Biosciences, Biotechnology Research Asia Vol. **3**(2), 285-290 (2005)

THE FOOD AND FEEDING HABIT OF THE AFRICAN CLAWED TOAD, (*Xenopus laevis)* IN ROCKWATER FISH FARM, JOS, PLATEAU STATE NIGERIA

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(Received: November 08, 2005; Accepted: December 13, 2005)

ABSTRACT

The food and feeding habitat of the African Clawed Toad, *Xenopus laevis* collected from Rockwater fish farm *Rayfield*, Jos Plateau state were investigated over a ten month period. The range of food consumed does not differ significantly within the month of the study period (P>0.05). The relative abundance of a given prey population altered the diet composition of *X. laevis.* There was no significant change in mean condition factor with age. Computed values of correlation coefficients of length against weight indicates a highly significant correlation in females (r= 0. 897) and some level of significance in males (r= 0.105).

Key words: Feeding habit, African Clawed toad, *Xenopus laevis*, rock water, fish farm.

INTRODUCTION

The African clawed toad *X. laevis*, is one Amphibian species that has received little attention from herpetologists, fishery biologists and other workers in Nigeria. Heuser (1974) reported that the use of this species was wide- spread in Europe and North America due to its importance to the medical sciences. Deucher (1975) observed that the use of the African clawed toad for pregnancy test on human expectant mothers was first reported by Hogben *et al.,* (1931).

Rastogi *et al.,* (1983) observed that hibernating frogs awake usually in late February to early March and eat vigorously prior to spawning. They do not eat much during the breeding season but after the spawning period is over, they feed vigorously through July, August and September, thus replenishing their fat bodies in preparation for the next hibernating season. Deucher (1975) observed that *X. laevis* are carnivores, which feed fairly indiscriminately on all kinds of living or dead materials in pools where the live. They are rarely found in lotic water. Savage (1961) noted that the organism shows a strong tendency to cannibalism in captivity. When kept in temporary pools, it fed on its eggs and tadpoles when the food resources in the medium were exhausted. He observed that the Anura are not general indiscriminate feeders. Aluko *et al.,* (2001) observed cannibalism also in *Clarias gariepinus*, a fish species and stated that cannibalism as a biological phenomenon is an environmental strategy developed to contribute to the success of future generation. Some toad and frogs were said to be fairly more specific in the choice of their food.

The major foods consumed by frogs were mostly mollusks. Toad collection in the same areas had on the contrary, eaten large numbers of ants which frogs hardly eat at all. A frog species, *Bombina variegata* reportedly fed skillfully, on flies from the water surface and slug while mealworm were rejected. The tree frog *Hyla* was also observed feeding on earthworm readily whereas *Bufo bufo*, (a toad) avoided bees by trial and error. Savage (1961) attributed these differences in the food

preference of toad and frog to the fact that these animals most readily feed on prey that are found in their natural habitat.

The African clawed toad *X. laevis* has been a great threat to the fish-seed multiplication effort of the farm management. It causes huge losses every year both in monetary terms and the number that could be raised to commercial size fish. The potential danger these organism poses to the development of fishpond culture system as a voracious predator of fish seed was the bases and justification for this investigation.

MATERIALS AND METHODS

Samples of the African clawed toad *X. laevis* were collected weekly from ponds of the Rockwater Fish Farm for ten months from March to December. Collection were done using seine net. A total of forty specimens were sampled each month. Specimens were collected and transported to the laboratory and immediately transferred into circular fish hatchery tanks for observation of food and feeding habit. Animals were monitored following the method of Savage (1961) for about six months during which time they were fed with various food items ranging from fish fry, tadpoles to corn wastes, and compounded feeds. Before the analysis of stomach content, samples were killed and preserved in 10% formaldehyde.

The stomachs of the toads were cut open and the contents removed and preserved in labeled vials containing 10% formaldehyde. The number of empty stomachs were recorded. The contents were identified using a key (Olaniyan, 1968) or a hand leans in case of partly digested food particles following the method of Jacob and Nair (1982). The incidence of all food items encountered was expressed as a percentage to show the composition of the diet according to the method of Hynes (1950), Jacob and Nair (1982). Quantitative values of each food type in each monthly sample were also recorded.

