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# Endo-Parasitic Helminthes of Four Mormyrid Species (Osteichthyes: Mormyridae) from a West African Flood River System

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**Abstract:** *Mormyrus rume rume*, *Hyperopisus bebe bebe*, *Campylomormyrus tamandua* and *Gnathonemus petersii* sampled from the Anambra river with a fleet of gill nets, traps and hook and line were examined for endo-parasitic helminthes from October 2005 to September 2006. Recovered helminthes were *Rhadinorhynchus horridus* from the intestine of *H. bebe bebe* and *G. petersii*; *Procamallanus laeviconchus* from the stomach of *M. rume rume* and *C. tamandua*; *Spinitectus mormyri* from the stomach of *M. rume rume*; *Contracaecum* sp. from the coelom of *H. bebe bebe*, *G. petersii* and *C. tamandua*, whereas an unidentified cestode infected the intestine of all the mormyrids. *G. petersii* constitutes a new host record for *R. horridus*; *M. rume rume* for *S. mormyri* and *M. rume rume* and *C. tamandua* for *P. laeviconchus*. In cases of mixed infection the parasites occupied their preferred habitats. The overall prevalence of the endo-parasites in the fish hosts was 41.9%, which is within the range (<50%) typical of southern Nigerian freshwater lotic habitats. Prevalence, mean intensity and mean abundance of *R. horridus* in its host fishes were higher in the dry (October/November-March) than the rainy season (April-September/October); in the nematodes (*P. laeviconchus*, *S. mormyri* and *Contracaecum*) the reverse was the case, whereas no definite pattern was exhibited by the unidentified cestode. *P. laeviconchus* appeared reddish from engorgement of blood but no damage was evident at the point of attachment. Local inflammation where *R. horridus* was attached to the mucosa of the intestine was not considered severe. *R. horridus* and *P. laeviconchus* are probably the most important parasites of the mormyrids in terms of fishery management in the Anambra river system.

**Key words:** Endoparasite, helminthes, prevalence, mormyrids, flood river, Africa

## INTRODUCTION

Mormyrids are widespread in Afro-tropical river systems and very abundant in West Africa. Roberts (1975) attributed their success primarily to two adaptations, namely, their electric organs, which are non-visual sense organs important in nocturnal movement and communication and diversification of feeding habits. The electric organ produces an often species-specific discharge (Hopkins, 1981; Kouamelan *et al*., 1999). In Nigeria, mormyrids appear to be more diversified in Sudanian than in Guinean river system. Thus, of the 31 species in 11 genera occurring in Nigerian freshwater (Olaosebikan and Raji, 1998), only 19 species probably exist in the lower Niger, including the Anambra flood river system. Even though Sydenham (1977) divides the 12 mormyrid species of the Ogun river into a small coastal group (*Brienomyrus brachyistus*, *Gnathonemus petersii* and *Isichthys henryii*) and a larger main-river group (*Mormyrus rume rume*, *Hippopotamyrus psittacus*, *Mormyrops anguilloides*, *Hyperopisus bebe bebe*, *Campylomormyrus tamandua*, *Petrocephalus* sp., *Marcusenius brucii*, *Marcusenius* sp. and *Pollimyrus adspersus*), both groups co-exist in the lower reaches of the Anambra flood river system, where they are abundant and of immense commercial importance. During the rains, when they constitute over 15% by number and about 7% by weight of the catch in experimental gill net fishery (HMGE, pers.com), they are prepared into various delicacies by the riverine inhabitants of the Anambra River. A similar situation obtains among the communities along the upper Warri river, where the mormyrids constitute about 30% of the total fish catch (Ikomi, 1996).

Mormyrids are increasingly becoming important in the world's aquarium business and in aquaculture; thus, the need arises for better knowledge about the nature and control of parasites infecting them. Probably because of this, as well as the number and economic importance

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of component species, ecto-parasites of mormyrids have been extensively investigated, particularly in the African ichthyofaunal region (Khalil, 1971; Paperna, 1996; Van As and Van As, 1999; Kostoingue *et al.*, 2001; Oniye *et al.*, 2002; Luss-Powell *et al.*, 2003), but endo-parasites have not received similar attention (Khalil, 1971; Azugo, 1978; Paperna, 1996; Oniye and Aken'ova, 2002).

