FOOD AND FEEDING HABITS OF SOME ANURAN SPECIES IN SOUTH-WESTERN NIGERIA

ONADEKO, A.B.
Department of Zoology, Faculty of Science, University of Lagos, Akoka, Lagos, Nigeria

Corresponding author: *onadeko2002@yahoo.com*

Abstract

The food and feeding habits of some anuran species in south-western Nigeria were investigated. Individuals of eighteen anuran species were selected randomly from collection made from the various survey sites which represented all the anuran families observed in the study. Morphometric measurements and analysis of the stomach contents of these selected species were carried out. High occurrences were recorded for stomachs that were 25% and 50% full while lower occurrences were observed for those that were 75% and 100% full. Anuran species having the lowest percentage (12.5%) of empty stomachs was *Amietophrynus maculatus* while *Phrynobatrachus latifrons* had the highest percentage (41.7%) of empty stomach. The order Coleoptera constituted the largest occurrence of insects observed in the stomach of anurans followed by the order Hymenoptera. Larger prey organisms were observed in the diets of larger anuran species such as *Amietophrynus maculatus* and *Hoplobatrachus occipitalis*, but were absent in diets of smaller anuran species such as *Phrynobatrachus latifrons* and *Arthroleptis variabilis*. Fossorial species (*Hemisus marmoratus* and *H. guineensis*) had isopterans as their major food item where as arboreal species (*Leptopelis boulengeri, L. hyloides* and *Hyperolius guttulatus*) had high occurrences of ants, bees and wasps in their diets. The morphology and habitat of anuran species have to a large extent a great influence on the food and feeding habits of these species as most species observed were generalist or opportunistic feeders taking prey roughly in proportion to their abundance in the habitat.

Keywords: anuran, morphometric measurement, Coleoptera, Hymenoptera, generalist and opportunistic feeders.

Accepted: October 28, 2011.

Introduction

Anurans are critical components of both aquatic and terrestrial communities. They play a very important role in the ecosystem as secondary consumers in many food chains and they occupy diverse trophic niches, from planktivores to carnivores and often serve as abundant and important prey for wildlife (Hopkins, 2007). Some species of anurans constitute the most abundant vertebrate in many aquatic and terrestrial communities, reaching densities of between 2,500 and 40,000 individuals/hectre, respectively. Such high biomass, coupled with the typical voracious appetites of amphibian larvae (Taylor *et al,* 1988) and the high food conversion efficiency, enables anurans to play important roles in the transfer of energy and nutrients through food chains (Beard *et al,* 2002; Ranvestel *et al,* 2004). The adult anurans feed on large quantities of insects and help keep their population in check. This is extremely important in controlling disease and crop pests (Inger and Marx, 1961). Because of their insectivorous nature, some species of anurans have been introduced to some parts of the world to control insect pests population (Hofrichter, 2000).

The feeding strategies of anurans include their choice of prey and the ways in which they locate, capture and ingest prey. Anurans generally are considered to be feeding opportunists with their diets reflecting the availability of food of appropriate sizes. Many constraints which influence the diets and feeding habits of anurans such as seasonal abundance of food and presence or absence of competitors are extrinsic while factors and such as ecological tolerances and morphological constraints that relate to ontogenetic stage, size and specialization are intrinsic factors (Duellman and Trueb, 1994). The authors also observed that with some notable exceptions, anurans that have generalized feeding mechanisms are active foragers with highly diverse diets, whereas those that have specialized feeding mechanism tend to use a sit-and-wait strategy.

Toft (1980) observed that most anuran species take prey in proportions significantly different from those occurring in the leaf litter and comprise two specialist guilds: dendrobatids and bufonids that eat hard-bodied, slow moving arthropods such as ants and mites; and leptodactylids that eat soft-bodied, mobile arthropods, primarily orthopterans and large spiders. Within these specialist guilds, body sizes of species vary and are correlated with the size of prey taken. Strussmann *et al* (1984) also observed that bufonids forage more widely and eats more social insects than the leptodactylid but the morphologies of the species did not correlate with the size of prey taken, rather it was habitat specific.

This study aims to investigate the food and feeding habits of some anuran species in south-western Nigeria. Also; observations would be made on the morphometrics of the anuran species to ascertain if there is positive correlation between the size of the species and the type of prey taken.

Materials and methods

Study-area

The study was undertaken between July 2003 and December 2004 in three states (Lagos, Ogun and Oyo) in south-western Nigeria. Lagos State is situated between Latitude 6.4° and 6.67° N and Longitude 2.7° and 4.43° E; Ogun State between Latitude 6.3° and 7.75° N and Longitude 2.7° and 4.6° E; and Oyo State between Latitude 7.08° and 9.2° N and Longitude 2.7° and 4.55° E (Figure 1).

South-western Nigeria is characterized by a south-north gradient of precipitation. This is mirrored by a gradient of vegetation zones, naturally from tropical humid evergreen forest in the south, gradually transforming into dry savannas in the north (Udo, 1970). Survey sites were chosen in these study areas which were representatives of the various vegetation zones (freshwater swamp, forest, derived savanna and savanna).

