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ANALYSIS OF FEEDING POTENTIALS IN SOME TILAPIA SPECIES ON SELECTED BURROW PITS IN KANO STATE NIGERIA

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ABSTRACT

Analysis of the stomach contents showed close similarities in all the burrow pits studied. With the use of the occurrence method, algae occurred the most in all the burrow pits while with the points method, offals of grains gained the highest points in Kofar Mazugal borrow pit with 20.36%. Algae was the most important food item with 23.15% in Aisami burrow pit while Rotifer gained 35% and 29.5% respectively in Hausawa and Hotoro burrow pits respectively.

The food fits in all the burrow pits ranged from 0.022 to 0.031 and showed no significant difference ($p<0.05$) between the burrow pits. Estimates of the food consumption/biomass ratio (Q/M)showed the highest rate of 5.69 in T. zill from Hausawa burrow pit which also belonged to the smallest size range, S. galilaeus from Hotoro burrow pit recorded the lowest food consumption/biomass ratio of 4.73.

Keywords:- Burrowpits, Biomass ration, potentials, feeding.

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1.0 INTRODUCTION

1.1 Food and Feeding

Feeding is one of the most important functions of an organism. Other basic functions of an organism which include growth, development, reproduction, all require adequate nutrition and all these functions take place at the expense of the energy which enters the organism in the form of its food. All the other energy processes within the organism also proceed at the expense of the food. The first stage in the life-cycle of a fish is completed at the expense of the food reserves which it receives from the maternal organism (the yolk in the egg). However, the first can only mixed feeding, it goes over completely to the consumption of external foods.

Fishes differ greatly in the character of the food they consume. Both the size and the systematic position of the food organism are extremely variable, the range of food types consumed by fishes is greater than that of other groups of vertebrates (Nikolsky, 1966). Some fishes feed on plants and are termed herbivorous, for example, *Tilapia spp.*. Others feed on animals and are termed carnivorous, for example, *lates niloticus* whereas and large group derive its proteins, carbohydrates and fats as well as vitamins and most minerals necessary for growth and upkeep from both plants and animals sources andare termed Omnivorous, for example, *Clarias spp.* There are also the specialized parasitic fishes such as the sea lamprey *(petromyzon marinus).*

A wide range of kinds and size of plants and animals are important in the food chains of fishes. Among the plants are the algae and higher plants. The algae are of many forms, they could be planktonic, others are associated with a substrate of some kind as benthiphytes, epiphytes or even epizophytes. Examples of algae

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include *Euglena, Volvox, Naircula.* Among the earliest animal food to be consumed by fishes are animals plankton organism –zooplankton and these include different kinds of protozoans, microcrustaceans and oher macroscopic vertebrates and the eggs of many insects and animals including those of fishes themselves. No particular food is constantly available to fishes all the year round and this is primarily due to the great changes in the composition of food organisms and their availability. Such fluctuations are often cyclic and due to factors of their life histories or to climatic or other environmental conditions. For example, insects tend to emerge to a peak level at the onset of the rainy season (Lagler, 1977). And so those fishes that feed mainly on insects tend to accomplish most of the annual growth during this season, while at other season they feed on the most available food. Olatunde (1978) observed that availability and abundance are the key factors in the feeding habit of fishes as most fishes are highly adaptable in what they eat, utilizing the most readily available food.

The more stable feeding condition of the species, the smaller the range of food to which it is adapted and conversely, the more variable the food supply, the greater the variety of food eaten by the species. Relatively, few fish species are strict herbivores or carnivores and perhaps none at all feed solely on any one organism.

Closely, related to the variety of foods consumed by fishes is the function of the organs for seizing and assimilating the food. The buccal apparatus which serves for seizing, chewing and swallowing the food varies in fishes. On this basis, fishes can be classified according to their feeding habits as predators, grazers, food strainers, food suckers, and parasites.