This study investigates the endo-parasitic helminthes of the commercially important *Morymrus rume rume*, *Hyperopisus bebe bebe*, *Campylomormyrus tamandua* and *Gnathonemus petersii* paying particular attention to their habits(s), seasonality of occurrence, prevalence in the sexes and seasons and pathogenic effect(s) on the host(s).

## MATERIALS AND METHODS

Samples were collected monthly around Otuocha and Ogurugu river ports along the Anambra river form October 2005 to September 2006 using a fleet of gill nets (38.1, 63.5, 76.2, 88.9, 101.6, 127.0 and 177.8 mm), 20 traps and 200 hook and line. Mormyrids which were not immediately processed were preserved in ice and examined within two days.

The standard length (snout to end of caudal peduncle) (SL, to the nearest millimeter) and body weight (to the nearest gram) of each mormyrid were measured and the sex determined by examination of the gonads after dissection. The internal organs-liver, ovaries, kidney, gall bladder, muscles, brain and alimentary canal-were thoroughly examined for endo-parasitic helminthes. For the alimentary canal, various sections (oesophagus, stomach, duodenum, small intestine, large intestine and rectum) were slit open and examined. Any endo-parasite recovered was introduced into normal saline to remove mucus and other host debris. Live nematodes were killed in extended form by pouring hot (steaming) 70% alcohol on them in petri dishes. They were then preserved in cold 70% alcohol to which 2% glycerin had been added. Acathocephalans and cestodes were shaken vigorously in cold 4% formaldehyde until they died. The Coefficient of Variation (CV) was computed as:

$$CV = (100 \times S/X)\ \%$$

Where:
S = Standard deviation
X = Population mean

Terminology of infection statistics (Bush *et al.*, 1997) was employed in the analysis of parasite data.

## RESULTS

The endo-parasitic helminthes recovered from the mormyrid species in the Anambra river were the rhadinorhynchid, *Rhadinorhynchus horridus* (Acanthocephala), the camallanid, *Procamallanus laeviconchus*, the anisakids, *Spinitectus mormyri* and *Contracaecum* sp. (larva) (Nematoda) and an unidentified cestode, the status of which shall be the subject of a later communicant (Table 1). The overall prevalence of the endo-parasites in the fish hosts was 41.9%. The prevalence of *R. horridus* was relatively high in *H. bebe bebe* (40.6%) and *G. petersii* (34.6%), which it parasitized; *P. laeviconchus*, *S. mormyri* and *Contracaecum* sp. had moderate prevalence (8.7-20.3%) in the infected mormyrids, whereas the unidentified cestode had relatively low prevalence (3.3-8.6%). Table 1 also shows that *R. horridus*, *P. laeviconchus* and *S. mormyri* exhibited some degree of host specificity, whereas *Contracaecum* sp. and particularly, the unidentified cestode, infected all the mormyrid species examined.

Table 2 shows that the parasites had preferred habitats in their hosts. Thus, the unidentified cestode and *R. horridus* were present only in the intestine, *P. laeviconchus* and *S. mormyri* in the stomach, whereas the *Contracaecum* sp. was in the coelom. The scolex of the unidentified cestode was always embedded in the mucosa of the intestine. The prevalence of the helminthes in habitats in their fish hosts showed high variability (CV = 53.21%) (Table 2); *R. horridus* had the highest prevalence (26.3%) in the small intestine of *H. bebe bebe*, whereas the unidentified cestode had the lowest (3.3%) in the small intestine *G. petersii*. Generally, *R. horridus* had low mean intensity (0.5±0.4; range, 0.2-1.2) and moderate mean abundance (0.3±0.1; range, 0.2-0.4) in its habitats, whereas the nematodes and the unidentified cestode had moderate mean intensity 1.9±0.7 (range, 1.1-3.1) and 2.1±0.2 (range, 1.8-2.3) and low mean abundance 0.2±0.1 (range, 0.1-0.3) and 0.1±0.0 (range, 0.1-0.2), respectively.

