Direct Research Journal of Veterinary Medicine and Animal Science
Vol. 6(2), Pp. 15-26, December 2021
ISSN 2734-2166
DOI: https://doi.org/10.26765/DRJVMAS091832443
Article Number: DRJVMAS091832443

https://directresearchpublisher.org/drjafs/

*Full-Length Research Paper*

# The Prevalence of Ecto and Endo Parasites in some Fresh Water Fishes from Jabi Lake, Abuja, F.C.T.

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Received 2 November 2021; Accepted 24 November 2021; Published 30 December 2021

**ABSTRACT:** A study on the prevalence of Ecto and Endo parasites in some fresh water fishes from Jabi Lake was carried out from July to September 2015. The fishes examined were *Clarias gariepinus*, *Chrysichthys nigrodigitatus, Tilapia zilli, Gnathonemus cyrinoides and Mormyrops deliciosus*. Ninety specimens each were examined in the laboratory for ecto and endo parasites using standard methods and equipment. The condition factors of all individual fishes were determined, and the following mean values were obtained: 1.29 ± 2.77 for *C.gariepinus,* 1.14 ± 2.38 for *C. nigrodigitatus* 1.52 ± 2.56 for *T. zilli,* 1.65 ± 1.82 for *G. cyprinoides*, and 0.59 ± 2.09 for *M. deliciosus*. Parasitic infections were greater for *Mormyrops deliciosus* (1.63) *and Chrysichtys nigrodigitatus* (2.33; low condition species, than *Tilapia zilli* (2.80) and *Clarias gariepinus* (2.67; high condition species. Of the 450 fishes examined, for *C. gariepinus,* female and male parasitic prevalence was 55% and 45% respectively. For *Tilapia zilli*, female parasitism was 51% while male was 49%. For *C. nigrodigitatus*, female parasitism was 74% while male was 60%. For *G. cyprinoides,* female parasitic level was 37%, while male was 62%, and for *M. deliciosus*, female parasitic level was 36% while the male was 64%. Some of the ecto parasites found were; *Flexibacter litoralis, Argulus japonicas, Diplostomulum flexicaudum, Saprolegnia ferax and Ichthyophthirius multifilis* and some of the endo parasites found were; *Lingula anatina, Clinostomum marginatum, Diphyllobothrium latum and contraceacum spiculigerium.*

**Keywords:** Ecto and Endo parasites, fresh water fishes, Jabi Lake, Abuja

## INTRODUCTION

Fish is very important to human populace in trade and economy; it is of importance in the diet of different countries, especially in the tropics and subtropics where malnutrition is a major problem (Alune and Andrew, 1996). As the human population inevitably increases, the demand for fish as source of protein also grows. In recent times, there has been tremendous increase in the development of fish farming and culture attributed to the increased need for affordable animal protein, especially in the tropics (Davies *et al.,* 2006). Therefore, catfishes of the family Clariidae are increasingly being used for freshwater aquaculture in Africa, owing to several favourable cultural characteristics. A parasite is an organism that lives in or on another larger organism of a different species (the host), upon which it depends for food. Although the parasite benefits from the association, the host is harmed. Depending on the species, the host/parasite relationship may be temporary or permanent. Bacteria and viruses are classified as parasites in some branches of biology. Fishes are subject to a wide variety of diseases including bacteria, fungi and miscellaneous parasites. Broken head disease with a symptom of skeletal deformities (lardosis and scoliosis) makes fish suddenly stop feeding, becomes lethargic and dies with swollen weak tissues on both sides of the head, usually observed on fish >10 cm, dead fish exhibit thick and curved skulls. Parasitic infection and diseases are some of the factors hindering high productivity in fish farming (Doglel *et al.,* 1961; Kayis *et al.* 2009). The majority of the fish parasites which cause disease in fish include protozoan parasites. Typically, these parasites are present in large numbers either on the surface of the fish, within the gills, or both. When they are present in the gills, they cause problems with respiration, and death will commonly occur when additional stressors are present in the aquatic environment. Protozoan parasites on the skin, fins or scales only (i.e., not affecting the gills) usually do not result in death unless they are accompanied by a secondary bacterial infection. According to Klinger and Francis (2000), protozoa are a vast assemblage of eukaryotic organisms, and most of the commonly encountered fish parasites are protozoa, which with practice are the easiest to identify and easiest to control. In general, protozoa are one of the major fish parasites that have been long neglected because of the inherent difficulty in studying compared to other larger parasites. Among protozoa, ecto and endo parasitic protozoa occupy a very important sector as one of the hazardous threats to fish health.

