

Effects of Season on Food, Feeding Habit and Condition Factor of Squeakers (*Synodontis vermiculatus*, Daget 1954) in Shagari Dam Sokoto State, Nigeria

¹Ibrahim S. Jega, ²Balkisu H. Augie, ¹Dalhatu Y. Bawa and ³Mohammad Y. Abubakar

¹Department of Forestry and Fisheries, Faculty of Agriculture, Kebbi State University of Science and Technology Aliero, Kebbi State

²Department of Biology, School of Secondary Education Sciences, Federal College of Education (Technical), Gusau, Zamfara State.

³Department of Fisheries and Aquaculture, Faculty of Agriculture, Usmanu Danfodiyo University, Sokoto

Corresponding Author Email: ibrahimshehu77@yahoo.com; Tel: +2348039370546

Abstract

The research examined the effect of season on food and feeding habit and condition factor of *Synodontis vermiculatus* (Daget, 1954) in Shagari Dam, Sokoto State. The period of the research was from March 2020 to February, 2021. Eighty two (82) fish samples used for this research were collected from the commercial fishermen at the landing site of the Dam. Morphometric data were collected using electric weighing balance and a measuring ruler. Frequency of occurrence method was implored for the study of feeding habit. Index of preponderance was used to determine the importance of food item to the fish. The maximum total length and body weight recorded was 18.60cm and 67.86g, respectively, in September. The minimum total length recorded in December was 9cm and the minimum body weight in October was 9.81g. The highest condition factor obtained was in February and March for female (4.332) and male (1.083), respectively. Food items consumed by the fish were *Microcystis spp.*, *Oscillatoria spp.*, *Anabaena spp.*, *Cylindrospermopsis spp.*, *Aphanizomenon spp.*, Detritus, Mud, Copepod, Adult *Oikopleura*, *Barnacle nauplius*, worms and fish larvae, which indicate that the fish is an omnivore. The research revealed that the fish does not grow large. The result of season and food and feeding habit also revealed that the species feed most in the months of June, July, August and October.

Key words: *Synodontis vermiculatus*, Frequency of occurrence, Condition factor, Food and feeding habits.

1.0 Introduction

The genus *Synodontis* is the largest of Mochokid catfishes which comprises of 10 genera and 131 different species in the family Mochokidae (Stephen *et al.*, 2006). They are small to medium sized fishes commonly called “squeakers” or upside down catfishes, chiefly as a result of the stridulating sounds they make through their pectoral spines when troubled. *Synodontis* are bottom dwellers in general, however certain species spend virtually all their time in feeding and swimming in upside down position. *Synodontis* species are of high market value commonly found in many waterbodies in Nigeria. The commercial worth of different *Synodontis* species varies depending on location where they are found; vast number of them are significant food fish, with some having beautiful skin colour and depict behavioural features, making them possible ornamental candidates (Ezenwa *et al.*, 1987).

Successful aquaculture practice is highly dependent on understanding the food and feeding habit of fishes in the wild. It is beneficial to select the fish species for aquaculture that will live in tandem with other species rather than compete for the available aquatic resources. This will enable the judicious use of the food sources found in the water body and result in highest yield. Knowledge about the food habits of fishes entails defining the nature of the food chain and the designing of trophic models as a means to understanding the ecosystem in its entirety. Freshwater species are declining as a result of changing climate due to temperature increases (Pecl *et al.*, 2017), thereby placing more pressure on fishery systems which are currently experiencing pollution, habitat loss and overfishing. To ensure optimal production of fishes, information on the food and feeding habits directs the selection of feedstuff required for the artificial diets of cultured species. The studies of food and feeding habits of fishes have been carried out by various workers (Chaturvedi and Parihar, 2014; Jega *et al.* 2018). However, there is paucity of information on food and feeding habits of *S. vermiculatus* in Shagari Dam, therefore the need for this study to provide base line information of the likely food preference of this species under captivity.

2.0 Materials and Methods

2.1 Description of the Study Area

Shagari Dam falls between Latitudes 12° 37'44"N, and Longitudes 4° 59'27.41"E and lies south east of Sokoto city (Figure 2.1). Shagari town is in a tropical climate which has distinct wet and dry seasons.