The mean abundance as well as prevalence of the helminthes was generally higher in male than in female mormyrids examined (Table 3), the mean intensity did not exhibit any clear pattern between the sexes.

Prevalence, mean intensity and abundance of *R. horridus* in its host fishes were higher in the dry (October/November-March) than the rainy season (April-September/October); in the nematodes (*P. laeviconchus*, *S. mormyri* and *Contracaecum*) the reverse was the case, whereas no definite pattern was exhibited by the unidentified cestode (Table 4).

There were frequent cases of mixed infection involving the nematodes, *P. laeviconchus* and

Table 1: Parasite species composition and their prevalence in mormyrids in Anambra River

| Taxa | Species of parasites | Host fish | No. of fish Examined | No. of fish infected received | Total No. of parasites recovered | [a]Prevalence | Intensity [b]Mean | Intensity Range | [c]Mean Abundance |
|---|---|---|---|---|---|---|---|---|---|
| Acanthocephala | *Rhadinorrhynchus horridus* | *Hyperopisus bebe bebe* | 384 | 156 | 189 | 40.6 | 1.2 | 1-20 | 0.5 |
| | *Gnathonemus petersii* | | 335 | 116 | 178 | 34.6 | 1.5 | 1-16 | 0.5 |
| Nematode | *Procamallanus laeviconchus* | *Mormyrus rume rume* | 400 | 81 | 158 | 20.3 | 2.0 | 1-15 | 0.4 |
| | | *Campylomormyrus tamandua* | 417 | 66 | 165 | 15.8 | 2.5 | 1-17 | 0.4 |
| | *Spinitectus mormyri* | *Mormyrus rume rume* | 400 | 76 | 112 | 19.0 | 1.5 | - | 0.3 |
| | *Contracaecum* sp. (larva) | *Gnathonemus petersii* | 335 | 29 | 36 | 8.7 | 1.2 | 1-10 | 0.1 |
| | | *Hyperopisus bebe bebe* | 384 | 67 | 93 | 17.5 | 1.4 | 1-8 | 0.2 |
| | | *Campylomormyrus tamandua* | 417 | 43 | 89 | 10.3 | 2.1 | 1-10 | 0.2 |
| Cestoda | *Unidentified cestode* | *Mormyrus rume rume* | 400 | 16 | 28 | 4.0 | 1.8 | 1-6 | 0.1 |
| | | *Hyperopisus bebe bebe* | 384 | 33 | 76 | 8.6 | 2.3 | 1-8 | 0.2 |
| | | *Campylomormyrus tamandua* | 417 | 21 | 44 | 5.0 | 2.1 | 1-7 | 0.1 |
| | | *Gnathonemus petersii* | 335 | 11 | 25 | 3.3 | 2.3 | 1.4 | 0.1 |
| | | Total | 1536 | 719 | | 46.5 | | | |

[a] = Number of host infected divided by number examined expressed as a percentage, [b] = Mean number of parasites per infected host, [c] = Mean number of parasites per host examined

Table 2: Prevalence of helminth endo-parasites in relation to habitat in mormyrid species

