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ORIGINAL ARTICLES

An Investigation into the Food and Feeding Habits of *Sarotherodon Galilaeus* (Pisces: Cichlidae) in a Shallow Tropical Reservoir

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ABSTRACT

An investigation was conducted into the stomach content of *Sarotherodon galilaeus* in a shallow reservoir in the Northern Region of Ghana. Two hundred and seventy specimens were used for the study. Diet indices such as percentage composition by number and frequency of occurrence methods used to analyze the stomach contents showed that the food items covered a wide range of diatoms, desmids, algae, protozoan, detritus and accessory prey items suggesting that the fish species feeds on both surface water and bottom sediments. There was no significant difference ($p>0.05$) in items ingested by both adults and juveniles. This suggests that the diversity of food items exploited by the adults is similar to that of the juveniles. However, the juvenile fish had preference for fish fry, diatoms and algae whiles the adults generally preferred diatoms and detritus, suggesting age specific dietary preference. There was also a high degree of feeding intensity during the study period since percentage of full stomachs in both adults and juveniles was higher than that of empty stomachs and this also indicates that food was abundant in the reservoir during the study period. The ability of *Sarotherodon galilaeus* to feed on a wide range of food items makes it possess a high aquaculture potential. This is particularly important for the culture of this species since it is possible to formulate artificial diets necessary for its mass production but this is yet to be realized in Ghana.

Key words: shallow reservoir, juveniles, adults, euryphagous, feeding intensity.

Introduction

The analysis of stomach content of a fish provides information about a particular fish in the ecosystem. The stomach content of the organism is a valuable source in order to obtain data about the animal and plant population in a certain area as well as to determine the population parameters of species that cannot be determined by other methods (Ibrahim, S., 2003) Various investigations have been conducted into stomach content of fish with the aim of determining their dietary requirement. For instance, (Pauly, D., 1976) found the stomachs of adult *Sarotherodon melanotheron* to contain the fine fraction of bottom mud, comprising inorganic granules of 50-100μ diameter, pinnate diatoms and organic detritus.

The rivers, lakes, dugouts and reservoirs all offer diverse freshwater habitats and niches for various fishes. The various species in the water body differ in their food and feeding habits depending on the niche of the species (Dankwa, H. R). Food is the most vital factor for growth, survival and very important for increasing fish production. Stomach content of a fish varies with the time of the day, size of the fish and the season of the year. Given appropriate temperature and water conditions, the health and growth of a fish will depend entirely on what and how it feeds. Knowledge on the natural food of fish species and its feeding is an integral part of aquaculture development. It suggests to fish farmers the type, as well as the quantity of local supplementary feed to use. It is also important to know an animal in its habitat in order to be aware of its nutritional needs and interaction with other organisms. For this reasons, studies to evaluate the stomach content try to identify and quantify the resource that a species uses, providing information on those selected from the choice available in the environment (Williams, 1981). Therefore, this research is undertaken to determine the stomach content of both juveniles and adults *Sarotherodon galilaeus* in the Golinga reservoir which might be helpful to fish farm managers to increase production of cultured fish in Ghana.

Materials and methods

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The study was conducted in the Golinga reservoir located in the Northern Region of Ghana, which is found in the Guinea Savanna ecological zone and characterized by unimodal rainfall pattern with varying temperature regime. The Golinga reservoir has a surface area of about 18 ha and a mean depth of 2.473 m and a volume of 15623E6 m² at full capacity (Kpodonu, T. A, 2008.)

Fish samples were collected from commercial artisanal fishermen at two (Amisah, S, 2008.) landing sites every fortnight from September, 2009 to August, 2010. Specimens were placed on ice packs in an ice chest to preserve it from deteriorating and taken to the laboratory for analysis. In the laboratory, each fish was weighed to the nearest 0.1 g using sartorius TE612 weighing scale and the standard length (SL) of the specimen were measured to nearest 0.1 cm with the aid of a fish measuring board.