2.2 Sample Collection

Species of *Synodontis vermiculatus* were collected at Shagari Dam fish landing site. The fish samples were obtained monthly, from June 2021- May 2022. The samples were dissected while in fresh form and in case of large number of samples, they were chilled in a freezer till the next day.

2.3 Identification of the Gut Content

For the examination of the food items, the fish were carefully dissected and the stomach taken out by cutting the alimentary tract between the end of oesophagus and the pylorus. The stomach content was transferred into petri dishes. From each individual, the weight of the stomach with content and weight without food content was measured using a digital scale to the nearest gram.

Food items found in the stomach were first sorted by eye for larger food substances and then dispersed with small amount of distilled water. For identification purpose, the samples were examined under a Celestron Digital LCD microscope at different magnifications up to x10. Wherever possible, food items were identified up to the genus level with the aid of identification guides prepared by Yamaguchi and Bell (2007).



Figure 2.1: Map showing the study area (Source; Google Earth Map 2022).

2.4 Data Analysis

2.4.1. Stomach Content Analysis

2.4.1.1. Determination of frequency of occurrence

The stomach content was analyzed using frequency of occurrence method as described by Hynes (1950). Each food item occurred in number of stomach was recorded and expressed as a percentage of the number of fish stomach examined as follows:

$$\% Fi = \frac{Nfi}{Nf} \times 100$$

Where, % *Fi* = percentage frequency of occurrence of a given food item *i* in the sample

Nfi = Total number of stomachs in which given food item *i* occurs

Nf = total number of stomachs with food items examined.

2.4.1.2 Determination of Gastro somatic index (GaSI)

Gastro somatic index was determined using the formula of Desai, (1970).

$$\text{GaSI} = \frac{\text{Weight of the gut}}{\text{Total weight of the fish}} \times 100 \quad (\text{Desai, 1970})$$

3.0 Results

The maximum Total length (TL) and Body weight (BW) (18.60cm and 67.86g) of the fish was recorded in September. Minimum Total length was recorded in December with 9.0 cm and weight in October with 9.81g (Table 3.1). The highest mean TL was recorded in July with 14.6cm and lowest in December with 10.81cm. The highest mean BW was recorded in July (37.70g) and lowest in December (13.57g).

Table 3.1: Monthly summary of length and weight distribution of *Synodontis vermiculatus* in Shagari Dam, Sokoto State

Month	No. of fish	Total length (cm)				Body weight (g)			
		Min.	Max.	Mean	Std. E	Min	Max.	Mean	Std. E
March	5	10.50	15.60	12.92	0.93	12.59	49.11	28.41	6.27
April	7	11.60	17.80	13.80	0.89	16.08	67.57	33.51	7.34
May	6	11.40	15.70	13.21	0.76	17.23	42.29	27.51	4.12
June	6	10.30	14.30	12.03	0.66	12.53	31.56	21.45	3.47
July	11	12.00	16.80	14.62	0.55	18.66	58.37	37.70	3.69
August	5	11.60	16.10	13.36	1.02	19.80	40.41	26.55	4.28
Sept.	11	10.40	18.60	12.74	0.85	12.59	67.86	24.46	5.55
Oct.	7	9.50	16.70	12.21	0.87	9.81	55.12	22.45	5.69
Nov.	8	10.50	14.50	12.31	0.54	13.85	32.40	21.68	2.48
Dec.	7	9.00	13.20	10.81	0.68	9.85	18.70	13.58	1.45
Jan.	4	9.50	13.50	11.13	0.85	10.82	23.82	16.31	2.75
Feb.	4	10.50	12.00	11.03	0.34	14.86	18.53	15.79	0.91

The food item composition by Frequency of Occurrence method (Table 3.2) shows *Microcystis spp* form the most frequently consumed diet with (30.06%), followed by *Oscillatoria spp* (15.03%), detritus (12.72%), while the lesser consumed by frequency include the *Barnacle nauplius* (1.16%), copepod, adult *Oikopleura spp.* and worms (0.58%).