| Species of parasites | Fish of hosts (No. of examined) | Habitat in hosts | No. of hosts infected | Total No. of parasites recovered | [a]Prevalence | [b]Mean Intensity | [c]Mean Abundance |
|---|---|---|---|---|---|---|---|
| *Rhadinorrhynchus horridus* | *Hyperopisus bebe bebe* | Small intestine | 101 | 118 | 26.3 | 1.2 | 0.3 |
| | (384) | Large intestine | 55 | 71 | 14.3 | 0.2 | 0.2 |
| | *Gnathonemus petersii* (335) | Small intestine | 74 | 127 | 22.1 | 0.4 | 0.4 |
| | | Large intestine | 42 | 51 | 12.5 | 0.2 | 0.2 |
| *Procamallanus laeviconchus* | *Mormyrus rume rume* (400) | Stomach | 81 | 158 | 20.3 | 2.0 | 0.4 |
| | *Campylomormyrus tamandua* (417) | Stomach | 66 | 165 | 15.8 | 2.5 | 0.4 |
| *Spinitectus mormyri* | *Mormyrus rume rume* (400) | Stomach | 76 | 112 | 19.0 | 1.5 | 0.3 |
| *Contracaecum* sp. (larva) | *Gnathonemus petersii* (335) | Coelom | 29 | 36 | 8.7 | 1.2 | 0.3 |
| | *Hyperopisus bebe bebe* (384) | Coelom | 67 | 93 | 17.4 | 1.4 | 0.2 |
| | *Campylomormyrus tamandua* (417) | Coelom | 43 | 89 | 10.3 | 2.1 | 0.2 |
| Unidentified cestode | *Mormyrus rume rume* (400) | Small intestine | 16 | 28 | 4.0 | 1.8 | 0.1 |
| | *Hyperopisus bebe bebe* (384) | Small intestine | 33 | 76 | 8.6 | 2.3 | 0.2 |
| | *Campylomormyrus tamandua* (417) | Small intestine | 21 | 44 | 5.0 | 2.1 | 0.1 |
| | *Gnathonemus petersii* (335) | Small intestine | 11 | 25 | 3.3 | 2.3 | 0.1 |

[a] = Number of host infected divided by number examined expressed as a percentage, [b] = Mean number of parasites per infected host, [c] = Mean number of parasites per host examined

Table 3: Prevalence of helminth endo-parasites in relation to sex in the mormyrids

| Species of parasite | Fish host | Host sex/No. examined | No. of hosts infected | Total No. of parasites recovered | [a]Prevalence | [b]Mean intensity | [c]Mean Abundance |
|---|---|---|---|---|---|---|---|
| *Rhadinorrhynchus horridus* | *Hyperopisus bebe bebe* | M/211 | 59 | 65 | 28.0 | 1.1 | 0.3 |
| | | F/173 | 97 | 124 | 56.1 | 1.3 | 0.7 |
| | *Gnathonemus petersii* | M/156 | 43 | 72 | 27.6 | 1.7 | 0.5 |
| | | F/179 | 73 | 106 | 41.0 | 1.5 | 0.6 |
| *Procamallanus laeviconchus* | *Mormyrus rume rume* | M/217 | 33 | 68 | 15.2 | 2.1 | 0.3 |
| | | F/183 | 48 | 90 | 26.2 | 1.9 | 0.5 |
| *Spinitectus mormyri* | *Campylomormyrus tamandua* | M/235 | 38 | 75 | 16.2 | 2.0 | 0.3 |
| | *Mormyrus rume rume* | M/217 | 24 | 51 | 11.1 | 2.1 | 0.2 |
| | | F/183 | 52 | 61 | 28.4 | 1.2 | 0.3 |
| *Contracaecum* sp. | *Gnathonemus petersii* | M/156 | 13 | 13 | 8.3 | 1.0 | 0.1 |
| | | F/179 | 16 | 23 | 8.9 | 1.4 | 0.1 |
| | *Hyperopisus bebe bebe* | M/211 | 18 | 27 | 8.5 | 1.5 | 0.1 |
| | | F/173 | 49 | 9 | 28.3 | 1.0 | 0.3 |
| | *Campylomormyrus tamandua* | M/235 | 29 | 35 | 12.3 | 1.2 | 0.1 |
| | | F/182 | 14 | 54 | 7.7 | 3.9 | 0.3 |
| Unidentified cestode | *Mormyrus rume rume* | M/217 | 5 | 13 | 2.3 | 2.6 | 0.1 |
| | | F/183 | 11 | 15 | 6.0 | 1.4 | 0.1 |
| | *Hyperopisus bebe bebe* | M/211 | 14 | 34 | 6.6 | 2.4 | 0.2 |
| | | F/173 | 19 | 59 | 11.0 | 3.1 | 0.3 |
| | *Campylomormyrus tamandua* | M/235 | 8 | 15 | 3.4 | 1.9 | 0.1 |
| | | F/182 | 13 | 29 | 7.1 | 2.2 | 0.2 |
| | *Gnathonemus petersii* | M/156 | 7 | 9 | 4.5 | 1.3 | 0.1 |
| | | F/179 | 4 | 16 | 2.2 | 4.0 | 0.1 |

