However, the higher diet diversity index in the male population of Trichiurus lepterus over their female counterparts was in concomitant with the theory of foraging performance.

Keywords*: Diets; gut fullness indices; feeding intensity; ribbonfish; piscivore-invertivore; T. lepturus*

INTRODUCTION

Ribbonfish, *Trichiurus lepturus* is documented as one of the fish assemblages in the Atlantic eastern central (CECAF) fishing area 34 (FAO, 1981). The *T. lepturus* represents an important group of food fish in the Nigerian waters. Along Qua Iboe River estuary where this study was conducted, it is a delicacy and a source of protein. It is exploited by a variety of gears from hand lines, drift gill nets, set nets and trawl nets. In the last decades, the fish has been reported in the United Nations Food and Agricultural Organization (FAO) statistics as one of the ten marine species with the highest landing worldwide (Mello *et al.*, 1992; Haimovic *et al.*, 1994). Apart from its commercial importance in some regions of the world, ribbonfish is notable for its trophic position in coastal areas where it behaves as a carnivorous species (Chiou *et al.*, 2006). Save for report by Abowei *et al*. (2009), on length–weight relationship and condition factor of five (5) fish species, including the ribbonfish, from Nkoro River, Niger Delta, Nigeria, no literature was encountered on the biology of the *T. lepterus* in Nigerian coastal waters.

Preliminary reports on its food and feeding habits off the coastal waters of Qua Iboe River estuary, Nigeria, revealed that it is a piscivore–invertivore with aggressive affinity for piscine dietaries; it feeds more during the wet seasons *vis-a-vis* the dry months (Udo *et al.*, 2014). In spite of the importance of *T. lepturus* landings to Nigerian artisanal and industrial fisheries, very little attention has been given to its biology and ecology. Considering this paucity of information, the present study on the trophic status of *T. lepturus* from the distant waters off Qua Iboe River estuary was conducted. This involved a 12-month assessment of the diet and feeding intensity of the fish in relation to status, temporal and intersexual dynamics.

MATERIALS AND METHODS

Description of study area

This study was carried out off the Qua Iboe River estuary at Iwuochchang fishing settlement in Ibeno, Ibeno Local Government Area, Akwa Ibom State. Qua Iboe River estuary is located in the south-east flank of Nigeria (Fig. 1). It is one of the largest and well known estuaries along the West African Sub region (Akpan, 1999).

Sampling method

A total of 483 fish specimens of *Trichiurus lepturus* were collected (March, 2014 – February, 2015) from trawl landings at Iwuochchang fishing settlement in Ibeno, Akwa Ibom state. The collected samples were transported to the laboratory in coolers containing ice. In the laboratory, the specimens were washed and preserved in 10% formalin for further analysis. The gut of each specimen was slit open and contents emptied into a petri-dish. The contents were accessed physically and by use of microscopes (magnification x40 – 100) and were sorted and identified according to their taxonomy using relevant keys. The integrated importance of each item was then expressed by the Food Preponderance Index (FPI) (King, 1991). This index has a range of 0 to 100%; items with FPI ≥ 10% were considered as primary dietaries, those with FPI = 1.0 to 9.9% was considered as secondary items and those with FPI < 1.0% as incidental items. There exist several methods for expressing the quantitative

importance of different food items in the diet of fish (Hyslop, 1980; Nataragran, and Jhingram, 1961). Those used in the present study were:
Vacuity index (i.e. number of empty guts divided by total number of gut multiplied by 100).
Average gut fullness (AGF: point scores of each gut proportional to its degree of fullness according to an arbitrary 0 – 20 scale (i.e. 0, 5, 10, 15, 20). Gut repletion index (GRI: i.e. number of non-empty gut divided by the total number of gut multiplied by 100). Test of significance (t-test statistic) was used to evaluate intersexual differences in feeding intensity using the indices of feeding gut fullness (AGF and GRI).