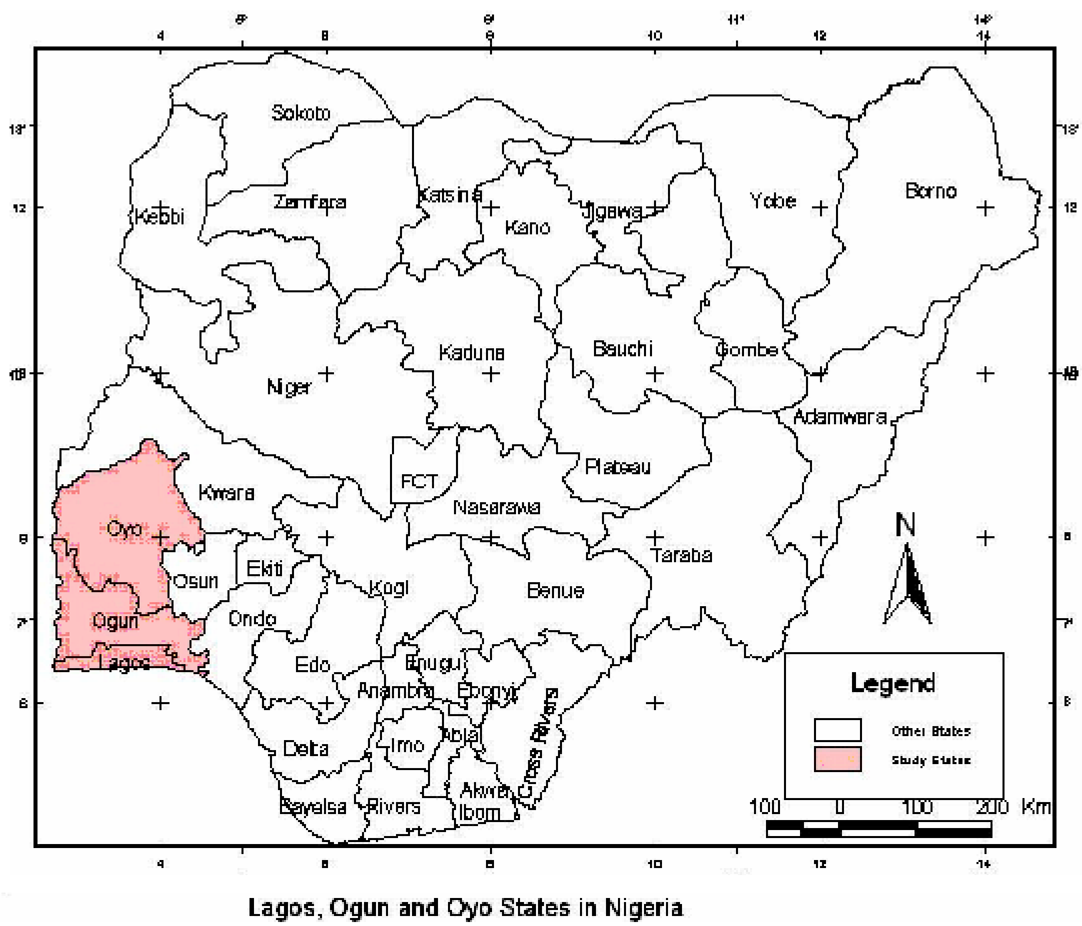


Figure 1: Nigeria showing selected states of Lagos, Ogun and Oyo (shaded region). (LABCARS, Geography Department, University of Lagos, 2010).

Morphometric measurements

Individuals of eighteen anuran species were selected randomly from collection made from the various survey sites between 0700-0900 hours. This selection represented all the anuran families observed in the study. Measurements of some body parts were made with a digital venier calipers (Model No. TCMD-22290). This was done with the live specimen gently pressed on a flat surface. The parameters measured were the lengths of the snout to vent (SVL), thighs, shank, foot (up to the end of the longest toe) and the diameter of the eye and tympanum. All animals were also weighed on an electronic Ohaus laboratory balance (Model No. EP 214C). The length-weight relationships of these species were determined and graphs were plotted.

Stomach content and food analysis

Investigations of the food and feeding habits of some species collected in the surveys were carried out in the laboratory. Fifteen to forty individuals of the eighteen selected species representing all the anuran families observed in the study were dissected. When caught in the field, the animals were immediately chloroformed and brought to the laboratory for dissection. This prevented the food items recently consumed from being thoroughly digested. Specimens collected at sites far away from the laboratory had their stomach removed and the contents emptied into labelled specimen bottles containing 5% formalin. These were stored for further examination in the laboratory.

The fullness of stomach in each specimen was determined by first observing the dissected stomach and then categorized as empty (0%), ¼ full (25 %), ½ full (50 %), ¾ full (75 %) or full (100 %). The stomachs were slit lengthwise and the contents emptied into a petri dish and diluted with a small quantity of distilled water. The contents were examined under a binocular dissection microscope (mag. 10-40X). Large food items were identified to the lowest possible taxonomic level. If and when necessary, a binocular compound microscope (mag. 100-4000X) was also used. All identified food items were counted and recorded.

The two methods used for food analysis were the frequency of occurrence and the points methods (Houston, 1973; Blackith and Speight, 1974). In the frequency of occurrence method, the number of stomachs in which each food item occurred was listed as a percentage of the total number of stomach with food examined. This method gives the proportion of the population that fed on a particular food item. In the points method, each of the food item was scored points (5 points each) according to their abundance in the stomach of a given species. This method was used to identify the most important food item consumed by a given species.

Specimens were identified by Professor Mark Rodel from the Natural Museum of Herpetology, Berlin. The treefrogs were identified through courtesy of Dr. Arne Schiotz. Identification was also carried out using literature by Schiotz (1963, 1967, and 1999) and Rodel (2000).

Results

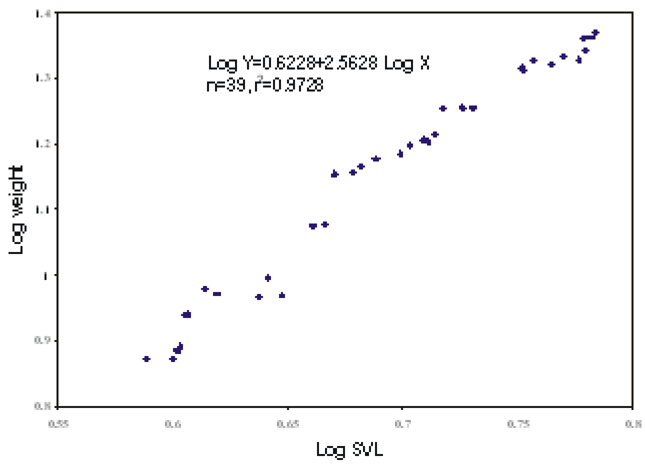
Morphometric measurement

The morphometric measurements of the different body parts of some of the species of anurans are given in Table 1. The species varied in sizes: The largest mean SVL value was recorded for *H. occipitalis* (8.45 cm)

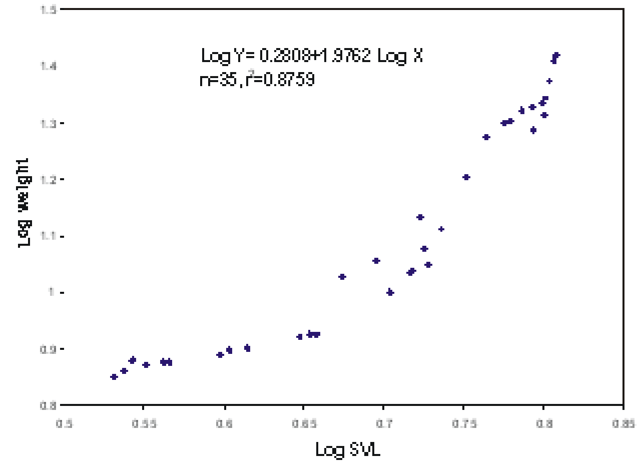
Table 1: Mean morphometric measurements of the different body parts of 18 species of anurans pooled from all the study-sites.

Anuran Families	Species	No. of individuals	Parameters SVL (cm)	Weight (g)
Bufonidae	*Amietophrynus maculatus*	40	6.52 ± 1.54	36.66 ± 22.5
	Amietophrynus regularis	40	7.55 ± 1.54	62.64 ± 36.4
Ranidae	*Aubria subsigillata*	18	6.28 ± 1.0	31.74 ± 8.6
	Hylarana galamensis	15	6.89 ± 0.86	27.59 ± 5.67
	Hylarana albolabris	22	5.66 ± 0.68	10.63 ± 2.46
Dicroglossidae	*Hoplobatrachus occipitalis*	40	8.45 ± 1.59	55.68 ± 27.5
Arthroleptidae	*Leptopelis hyloides*	20	3.11 ± 0.58	3.11 ± 1.07
	Leptopelis boulengeri	25	3.88 ± 0.47	3.71 ± 0.53
	Arthroleptis variabilis	32	2.39 ± 0.36	1.74 ± 0.86
	Arthroleptis poecilonotus	21	2.46 ± 0.25	1.56 ± 0.31
Phrynobatrachidae	*Phrynobatrachus latifrons*	24	2.1 ± 0.29	1.05 ± 0.20
	Xenopus mulleri	31	5.04 ± 0.74	15.74 ± 5.36
	Silurana tropicalis	26	4.9 ± 1.08	12.62 ± 6.87
Hemisotidae	*Hemisus mamoratus*	31	3.15 ± 0.73	5.22 ± 3.84
	Hemisus guineensis	30	4.79 ± 0.49	14.96 ± 4.65
Hyperoliidae	*Hyperolius guttulatus*	26	3.31 ± 0.19	3.32 ± 0.46
Ptychadenidae	*Ptychadena oxyrhynchus*	27	6.7 ± 0.78	38.34 ± 12.6
	Ptychadena mascareniensis	24	5.52 ± 0.47	17.1 ± 4.96

