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Diet of *synodontis victoriae* (mochokidae) from Kunya beach lake Victoria, Kenya

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Abstract
Studies on the diet of *Synodontis victoriae* were conducted from Kunya beach Lake Victoria, Kenya. Sampling was done four times: twice during rainy period (December, 2015) and twice during dry spell (January, 2016). The fish were caught using beach seine of mesh size 1.5-3.0 inches, length 350m and width 3m. Each specimen was measured in centimeter Fork length (FL, cm) and sex determined. The guts were then removed and preserved in 4% formalin prior to laboratory analysis. A total of 173 stomachs were examined, and the diet constituted of 9 food items out of which plant detritus, chironomids and copepods formed the major components. Spearman test revealed significant similarities in diet with respect to sex, season and size classes ($p<0.05$). However, the fish fed more on plant detritus (index of preponderance: *I*p = 24.0%)) during the dry season and more on chironomids (*I*p = 24.0%) in the rainy season. In terms of size, smaller fish 8.0-9.9 cm FL fed more on zooplankton copepods (*I*p = 22.4.0%), while plant detritus (*I*p = 32.0%) dominated the diet of adults in the length group 14.0-15.9 cm FL. *Synodontis victoriae* was considered to be omnivorous from the nature of the food items eaten. We also recommended further studies of the diel feeding and spatial/temporal change in its diet since these were not covered in the present study.

Keywords: Diet, *Synodontis victoriae*, zooplankton

1. Introduction

Synodontis victoriae is a species of the upside-down catfishes in the Mochokidae family. They are common in Africa, occurring mostly in Lakes Kyoga, Victoria, Victoria Nile, lower Kagera River and Malagarasi drainage (Koblmüller *et al.*, 2006) [6]. They inhabit creeks, ponds, streams, lakes, and rivers (Friel and Vigliotta, 2006) [5]. Other species are *S. afrofischeri*, *S. multipunctatus*, *S. contractus*, and *S. nigriventris*. *S. victoriae* are oviparous, and reproduce with the flooding period of the rainy season (Lalèyè *et al*., 2006) [7]. *S. victoriae* are omnivorous generalists, feeding on a wide spectrum of different foods, including insects, crustaceans, mollusks, annelids, seeds and algae (Friel and Vigliotta, 2006) [5]. They are bottom-feeders and may be detritivores though some species may also be able to adapt to filter feeding (Lalèyè *et al*., 2006) [7]. This allows them to cope with the seasonal and habitat changes and gives them a better ability to colonize different habitats.

Most of the landed Nile perch in Lake Victoria are processed and exported, so *S. victoriae* becomes one of the most available and affordable fish by the communities, especially within the Nyanza Gulf. This species has also been used as ornamental based on its spotted colorations. The effects of pollution and eutrophication, use of illegal gears and introduced species in Lake Victoria has affected the diversity of the fishes and other organisms. This effect has altered the feeding habit of many fishes in Lake Victoria including *S. victoriae.* The present study therefore investigated on the feeding ecology of *S. victoriae* currently lacking in the Kenyan waters of Lake Victoria.

2. Materials & Methods

The present study was conducted at Kunya fishing ground (Fig.1) in the Nyanza Gulf of Lake Victoria, Kenya. The Gulf is a large inlet from Lake Victoria that extends into Kenya, and it`s comparatively shallow, with maximum and average depth of 68 m and 6 m respectively. It is connected to the main lake by Rusinga Channel (3 m wide). The fishery at Kunya (56°17'43.008''N 30°58'57.32''E) covers the shallow part inside the Nyanza Gulf.

