Food and Feeding Habit of *Clarias gariepinus*, *Mormyrus rume rume* and *Synodontis budgetti* in Dadin Kowa Reservoir, Gombe State, Nigeria.

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ABSTRACT

The study of food and feeding habits of *Clarias gariepinus*, *Mormyrus rume rume* and *Synodontis budgetti* in Dadin Kowa Reservoir were carried out for a period of Eighteen month, (October 2022 to March 2024). A total of 189 *Clarias gariepinus*, 81 *Mormyrus rume rume* and 272 *Synodontis budgetti* were purchased from the local fishermen as soon as they returned from their catch and were brought immediately to the laboratory for analysis. The fishes were identified using appropriate fish identification keys. Stomach contents were observed under the microscope and analysed using Frequency of occurrence, Numerical methods and Fullness method. In *Clarias gariepinus*, Macrophyte accounted for 23.88% and 25.96% under frequency of occurrence and numerical method followed by Insect part with 13.68% and 13.14%, Small fish, Mud, Detritus and Zooplankton had 11.67% and 10.89%; 9.73% and 9.62 %; 9.25% and 8.65%; and 7.64 and 7.37%, respectively. Sand particles and phytoplankton have 6.07% and 6.73; and 4.64% and 6.73% by Frequency of occurrence and Numerical method respectively. Worm 4.17%, 3.31%; Insect 2.67%, 1.60%; Grain 2.29%, 0.96%; and Fluid 1.63%, 0.32% appeared to be incidental diets. In *Mormyrus rume* rume, Detritus constituted 30.07% and 30.48% of the content under frequency of occurrence and numerical method followed by Plant part with 21.03% and 21.90%. Phytoplankton, Worm, Insect, Mud and Insect part accounted for 14.09% and 14.76%; 7.84% and 7.14%; 7.52% and 7.14%; 7.38% and 7.14%; and 6.54% and 6.66 respectively. Sand particles, Fluid and Unidentified materials accounted for 3.79% and 3.33%; 1.33% and 0.95%; and 0.39% and 0.48% respectively in Frequency of occurrence and Numerical method as incidental diets. In *Synodontis budgetti*, Detritus constituted 31.45% and 31.93% of the content under frequency of occurrence and numerical method, followed by plant part with 21.68% and 22.69%. Insect part, Mud and Worm constituted 11.30% and 11.20%; 9.00% and 10.36%; and 5.36% and 5.04% respectively. Insect, Phytoplankton and Sand particles had 4.41% and 3.64%; 4.25% and 4.20%; and 4.24% and 4.48% in Frequency of occurrence and Numerical method respectively. Small fish, 2.65% and 1.40%; Snail, 1.78% and 1.12%; Grain, 1.61% and 1.68; Fluid, 1.28% and 1.12%; Shell, 0.86% and 0.84% and Unidentified material, 0.13% and 0.28% appeared as incidental diets in Frequency of occurrence and Numerical method respectively. *Clarias gariepinus*, *Mormyrus rume rume* and *Synodontis budgetti* exploit different varieties of food both of plant and animal origin. This ability makes these species to be Omnivorous in their feeding habit.

Keyword: Food, Feeding habit, Dadin kowa, Reservoir.

INTRODUCTION

Nutrition is one of the essential requisites of living beings in nature for continuance of their vital needs viz., growth and reproduction for survival and thus maintain their kind. Fishes directly depend upon their surrounding aquatic environment for their

food requirements and are highly adapted in their food and feeding habits, utilizing most of the readily available food. The food composition may also vary depending on size of the fish, maturity, environmental condition and habitat types (Majumder et al., 2024). Habitats and geographical positions tend to dictate on food items to be ingested by a fish species (Babita et al., 2024).

The study of food and feeding habits of freshwater fish species is an issue of continuous research. This is because it makes up a basis for the development of a successful management program on fish capture and culture (Kefas et al., 2020). Moreover, studies on natural feeding of fish enable to identify the trophic relationships present in aquatic ecosystems, identifying feeding composition, structure and stability of food webs in the ecosystem (Babita et al., 2024). The knowledge of the food and feeding habits of a fish helps in finding out the distribution of a fish population and a thorough Survey of literature indicates that such knowledge is highly essential for successful management of a fishery and such studies are undoubtedly important in any fisheries research program (Kefas et al., 2020).

Food and feeding habit of fish are important biological factors for selecting a group of fish for culture in ponds to avoid competition for food among themselves and live in association and to utilize all the available food (Soe et al., 2022). It is virtually impossible to gather sufficient information of food and feeding habit of fish in their natural habitat without studying its gut contents (Soe et al., 2022). Understanding the relationship between body structures and fish diet could be important for predicting the diet of, how they feed and the mechanics of feeding (Suresh et al., 2024). Studies on stomach composition could provide useful information in positioning of the fishes in a food web in their environment and in formulating management strategy options in multi species fishery (Suresh et al., 2024).

