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Feeding habits and growth parameters of *Hydrocynus forskalii* and *Alestes nurse* in River Benue, Nigeria

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ABSTRACT
Objective: To investigate the feeding habits and the relationship between growth parameters of two characid species during the dry season in River Benue at Makurdi in Nigeria.
Methodology and results: Sampling was conducted between November 2005 and April 2006. Total length (TL) and Standard length (SL) were measured to the nearest 0.1 cm and weight to the nearest 0.1g. Analysis of the stomach contents was done by the frequency of occurrence and point methods. The length-weight relationship equations are: Log W=0.3393 + 1.11958Log L (r^2 = 0.6182) and Log W= -0.0919 + 1.5362LogL (r^2 = 0.7134) for *H. forskalii* and *A. nurse,* respectively. Fish materials and whole fish dominated the diet of *H. forskalii* while fish materials alone formed a significant portion of the diet of *A. nurse*.
Conclusion and application of findings: The growth pattern of the two fish species was determined to be negative allometry. This study has identified the diet of the two characid species in the dry season, which is of importance to fish biologists, aquarists and conservationists as it makes it possible to keep the fish under captivity.

Key words: Characidae, diet, growth, condition factor

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INTRODUCTION

The habitats of a fish species as well as its feeding habit influence its growth, behaviour and other ecological characteristics. *Hydrocynus forskalii* (tiger fish), *Hepsetus odoe* (African pike), *Channa obscura* (snake head) *Lates niloticus* (Nile perch) and *Schilbe mystus* have been reported to be principally piscivorous (Holden, 1970; Aramowo, 1976; Adebisi, 1981; Ogbe & Fagade, 2002). *H. forskalii* is a pelagic predator that is widely distributed in Nigerian inland waters except the Cross River (Paugy, 2002; Olaosebikan & Raji, 2004). However, Oti (2005) reported a swamp zone habitat for this species in Ehoma floodplain of Afikpo in Nigeria. This piscivorous species prefers long bodied fish as they are easier to swallow as well as insects, grass and snails (Bell-Cross & Minshull, 1988).

Alestes nurse, syn. *Brycinus nurse,* is native to freshwater systems in Africa, thriving well in both lacustrine and riverine conditions (Saliu, 2002). It is a common freshwater characid species with wide distribution in the Guinean and Sudan Sahelian basins of Africa excluding the Upper Guinea and Nile (Teugels *et al*., 1992). *A. nurse* has been reported to utilize various kinds of food resources that may be available in its habitat. It has been described as a planktivore (Hanna & Scheimer, 1993; Lévêque, 1995), an entomophagous fish (Fagade, 1983) and a detritivore (Victor & Brown, 1990).

Biological information on these two ecologically and commercially important fish species in River Benue is not available. This study aimed to fill part of this knowledge gap.

MATERIALS AND METHODS

Study area: The study was carried out in Makurdi, Benue State (7° 46'N; 8° 29'E). Makurdi has two main seasons: a wet season usually between May and September and a dry season usually between October and April. Average annual rainfall is between 1000 and 1500 mm. River Benue is the main tributary of the Niger River. It rises in the Adamawa Plateau of central Cameroon, flows west across central Nigeria, and joins the Niger 483 km from the coast. River Benue's width varies from about 488 to 976 m, is 1,370 km long and its navigable length is more than 965 km during the wet season (Microsoft Encarta, 2004).

