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FISH SPECIES PARASITES: A REVIEW IN NIGERIAN WATER BODIES

***Adebambo, A. A. R**

Department of Biological Sciences, Tai Solarin University of Education, P.M.B. 2118, Ijagun, Ogun State
***Corresponding Author:** *adebamboadesoji@yahoo.com,* +234 803 370 4631

ABSTRACT

Parasitic infection constitutes a major threat to the well-being and productivity of fishery industries in Nigeria. The parasites have been found and reported in the wild and different culturing media. The effect of parasitism ranges from infliction of injuries on organs, reduction in population of fish, impairment of proper organ functions, and disturbance in the physiology of the fish. Its effects also include reduction of both biomass and weight through parasites feeding on the fish host. Parasitism in fish has been aided by various ecological factors such as rainfall, temperature, dryness, of water, $_{P}H$, turbidity and a suitable intermediate host. However man made factors such as deposit of waste and faeces to some water bodies also influence the prevalence of parasitism of fish. Parasites encountered by various investigators included Protozoans such as Ichtoyobodo necator Eimeria chrysichthyic, Hexaimita sp, Tricodina sp, Crytobia ubilans, and Trypanosoma. Worms found in fish included Nematodes such as Cammalanus, sp Spironoura sp, Procamalus laevionchus, Gnathostoma sp, Paracamallanus, Eustrongyloides, Trematodes encountered were Clinistomidae, Clinostomium tilapiae, Paramphistomium sp, Euclinustomium heterostomium, Allocreadium ghaensis, Sandonia sadanensis, and Polyoncobothrium clariae. Records of cestodes were Proteocephalus sp, Diphyllobothrium, Amonotaenia sp, Polyoncobothrion clariae., Monobothriode wordlandi, and Heterophyid fluke. Acanthocephalans recorded in fish included Neochinorhyncus rutili, Pomporhynchus Quadrigidae.The annelida recorded was the Leech. Some fish hosts inhabiting parasites in various investigations across the country included Clarias gariepinus, Clarias lazera, Synodontis sorex, Tilapia zilli, Oreochromis niloticus, Clarias Pachynema, Malapterurus electricus Heterobranchus brisordalis amongst other numerous fish species. There is need to constantly investigate parasitism of fish in Nigerian waters with the view of creating a data bank that will accommodate the diversity of fish parasites in Nigerian waters

Keywords: Parasites, Fish species, Water, Data bank, Diversity

INTRODUCTION

Parasites across different aquatic habitats have infected fish species, inflicting injuries, which become a substrate to other opportunistic microorganisms reducing fish production as a result of the menace they cause. Aquaculturists may have done their best to combat this menace based on their knowledge which seems not adequate. Still parasites have not allowed fishes to rest. Parasites have constituted a major problem confronting aquaculture with pathological conditions that arise from their infection, with potentially serious consequences most especially in crowded conditions Vandenbrock (1979). Paperna(1996) reported parasitism effects to include reduction of hosts' biological fitness, specialized pathology such as parasite castrations, Mbuthia(1993) reported that fish reproduction, growth, appearance and welfare are hampered by parasites.

Baldwin *et al*., (1967) have reported susceptible relationships between different fish species and parasites infection. The overall prevalence in Zaria and Imo river according to Oniye *et al.* (2004) and Ugwuzor (1987) were 19.17% and 13.6% respectively, Ekanem *et al*. (2011) reported3.33% prevalence in Calabar, Anosike *et al*., (1992) in Jos, had 52.0% and 34.67% in cultured and wild

population of *Clarias gariepinus* respectively, The prevalence of 59.8% and 63% in cultured and wild *Clarias lazera* was reported by Onwuliri and Mgbemena(1987) in Jos.

The overall prevalence of infection in *Synodontis sorex* which is a common fish in the confluence of river Niger and Benue was 59.37%, with River Niger and Benue portions recorded 70.96% and 56.52%, respectively (Iyaji *et al.*, 2015); the investigation was similar to Onyedineke *et al.* (2010) in terms of quantity of parasites, which indicated similarities in ecology of River Niger irrespective of location of sample collection. Onyedineke *et al*. (2010) in illushi, Edo state South south Nigeria reported overall prevalence of 66%, however prevalence was 57.96% and 12.54% in the case of cestodes and nematodes respectively

Parasites studies of *Oreochromis nilotius* carried out by Biu *et al*. (2014), in Maiduguri, North East, Nigeria revealed blood parasite *Haemogregania* as the most prevalent (P<0.05), even though reported to be scanty in Nigeria according to Sidall and Dessar(1993). Biu *et al*. (2014) reported that female fishes were more parasitized than males with 26.7% and 25.7% prevalences respectively (P<0.05). Parasito fauna survey of fishes in Warri, carried out by Vincent *et al.* (2014) revealed overall prevalence of 32.9%, The break-down included; *Tilapia zilli*(23.8%), *Synodontis clarias*(39.1%) *Chrysicthys nigrodigitatus* (30.4%) *Clarias angullaris* (50.0 %), *Hepsetus odoe* (37.5 %). The infection rates were Acanthocephalan (75.6%), Nematode (22.2%). This is contrary to the findings of Iyaji *et al.*(2015), Oniye *et al.* (2004), Okoye *et al.* (2014) where Acanthoceplalan were not recorded in total abundance.

