# FOOD AND FEEDING HABITS OF *Campylomormyrus tamandua* IN ANAMBRA RIVER, NIGERIA

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**ABSTRACT**

***The food and feeding habits of 417 samples of Campylomormyrus tamandua (Osteichthyes: Mormyridae) in Anambra River, Nigeria were studied from October 2002 to March 2004. Fish samples were collected monthly at Otuocha and Ogurugu river ports along the Anambra river using a fleet of gill nets of various mesh sizes, traps and hook and lines. Out of the eight (8) categories of food consumed, the most dominant group was benthic invertebrates (IFS = 44.92) followed by allochthonous invertebrates (IFS = 33.40) while the least was mud/sand (IFS = 10.02). Variation in the stomach fullness condition showed that 82 (19.66%) of the stomachs studied were empty, 40 (9.59%) were full while 295 (70.74%) were partially filled. Food richness and diet breadth showed no significant difference between the seasons and sex respectively (P > 0.05). The trophic variations and flexibility in C. tamandua are discussed.***

**Keywords:** Anambra river, *Campylomormyrus tamandua,* Food, Feeding habits

## INTRODUCTION

*Campylomormyrus tamandua* is among the mormyrid species inhabiting fresh waters of tropical Africa including Anambra River (Lowe –McConnell, 1972). Popularly known as "Onu-Enyi" in the Anambra area, the fish is covered with small scales with a head, which is smooth and fleshy. Roberts (1975) attributes its success primarily to two adaptations, namely their electric organs important in nocturnal movement and communication and diversification of feeding habits. It is also a good specimen for neurological studies (Gosse, 1984). The fish is mostly favoured by the inhabitants of the study area probably because the flesh, though oily is quite tasty and of high flavour. The high oil content makes the fish difficult to dry but when patiently dried and stock-piled are transported to neighbouring towns and markets where they are sold. They are of high food value with price index ranging from two hundred naira (₦ 200:00) to three hundred naira (#300.00) per kilogram (Olaose-bikan and Raji 1998). Only limited information exists on the biology of the fish especially the food and feeding habits its importance and potentials notwithstanding.

Imevbore and Bakere (1970) noted that *C. tamandua* feed almost exclusively on the larvae of bottom dwelling insect families such as larvae of chironomidae, ephemeropterae, ceratopogonidae, chaoboridae and trichoptera. Imevbore and Okpo (1972) also reported that the mormyrids of Kainji area feed on algae, zooplankton and mud/sand. Olatunde and Moneke (1985) reported that the diet of the mormyrid species in Zaria consist mainly of immature insects and some items of plant origin. Other reports on food and feeding habits of some mormyrid species in Nigeria include Blake (1977), Hyslop (1986), King (1989), Tuegels *et al* (1992), Ikomi (1996), Kouamelau *et al* 1999, 2000 and Nwani 1998, 2004.

Mormyrids especially *C. tamandua* are increasingly becoming important in the world aquarium business and aquaculture, thus, the need arises for better knowledge about the food and feeding habits. Knowledge from such studies would help in proper fish management and feed formulation.

## THE STUDY AREA

The Anambra River has its source from Ankpa highlands of Kogi State of Nigeria. It lies between latitude 6°10' and 7°20' and longitude 7°40' East of River Niger. There is a rainy season (April–September/October) and a dry season (October/November – March). From December to January, the basin is influenced by the harmatan but its effect is not well marked. The vegetation in the basin is guinea savanna but the lentic water bodies are often fringed with macrophytes like *Pterocarpus spp, Dalbergia spp, Jussiaea spp, Vossia cuspidate, Pennisetum spp, Cybodon spp* and in some areas *Raphia hookeri.* The people of the area are part time fishermen, traders and crop farmers. The farm produce include yam, cassava, rice, potato, vegetables, groundnuts, banana etc. Crop farming activities in the River basin go hand in hand with fisheries activities, which in turn are closely related to the flood regime. During the flood period when the water level becomes increasingly high, active farming becomes increasingly intensified. However, towards the end of the flood regime, the above cycle alternates with the resumption of fishing activities, which get to the peak during the dry season.