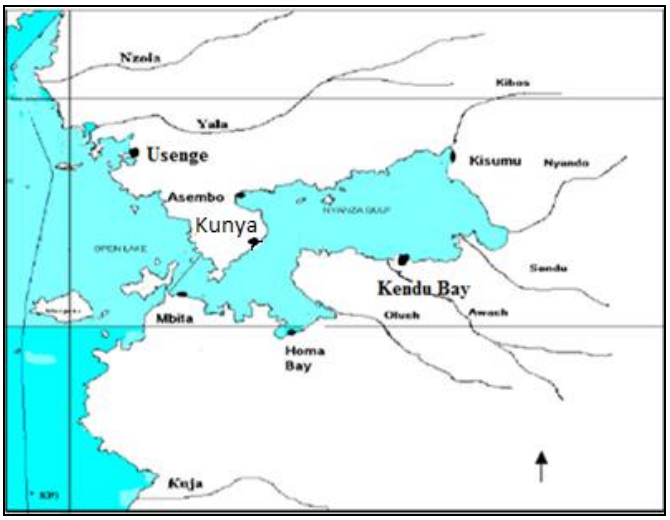

Fig 1: Map of Lake Victoria, Kenya showing sampling station (Kunya beach)

Sampling and stomach contents analysis

Sampling was done four times: twice during rainy period (December 2015) and twice during dry spell (January 2016). Samples (173) were collected using beach seine mesh size 1.5-3.0 inches of length 350m and width 3m. The Fork length (FL, cm) for each specimen was measured in the field, and guts were removed and preserved in 4% formalin. Sex was determined by visual inspection of gonads. In the laboratory, each stomach was emptied into a Petri dish and the aggregates dispersed with distilled water. Prey identification was done under a binocular (× 50) microscope. Wet weight (mg) were

recorded after removal of surface water by blotting on tissue paper.

Three (3) indices were calculated for qualitative and quantitative analysis of the importance of the different preys in the diet:

1. Corrected occurrence percentage (F_C) (Rosecchi and Nouaze, 1987):

$$F_C = F_i / \sum F_i \times 100 \text{ with } F_i = n_i / N_T$$

Where F_i represents the frequency of prey i, n_i the number of stomachs including prey i and N_T the total number of non-empty stomachs examined.

2. Weight percentage (W) (Hyslop, 1980):

$$W = (W_i / W_T) \times 100$$

Where W_i represents the total weight of prey i and W_T the total weight of all preys.

3. The index of preponderance (Ip) (Natarajan and Jhingran, 1961):

$$I\text{p} = F_C \times W / \sum (F_C \times W)$$

Combines both (F_C) and (W), and is used to assess the relative importance of each type of prey

Statistical analysis

Analyses was performed using the software Statistica version 10. The effects of sex, season and length class on diet were tested by Spearman rank-order analysis.

3. Results

General diet composition

A total of 173 stomachs of *S. victoriae* were examined, out of which 3 were empty. The diet of *S. victoriae* constituted of 9 food items (Table 1). They were assigned to five main categories: (1) Molluscs (Bivalves), (2) Crustacea (Copepoda, Cladocera and Ostracoda), (3) Insects (Chironomids, Chaoborus sp and other insects), (4) Macrophytes (Plant detritus) and (5) Other prey (Fish scales). Plant detritus (F_C = 13.9%) and Copepoda (F_C = 13.4%) occurred the most, followed by Chironomids (F_C = 12.12%). Lowest frequencies were showed by the Bivalves (F_C = 8.91%) and fish scales (F_C = 8.5%). In terms of weight, plant detritus (W = 19.7%) and Chironomids (W = 19.5%) constituted the main food items, followed by Copepoda (W = 16.7%), and fish scales the least (W = 5.61%). In relation to the feeding index (Ip), the most important food sources were plant detritus (Ip = 23.1%). The diet was supplemented with Chironomids (Ip = 20.03%), followed by Copepoda (Ip = 19.0%).

