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Stomach Contents and Feeding Habits of *Oreochromis niloticus* (L.) From Abu-Zabal Lakes, Egypt

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Abstract: The present study aimed to provide information on the abundance of natural foods needed by *Oreochromis niloticus* (L.) in newly formed mining lake namely Abu-Zabal lakes. The natural food of *O. niloticus* in Abu-Zabal lake, Egypt was studied from the gut contents of fish measuring 10- 23 cm total length. Gut contents were analyzed using two methods, the frequency of occurrence and numerical method. Diatoms, blue green algae and green algae constituted main food of plant origin. Diatoms were found to be the most preferable food of plant origin where it occurred in more than 68.0% of the examined fish. Rotifers, cladoceranes, ostracods, copepods, molluscanes and animal derivatives were comprised the food of animal origin. Sand particles, detritus and macrophytes (plant tissues) occurred in about 40.0, 75.4 and 33.3% of the examined guts respectively. It was concluded that *O. niloticus* in Abu-Zabal lakes is omnivorous.

Key words: Abu-Zabal lakes % *Oreochromis niloticus* % Natural food % Gut contents % Frequency of occurrence % Numerical method

INTRODUCTION

Abu-Zabal man-made lakes are located in north of Al Qalyobiyah Governorate, Egypt. The Lakes were formed, during last century, probably due to fracture and extract of basalt rocks. The lakes, inland closed basins, receive their water from the ground and seepage water. The lakes waters cover an area of $608.050\times10^3 m^2$ [1].

The study of [1] was considered the first attempt to light the physical properties of Abu-Zabal Lakes, this study aimed to determine the pathymetry and phsico-chemical characteristic of water. The results of most physical and chemical parameters revealed that the water of Abu-Zabal Ponds can be classified as brackish water basins [1, 2]. Some pathological conditions in *Tilapia zillii* collected from the lake were recorded by [3]. Also [4] studied the community structure of phytoplankton in the newly formed aquatic lakes at Abu-Zabal. Other studies detected the levels of some heavy metals in water, sediment and several organs of fish species collected from Abu-Zabal Lakes [5-7]. Pysico-chemical and bacteriological analysis of the lakes were investigated by [8], the results revealed that lake waters were on the alkaline side, high total bacterial counts and high bacterial indicators of sewage pollution were recorded during summer. On the other hand [9] studied the distribution, community structure of zooplankton and macrobenthos of the ponds water. The zooplankton community of Lake Abu-Zabal was detected by [10]. Effects of environmental conditions of Abu-Zabal Lakes on fish caught were investigated by [11]. This study proved that Abu-Zabal lake fishes are safe because heavy metals (Zn, Cu, Pb and Cd) concentration levels are comparable to the permissible international limits.

Studies on natural feeding of fish permit to identify the trophic relationships present in aquatic ecosystems, identifying feeding composition, structure and stability of food webs [12-16]. In the same time, the study of the food and feeding habits of freshwater fish species is a subject of continuous research because it constituted the basis for the development of a successful fisheries management programme on fish capture and culture [17, 18]. Studies on diet composition are important in community ecology because the use of resources by organisms has a major influence on population interactions within a community [19]. Studies of species resources requirements have been used in attempts to understand factors controlling the distribution and abundance of organisms [20]. Data on different food items consumed by fish may eventually result in identification of stable food preference and in creation of trophic models as a tool to understand complex ecosystems [21, 22].

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There is no published data available on the food and feeding habits of *O. niloticus* which constitute the major content of the bulk of Abu-Zabal lakes [11]. So, this study aimed to provide information about stomach contents and feeding habits of *O. niloticus* in these newly formed mining lakes.

MATERIALS AND METHODS

Specimens (n = 280) for food analysis were obtained from gill net; trammel net and basket traps operating in Abu-Zabal Lakes on a bimonthly basis from March 2005 till February 2006. For each specimen, length to the nearest millimeter and total and gutted weight to the nearest gram were recorded. Specimens were dissected and their gut removed and preserved in 4% formalin. After that, total weights of stomachs to the nearest 0.01 g were recorded. The stomach contents of individuals were analyzed and the bimonthly data were grouped by season and the number of empty stomachs was recorded. The stomachs were dissected and the contents were emptied into a Petri-dish. Analysis was done using frequency of occurrence and numerical methods as described by [23]. In the frequency of occurrence method, the occurrence of food items was expressed as the percentage of the total number of stomach containing food. In the numerical method, the number of each food item was expressed as the percentage of the total number of food items found in the stomach.