These parasites attack the fish, causing massive destruction of skin and gill epithelium. Even moderate infection of these organisms on small fish may prove a fatal disease, since the infection may cause the fish to stop feeding (Enayat, 1996).

Some fish parasites would develop in humans if the fish is eaten raw, but none would be harmful if the fish is thoroughly cooked. All reports of people being infested with fish parasites were because of ingestion of raw fish or insufficiently cooked fish (Food Agricultural Organization, 1996). Most fish, especially in the wild population, are likely to be infested with parasites, but in the great majority of cases, no significant harm to the host may be encountered or identified; thus, there are only few reports of parasites causing mortality or serious damage to the fish populations, but this may be largely because such effects go unnoticed (Robert, 2001). Fishermen or consumers often observe parasites in wild fish only when they are so obvious as to lead to rejection of fish (Robert, 1995).

In culture fish population, on the other hand, parasites often cause serious outbreak of diseases. The presence of dense populations of fish kept in particular environmental conditions may favour certain parasites so that the parasite population increases to a very high level (Roberts *et al*.,2000).

Parasites are the most diverse and common pathogens the aqua culturist may likely encounter, and parasitic diseases which are very common in fish all over the world, are of particular importance in the tropics.

Parasite of fish can either be external or internal. Parasitic infections often give an indication of the quality of water, since parasites generally increase in abundance and diversity in more polluted waters (Poulin 1992; Avenant, 2002)

Parasites are capable of causing harm to the fish host notwithstanding the sp., either through injury to the tissues or organs in the process of burrowing or consuming food or the removal of digested food in the gut of the fish as well as the secretion of proteolytic enzymes. Parasites generally don't kill their hosts (it is a dumb parasite that kills its free lunch), but some can severely stress fish populations to the point of becoming biological and economical concerns. Parasites have a stake in the survival of their host. Sometimes, when parasites are numerous or the fish is stressed from another cause, the fish will die. Parasites can weaken a fish by destroying tissue, removing blood and cellular fluids, diverting part of its nutrient supply and allowing secondary infections to develop.

Fish parasites result in economic losses not only mortality, but also from treatment expenses, growth reduction during and after outbreak of disease and this militates against expansion of aquaculture. Protozoan parasites cause serious losses in fishponds and wild in Nigeria, and their lesions render the fish unmarketable. Fish carrying protozoa parasites are capable of passing on the infective disease to man after its consumption. Protozoa are common tropical freshwater fish parasites that affect public health and cause losses to fishes, hence its choice for this study. One of the scientific importance of identifying a fish properly is to tell to some extent the health condition of the fish, and certain parasitic infections present with some symptoms that bear on the external treatment of the fish (Schmitt and Dethloff, 2000). Total African aquaculture production in 1994 amounted to 76 660 metric tonnes (t). Of this, 53.8% (41 211 t) was produced by five countries bordering the Mediterranean, while the remainder (35 449 t or 46.2%) was produced by 30 sub-Saharan countries. These figures highlight the low-level intensity of aquaculture in sub-Saharan Africa. A comprehensive literature search was undertaken to gauge the extent of disease and pathogenic agents in fish and shellfish aquaculture in Africa south of the Sahara. The study revealed that bacterial infections as well as parasitic ectoprotozoans, cestodes, trematodes, nematodes, polychaetes and crustaceans are the most prevalent problems in African freshwater, the wild, brackish water and marine aquaculture. There have been isolated reports of viral diseases (infectious pancreatic necrosis (IPN), lymphocystis and spring viraema). Bacterial diseases are restricted to common agents such as *Aeromonas*, myxobacteria and some other ubiquitous facultative bacteria. *Saprolegnia* is the most common problematic fungus affecting fish under culture conditions. Currently, the most widely used chemicals for prophylaxis and treatment include wide spectrum antibiotic formulations, malachite green, methylene blue, formalin/ethanol, copper sulphate, salt and several organophosphates. From an aquaculture perspective, it was noteworthy that disease and parasite infestations have been poorly studied in Africa as a whole and in sub-Saharan Africa in particular (South Africa being the exception). It is hypothesized that this is mainly due to the low-level intensity of aquaculture in the region. At present the paucity of research on fish diseases in Africa is not seen as a factor that will negatively impact on aquaculture development and in the wild, and as such is not a target research area. Africa is considered to be the sleeping giant of aquaculture, and at the present moment it is relatively disease free. It is vitally important that African countries take steps to safeguard this status. One method of accomplishing this is to restrict the importation of fishes into Africa. The importation of ornamental aquarium fish as well as hybrid and genetically improved fish strains poses the greatest threats. The smorgasbord of fish and shellfish parasites and diseases that occur in Israel, for example, can to a large extent be ascribed to uncontrolled translocations. Every effort needs to be made to prevent a similar occurrence in Africa. This research examining the prevalence of ecto and emndo parasites in some fresh water fishes from Jabi Lake, reveals that species get infected based on the content and the level of toxicity of the water they live in, once the fish is infected with one diseases or the other, they show various types of symptoms depending on the type of disease. Also artificially constructed ponds that are over stocked with fish are likely to have diseased fish. Early detection of fish parasites prevents more serious outbreak which may lead to fish stress and death if not treated on time. A situation that fish farmers dread. Due to economic and biological losses associated with parasites infestation, it becomes imperative to study the level of parasitism in the lakes/water bodies in which fishes live.