## MATERIALS AND METHODS

Fish samples were collected monthly around Otuocha and Ogurugu river ports along the Anambra river from October 2002 to March 2004 using a fleet of gill nets (38.1 mm, 63.5 mm, 76.2 mm, 88.9 mm, 101.6 mm, 127.0 mm, and 177.8 mm), 20 traps and 200 hook and lines. Fish collected were preserved in ice and transported to the project laboratory of the Department of Zoology University of Nigeria Nsukka where the analysis was done. Fish collected were identified using the keys of Holden and Reed (1972), Lowe-McConnell (1972), Teugels *et al* (1992) and Olaosebikan and Raji (1988). The stomach of each fish was dissected out and slit open and its degree of fullness estimated by arbitrary 0 –20 points scale thus 0, 5, 10, 15 and 20 points were representing empty, ¼ full, ½ full and fully extended stomachs respectively. The percentage of partially filled stomachs (PS) i.e. ($^1/_4$ – ¾ full) were used to evaluate patterns of feeding activity.

Stomach contents were sorted out into categories and analysed using relative frequency (RF) and percentage point (PP) methods (Hynes 1950, Hyslop 1980, King 1988). Thus

%RF = (ai/n) $\sum A_{i=1}$; where ai = frequency of item a, A = frequency of the nth item (i.e. sum of all ai values).

For the point scheme, each stomach was allotted 20 points regardless of the fish size and these were shared amongst the various categories of food taking into account their relative proportion by volume. The points gained by each food item in all stomachs examined were computed and expressed as a percentage of the total points of all food items. The %RF and %PP were then used to compute the index of food significance as follows:

IFS = % RF x %PP/∑%RF x %PP x 100; Where RF = relative frequency, PP = percentage point. IFS ≥ 10 was regarded as primary, IFS ≥3 but < 10 as secondary whereas food with IFS < 3 was incidental. The IFS data were used to compute diet breadth based on Shannon –Weiner function (H) as follows:

(H) IFS = - ∑ (ni/N) $Log_e$ (ni/N); Where ni = IFS of each food item, N = total IFS of all food items.

Food richness was defined as the number of food items in the diet (King, 1988). Food composition was analysed by students't–test. Differences were considered significant at 5% level of probability.

## RESULTS

**Variations in Stomach Fullness Condition:** The overall stomach fullness condition showed that out of the 417 samples of *C. tamandua* stomachs examined, 82 (19.66%) were empty, 40 (9.59) were full while 295 (70.74 %) were partially filled. Among the partially filled stomachs, 91 (21.82 %) were ¼ full, 114 (27.34 %) were ½ full and 90 (21.58 %) were ¾ full.

The monthly changes in stomach fullness condition (Figure 1) indicated that the peak of empty stomachs (ES) was in January. This month coincided with the lowest full stomach (FS) suggesting low feeding activity at this period. The peak of the partially filled stomachs (PS) was recorded in September. With respect to seasonal variation in stomach fullness condition (Figure 2), empty and ¼ full stomachs were dominant during the dry season while ½ full and ¾ full stomachs were dominant during the wet season. There was a significant dry season increase in empty stomach (d = 4.06, P<0.05) and ¼ full stomach (d = 3.86, P < 0.05) while the ½ full and ¾ full stomachs were significantly higher in the rainy than in the dry season (P < 0.05).

