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A Comparative Study of the Parasitic Helminth Fauna of *Gymnarchus niloticus* (Gymnarchidae) and *Heterotis niloticus* (Osteoglossidae) from Lekki Lagoon, Lagos, Nigeria

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Abstract: A comparative study of the gut helminthes of *Gymnarchus niloticus* and *Heterotis niloticus* were undertaken. A total of 38 fishes comprising of 20 *Gymnarchus niloticus* and 18 *Heterotis niloticus* were examined for helminth parasites. The overall prevalence of gastrointestinal helminth infections was 34.2%, which implied that 13 of the specimens examined were infected with parasites. A total of 18 parasites were recovered from the fish specimens. The male specimens of *Heterotis niloticus* had 38.9% prevalence of infections while the male specimens of *Gymnarchus niloticus* had 0% prevalence of infections. The female specimens of the two fishes had 50% prevalence of infections. *Gymnarchus niloticus* harboured two nematodes; *Raphidascaroides* species in the stomach and the *Philometrids*, *Nilonema gymnarchi*, in the intestine. *Heterotis niloticus* were infected with a trematode *Brevimulticaecum heterotis* in the liver and *Tenuisentis niloticus* and *Sandonella sandoni* in the intestine. The worm burden and intensity were low and independent of sex and age of fish with no seasonal variation in parasite intensity observed. The low prevalence of infection is possibly due to the randomness of specimens' selection.

Key words: Gut helminthes, *Gymnarchus niloticus*, *Heterotis niloticus*, helminth parasites

INTRODUCTION

Fish diseases are the major problems confronting the fish culturists. In Nigeria, the demands for fish exceed supply and the proportion of annual protein in the daily diet is generally low.

Gymnarchus niloticus (Cuvier, 1829) is a common fish species in Nigeria and several West African countries. The fish species lives in demersal, potamodromous, freshwater environment with a pH range of 6.5-8.0 and a dH range of 10-25 (Riede, 2004). The species occur widely in the Nile, Volta, Chad, Senegal, Gambia basins and Lake Rudolf. The fish species is known to lay about one thousand amber-like eggs; larvae hatching after five days (Budgett, 1901).

Gymnarchus niloticus is a carnivorous fish feeding on crustaceans, insects and fish (Bennett, 1971). The body is elongated with no anal and pelvic fins.

Bigorne (1990) reported a standard length of 167 cm and a weight of 18.5 kg for male of *Gymnarchus niloticus*. The fish is also reported to possess an electric organ that extends along almost the entire trunk to the tip of the tail (Bennett, 1971). It is also equipped with ampullary receptors and two types of tuberous receptors for electroreception (Szabo, 1974).

The fish breeds in well-vegetated, marginal areas of swamps and rivers where large, floating nest, about 1 m in diameter is constructed. The eggs laid are later guarded by one of the parents (Greenwood and Wilson, 1998).

Heterotis niloticus, family Osteoglossidae is an omnivorous and microphagous species. The fish is predominantly a bottom feeder. The fish species also occur widely in the Nile, Senegal, Gambia and Niger Rivers and also Lake Rudolf and Lake Chad. It has an elongate and robust body with height of 3.5 to 5 times in standard length (Paugy, 1990). The fish also has a relatively short head with length of 3.5 to 5 times in standard length (Paugy 1990; Moreau, 1982). The young feed on zooplankton while adults feed mostly on dipteran insect larvae and copepods which is supplemented with molluscs and higher plants. Acclimated specimen may accept pellets. The sex is difficult to distinguish and breeding has been unsuccessful in captivity because of the size of the fish. The fish also feeds on algae.

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Heterotis niloticus is found in swamps, weedy areas of rivers and shallow well-vegetated lakes. It is also found in flowing channels and floodplains and also in brackish water in estuaries. The fish tolerates very low limits of dissolved oxygen. Since the swimbladder is modified to form suprabranchial organ, the fish can breathe atmospheric oxygen. The fish dermal bones of the cranium are reported to be deeply carved by large sensory pits (Boulenger, 1990; Paugy, 1990). The young specimens of the fish possess external gills (Dankwa *et al*., 1999).

In the present research a comparative study of the gut helminthes of *Gymnarchus niloticus* and *Heterotis niloticus* were undertaken.