Length –weight measurements were taken in which the snout to vent length of each specimen was measured using a standard metre rule by following the method of Rastogi *et al* (1982) and Haris *et al* (1987). The weight was measured using a *Meler balance* (P.1210 Model). Both length and weight of the specimens were measured to the nearest centimeter (cm) and gramme (g) respectively.

RESULTS

The length grouping of *X. laevis* showed six (6) size classes (Table 1). Specimens having the highest frequency were those in the size group 5-5.9 cm, which had a percentage of 35. Immature stages fell in the lower size-class ranges, whereas the largest individuals fell in the range 6-6.9 and 7-7.9 cm.

Table -1: Size-classes and frequency of occurrence of *X. laevis* in Rockwater fish farm.

Size-class (cm)	Frequency	%Frequency
2-2.9	20	5
3-3.9	68	17
4-4.9	82	20.5
5-5.9	140	35
6-6.9	58	14.5
7-7.9	32	8

Weight measurements ranged from 1.85g to 43.37g. Computed values of correlation coefficients of length against weight in matured individuals indicated a highly significant correlation in both males, r=0.105 (calculated), and 0.765 (tabulated) n = 10; (Females r=0.897 (calculated). The regression line gives a positive association between length and the regression coefficient is -0.433. This result shows that length is positively correlated with body mass in both males and females. Therefore length increases with body mass in both sexes.

The mean condition factor for the size classes was computed as

$$K = \frac{100}{l^3}$$

Where

K =Condition factor, W =Weight, L = Snout to vent length in cm following Wah'beh and Ajiad (1985) and Ikomi (1990).

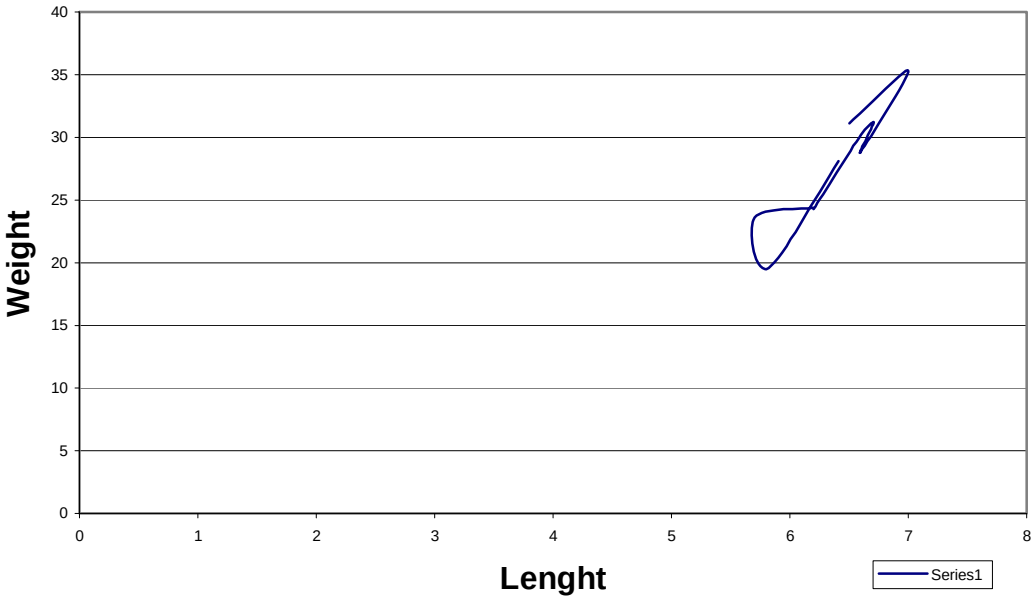

Fig. - 1: Length - Weight relationship of matured *X. laevis*

The K-values did not show a definite pattern of increase or decrease with respect to the size classes of the toads. However, toads in size group 7-7.9cm had the highest K-values while size group 4-4.9 had the lowest values as indicated in Table -3.