Modern conservation and ecosystem-based management strategies for freshwater species require updating and area specific information. There is paucity of information available on the food and feeding habit of fish in Dadin kowa reservoir, hence the need for this study.

MATERIALS AND METHODS

Study Area

Dadin-Kowa Reservoir is in Yamaltu Local Government Area of Gombe State in the North East of Nigeria. It lies within latitude 10°17 '18" N and longitude 11°30'32 "E of the equator (Muhammad et al., 2018). It has total capacity of 800 milllion m^3 and a surface area of 300km^3. The dam is located about 35 kilometers to the East of Gombe town. The Reservoir was built with the major objective of providing domestic water supply to Gombe State, hydroelectric power supply, Irrigation farming around Dadin Kowa and many areas around the town and has potentials as a source of fisheries (Muhammad et al., 2018).

Sample Collection

The species *Clarias gariepinus (tarwada), Mormyrus rume (sawanya),* and *Synodontis budgetti. (Karaya/Kurungu)* were purchased monthly from artisanal fishermen from the landing site for the period of 18 months (October 2022-March 2024) and transported immediately in boxes with ice to the laboratory for analysis.

Sample Identification

The samples collected were identified by Taxonomical keys of identification of fish provided by Olaosebikan and Raji (2013).

Determination of Food and Feeding Habit of the Species

Each stomach were split open by making a longitudinal incision along the mid ventral line from the mouth to the anus to expose the visceral organs; contents were emptied on a petri- dish and preserved immediately in

formalin for subsequent examination of the food items (Suresh et al., 2024). Some food items were identified with the naked eye, while others were identified with the aid of a microscope and analysed using frequency of occurrence, numerical and fullness methods.

Frequency of Occurrence of Food Item

In the Frequency of occurrence of food item, the occurrence of each food item is recorded and expressed as the percentage of the total number of stomach containing food. Frequency of occurrence:

$\% \, Oi = Ni/N \times 100$

Where: % O is the frequency of occurrence of given food i

N is the number of stomach containing prey i

N is the total number of stomach with some food (Majumder et al., 2024).

Numerical Method of Food Item

In the Numerical method of food item, the number of each food item are recorded and expressed as the percentage of the total number of food items found in the stomachs.

Numerical method:

$\% \, N = Ni/Nt \times 100$

Where: N is the percentage of food item i

Ni is the number of particular food item i

Nt is the total number of food item (gut content) (Sylvie et al., 2023).

Fullness Method

In the fullness method, the stomach fullness was determined using visual observation of the stomach and the stomachs were scored 0 (empty stomach), ¼ (one quarter full stomach), ½ (half full stomach), ¾ (three quarter full stomach), or ¾ (full stomach)

according to their fullness to show the level of feeding intensity of fish species as described by (Matunguru et al., 2022).

Statistical Analysis

Data obtained were subjected to simple statistical tools like percentage and mean. Microsoft Excel sheet were used to analyse and manage the data.

RESULTS

Determination of Food and Feeding Habit of *Clarias gariepinus* in Dadin Kowa Reservoir

Table 1 shows the summary of the food item of *Clarias gariepinus* in Dadin Kowa Reservoir. Macrophyte accounted for 23.88% of the content using frequency of occurrence method followed by Insect part with 13.68%. Small fish, Mud, Detritus and Zooplankton had 11.67%, 9.73%, 9.25% and 7.64 respectively. In the numerical analysis Macrophyte constituted 25.96%, Insect part had 13.14%. Small fish, Mud, Detritus and Zooplankton had 10.89%, 9.62 %, 8.65% and 7.37%, respectively. Sand particles and phytoplankton have 6.07%, 6.73 and 4.64%, 6.73% by Frequency of occurrence and Numerical method respectively. Worm 4.17%, 3.31%; Insect 2.67%, 1.60%; Grain 2.29%, 0.96%; and Fluid 1.63%, 0.32% appeared to be incidental diets.

Table 2 shows the level of feeding intensity of *Clarias gariepinus* in Dadin Kowa Reservoir in which 37.57% of the stomachs were empty, 30.69% of the stomach were found with one quarter full stomach (1/4), 16.93% were with half full stomach (1/2), 8.47% with three quarter full stomach (3/4) while 6.35% appeared to have full stomach (4/4).

Table 1: Summary of the stomach contents of *Clarias gariepinus* in Dadin Kowa Reservoir.