3.1 Gastrosomatic index (GaSI)

Gastrosomatic index show the feeding intensity of fish. Fluctuation of GaSI between the months was found. The highest (4.54) Gastrosomatic index was recorded in August and the lowest (1.03) in March. The monthly fluctuation is shown in Table 3.3.

3.3 Condition factor of *Synodontis vermiculatus*

The condition factor for female and male *S. vermiculatus* are presented in Table 3.4 and Table 3.5, respectively. The highest condition factor obtained was in February and March for female (4.332) and male (1.083), respectively.

Table 3.2: Composition by frequency of occurrence of prey items in the diet of *S. vermiculatus* found in Shagari Dam, Sokoto State

Organism	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	%F
<i>Oscillatoria spp.</i>	1.73	1.16	1.16	1.16	2.89	1.73	1.16	2.89	0	1.16	0	0	15.03
<i>Microcystis Spp.</i>	2.31	1.73	2.89	2.31	5.78	2.31	2.89	2.31	2.31	2.31	1.73	1.16	30.06
Anabaena	1.73	0	1.73	0.58	1.73	0	1.73	0	0	0	0	0.56	8.07
<i>Cylindrospermopsis spp.</i>	1.16	0	0	0.58	0	0.58	1.16	0	0.58	0	0	0	4.05
<i>Aphanizomenon spp.</i>	0	0.58	1.16	0	0	0	0.58	0.58	0	0	0.58	0	3.47
Detritus	0	0	1.73	0.58	1.73	0	2.31	2.31	1.16	1.73	1.16	0.00	12.72
Mud	0	0	0	0	1.16	1.16	0	0	1.16	1.16	0.58	0.58	5.78
Empty	0	1.73	0.58	1.16	1.16	0.58	2.89	1.16	2.31	1.73	0.58	1.16	15.03
Copepod	0	0	0	0	0	0	0	0.58	0	0	0	0	0.58
Adult oikopleura	0	0	0	0	0	0.58	0	0	0	0	0	0	0.58
<i>Barnacle nauplius</i>	0	0	0	0	0	0.58	0	0	0.58	0	0	0	1.16
Worms	0	0	0	0	0	0	0	0	0.58	0	0	0	0.58
Fish larvae	1.16	1.16	0.58	0	0	0	0	0	0	0	0	0	2.89
Total	8.09	6.36	9.83	6.36	14.4	7.51	12.7	9.83	8.67	8.09	4.62	3.47	100

Table 3.3: Gastrosomatic Index (GaSI) of *S. vermiculatus* in Shagari Dam

Month	Mean Gut Weight (g)	Mean Body Weight (g)	GaSI
March	0.35	34.10	1.03
April	0.55	33.51	1.63
May	0.48	27.51	1.75
June	0.39	21.45	1.83
July	0.68	37.40	1.82
August	1.21	26.55	4.54
September	0.40	25.46	1.57
October	0.32	22.45	1.40
November	0.47	21.68	2.17
December	0.29	13.58	2.14
January	0.29	16.31	1.75
February	0.23	15.80	1.44

Table 3.4: Condition Factor of Female *Synodontis vermiculatus* from Shagari Dam, Sokoto State

Month	Mean SL (cm)	Mean BW (cm)	LN SL	LN BW	a	b	K	Comment
March	8.833	20.587	0.946	1.314	0.354	2.561	0.332	Lean
April	10.575	40.135	1.024	1.608	0.354	2.561	0.214	Lean
May	10.175	2.065	1.008	1.506	0.354	2.561	0.910	Fatty
June	9.3	27.743	0.968	1.443	0.354	2.561	0.383	Fatty
July	10.171	38.479	1.007	1.585	0.354	2.561	0.075	Lean
August	9.467	26.703	0.976	1.427	0.354	2.561	0.349	Lean
September	11	48.49	1.041	1.686	0.354	2.561	0.405	Fatty
October	8.82	25.242	0.945	1.402	0.354	2.561	0.147	Lean
November	8.75	22.813	0.942	1.358	0.354	2.561	0.213	Lean
December	7.75	14.268	0.889	1.154	0.354	2.561	0.192	Lean
January	6.75	13.565	0.825	1.132	0.354	2.561	1.103	Fatty
February	7	14.86	0.845	1.172	0.354	2.561	4.332	Fatty