Predators usually possess well developed grasping and holding teeth as in the genus *Hydrocynus,* for example, *H. brevis and H. vittatus.* The group of fishes have a well defined stomach with strong acid secretions. Gill rakers are short, few and serve to protect the gill filaments from harm by the food. Grazing characterizes many fishes that feed on plankton or on bottom organism, for example, *Mormyrus spp.* Straining of organisms from the water is a generalized type of feeding as the food materials are selected by size and not by kind. Food is taken in along with water passes into the gill chamber through the mouth. They usually possess gill rakers that are numerous, fine and close-set, for example, *Heterotis niloticus.* Sucking of food into the mouth is often practiced by bottom-feeders, for example, the African carp, *Labeo spp.* Which often possess protractile mouth which is equipped with well developed lips forming a sucker ideally suited for feeding on algae and detritus. Parasitism is perhaps the most unusual feeding habit among fishes. An outstanding example is the parasitic lampreys and hag fishes that such body fluids from the host fish after rasping a hole in the side of the body (Lagler, 1977)

An important factor in feeding is the time of day, where fishes that find food by smell and tastes are mainly night feeders, for example, the family *Mormyridae* which can feed both during the day and night. This is because they have very poor eye sight and so they use an electric organ situated on the side of the terminal portion of the tail which serves as radar. Most predators feed largely by sight and are more active during the day light hours.

Seasons, strongly influencing water temperature in the non-tropical areas and water levels in the tropics seem to interfere with feeding in fishes. In the tropics, during the rainy season, the volume of the water increases, reducing transparency and concentration of the water which reduces the primary production and all these affect the feeding habit of the fishes, for example, the lung-fish *protopterus annectens* during the dry season living for months on accumulated fats (Holden and Reed, 1991). Other fishes find and selected their food primarily by smell, taste, for example, *Gymnarchus niloticus.*

Temperature also determines the level where the higher the temperature, the higher the feeding rate and vice-versa, although in the tropics, temperature does not usually alter the feeding rate of fishes as most tropical regions have a stable temperature range. Distribution of food is equally important in which when the food materials are distributed in patches, the fish tends to more around in search of food, thereby reducing the feeding rate (Jammens, 1983). The rate of consumption of food is also connected with the condition of the fish itself. Many fishes cease to feed at their spawning time, for example, *O. niloticus* which is a month brooder. A well fed, satiated fish usually feeds less intensively that a thin, underfed one (Nikoslky, 1966).

1.2 Food Fits

A rationale fishery is one conducted in such a way to ensure the maximum production of fish of the highest possible quality with the minimum expenditure of efforts and materials. Most commercially cultured species are grown on prepared diets which have been formulated to optimize growth and flesh quality and are often expensive. With experience, one should be able to estimate the cost of such a diet for any particular species based on its natural food preference and tissue analysis and combine this with an index such as that suggested by Matthew and Samuel (1992).

In feed formulation, two factors are mainly put into consideration, namely, maximum production in terms of growth, and profitability factors, *Moraeu et al (1986)* Pauly et al (1988) proposed systems for species selected for translocation or aquaculture based on the estimates of their growth rates under natural or culture conditions. Matthews and Samuel (1990, 1992) used these estimates with data on the market value of a species to generate a general bio-economic selection index for identifying candidate species for aquaculture.

To give an indication of how well particular fish species might fit into a pond culture environment, the frequencies of organisms of the food groups in the stomach or gut and in the pond system to which they would be stocked is compared.

With the knowledge of the natural food organisms in the pond culture and that in the fish stomach, the fish 'food fit' (F_I) with the proposed environment can be known.

A perfect fit using this method would be represented by zero value while a perfect mismatch would give a value of 0.5. For example, using *Oreochromis shiramus* stomach content data from Bourn (1974) and aquatic food resources data from Tang (1970), the numbers represent frequency of individual groups in the total stomach contents.