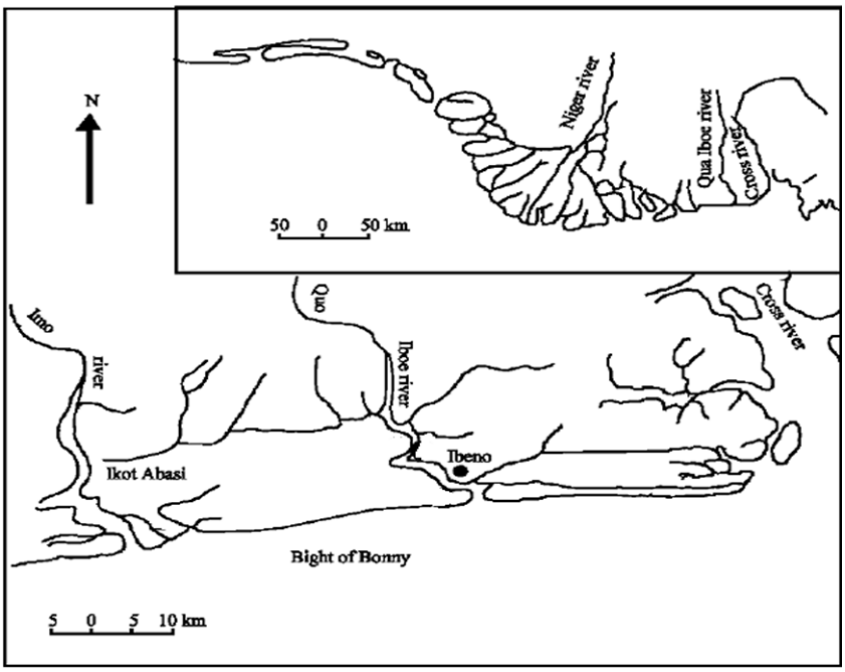

Fig 1. Map of Southeastern Coast of Nigeria showing the Qua Iboe Estuary. Inset: The Coast of Nigeria showing the Qua Iboe River

RESULTS

Of the 483 specimens of *Trichiurus lepturus* (17.5 cm – 85.0 cm TL) examined for food and feeding habits (Table 1) 380 (78.6%) contained food. 103 (21.4%) had empty guts, 267 (70.3%) had partially filled guts, while 113 (29.7%) were full guts.

Overall variations in diets and feeding intensity

The overall trophic spectrum of *T. lepturus* (Table 2) revealed the utilization of a narrow category of food resources, which were assigned to five major groups viz: Algae (Chlorophyceae), Crustacea (*Macrobrachium* species, *Penaeus notialis*, unidentified shrimp remains and *Squilla aculeata calmani*) Pisces (*Sepia elegans*, juveniles of *T. lepturus*, unidentified juvenile fish and fish remains), plant matter, and abiogenic sand. The feeding pattern was overwhelmingly carnivorous with 69.8% of the diet comprising Pisces, 28.9%, Crustacea, 1.1% Algae, 0.1% plant matter and sand grains less than 0.1% FPI. Of the 10 food items that formed the 5 major groupings, Pisces and Crustacea were primary dietaries only.

Monthly variations in diet and feeding intensity

Monthly dynamics in food richness ranged from 5 to 11 (Table 3), high values were recorded all year round except in September which recorded the lowest value of 5. Fish remains (Pisces) pre - dominated in all months with peaks in October, November and December. Shrimp remains, *S. elegans* and fish remains were of primary importance throughout the study period. Sand grains were only encountered between December and February as incidental food items, plant matter occurred only between June and August only as incidental food items. The monthly rhythms in diet breadth showed high variability with values ranging from 0.618 – 0.765.

Table 1: Monthly variations in lengths and weights of *T. lepturus* examined for food (March 2014 – February 2015)

Month	N	Total length (TL, cm)	Total weight (TW, g)
March	41	29. 5 – 85.0	15.66 – 415.61
April	42	17.5 – 72.0	12.71 – 239.00
May	40	23.1 – 80.6	19.61 – 397.41
June	35	20.1 – 77.5	55.96 – 240.65
July	40	22.0 – 71.0	9.06 – 306.86
August	40	25.5 – 65.0	20.32 – 226.90
September	40	28.0 – 66.0	16.71 – 241.24
October	40	43.0 – 61.0	50.50 – 141.34
November	41	37.0 – 66.0	35.60 – 275.00
December	44	26.0 – 69.0	15.66 – 193. 25
January	40	22.1 – 70.0	18.07 – 181. 73
February	40	31.5 – 71.5	19.26 – 202.19

Table 2: Overall and sex-dependent variations in food composition of *T. lepturus*