Table 1: Diet composition of *Synodontis victoriae* from Kunya beach Lake Victoria, Kenya

Prey taxa	Fc (%)	W (%)	*I*p (%)
Molluscs			
Bivalves	8.91	9.41	7.10
Crustacea			
Copepoda	13.43	16.66	18.95
Cladocera	10.51	6.71	5.98
Ostracoda	10.66	8.85	7.99
Insects			
Chironomids	12.12	19.51	20.03
Chaoborus sp	10.22	5.62	4.87
Other insects	11.82	7.97	7.99
Macrophytes			
Plant detritus	13.87	19.65	23.08
Other Prey			
Fish scales	8.47	5.61	4.03

Diet variation in relation to sex

Plant detritus (Ip = 22.6% in males and 22.7% in females), Chironomids (Ip = 20.3% in males and 18.7% in females) and Copepoda (Ip = 17.1% in males and 21.2% in females) were the dominant food items for both sexes (Fig. 2). The Spearman test showed that diets of males and females were significantly correlated (R = 0.83; p = 0.005).

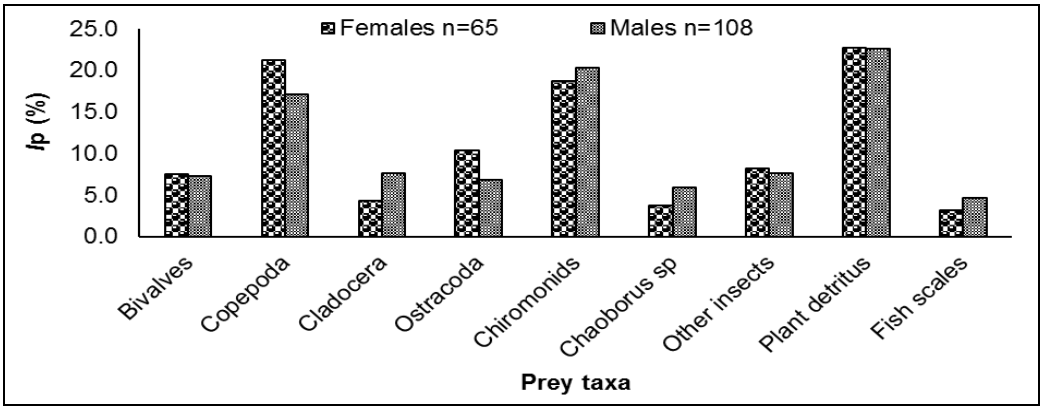

Fig 2: Diet of females and males of *S. victoriae* from Kunya beach Lake Victoria.

Diet variation in relation to season

Plant detritus (Ip = 24.0%) dominated the diet of *S. victoriae* during the dry season, Chironomids (Ip = 24.0%) in the rainy season and Copepoda (Ip = 19.3%) in the dry season (Fig. 3). The Spearman test revealed significant similarities in diet between the seasons(R = 0.68; p = 0.04).

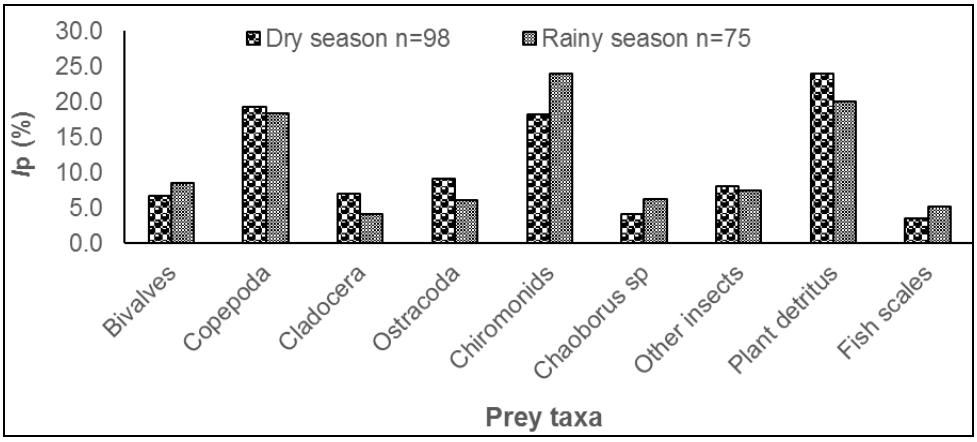

Fig 3: Seasonal composition of the diet of *S. victoriae* from Kunya beach Lake Victoria