	Plankton	Invertebrates	Plants	Fish
Tainan Pond	0.925	0.05	0.15	0.01
Taoyuan Reservoir	0.59	0.06	0.32	0.03
O. *shuanus* stomach	0.67	0.00	0.28	0.05

The 'food fit' Ff with the proposed environment is

Pond: (0.925-0.67) + (0.050-0) + (0.015-0.28) + (0.01-0.05) ÷ 4 = 0.15

Reservoir: (0.59-0.067) + (0.06-0) + (0.32-0.28) + (0.03-0.05) ÷ 4 = 0.05

The results shows that the reservoir would be the better of the two environment for growing *O. shiranus* . Thus the concept of food fit could give a quick overview of the status of fish in an aquaculture enterprises.

1.3 Food Consumption / Biomass (Q/B)

Most tropical and sub-tropical fisheries are based on multi-species resources. Hence, management oriented modeling studies which take multi species aspects into account require the estimation of vital statistics for a large number of species, often without access to a historic database (Pauly, 1982).

Further basic requirement needed in constructing a multi-species model is the food requirements of the constituent organism. Such knowledge is often hard to obtain for individual species and therefore one may be tempted to transfer estimates from one species to the other. However, in order to ensure that the values transferred are realistic, it is appropriate to devise a general relationship between metabolic expenditure of populations and their ecological or morphological characteristics (Pauly, 1989) Three aspects of models were recently presented for this purpose by Palomeres and Pauly (1989) by relating the aspect ratio of the caudal fin of a fish to its level of activity, accounting for the body ratio in the model and adjusting the linearizing transformation function of the temperature. The aspect ration (A) of the caudal fin of fishes is usually used as the key variable. Fishes may belong to the active, intermediate or sluggish type which is well characterized by their respective values of A.

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This work reveals the feeding potentials of various *tilapia* species in their different burrow-pits selected within Kano State Nigeria.

2.0 Materials and Methods

2.1 Fish Sampling

Fishes were collected using a combination of cast-nets, drift-nets, gill nets with mesh sizes 20mm x 20mm, hook and line from five different sampling sites. The fishes were packed soon after capture and kept chilled under ice-blocks and taken to the laboratory for further examination.

2.2.1 Length-Weight Measurement

Each fish was identified and its body weight and length measured. The fish's length measurements taken were the standard length (SL) and total length (TL) using a measuring board. The total mouth closed to the end of its tail while the standard length is the distance from the anterior most extremity of the fish to the base of the tail fin rays. Fish weight was measured to the nearest gram using a top loading balance. The parameters a (Proportionality constant) and b(exponent) of the length-weight relationship of the form.:

$$W = aL^b \qquad \ldots\ldots\ldots \qquad (1)$$

Were estimated through base 10 logarithm transformation of length weight data pairs by the method of least square linear regression:

$$\text{Log } W = \text{log}a + b/\text{Log}L \qquad \ldots\ldots\ldots \qquad (2)$$

2.2. Stomach Content Analysis

Each fish was dissected and its stomach removed and preserved in labeled specimen tubes containing 5% formalin prior to examination. The contents of the stomach were removed, identified and analysed by the frequency of occurrence, dominance and 'points' scheme as described by Hynes (1959).

a. Occurrence Method

The stomach contents were examined and the food items were enumerated. The number of fish in which each food item occurred was listed as a percentage of the total number of fish examined.

b. Dominance Method

The number of fish in which each food items occurred as the dominant food item was expressed as a percentage of the total number of fish examined.

c. 'Points' Method

Food items were sorted out and points were awarded to each food item. The point awarded to each food items was determined by the size and number. The points scored by the food item was expressed as a percentage of the total points scored for all food items in the stomach. Only the stomach that were half full were considered using this method.

2.3 Water Analysis

A combination of the tubular water sampler and the plankton net were used. The tubular water sampler (Strasvkraba and Javornicky, 1973) permits the collection of water from the surface of some pre-selected depth for a composite plankton sample.

The sampler was lowered into the water body. The water containing food materials and other substance were collected in the sampler through the opening at the base and closed by means of a weight messenger that is dropped along the cable to trip the closing mechanism. A plankton net was lowered into the water at a depth of one meter and dragged along a distance of 5 meters in order to increasing depth.

