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# Diets of *Silurana tropicalis* from Two Rainforest Habitats in Edo State, Nigeria

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## Abstract
*The stomach of 180 Silurana tropicalis specimens, (106 from Obazuwa wetland (OBW) and 74 from Okomu National Park (ONP) were examined for their dietary composition. A total of 12 invertebrate orders (Acarina, Arachnida, Coleoptera, Diptera, Hemiptera, Odonata, Hymenoptera, Orthoptera, Isoptera, Blattoidea, Annelida and Diplopoda), both terrestrial and aquatic were recorded in addition to amphibian eggs and tadpoles. The prey orders from OBW had both aquatic and terrestrial species, with the aquatic invertebrates predominating (57.14%). Although less number of prey orders was recorded in frogs from ONP, terrestrial invertebrates constituted 80% of their diet. The presence of amphibian eggs and tadpoles in the stomach content of these frogs is an indication that S. tropicalis is also cannibalistic as already reported in other pipid and non-anurans species. The results suggest that S. tropicalis is an opportunistic generalist feeder which may be constrained by food available in its habitat.*
**Keywords:** *Silurana tropicalis*, Diet, Stomach, Rainforest habitat

## Introduction
In recent times, interest in the dietary composition of amphibians has increased. This has been necessitated by the need to understand the factors driving amphibian population decline (1, 2) and to have an insight into their maintenance requirements in captivity, both for research and husbandry purposes (3). Investigations into this subject have been undertaken in different parts of Africa including Rwanda (4); Ghana (5, 6); Ivory Coast (7); Benin (8). Previous contributions from Nigeria include (3, 9-13), Onadeko (10), Enabulele and Aisien (11) and Enabulele and Imasuen (12).
Amphibians generally exhibit a biphasic mode of life, living on land and in water (13). However a few are exclusively aquatic as exhibited by members of the family Pipidae: *Hymenochirus, Pseudohymenochirus, Silurana* and *Xenopus* in sub-saharan Africa and *Pipa* in tropical South and Central America to Panaman (14). Relatively few studies on the dietary constituents of the pipid anurans have been undertaken (15-18). Pipid anurans are regarded as generalist feeders, their main diet being benthic invertebrates and zooplankton (15-17, 19). Also reported as their food items were aquatic and terrestrial invertebrates along with a few aquatic vertebrates (18, 20).
*Silurana tropicalis* (21) is principally an aquatic clawed frog associated with primary and secondary forest environment where it lives and breeds in slow flowing and stagnant waters (22, 23). It's presence in the savanna has been reported in Nigeria by Schiotz (22), and Aisien *et al*. (24). *Silurana tropicalis* is similar to the other pipid anurans in their mode of food capture. In the water, detection of prey is believed to be by the use of the extremely sensitive lateral line organs which are distributed all over the head and trunk. However, terrestrial prey capture is aided by their sight and the use of their toothed jaws and forelimbs since they are tongueless. Detection of carrion in water is primarily through olfaction, although the use of lateral line may be involved (25, 26). The role of this frog as definitive host to a number of helminth parasites (23, 27) and their role in the trophic transfer of helminth parasitic infection have been documented (28). However, its dietary constituent is unknown, which necessitated the need to undertake this study. In this paper we report on the diets of *S. tropicalis* collected from two rainforest habitats in Obazuwa wetlands and seasonal lakes in Okomu National Park, both in Edo State of Nigeria. This study is probably the first of such investigations on aquatic anurans in Nigeria.

## Materials and Methods
### *Study Area*
The study was conducted concurrently in seasonal lakes at the Okomu National Park (ONP) in Ovia south-west LGA ($6^{\circ}15'$ and $6^{\circ}25'$N and $5^{\circ}9'$ and $5^{\circ}23'$E) and in Obazuwa wetland (OBW) located in Ovia North East LGA ($5^{\circ}$ and $6^{\circ}$ N and Longitude $5^{\circ}$ and $7^{\circ}$ E) of Edo State November, 2013 to June, 2014. Anurans were collected from the seasonal lakes at the Okomu National Park (ONP) concurrently with the Obazuwa Wetland (OBW). Both sites are rainforest biotopes with the wet season lasting from April to October and the dry season from

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November to March. While ONP is a strictly protected environment for both flora and fauna, OBW is located within an altered rainforest environment with controlled anthropogenic activities.


