The dietary habits of the upside-down catfish, *Synodontis membranaceus* (Osteichthyes: Mochokidae) in Jebba lake, Nigeria

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Abstract: Dietary habits of the up side-down Mochokid catfish, *Synodontis membranaceus* were investigated for 24 months (April 2002-March 2004, in Jebba lake, Nigeria) using frequency of occurrence, numerical, gravimetric and index of relative importance (RI) methods. The fish is euryphagus and feeds more at night. RI values indicate that 10 of the 16 food items were major diet components. The main five food categories are detritus (10.64 %), *Aspatharia* (9.08 %), plant parts (8.85 %), seeds (8.61 %) and *Spirogyra* (8.43 %), while the 5 less prominent food categories were gastropods (7.05 %), insect appendages (6.88 %), copepods (6.31 %), adult *Povilla adusta* (5.89 %) and coleoptera larvae (5.36 %). The remaining six food items, dragon flies, *P. adusta* larvae, chironomid larvae, *Daphnia,* water mites and fish scales had RI values considerably under 5 %. The prominence of detritus in the diet indicated that the fish is a bottom or benthic feeder. The wide variability in food supply enables *S. membranaceus* to maintain its overwhelming prominence in Jebba lake, and its euryphagus habit makes it suited for pond culture. Rev. Biol. Trop. 56 (2): 931-936. Epub 2008 June 30.

Key words: *S. membranaceus*, food, trophic activity, Jebba lake, Nigeria.

The genus *Synodontis* is among the most favoured edible fish in Northern Nigeria (Reed *et al*. 1967), owing to their overwhelming abundance in the artisanal fisheries. It contributes a large proportion to the annual fish landings in the region. The genus consists of many species, some of which are commercially more important. *Synodontis membranaceus* is generally preferred by fishermen and consumers because of their relatively large sizes. They command a higher market value than other species of the genus. In Jebba lake, *S. membranaceus* is the dominant species, occupying unique and prominent position in the commercial fisheries of the lake (Owolabi 2005). It is highly relished either fresh or smoke-dried. The study of dietary habits of fishes based on stomach content analysis is widely used in fish biology and ecology to indicate the position of a species within a food web and to provide information on the contribution of different prey items to the diet. Information about the food habits of fishes is useful in defining predator-prey relationships, estimation of trophic level (Sa-a *et al*. 1997) and in the creation of trophic models as a tool to understanding complex ecosystems (Lopez-Peralta and Arcila 2002). *S. membranaceus* has been found to be a typical example of fish without strict feeding habit. It is regarded as omnivore, because of its ability to use just any food material present in its habitat. Many food types ranging from insects, planktons, molluscs to fish and crustaceans have been observed in the stomachs of *S. membranaceus* in different waters. In lake Chad, Blache (1964) documented the presence of plant materials, mud deposits and plankton in the stomach of *S. membranaceus*, while Bishai and Abu-Gideiri (1965) working on River Nile at Khartoum reported that its food consists of plankton, mud deposits and insect larvae. While the species fed on plant materials and mud deposits

in lake Volta (Petr 1967), Willoughby (1974) observed that plant materials and insect larvae constitute the diet of the species in lake Kainji. In lower River Benue, the fish is described as omnivore feeding on insects, fragments of higher plants, molluscs, bottom deposits and fish scales (Fagade 1983). Apart from the fact that information provided by these studies has proved inadequate since few specimens were examined; no information exists on the feeding intensity and diel feeding pattern of *S. membranaceus*. Even though *S. membranaceus* constitutes an important part of the ichthyofauna of Jebba lake, its food composition, position in the food web of the lake, intensity of feeding and diel feeding activity is not yet ascertained. This study is therefore aimed to identify the dietary items of *S. membranaceus,* its trophic activities and position in Jebba lake.

MATERIALS AND METHODS

Jebba lake (9°10' to 9°55' N and 4°30' to 5°00' E) was formed in August 1993 as an impoundment in the valley of River Niger. It extends from the dam-site at Jebba to southern tip of Kainji dam. The lake is therefore unique as the first and only man-made lake in Nigeria that has a direct inflow from another man-made lake located upstream. It is bounded by Kwara State on the West and Niger State on the East. The lake has a surface area of $303x10^6$ m^2, length of 100 km, maximum depth of 33.0 m; maximum width of 10.0 km; and maximum volume of 1 $000x10^6$ m^3. One sampling station was selected from each of the three zones (basins) i.e. Dam-site from the Southern basin (maximum depth: 23.0 m), Old Gbajibo from middle basin (maximum depth: 27.0 m) and Faku from the Northern basin (maximum depth: 33.0 m).