Food item	Frequency of occurrence		Numerical method	
	Total	Percentage (%)	Total	Percentage (%)
Macrophyte	1044.6	23.88	81	25.96
Insect part	598.5	13.68	41	13.14
Zooplankton	334.2	7.64	23	7.37
Mud	425.6	9.73	30	9.62
Sand particles	265.3	6.07	21	6.73
Detritus	404.7	9.25	27	8.65
Phytoplankton	202.9	4.64	21	6.73
Worm	182.5	4.17	1	3.31
Insect	116.7	2.67	3	1.60
Small fish	510.7	11.68	34	10.89
Unidentified material	116.7	2.67	3	0.96
Fluid	71.4	1.63	10	0.32
Grain	100	2.29	5	0.96

Table 2: Stomach Fullness of *Clarias gariepinus* in Dadin Kowa Reservoir.

Stomach fullness	No of fish	%fullness
Empty (0)	71	37.57
¼	58	30.69
½	32	16.93
¾	16	8.47
Full	12	6.35
Total	189	100

Determination of Food and Feeding Habit of *Mormyrus rume rume* in Dadin Kowa Reservoir

Table 3 shows the summary of the food item in *Mormyrus rume rume*. Detritus constituted 30.07%, of the content under frequency of occurrence method followed by Plant part with 21.03%. Phytoplankton, Worm, Insect, Mud and Insect part accounted for 14.09%, 7.84%, 7.52%, 7.38% and 6.54% respectively. In the numerical analysis, Detritus accounted for 30.48%, followed by Plant part with 21.90%. Phytoplankton, Worm, Insect, Mud and Insect part had 14.76%, 7.14%, 7.14%, 7.14% and 6.66 respectively. Sand particles, Fluid and Unidentified materials accounted for 3.79%, 3.33%; 1.33%, 0.95%; and 0.39%, 0.48% respectively in Frequency of occurrence and Numerical method as incidental diets.

Table 4 shows the level of feeding intensity of *Mormyrus rume rume* in Dadin Kowa Reservoir in which 12.35% of the stomachs were empty, 40.74% of the stomach were found with one quarter full stomach (1/4), 37.04% were with half full stomach (1/2), 6.17% with three quarter full stomach (3/4) while 3.70% appeared to have full stomach (4/4).

Table 3: Summary of the stomach contents of *Mormyrus rume rume* in Dadin Kowa Reservoir.

Food item	Frequency of occurrence		Numerical method	
	Total	Percentage (%)	Total	Percentage (%)
Phytoplankton	705.6	14.09	31	14.7
Plant part	1052.6	21.03	46	21.90
Sand particles	190	3.79	7	3.33
Mud	369.3	7.38	15	7.14
Insect part	327.4	6.54	14	6.66
Detritus	1505.2	30.07	64	30.48
Unidentified material	20	0.39	1	0.48
Worm	392.5	7.84	15	7.14
Insect	376.5	7.52	15	7.14
Fluid	66.6	1.33	2	0.95

Table 4: Stomach Fullness of *Mormyrus rume rume* in Dadin Kowa Reservoir.

Stomach fullness	No of fish	%fullness
Empty (0)	10	12.35
¼	33	40.74
½	30	37.04
¾	5	6.17
Full	3	3.70
Total	81	100

Determination of Food and Feeding Habit of *Synodontis budgetti* in Dadin Kowa Reservoir

Table 5 shows the summary of the food item in *Synodontis budgetti.* Detritus constituted 31.45%, of the content under frequency of occurrence method, followed by plant part with 21.68%. Insect part, Mud and Worm constituted 11.30%, 9.00% and 5.36% respectively. In the numerical analysis, Detritus had 31.93%, followed by plant part with 22.69%. Insect part Mud and Worm constituted 11.20%, 10.36%, and 5.04% respectively. Insect, Phytoplankton and Sand particles had 4.41%, 3.64%; 4.25%, 4.20% and 4.24%, 4.48% in Frequency of occurrence and Numerical method respectively. Small fish, 2.65%, 1.40%; Snail, 1.78%, 1.12%; Grain, 1.61%, 1.68; Fluid, 1.28%, 1.12%; Shell, 0.86%, 0.84% and Unidentified material, 0.13%, 0.28% appeared as incidental diets in Frequency of occurrence and Numerical method respectively.

Table 6 shows the level of feeding intensity of *Synodontis budgetti* in Dadin Kowa Reservoir in which 46.69% of the stomachs were empty, 31.99% of the stomach were found with one quarter full stomach (1/4), 15.44% were with half full stomach (1/2), 1.84% with three quarter full stomach (3/4) while 4.04% appeared to have full stomach (4/4).