Contents of the net was emptied into labeled specimen bottle containing 5% formalin.

In the laboratory, the specimens were scanned through using hand lens. However, some organisms were so minute that they could not be seen with the hand lens and so they were viewed under the microscope. The planktons were counted using a Sedquik-Rafter counting chamber. The food resources were categorized as follows:

Planktons (Phyto+ Z00)
Micro-invertebrates (Rotifers and Cladocerans)

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Macro-Invertebrates (Insects)

The 'food fit' F_1 was determined after the method of Brummett (1996) as an indication of the average of the absolute value of the difference between the food available and the food consumed for each food group.

2.4 Food Consumption/Biomass Ratio Analysis (Q/B)

The regression model described by Jarre et al (1991) was used to estimate Q/B for all the fish species. This model is described by the equation:

Log_{10} Q/B = 4.885-1309.1339 (1/T) + 0.423 log_{10} A + 0.285 log_{10} D – 0.11 log_{10} W_{00}- 0.445 log_{10} CP ………. 3

Where T = Temperature in Kelvin

A = Aspect ratio of the caudal fin = Fin height2/fin surface area

D = Depth ratio (standard length/maximum body depth)

W_{oo} = Maximum live weight (g) in the population.

CP = Caudal peduncle depth/maximum body depth

The height of the caudal fin and its surface area were determined by tracing the fully stretched fin on a graph paper and measuring its image. The surface area of the caudal fin was derived using the formula

S = B + b x h 2 ……… (4)

Where B = height of caudal fin

b = height of caudal peduncle

h = width of caudal fin

The maximum body depth (Girth) and caudal peduncle were measured using a diel caliper.

3.0 Result

3.1 Length Wight Relationship

Results of the regression analysis of weight on length of the fishes in the burrow pits in Kano metropolis are shown in Table 1. The sexes were combined in the analysis because only few fishes were collected in the sample.

Inter-populational variability in the value of the intercept (a) was highly heterogeneous (CV = 111.81%) and varied from amin. = 3 x 10^{-a} in Hotoro burrow pit to amax = 2.58 x 10^{-3} in Kofar Mazugal burrow pit. Iner-populational variability in the exponent (b) showed homogeneity (CV = 14.16%) with values ranging from bmin. = 2.122 in Kofar Mazugal burrow pit. The mean exponent (b=2.576; s.d = 0.365) is significantly lower than 3 (P<0.001) (Table 1).

3.2 Food and Feeding

3.4.1 Stomach

Table 2 show the stomach content analysis of the fishes in the studied burrow pits in Kano metropolis. 19 (70.37%) were empty. The results from Aisami burrow, it shows that 20(51.28%) out of the 39 stomachs examined had food whole 19(48.72%) had no food (Table 2). 42*82.35%) stomachs had food while 9(17.65%) stomachs were empty from Hotoro Burrow pit.

Table 1: Length-weight relationships with linear regression analysis data of O. *niloticus* in some burrow pits within Kano Metropolis.

Length (cm)* Min	max	a	b	r	N	Sampling Site
10.3	16.1	0.00012	2.775	0.910	44	Court Road
10.3	14.9	0.00258	0.944	0.944	27	Kofar Mazugal
10.8	17.5	0.00014	2.745	0.984	39	Aisami
10.1	16.3	0.0003	3.060	0.970	51	Hotoro
9.9	14.3	0.00205	2.180	0.886	37	Hausawa

Note: the standard length of the fish was used in all the analyses

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Table 2:Analysis if the stomach content of O. *niloticus* from some burrow pits within Kano metropolis assessed by the dominance, occurrence and 'point' method