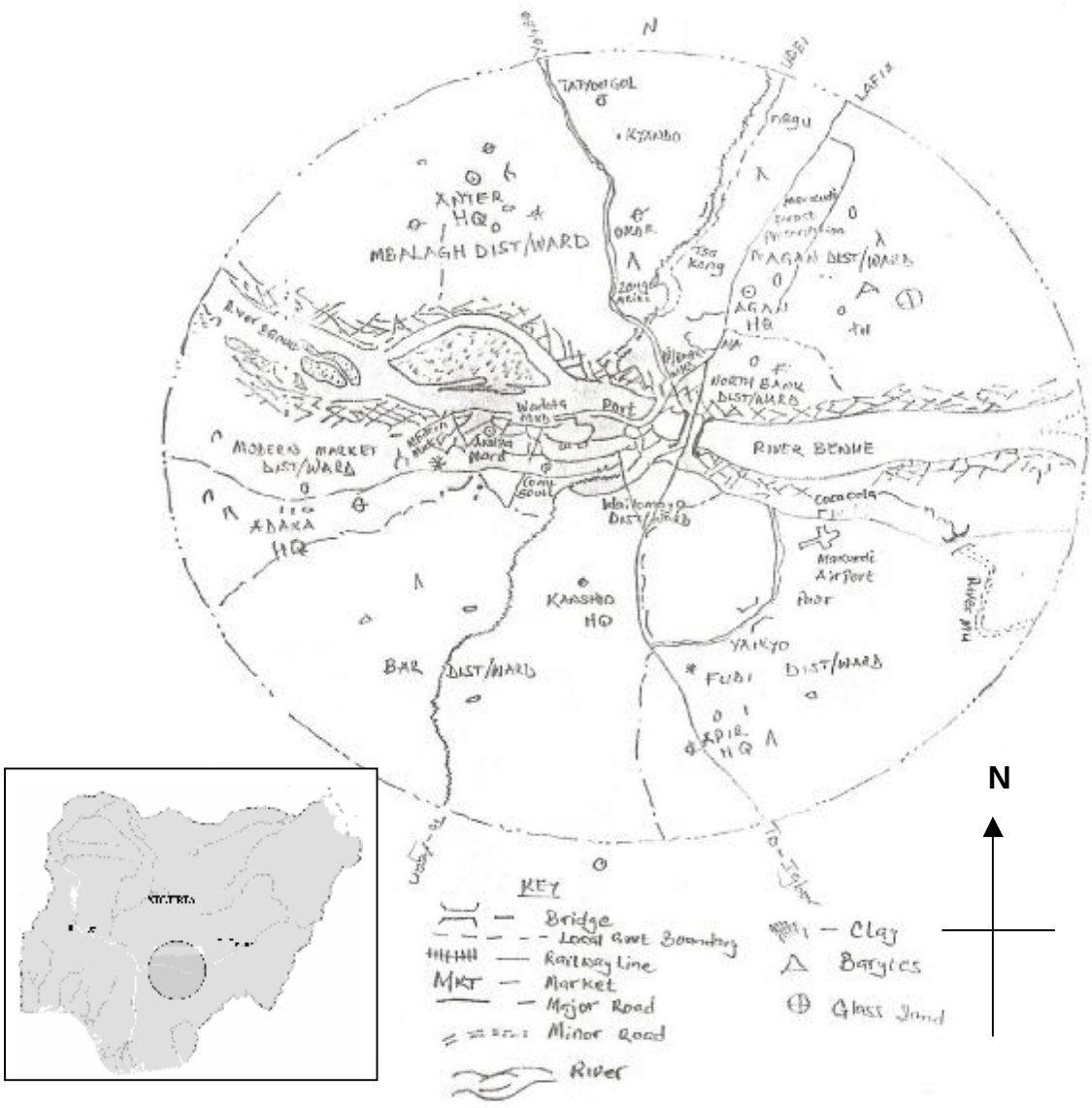

Figure 1: Map showing the sampling locations and the path of River Benue at Makurdi. Inset is a map of Nigeria.

Fish sampling: Fish were sampled monthly from the Benue River as from November 2005 to April 2006. Sampling was conducted during the day (0700–1200 hours). Fish were collected from fishermen at landing

sites at the Wadata market area in Makurdi. Information from the fishermen indicated that the fish were caught using mixtures of fishing gear including set gill nets (22–70 mm stretched mesh size), cast nets (10 - 12 mm stretched mesh), and drag nets (10 mm stretched mesh size). Fresh fish samples were transported in ice using a plastic bowl.

In the laboratory, data on length, weight and stomach contents (food items) were recorded for each fish. Total length (TL) and Standard length (SL) were measured to the nearest 0.1 cm and weight to the nearest 0.1g. The vent of the fish was split open and stomachs were removed, dissected and their contents identified under a light microscope (10–100×). Stomach contents were analyzed by the frequency of occurrence and point methods (Hynes, 1950; Hyslop, 1980). Food items were awarded points based on the volumes they were judged to have occupied. Stomach fullness was assessed on a 0–100 point scale with 0, 25, 50, 75, and 100 representing empty stomach, quarter full, half full, three quarter full, and full stomachs, respectively.