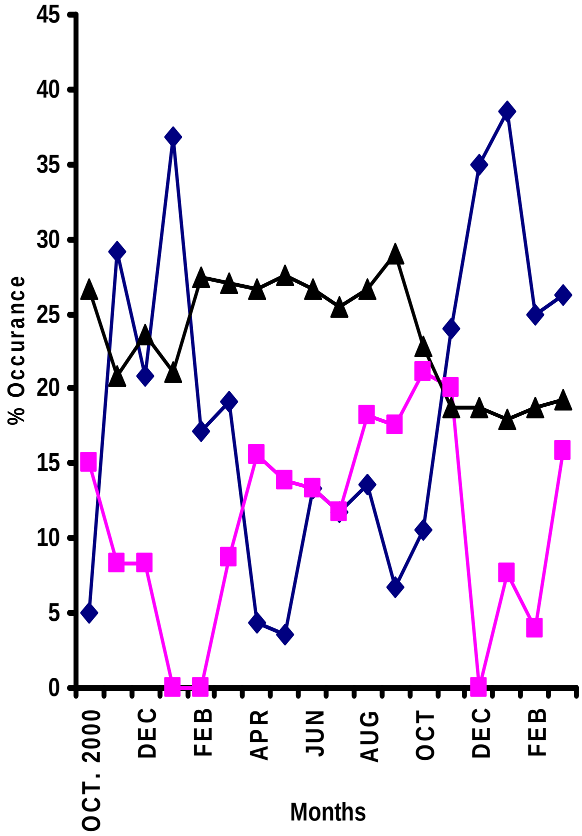


**Figure 1: Monthly variations in feeding intensity among *Campylomormyrus* species of Anambra river, Nigeria**

**Diet Composition:** Twenty-five food items were recorded in the diet of *C. tamandua* (Table 1). Lepidopteran larvae contributed the highest value (10.00 %) in terms of percentage relative frequency (%RF). This was followed by fine particulate organic matter (9.02 % RF) and mud/sand (8.80 % RF). The lowest value (0.01 % RF) was recorded in the ephemeropteran larvae. Considering the percentage point (PP), lepidopteran larvae contributed the highest value (13.30 % RF) followed by formicidae

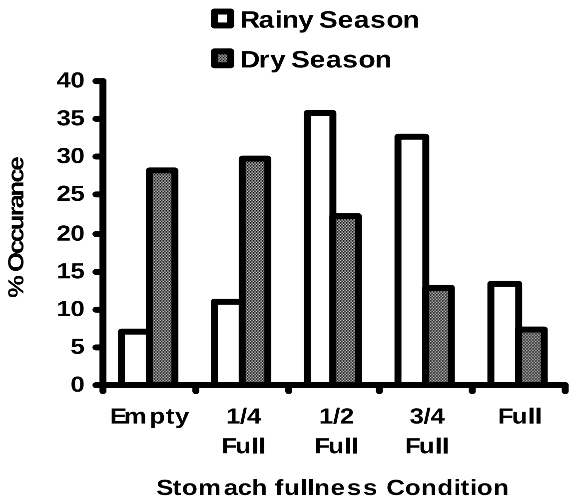


**Figure 2: Variation in indices of feeding activities in *Campylomormyrus tamandua* of Anambra river, Nigeria**

**Table 1: Trophic spectrum of the diet of all sizes of *Campylomormyrus tamandua* in Anambra Rive**

| Dietaries | %RF | %PP | IFS |
|---|---|---|---|
| **Algae:** Filamentous Algae | 8.60 | 5.60 | 6.95 |
| Colonial Algae | 4.02 | 2.00 | 1.16 |
| Unicellular Algae: Diatoms | 2.02 | 2.04 | 0.59 |
| Desmids | 2.70 | 1.50 | 0.58 |
| Euglenids | 0.02 | 0.04 | 0.29 |
| **Benthic invertebrates** | | | |
| Diptera: Chironomid larvae | 6.05 | 8.50 | 7.42 |
| Chironomid pupae | 4.04 | 3.03 | 1.77 |
| Unid diptera larvae | 7.70 | 10.86 | 12.07 |
| Odonata Anisoptera nymph | 2.60 | 2.40 | 0.97 |
| Ephemeropteran larvae | 0.01 | 0.02 | 0.40 |
| Trichoptera larvae | 4.26 | 6.04 | 3.31 |
| Crustacean: Ostracoda | 0.02 | 0.03 | 0.97 |
| Arachnida: Hydracarina | 0.03 | 0.80 | 0.40 |
| **Allochthonous invertebrates** | | | |
| Hymenoptera: | | 12.02 | 13.00 |
| Formicidae imagines | 8.03 | 13.30 | 19.19 |
| Lepidopteran larvae | 10.00 | 1.50 | 0.28 |
| Diplopoda polydesmida | 1.31 | 2.60 | 0.76 |
| **Miscellaneous invertebrates** | 4.70 | | |
| **Zooplankton** | | | |
| Crustacea cyclop copepods | 1.40 | 0.60 | 0.12 |
| Cladocera –Bosmina | 0.07 | 0.04 | 0.16 |
| Rotifera –Keratella | 2.00 | 0.30 | 0.10 |
| **Macrophyte material:** | | | |
| Leaf fragments | 2.80 | 2.00 | 0.41 |
| Seeds | 3.00 | 1.32 | 0.57 |
| **Detritus** | | | |
| Coarse particulate organic matter | 6.53 | 6.25 | 5.60 |
| Fine particulate organic matter | 9.02 | 10.11 | 13.00 |
| **Mud/sand** | 8.80 | 7.10 | 10.02 |