[a] = Number of host infected divided by number examined expressed as a percentage, [b] = Mean number of parasites per infected host, [c]= Mean number of parasites per host examined

Table 4: Prevalence of helminth endo-parasites in relation to seasons in the Mormyrids

| Species of parasite | Fish host | Season/No. examined | No. of hosts infected | Total No. of parasites recovered | [a]Prevalence (%) | [b]Mean intensity | [c]Mean Abundance |
|---|---|---|---|---|---|---|---|
| *Rhadinorrhynchus horridus* | *H. bebe bebe* | D223 | 105 | 134 | 47.1 | 1.3 | 0.6 |
| | | R/161 | 51 | 55 | 31.7 | 1.1 | 0.3 |
| | *G. petersii* | D/188 | 94 | 154 | 50.0 | 1.6 | 0.8 |
| | | R/147 | 22 | 24 | 15.0 | 1.1 | 0.2 |
| *Procamallanus laeviconchus* | *M. rume rume* | D/226 | 28 | 52 | 12.4 | 1.9 | 0.2 |
| | | R/174 | 53 | 106 | 30.5 | 2.0 | 0.6 |
| | *C. tamandua* | D/233 | 37 | 49 | 15.9 | 1.3 | 0.2 |
| | | R/184 | 49 | 116 | 26.6 | 2.4 | 0.6 |
| *Spinitectus mormyri* | *M. rume rume* | D/226 | 30 | 34 | 13.3 | 1.1 | 0.2 |
| | | R/174 | 46 | 78 | 26.4 | 1.7 | 0.4 |
| *Contracaecum* sp. | *G. petersii* | D/188 | 5 | 6 | 2.7 | 1.2 | + |
| | | R/147 | 24 | 30 | 16.3 | 1.3 | 0.2 |
| | *H. bebe bebe* | D/223 | 21 | 24 | 9.4 | 1.1 | 0.1 |
| | | R/161 | 46 | 52 | 28.6 | 1.1 | 0.3 |
| | *C. tamandua* (417) | D/233 | 12 | 24 | 5.2 | 2.0 | 0.1 |
| | | R/184 | 31 | 65 | 16.8 | 2.1 | 0.4 |
| Unidentified cestode | *M. rume rume* (400) | D/226 | 6 | 8 | 2.7 | 1.3 | + |
| | | R/174 | 10 | 20 | 5.7 | 2.0 | 0.1 |
| | *H. bebe bebe* (384) | D/223 | 18 | 56 | 8.1 | 3.1 | 0.3 |
| | | R/161 | 15 | 37 | 9.3 | 2.5 | 0.2 |
| | *C. tamandua* (417) | D/233 | 14 | 35 | 6.0 | 2.5 | 0.2 |
| | | R/184 | 7 | 9 | 3.8 | 1.3 | + |
| | *G. petersii* (335) | D/188 | 7 | 16 | 3.7 | 2.3 | 0.1 |
| | | R/147 | 4 | 9 | 2.7 | 2.3 | 0.1 |

[a] = Number of host infected divided by number examined expressed as a percentage, [b] = Mean number of parasites per infected host, [c] = Mean number of parasites per host examined

*S. mormyri*, whereas *R. horridus* and the unidentified cestode were only found twice together in the intestine of *H. bebe bebe*, occupying their preferred habitats, the small intestine in the later and the large intestine in the former.

Even though the heads of *P. laeviconchus* and unidentified cestode were tightly embedded in the mucosa of the stomach and intestine, respectively, no observable damage was observed. However, *P. laeviconchus* appeared reddish indicating engorgement of blood probably with the aid of its lips. For *R. horridus*, local inflammation was evident at the point of attachment to the wall of the intestine but this was not considered serious and/or life threatening.