Bi-monthly collection of 1 208 fish specimens was carried out for 24 months (April 2002 to March 2004) using gill nets of different mesh sizes ranging from 5.08 cm to10.16 cm. Of this, 310 fish specimens were caught during the day and night (i.e. 128 during the day and 182 at night) at three hours interval. Fishes caught were identified using the meristic features provided by Willoughby (1974) and were put in ice chest to reduce post humous digestion.

In the laboratory, the total and standard lengths (to the nearest cm) and weight (to the nearest g) of each specimen were measured following the procedure of King (1996) after blotting out excess water on the fish. Each specimen was slit open and its degree of stomach fullness rated as 0 (Empty; ES), 1 (quarter-full; QFS), 2 (half-full; HFS), 3 (three quarter-full; TQF) or 4 (Full stomach; FS). The fullness proportions (%) of each stomach was used to evaluate feeding pattern and the diel feeding activity.

The contents of the stomachs were emptied into separate petri dishes and the items identified to the lowest taxonomic level according to the method of Ward and Whipple (1950). The contents were analyzed instantly, but when this was not possible, the contents were preserved in 4 % formaldehyde. Frequencies of occurrence, numerical and gravimetric methods (Ricker 1968, George and Hadley 1979) were employed in the analysis of the gut contents. To reduce bias, dietary importance of food items was determined using the relative importance (RI) index (George and Hadley 1979, Hyslop 1980). Food items with RI >5.0 % were considered major or important food items.

RESULTS

Of the 1 208 *S.membranaceus* examined, 366 (30.29 %) had empty stomachs, 202 (16.72 %) quarter-full stomachs, 194 (16.06 %) half-full stomachs, 172 (14.25 %) three quarter-full stomachs and 274 (22.68 %) full stomachs. The diel feeding pattern (Fig. 1) shows that the stomachs were fuller, at least, half-full during the night and at dawn (20.00-05.00 h), with a higher percentage of FS (20.3), TQF (22.5), HFS (29.1) and lower ES (13.7) recorded respectively than during the day. The food items found in the stomachs (Table 1) showed that the variety of food items comprised organisms of both plant and animal materials as

