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Research Paper

Endoparasites of *oreochromis niloticus* and *clarias gariepinus* found in Utako flowing gutter

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A prevalence study on the endoparasites of *Clarias gariepinus* and *Oreochromis niloticus* in Utako flowing gutter was conducted using standard parasitological methods. A total of 60 *Clarias gariepinus* and 60 *Oreochromis niloticus* were examined for Endoparasites. Of the total number of *Clarias gariepinus* examined, 21(35%) were infected with endoparasites which includes:Nematodes (*Polyonchobothrium latum)* with percentage prevalence of 4(6.67%) and Cestodes (*Diphyllobothrium latum* and *Procamallanus spp),* with a percentage prevalence of 8(13.33%) and (16.67%) respectively. While of the total number of *Oreochromis niloticus* examined, 14(23.33%) were infected with Endoparasites which consists of only Cestodes (*Diphyllobothrium latum)* with percentage prevalence of 14(23.33%). There was however no significant difference between the prevalence of infection and sex, length and weight of fishes examined.

Key Words: Utako, *Clarias gariepinus* and *Oreochromis niloticus,* Nematodes

INTRODUCTION

A fish is a member of a paraphyletic group Parasites of organisms that consist of all gill-bearing aquatic craniate animals that lack limbs with digits. Most fishes are ectothermic (cold blooded), allowing their body temperatures to vary as ambient temperature change (Goldman, 1997). Fishes are abundant in most bodies of water. They can be found in nearly all aquatic environments. At 32,000 species, fishes exhibit greater species diversity than any other group of vertebrates (Fish Base, 2011). Fishes are important resources for humans worldwide, especially as food. Commercial and subsistence fishers hunt fish in world fisheries or farm them in ponds or in cages in the ocean. They are also caught by recreational fishers, kept as pets, raised by fish keepers, and exhibited in public aquaria. Fish have had role in culture through the ages, serving as deities, religious symbols, and as the subject of art, books and movies.

Like other animals, fishes suffer from parasites and diseases. Parasites of fishes constitute one of the major problems confronting the modern fish culturists, and pathological conditions arising from parasitic infections assume a high magnitude especially under crowded conditions (Van Due Brock, 1979). All fishes are potential hosts to many different species of parasites that cause significant mortalities among captive and wild fish stocks. Accurate identification of parasites is therefore important so that a build-up of parasites numbers can be prevented. Fresh water fish can serve as definitive, intermediate or parenthetic (transport) hosts in the life

cycle of many species of protozoan, metazoan and crustacean parasites. The parasites usually affect the marketability of commercially produced fish, thus raising public health concerns especially in areas where raw or smoked fish is eaten (Hoffman and Bauer, 1971; Paperna, 1996). In fish farming or aquaculture, some parasites may be highly pathogenic and contribute to high fish mortalities and economic losses, while in natural systems; they may threaten the abundance and diversity of indigenous fish species. The importance of fish pathology has been realized and efforts are being made to intensify work in this field in various part of the world especially in Africa, parasites occurring in African fresh water fishes require urgent attention; particularly those that infect economically important fishes which in many cases devalue their aesthetic quality and palatability (Okorie, 1972). Parasites have been a great concern since they often produce disease conditions in fish thereby increasing their susceptibility to other diseases. In addition, due to the importance of fish as one of the major sources of obtaining cheap animal protein, studies on this aspect of biology, morphology and diseases of fishes is very important (Bichi and Ibrahim, 2009). This study was therefore designed to investigate the endoparasites prevalent in these fishes with a view to providing relevant information that could be useful in the attempt to combat the rate of economic losses experienced as a result of parasitic infestations.

LITERATURE REVIEW

Parasitism is a relationship between two organisms in which one organism benefits, the parasite, while the other organism is harmed, the host animal (Roberts and Janovy, 2005). Harm to the host can be caused by tissue damage during the parasite's various life cycle stages, which in themselves are detrimental to the host, but can also make the host more susceptible to other diseases. Parasites can also harbor bacteria or viruses and transmit them to the host organism (Lasee, 1995). Parasites are common in most ecological system and all free living organisms can be potential hosts to parasites; parasitism in itself is one of the most common lifestyles on earth (Madanire-Moyo and Barson, 2010).One reason of concern is parasites not only impact other animals but humans also. There are some parasites that are zoonotic or can be passed from animals to humans. This can occur if animals and humans are living closely in the same environment, from human consumption of animal products, or other means. Parasites show some level of preference for the host they parasitize (Rosas-Valdez and Perez-Ponce de Leon, 2011). This concept is further supported by a study done by Poulin, (1997) where he examined what composition of parasites made up species rich and species poor parasite assemblages and the percentages of generalist parasites and specialist parasites that make up these assemblages. Generalist parasites do not show a preference for a certain host species and can affect many different host organisms, whereas specialist parasites will only infect a few select organisms (Poulin, 1997). Along with host specificity some parasites exhibit, body size is one of the more important factors influencing the number of different parasite genera present as well as the number of the parasites that are found (Rosas-Valdez and Perez-Ponce de Leon, 2011). Physiological traits such as body size (weight and length) of fish are used for data analysis because those measurements are more readily available than age and gender data, and are highly correlated with one another (Bell and Burt, 1991). This correlation of body weight to length is a positive one; as the organism gets longer its weight increases. Bell and Burt, (1991) showed that diversity of helminthic parasites, which include the digenetic trematodes (flukes), cestodes (tapeworms), nematodes (roundworms), and acanthocephalans (spiny headed worms), correlate with host fish body size. Parasites are divided into two distinct groups: ectoparasites and endoparasites. Within these two groups they are categorized by parasite type according to the physical characteristics of the parasite, life cycle, and host infection site. Some examples of these parasite types include fungi and algae, protozoans, trematodes, nematodes, cestodes, acanthocephalans, parasitic crustaceans, and leeches. Parasites can range in body size from small, microscopic organisms like bacteria and single celled organisms to large organisms such as tapeworms and copepods. Ectoparasites are parasites that are located on the external surfaces of a host organism (Roberts and Janovy, 2005). In fish this would include the skin or scales depending on the fish species, fins, and other structures considered external such as gills, gill rakers, and the oral cavity. Clinical signs and symptoms vary with the type and severity of parasite infestation. Most parasites are not harmful to humans but can make fish unappealing to anglers. Endoparasites are parasites that are located within the flesh and cavities of the host organism (Roberts and Janovy, 2005). These parasites can be found within the muscles, organs, and membrane linings of the cavities of the host organism. The increased potential for infecting humans with a fish parasite is more common for endoparasites since tapeworms and roundworms can be passed to humans who eat undercooked or raw meat. Unlike ectoparasites, endoparasites can and do infect humans if fish or meat is not prepared correctly (Hoffman, 1998). Examples of both of these groups of parasites are species of trematodes, cestodes, nematodes, and protozoans. According to Plumb (1999), there are two peak seasons for diseases and parasites of warm freshwater fish, in the spring from March to June and then again in the fall from September to October.