Each labeled specimen was dissected using the dissecting kits to remove the stomach and preserved in 4% formalin solution in labeled sampled bottles prior to analysis in the laboratory. In the laboratory, the total weight of the stomach was taken to the nearest 0.001 g using sartorius CP124S analytical scale. Fish specimens were classified into two (Amisah, S., 2008.) size groups viz: juveniles (14.6-21.9 cm) and adults (≥ 22.0 cm) (Kone and Teugels, 2003).

Each stomach was then split opened using the dissecting kits and the stomach content poured onto a Petri dish for examination. A portion of the stomach content was picked with a forceps and placed on a piece of slide. A physiological saline was used to stain the content and the sample analyzed under the light microscope. Food items were identified to the lowest convenient taxonomic level using identification keys provided by (Needhem, P. R., 1962; Jeje, C. Y., and C. H. Fernando, 1986). The procedure was repeated until a quantifiable portion of particular stomach content was analyzed using diet indices such as percentage composition by numbers (% Cn) and frequency of occurrence (Fo) and stomach fullness (Hyslop, E. J., 1980); (Bowen, S. H., 1984). Frequency of empty stomachs and prey in non-empty stomachs were considered using X^2 test ($P < 0.005$). The percentage fullness of the stomach was visually calculated and categorized according to the following: 0/4) empty; ¼) almost empty; 2/4) half; ¾) almost full; 4/4) full (Williams, M. J., 198).

Results and Discussion

The studies revealed that there were nine (Jeje, C. Y., and C. H. Fernando, 1986) taxa of food items exploited by adults *Sarotherodon galilaeus* while the juveniles exploited ten (Kone, T. and G. G. Teugels, 2003.) taxa in the Golinga reservoir. Fry contributed (13 % composition by number) of food items in juvenile fishes while completely absent in adult fishes. This may be due to the fact that the digestive system of juveniles were not well developed and could not digest the fry before being captured by the fishermen. The diet of juveniles in this study was made up of diatoms (52 % composition by number) and protozoans (16 % composition by number) (Figure 2) while that of adults was mostly made up of diatoms (56 % composition by number) and algae (15 % composition by number) (Figure 1). This confirms the findings of (Amisah, S. and N. W. Agbo, 2008) who reported that adult *Sarotherodon galilaeus multifasciatus* in Lake Bosumtwi in Ghana fed heavily on phytoplankton and insect parts. They however found sand particles (detritus) only in stomachs of the juveniles while in this study, detritus was present in the stomachs of both adults and juveniles but in different quantities. (Armah, A. K., G. A. Darpaah, and S. Addo, 2003.), identified organic detritus, filamentous algae and diatoms in small size *Sarotherodon melanotheron* of the Keta Lagoon in Ghana but diatoms were not found in the stomachs of both medium and large size fish. Also, (Ofori-Danson, P. K. and G. N. Kumi, 2006) identified phytoplankton, zooplankton, detritus and accessory preys in the diet of both juveniles and adults of *Sarotherodon melanotheron* in the Sakumo Lagoon in Ghana. The knowledge of the diet of a species in nature is important for the establishment of its nutritional needs and of its interaction with other organisms [18; 1]. Most aquatic animals appear to be opportunistic feeders, consuming a large diversity of prey (Cortes, E., 1999), and results from this study indicates that *Sarotherodon galilaeus* is a non-selective opportunistic feeder and its diet include a diverse spectrum of plankton, but with chlorophyta and bacillariophyta (diatoms) and protozoans being the dominant food items. (Welcomme, R. L. 2001) reported that unspecialized feeders eat insects, plankton, detritus and plant matter according to their abundance while (Liem, K., 1984) stated that teleost including cichlids were able to exploit more than one food source. This ability to exploit different varieties of food makes *Sarotherodon galilaeus* to be omnivorous. Examination of the diet also showed that there was some percentage of detritus in its stomach (both adults and juveniles) and this indicates that the species could be a bottom grazer (Welcomme, R. L. 2001).