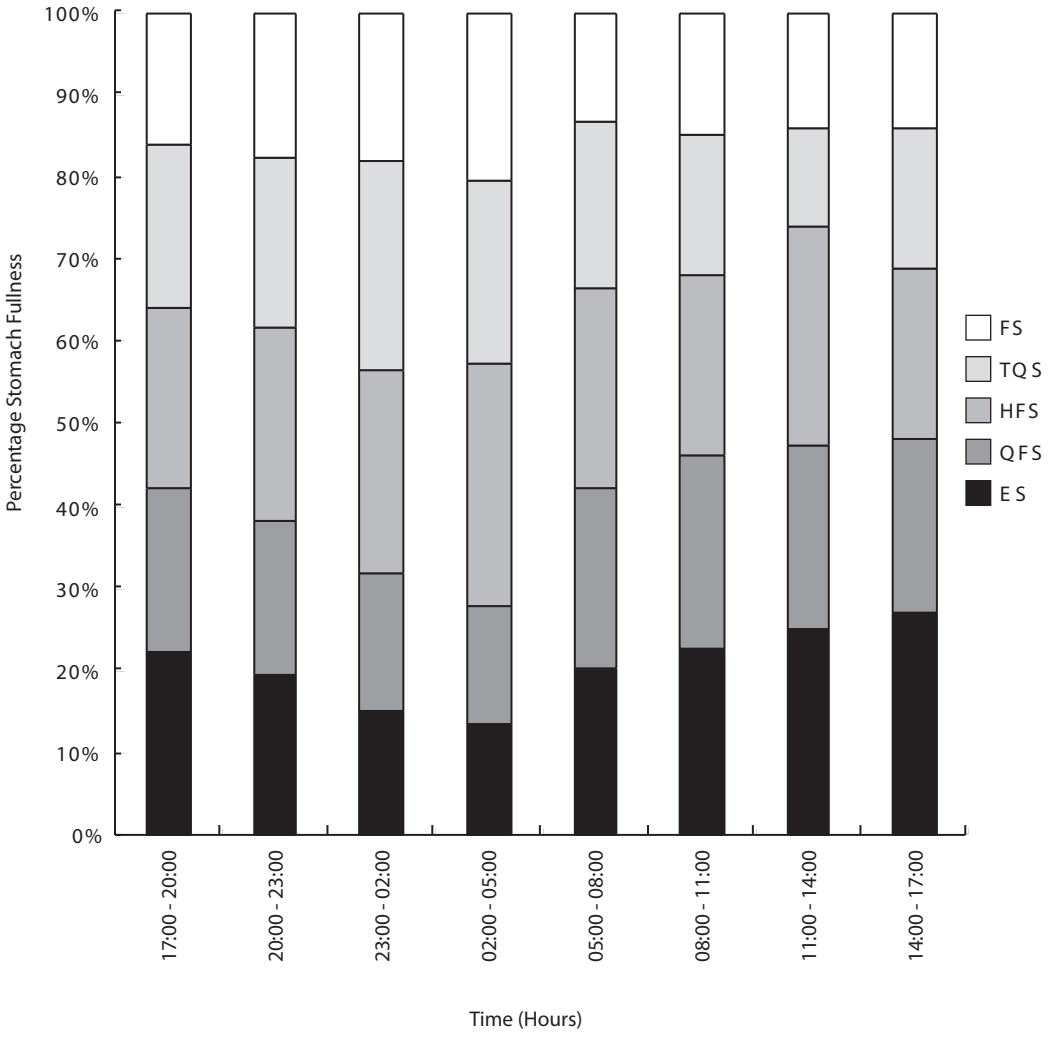

Fig. 1. Diel variation in stomach fullness of *S. membranaceus* from Jebba lake, Nigeria.

well as detritus. The most important plant food consumed were materials in form of aquatic plants, which occurred in 49.76 % of stomachs, accounting for 3.68 % by weight. The most frequently utilized food types were the insects. They were, however, encountered in their dismembered form in 39.67 % of the stomachs representing 1.88 % of stomach contents by weight. However, of all the dietary items, detritus contributed most by occurrence (51.54 %) and by weight (12.84 %), while fish scales and water mites were less significant.

Of the 16 food items ingested by *S. membranaceus*, 10 constituted major food items. The ranking or relative importance index (RI) established five of them as most prominent food categories viz detritus (10.64 %), *Aspatharia* (9.08 %), plant parts (8.85 %), seeds (8.61 %) and spirogyra (8.43 %); while the relatively less prominent foods were gastropod (7.05 %), insect appendages (6.88 %), copepod (6.31 %), adult *P.adusta* (5.89 %) and *Coleoptera* larvae (5.36 %). The remaining food items showed no great significance as their RI values were

TABLE 1
Diet composition and relative importance index (RI) of major food items in the stomach of S. membranaceus *from Jebba lake, Nigeria*

Food item	Occurrence method		Numerical method		Gravimetric method		RI
	No	%	No	%	Weight (g)	%	
PLANT							
Plant parts	419	49.76	*	*	23.62	3.68	8.85
Spirogyra	415	49.29	*	*	10.32	1.61	8.43
Seeds	209	24.82	5,125	12.15	97.36	15.17	8.61
ANIMAL							
Insect appendages	3.34	39.67	*	*	12.09	1.88	6.88
Aspatharia sp	210	24.94	5,790	13.93	102.81	16.02	9.08
Gastropods	179	21.26	4,490	10.64	68.25	10.64	7.05
Povilla adusta (adult)	174	20.67	4,044	9.59	34.39	5.36	5.89
Dragon fly (adult)	134	15.91	3,191	7.57	37.37	5.88	4.86
P. adusta (larvae)	138	16.39	3,001	7.12	16.62	2.59	4.32
Chironomid larvae	121	14.37	2,460	5.83	17.92	2.79	3.81
Coleoptera larvae	166	19.72	4,105	9.87	18.21	2.84	5.36
Copepod	165	19.59	3,590	8.51	64.43	10.04	6.31
Daphnia	139	16.51	2,782	6.59	21.87	3.41	4.39
Water mite	110	13.06	2,574	6.10	21.59	3.37	3.74
Fish scales	57	6.77	886	2.10	12.08	1.88	1.78
OTHERS							
Detritus	434	51.54	*	*	82.38	12.84	10.64

* Did not occur in discrete unit
RI = Relative Importance Index

considerably less than 5 %. However, the average RI values of the dietary components from each of plant (8.63 %), animal (5.20 %) and detritus (10.64 %) were not less than 5 %.