Standard length (SL), Body weight (BW)

Table 3.5. Condition Factor of Male *Synodontis vermiculatus* from Shagari Dam, Sokoto State

Month	Mean SL (cm)	Mean BW (cm)	LN SL	LN BW	a	b	K	Comment
March	9.75	40.135	0.989	1.604	0.9560	1.355	1.083	Fatty
April	8.50	24.10	0.929	1.382	0.9560	1.355	0.436	Lean
May	7.67	18.405	1.0884	1.265	0.9560	1.355	1.028	Fatty
June	7.27	15.163	0.861	1.181	0.9560	1.355	0.439	Lean
July	10.20	35.88	1.009	1.555	0.9560	1.355	0.135	Lean
August	9.75	26.325	0.989	1.420	0.9560	1.355	0.710	Lean
September	7.84	16.82	0.894	1.226	0.9560	1.355	0.055	Lean
October	7.50	15.475	0.875	1.189	0.9560	1.355	0.917	Lean
November	8.38	20.553	0.923	1.313	0.9560	1.355	0.219	Lean
December	7.0	12.653	0.845	1.102	0.9560	1.355	0.409	Lean
January	8.5	19.06	0.929	1.280	0.9560	1.355	0.776	Lean
February	7.5	16.107	0.875	1.207	0.9560	1.355	0.424	Lean

Standard length (SL), Body weight (BW)

4.0 Discussion

Morphometric analysis is vital in fish conservation and management as it gives information on the size, condition and is also used for the identification of a particular species. In this study, highest and mean total length and body weight of the fish recorded in August and September correlate with findings in feeding habit analysis as reported by Laleye *et al.*, (2006) who recorded higher number of abundance of prey in September and October which begins to decline with each successive month. This indicates that the increase in size of fish may be commensurate with availability of food in the environment of the fish. This tally with the findings of Laleye *et al.*, (2006) on *Synodontis schall* and *Synodontis nigrita* in Ouémé River, Benin. The study shows that *Microscystis spp.*, *Oscillatoria spp.*, detritus and *Anabaena spp.*, are the most important consumed food items. They also formed the most frequently consumed food items of the fish. Other food items were *Cylindrospermopsis spp.*, *Aphanizomenon spp.*, fish larvae, mud, Adult Oikopleura, *Barnacle nauplius*, worms and copepod. This shows the fish has omnivore feeding habit due to the wide range of feed items found in the stomach.

This result agree with the findings of Adeyemi (2010) who observed a species of same genus, *Synodontis resupinatus* (boulenger, 1904) at Idah area of River Niger, Kogi State. The result also agrees with the finding of Shinkafi. *et al.*, (2010) who observed a species of the same genus, *Synodontis nigrita* in River Rima, Sokoto. The result of the finding shows that the species is an omnivorous feeder. Courant *et al.* (2017) observed that the diet of *Trachelyopterus galeatus* was composed of many prey items including plant leaves, fish, detritus and insects and was of the opinion that varied diet facilitates the exploitation of diverse food items based on availability, thereby according the species competitive advantage. Yongo *et al.*, (2019) also carried out similar research review of food and feeding habit of some *Synodontis* fishes in African freshwaters involving *S. nigrita*, *S. schall*, *S. resupinatus*, *S. membranaceus*, *S. victorae* and *S. afrofisheri*. The findings reveal that the studied species were omnivorous in their feeding habits

due to the wide array of food items encountered in the stomach contents during the period of study.

The gastrosomatic index (GaSI), denotes the feeding intensity of fish (Desai, 1970). In this study, the GaSI of *S. vermiculatus* shows fluctuation in different months of the year. The Gastrosomatic index was generally low during February, March and April, as a result of poor food content found in the gut. In the aspect of relationship between season and food and feeding habit of *S. vermiculatus* in Shagari Dam, the result shows that the species consumes more of *Oscillatoria*, *Microcystis* spp., detritus and *Anabaena* in the months of August and November than in other months. Detrital particles together with allochthonous food such as plant seeds washed by flood from the surrounding vegetation into the water bodies might have been responsible for the high incidence of each of these diets during the rainy season. This is further corroborated by the findings of Pujarra *et al.* (2017) who observed that continuous rainfall during the wet season increases water flow thereby impeding the establishment of the benthic invertebrate community and increasing inputs of terrestrial resources.