The degree of stomach fullness is divided into 3 classes ranging from empty, half to full. Mean relative weight of content was calculated as described by [23, 24] as follow:

Mean weight of content = Total stomach contents weight/Total fish weight x 100

RESULTS

Gut contents were analyzed using frequency of occurrence and numerical methods. Bacillariophyceae (diatoms), Chlorophyceae (green algae) and Cyanophyceae (blue green algae) constituted main food of plant origin. Diatoms were represented mainly by *Navicula sp., Cyclotella sp., Achnanthes sp.* and *cocconies sp.* Green algae were represented in fish stomachs mostly by *Scenedesmus sp., Ankistrodesmus sp., Coelastrum sp.* and *Cosmarium sp.*, while blue green algae were represented by *Merismopedia sp, Oscillatoria sp., Anabaena sp., Micrcystis sp.* and *Coelospharium sp.* whereas rotifers, molluscanes (bivalves), cladoceranes, ostracods, copepods and animal derivatives constitute the food of animal origin. In occurrence method, diatomes was found to be the most preferable food of plant origin where it occurred in more than 68.0% of the examined fish. Green algae and blue green algae as a groups contribute about 56.5 and 18.8, respectively. Macrophytes (plant tissues) occurred in 33.3%. Examination of the diet of *O.niloticus* showed that, there was high percentage of detritus and sand particles occurred in its stomach, which compressed about 75.4 and 40.0% respectively. Rotifers were observed as the preferably food of animal origin contribute about 40.0% of the examined fish and mostly represented by *Brachionus sp.*, while mollusca was the least (0.36%).

Regarding seasonal occurrence of different food items in the guts of *O. niloticus*, Fig. 1 shows that, a high percentage of occurrence of green algae were recorded during both spring and summer (72.7and 90.0%, respectively), while the highest percent of blue green algae occurred during winter (42.9%). Detritus constituted the highest percentage in spring comprised about 90.9% of the total examined stomachs. While sand particles

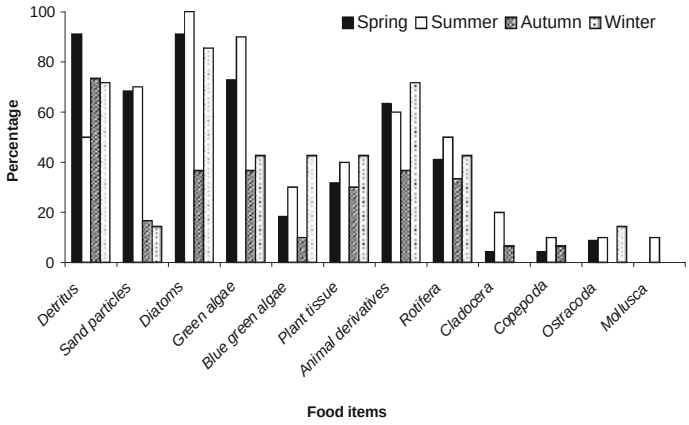

Fig. 1: Seasonal occurrence of food items of *O.niloticus* in Abu-Zabal Lakes

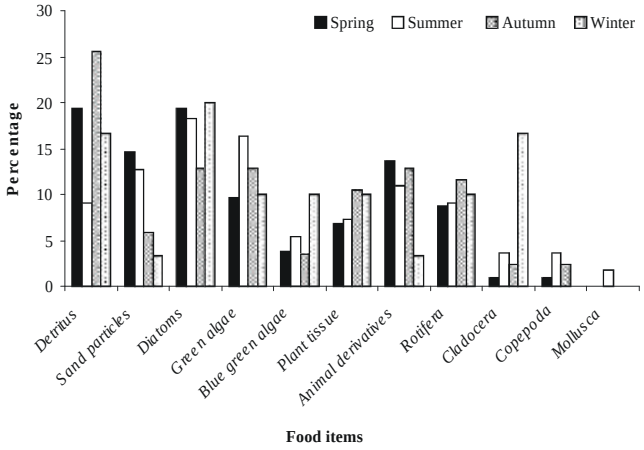

Fig. 2: Seasonal percentage of food items of *O.niloticus* in Abu-Zabal Lakes by numerical method

attainted its highest occurrence during summer and spring formed about 70.0 and 68%, respectively. The highest percentage of occurrence of rotifers was detected during summer season (50%). Animal derivatives (eggs, scales, insect and crustaceans appendages, etc.) occurred in high percent during winter season constituting 71.4% of the examined guts. The rest food of animal origin (molluscanes, cladocerans and copepods) attained the highest percent during summer season (Fig. 1).