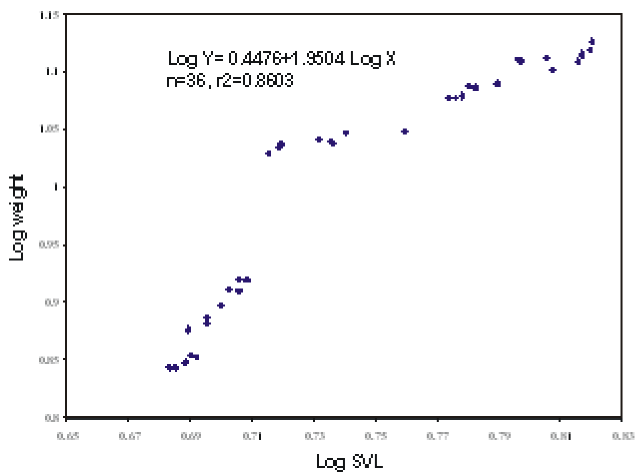
Figures 2(a-r): Graphs of SVL-weight relationships of anuran species examined in this study.



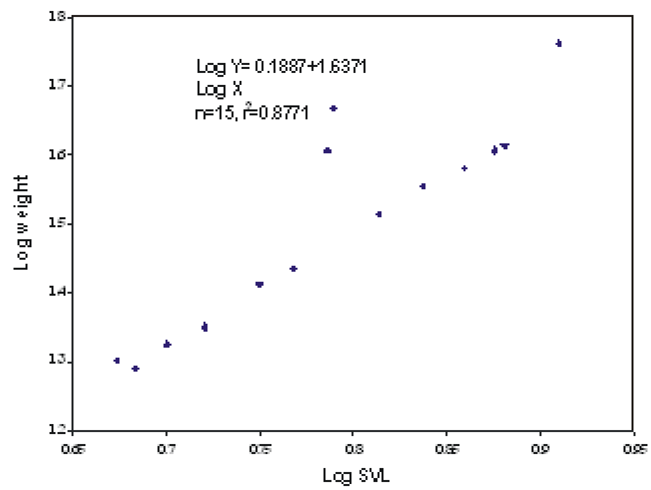
(a) Log SVL-weight relationship of *Xenopus muelleri.*



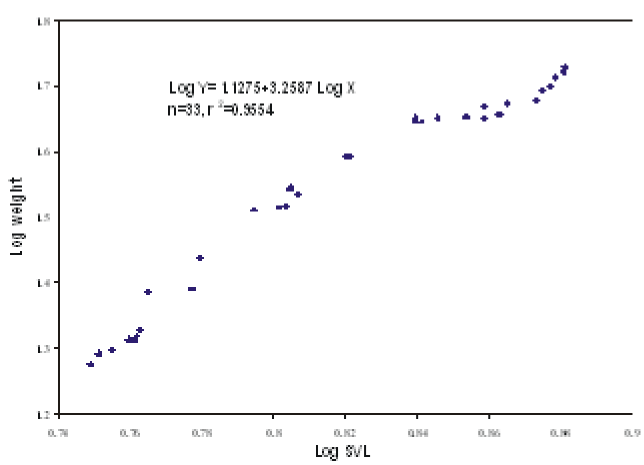
(b) Log SVL-weight relationship of *Silurana tropicalis.*



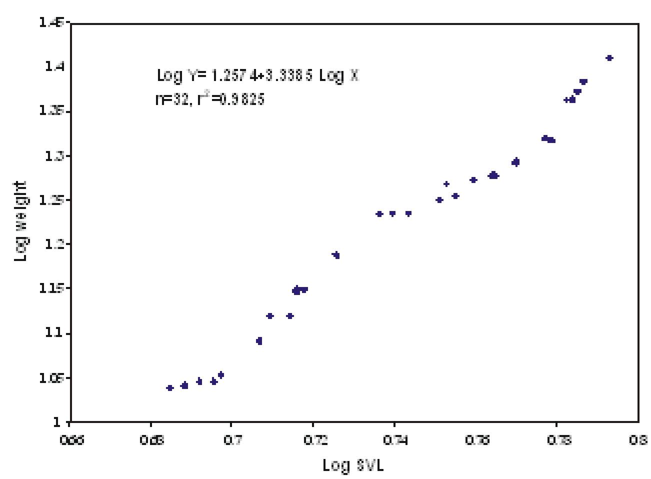
(c) Log SVL-weight relationship of *Hylarana albolabris.*



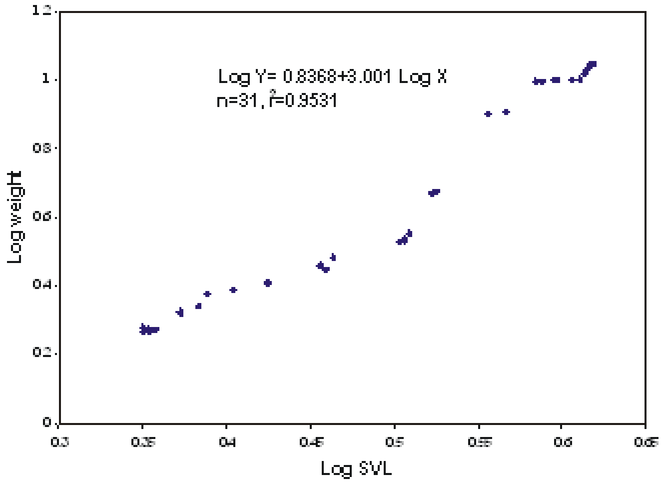
(d) Log SVL-weight relationship of *Aubria subsigillata.*



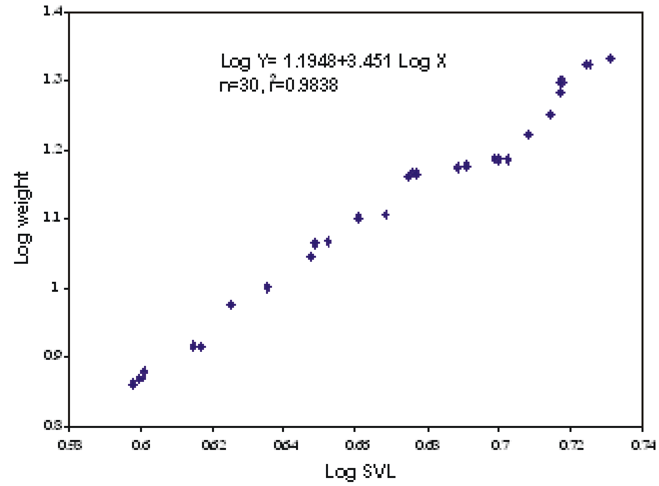
(e) Log SVL-weight relationship of *Ptychadena oxyrhynchus.*