## DISCUSSION

Apart from *Contracaecum* sp. and the unidentified cestode, all the parasites of this study have previously been recovered form mormyrids (Khalil, 1969, 1971; Oniye and Aken'ova, 2002). But *G. petersii* constitutes a new host record for *R. horridus*; *M. rume rume* for *S. mormyri* and *M. rume rume* and *C. tamandua* for *P. laeviconchus.*

Specificity to a fish family by an acanthocephalan has been previously reported. For example, *Acanthogyrus tilapiae* is known to be specific to cichlids (Paperna, 1996). It is becoming increasingly evident that *R. horridus* as well as *S. mormyri*, is probably a *mormyrid* parasite. The reports by Khalil (1971), Oniye and Aken'ova (2002) and this study are pointers in this direction. *P. laeviconchus* is found in many fish hosts in several families in Africa and has been described by Khalil and Thurston (1973) as a transafrican species. Its recovery from *M. rume rume* and *C. tamandua* add to the list of the hosts for this parasite. Similarly, larval *Contraecum* sp. infects a wide range of African fishes in different families (Khalil, 1971; Azugo, 1978), but it is not as widespread as *P. laeviconchus.*

The observed overall prevalence of endo-parasites in the mormyrids (41.9%) is <50%, which is generally typical of Southern Nigerian fresh water lotic habitats when large numbers of fish are examined (Azugo, 1978, -37.9%; Ilozumba and Ezenwaji, 1985-42.99%; Ugwuozor, 1987; Ezenwaji and Ilozumba, 1992-25.09%; Ezenwaji, 2002 -24.21%). Differences in prevalence could be explained largely in terms of the frequency of contact between the fish and the infective stage of the parasite. Southern Nigerian river systems are usually perennial with very large volumes resulting from run off from the systems' catchment areas during the flood phase of the hydrological regime. During this period, the volume of water enables a wide dispersal of both the parasite and its fish host, considerably reducing the contact between them. The high flow of water further ensures minimal contact and therefore low prevalence. In the dry season, which roughly corresponds to the dry phase of the hydrological cycle, there is virtually no precipitation and the flow and volume of water are very much reduced, resulting in much higher contact between the parasite and fish leading to the relatively higher prevalence usually observed at this time. Infect, the increased host-parasite contact frequency is a major reason why prevalence is higher, sometimes up to 95%, in lentic habitats, particularly in floodplain ponds, lakes and marshes and in culture situations (Ilozumba and Ezenwaji, 1985; Anosike *et al*., 1992). In the north, most of the lotic habitats are seasonal and the situation in most parts of the year is likened to the dry phase conditions in the south. To a large extent, this explains the high prevalence recorded by Onwuliri and Mgbemena (1987-59.8%) and Yakubu *et al.* (2002-59%) in this area.

Apart from climate, other factors of considerable importance, which affect prevalence, are the environment of host and the behaviour and life history of both the parasite and fish host. Stressors (Kadlec *et al*., 2003) appear to have a moderating, sometimes overriding, influence on prevalence. This may account for the disparity in prevalence of the parasites during the wet and dry seasons recorded in this study. These factors probably interact in such as manner that is not presently understood as to offer relative advantage to some parasites in the rainy season (*P. laeviconchus*, *S. mormyri* and *Contracaecum* sp.) and some in the dry season (*R. horridus*). The well being of the host during the seasons, particularly in terms of stress, may probably be very important as can be deduced generally from the prevalence of the unidentified cestode. Habitat preferences of the parasites in the gut of their host may be attributed to physiochemical and physiological conditions of the gut as helminthes differ in these conditions, particularly in nutritional requirements (Ugwuozor, 1987; Anosike *et al*., 1992; Onwuliri *et al*., 1989; Auta *et al*., 1999; Oniye and Aken'ova, 2002). Mormyrids, including *Hyperopisus bebe bebe*, are generally omnivorous, subsisting mainly on insects, but species of *Momyrops* and *Mormyrus rume rume* ingest substantial amounts of phytoplankton (Petr, 1968; Okedi, 1971; Blake, 1977; Olatunde and Moneke, 1985; Ikomi, 1996; Kouamelan *et al*., 1999; Fawole, 2002). As already noted by Fagbenro *et al.* (2005), the degree of activity of the gut enzyme mix (glycosidases, lipases and proteases) depends on the proportion of the class of food items ingested by host fish. This in turn determines the physico-chemical and physiological conditions in various sections of the gut. This probably explains why *R. horridus* was concentrated in the intestine, while *P. laeviconchus* and *S. mormyri* were found only in the stomach, habitats known to be slightly basic and acidic, respectively. *R. horridus* and *P. laeviconchus* are probably the most important parasites in terms of fishery management in Anambra river system because of their potential to cause damage in the intestinal and stomach mucosa, respectively to which they attach. Attachment of *P. laeviconchus* may result in anaemia following engorgement with blood, while inflammation occurs at the point of attachment of *R. horridus.* While these effects are minimal in this study because of low infection, they may be severe in heavy infection, especially by the acanthocephalans, *R. horridus.* Paperna (1996) has reported server pathological damages resulting from heavy infections in some acanthocephalans.