The Fulton condition factor (*K*) for each specimen was calculated from the equation:

$$K = \frac{100.W}{L^3}$$

Where: *K* = condition factor, *L* = standard length (cm), *W* = weight (g).

Fisat II (Fish Stock Assessment Tools of the World Fish Center) was used to determine the regression relationship between Standard length and weight for both species studied following Le Cren's (1951) formula: LogW = Loga + bLogL.

RESULTS

The mean standard length, weight and condition factor for *H. forskalii* were 19.88±1.25 cm, 80.59±5.79 g and 1.23±0.22 respectively (Table 1) while the highest length range was 36 – 40 cm (Fig. 2). For *A. nurse* the mean standard length, weight and condition factor were 14.44±1.70 cm, 51.08±8.38 g and 1.88±0.29, respectively (Table 2). The highest length frequency range for the species was 26 – 30 cm (Fig. 3).

The predictive equations for length weight relationship of *H. forskalii* and *A. nurse* were Log W=0.3393 + 1.11958Log L (r^2 = 0.6182) and Log W= -0.0919 + 1.5362Log L (r^2 = 0.7134), respectively. *H. forskalii* have a mean condition factor of 1.23±0.22 whereas *A. nurse* have a mean condition factor of 1.88±0.29 (Fig. 4).

TABLE 1: Monthly variation in sizes of *Hydrocynus forskalii* in River Benue, Nigeria.

Month	No. Examined	Mean S.L. (cm) ± S.E.	S.L. Range(cm)	Mean Weight(g)±S.E.	Weight Range
Nov. 2005	31	21.43±0.52	17.0 – 30.0	88.95±5.26	25.0 – 160.0
Dec. 2005	32	21.40±0.51	16.0 – 27.0	95.94±4.70	65.0 – 172.0
Jan. 2006	21	13.75±0.69	10.0 – 20.0	56.37±4.44	23.0 – 90.0
Feb. 2006	27	20.04±0.56	11.5 – 23.0	88.85±3.70	56.0 – 123.5
Mar. 2006	32	21.88±0.75	16.0 – 38.0	79.36±1.85	64.0 – 108.0
Apr. 2006	32	20.79±0.77	16.0 – 32.0	74.09±3.09	10.1- 108.0
Mean		19.88±1.25		80.59±5.79	

TABLE 2: Monthly variation in sizes of *Alestes nurse* in River Benue, Nigeria.

Month	No. Examined	Mean S.L. (cm) ± S.E.	S.L. Range(cm)	Mean Weight(g)±S.E.	Weight Range
Nov. 2005	31	13.58±0.66	5.0 – 22.0	50.18±3.90	3.0 – 88.0
Dec. 2005	27	14.15±0.81	8.8 – 23.0	60.71±3.39	36.0 – 100.0
Jan. 2006	25	20.88±0.42	17.0 – 25.0	72.88±2.36	41.0 – 90.0
Feb. 2006	15	17.46±0.44	15.0 – 21.0	68.13±1.59	58.0 – 80.0
Mar. 2006	9	10.94±0.84	7.0 – 15.0	35.00±8.68	4.0 – 80.0
Apr. 2006	6	9.60±0.51	8.0 – 11.0	19.60±3.08	21.0 – 30.0
Mean		14.44±1.70		51.08±8.38	