As yet, no epidemics of endoparasites have been reported in Nigeria, it 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.

## Literature review

### *Clarias gariepinus*

*Clarias gariepinus* or African sharp tooth catfish is a specie of catfish of the family Clariidae, the air breathing catfish. They are found throughout Africa and the Middle East, and live in freshwater lakes, rivers, and swamps as well as human-made habitats such as oxidation ponds or urban sewage systems. The African sharp tooth catfish is a large eel-like fish usually of dark gray or black coloration on the back, fading to a white belly. *C. gariepinus* has an average adult length of 1–1.5 m. It reaches a maximum length of 1.7 m and can weigh up to 60 kg .These fish have slender bodies, flat bony heads, and broad terminal mouths with four pairs of barbells. They also have large accessory breathing organs composed of modified gill arches. It is a nocturnal fish like many catfish. It feeds on living as well as dead animal matter. Because of its wide mouth, it is able to swallow relatively large prey whole. It is also able to crawl on dry ground to escape drying pools. Further, it is able to survive in shallow mud for long periods of time between rainy seasons. The rearing of the African sharp tooth catfish in Africa started in the early 1970s in Central and Western Africa, as it was realized to be a very suitable species for aquaculture and survives well in the wild, because it grows fast and feeds on a large variety of agriculture byproducts. It is hardy and tolerates adverse water quality conditions, and can be raised in high densities, resulting in high net yields. In most countries, it fetches a higher price than tilapia, as it can be sold live in the market, it matures and relatively easily reproduces in captivity and it tolerates difficult conditions in the wild and in aquaculture. *Clarias gariepinus* has all the qualities of an aggressive and successful invasive species. Its high fecundity, flexible phenotype, rapid growth, wide habitat preferences, tolerance to extreme water conditions and the ability to subsist on a wide variety of prey can devastate indigenous fish and aquatic invertebrate populations (Bruton, 1986). It is because of these characteristics that countries such as India have imposed a ban on the introduction and culture of *C. gariepinus* (Dhawan and Kaur, 2001). Nevertheless, the effects of the illegal and indiscriminate introduction of this fish into India, as in other countries, have brought about potential ecological problems such as the loss of biodiversity in natural inland waters (Singh, 2000). Genetic introgression of native wild clariid catfish by escapees of hybrid catfish (*C. gariepinus* x *C.*

*macrocephalus*) from fish farms has been reported in Thailand (Senanan et al., 2004). The introduction of *C. gariepinus* into Asia has resulted in the rapid expansion of the hybrid catfish culture when the exotic male *C. gariepinus* is hybridized with local female clariid species. The resultant hybrid with high growth rates and disease resistance (from paternal genes), and high flesh quality and taste (from maternal genes), is very popular with fish farmers and has almost completely replaced the native clariid catfish aquaculture in countries such as Thailand (Poompuang and Na-Nakorn, 2004). It has given a great boost to the aquaculture of clariid catfishes in many Asian countries and positively impacted the livelihoods of many catfish farmers. *Clarias gariepinus* are readily recognized by their cylindrical body with scaleless skin, flattened bony head, small eyes, elongated spineless dorsal fin and four pairs of barbells around a broad mouth.