Parasitic diseases of fish are of particular importance in

the tropics. Parasites usually exist in equilibrium with their host as a survival strategy. However, in instances where hosts are overcrowded such as in aquaria or in fish farms, parasitic diseases can spread very rapidly causing high mortality. Although this is usually not the case in the wild natural aquatic environments. It occurs when the environment is disturbed by human activity and interference especially with populations which alter the natural distribution of their parasite communities (Imam and Dewu, 2010). Ayanda, (2009) reported *Amonotaenia* and *Polyonchobothrium* species of Cestodes; *Procamallanus* and *Paracamallanus* species of nematodes and *Neoechinorhynchus* species of acanthocephalans in wild and cultured *Clarias gariepinus* in Ilorin while Hussein *et al.* (2012) reported *Capillaria*, *Contracaecum* and Cestodes in *Clarias gariepinus* caught from Lake Hawassa, Ethiopia. Cross, (1933) showed that the parasite infection tends to decrease the growth rate resulting in the stunting of fish. Sinderman, (1953) studied the migration of herrings on the basis of their parasites and showed that the kinds and number of parasites may vary seasonally, geographically and with age of the host. He observed that differential mortality may also vary seasonally or with age of the host. As yet no epidemics of endoparasites have been reported in Nigeria, is likely that as fish culture becomes more intensive and widespread, fish parasites are likely to become a serious economic and health issues (Imam and Dewu, 2010). As a result of this, there is need for the study of fish parasites with the aim of controlling them.

The African sharp tooth catfish (*Clarias gariepinus)*

Taxonomy

Species: *Clarias gariepinus*
Family: Clariidae
Order: Silurformes
Class: Actinopterygii

African sharp tooth catfish, *clarias gariepinus* is a typical air breathing catfish with a scale less, bony elongated body with long dorsal and anal fins, and a helmet-like head. Color varies dorsally from dark to light brown and is often mottled with shades of olive and grey while the underside is a pale cream to white (Skelton, 2001). It can grow very large with maximum reported length of 170 cm (IGFA, 2001). And weight of 60 kg (Robins *et al.,* 1991). The native range of *clarias gariepinus* covers most of the African continent, with the exception of Maghreb, upper and lower guinea, and cape provinces of south Africa (Picker and Griffiths, 2011). According to Skelton (2001), it is probably the most widely distributed fish in Africa. *Clarias gariepinus* is considered to be omnivorous displaying both scavenging and predatory behavior (Bruton, 1979a). Larger individuals show a specific dietary shift towards fish as they grow bigger (Willoughby and Tweddle, 1978).

Clarias gariepinus is considered to have a rapid growth rate (in length and weight), the rate of which strongly depends on ambient conditions and habitat (Bruton and Allanson, 1980; Hecht and Appelbaum, 1987; Britz and Pienaar,1992) shoals of the fish migrate upstream or to the shores of still water bodies prior to breeding (de moor and Bruton, 1988). *Clarias gariepinus* can endure extremely harsh conditions (Skelton, 2001). It is able to tolerate very low oxygen conditions and even survive for considerable periods out of water, via the use of a specialized suprabranchial organ (Safriel and Bruton, 1984, Hecht *et al*., 1988).

Nile Tilapia (*Oreochromis niloticus*

Taxonomy

Species: *Oreochromis niloticus*
Family: Cichlidae
Order: Perciformes
Class: Actinopterygii

The Nile Tilapia, *Oreochromis niloticus* is a deep bodied fish with cycloid scales. Silver in colour with olive/grey/black body bars, the Nile tilapia often flushes red during the breeding season (Picker and Griffiths, 2011). It grows to a maximum length of 62 cm weighing 3.65 kg (at an estimated 9 years of age) (FAO, 2012). The average size (total length) of *Oreochromis niloticus* is 20 cm (Bwanika *et al*., 2004). Nile tilapia are known to feed on phytoplankton, periphyton, aquatic plants, invertebrates, benthic fauna, detritus, bacterial films, (FAO, 2012) and even other fish and fish eggs. Depending on the food source, they will feed either via suspension filtering or surface grazing (GISD, 2012), Nile tilapia can live longer than 10 years. Optimal growth is achieved at 28-36^{o}c and declines with increasing temperature (Teichert-Coddington *et al*., 1997; FAO, 2012). The ability to vary their diet may result in variation in growth (Bwanika *et al*., 2007). The Nile tilapia will reportedly thrive in any aquatic habitat except for torrential river systems and the major factors limiting its distribution are salinity and temperature (Shipton *et al.,* 2008). The concentration of dissolved oxygen is not a major factor for Nile tilapia as they tolerate levels as low as 3-4 mg/l (Boyd, 2004).

Endoparasites of fish

Protozoans

Since the time when parasitic Protozoans were discovered,

they have become one of the most studied groups of parasites. This may be due to the fact that they are still killing, mutilating, and debilitating more people throughout the world than any other group of disease causing organism (Roberts and Janovy, 2005). Some of the more common protozoans that infect fish are a *Trichodina* species and *Ichthyophthirius multifillis*, also known as Ich (Plumb, 1999). *Trichodina* is not a very serious cause of mortality in freshwater fish, but Ich has a large mortality rate not only in the wild but also in hatchery reared fish and even in home aquariums (Plumb, 1999; Untergasser, 1989).

Helminths

Helminths, worm and fluke parasites, are normally found in the alimentary tract, body cavities, internal organs, or even become encysted in the muscle (Bell and Burt, 1991). Trematodes (flukes), monogeneans (flatworms), cestodes (tapeworms), nematodes (roundworms), and acanthocephalans (spiny headed worms) are all part of this category. With the exception of the roundworms, all of these parasites have a head region with a specialized attachment mechanism followed by a body region. Some of these parasites are free living in the environment when they are picked up by an unsuspecting organism which then becomes its host. Others will exhibit an indirect life cycle which means that the parasite must transfer to a different host or hosts (usually involving a crustacean or insect vector) between different stages of its life in order to survive (Lasee, 1995).