## REFERENCES


Anosike, J.C., P.C. Omoregie and I.E. Nweke, 1992. A survey of helminthes parasites of *Clarias gariepinus* in Plateau State, Nigeria. J. Aquat. Sci., 7: 39-43.

Auta, J., S.J. Oniye and J.A. Adekole, 1999. The Helminth Parasites of the gastrointestinal tracts of *Synodontis* species in Zaria, Nigeria. Zuma J. Pure Applied Sci., 2 (2): 47-52.

Azugo, N.I., 1978. Ecological studies of the helminth parasites of the fish of anambra river system. M.Phil. Thesis, University of Nigeria Nsukka, pp: 178.

Blake, B.F., 1977. The effect of the impoundment of Lake Kainji, Nigeria, on Theindigenous species of mormyrid fishes. Freshwater Biol., 7: 37-42.

Bush, A.O., K.D. Lafferty, J.M. Lotz and A.W. Shostak, 1997. Parasitology meets ecology on its own terms: Margolis *et al.* revisited. J. Parasitol., 83 (4): 575-583).

Ezenwaji, H.M.G. and P.C.O. Ilozumba, 1992. Helminthofauna of four West African small *Clarias* species (Osteichthyes: Clariidae) from Nigeria. J. Afr. Zool., 106: 391-400.

Ezenwaji, H.M.G., 2002. The biology of *Clarias ebriensis* Pellegrin, 1920 (Osteichthyes: Clariidae) in an African rainforest river basin. Fish. Res., 54: 235-252.

Fagbenro, O., O. Adedire O. Fateru, I. Owolabi, O. Ogunlana, B. Akanbi, T. Fasanmi and P. Ayo-Amu, 2005. Digestive enzyme essay in the gut of *Oreochromis niloticus* Linnaeus, 1757, *Parachanna obscura* Gunther, 1861 and *Gynnarchus niloticus* Curvier, 1829. Anim. Res. Int., 2 (2): 292-206.

Fawole, O.O., 2002. Morphometry and diet of *Mormyrus rume* in the Lekki lagoon, Nigeria. Rev. Biol. Trop., 50 (2): 689-694.

Hopkins, C.D., 1981. On the diversity of electric signals in a community of mormyrid electric fish in West Africa. Am. Zool., 21: 211-222.

Ilozumba, P.C.O. and H.M.G. Ezenwaji, 1985. The helminth parasites of *Heterotis niloticus* Muller, 1843 (Pisces: Osteoglossidae) in River Anambra, Nigeria. J. Sci. Educ., 1 (1): 106-116.

Ikomi, R.B., 1996. Studies on the growth pattern, feeding habits and reproductive characteristics of the mormyrid *Brienomyrus longianalis* (Boulenger, 1901) in the upper Warri river, Nigeria. Fish. Res., 26: 187-198.

Kadlec, D., A. Simkovi and J. Jarkovsky, 2003. Parasite communities of freshwater fish under flood conditions. Parasitol. Res., 89: 272-283.

Khalil, L.F., 1969. Studies on the helminth parasites of freshwater fishes of the Sudan. J. Zool. Lond., 158: 143-170.

Khalil, L.F., 1971. Checklist of the helminth parasites of African freshwater fishes. Tech. Commun. Commonwealth Inst. Helminth, 42: 1-80.