Food item	Food Preponderance Index (%FPI)		
	Overall	Males	Females
Algae			
Chlorophyceae	1.1	0	1.1
Crustacea			
Macrobrachium species	10.3	1.0	2.6
Peneaus notialis	5.1	0.1	3.0
Unidentified shrimp remains	13.4	17.2	13.2
S. aculeate calmani	0.1	0	***
	(28.9)	*(18.3)*	*(18.8)*
Pisces			
T. lepturus	8.6	12.5	14.6
Unidentified fish juveniles	18.8	6.8	8.0
Fish remains	16.7	46.9	44.8
Sepia elegans	25.7	15.4	12.3
	(69.8)	*(81.6)*	*(79.7)*
Plant matter	0.1	0.1	0.3
Sand grains	***	0	0.1
UFR		9	12
AFR		1.607	1.451
Diet breadth		0.736	0.707

*** = % FPI value < 0.1

Table 2. Monthly variations in food composition of *T. lepturus*

Food item	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Algae												
Chlorophyceae	0.3	0.1	4.5	0.1	0.3	0.2	-	3.9	2.6	1.7	0.2	0.4
Crustacea												
Macrobrachium species	2.5	5.2	8.3	5.4	9.7	0.2	-	3.9	4.3	1.7	1.4	2.0
P. notialis	-	1.5	3.7	3.0	7.9	6.4	-	8.6	-	10.7	5.9	-
S. aculeata calmani	-	-	-	8.8	1.3	-	-	1.8	-	-	-	-
Unidentified shrimps remains	15.4	9.8	3.1	18.2	18.0	14.6	15.7	3.6	11.2	15.7	17.4	20.1
Pisces												
S. elegans	14.1	37.8	41.5	17.2	12.4	17.3	17.5	33.8	14.8	19.5	13.2	14.1
T. lepturus (juveniles)	14.7	4.8	25.5	17.6	16.1	14.4	-	-	-	-	12.9	15.0
Unidentified fish (juveniles)	25.5	11.2	6.3	13.0	12.4	19.0	19.3	-	21.0	12.1	21.0	21.1
Fish remains	27.4	29.9	4.6	16.0	21.3	26.0	46.2	41.3	42.5	37.1	25.0	22.9
Plant matter	-	-	0.5	0.7	0.1	-	-	0.8	-	-	-	-
Sand grains	***	0.7	2.0	-	0.5	1.9	1.3	2.3	3.6	1.5	3.0	4.4
UFR	8	9	10	9	11	9	5	9	8	9	10	9
AFR	1.01	1.63	1.64	1.20	1.50	1.21	0.72	1.48	1.31	1.50	1.60	1.20
Diet breadth	0.618	0.729	0.718	0.691	0.765	0.720	0.628	0.720	0.713	0.749	0.72	0.71

UFR = Unadjusted food richness; AFR = Adjusted food richness; *** %FPI < 0.1

The monthly changes in stomach fullness condition (Fig. 2) showed that peak values in mean average gut fullness condition (AGF) occurred between May – September, December – March and was at its lowest between September – December and April. These results indicate high feeding intensity in May – September and December – March.