Diet variation in relation to size

The fish examined ranged from 8.0 to 15.5 cm FL. All the size classes consumed all the important food items (Fig. 4). The Spearman rank correlation showed that the size variations in diet composition were significantly similar for all groups (Table 2). However, fish in the length group 8.0-9.9 cm FL fed more on Copepods (*I*p = 22.4.0%), whereas adults in the group 14-15.9 cm FL fed more on plant detritus (*I*p = 32.0%). Chironomids were consistently important to all sizes.

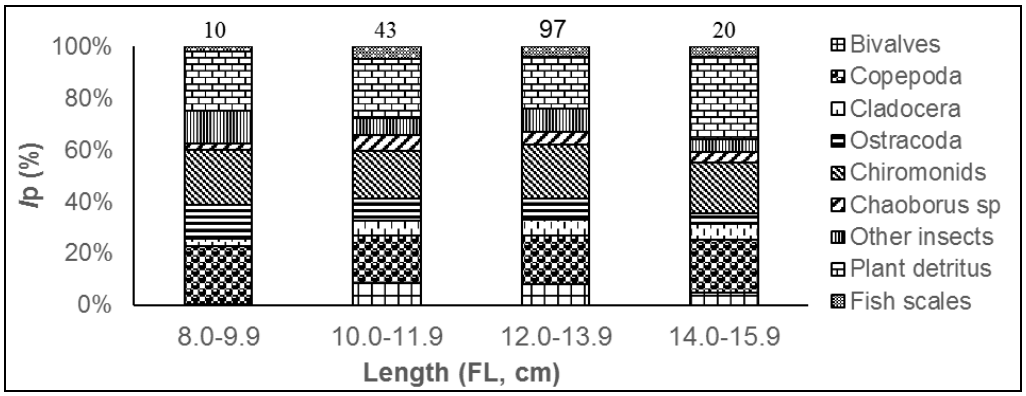

Fig 4: Food of *S. victoriae* of different lengths. Numbers above column are sample size (n)

Table 2: Spearman Rank Order Correlation Analysis. *= correlation significant at p <0.05

Source of variation		Spearman coefficient of correlation R	t(N-2)	*p*-level
Sex	Male-Female	0.83	3.99	0.005*
Season	Dry-Rainy	0.68	2.48	0.04*
Size classes	{8.0-9.9}-{10.0-11.9}	0.72	2.72	0.03*
	{8.0-9.9}-{11.9-13.9}	0.83	3.99	0.005*
	{8.0-9.9}-{14.0-15.9}	0.72	2.72	0.03*
	{10.0-11.9}-{12.0-13.9}	0.90	5.46	0.0009*
	{10.0-11.9}-{13.9-15.9}	0.77	3.16	0.02*
	{12.0-13.9}-{14.0-15.9}	0.78	3.33	0.01*

4. Discussion

The present findings on the diet of *S. victoriae* are comparable with previous studies on the diet of various Synodontis species from different water bodies as shown in Table 3.

Table 3: Diet of various Synodontis species from different water bodies.