MATERIALS AND METHODS

Study area: Lekki lagoon supports a major fishery in Nigeria. The lagoon is located in Lagos State, Nigeria and lies between longitudes 4°00' and 4°15' E and between latitudes 6°25' and 6°37' N. It has a surface area of about 247 km^2 with a maximum depth of 6.4 m, a greater part of the lagoon is shallow and less than 3.0 m deep.

The Lekki lagoon is part of an intricate system of waterways made up of lagoons and creeks that are found along the coast of South-western Nigeria from the Dahomey border to the Niger Delta stretching over a distance of about 200 km. it is fed by the River Oni discharging to the North-eastern and the Rivers Oshun and Saga discharging into North-western parts of the lagoon. Lekki lagoon experiences both dry and rainy seasons typical of the southern part of Nigeria.

The vegetation around the lagoon is characterized by shrub and raphia palms, *Raphia sudanica* and oil palms, *Elaeis guneensis*. Floating grass occur on the periphery of the lagoon while coconut palms *Cocos nucifera* are widespread in the surrounding villages.

The rich fish fauna of the lagoon includes *Heterotis niloticus*, *Gymnarchus niloticus*, *Clarias gariepinus*, *Malapterurus electricus*, *Synodontis clarias*, *Chrysichthys nigrodigitatus*, *Channa obscura*, *Mormyrus rume*, *Calabaricus calamoichthys*, *Tilapia zilli*, *Tilapia galilae*, *Hemichromis fasciatus* and *Sarotherodon melanotheron* (Kusemiju, 1981). Figure 1 shows map of Lekki lagoon, Lagos, Nigeria.

Collections of specimens: The two specimens, *Gymnarchus niloticus* and *Heterotis niloticus* were caught at Lekki lagoon, Lagos, Nigeria. The fishes were kept in a long tank that suits their elongated and robust body. This is done to keep them alive for sometime. The collections of the specimens were done for more than one year.

Determination of fish parameters: The fishes were identified. The standard length of the fishes were measured from the head to the region where the tail develops. The total length is the measurement of the entire length of the fish which is from the head to the end of the tail. The lengths were measured using a metre rule. The weight of each fish was obtained using a chemical balance. The sex of the fishes were determined based on the presence or absence of gonads.

Examination of specimens for parasites: The abdominal cavity of each fish was cut open and the gastrointestinal parts was removed and cut into parts. The gastrointestinal

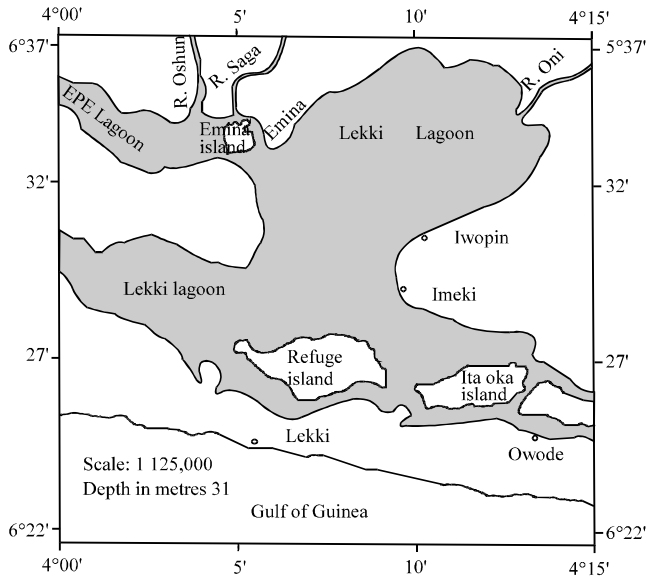

Fig. 1: Map of Lekki lagoon

parts were separated from the other visceral organs and placed in petri dishes containing physiological saline. The intestines were further carefully slit open to aid the emergence of the parasitic helminthes. The emergence of any worm was easily noticed by its wriggling movement in the saline solution. Some of the worms however remained permanently attached with their attachment organs to the gut walls. They were carefully removed and put into the physiological saline.

Processing of recovered parasites: The different kinds of helminth parasites found were immediately fixed in 70% alcohol. They were counted and recorded against each of the specimen. Identification of the helminthes to species level was undertaken at the British Museum (Natural History), Parasitic Worm Division and United Kingdom.