The upper surface of the head is coarsely granulated in adult fish but smooth in young fish (Van Oijen, 1995). The anal, caudal and dorsal fins are not united. The males can be easily recognized by a distinct sexual papilla located immediately behind the anal opening. This sexual papilla is not present in female fish.

The body is greyish-black with the underside of the head and body a creamy-white color (Van Oijen, 1995), with a distinct black longitudinal band on each side of the ventral surface of the head (which is absent in young fish of less than 9 cm long).

Larger fish (more than 9 cm) are mottled with an overall grey-khaki color. Skin coloration is known to change slightly according to substrate and light intensity in culture systems. *Clarias gariepinus* is indigenous to the inland waters of much of Africa and they are also endemic in Asia Minor in countries such as Israel, Syria and the south of Turkey. *C. gariepinus* has been widely introduced to other parts of the world including the Netherlands, Hungary, much of South-East Asia and East Asia.

These species can be cultivated in areas with a tropical climate, areas with access to geothermal waters or with the use of heated recirculating water systems. It is a hardy fish that can be densely stocked in low oxygen waters making it ideal for culture in areas with a limited water supply. Its air-breathing ability, high fecundity, fast growth rate, resistance to disease and high feed conversion efficiency make it the freshwater species with the widest latitudinal range in the world.

### *Chrysichthys nigrodigitatus*

*Chrysichthys nigrodigitatus* is also known as silver cat fish, found in Africa, including Nigeria. They belong to the family Bagridae. The fish is common in the Niger Delta where it is a valued source of protein and constitutes the dominant commercial catch of artisanal fishermen. *C. nigrodigitatus* has an omnivorous feeding habit which exposes it to a variety of parasites that negatively impact on its health. Due to its place in the daily diet of humans in Africa, zoonotic infections arising from ingesting raw fish, knowingly or unknowingly, could cause serious problems.

The fast growing need to culture fishes for protein consumption for the teeming populace of the developing countries has made it necessary to intensify studies on the parasitic fauna of the African freshwater fishes. Infected fish species manifest numerous symptoms including: anemia, lesions, ulcers, skin and fin rot, distended stomach, blockage of the intestine, pop-eye, immune- suppression, retarded growth, loss of appetite, depressed reproduction, emaciation and loss of organ. Protein is a major component of animal composition and is required in the diet for the formation and repair of tissue, alongside many other functions.

### *Tilapia zilli*

*Tilapia zilli* are freshwater fish inhabiting shallow streams, ponds, rivers and lakes and less commonly found in brackish water. It is a species of fish in the family cichlidae, its natural habitats are marginal vegetation and seasonal floodplain streams, lakes, and ponds. It has a maximum length of 40 cm and a maximum published weight of 300 grams with a total of 13-16 dorsal spines. The non-breeding coloration of *T. zilli* is dark olive on top and light olive to yellow-brown on the sides. Lips are bright green and chest is pinkish. Cichlids can be distinguished from superficially similar sunfishes and black basses (*Lepomis* and *Micropterus*; family Centrarchidae) by a single nostril opening on each side of the head (vs. two in centrarchids) and the presence of a discontinuous or two-part lateral line (vs. a continuous lateral line in centrarchids). Red belly tilapia is included in identification keys given in Moyle (1976) and Hubbs *et al*. (1991). Distinguishing characteristics were given in Taylor *et al*. (1986), Page and Burr (1991), and Eccles (1992). Photographs appeared in Taylor *et al*. (1986), and Axelrod (1993). Identification of this species in the United States has been problematic and some reports in the literature may be misidentifications (Lee *et al*. 1980) or reports of hybrids (Courtenay *et al*. 1984; Taylor *et al*. 1986; Howells 1991). Red belly tilapia is nearly identical to red breast tilapia *T. rendalli*; many reports or specimens of *T. zillii* may have been *T. rendalli*. Redbelly tilapia is similar to another North American introduced cichlid, spotted tilapia *(T. mariae)*: which lacks the deep red ventral coloration present in *T. zillii*, has lateral bars that extend onto the dorsal fin, and 5-6 square black blotches along the side (lacking in *T. zillii*).