During the analysis of the stomach contents, four hundred stomachs were examined in all. A large number of empty guts occurred in the size class 2-2.9cm where many stomachs with fluid contents were encountered. Toads of the size-class 7-7.9cm seem to feed better probably due to the advantage of their size as shown by the condition factor (Table -3).

Table -2: Monthly total Snout –Vent length of samples collected during the study period

Month	Snout-Vent Length (cm)	No. of specimens
March	180.1	40
April	183.0	40
May	197.3	40
June	189.6	40
July	201.0	40
August	205.1	40
September	184.6	40
October	225.5	40
November	234.5	40
December	224.7	40

Table - 3: Mean condition factor for the size –classes

Size class	Weight	Length	K. Value
2-2.9	40.35	54.4	0.025
3-3.9	337.72	241.1	0.024
4-4.9	860.74	345.4	0.021
5-5.9	2,404.64	741.6	0.059
6-6.9	1261.79	371.1	0.024
7-7.9	1071.33	228.9	0.089

The relative abundance and percentage occurrence of the main food items consumed are given in Tables 5 and 6 respectively Fish try and larvae of ephemeroptera are numerically higher in the bigger toads while the smaller ones tend to feed more on chironomid larvae (Diptera).

Table - 4: Monthly food intake of *X. laevis* in Rockwater fish farm

Month	No. of Stomachs Examined	No. with Food	No. Empty
Mar.	40	34	6
April	40	38	2
May	40	36	4
June	40	37	3
July	40	37	3
Aug.	40	36	4
Sept.	40	37	3
Oct.	40	38	2
Nov.	40	38	2
Dec.	40	33	7
Total	400	364	36

The analysis of variance for the monthly relative abundance of the food consumed was not significantly different (P>0.05). There was however, a significant difference in the food types identified (P <0.05). The number of toads that fed on each food type showed 82 toads with fish fry in their stomachs (highest No.) and 28 toads the (lowest number) with tadpoles making up 22.5 percent and 7.7 percent respectively of the entire toads with food in their gut contents. The toad was observed to feed indistrinately on tadpoles of its own and other species and on fish fry when starved. Food of non-animal origin were also fortuitously ingested.

DISCUSSION

The migration of *X. laevis* to Rockwater fishfarm is a fasinating phenomenon that requires more than just a passing mention. The toads are rarely found in the farm during the cold months of the harmattan period. This observation corresponds with those of Koskela *et al* (1974) and Rastogi *et al* (1983) that toads and frogs hibernate during the cold months of winter. *Beatle* (1985) also reported that during winter, frogs use places like pond and river bottoms, as well as crevices in the ground for hibernation. This means that the migration of the African clawed toad to Rockwater fish farm takes

Table - 5: Monthly analysis of the gut contents of *X. laevis.*

Food Type	Mar	Apr	May	Jun	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Amphibia	17	15	12	0	0	0	0	0	0	0	44
Hemtptera	11	5	4	6	8	6	6	6	8	5	65
Crustacea	12	12	6	10	6	11	4	6	7	4	78
Diptera	8	8	7	8	8	5	8	11	4	8	85
Placoptera	6	4	10	5	7	9	3	3	3	6	56
Pisces	13	5	15	14	11	12	14	9	11	15	119
Odonata	7	6	13	11	9	6	7	8	6	7	80
Ephemeroptera	10	7	11	7	7	9	8	10	17	12	98

Table - 6: Mean monthly percentage occurrence of food type in the diet of *X. laevis.*

Food Type	Mar	Apr	May	Jun	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Amphibia	38.6	34.1	27.3	0	0	0	0	0	0	0
Hemiptera	16.9	7.7	6.2	9.2	12.3	9.2	9.2	9.2	12.3	7.7
Crustacea	15.4	15.4	7.7	121.8	7.7	14.1	5.1	7.7	9.0	5.1
Diptera	9.4	9.4	8.2	9.4	9.4	5.9	9.4	12.9	16.5	9.4
Plecotera	10.7	7.1	17.9	8.9	12.5	16.1	5.4	5.4	5.4	10.7
Pisces	10.9	4.2	12.6	11.8	9.2	10.1	11.8	7.6	9.2	12.6
Odonata	8.8	7.5	16.3	13.8	11.3	7.5	8.8	10.0	7.5	8.8
Ephemeroptera	10.2	7.1	11.2	7.1	7.1	9.2	8.2	10.2	17.3	12.2

place from the surrounding area and/ or hibernating toads in the farm emerge when environmental conditions become favourable. As the temperature starts to improve from February, the presence of the animals becomes gradually established.