imagines (12.02 % PP) and unidentified dipteran larvae (10.86 % PP).The lowest value (0.02 % PP) was recorded in the ephemeropteran larvae. Considering the value for the index of food significance (IFS) of each food group, the benthic invertebrates were the most dominant food group (IFS = 44.92 %) followed by allochthonous invertebrates (IFS = 33.40 %) and detritus (IFS = 18.60 %). The lowest value (IFS = 10.02 %) was recorded in the mud/sand. Food of primary importance (IFS >10) was fine particulate organic matter, unidentified dipteran larvae, formicidae imagines, lepidopteran larvae and mud/sand. Other foods of secondary importance (IFS < 10 but ≥ 3) were filamentous algae, coarse particulate organic matter, chironomid larvae and trichopteran larvae. Other food items were of minor importance (IFS < 3).

**Variation of Diet with Season:** The seasonal changes in the index of food significance (IFS) Table 2 indicated that the IFS of anisopteran nymph and fine particulate organic matter were significantly higher in the dry than wet season (P < 0.05). The IFS of chironomid larvae, ephemeropteran larvae, leaf fragments and seeds were significantly higher in the rains than in the dry season (P < 0.05). No significant seasonality difference was observed in the IFS for other food items. Food of primary importance in the dry season was formicidae imagines while unidentified dipteran larvae were important in the rainy season.

**Table 2: Seasonal variation in the IFS of *Campylomormyrus tamandua* in the Anambra River system**

| Dietaries | DRY | RAINY | P* |
|---|---|---|---|
| **Algae:** | | | |
| Filamentous Algae | 0.965 | 1.538 | NS |
| Colonial Algae | 1.351 | - | |
| Unicellular Algae: Diatoms | 0.998 | 1.349 | NS |
| Desmids | 0.487 | 1.288 | NS |
| Euglenids | 1.527 | 1.710 | NS |
| **Benthic invertebrates** | | | |
| Diptera: Chironomid larvae | 6.902 | 9.265 | <0.05 |
| Chironomid pupae | 5.776 | 5.333 | NS |
| Unid diptera larvae | 9.620 | 13.499 | <0.05 |
| Odonata Anisoptera nymph | 4.721 | 2.425 | <0.05 |
| Ephemeropteran larvae | 0.381 | 0.658 | NS |
| Trichoptera larvae | 6.089 | 6.666 | NS |
| Crustacean: Ostracoda | 0.089 | - | |
| Arachnida: Hydracarina | 1.545 | 1.893 | NS |
| **Allochthonous invertebrates** | | | |
| Hymenoptera: | | | |
| Formicidae imagines | 10.059 | 9.756 | NS |
| Lepidopteran larvae | 7.850 | 6.651 | NS |
| Diplopoda polydesmida | 1.475 | 1.561 | NS |
| **Miscellaneous invertebrates** | 6.357 | 4.230 | NS |
| **Zooplankton:** | | | |
| Crustacea cyclopod copepods | 2.017 | 1.114 | NS |
| Cladocera –Bosmina | 0.918 | 0.866 | NS |
| Rotifera –Keratella | 0.922 | 0.477 | NS |
| **Macrophyte materials:** | | | |
| Leaf fragments | 3.630 | 9.389 | <0.05 |
| Seeds | 4.484 | 7.922 | <0.05 |
| **Detritus** | | | |
| Coarse particulate organic matter | 6.487 | 4.614 | NS |
| Fine particulate organic matter | 6.861 | 3.386 | <0.05 |
| **Mud/sand** | 8.579 | 4.401 | |
| **Food richness** | 25 | 23 | |
| **Diet breadth** | 2.88 | 2.81 | |

** = Probability @ 0.05 NS = No significant difference.*

**Variation of Diet with Sex:** The IFS of female was higher in five (5) food items (filamentous algae, colonial algae, chironomid larvae, formicidae imagines and coarse organic matter) and lower in three (Dipteran larvae, Lepidopteran) larvae and fine particulate organic matter) than males ($P < 0.05$) (Table 3). Other food items were not significantly different between the sexes. Food richness and diet breadth were slightly higher in females than males. Three food items (fine particulate organic matter, unidentified dipteran larvae and formicidae imagines) were of primary importance in both males and females.