Monogeneans

A monogenean, is a highly pathogenic and obligatory parasite of the skin and gills, a monogenean, *Cleidodiscus mirabilis*, also referred to as *Ligictaluridu floridanus*, and is one of the most common endoparasites found in freshwater systems (Hoffman, 1998). Monogenean infected fish may show behavioral signs of irritation, including flashing and rubbing the sides of their bodies against objects in the aquarium. Fish become pale as colors fade. They breathe rapidly and distend their gill covers, exposing swollen, pale gills. Localized skin lesions appear with scattered hemorrhages and ulcerations. Ulceration of the cornea may become evident if the eyes are involved. Mortality may be high or chronic (Klinger and Francis-Floyd, 2002).

Cestodes (Tape worms)

Fish tapeworms, also called broad tapeworms, may range in size from an inch to more than a foot in length. They are most often seen crawling from the anus or when the gut is accidentally cut while cleaning the catch. The scolex (head) is used for attachment. The tapeworm has no mouth and so it absorbs all its nutrients directly through its body wall. The tapeworms' body grows by producing small segments (called proglottids) behind the scolex, hence the name "tapeworm". The tapeworm's body is a series of reproductive units. The proglottids closest to the scolex are sexually immature. Tapeworms can self-fertilize and as the proglottid develops the eggs inside are fertilized. By the time the proglottid reaches the end of the worm it is full of ripe eggs. The eggs leave the fish or shark with its feces. Depending upon the type of tapeworm, the egg may be eaten by a micro crustacean, such as a copepod, or a small larva may hatch from the egg, swim freely and then be eaten by a small crustacean. The larval tapeworm undergoes development in the crustacean. When this infected host is in turn eaten by a fish a second type of larval stage develops. This larva will remain embedded in the flesh or viscera until it is eaten by the proper species of fish or shark while adults are usually found in intestinal tracts (Cake *et al*., 2001). Here it will mature and begin the life cycle once again. Both larval and adult cestodes are common in fish (Cake *et al.,* 2001).

Trematodes (flukes)

Trematoda is a class within the phylum Platyhelminthes. It includes two groups of parasitic flatworms, known as “flukes”. The trematodes or flukes include 1800 (Littlewood and Bray, 2000) to 24000 (Poulin and Serge, 2005) species divided into two subclasses. Their most distinctive external feature is the presence of two suckers, one close to the mouth and the other on the underside of the animal (Barnes, 1982). The body surface is the surface of gas exchange; there are no respiratory organs (Barnes, 1982). As in other flatworms, there is no anus and waste material must be egested through the mouth (Barnes, 1982).

Nematodes (sRoundworms)

Nematodes are common in wild fish that are exposed to the intermediate host. Fish may be definitive host for adult nematodes, or they may act as transport or intermediate hosts for larval nematode forms (anisakids, eustrongylids, and others) that infect higher vertebrate predators, including humans. Encysted or free nematodes can be found in almost any tissue or body cavity of fish. Aquarium and cultured pond fish may be heavily infected if crustacean intermediate hosts are present (Ibiwoye *et al*., 2004). Nematodes are very distinctive in shape, with a solid cuticle. Because of their resistant cuticle, these worms last longer than flatworms in post-mortem conditions. Most adult forms are large

enough to be visible to the naked eye. Khalil, (1971) reports 40 species of adult nematodes, respective of families from fish in Africa majority occurs in the alimentary system and only a few enter tissues or inner cavities.

Acanthocephalans (spiny headed worms)

Acanthocephalans (thorny headed worms) are common in wild fish as both larval tissue stages and adult intestinal parasites. They are highly specialized for life in the digestive tract of the host. They have spines on the eversible proboscis at the anterior end of the body by which the worm anchors to the tissues of the digestive tract. Arthropods are the first intermediate host. Adult acanthocephalans are easily recognized by their protrusible proboscis, armed with many recurrent hooks (Oniye *et al.,* 2004). They can cause damage by puncturing the intestinal tract or blocking the passage of food through the gastro-intestinal tract. It is present in representatives of diverse African fish families (Khalil, 1971).

Crustaceans

Parasitic crustaceans have a wide range of physical characteristics which makes them distinguishable from each other. These parasites are macroscopic, do not exhibit host specificity and are found on a wide range of freshwater fish species. Crustaceans, such as copepods and parasitic crustaceans (which are also copepods, but have become specialized) are found in most water systems. They provide food for fish, are parasitic to some fish, and may serve as an intermediate host for other parasites (Piasecki *et al*., 2004). In small numbers, they do not cause serious injury to fish, but can cause harm to the host organism when infestations are high (Plumb, 1999). The most studied copepod is from the Genus *Lernaea* (anchor worms). These kinds of infections are more evident in fish hatcheries and farms, especially when channel catfish are polycultured with bighead carp, *Hypophthalmichthys nobilis* (Goodwin, 1999). *Achtheres* species will attach to the inner gill surfaces of freshwater fish and can cause severe damage to gills in large infestations (Hoffman, 1998). They cause damage by decreasing the filtration of oxygen across gill filaments of fish (Lasee, 1995). Adult *Ergasilus* parasites are usually found on gill filaments but can attach to gill rakers or some other external location as well (Hoffmann, 1998). They will rarely attach to any other surface than the gill filaments, but there is evidence to suggest they can also be found in the nasal fossae of some fish and lampreys (Muzzall and Hudson, 2004). They like to feed on surrounding tissue and mucous secreted by fish and can cause enough damage to allow a secondary infection of bacteria or virus (Lasee, 1995).

Life cycle of endoparasites

Life cycles vary among the different types of parasites. Some have simple life cycles involving only one host while others have more complicated life cycles involving two or more hosts. The mode of transmission from one host to another also varies by type of parasite. Some need to be ingested while others are transferred through an arthropod vector. If the life cycles of some of these parasites are interrupted, it may decrease survival for those parasites (Roberts and Janovy, 2005). Some parasites have evolved methods of coping with this potential problem by developing a protective capsule.