The condition factor shows the physical wellbeing of the fish (Abowei 2010). It provides information on when comparing two populations living in a particular water body with regards to feeding, density, climate and other conditions when determining the period of gonad maturation, and when following up the degree of feeding activity of species to verify if it is making good use of its resource (Ighwela *et al.*, 2011). Condition factor can also be affected by factors like sex, season, age and maturity stages of fish (Edah *et al.*, 2010). Therefore the condition factor in relation to season in this study shows that only females were in good condition in the month of February (with K value of 4.332). The mean condition factor obtained in this study did not tally with the results of other studies. Akombo *et al.*, (2014) reported a range of 3.3667 for females and 2.9954 for males in *S. clarias* (Linnaeus, 1758) in lower river Benue at Markurdi. Adeyemi (2010) reported a range of 2.34- 4.90 for males and 2.56- 4.03 for females in *S. resupinatus* at Idah area of River Niger. Baijot *et al.* (1997) documented 2.65- 3.32 while Offem *et al.* (2013) reported the mean range values of 0.32.

5.0 Conclusion and Recommendation

Study on the effects of season, food and feeding habit and condition factor of *Synodontis vermiculatus* in Shagari Dam revealed that the fish are omnivore as they feed on variety of food items of both animal and plant sources, ranging from phytoplankton to fish larvae and worms. The result of morphometrics shows that the species does not grow very big. The research further revealed that phytoplankton, fish larvae and worms can be utilized for the culture of *S. vermiculatus*. The variety of food items discovered in the stomach shows that the fish is a good candidate for aquaculture.

Recommendations

1. Further studies on the breeding of *Synodontis vermiculatus* in captivity is recommended in order to enable its culture.
2. The study of food and feeding habit of the species will help Aqua culturist to know the type of feed to formulate for the species when they are in culture.
3. It will be worthwhile to conduct more studies on this fish species in Shagari Dam and other locations for a better understanding of its food and feeding habits

References

- Abowei, J.F.N, Davies, A. O. (2010). Some population parameters of *Clarotes laticeps* (Rupell, 1829) from the Fresh water reaches of the lower river, Niger Delta, Nigeria, *American Journal of Scientific Research*., 2: 15- 19.
- Adeyemi, S. O. (2010). Food and feeding habits of *Synodontis resupinatus* (BOULENGER 1904) at Idah Area of River Niger, Kogi State, Nigeria. *Annual Research International*. 7 (3): 1281- 1286. ISSN.159- 3115
- Akombo, P. M, Akange, E. T., Amali, B. O. and Shima, J. N. (2014). Length- weight Relationship, Condition Factor and Feeding Habits of *Synodontis clarias* (Linnaeus, 1758) in the Lower River Benue at Makurdi, Nigeria. *Nigerian Journal of Pure and Applied Sciences*, 6: 59- 67. ISSN: 0795- 25070.
- Baijot, E., Moreau, J. and Bouda, S. (1997). Hydrobiology aspects of fisheries in small reservoirs in the Sahel Region. *CTA Publication, the Netherlands*.
- Chaturvedi, J. and Parihar , D. S. (2014). Food and Feeding Habits of Two Freshwater Catfish, *Mystus cavasius* and *Xenentodon cancila* from Chambal River (M.P). *International Journal of Science and Research (IJSR)*, Volume 3 Issue 8, 639 -642.
- Courant, J, Vogt, S., Marques, R., Measey, J., Secondi, J., Rebelo, R. (2017). Are invasive populations characterized by a broader diet than native populations? *Peer J*. 5:e3250. <https://doi.org/10.7717/peerj.3250>.
- Desai, V.R. (1970). Studies on the fishery and biology of *Tor tor* (Ham.) from River Narmada. I. Food and feeding habits. *Journal of the Inland Fisheries Society of India*, 2:101-12.
- Edah, B., Bankole N. O., Akande, G. R., Adeyemi S. and Ayo-olalusi, C. I. (2010). Organoleptic Characteristics, Length- Weight Relationships and Condition Factors of *Oreochromis niloticus* in Egah River at Idah L.G. A. of Kogi state. Nigeria. *Internet Journal of Food Safety*, 12:62-70.
- Ezenwa, B, Alegbeye, O., Wumba, N. J. and Atanmu, A. (1987). Nigeria waters, A research survey (1978- 1985) 136. *Proceedings*, FISON. Port Harcourt, River State.
- Google Earth Map (2022). Shagari Map- Satellite Images of Shagari. <http://maplandia.com/Nigeria>. Retrieved on 15 November, 2022.
- Hynes, H.B. N. (1950). The food of the freshwater sticklebacks (*Gastrosteus aculeatus*) and *Pygosteu pungitius*) with a review of methods used in studies of the food of fishes. *Journal of Animal Ecology*, 19: 36-58.
- Ighwela, A., Ahmed, B. and Abol- Munafi, B. (2011). Condition as an indicator of growth and feeding intensity of Nile Tilapia fingerlings (*Oreochromis niloticus*) fed on different levels of Maltose. *American- Euracian Journal of Agriculture and Environmental Sciences*, 11: 559- 563.
- Jega, I. S., Miah, M. I, F, M. Kaniz and Shahjahan, M. (2018). Food and feeding habits of wild Hemibagrus menoda (Hamilton1822) in Kangsha River, Bangladesh. *Bangladesh Journal of Fisheries*. 30 (1): 47-59.
- Laleye, P., Chikou, A., Gnohossou, P., Vandewalle, P., Philippart, J., Teugels, G. (2006). Studies on the biology of two species of catfish *Synodontis schall* and *Synodontis nigrita* (Ostariophysis :Mochokidae) from the Ouémé River, Bénin (PDF). *Belgian*