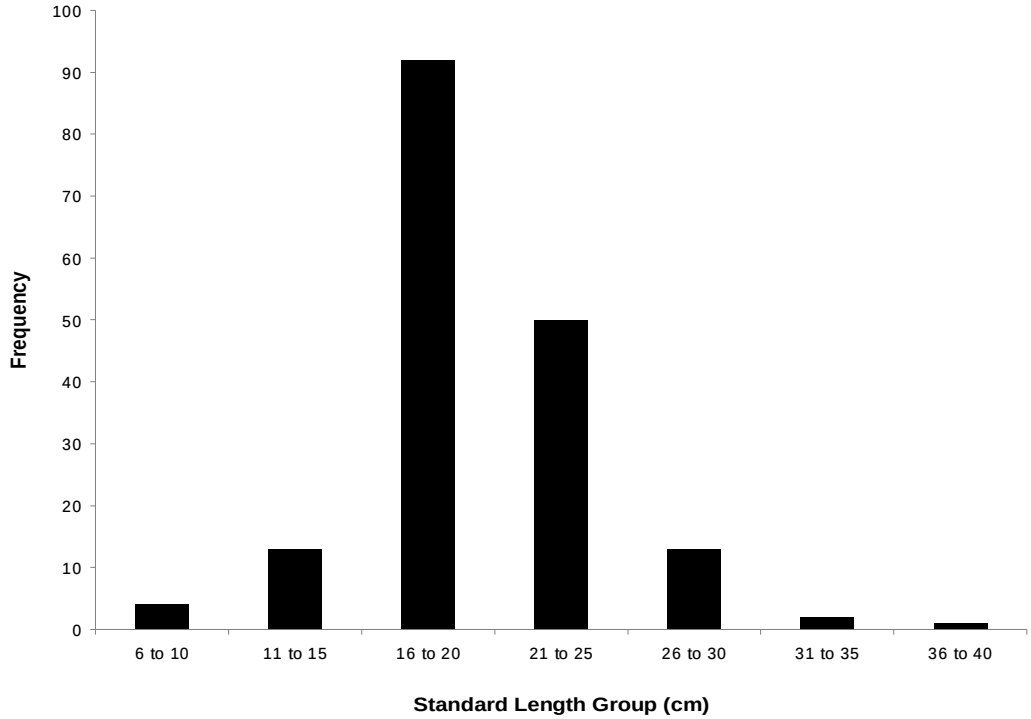

Figure 2: Length distribution frequency of *H. forskalii* in River Benue, Nigeria.

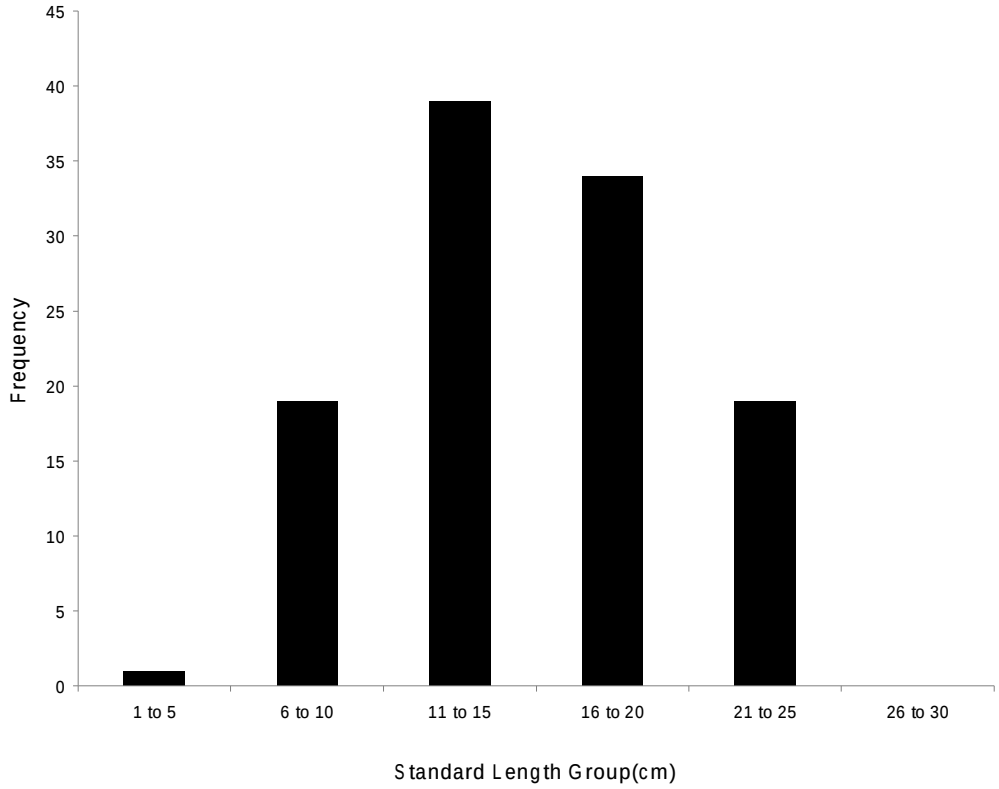

Figure 3: Length distribution frequency of *A. nurse* in River Benue, Nigeria.