Khalil, L.F. and J.P. Thurston, 1973. Studies on the helminth parasites of freshwater fishes of Uganda, including descriptions of two new species of digeneans. Rev. Zool. Bot. Afr., 87 (2): 231-248.

Kostoingue, B., C. Diebakate, N. Faye and B.S. Toguebaye, 2001. Presence of Myxosporidea (Myxozoa: Myxosporea) of the *Genus Henneguya* Thelohan, 1892 in freshwater fishes from Chad (Central Africa). Acta Protozool., 40: 117-123.

Kouamelan, P.E., G.G. Teugels, G. Gourene, F. Ollevier, Thys van den and D.F.E. Audenaerde, 1999. The effect of a man-made lake on the diet of the African electric fish *Momyrus rume* Valenciennes, 1846 (Osteoglossiformes: Mormyridae). Hydrobiologia, 380: 141-151.

Luss-Powell, W.J., S.N. Mashego and L.F. Khalil, 2003. *Mormyrogyrodactylus gemini* gen. et sp. n. (Monogenea: Gyrodactylidae), a new gyrodactylid from *Marcusenium macrolepidotus* (Mormyridae) from South Africa. Folia Parasitol., 50: 49-55.

Okedi, J., 1971. The food and feeding of the small mormyrid fishes of LakeVictoria, East Africa. Afr. J. Trop. Hydrobiol. Fish. 1: 1-12.

Olaosebikan, B.D. and A. Raji, 1998. Field Guide to Nigerian Freshwater Fishes. Federal College of Freshwater Fisheries Technology, New Bussa, pp: 106.

Olatunde, A.A. and C.C. Moneke, 1985. The food habits of four momyrid species in Zaria, Nigeria. Arch. Hydrobiol., 102: 503-517.

Oniye, S.J. and T.O. Aken'ova, 2002. The dynamics of adult and larva stages of *Rhadinorrhynchus horridus* (Luche, 1912) in *Hyperopisus bebe occidentalis* (Gunther) in Zaria Dam. The Zoologist, 1 (1): 41-48.

Oniye, S.J., O.J. Ajanusi, R.A.T. Ega and R.I.S. Agbede, 2002. Gill parasites of *Hyperopisus bebe occidentalis* (Gunther) Zaria Dam, Nigeria. J. Trop. Biosci., 2 (1): 98-105.

Onwuliri, C.O.E. and M.O. Mgbemena, 1987. The parasitic fauna of some freshwater fish from Jos Plateau, Nigeria. Nig. J. Applied Fish. Hydrobiol., 2: 33-37.

Onwuliri, C.O.E., D.I. Anadu, C.J. Ejike and D.O. Ademarati, 1989. The effects of parasitism on the protein and amino acid contents of *Clarias lazera*. J. Aquat. Sci., 4: 45-48.

Paperna, I., 1996. Parasites, infections and diseases of fishes in Africa-An update. CIFA Tech. Pap. No. 31, Rome, FAO., pp: 220.

Petr, T., 1968. Distribution, abundance and food of commercial in the Black Volta and Volta man-made lake in Ghana during its first period of filling (1964-1966). Hydrobiologia, 32: 417-448.

Roberts, T.R., 1975. Geographical distribution of African freshwater fishes. Zool. J. Linn. Soc., 57: 249-319.

Sydenham, D.H.J., 1977. The qualitative composition and longitudinal zonation of the fish fauna of the River Ogun, Western Nigeria. Rev. Zool. Afr., 91: 974-995.

Ugwuozor, G.N., 1987. A survey of the helminthes parasites of fish in Imo River. Nig. J. Applied Fish. Hydrobiol., 2: 25-32.

Van As, J.G. and L.L. Van As, 1999. *Chonopeltis liversedgei* sp.n. (Crustacea: Branchiura), parasite of the Western bottlenose *Mormyrus lacerda* (Mormyridae) from the Okavango Delta, Botswana. Folia Parasitol., 46: 319-325.

Yakubu, D.P., E. Omoregie, J.W. Wade and D.U. Faringoro, 2002. A comparative study of helminthes of *Tilapia zilli* and *Clarias gariepinus* from River Uke, Plateau State, Nigeria. J. Aquat. Sci., 17(2): 137-139.