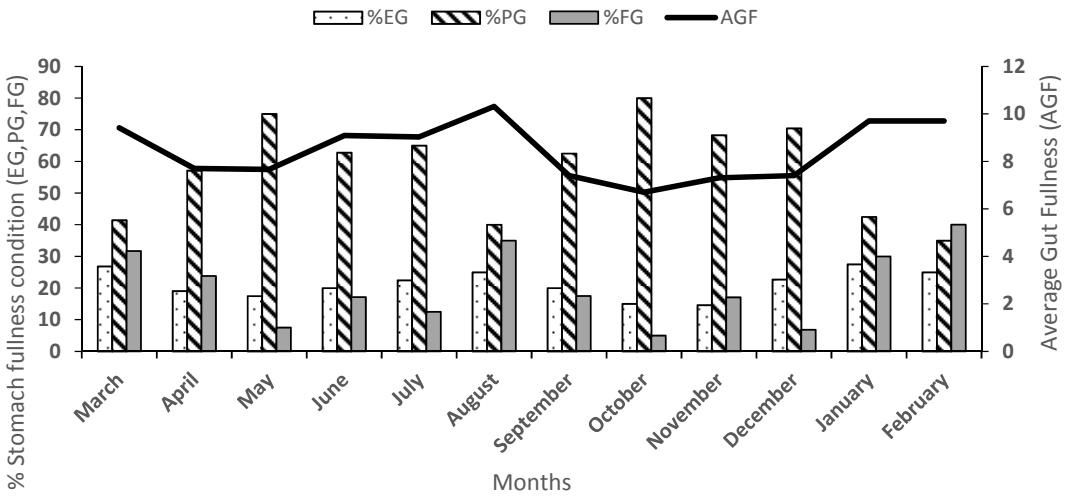

Fig. 2: Monthly Stomach fullness condition

Intersexual variation in diet and feeding intensity

Sex dependent changes in food composition of *T. lepturus* are summarized in Table 2b. Food richness was higher in females than males. Chlorophyceae and *S. aculeata calmani* were not ingested by males, while the complete array of items in Table 4 was consumed by the females. The Figures 3 and 4 illustrate the stomach fullness conditions in both sexes. Males and females were observed to exhibit similar trend in average gut fullness (AGF) index with peak values in January and September. Nevertheless, females were higher in feeding intensity of average gut fullness (AGF) ($p< 0.05$) than males. The study showed also that females ingested more dietaries than their male counterparts, thus buttressing that they fed more than the latter.

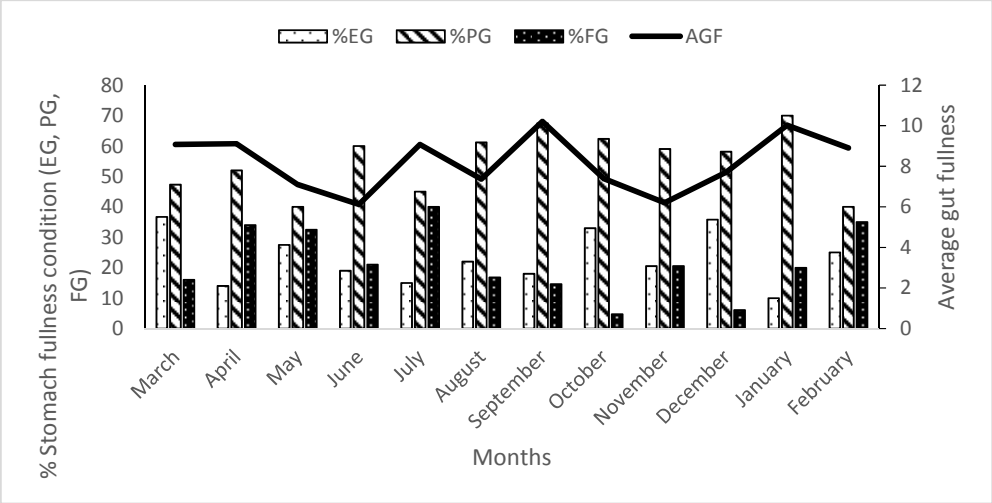

Figure 3: Stomach fullness condition of male *T. lepturus*

DISCUSSION

The *Trichiurus lepturus* from Qua Iboe River estuary are piscivorous cannibals. They fed mostly on Pisces and Crustacea, while Algae, plant matter, and sand grains were of subsidiary importance. The trophic status of the fish can be primarily assigned to open and mid water foraging. The preliminary report of a 6-month study of Udo *et al*. (2014) is broadly similar to the present findings. Most of the gut contents analyzed portrayed reliance on piscine dietaries. The findings confirmed the reports of Ghosh *et al*. (2014) and Udo *et al.* (2014). This report on *T. lepturus* is also in agreement with several workers who documented that the behaviour of piscivorous species primarily associated with the consumption of pelagic organisms could be an adaptation stratagem to maximize food hunt time. In south Brazil, adults of *T. lepturus* fed on a wide range of larger prey, such as anchovy, sciaenid fish, cephalopods and coastal shrimps, as well as euphausiids; abundance of this cutlassfish may be explained by the fact that it is adapted to feed on a wide size-range of both pelagic and demersal prey (Martins *et al*., 2005).