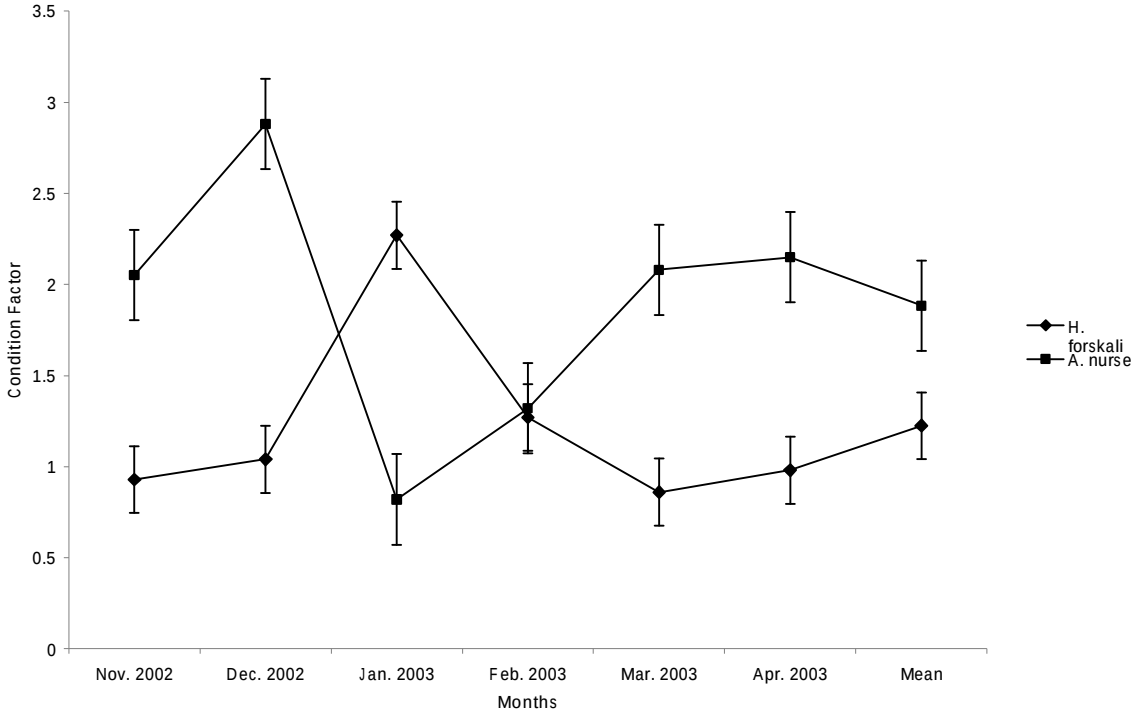

Figure 4: Monthly condition factor of *H. forskalii* and *A. nurse* in River Benue, Nigeria

Adult *H. forskalii* were found to be predominantly piscivorous, with invertebrates (insects and crustaceans) constituting a very small proportion of the diet. Food was present in 160 stomachs of the 175 examined (91.4%). Fish materials (scales, fins and bones) as well as whole fish were the dominant food items for *H. forskalii* with a total point of 67.1% and 12.5%, respectively, and a frequency of occurrence of 87.5% and 37%, respectively. Fish materials formed a significant portion of food items in the stomach of *A. nurse* with 81.5% frequency of occurrence and a total point of 55.2% (Fig. 5).