*Figure 1 Map Showing Study Areas – Obazuwa Wetlands and Okomu National Park*

***Frog specimens***

*Silurana tropicalis* was collected with the aid of funnel traps baited with processed fish from 8 pm to midnight. Captured frogs were transported to the base camp in plastic containers with perforated tops. The frogs were euthanized immersing them in Benzocaine solution after which 5% formalin was injected into their stomach to fix the food content. The specimens were then preserved in a jar containing 5% formalin.

Prior to analysis, the specimens were washed over running water to remove the fixative, measured with the aid of a vernier caliper to determine the snout to ventral length (SVL) and then sexed. The specimens were dissected and the stomach content emptied into a petri dish containing distilled water and examined under a dissecting microscope. Prey items in each stomach were identified to group category and stored in separate vials containing 70% alcohol.

Parameters such as frequency of occurrence for each prey item and the rate of feeding were calculated. The frequency of occurrence for each prey item was calculated as number of stomachs with a particular prey divided by total number of stomachs with that prey. The rate of feeding was estimated as the percentage of stomachs containing food divided by the total number of stomachs examined (29). Chi-square test was used to determine any significant difference in the rate of feeding of frogs from the two habitats.

## Results

A total of 180 specimens of *S. tropicalis* were collected from both sites; 106 from OBW and 74 from ONP. The identifiable stomach contents consisted mainly of invertebrates, frog eggs, tadpoles and plant material (Table1). 192 prey items were recorded in 45(42.45%) stomachs from OBW and 107 in 35(47.30%) stomachs from ONP. Prey items recovered spread across 12 taxa: Acarina, Arachnida, Coleoptera, Diptera, Hemiptera, Odonata, Hymenoptera, Orthoptera, Isoptera, Blattoidea, Annelida and Diplopoda (Table 2). Plant parts, anuran eggs and tadpoles were recorded in frog specimens from both sites. Prey items from Orders Diptera, Hymenoptera, Orthoptera and Annelida were recovered from frogs examined from both sites. Acarina, Arachnida, Coleoptera, Hemiptera, Odonata and Blattoidea along with amphibian eggs were recorded only at OBW. Isoptera and Diplopoda along with tadpoles were recorded only at ONP (Table 2).

Table 1. Stomach contents of *S. tropicalis* from Obazuwa wetland and Okomu National Park.

| Stomach contents | Obazuwa wetland | Okomu National Park |
|---|---|---|
| Identifiable items | 45 | 35 |
| Digested food + bait | 41 | 30 |
| Plant material | 15 | 04 |
| Empty stomach | 05 | 05 |

Class Insecta (aquatic and terrestrial forms) made up eight Orders and formed the predominant invertebrate group encountered. In this class, the Order Diptera ranked the highest (26.67) in OBW followed by Coleoptera (11.11%) as shown in Table 2.

Table 2. Percentage frequencies (%FO) of prey items in *S. tropicalis* from Obazuwa wetland and Okomu National Park

| | Obazuwa wetland | | Okomu National Park | |
|---|---|---|---|---|
| Food Items | No. of prey items | % of FO | No. of prey items | % of FO |
| Acarina | 03 | 6.67 | 00 | 00 |
| Arachnida | 01 | 2.22 | 00 | 00 |
| Coleoptera | 06 | 11.11 | 00 | 00 |
| Diptera | 39 | 26.67 | 08 | 5.71 |
| Hemiptera | 02 | 4.44 | 00 | 00 |
| Odonata | 05 | 8.89 | 00 | 00 |
| Hymenoptera | 07 | 6.67 | 07 | 11.43 |
| Orthoptera | 01 | 2.22 | 01 | 2.86 |
| Isoptera | 00 | 00 | 06 | 14.28 |
| Plant part | 00 | 00 | 10 | 8.57 |
| Blattoidea | 01 | 2.22 | 00 | 00 |
| Annelida | 09 | 11.11 | 48 | 34.28 |
| Diplopoda | 00 | 00 | 01 | 2.86 |
| Amphibian eggs | 67 | 33.33 | 13 | 22.85 |
| Tadpoles | 00 | 00 | 06 | 11.45 |

In the vertebrate group amphibian eggs represented 33.33% at OBW while eggs (22.85%) and tadpoles (11.45%) had quite high of frequency of occurrence at ONP. Digested stomach contents mixed with bait occurred in the following proportions: 41(38.68%) at ONP and 30(40.54%) at OBW. At both sites, 5 stomachs each were found empty while 5(14.10%) stomach contained plant material at ONP and 4(11.42%) at OBW (Table 2). The rate of feeding activity of *S. tropicalis* specimens collected from OBW and ONP were determined to be 42.46% and 47.30%, respectively. Chi-square ($\chi^2$) showed significant difference in the rate of feeding activity of *S. tropicalis* from both sites ($p<0.05$).