Gittins (1983) reported that Bu*fo bufo*, Some times congregate in hundreds or thousands within a few days but that relatively few quantitative studies of this phenomenon have been made. In the present study *X. laevis* were fewer at the beginning of sampling as evidenced by the law numbers encountered initially.

Result of length –weight measurements showed that length increased with body weight. There was a positive correlation between these two parameters. This trend was observed by Dixon and Staton (1976) in *Hyptodactulus macrosternum*, an anuran species. Wahbeh and Ajiad (1985) found a highly significant correlation between total length and body weight in the goat fish, *Parupeneus barberinus* while Ikomi (1990) reported a similar result in the grey mullet, *Mugel cephalus.*

The mean condition factor of the various size classes ranged between 0.025and 0.089 through relatively higher values were obtained in the size classes 5-5.9 cm and 7-7.9 cm, there was little fluctuation about the overall mean of 0.040.The independence of condition factor from size effect indicates favourable environmental conditions, especially food availability.

X. laevis is entirely aquatic unlike most other common toads and fogs as *Deucher* (1975) observed. It dwells mostly at the bottom of the pond. These characteristics explain the absence of terrestrial organisms in the food composition of these toads during gut content analysis. The feeding behavior reveal that frogs and toads generally seem to remain in their hiding place fully alert during the day. They take any suitable prey that comes within a short range of their position. However, Savage (1961) stated that these animals can move out from a place depleted of food to an area populated by prey. A ready position in *X. laevis* is followed normally by a sweep as the toads glide along the bottom of the water. Frye *et al* (1979) observed that when a sweep resulted in the tactile location of the prey, scooping it in to the mouth or a lunge completed the act of consumption.

Food organisms are swallowed whole and can be recovered in that condition as observed during this work, where digestive enzymes had not acted on the food. Data obtained from stomach content analysis showed fish fry as the highest food type consumed during the period of study. Eighty – two of the 400 toads analysed had them in their gut, constituting about 22.5% of the overall stomachs observed with food. This followed by ephemeropteran larvae found in 60 toads (16.5%) with the least food prey being amphibian tadpoles in 28 toads constituting 7.7% of the stomachs analyzed with food (Table -7)

Table - 7: Number and percentage of toads and type of food recovered in their gut

Food Type	No. of Toads	Percentage
Amphibia	28	7.7
Hemiptera	35	9.6
Crustacea	36	9.9
Diptera	50	13.7
Placoptera	29	8.0
Pisces	82	22.5
Odonata	44	12.1
Ephemeroptera	60	16.5

Result indicated that toads sampled from ponds where fish fry had been transferred out fed on a large quantity of ephemeropteran larvae. Other available prey in the pond were also taken. Samples collected from ponds containing fish fry had a higher frequency of occurrence of these fry in their stomachs. There was a significant difference between the food types consumed ($P<0.05$). These results are shown in table 5,6 and 7;but the monthly variation in the relative abundance of the food organisms was not significant ($P>0.05$) as indicated in Table 4. This trend in the composition of the diet can be explained as a probable reflection of the type of food in the habitat and their relative abundance. This assumption is line with the observations of Savage (1961) that food available to toads and frogs in their habitat are not the same –they eat what happens to be there.

The tadpoles of other toads and frog species that were encountered in the diet of *X laevis* include those of the common toad *Bufo regularis,* bull frog, *Diocroglossus occipitalis* and *Hylarana galanensis*. These formed a major part of the food components during the months of March, April and May. This observation aggress with the report of Deucher (1975) that *X. laevis* feeds indiscriminately and sometimes cannibalizes when food is scarce.

Most acquatic macro invertebrates of suitable size are potential prey to the African clawed toad depending on the availability and ease of capture.

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