Diversity of endoparasites

Wild populations of animals will have greater parasite species diversity due to larger home ranges compared to domesticated ones. Animals kept in pens and pastures for years increase the buildup of potentially harmful parasites which increases the chance for re-infection, and parasite loads increase dramatically to sometimes lethal levels (Roberts and Janovy, 2005). This kind of reasoning can be applied not only to land animals, but to aquatic environments and fish as well since the use of aquaculture has increased in the past few decades. Fish that preferred to occupy areas of stronger current of a river or stream were reported to have fewer parasites than those fish that preferred calm pools and backwaters (Cloutman, 1974).Parasites are found in both captive and wild fish populations, but in wild populations they maintain a kind of equilibrium until something happens to upset that balance. Wild fish are also reported to have larger parasite species diversity than fish that are raised in hatcheries (Hoffman, 1998).

MATERIALS AND METHODS

Study area

Clarias gariepinus and Oreochromis niloticus were obtained from the Utako flowing gutter, Abuja. The Utako flowing gutter is located in the municipal area council of Abuja, the federal capital territory of Nigeria with latitude 9.07558 north and longitude 7.43879 east of Greenwich (Figure 1). The gutter is a major sewage collection canal which passed through the Eden's parks and gardens opposite Chida hotel, Abuja (the very sport from where the fishes were obtained). The area experiences three weather conditions annually. This includes a warm, humid rainy season and an extremely hot dry season. In between these seasons, there is a short period of harmattan accompanied by the North East Trade Wind, with the main feature of dust haze, intensified coldness and dryness. The rainy season begins from April and ends in October, when day time temperatures reach 28-

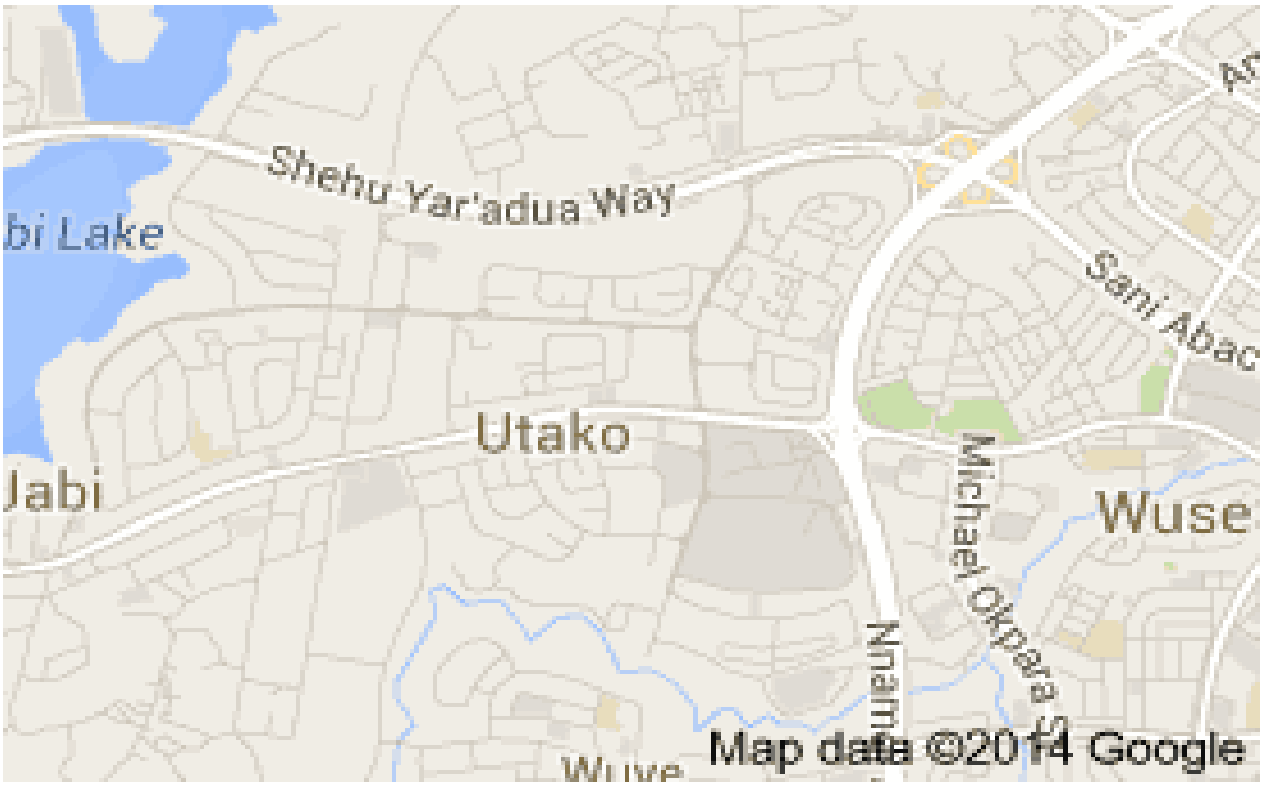

Figure 1. Google Map showing the study areas.

30 degrees and night time lows range around 22-23 degrees. In the dry season, daytime temperatures can soar reach 40 degrees and night time temperatures can drop to 12 degrees, resulting in chilly evenings. Even the chilliest nights can be followed by daytime temperatures well above 30 degrees.

The high altitudes and rolling terrain of the Federal Capital Territory, Nigeria act as moderating influence on the weather of the territory. Rainfall in the FCT reflects the territory's location on the windward side of the Jos Plateau and the zone of rising air masses. The annual total rainfall is in the region of 1100 mm to 1600 mm.

Collection of specimens

One hundred and twenty live fishes of two species (*Clarias gariepinus* and *Oreochromis niloticus*) of different sizes were collected using cast net method, transferred into a plastic container with water and transported to the research laboratory in Biological science Department, University of Abuja. Samples were collected between 7:00am and 10:00am hours every day as recommended by Adebisi, (1981). Transportation was done in the morning to avoid undue stress due to temperature rise. Dead fishes were removed from the collections and examined immediately while the live ones were preserved in a plastic aquaria containing tap water, and examined subsequently as the investigation progresses. The Tilapia species were usually dissected immediately after capture because they only survive for a few hours in the plastic container after capture from their natural habitat due to their fragile nature. The fishes were sorted by size and sexes; they were identified using the atlas by Olaosebikan and raji, (2004).