**Table 3: Sex dependent variation in IFS of *C. tamandua* in Anambra**

| Dietaries | Male | Female | P* |
|---|---|---|---|
| **Algae:** Filamentous Algae | 2.91 | 6.49 | <0.05 |
| Colonial Algae | 1.42 | 1.44 | <0.05 |
| Unicellular Algae: | | | |
| Diatoms | 0.37 | 0.79 | NS |
| Desmids | 0.58 | 0.90 | NS |
| Euglenids | 0.04 | - | |
| **Benthic invertebrates** | | | |
| Diptera: Chironomid larvae | 6.01 | 9.35 | <0.05 |
| Chironomid pupae | 1.64 | 2.20 | NS |
| Unid diptera larvae | 14.00 | 10.13 | <0.05 |
| Odonata Anisoptera nymph | 0.93 | 1.01 | NS |
| Ephemeropteran | - | 0.08 | |
| larvae | 3.50 | 4.16 | NS |
| Trichoptera larvae | 0.08 | 0.32 | NS |
| Crustacean: Ostracoda | - | 0.46 | |
| Arachnida: Hydracarina | | | |
| **Allochthonous** | | | |
| **invertebrates** | 10.48 | 14.01 | <0.05 |
| Hymenoptera: Formicidae | 20.76 | 8.92 | <0.05 |
| imagines | 0.76 | 1.37 | NS |
| Lepidopteran larvae | 3.80 | 4.30 | NS |
| Diplopoda polydesmida | | | |
| **Miscellaneous** | | | |
| **invertebrates** | | | |
| **Zooplankton** | | | |
| Crustacea cyclopod copepods | - | 0.35 | |
| Cladocera – | 2.76 | - | |
| Bosmina | 0.38 | 0.37 | NS |
| Rotifera –Keratella | | | |
| **Macrophyte material:** | | | |
| Leaf fragments | 0.76 | 1.04 | NS |
| Seeds | 0.73 | 0.86 | NS |
| **Detritus:** | | | |
| Coarse particulate organic | 5.29 | 8.74 | <0.05 |
| matter | 17.6 | 12.90 | <0.05 |
| Fine particulate organic matter | | | |
| **Mud/sand** | 5.64 | 9.81 | 10.02 |
| Food richness | 22 | 24 | |
| Diet breadth | 2.43 | 2.60 | |
| No examined | 235 | 182 | |
| No with food | 190 | 145 | |

** Probability @ 0.05, NS = No significant difference*

## DISCUSSION

The result of this finding shows that Benthic invertebrates (IFS = 44.92%) were the most dominant food group in the diet of *C. tamandua*. Ezenwaji and Inyang (1998) and Ezenwaji (1999) had in agreement with this finding reported that autochthonous and allochthonous insects constituted important proportion of food of many fish species inhabiting the Anambra river system. Olaosebikan and Raji (1998) also reported similar results on *Mormyrus rume, Hyperopisus bebe* and *Gnathonemus petersii* in lower Niger basin. In a similar report, King (1989) noted the high preponderance of chironomid larvae in the diet of *Brienomyrus brachyistius* in a Nigerian rainforest stream. Teugels *et al* (1992) also reported high occurrence of benthic invertebrates and such common inclusions as Zooplankton, terrestrial invertebrates, plant materials, mud and sand in the diet of *B. brachyistius, G. petersii, Isichthys henri* and *Petrocephalus ansorgi.*

The discovery of the allochthonous invertebrates such as Formicidae imagines, Lepidopteran larvae and polydesmids in the stomach of *C. tamandua* indicates some degree of surface feeding. Mud and sand were also picked from the bottom. It thus appears that *C. tamandua* is able to exploit all food niches (bottom, mid-water and water surface) in its habitats. It thus exhibits wide plasticity (i.e. high trophic flexibility) in its feeding behaviours. This report agrees with the findings of Ezenwaji and Offiah (2003) that reported high trophic flexibility in *Pellonula leonensis* in Anambra River. Nwani (2004) also obtained similar results for *Hyperopisus bebe* in Anambra River. The seasonality in the dietaries of *C. tamandua* indicated that food richness and feeding intensity were higher in the rainy season than dry season. This finding deviated from the optimal foraging theory (King, 1989), which stated that diet breadth expands during the time of scarcity and contracts during the period of plenty. This reports however is in consonance with the reports of Lowe – McConnell (1972) and Welcome (1979, 1985) that many tropical fresh water fishes have a broader trophic spectrum during the rainy (flood season). This result is also in agreement with the report of Ezenwaji (1999) who attributed a higher food richness and diet breadth of *Clarias albopunctatus* during the rainy season to increased availability of food resource.

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