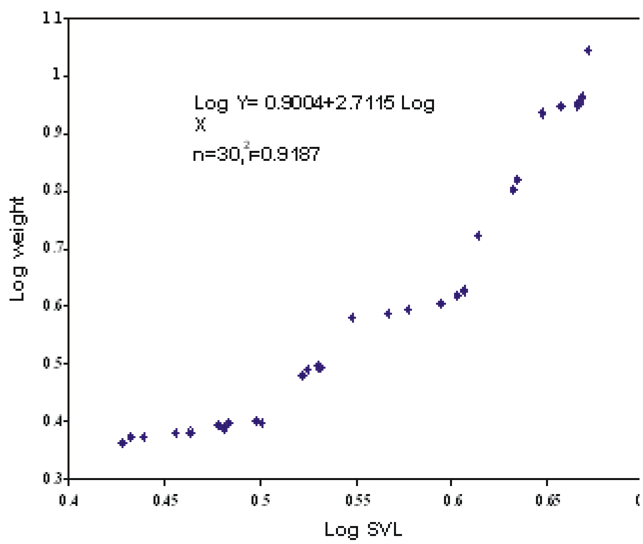
(f) Log SVL-weight relationship of *Ptychadena mascareniensis.*



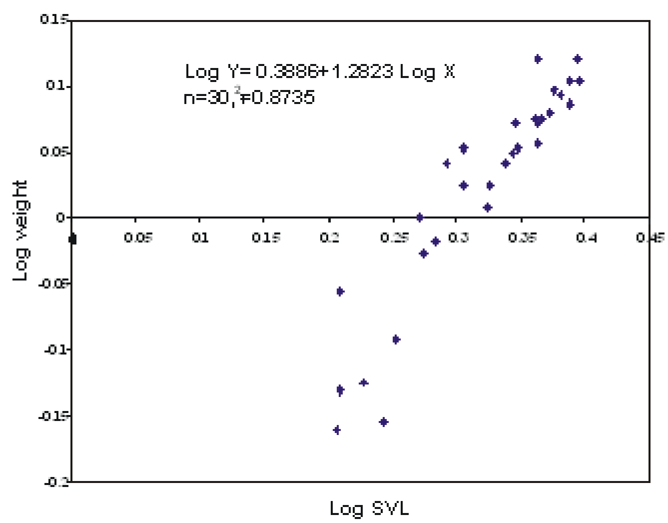
(g) Log SVL-weight relationship of *Hemisus mamoratus.*



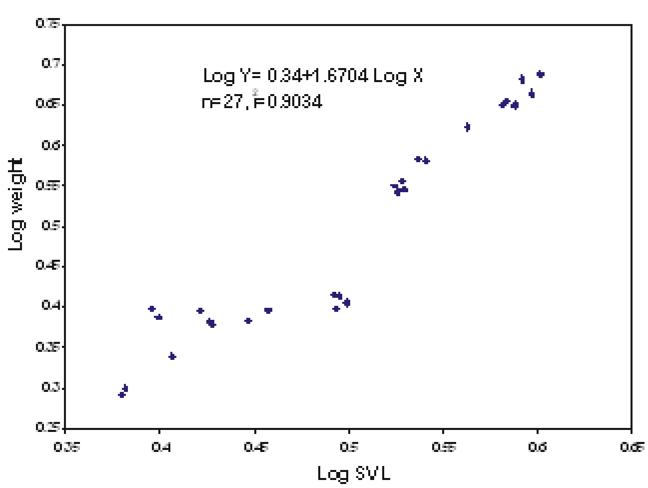
(h) Log SVL-weight relationship of *Hemisus guineensis.*



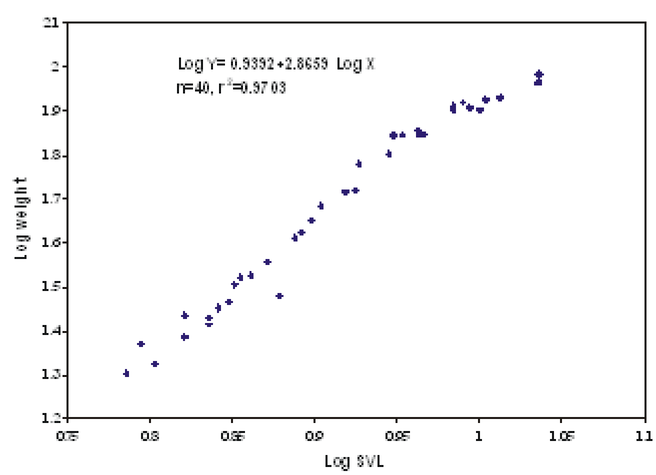
(i) Log SVL-weight relationship of *Leptopelis boulengeri.*



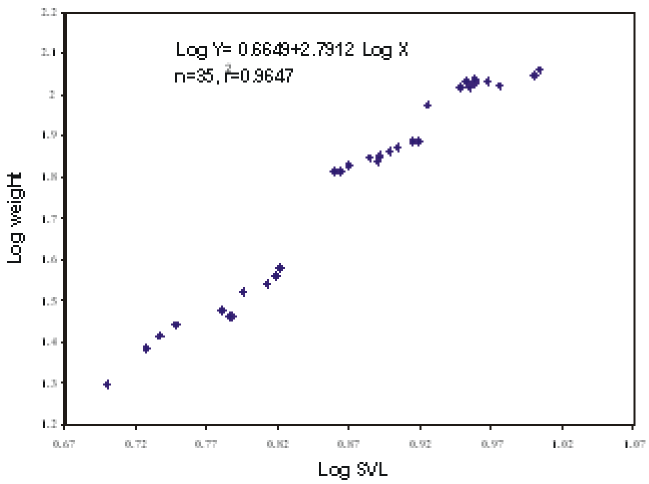
(j) Log SVL-weight relationship of *Phrynobatrachus latifrons.*



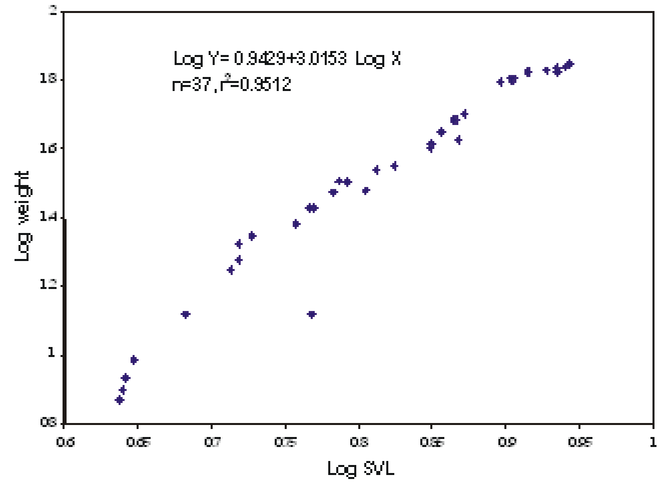
(k) Log SVL-weight relationship of *Leptopelis hyloides.*