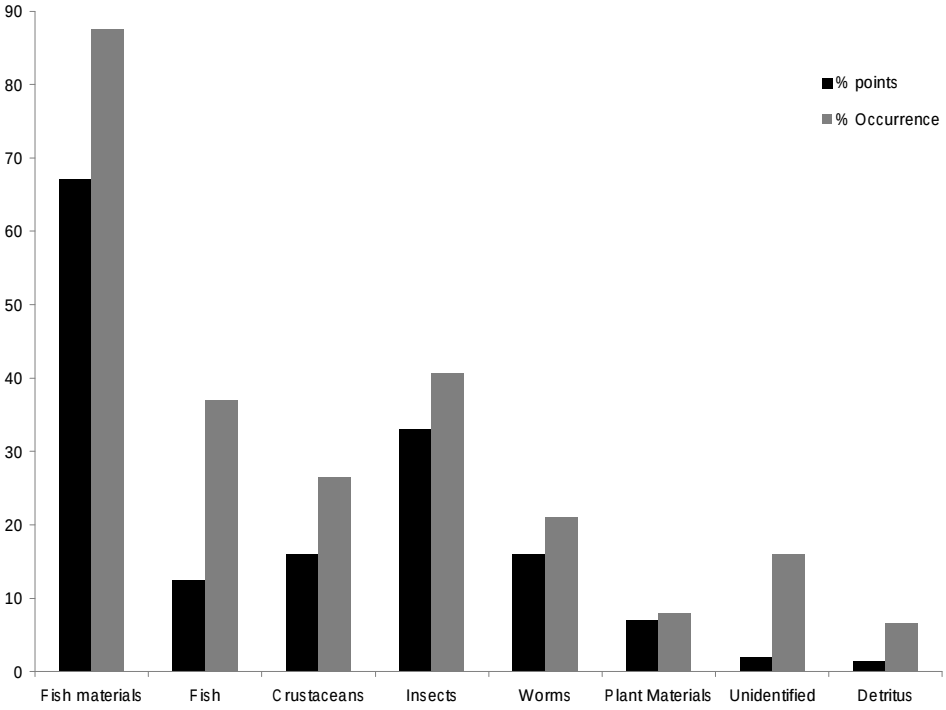

Figure 5: Relative importance and frequency of occurrence of dietary items in the stomach of *H.forskalii*.

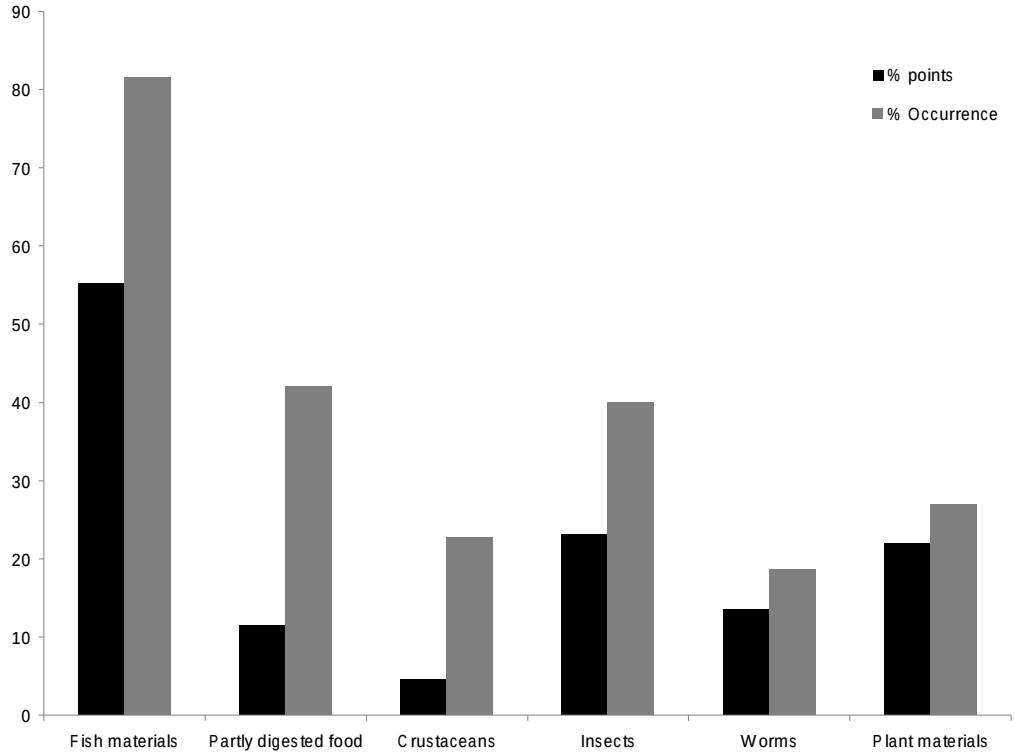

Figure 6: Relative importance and frequency of occurrence of dietary items in the stomach of *A. nurse.*