Food type	Dominance				Occurrence				Occurrence %				Points Scored				% Points Scored			
	*1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Algae																				
Microcystis delicatissima	*	*	*	*																
M. aeruginosus	*	*	*	*																
Synechocystic aqualitis	4	3	16	-	12	16	42	28	44.4	80	82.4	75.7	245	347	1045	350	175	23.1	27.5	21.9
Coelosphhaerum kuetzingianum			*	*																
C. confertum				*																
Euglena	*																			
Chlorella		*		*																
Denticular thermalis			-				6				11.8				135				3.6	-
Cocconeis placentula	-		-	2	8		10	23	29.6		19.6	62.2	45		82	120	3.2		2.2	7.5
Nairculla bacillum	-				5	23			18.5				30				2.1			
Oscilllatoria platensis	-	-			6	9		6	22.	45		16.2	10	21		18	0.7	1.4		1.1
Filamentous algae			-				4				7.8				68				1.8	
Chlamydomonas			-				7				13.7				93				2.5	
Crytomonas			-				14				27.5				102				2.7	
Cladocerans																				
Daphnia	1	6	-	-	2	7	1	5	7.4	35	2	13.5	80	280	85	30	5.7	18.7	2.2	1.9
Cyclops}																				
Calanoids} copepods	3	-		3	5	4		8	18.5	20		21.6	115	218		125	8.2	14.4		7.8
Rotifers																				
Brachionus dimidiatus			9	17			12	26			23.5	70.3			620	560			16.3	3.5
B. falcatus			2				7				13.7				290				7.6	
Feratella quadrata			4				4				7.8				120				3.2	
K. lenzi			-				1				2				90				2.4	
Fragments of higher plants	4	6			5	10			18.5	50			270	240			19.3	16		
Mosquito larvae	1	-			4	2			14.8	10			105	42			7.5	2.8		
Offals of grains	1		-		7		6		26		11.8		285		125		20.4		3.3	
Insects		-	-	-		4	4	3		20	7.8	8.11		35	40	22		2.3	1.1	1.4
Unidentified organic mater	3	4	6	8	6	9	26	23	22.2	45	51	62.2	215	218	819	355	15.4	14.5	21.6	22.2
Sand grains		-	-	-		5	7	6		25	13.7	16.2		53	86	20		3.5	2.3	1.3
Fish eggs		1				2				10				46				3.1		
Total points																	**1400**	**1500**	**3800**	**1600**

Note: * Study Sites

1- Kofar Mazugal burrow pit, 2- Aisami burrow pit, 3-Hotoro burrow pit ,4-Hausawa burrow pit

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The stomachs of 27 (72.97%) of 37 examined from Hausawa burrow pit had food while 10(27.03%) were empty (Table 2). All the 44 stomachs sampled from Court Road burrow pit were empty. Among the food found in the sampled stomachs from the different burrow pits were Alhae – *Microcystis spp, synechocystis spp, Oscillatoria platensis,* Cladocerns – *Daphnia, Cyclops, Calanoids,* Rotifers – *Brachionus spp, Keratella spp,* unidentified organic matter, fragments of higher plants (Table 2). There appears to be close similarity in the stomach contents between the different study area (Table 2).

By the dominance method, fragments of higher plants and algae *Microsystis spp.* and *Synechocystis aquatilis* were dominant in 4 stomachs from Kofar Mazugal burrow pit (Table 2). Algae – *Macrocystis delicatissima, M. aeruginosa* and *Coelosphaerum kuetzingianum* were dominant in 16 stomachs from Hotoro burrow pit (Table 2). Fragments of higher plants and *Daphnia* were dominant in 6 stomachs out of 10 and 7 stomachs respectively from Aisami burrow pit (Table 2) Rotifer – *Brachinus dimidiatus* was dominant in 17 stomachs from Hausawa burrow pit (Table 2).

With the occurrence method, algae occurred the most in the stomach contents from the burrow pits with 28.7%, 62.5%, 27.1% and 51.4% in Kofar Mazugla, Aisami, Hotoro, and Hausawa burrow pits respectively (Table 2).

The result based on the 'point' methods showed that offal of grains gained the highest points with 20.36% from Kofar Mazugal burrow pit (Table 4), algae gained the highest points with 23.13% from Aisami while Rotifer – *Brachionus dimidiatus* scored 35% from Hausawa burrow pit and 29.5% in Hotoro burrow pit (Table 2). Unidentified organic matter contributed a significant part to most of the stomach content analyzed. The least significant food type was aquatic insects (Table 2).