RESULTS

A total of thirty-eight specimens of *Gymnarchus niloticus* 20 and *Heterotis niloticus* 18 were subjected to parasitologic investigations. In *Heterotis niloticus* 11 specimens were infected with gastrointestinal helminth parasites with a prevalence of 61.1%. *Gymnarchus niloticus* had a prevalence of 10% with two specimens infected with gastrointestinal helminth parasites. A total of 13 specimens were infected with an overall prevalence of gastrointestinal helminth infections of 34.2%. All helminthic infections were restricted to the intestine. A total of 14 parasites were recovered from *Heterotis niloticus* and 4 parasites recovered from *Gymnarchus niloticus*.

In *Gymnarchus niloticus*, two nematodes *Raphidascaroides* species (Heterocheillidae) (Khalil, 1961) (Anisakidae) (recovered from the stomach) and *Nilonema gymnarchi* (Khalil, 1960a) (Philometridae) (recovered from the intestine) were obtained. Females' parasites of the latter were recovered.

Heterotis niloticus were infected with three kinds of gastrointestinal helminth parasites. A trematode, *Brevimulticaecum heterotis* (Petter, 1978) were recovered and seen perforating the liver. *Tenuisentis niloticus* (Meyer, 1932) (Tenuisentidae), an acanthocephala and *Sandonella sandoni* (Lynsdale, 1960) (Proteocephalidae) a cestode were obtained from the walls of the intestine. There was no nematode infections observed in *Heterotis niloticus* while there was only nematode infections observed in *Gymnarchus niloticus*. Single and mixed infections with two and three helminth worms was observed in the two specimens. Table 1 shows sex in relation to gastrointestinal helminth infections in *Heterotis niloticus*.

Table 1: Helminth infection in relation to sex of *Heterotis niloticus* in Lekki lagoon

Sex of fish	No. examined	No. infected	Prevalence (%)
Male	10	7	38.9
Female	8	4	50.0
Total	18	11	61.1

The Chi-square = 3.841

Table 2: Helminth infection in relation to size of *Heterotis niloticus*

	66-70 cm	71-75 cm	76-80 cm	81-85 cm	86-90 cm	Total
No. examined	3.0	5	2	6	2	18.0
No. infected	2.0	4	1	3	1	11.0
Infection (%)	66.7	80	50	50	50	61.1

Chi-square = 9.488, Chi-square = 3.841

Table 3: Gastrointestinal helminth infections in relation to sex of *Gymnarchus niloticus*

	Male	Female	Total
No. examined	16	4	20
No. infected	0	2	2
Infection (%)	0	50	10

Chi-square = 3.841

The male specimens of *Heterotis niloticus* had a prevalence of 38.9% which accounts for 7 out of the 10 male specimens examined to be infected with gastrointestinal helminth parasite.

The female specimens had a prevalence of 50% which is higher than the prevalence of infection in that of the male specimens. A total of 8 female specimens were examined for gastrointestinal helminth infections and 4 were infected with helminth parasites.

Table 2 reveals intestinal helminth infections in relation to size in *Heterotis niloticus*. The length groups 66-70 and 71-75 cm had a prevalence of infections of 66.7 and 80%, respectively. The other length groups 76-80, 81-85 and 86-90 cm had a prevalence of infection of 50% each.

The total length of *Heterotis niloticus* examined ranged from 69.00 to 89.50 cm. An overall prevalence of infections was 61.1%.

There was no relationship between size and infection in *Heterotis niloticus*. The results of the gastrointestinal helminth infections in *Heterotis niloticus* reveals that smaller specimens are more liable to infections than the bigger ones.

Table 3 reveals sex in relation to gastrointestinal helminth infection in *Gymnarchus niloticus*. The male specimens had zero percentage of infection while the female specimens had a prevalence of 50%.

The results of the gastrointestinal helminth infections in relation to sex of *Gymnarchus niloticus* was found to be significant. This implies that there is relationship between sex and helminth infections in the fish specimen.