Sample analysis

Sex determination

The external and internal reproductive structures were used to determine the sex of fish. In tilapia, Males were characterized by the presence of genital papillae located on the ventral side, just before the anal fin through which both milt and urine pass; this structure is absent in females, the female possess an oviduct and a urinary pore.

This was later confirmed by the presence and absence of testes and ovaries which was observed during dissection. In *Clarias gariepinus* the sexes were determined by both internal and external examination, with external papillae in female sex organs (Bichi and Yelwal, 2010).

Table 1. Incidence of Endoparasites in relation to sex of *Clarias gariepinus* examined.

Sex	No Examined	No Infected	Prevalence (%)
Male	27	9	33.33
Female	33	13	39.39
Combined	60	22	36.67

Table 2. Incidence of Endoparasites in relation to sex of *Oreochromis niloticus* examined.

Sex	No examined	No infected	Prevalence (%)
Male	37	6	16.22
Female	23	8	34.78
Combined	60	14	23.33

Measurements of length and weight

The total length was taken from the tip of the snout to the extreme end of the caudal fin using a meter rule to the nearest centimeter as shown in the Appendix and the standard length from the tip of the snout to the end of the caudal peduncle. Fishes were weight to the nearest gram using a manual weighing balance and recorded.

Parasitological analysis

The body of the fish was examined and placed on the dissecting board. A cut was made on the ventral side of the fish from the anal opening to the lower jaw using a surgical blade to expose the body cavity and most of the internal organs. The oesophagus, stomach, intestine and rectum were separated and kept in different petri-dishes, containing saline solution. The contents of the stomach and intestine were washed in different petri-dishes for sedimentation and floatation and then examined for parasites under the microscope using the x40 objective. Parasites found were transferred into another petri-dish containing normal saline and examined. The parasites specie and location in the host species were recorded.

Identification of parasites

Identification of parasites was done using standard text by Paperna, (1996).

Data analysis

Statistical package for social sciences (SPSS) version 20 was used to test the independency and dependency of infestation rate to sex, length and weight. Analysis of data was done using chi-square at 0.05 level of significance and also the Microsoft excel was used in plotting a chart showing the relationship between the experimental variables.

RESULTS

The results of the survey of endoparasites in Nile Tilapia (*Oreochromis* niloticus) and African sharp tooth catfish (*Clarias* gariepinus) found in Utako flowing gutter are shown in the tables ahead. This study has shown that a total sum of 120 fish specimens (60 *Clarias gariepinus* and 60 *Oreochromis niloticus*) was examined for endoparasites. Of the 60 *Clarias gariepinus* that were examined, 21(35%) were infected with parasites while 14(23.33%) out of the 60 *Oreochromis niloticus* were infected with parasites. A study of the results revealed that only two classes of parasitic helminthes were found. These classes are; the Cestodes and Nematodes. Table 1 showed that of the 60 *Clarias gariepinus* that were examined, 27(45%) were males and out of these 27 males, 9(33.33%) were infected, while 33(55%) of these fishes were females and out of these 33 females, 13(39.39%) were also infected. Table 2 showed that of the 60 *Oreochromis niloticus* that were examined, 37(61.67%) were males and out of these 37 males, 6(16.22%) were infected while 23(38.33%) of these fishes were females and out of these females, 8(34.78) were also infected. Tables 3 and 4 reveal the prevalence of endoparasites in relation to length of *Clarias gariepinus* and *Oreochromis niloticus* respectively. While (Table 5 and 6) reveals the prevalence of endoparasites in relation to weight of *Clarias gariepinus* and *Oreochromis niloticus* respectively. Table 7 reveals that 3 parasitic helminthes were parasitizing the *Clarias gariepinus.* These are nematode; *Polyochobothrium clarias* which affected a

Table 3. Prevalence of Endoparasites in relation to length of Clarias gariepinus examined.

Length (cm)	Class interval	No of fishes examined	No of fishes infected	Prevalence (%)
14 – 18	16	5	2	40
19 – 23	21	15	7	46.67
24 – 28	26	11	4	36.36
29 – 33	31	24	8	33.33
34 – 38	36	5	1	20

Table 4. Prevalence of Endoparasites in relation to length of Oreochromis niloticus examined.

Length (cm)	Class interval	No of fishes examined	No of fishes infected	Prevalence (%)
9 – 11	10	3	2	66.67
12 – 14	13	28	7	25
15 – 17	16	23	4	17.39
18 – 20	19	5	1	20
21 – 23	22	1	-	-

Table 5. Prevalence of Endoparasites in relation to weight of Clarias gariepinus examined.

Weight (g)	Class interval	No of fishes examined	No of fishes infected	Prevalence (%)
21 – 34	86.5	22	9	40.90
35 – 48	118.5	2	1	50
49 – 62	150.5	2	-	-
63 – 76	182.5	13	7	53.85
77 – 90	214.5	21	5	23.81

total of 4(6.67%) fishes, and cestodes; *Diphyllobothrium latum* which affected a total of 8(13.33%) fishes and *Procamallanus spp* which affected a total of 10(16.67) fishes. Table 8 reveals that only 1 parasitic helminthic was parasitizing the Nile tilapia (*Oreochromis niloticus*) which was the cestode; *Diphyllobothrium latum* which affected a total of 14(23.33%) fishes.

DISCUSSION

The results of this work revealed that Nile Tilapia (*Oreochromis niloticus*) was infected with only 1 class of parasite, which is the cestode with a percentage prevalence of (23.33%). The African sharp tooth catfish (*Clarias gariepinus*) on the other hand was infected with 2 classes of parasites, cestodes and nematode. Cestodes had the highest total of infestation followed by the nematode. This finding supports earlier work of Akhamerov, (1980) who discovered higher number of cestodes in *T.lazer* in the basin of the river Amur (Russia) while Mgbemena, (1983) reported a higher number of nematodes infection on *C. tilapiae.* Though some earlier workers found that Acanthocephalan was the commonest parasites of fresh water fishes in the tropics, none was discovered in this research. Both Shotter, (1974) and Mgbemena,(1983) reported high prevalence of Acanthocephalan in fish during the dry season. The absence of acanthocephalan in this research could probably be due to the fact that it was carried out during the rainy season.