Table 5: Summary of the stomach contents of *Synodontis budgetti* in Dadin Kowa Reservoir.

Food item	Frequency of occurrence		Numerical method	
	Total	Percentage (%)	Total	Percentage (%)
Insect part	528.6	9.00	40	11.20
Plant part	1013.6	21.68	81	22.69
Detritus	1470.8	31.45	114	31.93
Sand particles	198.3	4.24	16	4.48
Phytoplankton	198.6	4.25	15	4.20
Grain	75.2	1.61	6	1.68
Insect	206	4.41	13	3.64
Mud	420	9.00	37	10.36
Small fish	123.8	2.65	5	1.40
Snail	83.3	1.78	4	1.12
Worm	250.7	5.36	18	5.04
Shell	40.4	0.86	3	0.84
Fluid	59.9	1.28	4	1.12
Unidentified material	6.25	0.13	1	0.28

Table 6: Stomach Fullness of *Synodontis budgetti* in Dadin Kowa Reservoir.

Stomach fullness	No of fish	%fullness
Empty (0)	127	46.69
¼	87	31.99
½	42	15.44
¾	5	1.84
Full	11	4.04
Total	272	100

DISCUSSION

The major food item of *Clarias gariepinus, Mormyrus rume rume* and *Synodontis budgetti* in Dadin Kowa Reservoir were similar, mainly Macrophyte/Plant part, Insect part, Detritus, Worm, Mud, Phytoplankton etc. The feeding habit were similar to those reported by (Tidi & Pius, 2021), (Jibrin & Shu'aibu, 2023) and (Yongo et al., 2019) in River Donga, Taraba State, Nigeria; Lake Geriyo, Adamawa, Nigeria and African Freshwaters respectively. The food habit of different fish varies from month to month. This variation is due to changes in the composition of food organisms occurring at different times of the year (Alzeny et al., 2024).

Apart from the major food items, they also picked a variety of other food items. Teleost including cichlids were able to exploit more than one source (Kefas et al., 2020). This ability to exploit different varieties of food makes *Clarias gariepinus*, *Mormyrus rume rume* and *Synodontis budgetti* to be

omnivorous. Several other workers have also reported on the high degree of overlap in the diet of fishes, (Majumder et al., 2024; Haque et al., 2022).

The results from Dadin Kowa Reservoir indicated that the fishes has a broad spectrum of food ranging from bottom organism mainly detritus, fish, insects, other materials such as sand particles and unidentified materials, plant materials, phytoplanktons and zooplanktons which were in agreement with the findings of (Dadebo et al., 2014)) who reported same for *Clarias gariepinus* from Lake Koka, Ethiopia and (Onimisi & Shittu, 2015) for *Mormyrus rume rume* in Lower River Niger, Idah, Kogi State, Nigeria.. The broad food spectrum of this fishes indicated that they feed both in surface water column and even near the substratum.

Food items of animal origin contributed significantly to the diet of the studied fishes, which is dominated principally by Insects, Worms, Insect part, Small fish and Zooplankton. In addition, plant materials/ macrophyte, Phytoplankton and grains contributed significantly to the stomach content of the fishes. It may therefore be justifiable to classify *Clarias gariepinus, Mormyrus rume rume* and *Synodontis budgetti* as omnivorous species, which is in agreements with the findings of (Dadebo et al., 2014; Onimisi & Shittu, 2015; Ekpo et al., 2014) on the same species respectively.

Examination of the diet of these three species in this study showed that there was high percentage of mud and detritus in their stomach. This is an indication that the species are bottom grazers and inter-specific competition can be said to occur in the reservoir between the three species (Oso et al., 2006).

The result obtained from this study showed that about 37.57% of the *Clarias gariepinus* examined had empty stomach while *Mormyrus rume rume* and *Synodontis budgetti* had about 12.35% and 46.69%

empty stomach. The reason for this may be due to the fact that the food items in their stomach may have been regurgitated or digested as the fish struggled for escape in the traps and gill nets. It was observed that specimens caught with cast net had lesser amount of empty stomach (Kefas et al., 2020). Thus, cast netting may be recommended for study of food and feeding. The occurrence of a high percentage of empty stomachs is a characteristic feature of predatory fishes which is associated with their rapid rate of digesting food. Similarly, higher occurrence of non-empty stomach was due to good feeding strategy of species, (Tran et al., 2021) and food abundance in most part of the year (Hakimelahi et al., 2020).

CONCLUSION

Clarias gariepinus, *Mormyrus rume rume* and *Synodontis budgetti* exploit different varieties of food both of plant and animal origin. This ability makes these species to be Omnivorous in their feeding habit.

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