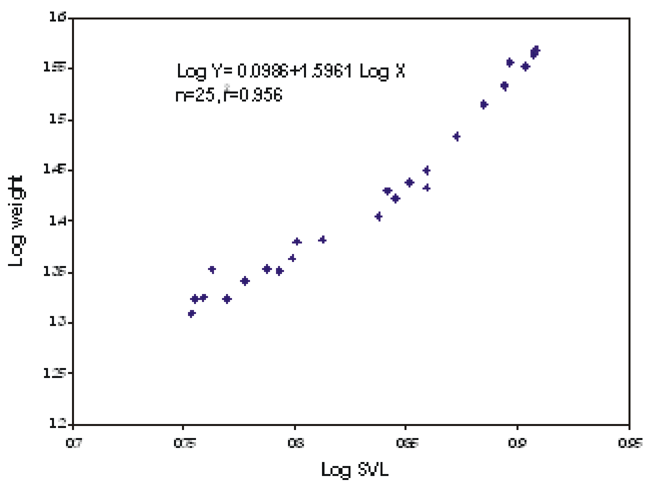
(l) Log SVL-weight relationship of *Hoplobatrachus occipitalis.*



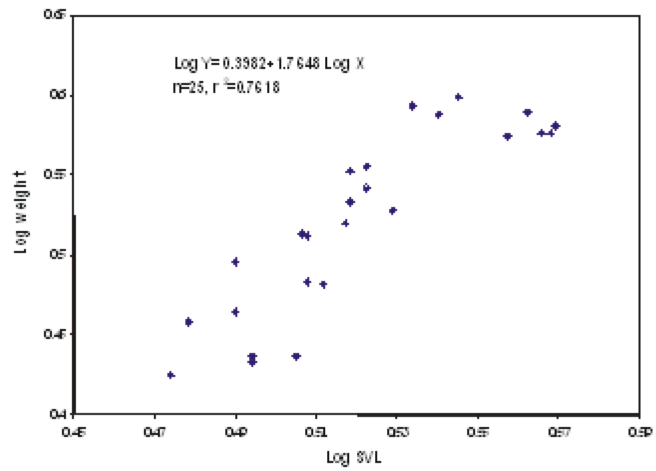
(m) Log SVL-weight relationship of *Amietophrynus regularis.*



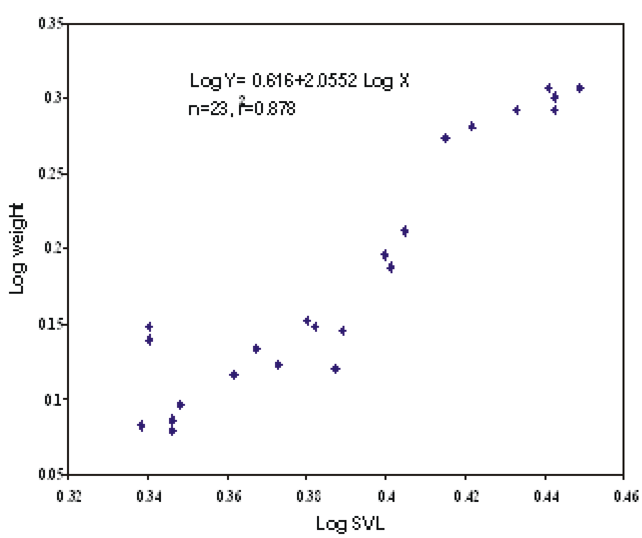
(n) Log SVL-weight relationship of *Amietophrynus maculatus.*



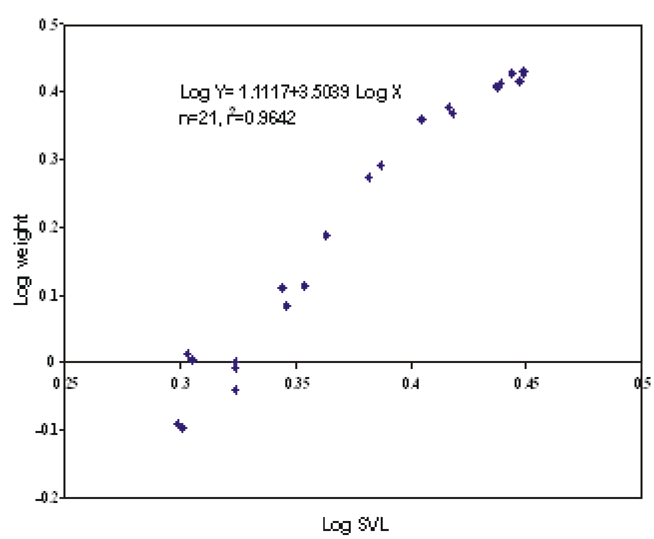
(o) Log SVL-weight relationship of *Hylarana galamensis.*



(p) Log SVL-weight relationship of *Hyperolius guttulatus.*



(q) Log SVL-weight relationship of *Arthroleptis poecilonotus.*



(r) Log SVL-weight relationship of *Arthroleptis variabilis.*

while the smallest (2.10 cm) was for *P. latifrons.* The mean weights of the two species were 55.68 g and 1.05 g respectively.

The weight also varied from 62.64 g (*A. regularis)* to 1.05 g (*P. latifrons).*

Amietophrynus regularis and *P. oxyrhynchus* had a mean SVL of 7.55 cm and 6.70 cm respectively. The SVL-weight values determined on these common species are shown in Figures 2. There was a positive correlation between the SVL and body weight in all the species investigated.

Stomach content and food analysis

Table 2 shows the frequency of stomach fullness status of the various anuran species examined. The highest percentage of empty stomach was recorded for *P. latifrons* which was 41.7%. This was followed by *X. muelleri* and *H. albolabris* which had 38.7% and 38.4% respectively. The lowest percentage of empty stomach was recorded for *A. maculatus* (12.5%). *H. galamensis* and *A. regularis* also had low percentages of empty stomachs.

High percentages were recorded for stomachs that were 25% and 50% full whereas lower percentages were recorded for stomachs that were 75% and 100% full.

The major food item of *A. maculatus* were mainly insects represented by several orders. Members of the order Coleoptera constituted 60% by occurrence and 38.2% by points methods as shown in Tables 3 (a-f). The next important food items were the Hymenopterans which occurred most frequently in the stomachs by both occurrence and points constituting 48.6% and 34.3% repectively. Next to the Hymenoptera was Isoptera which constituted 8% and 14% by occurrence and points respectively. Other food items encountered in order of importance were Arachnida, Diptera, plant parts, Orthoptera, Odonata, Isopoda and Annelida. Isopoda and Annelida had the lowest occurrence of 2.9% each but Isopoda had a point percentage of 1.0 while for Annelida it was 0.5.

In larger anuran species such as *A. maculatus* and *H. occipitalis* , larger prey organisms were observed in their diets from the orders Orthoptera and Odonata with each having points value of 30 and 80; 10 and 55 respectively (see Tables 3). None were recorded for the two smallest sized species of *P. latifrons* and *A. variabilis.*

In *A. subsigillata,* the major food item of this species was Coleoptera which constituted 66.7% by occurrence and 28.3% by points method which was followed by Hymenoptera with 60% and 38.1% by occurrence and points method respectively.