Table 4 also reveals intestinal helminth infection in relation to size of *Gymnarchus niloticus*. The length groups 41-60, 81-100 and 101-120 cm recorded zero

Table 4: Gastrointestinal helminth infections in relation to size in *Gymnarchus niloticus*

	41-60 cm	61-80 cm	81-100 cm	101-120 cm	Total
No. Examined	6	8	3	3	20
No. Infected	0	2	0	0	2
Infection (%)	0	25	0	0	10

Chi-square = 7.815

Table 5: Overall Prevalence of gastrointestinal helminth infections in the two specimens

	Male	Female	Total
No. Examined	26	12	38
No. Infected	7	6	13
Percentage of Infection	26.9	50	34.2

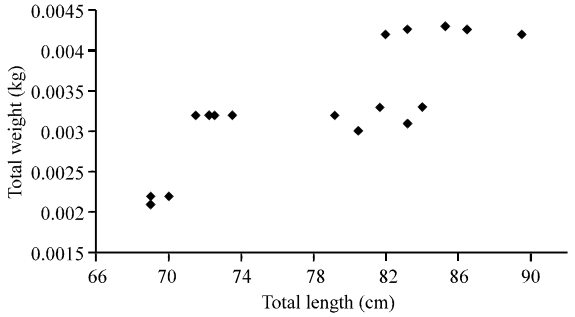

Fig. 2: Scattered diagram total length against total weight of *Heterotis niloticus* (Combined Sexes)

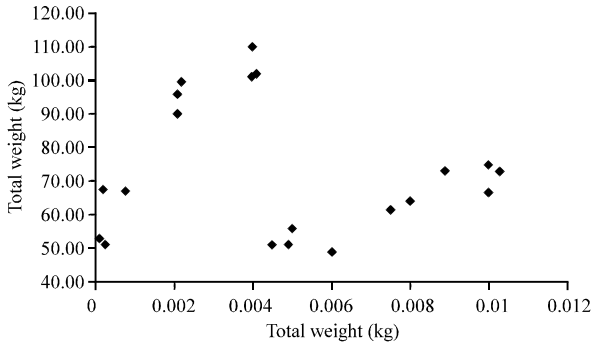

Fig. 3: Diagram of total length against total weight of *Gymaorclus niloticus* (Combined Sexes)

prevalence of infections. The length groups 61-80 cm had a prevalence of gastrointestinal helminth infections of 25%. The two infected female specimens of *Gymnarchus niloticus* belong to this length group.

The results of gastrointestinal helminth infections in relation to size in *Gymnarchus niloticus* reveals that there is no relationship between size and infection in the fish specimen. The total length of *Gymnarchus niloticus* examined ranged from 48.80 to 110 cm. An overall prevalence of 10% was recorded in the fish specimen.

Figure 2 and 3 showed scatter diagrams of total length against weight of combined sexes in *Heterotis niloticus* and *Gymnarchus niloticus* respectively.

The results reveal that a total of 26 male specimens were infected with a prevalence of 26.9%. The female specimens recorded a prevalence of 50% with 6 infected specimens out of the 12 examined.

An overall prevalence of 34.2% was observed in the two specimens (Table 5).

The results also reveal that the female specimens are more liable to infections than the male specimens in the two fish species.

DISCUSSION

Gymnarchus niloticus (Cuvier, 1829) (Gymnarchidae) and *Heterotis niloticus* (Cuvier, 1829) (Osteoglossidae) were randomly selected from Lekki lagoon and subjected to parasitologic examinations. A total of 20 specimens of *Gymnarchus niloticus* and 18 specimens of *Heterotis niloticus* were examined for gastrointestinal helminth parasites. A high prevalence of 61.1% were recorded in *Heterotis niloticus*. *Gymnarchus niloticus* had a prevalence of 10%. An overall prevalence of 34.2% were recorded from the two specimens.

Heterotis niloticus were infected with *Brevimulticaecum heterotis* (Petter, 1978) in the liver, *Tenuisentis niloticus* (Meyer, 1932) (Tenuisentidae) and *Sandonella sandoni* (Lynsdale, 1960) (Proteocephalidae) were recovered from the walls of the intestine.

According to the host parasite checklist on African freshwater fishes of Khalil and Polling (1997), *Tenuisentis niloticus* (*Rhadinorhynchus niloticus*) has been documented in *Heterotis niloticus* (Meyer, 1932; Khalil, 1969; Van Cleave, 1936; Dollfus and Govan, 1956).

Dollfus and Govan (1956) also recovered encysted immature of *Tenuisentis niloticus* in *Hydrocynus brevis* in Mali.

Golvan (1957, 1965) and Khalil (1971) reported that the thorny-headed worms are present in representatives of diverse African fish families. Other parasites such as *Heterotesia voltae, Nephrocephala bagri incapsulatum* (metacercaria) and *Sardonella sandoni* have also been documented in *Heterotis niloticus* (Khalil and Polling, 1997). Khalil (1969) recorded 5-27 *Tenuisentis niloticus* in 93% of *Heterotis niloticus* in the Sudan White and Blue Nile. Pathogenic effects of the thorny-headed worms are simply due to their attachment in the digestive tract of the fish and also to the encapsulation of larval stages in the tissues.