Species	(n)	Water body/country	Most important food items	Feeding habit	Source
Synodontis schall	635	River Benue, Nigeria	Plant, mollusks, algae, insects, crustacean	Omnivorous	Akombo *et al.*, 2014
Synodontis zambezensis	441	Lake Kariba, Zimbabwe	Lymnaea and chironomid larvae	Molluscivore	Rudo, 1998
Synodontis schall	545	Lake Chamo, Ethiopia	zooplankton, fish scales, macrophytes		Dadebo *et al*., 2012
Synodontis resupinatus	60	River Niger, Nigeria Bandama	Phytoplankton, fish parts, insects, crustacean	Omnivorous	Adeyemi, 2010
Synodontis punctifer	110	River Coˆte d'Ivoire	Macrophytes and insects		Essetchi *et al.*, 2012
Synodontis membranaceus	1208	Jebba lake, Nigeria	Detritus, *Aspatharia*, *Spirogyra*, plant, seed	Euryphagus	Owolabi, 2008
Synodontis koensis	303	R. Sassandra Côte d'Ivoire	Plant detritus and chironomid larvae	Omnivorous	Yao *et al*., 2010
Synodontis clarias	500	Cross River, Nigeria	Insects, planktons, detritus, etc.	Euryphagus	Offem *et al*., 2013
Euchilichthys guentheri	243	Malebo Pool Kinshasa, DRC	Periphyton	Herbivorous	Makiadi *et al*., 2013
Synodontis victoriae	173	Lake Victoria Kenya	Plant detritus, chironomids, copepods	Omnivorous	Present study

The study revealed that *S. victoriae* in Lake Victoria fed on a variety of food items including mollusks, crustacea, insects, macrophytes and fish scales. However, the most important food items were plant detritus, chironomids and copepods, and the prominence of plant detritus in the diet could show that this fish is a benthic or bottom feeder. There were no statistical difference with respect to sex of fish, seasons and size, though Plant detritus and copepods dominated the diet of *S. victoriae* during the dry season, while chironomids in the rainy season. Also juveniles in the length group 8.0-9.9 cm FL fed more on copepods, whereas adults in the group 14-15.9 cm FL fed more on plant detritus. The feeding on plant detritus and copepods during the dry season could be attributed to the poor food resources at this period and the dominance of chironomids may be linked to the emergence of insects during the wet season. By comparing with the previous studies, for *S. membranaceus* in Jebba Lake, Nigeria, Owolabi (2007) reported that the dietary composition and feeding intensity were sex dependent and food preference also varied with season.

The author added that there was a progression from a detritivorous diet in fish below 20 cm Standard Length (SL), through a transitional planktivorous phase (20-27 cm, SL), to a predominantly molluscivorous/insectivorous diet in fish above 27 cm SL; thus indicating a switch from a relatively passive filter-feeding habit when young to an active predatory habit at adult stage. Yao *et al* (2010) documented that the diet of *S. koensis* in Sassandra River, Côte d'Ivoire did not show significance difference according to the study zones, sex of fish and seasons however, significant ontogenic shifts in diet were observed with increasing importance of plant detritus, and decreasing importance of chironomids in the diet with increased fish size.

According to Dadebo *et al* (2012), zooplankton and insects were the most important food items for the juveniles of *S. schall* in Lake Chamo, Ethiopia, while fish scales, fish fry and macrophytes were the most important food items of adults. The juveniles of *S. resupinatus* in River Niger, Nigeria showed more indignation towards phytoplankton, diatoms and plant parts while the adults exhibited more diverse and complex feeding habits (Adeyemi, 2010). The study by Makiadi *et al* (2013) on *Euchilichthys guentheri* in Malebo Pool Kinshasa, Democratic Republic of Congo did not find any statistical differences in the diet related to the size of the specimens, the site and the hydrological season.

Rudo (1998) in studying the feeding habit of *S. zambezensis* in Lake Kariba, Zimbabwe observed no dietary shifts from the smallest fish (12 cm) to the largest fish caught (38 cm). At the rainy season, the main foods of *S. punctifer* in Bandama River, Coˆte d'Ivoire were Macrophytes and during the dry season this species ate Insects and Macrophytes (Essetchi Paul Kouame´lan *et al*., 2012). According to Offem *et al* (2013), during the dry season, predominant food items in the stomach of *S. clarias* in the Cross River, Nigeria were planktons; cyanophytes, dinoflagellates, copepods, cladocerans and fish species while insects, gastropods, trichocerca and trichotria and mollusk were more frequent in the wet season.

5. Conclusion

Synodontis victoriae was considered to be omnivorous from the nature of the food items eaten. We also recommended further studies of the diel feeding and spatial/temporal change in its diet since these were not covered in the present study.

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