In the numerical methods, detritus and diatoms formed the most important diet (18.57 and 16.79%, respectively). Seasonal variation of different food items showed that, diatoms formed the most important food items of plant origin during the four seasons as shown in Fig. 2. Animal derivatives were the preferable food of animal origin during spring, summer and autumn. Rotifera nearly attained the same percent during the four seasons, whereas Cladocera was the most important animal food origin during winter (16.67%). Generally, results of the two methods of analysis emphasized the importance of plant as a major food resource in the stomach of Nile tilapia and foods of animal origin were observed on some occasions and these were mainly rotifers and animal derivatives.

Table 1: Percentages of seasonal variation in gut fullness of *O. niloticus* in Abu-Zabal Lake

State of gut	Spring	Summer	Autumn	Winter
Full	54.2	33.3	25.8	60.0
Half	33.3	66.7	45.2	40.0
Empty	12.5	-	29.0	-

Table 2: Seasonal variation in mean weight of content ±SD of *O.niloticus* in Abu-Zabal Lake

Season	Mean weight of content
Spring	5.01±1.38
Summer	5.78±2.30
Autumn	4.61±1.50
Winter	5.15±1.78

Regarding the seasonal variation in the feeding intensity as an index of the stomach fullness, it could be stated that, the maximum number of empty stomach was recorded during spring and autumn seasons (12.5 and 29.0%, respectively) as shown in Table 1.

The seasonal variations in the mean weight of content in collected fish samples in Table 2 showed that, summer attained the highest mean weight of content whereas the lowest was recorded during autumn.

DISCUSSION

The study of the trophic ecology is useful and fundamental to understand the functional role of the fish within their ecosystems [16, 25, 26]. Analysis of stomach contents of *O. niloticus* during the study showed the presence of three algal groups and diatoms was the most preferable food of plant origin where it occurred in more than 68.0% of the examined fish. Investigation of [4] found that, the phytoplankton assemblage of the Abu-Zabal Lakes consists of 138 species belonging to 7 classes. Chlorophyceae, Bacillariophyceae and Cyanophyceae represented the three main classes in lakes, diatoms was the second important predominant phytoplankton group and it attained its maximum occurrence during winter season. The study [27] pointed out that the diatoms is the most important food item than any food items in the gut of *O.niloticus* in Nyanza Gulf Lake Victoria. Rotifers were observed as the prefer food of animal origin whereas, it contributed about 40.0% of the examined fish. Moreover [9] mentioned that, rotifers dominated the zooplankton groups forming about 87% of total zooplankton in Abu-Zabal Lakes and *Brachionus plicatlis* proved to be the most dominant species. The study also added the presence of seven macrobenthic

species belong to Arthropoda (3 species), Mollusca (3 species) and one species to Annelida. Also [10] found that the pelagic zooplankton community in the same lake comprised Rotifera, Protozoa (Ciliophora and Rhizopoda) and Copepoda, Cladocera were seldom recorded. The study [28] pointed out that, animal foods were observed on the guts of *O. niloticus* on rare occasions and these were mainly rotifers. So, analysis of stomach contents of *O. niloticus* in this study showed good relation with the ambient plankton, where all species found in the stomach of this fish were previously recorded in the water of Abu-Zabal Lakes. Results of the two methods of analysis emphasized the importance of plant as a major food resource in the stomach of Nile tilapia, which agrees with [29].

Examination of the diet of this species showed that, there was high percentage of detritus and sand particles occurred in its stomach during, both spring and summer comprising about 90.9 and 70.0%, respectively. An increase in reactive silicate during hot period, especially summer and the pronounced decrease in Abu-Zabal water during winter was obvious [2]. The study pointed out that, the increase in silicate concentration may be related to the nature and chemical composition of the basalt rocks in Abu-Zabal Lakes. This is an indication that *O. niloticus* is bottom grazers, which agrees with [18].