Redbelly tilapia is primarily herbivorous, with aquatic macrophytes, algae and diatoms generally comprising >80% of its diet and the remainder including aquatic insects and crustaceans and fish eggs. Proportion of diet from animal sources is generally size-related, with larger fish consuming more animal-based food items (Khallaf and Alne-na-ei 1987). Redbelly tilapia is extremely tolerant of saline conditions, with survival and growth occurring in salinities up to 40‰ and reproduction occurring up to 29% (Stickney, 1986). This species is a substrate spawner, with fishes forming monogamous pairs and exhibiting biparental guarding behavior. Nests are primarily small, saucer-shaped depressions in the substrate, but show some variation in morphology due to environmental conditions (Bruton and Gophen, 1992). Breeding season is dependent on climate, with warm, temperature-stable equatorial populations breeding year-round, and those in areas with more defined seasons breeding during summer months (Siddiqui 1979; Bruton and Gophen, 1992).

*Mormyrups deliciosus* 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, 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). Gnathonemus is a genus of elephant fish in the family Mormyridae, they exhibit two structural, sexually dimorphic characters; anal fin ray bone expansion and indentation of the posterior ventral body wall (formally described as anal fin indentation). Females lack this bone expansion, but may show a slight indentation. An examination of the permanent body structures of the anal fin complex in the mormyrid fish, Gnathonemus revealed two new structural sexual dimorphisms: longer proximal pterygiophores and wider anal fin rays in males than in females. Both structures are thought to facilitate the male's courtship-associated anal fin reflex.

Adult male mormyrid fishes are characterised by a dorsally directed indentation of the posterior body wall (anal fin indentation). The expression of this indentation in males, presumably driven by anal fin musculature, was correlated with the fish's gonadal state: large indentations were associated with high gonado-somatic indices and small indentations with low indices. 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 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).

**Parasites**

Parasites are microscopic organisms that infect other organisms and derive nutrients from them for survival. Parasites are common in various water bodies and attack virtually every part of the organisms present in the water bodies.

Parasites of fish can be grouped into ectoparasites and endoparasites and in serious infestations, coupled with poor environmental conditions, death can occur, leading to a decrease in fish stock available for consumption. Other economic effects of parasites on fish include: reduced market value which results in financial loss to the farmers. The increased demand for fish as a safe source of animal protein to humans has necessitated the evaluation of the status of parasitic fauna in fish species in Nigerian inland waters.

**Bacteria**

Includes a large group of one-celled microscopic organisms. While bacteria cannot be seen with the unaided eye, the signs of bacterial infection are usually visible.

**Copepod**

Member of a group of small crustaceans. It is very abundant in aquatic systems and commonly used as food by fish. Although most copepods are free-swimming, those mentioned here are fish parasites.

**Cyst**

A non-living sheet-like structure enclosing a parasite. The sheet-like structure or membrane may be produced by the host, the parasite, or both.

**Fluke**

Another name for TREMATODE or GRUB. These parasites cause flattened worm-like cysts in and on fish.

**Fungus**

Minute thread-like plants that lack chlorophyll. Common in fresh water, most fungi grow on decaying organic matter. Fungi usually attack fish only when the skin has been injured through abrasion or by other parasites.

**Protozoan**

A single-celled organism of the lowest division in the animal kingdom. Although a few may be seen with a magnifying glass, a microscope is required to see most species. Not all protozoa are parasites.

**Roundworm**

A class of organisms also known as NEMATODE. They have round elongated bodies tapering at both ends and lack segmentation and suckers. They are among the most common of fish parasites. There are free-living (nonparasitic) as well as parasitic roundworms.

**Spiny-Headed Worm**

A common name for a group of parasitic worms called Acanthocephalans. Usually under one-and-a-half inches long, they live in the digestive tract of various animals.

**Tapeworm**

Also known as CESTODE; adults are white, flattened, segmented worms that inhabit the intestine. Some tapeworms occur only as larvae in fish and develop into adults in other animals such as predatory fish, birds, or mammals. All tapeworms are parasitic.

**Yellow Grub (*Clinostomum marginatum*)**

Spends most of its life in the mouths of herons. Leaves the heron, and invades snails and eventually a particular species of snail. Next, it burrows into the muscle of a fish.

**White Grub (*Scarabaeidae*)**

Typically found in the liver, heart, and other internal organs of sunfish. It's visible as numerous white "specks."