Isopterans formed the major food item of *H. guineensis* and *H. mamoratus* which had a high occurrence percentage of 52.2% and 47.8% respectively. Only three families of insects and one arachnid were present in the stomach of *L. boulengeri*. Other food items were either present in moderate or small quantities in all the species studied.

The highest percentage of occurrence of insects seen in the stomach of the anurans was from the order Coleoptera (Figure 3). *A. poecilonotus* had the highest percentage (69.2%) of Coleoptera occurring in its diet followed by *A. subsigillata* (66.7%).

The second largest percentage of occurrence of insects was the hymenopterans (Figure 4). *H. occipitalis* had the highest percentage of Hymenoptera in its diet followed by *H. albolabris* which are 71.9% and 64.3% respectively. *P. oxyrhynchus* had the lowest (18%) occurrence.

The highest number of stomachs in which isopterans were recorded from were *H. guineensis* (12)*, H. mamoratus* (11) and *A. poecilonotus* (11). Low occurrences recorded in other anuran species.

The least percentage of occurrences among the insect order was the Odonata. Over 60% of the stomach did not include it. *P. mascareniensis* and *A. subsigillata* had the highest occurrence in their diet; 11.1% and 6.7% respectively.

Discussion

Anuran species obtain their food by the use of a long sticky tongue, which is occasionally flipped out to catch moving prey. They often respond only to the stimuli provided by moving prey items (Lettvin *et al,* 1959). Most species are sit-and-wait predators that eat relatively large preys such as Orthoptera, large Coleopterans and Dictyopterans (Hickman *et al,* 2001). They feed mainly on insects and other member of the phylum Arthropoda. Studies of the diet of individual species of temperate zone anurans have not revealed much evidence of diet specialization in anuran species. Most species are generalist or opportunistic feeders that take prey roughly in proportion to their abundance in the habitat (Houston, 1973; Blackith and Speight, 1974).

Results from the examination of the state of the stomach of anuran species in this study showed that percentage of empty stomachs ranged from 12.5% to 41.7%. Generally higher percentages were recorded for stomachs that were 25% and 50% full while lower percentages were recorded for stomachs that were 75% and 100% full. As expected during the rainy season, the availability and abundance of prey organisms are higher compared to that of the dry season. The capturing of these prey organisms in the environment by the anuran predators may not be a regular event as most of them exhibit sit-and-wait attitude. As a result, most species

Table 2: Summary of stomach fullness status of anuran species collected in south-western Nigeria.

Anuran Families	Species	Stomachs Number Examined	Full (100%)	¾ Full (75%)	½ Full (50%)	¼ Full (25%)	Empty (0%)	% Empty
Bufonidae	*Amietophrynus maculatus*	40	4	7	12	12	5	12.5
	Amietophrynus regularis	40	4	4	13	13	6	15
Ranidae	*Aubria subsigillata*	18	3	3	4	5	3	16.7
	Hylarana galamensis	15	2	3	4	4	2	13.3
	Hylarana albolabris	22	2	2	4	6	8	36.4
Dicroglossidae	*Hoplobatrachus occipitalis*	40	8	6	6	12	8	20
Arthroleptidae	*Leptopelis hyloides*	20	0	1	4	10	5	25
	Leptopelis boulengeri	25	0	2	7	8	8	32
	Arthroleptis variabilis	32	2	4	7	11	8	25
	Arthroleptis poecilonotus	21	2	2	3	6	8	38.1
Phrynobatrachidae	*Phrynobatrachus latifrons*	24	2	2	6	4	10	41.7
	Xenopus mulleri	31	2	2	5	10	12	38.7
	Silurana tropicalis	26	3	4	6	6	7	26.9
Hemisotidae	*Hemisus mamoratus*	31	2	5	10	6	8	25.8
	Hemisus guineensis	30	2	3	8	10	7	23.3
Hyperoliidae	*Hyperolius guttulatus*	26	2	3	3	11	7	26.9
Ptychadenidae	*Ptychadena oxyrhynchus*	27	2	5	7	6	7	25.9
	Ptychadena mascareniensis	24	4	4	4	6	6	25

Tables 3: Summary of the stomach contents of 18 anuran species from south-western Nigeria.

Table 3a

Stomach Content	*Amietophrynus maculatus*				*Aubria subsigillata*				*Hoplobatrachus occipitalis*			
	Occurrence Method		Points Method		Occurrence Method		Points Method		Occurrence Method		Points Method	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Hymenoptera	17	48.6	355	34.3	9	60	255	38.1	23	71.9	595	30.2
Isoptera	8	22.9	140	14	4	26.7	30	4.8	2	6.3	25	1.3
Coleoptera	21	60	395	38.2	10	66.7	190	28.3	16	50	640	32.5
Diptera	4	11.4	20	1.9	3	20	20	3.0	15	46.9	120	6.1
Orthoptera	2	5.7	30	2.9	2	13.3	10	1.5	10	31.3	80	4.1
Odonata	2	5.7	10	1.0	1	6.7	5	0.7	8	25	55	2.8
Arachnida	5	14.3	50	4.8	6	40	65	9.7	6	18.8	256	12.9
Isopoda	1	2.9	10	1.0	0	0	0	0	0	0	0	0
Annelida	1	2.9	5	0.5	3	20	65	9.7	6	18.8	95	4.8
Plant Parts	3	8.6	20	1.9	4	26.7	30	4.5	14	43.8	105	5.3
Detritus	30	85.7	–	–	15	100	–	–	25	78.1	–	–
Sand Grains	14	40	–	–	10	66.7	–	–	17	53.1	–	–
Unidentified Matter	9	25.7	–	–	6	40	–	–	17	53.1	–	–

Table 3b

Stomach Content	*Leptopelis boulengeri*				*Hyperolius guttulatus*				*Leptopelis hyloides*			
	Occurrence Method		Points Method		Occurrence Method		Points Method		Occurrence Method		Points Method	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Hymenoptera	6	35.3	270	37.0	10	52.6	450	35.3	8	53.3	355	38.0
Isoptera	0	0	0	0	0	0	0	0	0	0	0	0
Coleoptera	8	47.1	305	41.8	11	57.8	445	34.9	8	53.3	370	39.6
Diptera	4	82.4	90	12.3	8	42.1	315	24.7	6	40	155	16.6
Orthoptera	0	0	0	0	0	0	0	0	1	6.7	5	0.5
Odonata	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida	5	88.2	65	8.9	4	21.1	55	4.3	3	20	55	5.9
Isopoda	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	0	0	0	0	0	0	0	0	0	0	0	0
Plant Parts	0	0	0	0	2	10.5	10	0.8	0	0	0	0
Detritus	14	82.4	–	–	13	68.4	–	–	7	46.7	–	–
Sand Grains	7	41.2	–	3	15.8	–	–	2	13.3	–	–	–
Unidentified Matter	11	64.7	–	–	5	26.3	–	–	5	33.3	–	–