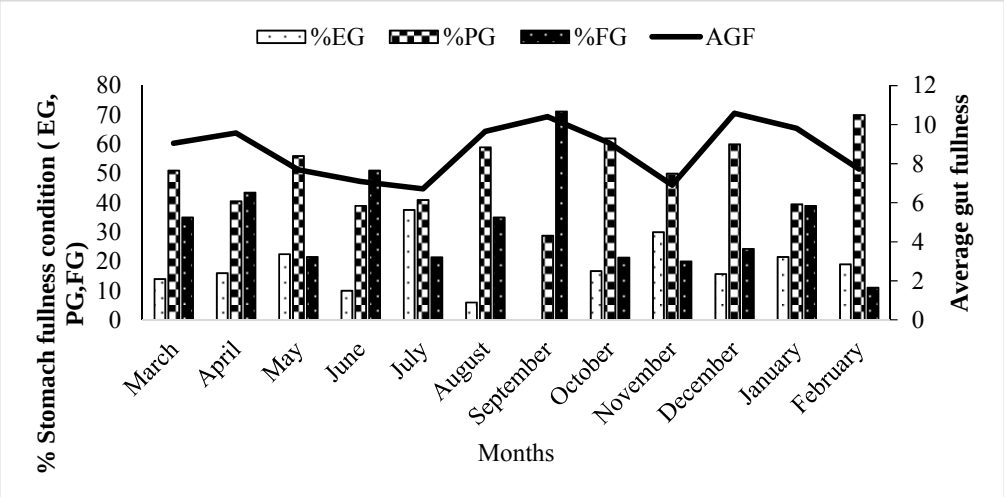

Fig. 4: Stomach fullness condition of female *T. lepturus*

However, the narrow food spectrum observed during this study is similar to that reported by Ghosh *et al*. (2014) and it suggests that there seem to be a competition for food between conspecifics and congeners occupying the same water biotope thus resulting in adult *T. lepturus* feeding on their young ones. In a similar report, the preferred prey of this predator (*Trichiurus lepturus*), in the inner continental shelf from northern Rio de Janeiro State, southeastern Brazil, composed of fish co-specifics, *Pellona harroweri*, *Chirocentrodon bleekerianus*, *Lycengraulis grossidens*, *Peprilus paru*, squid *Doryteuthis plei*, and shrimp *Xiphopenaeus kroyeri* (Bittar *et al*., 2012). The feeding intensity of females of *T. lepturus* was significantly higher than those of the males. The precise reason for this difference is uncertain but could be attributed to sex-related differential energy requirements. The observed sex relative divergence in food habits of *T. lepturus* were food items like Algae, the Guinea mantis (*Squilla aculeata calmani)* and plant matter that were not consumed by the males probably reduces intersexual competition for food resource and is important for the estuary`s ability to sustain large population of fish (King *et al*., 1991).

The monthly dynamics in the relative importance of the food items eaten by *T. lepturus* are probably due to temporal pattern in their availability and abundance of the food resources in the estuary. The proportion of empty stomachs of *T. lepturus* observed in the present study is high in comparison to the value recorded by Udo *et al.* (2014) in the same population off Qua Iboe River estuary. The large proportion of the observed empty stomachs may be due to the fact that feeding is restricted to certain period of the day and the specimens studied were probably caught during low feeding activity. The present study revealed that feeding intensity of *T. lepturus* increased with months and peaked in May – September, and December – March, noting that Udo's *et al.* (2014) work was limited to 6 months (August – January) only. It may also be attributable to a generally low feeding activity of the population which maybe induced by low availability and abundance of specific food resources in the waters. However, this assertion needs further investigation. On the whole, it is documented that large adults of *Trichiurus lepturus* feed near the surface during the daytime and migrate to the bottom at night (Parin, 1986; Muus and Nielsen, 1999).

The present study revealed high unadjusted food richness (UFR) in females *vis-a-vis* the males, with the expected attendant higher values of adjusted food richness (AFR) and diet breath in the latter (i.e. according to the theory that diet diversity is predictably responsible to resource availability (Angermeier, 1985). The overall stomach contents (Table 2) showed that the 11 food objects re-classified into 5 major groupings that were eaten by *T. lepturus,* compares favourably with the 12 food objects and 6 groupings reported by Udo *et al.* (2014) for the same species in the same study area. However, feeding ecology of largehead hairtail (*Trichiurus lepturus*) in the South China Sea showed general omnivore while the hairtail, *T. margarites* p*scivore* (Yan *et al*., 2011).

CONCLUSION

The *Trichiurus lepturus* has a wide pelagic distribution and such constitutes accessible resource for exploitation. That this fish species should still be caught by the artisanal and industrial efforts, a dire study of its biology and ecology becomes very imperative. The present study on the species' trophic status is adaptively significant for a fish that is adjudged as the 10th most landed fish species in the world but in Nigeria there is no formally established fishery, in addition to the limited information on aspects of its biology in the study area. The concerted efforts will fill in many gaps which still exist on our knowledge of this piscivore-invertivore fish species in the Nigerian coastal water ecosystem.

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