The gastrointestinal helminth infections of the different length categories were also recorded. The length groups 66-70 and 71-75 cm recorded a high prevalence of gastrointestinal helminth infections of 66.7 and 80%, respectively. The other length groups recorded a lower

prevalence of infections of 50% each. This may no doubt be related to the random selection of the specimens and to the probable high level of immunity builded up in the fish specimens. An overall prevalence of 61.1% recorded in *Heterotis niloticus* is due to the omnivorous and microphagous feeding habits of the fish species.

Gymnarchus niloticus harboured two nematodes; Raphidascaroides species (anisakidae) recovered from the stomach and *Nilonema gymnarchi* (Khalil, 1960b) (Philometridae) recovered from the intestine.

The occurrence of Raphidascaroides species in the stomach of *Gymnarchus nioticus* in this present study is in conformity to the work done by Khalil (1961, 1969) in Sudan who also recovered *Raphidascaroides bishaii* from the stomach of *Gymnarchus niloticus*.

Moravec (1974b) reported that larvae in copepods or other invertebrate intermediate hosts, will develop to fourth stage larvae and further into adult males and females when ingested by a suitable definitive host. Petter *et al.* (1989) however demonstrated in the anisakids (Heterocheillidae) Dujardinascaris and Raphidascaroides and in species of *Anguillicola* that larvae ingested by wrong piscine hosts often survive as waiting stages in the gut or other tissues for a variable length of time and continue development into the adult stage if their carrier host is predated by the suitable host.

The host parasite checklist of Khalil and Polling (1997) also recorded *Acanthostomum gymnarchi, Opisthorchis, Piscicola, Phyllodistomum linguale* and *Nesolecithus africanus* in *Gymnarchus niloticus*.

In the present study, *Nilonema gymnarchi* was isolated from the intestine of *Gymnarchus niloticus*. Khalil 1969 however recovered *Nilonema gymnarchi* in the lung-like air bladder sacs of the fish species and *Thwaitia bagri*), under the skin lateral to the mouth, in *Bagrus bayad*. The helminth parasites (*Nilonema gymarchi* and *Thwaitia bagri* are the two representatives genera of the family Philometridae in Africa. Gravid Ngymnarchi presumably escape from the lungs into the water to discharge larvae (Khalil, 1969). Khalil (1969, 1971) and Moravec (1974a) also emphasized very strict host specifically of *Nilonema gymnarchi* and *Thwaitia bagri*.

Yakubu *et al.* (2002) in a comparative study of gut helminthes of *Tilapia zilli* and *Clarias gariepinus* from River Uke Plateau State, Nigeria also found a prevalence of 61% in *T. zilli* and 55% in *Clarias gariepinus* respectively.

In *Gymnarchus niloticus*, the length groups 41-60 cm, 81-100 and 101-120 cm recorded zero (0) prevalence of gastrointestinal helminth infections. This may also no doubt be attributable to the random selection of the specimens. The length groups 61-80 cm had a prevalence of gastrointestinal helminth infections of 25%.

This comparative study on the parasitic helminth fauna of *Gymnarchus niloticus* and *Heterotis niloticus*, revealed that the female specimens of *Heterotis niloticus* are more susceptible to infections than the male specimens.

The comparative study also reveals the female specimens of *Gymnarchus niloticus* to be more susceptible to gastrointestinal helminth infections than the male specimens. The nature of the Lekki lagoon may however influence the low prevalence of intestinal helminth infections in the male specimens of the two fishes.

CONCLUSIONS

In conclusion, the incidences of helminth infections of fishes of Lekki lagoon should not be taken with levity. The helminth parasites recovered from the intestines of *Gymnarchus niloticus* and *Heterotis niloticus* will no doubt have depended on the presence of absorbable food materials in the lumen of the gut of the fishes. Fish have carbohydrate, lipid, vitamin and inorganic ion requirements and are adapted to obtain these requirements from dietary intake. The absorption of the absorbable food materials from the gut of the fishes reduced fecundity and market value of the fishes. Further studies are still required to establish the changes in the environment, whether natural or man-made and to proffer probable biological control of the parasites in Lekki lagoon, Lagos, Nigeria.

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