Table 3c

Stomach Content	*Hemisus guineensis*				*Hemisus marmoratus*				*Silurana tropicalis*			
	Occurrence Method		Points Method		Occurrence Method		Points Method		Occurrence Method		Points Method	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Hymenoptera	6	26.1	165	18.1	8	34.8	255	30.5	8	42	50	7.8
Isoptera	12	52.2	190	20.9	11	47.8	130	15.6	3	15.8	55	8.5
Coleoptera	8	34.8	85	9.3	10	43.5	155	18.6	11	57.9	145	22.5
Diptera	2	8.7	15	1.6	2	8.7	10	1.2	5	26.3	35	5.4
Orthoptera	1	4.3	10	1.1	0	0	0	0	3	15.8	15	2.3
Odonata	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida	4	17.4	65	7.1	6	26.1	65	7.8	1	5.3	5	0.8
Isopoda	5	21.7	115	12.6	8	34.8	140	16.8	0	0	0	0
Annelida	7	30.4	255	28.0	7	30.4	60	7.2	10	52.6	315	48.8
Plant Parts	2	8.7	10	1.1	4	17.4	20	2.4	5	26.3	25	3.9
Detritus	16	69.6	–	–	13	56.5	–	–	15	78.9	–	–
Sand Grains	11	47.8	–	–	17	73.9	–	–	12	63.2	–	–
Unidentified Matter	13	56.5	–	–	12	52.2	–	–	9	47.4	–	–

Table 3d

Stomach Content	*Zenopus muelleri*				*Hylarana galamensis*				*Hylarana albolabris*			
	Occurrence Method		Points Method		Occurrence Method		Points Method		Occurrence Method		Points Method	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Hymenoptera	7	36.8	40	9.2	8	61.5	130	20.3	9	64.3	195	28.9
Isoptera	2	10.5	45	10.3	0	0	0	0	0	0	0	0
Coleoptera	11	57.9	135	31.0	8	61.5	275	43.0	8	57.1	305	45.2
Diptera	1	5.3	10	2.3	4	30.8	35	5.5	1	7.1	5	0.7
Orthoptera	1	5.3	5	1.1	1	7.7	5	0.8	0	0	0	0
Odonata	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida	0	0	0	0	4	30.8	130	20.3	6	42.9	165	24.4
Isopoda	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	5	26.3	185	42.5	3	23.1	25	3.9	0	0	0	0
Plant Parts	2	10.5	15	3.4	4	30.8	40	6.3	1	7.1	5	0.7
Detritus	17	89.5	–	–	13	100	–	–	12	85.7	–	–
Sand Grains	15	78.9	–	–	11	84.6	–	–	9	64.3	–	–
Unidentified Matter	10	52.6	–	–	4	30.8	–	–	5	35.7	–	–

Table 3e

Stomach Content	*Arthroleptis variabilis*				*Phrynobatrachus latifrons*				*Arthroleptis poecilonotus*			
	Occurrence Method		Points Method		Occurrence Method		Points Method		Occurrence Method		Points Method	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Hymenoptera	9	37.5	255	37.2	5	35.7	135	27.0	3	23.1	100	17.4
Isoptera	2	8.3	55	8.0	3	21.4	70	14.0	11	84.6	185	32.2
Coleoptera	14	58.3	330	48.2	8	57.1	265	53.0	9	69.2	275	47.8
Diptera	4	16.6	35	5.1	2	14.3	20	4.0	2	15.4	15	2.6
Orthoptera	0	0	0	0	0	0	0	0	0	0	0	0
Odonata	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida	0	0	0	0	0	0	0	0	0	0	0	0
Isopoda	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	0	0	0	0	0	0	0	0	0	0	0	0
Plant Parts	1	4.2	10	1.5	2	14.3	10	2.0	0	0	0	0
Detritus	12	50	–	–	11	78.6	–	–	13	100	–	–
Sand Grains	13	54.2	–	–	11	78.6	–	–	9	69.2	–	–
Unidentified Matter	4	16.6	–	–	7	50	–	–	6	46.2	–	–

Table 3f

Stomach Content	*Ptychadena oxyrhyncus*				*Ptychadena mascareniensis*				*Amietophrynus regularis*			
	Occurrence Method		Points Method		Occurrence Method		Points Method		Occurrence Method		Points Method	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Hymenoptera	3	15	175	19.7	5	27.8	215	32.3	20	58.8	415	37.4
Isoptera	5	25	205	23.0	4	22.2	90	13.5	8	23.5	130	11.7
Coleoptera	5	25	210	23.6	4	22.2	120	18.0	20	58.8	370	33.3
Diptera	6	30	40	4.5	3	16.7	15	2.3	9	26.5	55	5.0
Orthoptera	3	15	15	1.7	2	11.1	10	1.5	6	17.6	55	5.0
Odonata	1	5	10	1.1	2	11.1	15	2.3	1	2.9	5	0.5
Arachnida	3	15	180	20.2	5	27.8	155	23.3	3	8.8	20	1.8
Isopoda	1	5	15	1.7	1	5.6	20	3.0	2	5.9	10	0.9
Annelida	2	10	10	1.1	1	5.6	10	1.5	3	8.8	15	1.4
Plant Parts	6	30	30	3.4	3	16.7	15	2.3	7	20.5	35	3.2
Detritus	17	85	–	–	16	88.9	–	–	34	100	–	–
Sand Grains	15	75	–	–	3	72.2	–	–	18	52.9	–	–
Unidentified Matter	9	45	–	–	8	44.4	–	–	9	26.5	–	–

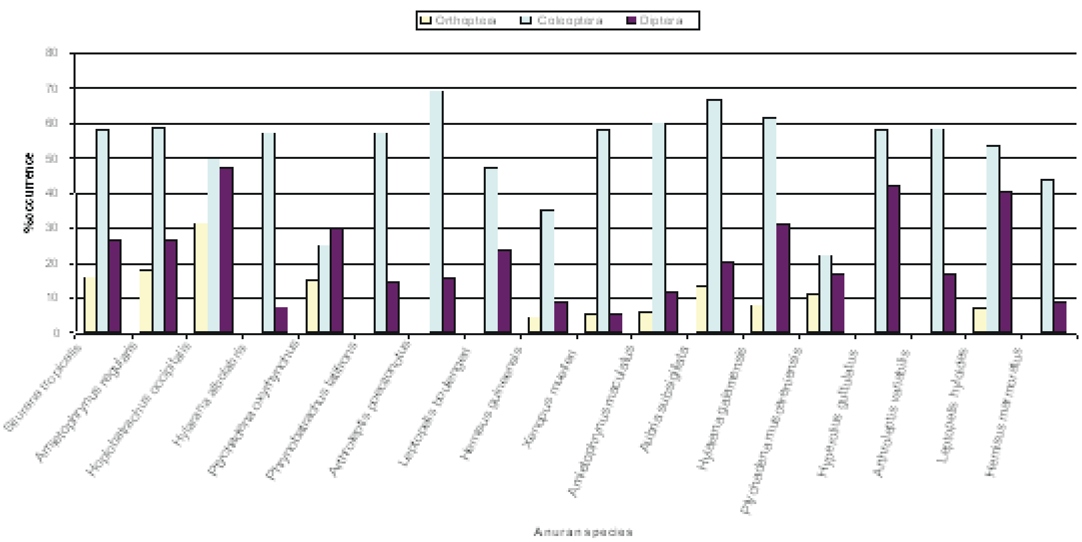


Figure 3: Percentage occurrence of insects (Orthoptera, Coleoptera and Diptera) in the stomachs of some anuran species.