It is important to emphasize that the effect of seasonality should always be considered in the studies on natural feeding of fish, because the temporal changes of biotic and abiotic factors alters the structure of the food web along the year and, as a consequence, the fish often shows seasonal diet shifts [30]. During this study the maximum number of empty stomach was recorded during spring and autumn (12.5 and 29.0% respectively), this period of poor feeding activity coincided with the spawning season of *O. niloticus* in Abu-Zabal Lakes [31]. So these results may be interpreted in light of the abdominal cavity is fully occupied by the ripe gonads and so stomachs were always empty during these season. Moreover [32] mentioned that, the period of poor feeding activity is coincided with the peak of spawning season because the abdominal cavity is fully occupied by the voluminous ripe gonads and so the stomachs were always empty and small in size. The recorded seasonal variations in the mean weight of content in collected fish samples revealed that, summer attained the highest mean weight of content while the lowest value was observed during autumn. These results coincide with that of variation in gut fullness in this study. Changes in mean weight of stomach contents through the year indicate differences in feeding intensity [33]. *Oreochromis spp*. was found to be an omnivorous opportunistic-generalist benthophagic browser or surface grazer [34]. The feeding habits in this study were similar to those reported by [18] in a Tropical Reservoir, Nigeria on *O. niloticus* and *S. galilaeus* (L.).

It was concluded that, the major food of *O. niloticus* in Abu-Zabal Lakes were detritus, diatoms, green algae, animal derivatives, sand particles, rotifers ect. So the ability to exploit different varieties of food items makes *O. niloticus* to be omnivorous. This ability to feed at different trophic levels, coupled with the potential for fast growth [11] makes this species a promising candidate for incorporation into locally-operated polyculture systems.

REFERENCES

1. Abd Ellah, R.G., 2003. On physical limnology of Abu Zabaal Lakes, Egypt. Bulletin of National Inst. Oceanograp. Fish., 29: 461-471.
2. Abdo, M.H., 2005. Physico-chemical characteristics of Abou Zabaal ponds, Egypt. Egyptian J. Aqu. Res., 31: 1-15.
3. El-Mansy, A.I., 2005. Pathological conditions in *Tilapia zillii* Geravais, 1848 caught from Abo-Zaabal Lake, North Eastern of Cairo, Egypt. J. Egyptian Acad. Soc. Environ. Develop., 6: 57-88.
4. Mohamed, A.M.H., 2005. Ecological studies on phytoplankton composition of newly formed aquatic depressions at Abou-Zabal quarries region. M.Sc. Thesis. Faulty of Science Al-Azhar University, Cairo, Egypt, pp: 213.
5. Gaber, H.S. and N.G. Fadel, 2005. Some studies on heavy metals pollution of Abo Zaabal Lake and their effect on three tilapia species. Egyptian J. Comp. Pathol. Clin. Pathol., 18: 211-233.
6. Mohamed, F.A.S. and N.S. Gad, 2005. Distribution of some heavy metals in tissues *Oreochromis niloticus*, *Tilapia zillii* and *Clarias lazera* from Abu ZaBaal lakes and their impacts on some biochemical parameters and on the histological structure of some organs. Egyptian J. Aqu. Biol. Fish., 9: 41-80.
7. Abdo, M.H., 2006. Distribution of the Ni, Fe, Mn, Zn, Cr, Pb, Cd, Co and organic matter in the recent sediment of Abu Zabaal ponds, Egypt. Egyptian J. Aqu. Res., 32: 196-207.
8. Rabeh, S.A. and E.A. Azab, 2006. Bacterial indicators of both sewage pollution and trophic status in Abu Za baal Lakes, Egypt. Res. J. Microbiol., 1: 480-491.