The overall 35% infection rate for *Clarias gariepinus* and 23.33% infection rate for *Oreochromis niloticus* described in this study are high particularly when compared to the 16.6% reported from Asa River and its impoundment at Ilorin (Obano *et al*., 2010a). The intestinal parasite recovered (*Diphyllobothrium*) was previously reported in Northern Nigeria by Bichi and Yelwa (2010) and (Adikwu and Ibrahim, 2004). It is worthy to note that infection rates vary greatly from one area to another, and this may not be unconnected with the fact that a number of factors like availability of intermediate host, susceptibility of definite host amongst others determine to a large extent the rate of infection (Obano *et al*., 2010a). Additionally *Diphyllobothrium latum*, the fish tapeworm is the biggest tapeworm in humans. It causes a parasitic infection called diphyllobothriasis which is acquired by eating raw fish infected with the parasite. *D. latum* is usually asymptomatic. In some cases it causes severe vitamin

Table 6. Prevalence of Endoparasites in relation to weight of Oreochromis niloticus examined.

Weight (g)	Class Interval	No. of fishes examined	No. of fishes infected	prevalence (%)
21 – 34	27.5	5	3	60
35 – 48	41.5	16	5	31.25
49 – 62	55.5	18	3	16.67
63 – 76	69.5	6	1	16.67
77 – 90	83.5	15	2	13.33

Table 7. Frequency of distribution of Endoparasites of Clarias gariepinus examined.

Parasites	Taxonomical Group	no of fishes Examined	no of fishes Infected (%)	location
Polyonchobothrium clarias	Nematoda	60	4(6.67)	Intestine
Diphyllobothrium latum	Cestoda	60	8(13.33)	Intestine
Procamallanus spp	Cestoda	60	10(16.67)	Intestine
Acanthocephalan spp	-	60	-	

Table 8. Frequency of distribution of Endoparasites Oreochromis niloticus examined.

Parasites	Taxonomical Group	no of fishes Examined	no of fishes Infected (%)	location
Diphyllobothrium latum	Cestoda	60	14(23.33)	stomach and intestine
Acanthocephalan spp	-	60	-	

B12 deficiency and even neurological symptoms. In relation to size (weight and length) for both species in this study, it was observed that the percentage infection increased with decreasing size (Tables 3,4,5 and 6) and it was also observed in this study that the prevalence of endoparasites are not dependent on the gender (p=0.317), length (p=0.59) and weight (p=0.59). This suggests that food / diet is probably responsible for the parasites burden as reported by Emere, (2000). The high infection observed in bigger fish in this study could be attributed to the fact that bigger fish provides larger surface area for the infection to multiply in numbers than in smaller ones, and also as a result of changes in diet from phytoplankton and zooplankton to insect larvae, snails, worms and crustaceans for food as smaller fishes grow into bigger ones (Obano *et al*., 2010b). Also, Roberts, (1978) showed that the number of parasites increases with the fish length and suggested that the increase in parasitization could be due to parasitic larva accumulation from year to year as the fish grows older. Variations in parasitic infection among the sexes of fish studied revealed a higher infection rate in females than in males. This was also further supported by the result from the chi-square analysis which the results were subjected to. This finding however supports the earlier work of Emere, (2000), who reported differences in the incidence of infestation between male and female fish, which may be due to differential feeding either by quantity or quality of feed, or as a result of different degrees of resistance to infection. Emere and Egbe, (2006) also reported that due to the physiological state of the female, most gravid females could have reduced resistance to infection by parasites. The presence of helminth parasitic infection in this study is enough to cause some pathological effect in fishes by reducing their growth, development and even the market value if the sources of capture were not well monitored. The problem of fish infestation by parasites in the study area could best be handled through proper management technique of elimination of all the conditions that could favor parasite infestation such as occasional surveillance and periodic checks of the water body for parasites (Carpenter, 2001). It is always mentioned that parasites could be controlled by elimination of overcrowding, any way one could attribute this to the conditions the fish is exposed to. In the case of my study areas overcrowding is not a serious problem as probably pollution. In the gutter, farmers are allowed to dispose of their waste and faecal matters therein which is subsequently washed into the river thus providing suitable conditions for parasites to thrive. Also in the Utako flowing gutter which is also a sewage collection canal, different forms of dirt, sewages and other pollutants are constantly being washed into the gutter. Both Watson and Dick, (1980) and Modhavi, (1980) stated that fish come in contact with worms by feeding on the crustacean intermediate hosts harboring the larval forms as such they become infected. Since it has been observed that parasite infection of fish affects its

palatability and aesthetic value as well as a resultant death of a good number of fishes especially in the wild, it is necessary to develop a method of control. Though one expects more parasitic infections in the wild than in the cultured pond, the species diversity is more or less the same in both locations because the use of artificial feeds in the cultured ponds creates a condition for the proliferation of parasites and also overcrowding. These could be prevented by elimination of infected fishes from the healthy ones, removal and destruction of dead fish and disinfecting the premises, materials and ponds. Awareness should be given to home makers and cooks to restrain from tasting the raw fish to test their skills in flavoring and also scientists should educate the public especially in the interior communities on fish parasites and how to control them. Inspite of all these, it was observed that the rate of infection in this study was below a lethal level as no resultant disease was observed.

Conclusion

In conclusion, fish parasitism constitutes a major threat to fish productivity, and the increased demand on fish as a ready and safe source of protein to humans should trigger further studies on fish fauna and their parasites.

Recommendations

The most viable interventions include: prevention of water contamination both by raising public awareness of the dangers of defecating in recreational bodies of water and by implementation of basic sanitation measures; screening and successful treatment of people infected with the parasite; and prevention of infection of humans via consumption of raw, infected fish. Also education about proper preparation of fish is a proper preventive measure. Fish that is thoroughly cooked, brined, or frozen at -10°C for 24–48 h can be consumed without risk of infection. Avoiding raw freshwater fish and cooking fish enough (to more than 140 degrees F for 5 min) will prevent infection with the fish tapeworm. Freezing fish to -4 degrees F for 24 hours also kills fish tapeworm eggs too. If you eat sashimi or sushi, freeze it first at -10°C (or below) for two days to kill the tapeworm larvae. If the fish tapeworm larvae cannot get in touch with the intermediate hosts, they cannot infect humans.

REFERENCES

Adebisi AA (1981). The physico-chemical hydrology of a tropical seasonal River – ogun River. *Hydrobiology* 7:157-167.

Adikwu IA, Ibrahim BA (2004). Studies on the endoparasites in the gastrointestinal tract of *Clarias gariepinus* (Tuegels) in Wase dam, Kano State, Nigeria Available on: ttp://www.uniportjournal.com/ajozeb2004 articles/4htm.