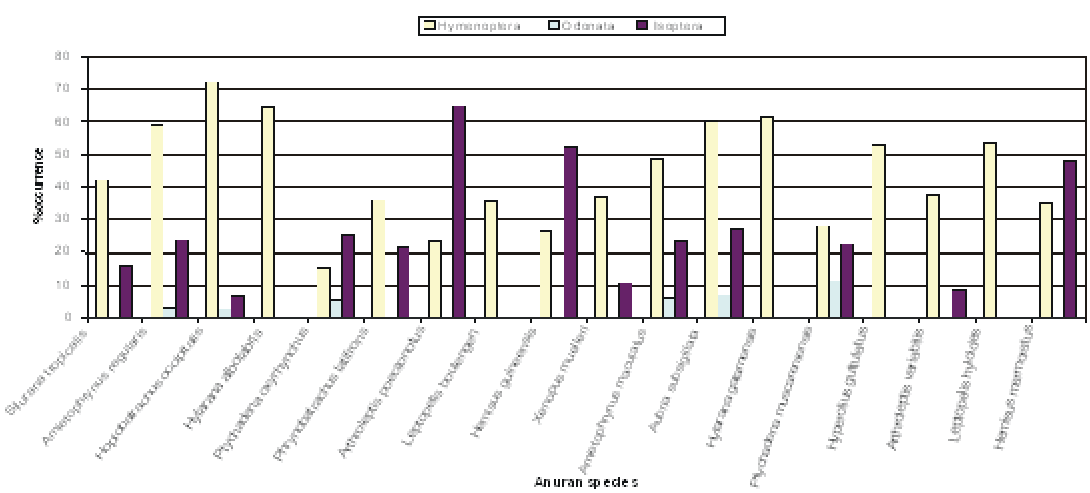


Figure 4: Percentage occurrence of insects (Hymenoptera, Odonata and Isoptera) in the stomachs of some anuran species.

may have to wait for a long duration of time to capture prey that may not even be available. This may have contributed to the high percentages of empty, 25% and half full stomachs whereas those few individuals observed with seventy five percent full and full stomachs might have caught the prey items in environments consisting of high population of prey organisms such as termite hill, pond edges, waste dump sites etc. *Leptopelis hyloides* and *L. boulengeri* did not have full stomach compared to other species examined. These two species are both arboreal species and prey organisms may not be readily available in the arboreal area compared to the ground surface. This may probably be the reason why some members of these species were observed at the forest floor during the dry season. They do normally descend from the arboreal area for the ground surface in search of food.

The positive correlation between the SVL and weight observed in the anuran species indicated normal growth. There was a proportionate increase in weight as the standard length of the species increased. The SVL of *H. occipitalis* (the longest SVL) and *A. regularis* (the heaviest weight) had body weights that correlated positively. These two species were among the largest observed in the collection. Large sized prey of the orders Orthoptera and Odonata were observed in their diets along with large amount of other organisms. *P. latifrons* had the smallest SVL length and weight followed by *A. variabilis*. Large-sized prey items were not seen in their diets and not many organisms were observed compared to larger sized anuran species. Therefore preys were eaten based on the size of the predators. Similar observations were made by Toft (1980) that body sizes of anuran species vary and are correlated with the size of prey consumed. Furthermore, the author observed that foraging behaviour and predator defense also correlated with the type and sizes of prey taken.

Insects formed the bulk of the food items consumed by the anurans in this study. The order Coeloptera (beetles and weevils) was dominant among the insects. Bulk of the stomach content of *A. poecilonotus* and *A. subsigillata* consisted of coleopterans. These findings supported the work of Olatunde (1976) who reported that insects formed the bulk of the diet of *A. regularis* and the most important insects were the coleopterans.

Hymenoptera (ants, bees and wasps) was the second largest insect in the diet of the frogs and toads encountered in this study. They constituted the bulk of the diet of *H. occipitalis* and *H. albolabris*. However, Barbault (1974) reported that bufonids ate mostly ants and beetles and several ranids show moderate specialization for ants. *Ptychadena oxyrhynchus* had the lowest occurrence of hymenopterans in its diet which maybe due to its non preference for the food or the non-availability of the food.

The least of the insect order occurring in the stomach of anuran species was the Odonata. It was not recorded for over 60% of the stomach. This maybe due to the non availability of this group of insects in the habitat or during the feeding period. It may also be due to the difficulty of their capture because they are very active insects but they constituted appreciable percentages in the diet of *P, muscareniensis* and *A. subsigillata*.

The availability of the various insect species also depends on the habitat-type of each anuran species. *Hermisus mamoratus* and *H. guineensis* had a high presence of isopterans in their diet probably because they are fossorial species that are usually found underground. This serves as a protective measure against predators during the day. Due to this fact, they may encounter isopterans which are also subterranean. This may possibly account for the high occurrence of isopterans in their diet despite the fact they actively forage for food above the ground at night. The tree frogs, *Leptopelis hyloides, Hyperolius guttulatus* and *Leptopelis boulengeri* had no Isopterans in their diet which points to the fact that these treefrogs do not usually encounter termites as their prey in the arboreal areas. However, high occurrence of hymenopterans such as ants, bees and wasps were recorded. These insects usually inhabit or forage for food in the arboreal habitats where the tree frogs frequent at nights, hence the high occurrence in their diets. These findings supported the reports of Duellman *et al* (1986) and Duellman (1993), that most arboreal species find their food in the under storey vegetation or even high in the forest canopies. Similarly Wells (2007) findings that arboreal species are mainly ant specialists while burrowing species such as *Hemisus marmoratus* feeds entirely on ants and termites are in conformity with observations of this study.

Other food items such as the Isopods (wood louse) and Annelids did not have much occurrence probably due to their non-availability and mode of life as they are usually found in microhabitats under dead woods and underground respectively hence may not be readily available to anuran species. They are more active during the day.

The occurrence of sand, detritus and plant parts in the diet recorded in this study maybe due to accidental intake during the feeding process of the frogs and toads. The highest amount of sand and detritus were recorded for the *Amietophrynus sp* and the least for the tree frogs. The tree frogs being above ground level has lesser chance of taking in sand and other detritus than species on the ground hence the lowest recordings for them.

Observations derived from this study indicate that larger size anuran species tend to ingest large-sized prey organisms in addition to other smaller prey whereas smaller anurans ingest small-size prey. Also the type of prey eaten also depends on the location of the anuran species as seen in the tree frogs (arboreal) and burrowing (fossorial) species. Hence the morphology and habitat of the anuran species have to a large extent a great influence on the food and feeding habits of these species.

Acknowledgements

Many thanks go to Prof. M. O. Rodel from the Natural Museum of Herpetology, Berlin and Dr. Arne Schiotz who assisted with the identification of some of the anuran species. I also thank the field guides and assistants from the various towns and villages who tirelessly assisted me during the various field campaigns.

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Onadeko, A.B.
© *The Zoologist, 9:*57-69 (2011), ISSN 1596 972X.
Zoological Society of Nigeria.