9. El-Shabrawy, G.M., S.H. Sleem and M.H.H. Ali, 2007. A preliminary study on zooplankton and macrobenthos in relation to some physical and chemical conditions at Abu Zabaal Ponds, Egypt. Egyptian J. Aqu. Biol. Fish., 11: 635-653.
10. El-Bassat, R.A. and W.D. Taylor, 2007. The zooplankton community of Lake Abo Zaabal, a newly formed mining lake in Cairo, Egypt. Afric. J. Aqu. Sci., 32: 185-192.
11. Ibrahim, S.M., K.A. Sh. Shalloof and H.M.M. Salama, 2008. Effect of environmental conditions of Abu Zabal Lake on some biological, histological and quality aspects of fish. Global Vetrinaria, 2: 257-270.
12. Zavala-Camin, L.A., 1996. *Introdução aos estudos sobre alimentação natural em peixes*. Maringã: Eduem/Nupelia, pp: 129.
13. Hahn, N.S., A.A. Agostinho and R. Goitein, 1997. Feeding ecology of curvina *Plagioscion squamosissimus* (Hsckel, 1840) (Osteichthyes, Perciformes) in the Itaipu and Porto Rico floodplain. Acta Limnol. Bras. Porto. Alegre., 9: 11-22.
14. Post, D.M., M.E. Conners and D.S. Goldberg, 2000. Prey preference by a top predator and the stability of linked food chains. Ecology, 81: 8-14.
15. Bacheler, N.M., J.W. Neal and R.L. Noble, 2004. Diet overlap between native bigmouth sleepers (*Gobiomorus dormitor*) and introduced predatory fishes in a Puerto Rico reservoir. Ecology of freshwater fish, 13: 111-118.
16. Abdel-Aziz, N.E. and S.M. Gharib, 2007. Food and feeding habits of round Sardinella (*Sardinella aurita*) in El- Mex Bay, Alexandria, Egypt. Egyptian J. Aqu. Res., 33: 202-221.
17. Oronsaye, C.G. and F.A. Nakpodia, 2005. A comparative study of the food and feeding habits of *Chrysichthys nigrodigitatus* and *Brycinus nurse* in a tropical river. Pak. J. Sci. Ind. Res., 48: 118-121.
18. Oso, J.A., I.A. Ayodele and O. Fagbuaro, 2006. Food and feeding habits of *Oreochromis niloticus* (L.) and *Sarotherodon galilaeus* (L.) in a Tropical Reservoir. World J. Zool., 1: 118-121.
19. Mequilla, A.T. and W.L. Campos, 2007. Feeding relationships of dominant fish species in Visayan Sea. Science Diliman, 19: 35-46.
20. Ross, S.T., 1986. Resources partitioning in fish assemblages: A review of field studies. Copeia, 2: 352-388.
21. Lopez-Peralta, R.H. and C.A.T. Arcila, 2002. Diet composition on fish species from the southern continental shelf of Colombia. Naga, 25: 23-29.
22. Bachok, Z., M.I. Mansor and R.M. Noordin, 2004. Diet composition and food habits of demersal and pelagic marine fishes from Terenggau waters, east coast of Peninsular, Malaysia. Naga, 27: 41-47.
23. Hyslop, E.J., 1980. Stomach contents analysis. A review of methods and their application. J. fish Biol., 17: 411-429.
24. Smyly, W.J.P., 1952. Observations on the food of fry of Perch (*Perca fluviatilis* Linn.) in Windermere. Proceedings of the Zoololgical Society, 122: 407-416.
25. Blaber, S.J.M., 1997. Fish and fisheries of tropical estuaries. London: Chapman and Hall, pp: 367.
26. Cruz, E.V.H., C.L.A. Abitttia, D.L. Campos and M.F. Galvan, 2000. Trophic interrelations of the three most abundant species from Laguna San Ignacio, Baja California Sur, Mexico. Bull. Marine Sci., 66: 361-373.
27. Getabu, A., 1994. A comparative study on the feeding habits of *Oreochromis niloticus* (Linnaeus) in Nyanza Gulf Lake Victoria and sewage fish ponds. Proceedings of the Second EEC Regional Seminar on Recent Trends of Research on Lake Victoria Fisheries, Nairobi: ICIPE Sci., pp: 93-103.
28. Getachew, T. and C.H. Fernando, 2004. The food habits of an herbivorous fish (*Oreochromis niloticus* Linn.) in Lake Awasa, Ethiopia. Hydrobiologia, 174: 195-200.
29. El-Gamal, A.R. and N.M. Ismail, 2005. Food composition and feeding habits of some fresh water fishes in various water systems at Abassa, Egypt, with special reference to snails transmitting diseases. J. Egypt. Soc. Parasitol., 35: 637-652.
30. Wootton, R.J., 1992. Fish ecology. London: Chapman and Hall, pp: 212.
31. Shalloof, K.A. Sh. and H.M.M. Salama, 2008. Investigations on some aspects of reproductive biology in *Oreochromis niloticus* (Linnaeus) inhabited Abu-Zabal Lake, Egypt. Global Vetrenaria, 2: 351-359.
32. Joadder, Md. A.R., 2007. Food and feeding habits of *Gagata youssoufi* (Rahman) from the river Padma in Rajshahi. Univ. J. Zool., Rajshahi University, 25: 69- 71.
33. Man, H.S.H. and I.J. Hodgkiss, 1977. Studies on the ichthyo-fauna in Plover Cove Reservoir, Hong Kong: feeding and food relation. J. Fish Biol., 5: 707-736.
34. Yousuf, A.K., K.A. Pittman and G. Blom, 1998. Diel feeding pattern and ration of two sizes of *Tilapia, Oreochromis spp*. in pond and paddy field. Asian Fish. Soc., 10: 281-301.