DISCUSSION

The stomach content analysis of *H. forskalii* has shown that it feeds extensively on fish. The results observed in this study as well as previous studies confirm that *H. forskalii* is a piscivorous species. Fish materials also formed the major food item in the stomach of *A. nurse.* Other food items fed on by the fish, but with less intensity, were invertebrates such as prawns, insects (Ephemeropteran larvae, Chironomid larvae, Diptera, Hemiptera and Plecoptera) and worms as well as plant materials and organic detritus. Bakare (1967) also reported that *H. forskalii* of Upper Ogun River fed on fish prey, prawns and remains of crabs, insects and some unidentified materials and organic detritus. Mhlanga (2003) reported that adult *H. vittatus* in Lake Kariba are predominantly piscivorous on the families Clupeidae, Cichlidae, and Characidae and sometimes on Clariidae, with invertebrates constituting a very small part of the diet. This suggests that for this fish prey captured depends to some extent on what is available.

Alestes nurse is an omnivorous species that feeds on various food items present within its ecosystem. Saliu (2002) reported the diet of *Brycinus nurse* (Pisces: Characidae) from Asa reservoir in Ilorin, Nigeria, to be omnivorous with a vast array of food items consumed including 9 families (flagellates, bivalves, copepods, branchiopods, ephemeropterans, arachnids, cyprinids, chlorophytes and higher plants), comprising 10 genera and 10 species. In the Jamieson River (Niger Delta, Nigeria), *Brycinus longipinnis* fed on allochthonous food items on the water surface and the substratum, and the primary food items consumed by the species were insects mainly Hymenoptera (tailor ants) and Coleoptera (Ikomi & Sikoki, 2003). Other insects, immature aquatic insects, aquatic macrophytes, algae, and detritus were supplementary diets and accounted for less than 10% of the species diet.

Size specific shifts in food or habitat type have been documented in many species. Guma'a and Yassin (1984) reported that *A. nurse* were observed to change their food from phytoplankton and small zooplankton during their pre-metamorphosis stages, to larger zooplankton (*Daphnia* and *Chydorus* spp.) and insects (larvae, pupae and imagoes) during their post-metamorphosis stage. In the Chari River, *H. forskalii* juveniles up to 30 mm are almost strictly zooplanktophages (Lauzanne, 1975). Between 30 and 45 mm the fish

eat both zooplankton and insects and above 50 mm length, they become strictly piscivorous.

Hydrocynus forskalii was in a better condition in January with the peak condition being 2.27. This can be attributed to the fall in water level and subsequent ease of prey capture. On the other hand, *A. nurse* was in a better condition in December with peak condition being 2.88. The variation in condition factor for this species is noticeable especially in January where it fell to 0.82, possibly due to stiff competition from voracious predators within the river as water begins to recede. For *H. forskalii*, the highest condition factor was recorded for fish of mean weight 56.37 g and mean standard length 13.75 cm while for *A. nurse* it was 60.71 g at mean length of 14.15 cm. This is in line with da Costa and Araújo (2003) who reported higher condition factors in *Micropogonias furnieri* of length <50 mm in the Sepetiba bay, Rio de Janeiro, Brazil. Also, Szypuła (2002) reported the highest condition coefficient *K* in February for Pike and in March for Perch in Lake Miedwie in Poland. Subsequently, the values of *K* were observed to clearly decrease until the minimum in April. The values of *K* for *H. forskalii* increased from December to January and began declining from February through April even though the climatic conditions in River Benue are not similar to the temperate climate of Lake Miedwie. For *A. nurse*, *K* declined between January and February and began increasing from March to April. The mean condition factors were 1.23 and 1.88 for *H. forskalii* and *A. nurse*, respectively. A result similar to that of *A. nurse* was reported by Ikomi and Sikoki (2003) for *B. longipinnis* with K ranging from 1.94 and 2.80.

The growth pattern of the two species was negative allometry, the slope b in the length-weight relationship of both species being much lower than 3. The b values of 1.1958 and 1.5362 for *H. forskalii* and *A. nurse*, respectively, are smaller than the value of 3.284 reported for both sexes of *B. longipinnis* by Ikomi and Sikoki (2003). The length frequency data shows that a greater number of *A. nurse* fell into the length group of 11 – 15 cm while a greater number of *H. forskalii* were in the length group of 21 – 25 cm regardless of the month. The length distributions suggest that there were two age groups or year class in the population sampled. Gear selectivity and the source of fish for the study i.e. open market could have influenced the sizes of fish observed. However, the results of this study are a good indicator of the fishable population of these species in the lower Benue River.

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