**Black grub**

Ironically, they are actually white. Dark pigment from the fish encysts the flukes, making them look black. Adults live in the intestines of kingfishers. Fluke eggs drop into the water with the birds' faeces. They hatch and enter aquatic snails. After maturing somewhat, they leave the snails and infect fish. Viral hemorrhagic septicemia virus (VHS) has infected fish in all the Great Lakes, except Lake Superior, and some inland lakes in New York, Michigan, and Wisconsin. It has not been reported in Minnesota as of early 2008. Fish afflicted with VHS may appear limp or swim abnormally, and show bleeding from their eyes, skin, gills, skeletal muscles and fin bases. They also may have abnormal eyes (popeyed or sunken eyes). The virus can cause significant fish die-offs. The USDA Animal and Plant Health Inspection Service has listed 28 species of fish located in the Great Lakes Basin that have been infected with VHS. Fish mortality from VHS is greatest at water temperatures between 38 and 54°F, and rare above 60°F.

**Aims and objectives**

The aim of this research work was to examine the various parasites that can be found in *Clarias gariepinus, Chrysichthys nigrodigitatus, Tilapia zilli, Gnathonemus cyprinoides, and Mormyrops deliciosus* from Jabi lake.

## MATERIALS AND METHODS

**Study area**

The study took place in Jabi Municipal Abuja Federal Capital Territory Nigeria, located at latitude 9.0647803 (7$^{o}$ 5' 0' N) and longitude 7.4219122 (8$^{o}$ 38' 0' E).
According to Mabogunje (1977), there are two weather conditions experienced in the year, the dry season which falls between November and February, and the rainy season which is between March and October.

**The studied fish**

***Clarias gariepinus***

It has an average adult length of 1–1.5 m. It reaches a maximum length of 1.7 m and can weigh up to 60 kg .These fish have slender bodies, flat bony heads, and broad terminal mouths with four pairs of barbells. They also have large accessory breathing organs composed of modified gill arches.It is a nocturnal fish like many catfish. It feeds on living as well as dead animal matter. Because of its wide mouth, it is able to swallow relatively large prey whole. It is also able to crawl on dry ground to escape drying pools. Further, it is able to survive in shallow mud for long periods of time between rainy seasons (Figure 1).

***Chrysichthys nigrodigitatus***

It is also known as silver cat fish, found in Africa,

**Figure 1:** *Clarias gariepinus*

**Figure 2:** *Crysichthys nigrodigitatus*

**Figure 3:** *Tilapia zilli*

**Figure 4:** *Mormyrups deliciosus*

**Figure 5:** *Gnathonemus. Cyprinoides*

including Nigeria. They belong to the family Bagridae. The fish is common in the Niger Delta where it is a valued source of protein and constitutes the dominant commercial catch of artisanal fishermen (Figure 2).

***Tilapia zilli***

It has a maximum length of 40 cm and a maximum published weight of 300 grams with a total of 13-16 dorsal spines. The non-breeding coloration of *T. zilli* is dark olive on top and light olive to yellow-brown on the sides. Lips are bright green and chest is pinkish (Figure 3).

***Mormyrups deliciosus***

They 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 (Figure 4).

***Gnathonemus cyprinoides***

It is a genus of elephant fish in the family Mormyridae, they exhibit two structural, sexually dimorphic characters; anal fin ray bone expansion and indentation of the posterior ventral body wall (formally described as anal fin indentation) (Figure 5).

**Sample Collection**

Fish samples were collected on weekly basis between July and September from the ponds using randomised sampling method through the help of a local fish farmer. A total of 450 fishes were examined, 90 fishes per species. The length and weight of each fish were measured to the nearest 1 cm and 0.1 g with the aid of a tape rule and a top loading meter balance respectively. The sexes of the fish were also determined by examining the papillae. Pond water samples were collected in sterilized glass bottles (250 ml) 15 to 20 cm below the water surface from three different locations in the pond in every sampling. This is in order to see a true picture of the general pond condition.

**Sample analysis**

Upon arrival at the laboratory, physico-chemical parameters were analysed for the three water samples separately and averaged. External examination of each of the fish for parasites was carried out using the technique of Emere and Egbe (2006) on the gills, fins and skin. The skin, gills and fins of each of the fish were also examined for ectoparasites using hand lens. The fish samples were filleted using scalpel blade. The tissue was placed in a petri-dish and 3 ml of 0.9% saline solution were added and stirred using a mounted pin. Some drops of the mixed solution were collected using dropper, placed on a slide, and then covered with a cover slip after which, observation on a light binocular microscope was made. Later, the gills of each of the fish were dissected using a dissecting kit, each of the gills was placed in 10 ml of normal saline in petri-dish, later, it was removed, place on a slide on which 1-2 drops of saline solution were added and observed on a binocular microscope. The stomach and the intestine of each of the fish was cut opened, and contents washed into the petri-dish containing the saline solution. The lining of the gut lumen was also scrapped out and placed in the saline solution. One to two drops of the preparation were placed on slide covered with slips and observed using a light binocular microscope for endoparasites. Ectoparasitic data was collected on the gills, fins, and skins of the fish, while the endoparasitic data were collected on the stomach and intestine of the fish using the techniques of Emere and Egbe (2000).