- Journal of Zoology*. 136 (2): 193–201. Archived from the original (PDF) on 2009-12-29.
- Offem, B. O., Ayotunde, E. O. and Ada, F.B. (2013). Trophic Ecology, Growth and Population Dynamics of *Synodontis clarias* (pisces: Siluriformes: Mochokidae) (Lin: 1758) in Cross Rivers, *Nigerian Journal of Fisheries and Aquaculture*, 4 (1):67- 74.
- Pecl, G.T., Araújo, M.B., Bell, J.D., Blanchard, J., Bonebrake, T.C. Chen, I.-C. Clark, T.D., Colwell, R.K., Danielsen, F. and Evengård, B. (2017). Biodiversity Redistribution under Climate Change: Impacts on Ecosystems and Human Well-Being. *Science*, 355, 6332.
- Pujarra, S., Pandolfo, A., Lourenço, D.K., Gurski, F.A., dosSantos, A.P.A. and Moretto, Y. (2017). Distribution of benthic communities in relation to the environmental integrity of subtropical streams. *Austrian Ecology Journal*, 27:482–491. <https://doi.org/10.25260/EA.17.27.3.0.374>
- Shinkafi, B. A., Argungu, L.A. and Akanbi, H.S. (2010). Food and feeding habits of catfish (*Synodontis nigrita* Cuvier and valenciennes) in River Rima, Sokoto, Nigeria. *Nigerian Journal of Basic and Applied Science*. 18 (2):304- 307. ISSN 0794- 5698.
- Stephan, K., Christian, S, Erik, V. Axel, M. and Walter, S. (2006). "Mitochondrial phylogeny and phylogeography of East African squeaker catfishes (Siluriformes: Synodontis)". *BMC Evolutionary Biology*. 6: 49. doi:10.1186/1471-2148-6-49. PMC 1543664.PMID 16784525.
- Yamaguchi, E. and Bell. C. (2007). Zooplankton and Phytoplankton Identification Guide. UGA Marine Extension and Georgia Sea Grant, 2pp. Available at <https://gacoast.uga.edu>.
- Yongo, E., Jacob, I. and Simon, A. (2019). Review of the food and feeding habits of some *Synodontis* fishes in African fresh waters. *Oceanography and Fisheries Open Access Journal*, Vol. 10. ISSN:2476- 0536.