For feeding intensity, out of 150 adult specimens examined, 65 (43.33%) had full stomachs while 23 (15.33%) had empty stomachs (Table 1). For the juvenile fishes, 43 (35.83%) had full stomachs while 33 (27.5%) had empty stomachs out of 120 specimens examined (Table 2). Feeding intensity of fish can be determined based on degree of fullness of stomach. (Omoigberale, M. O. and S. Aruoture, 2002) reported that if the percentage of full stomachs was more than that of empty stomachs, there is high degree of feeding intensity,

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and this phenomenon was observed in this present study in the Golinga reservoir in Ghana. The relatively high percentage of full stomachs suggests that food was abundant in the reservoir throughout the study period.

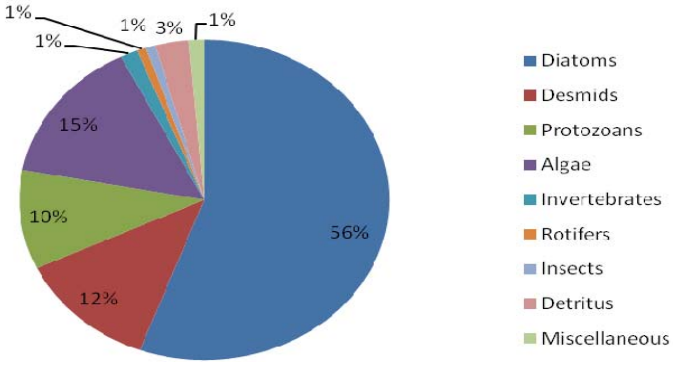

Fig. 1: Food items in the stomach of adults *Sarotherodon galilaeus* using percentage composition by number in the Golinga reservoir during the study period.

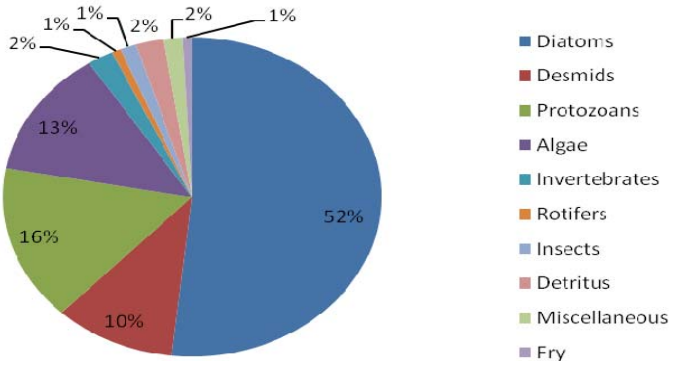

Fig. 2: Food items in the stomach of juveniles *Sarotherodon galilaeus* using percentage composition by number in the Golinga reservoir during the study period.

Table 1: Stomach contents classification of adult *Sarotherodon galilaeus* based on degree of fullness in the Golinga reservoir during the study period.

Degree of fullness	Number of stomachs	% Frequency
Full (4/4)	65	43.33
Almost full (3/4)	18	12.0
Half (2/4)	32	21.33
Almost empty (1/4)	12	8.0
Empty (0/4)	23	15.33
Total	150	100

Table 2: Stomach contents classification of juvenile *Sarotherodon galilaeus* based on degree of fullness in the Golinga reservoir during the study period.

Degree of fullness	Number of Stomachs	Frequency
Full (4/4)	43	35.83
Almost full (3/4)	8	6.67
Half (2/4)	27	22.5
Almost empty (1/4)	9	7.5
Empty (0/4)	33	27.5
Total	120	100

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Conclusions:

Sarotherodon galilaeus fed on a wide range of food items. Hence, it may be considered as euryphagous. This is particularly important for the culture of this species since it is possible to formulate artificial diets necessary for its mass production in Ghana.

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