3.3 'Food Fits'

Table 3 summarizes the 'food fits' values of four burrow pits. Fish from Aisami burrow pit had the highest food fit value 0.031 while Hausawa burrow pit had the lowest value of 0.022. It appeared that there was no significant difference in the food fit value between the different study areas P<0.05 (Table 3).

3.4 Food Consumption/Biomass Ratio Q/B

Estimates of food consumption/biomass rate (Q/B) for *O. niloticus, T. zilli, galilaeus,* and *Clarias gariepinus* are given in Table 4. The Q/B value for *Tilapia zilli* from Hausawa burrow pit showed the highest value of 5.69; *T. zilli* also belonged to the smallest size range (7.1-10.7cm) (Table 6). *Sarotherodon galilaeus* recorded the lowest Q/B value of 4.73 with the size range (11.1-16.6cm).

Table 3: 'Food fits' of *O. niloticus* in four different burrow pits within Kano metropolis

Study Site	Planktons	Micro-invertebrates	Macro-Invertebrate	Plants	(Ff)*
Kofar Mazugal burrow pit	0.81	0.15	0.01	0.03	0.026
(Stomach contents)	0.78	0.09	0.005	0.02	
Aisamu burrow pit	0.85	0.12	0.01	0.02	
(Stomach contents)	0.78	0.08	0.005	0.015	0.031
Hotoro burrow pit	0.80	0.18	0.01	0.01	
(Stomach contents)	0.75	0.15	0.005	0.002	0.023
Hausawa burrow pit	0.83	0.14	0.02	0.01	
(Stomach contents)	0.78	0.12	0.01	0.001	0.022
Court Road burrow pit	nd	nd	nd	nd	nd

Note: 'Food fit' (Ff) is an indication of the average of the absolute value of the difference between the food available and food consumed for each food group. nd = not determined because stomach of fish caught were empty.

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Table 4: Estimates of Q/B values for some common fish species in some burrow pits obtained from empirical relationships as described by Jarre et al (1991).

Species/Sampling Site	N	Standard length (cm)	Aspect[a] Ratio	Peduncle[b] Ratio	Depth[c] Ratio	W_{oo}[d] (g)	Q/B Year^{-4}
O. niloticus (Court Road)	44	10.3-16.1	2.34	0.36	1.99	165	4.84
O.niloticus (Kofar Mazugal)	27	10.3-14.9	2.45	0.36	20.6	108	5.22
O. niloticus (Aisami)	51	10.1-16-3	2.24	0.36	2.02	165	4.77
O. niloticus (Hotoro)	51	10.1-16-3	2.24	0.36	2.02	165	4.77
O. niloticus (Hausawa)	37	8.9-14.3	2.22	0.35	1.94	111	4.97
O. niloticus (Court Road)	2	12.9-13.1	2.20	0.38	2.10	86	5.02
S. galilaeus (Hotoro)	8	11.1-16.3	2.33	-.37	1.93	165	4.73
T. zilli (Court Road)	7	10.3-12.3	2.33	0.37	1.92	87	5.07
T. zilli (Hausawa)	8	7.1-10.7	2.31	0.34	2.04	49	5.69
C. gariepinus (Hausawa)	8	32-4-24.3	1.54	0.39	4.33	2.6	4.76

Log_{10} Q/B = 4.885-1309 (1/T) log_{10} A + 0.285 log_{10} D-0.111 log_{10} W_{oo}-0.445 log_{10} CP

Note:

a = Aspect ration of the caudal fins is descried by the equation fin height2/fin surface area

b = Peduncle ration = caudal peduncle depth/maximum body depth.

c = Depth ration = standard length/maximum body depth.

d = W_{oo} = maximum attainable live weight (g) in the population.