The parasites were identified by making their sketches as observed on the binocular microscope and compared with the pictorial guide on fish parasites by Pouder *et al* (2005). The number of parasites observed in the binocular microscope were counted and recorded.

## RESULTS

The total number of species examined were four hundred and fifty (450); 90 *C. gariepinus*, 90 *C. nigrodigitatus*, 90 *T. zilli*, 90 *M. deliciosus*, and 90 *G. cyprinoides*, with a total of 290 female and 160 male species. Among the male species, *Mormyrops deliciosus* had the highest percentage parasite prevalence, while *Tilapia zilli* had the lowest percentage parasite prevalence. Among the female species, *Chrysichthys nigrodigitatus* had the highest parasite prevalence while *Clarias gariepinus* had the lowest percentage parasite prevalence. In the overall, *Chrysichthys nigrodigitatus* had the highest prevalence of parasite while *Tilapia zilli* had the lowest prevalence of parasites (Tables 1 and 2).

## DISCUSSION

Parasite taxa and species encountered included the cestodes, *Woodland virilis, Proteocephalus largoprosglotis, Diphyllobothrium latum;* trematodes, *Diplostomum flexicaudum*, *Clinostomum marginatum,* protozoans and nematodes, *Contracaecum spiculigerium*. Protozoans are single celled organisms which live inside the body of the fish and are transferred through consumption of infected fish. From this study, among the male species, *Mormyrops deliciosus* had the highest percentage prevalence of parasites and *Tilapia*

**Table 1:** Condition factor of the sampled fish

| SPECIES | K -RANGE | K-MEAN |
|---|---|---|
| ***C. gariepinus*** | 1.29 - 2.77 | 2.675 |
| ***C. nigrodigitatus*** | 1.14 - 2.38 | 2.330 |
| ***T. zilli*** | 1.52 - 2.56 | 2.800 |
| ***G. cyprinoides*** | 1.65 - 1.82 | 2.560 |
| ***M. deliciosus*** | 0.59 - 2.09 | 1.635 |

**Table 2:** Prevalence of Ecto and Endo parasites in males *and Females of the sampled fish from JABI LAKE*

| | **Sex** | **Infected** | **Non Infected** | **Total** | **(% Prevalence)** |
|---|---|---|---|---|---|
| ***Clarias gariepinus*** | Male | 20 | 15 | 35 | (57.14) |
| | Female | 30 | 25 | 55 | (54.54) |
| | Total | 50 | 40 | 90 | 55.5% |
| | | | | | |
| ***C. nigrodigitatus*** | Male | 15 | 10 | 25 | (60.00) |
| | Female | 48 | 17 | 65 | (73.85) |
| | Total | 63 | 27 | 90 | 70% |
| | | | | | |
| ***Tilapia zilli*** | Male | 12 | 28 | 40 | (30.00) |
| | Female | 32 | 18 | 50 | (64.00) |
| | Total | 44 | 46 | 90 | 48.89% |
| | | | | | |
| ***G. cyprinoides*** | Male | 14 | 10 | 24 | (58.33) |
| | Female | 42 | 24 | 66 | (63.64) |
| | Total | 56 | 34 | 90 | 62.22% |
| | | | | | |
| ***M. deliciosus*** | Male | 22 | 14 | 36 | (61.11) |
| | Female | 36 | 18 | 54 | (66.67) |
| | Total | 58 | 32 | 90 | 64.44% |

*zilli* had the lowest percentage prevalence of parasites, while among the female species, *Chrysichthys nigrodigitatus* had the highest percentage prevalence of parasites and *Clarias gariepinus* had the lowest percentage parasite prevalence (Table 2). Based on the total prevalence, *Chrysichthys nigrodigitatus* had the highest prevalence of parasite while *Tilapia zilli* had the lowest prevalence of parasite. This implies that of all the studied fish samples, *Chrysichthys nigrodigitatus* is more susceptible to parasitic infections, this could be as a result of their omnivorous nature. Protozoans can be among the easiest to identify, and are usually among the easiest to control. Cestodes are parasitic and their life cycle varies, typically they live in the digestive tracts of vertebrates as adults and often in the bodies of other species of animals as juveniles. Trematodes are internal