## Discussion

Analysis of the stomach contents revealed some diversity in the food items consumed by frogs from both sites. Although the prey items consumed by frogs from both sites constituted mainly of arthropods, more aquatic prey items were recorded in the frog specimens from OBW than those of the ONP (57.14% and 20%, respectively). This finding is in agreement with the observations of Olomukoro and Oviojie (30), who recorded a large percentage of aquatic invertebrates at OBW. The authors attributed this to the high organic content of the habitat and the availability of water all year round. In contrast, the seasonal lakes at the ONP retain water only in the wet season, a condition that may be responsible for the lower diversity of prey orders and high percentage (80%) of terrestrial invertebrates.

This study has revealed that *S. tropicalis* like other members of the Pipidae are generalists, that is, feeding on a variety of items and that the aquatic invertebrates constitute the bulk of their prey items. This finding is consistent with the observations of other investigators (15, 16) on the diet of another pipid anuran, *Xenopus laevis* investigated in California in the United States and South Wales (UK), respectively. They observed that zoobenthos and zooplankton made the greatest contribution to the diet of *X. laevis* with a little addition from terrestrial invertebrates. Furthermore, Bwong and Measey (18) who investigated the diet composition of *Xenopus borealis* in both anthropogenically disturbed and pristine habitats in Kenya also found that *X. borealis* was a dietary generalist, feeding predominantly on invertebrates.

While the consumption of amphibian eggs had the highest frequency occurrence (33.33%) in the frogs from the wetland, the consumption of tadpoles had a greater occurrence (11.45%) in frogs from the National Park (Table 2). The first report on the subject of cannibalism among pipid anurans was that by McCold and Fritz (15), who reported the presence of *X. laevis* eggs in the stomach of *X. laevis* in California, and then by Bwong and Measey (18) in Kenya. The direct cannibalization of the tadpoles of other frogs by *S. tropicalis* has also been observed in a seasonal lake at the Okomu Oil Palm Plantation in Nigeria (M.S.O. Aisien, unpublished observations). This habit of cannibalism has also been reported for non-pipid anurans. Ogoanah and Uchedike (31) reported that the African tiger frog, *Hoplobatrachus occipitalis*, a semi aquatic frog, feeds on other amphibians, and juveniles of its own species. This frog has been observed to prey on *Ptychadena* spp. kept in the same basket with them and also in the wild (M.S.O. Aisien, unpublished observations). This frog is large and has an expansible gape that allows anything captured to be swallowed. *Ptychadena* spp have also been observed to prey on juvenile anurans (12). Elsewhere in Africa, D'cruze and Sabel (32) recovered the remains of a Chameleon, *Furciber lateralis* from the stomach of *P. mascareniensis* in Madagascar.

The reason for the cannibalistic tendency in *S. tropicalis* needs to be investigated. The preying on the tadpoles at the Okomu Oil Palm Plantation was observed during the rains when the invertebrate biomass is usually rich albeit dispersed by the large volume of water at the lake. It must however be noted that the tadpole population then was also dense and easily accessible. So it may be assumed that the availability of such a rich source of protein, requiring very little foraging effort was simply irresistible and hence the switching to this food source.

In conclusion, this study has shown that *S. tropicalis* is a generalist feeder like other members of the Pipidae. Differences however exist as to the prey items consumed with respect to their habitats. Frogs from the wetlands (OBW) preyed predominantly on aquatic invertebrates, which is attributable to the ability of this habitat to hold water all year round. In contrast, frogs from the temporary lakes at the Okomu National Park preyed more on terrestrial invertebrate species. In both habitats insects constituted the most common preys. Cannibalism which has previously been reported among pipid and some other anuran species was also observed in this study.

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