DISCUSSION

The increased stomach fullness during the night other than in the day (Fig. 1) indicated higher feeding intensity at night, thus confirming *S. membranaceus* to be nocturnal in feeding habits. Siluroid catfishes in tropical freshwaters have been reported to be nocturnal in their trophic activity (Boujard and Luquet 1976, Bruton 1979, Ezenwaji 1999, 2002, Idodo-Umeh 2005). The number of empty stomachs recorded, i.e. an incidence of 30.29 % is considered low enough to suggest a fairly regular feeding intensity by the fish in Jebba lake. The relatively higher incidence (>50 %) of half or more stomach full condition, according to Ikusemiju and Olaniyan (1977), Ikusemiju (1981) and Ekpo (1982) is indicative of abundant food supply in the habitat. The variety of prey items in the diets of *S. membranaceus* showed that all the major biotopes seem to be explored for food. The prominence of detritus in the diets of the fishes, as reflected by the RI values, is an indication that *S. membranaceus*

is a bottom-benthic feeder, feeding actively on mud and bottom deposits containing falling organic debris.

Ecological field studies on the dietary habits of *S. membranaceus* (Sandon and El-Tayib 1953, Bishai and Abu-Gideiri 1965, Blache 1964, Petr 1967, Willoughby 1974) showed that the usual diets of this species were insects, plant materials, mud deposits and plankton. Even though these results are limited by the sample size, they are fairly consistent with the observations made from this study. However, some food items such as water mite, *Aspatharia* and dragonfly that were not observed by these authors were recorded in Jebba lake. It is therefore pertinent to note that the food of a foraging fish depends on the availability of any dietary items in its environment. According to Dill (1983) the forager must monitor food availability and respond to any variation. This perhaps, explains the slight difference in dietary composition of the fish in Jebba lake from those reported by previous workers. The presence of fish scales in the stomach of *S. membranaceus* suggests a piscivorous habit and seems to negate its polyculture desirability and potentials, although they may have been ingested as part of the bottom deposits due to the ventral position of the mouth and not necessarily suggest a piscivorous habit.

The qualitative food composition indicated that food item from detritus; plant and animal sources are important, their RI values were higher than 5 %. It can therefore be inferred that *S. membranaceus* is omnivorous or euryphagous and occupy the third link of the food chain by feeding on phytoplankton and plant materials (primary producers); and makes the resultant energy available to predatory species within the water body. Omnivory or euryphagy is a characteristic feature of ubiquitous fishes (Lowe-McConnell 1975, Welcomme 1979, 1985) and explains *S. membranaceus's* wide distribution, a phenomenon reported also for other mochokid catfishes (Olatunde 1989, Owolabi and Omotosho 1999, Araoye and Jeje 1999). Therefore the overwhelming presence of *S. membranaceus* in Jebba lake appears to be consequent on the wide variety and adaptiveness to whatever natural diets that are present in the lake; and coupled with the potential for rapid growth impetus and high fecundity (Owolabi 2005) make *S. membranaceus* suited for culture in freshwater ponds.

RESUMEN

Los hábitos alimenticios del pez *Synodontis membranaceus* fueron investigados durante 24 meses (abril 2002-marzo 2004) en el lago Jebba, Nigeria; utilizando frecuencia de aparición, métodos numéricos, métodos gravimétricos y el Índice de Importancia Relativa (IR). El incremento de estómagos llenos durante la noche, en comparación con el día, indica una intensidad alta de alimentación durante la noche. El pez tiene una dieta eurífaga. De los 16 tipos de comida ingeridos, 10 constituyen la dieta principal, según los valores del IR. Las cinco principales categorías fueron detritos (10.64 %), *Aspatharia* (9.08 %), plantas (8.85 %), semillas (8.61 %) y *Spirogyra* (8.43 %), mientras que las cinco categorías menores corresponden a gastrópodos (7.05 %), apéndices de insectos (6.88 %), copépodos (6.31 %), adultos de *Povilla adusta* (5.89 %) y larvas de coleóptero (5.3 %). Las restantes seis categorías de alimentación son odonatos larvales, larvas de *P. adusta*, larvas de quironómidos, *Daphnia,* ácaros de agua y escamas de pez, las cuales no mostraron gran significancia debido a que los valores de IR fueron menores a 5 %. La importancia del detrito en la dieta indica que el pez habita en el fondo o posee alimentación bentónica. La amplia variabilidad de alimentos y la adaptabilidad natural a cualquiera de los recursos alimenticios presentes en el lago permite a *S. membranaceus* mantener su gran abundancia en el lago Jebba. Su comportamiento eurífago lo hace apropiado para su cultivo.

Palabras clave: *S. membranaceus*, alimento, actividad trófica, lago Jebba, Nigeria.

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