Akhamerov AH (1980). New parasites from fish in the Amur River. *Helminthologia*, 2:286-294. *Anim. Sci.* 1(4): 131-136.

Ayanda OI (2009). Comparative parasitic helminth infection between cultured and wild species of *Clarias gariepinus* in Ilorin, North Central Nigeria. *Scientific Research and Essay*, 4(1): 18-21.

Barnes RD (1982). Invertebrate zoology Philadelphia, PA: Holt – *saunders international*. Pp. 230-235.

Bell G, Burt A (1991). The comparative biology of parasite species diversity: internal helmets of freshwater fish. Journal of Animal Ecology. 60:1047-1063.

Bichi AH, Ibrahim AA (2009). Survey of ecto and endo parasites of fishes in Tiga lake, Kano. *NISEB journal* 2(3):219-222.

Bichi AH, Yelwa SI (2010). Incidence of Piscine parasites on the gills and gastrointestinal tract of *Clarias gariepinus* (Tuegels) at Bagauda fish farm, Kano. *Bayero Journal of Pure and Applied Sciences,* 3(1): 104-107.

Boyd EC(2004). Farm- level issues in aquaculture certification: Tilapia. Report commissioned by WWF- US in 2004. Aubum university, Alabama 36831.

Britz PJ, Pienaar AG (1992). Laboratory experiments on the effects of light and cover on the behavior and growth of African catfish, *Clarias gariepinus* (Pisces; clariidae). *Journal of Zoology*. 227:43-62.

Bruton MN (1979a). The food and feeding behavior of *Clarias gariepinus* (pisces: clarridae) in lake sibaya, South Africa, with emphasis on its role as a predator of cichlids .*transactions of the Zoological society of London*.35:47-114.

Bruton MN, Allanson BR (1980). Growth of *Clarias gariepinus* in lake sibaya, South Africa. *South African journal of zoology* 15:7-15

Bwanika G, Murie D, Chapman L (2007). Comparative age and growth of Nile tilapia (*oreochromis niloticus*) in lakes Nabugabo and Wamala, Uganda. *Hydrobiologia* 589:287-301.

Bwanika GN, Makanga B, Kizito Y, Chapman LJ, Balirwa J (2004). Observation on the biology of Nile tilapia, *Oreochromis niloticus,* in two Ugandan crater lakes. *African journal of ecology*. 42:93-101.

Cake EW, Menzel RW (2001). Infections of Tylocephalummetacestodes in commercial oysters and three predacious gastropods of the eastern gulf of Mexico. *Proc. Nat. Shellfish. Ass.* 70:94-104.

Carpenter DW (2001). *Exotic Animal Formulary*. Second Edition. WB Sunders Company.

Cloutman DG (1974). Monogenean and copepod parasites of fishes from the Smoky Hill River, Ellis County, Kansas. *Transactions of the Kansas Academy of Science (1903-)*. 77 (4):225-230.

Cross, S. X. (1933). Some host parasite relationship of the Trout lake region of Northern Wisconsin. *Journal of Parasitology*,20:132-133.

De moor I, Bruton MN (1988). Atlas of alien and translocate indigenous aquatic animals in southern Africa. *South African national scientific programme report no 144.* CSIR.

Emere MC (2000). Parasitic infection of the Nile prech (Lates niloticus) in River Kaduna. *Journal of Aquatic Sciences*. 31: 34-45. 17.

Emere MC, Egbe NEL (2006). Protozoan parasites of *Synodontis clarias* (A freshwater fish) in river Kaduna. *BEST Journal* 3(3):58-64.F.S), Washington DC.

FAO (2005-2012). Cultured aquatic species information programme. *Oreochromis niloticus*. cultured aquatic species information programme. Text by Rakocy, J.E In: *FAO fisheries and aquaculture department [online]*. Rome. Updated 18 February 2005 [cited 11 September 2012].

Fish Base" (2011). Update Fish Base. Retrieved 24 May 2011.

GISD (2012). Global invasive species database – *Oreochromis niloticus*.

Goldman KJ (1997). "Regulation of body temperature in the white shark, *Carcharodon carcharias*". *Journal of Comparative Physiology*. B Biochemical Systemic and Environmental Physiology **167** (6): 423–429.

Goodwin AE (1999). Massive Lernaea cyprinacea infestations damaging the gills of channel catfish polycultured with bighead carp. *Journal of Aquatic Animal Health*, 11:406-408.

Hecht T, Appelbaum S (1987). Notes on the growth of Israel's Sharp tooth Catfish (*Clarias gariepinus)* during the primary nursing phase. *Aquaculture*. 63:195-204.

Hecht T, Uys W, Britz PJ (Editors). (1988). Culture of sharp tooth catfish, *Clarias gariepnus*, in southern Africa. *National scientific programmes unit* CSIR, SANSP Report 153, 1988, pp. 146.