4.0 DISCUSSION

Intermittent feeding by O. *niloticus* was observed in the course of this study where the fish stops feeding at dusk and resumes feeding at dawn. This agrees with observation of *T. guinesis* (Fagade, (1970). From the five burrow pits studied, all the 44 stomachs observed from Court Road were empty while of the 154 stomachs of *O. niloticus* examined, 46 stomachs (29.9%) were empty. This could be attributed to the long hours during which the fishes have been in the gill-nets before being removed for examination. Munro (1967) postulated that empty stomachs could result from intermittent feeding habit in fish. Similar food items occurred in all the burrow pits. The presence of offal of grains in Kofar Mazugal burrow pit and Hotoor burrow pit (Table 1) could be due to addition as supplementary feed by the inhabitants around these burrow pits. Analysis of the stomach content assessed by the occurrence method showed that algae was the most significant food items found in all the burrow pits while with the 'point' method, offal of grains was the most significant in Kofar Mazugal burrow pit, algae in Aisami and Rotifers in Hotoro and Hausawa burrow pits. Haruna (1992) reported algae to be the most frequently occurring food item found in O. *niloticus* feed mainly on phytoplankton and small zooplanktons. It is noteworthy that the 'points' method has been considered the most satisfactory by Hynes (1959) due to the fact that it is not influenced by frequent occurrence of small organisms in large numbers not of few large food items, for example, snail. It also does not give the spurious impression of accuracy which is given by other methods.

The wide variety of food items in the stomach showed that they are non-selective in their feeding. Fagade (1970) reported that some *Tilapia spp* took advantage of a wide range of food items in the Lagos Lagoon. Olatunde (1978)….. that availability is the key factor in the feeding habit of fishes as most fishes are highly adaptable in what they eat, utilizing the most readily available foods. Dill (1983) observed that it was

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paramount importance for the larger to monitor food availability and responds adaptively to such. These observations could be said to have played significant roles in the feeding of the fishes in the burrow pits.

Organic matter occurred in high percentages in all the fishes studied in the burrow pits. This food source forms a rich source of crude protein, as Fagade (1970) has shown that significant nutritional benefits could be derived by fish feeding on organic deposits. The function of dietary protein is to supply amino acids required for maintenance and growth. Therefore, the nutritional value of protein is directly related to the amino acids composition of the protein.

The Hausawa burrow pit would be the best environment for growing O. *niloticus* in this study with F_1 of 0.022 (Table 2) because the fish is able to make optimal use of the food items found in the waterbody. Stomach content data from Burmmett and Katambalika (199) for adult *Barbus paludinosus,* a small plankivorous cyprinid indicate the pond to be a better environment than the reservoir with F_1 value of 0.023 against 0.19. With the knowledge of the 'food fits' a qualitative examination of imbalance between food needs and availability might be used to design input regimes. For example, Burmmett (1996) recommended adding chopped macrophytes to the Tainan pond (with F_1 value of 0.15 against the Taoyuan reservoir with F_1 value 0.05). At this rate, the need and availability of this food for *O.Shiranus* improves the 'food fit' for that species in that environment from 0.15 to 0.09.

Estimates of Q/B was highest in *T. zilli* from Hausawa burrow pit which also belonged to the smallest size range whilst the lowest Q/B occurred in *Clarias gariepinus* which belonged to the large size range (Table 2). Size appeared to affect the consumption rate of fishes i.e the smaller the fish, the highest the Q/B values in *Eugraulicypris sardella* which belonged to the smallest size range. The low values obtained for the depth ration (D) in the cichlids observed were as a result of the stumpy and compressed shape of the fishes. From the aspect ration (A) (Table 2) it appeared that the cichlids are intermediate species while the catfish is a sluggish species as regards the activity level described by Ursin (1967).

Conclusion

The Hausawa Burrow-pit is found to be the best environment because the fish is able to make optimal use of the food items found in the water today. The estimate of food consumption/biomass ration was also highest in Hausa burrow-pit (table 2). This work will certainly assist fish farmers within the environment especially when it comes to the types of feeds required by these species for optimal growth response.

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