List of Ecto and Endo parasites of the sampled fish

The Ecto parasites found were;

| | |
|---|---|
| *Flexibacter litoralis* | *Uvulifer amblopIitis* |
| *Arulus japonicus* | *Salmincola lavaretus* |
| *Diplostomulum flexicaudum* | *Ichthyophthirius multifilis* |
| *Saprolegnia ferax* | *Lernaea cyprinacea* |
| *Aeromonus hrdrophila* | |
| *Naescus brevicaudatus* | |

The Endo parasites found were;

| | |
|---|---|
| *Lingual anatina* | *Acanthocephalus lucii* |
| *Clinostomum marginatum* | *Diphyllobothrium latum* |
| *Contraceacum spiculigerium* | *Eustrongylides tubifex* |
| *Wenyonia virilis* | *Proteocephalas largoprosglotis* |

parasites with complex life cycle with at least two hosts. While nematodes occur within the intestine, they deprive their host of food and can feed on host tissues and blood causing emaciation and anaemia. Consequently, these parasites can build up to very high numbers when fish are crowded causing weight loss, debilitation, and mortality. Individuals with low condition factors were found to be more susceptible to the infection. Apart from climate, other factors of considerable importance, which affect parasite 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 parasite prevalence. One conceptual definition of ecosystem health is the absence of disease, as disease is considered a stress on the environment (e.g. contaminant), again conveying organismal properties on an ecosystem. To many, parasites are organisms of no value to contemporary society that simply should be eradicated. In case of deleterious diseases of humans and their biological resources, that will no doubt be desirable, but where does that leave the vast majority of parasites that occur in nature and the scientists who study them? Parasites are indeed important components of any ecosystem that not only play key roles in population dynamics and community structure, but that can provide important information on environmental stress, food web structure and function, and biodiversity that are relevant to societal needs. Indeed, in theory, the absence of disease under certain circumstances may reduce biodiversity and promote the expansion of introduced species. Exhaustive empirical surveys have shown that, almost without exception, intestinal helminthic parasites are aggregated across their host populations, with most individuals harbouring low numbers of parasites, but few individuals playing host to many. Heterogeneities such as these are generated by variation between individuals in their exposure to parasitic infective stages and by differences in their susceptibility once an infective agent has been encountered. In the absence of any heterogeneities in exposure, even small differences in susceptibility between hosts can rapidly produce non- random, aggregated distributions of parasites (Lafferty, 1997). Sex and host condition factor have been found to be one of these varying factors. The well-being of fish and the population in general can be determined by the analyses of condition factor (Carlander, 1969). Condition factor is a measure of energetics, nutritional status and viability of a host. There was much difference in the range of the length and weight of individuals of low and high condition factor of the fish species, each of these populations showed wide range variation in condition factor. This simply proves that condition factor is dependent on size and weight. Within populations, individuals differ in their ability to compete for limited resources (Begon *et al*, 1990) and the resulting unequal division of nutrients lead to variation in growth rates, body size and nutritional condition (Rubenstein, 1981).

## Conclusion

In conclusion, a multitude of parasites have been reported in fish, but only a few species are capable of infecting humans. The most important of the parasites capable of infecting humans are the nematodes *Contracaecum spiculigerium,* cestodes of the genus *Diphyllobothrium* and digenetic trematodes of the families *Heterophyidae*, *Opisthorchiidae* and *Nanophyetidae*. All of the parasites mentioned above are associated with socio-cultural and behavioural factors, in particular the consumption of raw or undercooked fish. Measures can be taken during harvesting, processing or post-processing (e.g., by the consumer) to mitigate the risks of infection. The fish industry and government authorities can apply various programmes to reduce these risks, including good manufacturing practices (GMPs) and hazard analysis and critical control point (HACCP) systems. Such measures may include avoiding particular harvest areas, sizes of fish, or even particular species of fish. The method of capture, handling and storage of the catch can directly affect the quality of the fish with regard to the presence and numbers of parasites. The extent of processing - including heading and gutting, candling and trimming - and the type of product derived (fresh, frozen, salted or pickled) can all contribute to the control of the risks posed by fish parasites. The most effective means of killing the parasites are either freezing or heat inactivation.

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