Hoffman GL (1998). *Parasites of North American Freshwater Fishes* (Second ed.). Ithaca, New York: Cornell University Press.
Hoffman GL, Bauer ON (1971). Fish parasitology in water reservoirs : A review. In : GE. Hall, (ed). *Reservoir fisheries and limnology.* American fisheries society , Washington, DC.
Hussein A, Tefera M, Asrate S (2012). Gastrointestinal helminthes parasites of *Clarias gariepinus* (catfish) in Lake Hawassa, Ethiopia. *Scientific J.*
Ibiwoye TII, Balogun AM, Ogunsusi RA, Agbontale JJ (2004). determination of the infection densities of nematode *Eustrongylides* in mud fish *Clarias garienpinus* and *Clarias angullaris* from Bida flood plain of Nigeria. *Journal of applied science and environmental management*. 8(2):39-44.
IGFA (2001), Database of IGFA angling records until 2001. IGFA, *Fort Lauderdale,* USA
Imam TS, Dewu RA (2010). Survey of Piscine ecto and intestinal parasites of *Clarias spp.* sold at Galadima Road Fish Market, Kano Metropolis, and Nigeria.
Khalil LF (1971). Checklist of the helminthes parasites of African fresh fishes. 19:145.
Klinger R, Francis-Floyd R (2002). Introduction to freshwater fish parasites. *Institute of food and agricultural sciences* (IFAS). University of Florida.
Lasee BA (1995). *Introduction to fish health management.* Onalaska, WI: U.S. Fish and Wildlife Service.
Littlewood DTJ, Bray RA (2000). "The Digenea". Interrelationships of Platyhelminthes. *Systematics association special volume 60* (1 ed.) CRC. Pp. 168-185.
Madanire-Moyo G, Barson M (2010). Diversity of metazoan parasites of the African catfish *Clarias gariepinus* (Gurchell, 1822) as indicators of pollution in a subtropical African river system. *Journal of helminthology*. 84:216-227.
Mgbemena MO (1983). Parasitic Fauna of Some Cichlids and Clariids in Jos Plateau. M. Sc. Thesis, *Hydrobiology and Fisheries Research Unit*. Unijos. Pp. 1-58.
Modhavi R (1980). Comparison of the parasitic fauna of cyprinids Aplochelus Panchax and A melastigma. *Journal of Fish Biology,* 17, 349-358.
Muzzall PM, Hudson PL (2004). Occurrence of *Ergasilus megaceros* Wilson, 1916, in the sea lamprey and other fishes from North America. *Journal of Parasitology*. 90(1):184-185.
Obano EE, Ezeri GNO, Aniyie UK (2010b). Studies on the parasitic infections in fishes in Ovia River at Ikoro, Ovia-South West Local Government Area of Edo State, Nigeria. *Bioscience Research Communications.* 22(3):137.
Obano EE, Odiko AE, Edoh DO (2010a). Helminthes parasitic infection of fishes from Okhuaihe river Benin City, Nigeria. *Bioscience Research Communications,* 22(3):129.
Okorie OO (1972). Some major unsolved aspects of the dynamics of African Fisheries as related to questions of rational development and management. *The African Journal of Tropical Hydrobiology and Fisheries.* edit. Okedi special Issue, I. E. Africans literature Bureaux. Pp. 27-33.
Olaosebikan BD, Raji A (2004). Field guide to Nigerian freshwater fishes. *Federal college of freshwater fisheries technology publication,* New Bussa, Nigeria. 106pp.
Oniye SJ, Adebote DA, Ayanda OI (2004). Helminth parasites of *Clarias gariepinus* in Zaria, Nigeria. *J. Aquatic sci.* 19(2):71-76.
Paperna I (1996). Parasites, infections and diseases of fishes in Africa: An update. *FAO/CIFA Technical paper,* no. 31.
Piasecki W, Goodwin AE, Eiras JC, Nowak BF (2004). Importance of copepoda in freshwater aquaculture. *Zoological Studies*.43(2):193-205.
Picker MD, Griffths CC (2011). Alien and invasive animals - a South African perspective. *Random house/Struik*, cape town, South Africa. pp.240.
Plumb JA (1999). Overview of warm water fish diseases. *Journal of Applied Aquaculture*. 9(2):1-10.
Poulin R (1997). Parasite faunas of freshwater fish: the relationship between richness and the specificity of parasites. *International Journal for Parasitology*. 27 (9):1091-1098.
Poulin R, Serge M (2005). Parasite biodiversity. Smithsonian. P. 216. *Research and Essay*, 4(1): 18-21.
Roberts LS, Janovy Jr. J (2005). *Foundations of Parasitology* (Seventh ed.). New York: McGraw-Hill.
Robins CR, Bailey RM, Bond CE, Brooker JR, Lachner EA, Lea RN, Scott WB (1991). World fishes important to North Americans. *Exclusive of species from the continental water of the united states and Canada*. Am. Fish.soc.spec. publ. 21:243.
Roberts JR (1978). Fish pathology. Bailliere Tindal, London: pp.268-275
Rosas-Valdez R, Perez-Ponce de Leon G (2011). Patterns of host specificity among helminth parasite fauna of freshwater Siluriformes: testing the biogeographical core parasite fauna hypothesis. *Journal of Parasitology*. 97 (2): 361-363.
Safriel O, Bruton MN (1984). A cooperative aquaculture research programme for South Africa. *South African national scientific programmes report 89.* CSIR, Pretoria, pp. 79.
Saurabh S (2007). Parasitic Diseases of Fish: Methods of Their Prevention and Treatment. *Central Institute of Fisheries Education*. Deemed University- ICAR.
Shipton T, Tweddle, D. and Watts, M. (2008). ECDC (2008). Introduction of Nile tilapia (*Oreochromis niloticus*) into the eastern cape. *A report from eastern cape development corporation.* 30pp.
Shotter RA (1974). Copepod parasites of fish from Zaria in Northern Nigeria proc. *Third International Congress of Parasitology,* 3, pp. 399.
Sieszko SF (1975). Effects of environmental stress on outbreak of infectious diseases of fishes. *Journal of Fish Biology,* 6, 157-208.
Sinderman CJ(1953). Parasites of Fishes of the North Central Massachusetts. Fishes. Rept. 1950. Massachusetts Div. Fish Game. Boston: 4-28.
Skelton P (2001). A complete guide to fresh water fishes of southern Africa. *Struik publishers.* Cape town. subtropical African river system. *Journal of Helminthology*. 84:216-227.
Teichert-Coddington DR, Popma TJ, Lovshin LL (1997). Attributes of tropical pond-cultured fish, pp183-198. In Enga, H.S and Boyd, C.E. (eds), dynamics of pond aquaculture. CRC press, Boca Raton, Florida, USA.
Untergasser D (1989). *Handbook of Fish Diseases.* Neptune City: T.F.H. Publications.
Van Dan Broek WLF (1979). Copepod ectoparasites of *Merlanginus malangus* (L) and *Platichys flescis* (L). *Journal of Fish Biology,* 14:234-238.
Watson PA, Dick TA (1980). Metazoan parasites of Pike, *Essox lucinus* L. from Southern Indian Lake. *Journal of Fish Biology,* 14:120-126.
Willoughby, NG, Tweddle D (1978). The Ecology of the Catfish *Clarias gariepinus* and *Clarias ngamensis* in the shire valley, Malawi, *journal of zoology* 186:507-534.

Plate 1. Showing the experimental site from which the fishes were obtained.

Plate 2. Showing the measurement of the total length of Tilapia using a meter rule.

Plate 3. Showing the measurement of weight of Tilapia using a manual Weighing balance.

Plate 4. Showing the dissected ventral side of the fish cut from the anal opening to the lower jaw using a surgical blade.