Reports of Vincent *et al*. (2014) indicated low prevalence in Warri (32.9%). Okaka and Akhigbe (1999) reported (17.1%) in Osse River, Edema *et al.* (2008) had (6.9%) in Okhwo River while Ekanem *et al.* (2011) reported 3.3% in Great kwa River Ibiowoye *et al.* (1999) gave reports of endoparasites of four non-scaly fishes such as *Synodontis* sp, *Clarias* sp, *Heterobranchus bisordalis* and nine scaly fishes, supporting five decades report of Nematodial infestation in the area. According to Ugbor *et al.* (2014) 41.1% of fishes were infected in Anambra River while infection rates were *Clarias gariepinus* (44.2%) and *Clarias angullaris* (35.7%). Report from Oyo State, South West Nigeria by Alade (2015) indicated that 62.6% of fishes were infected with *helminths* parasites, similar to Olofintoye (2006) and Fagbuaro *et al.* (2004). Helminths susceptibility of fishes of Ogun River, South west Nigeria was investigated by Fafioye *et al.* (2017), whose conclusion was that parasite infection in south-western Nigeria remained same in different fish hosts once infected, however amongst fish screened, the Cichlid were the most infected. The prevalance of *Synodontis membranaceus* screened for endoparasites in Jebba Lake according to Owolabi (2008) was (36.25%) amongst 438 fishes, though investigation revealed multiple infection in the oesophagus, gall bladder and liver of *Synodotis* sp, Ekanem *et al*. (2011) reported *Chrysicthys nigrodigitatus* had highest incidence of 50%,while the remaining three of the infected fish species had 16.67% each, At Abuja the North-central Nigeria, Kawe *et al.* (2016) reported the presence of gastro intestinal parasite of *C. gariepinus* as 67.5%; the report is similar to Salawu *et al.* (2013) as who reported 75%. in South-western, Nigeria. Aliyu and Solomon (2012) reported the presence of 59.38%, with reference to trematodes, cestodes and nematodes, however acanthocephalan were not recorded by Kawe *et al.*2016). Maybe the investigation was carried out in the rainy season, since acanthocephalans prevalence was higher in fish during dry season (Mgbemena, 1983).

Heterophid fluke was reported in Nigeria for the first time (Kawe *et al.* (2016), contrary to its prevalence in Egypt (Paperna, 1996), Heterophid fluke causes disease known as human trematodeaisis, resulting from eating raw salted and undercooked fish containing metacercariae of parasites. Comparison of endoparasites infestation of *Clarias gariepinus* from earthen and concrete pond was done in Makurdi North central Nigeria by Omeji *et al.* (2013). The prevalence was 60% from earthen pond and 20% from concrete ponds; the parasites found in the two culturing media were similar, however no clear cut reasons were given for high infection rate in earthen pond than concrete pond The prevalence reported by Aliyu and Solomon (2012) among *C. gariepinus* in Abuja, was

59.38%. The presence of nematodes in major portion of gut and stomach of fish reported by Kawe *et al.* (2016), Oniye *et al.* (2004) and Salawu *et al.* (2013) was due to advance development of alimentary canal of nematodes as described by Khalil (1969), Auta *et al*. *(*1999). Olurin and Somorin (2006) reported that parasitism was 47% among *Chromodotilapia guntheri*, *Tilapiae mariae* and, *Hemichromis fasciatus*, low amount of parasites were recorded in the investigation, which was attributed to diversity of fish species determining the number of parasite fauna as earlier reported by Wooten (1973).

There were similarities in the reports of Omeji *et al.* (2013), Emere and Egbe (2006), Nyaku *et al.* (2007) where gills of fishes investigated were the most infected. Somerville (1984) attributed the gills to being the site of filter feeding and gaseous exchange while Uneke *et al. (*2015) reported *Chrysichthys nigrodigitatus* were infected with *Cryptobia lubilans.* Omeji *et al. (*2011) revealed *C.gariepinus* were infected with *Cryptobia lubilans* In Gombe, North East Nigeria, Dauda *et al.* (2016) reported prevalence of gastrointestinal helminths of *Tilapia zilli* as 42.7%, while Gombe market had 17%, Gwadon market (15.0%), Gombe old market (0.705%); with no helminths found in gills of infected fish. This report is similar to Goselle *et al.* (2008). The prevalence report in Gombe is lower than that of Bichi and Ibrahim (2009) in Kano (53.40%) as well as Olofintoye (2006) in Ekiti (60.23%),. Hassan *et al. (*2010) recorded 68.57% prevalence in *Clarias gariepinus* and *Synodotis clarias* in Lekki lagoon with multiple infections in some infected specimens. Amaechi (2014) reported 56.4% in *Oreochromis niloticus* and *Tilapia zilli* in Ilorin, where factors responsible for survival, multiplication and host acceptability were the disposal of waste and faecal matter to the dam by the farmers.

Olurin *et al.* (2012) reported that paucity existed in helminths infection in *Sarotherodon galilaens* and *Tillapia zilli* in River Osun South-western Nigeria with 32.6% prevalence recorded. This report was similar to Olurin and Somorin (2006). The paucity was attributed to high water flow during the rainy season, which was supported by Martinez-aquino *et al.* (2008) in Mexico where high water flow was a determining factor of helminth assemblage in Mexico. Ezenwaji *et al.* (2005) in the studies on helminthes endoparasites of Mochokids in Anambra River, reported low prevalence of 8.7%, with a mixed infection involving *Sandonia sudanensis, Paracamallanus leavionchus* and *Wenyonia* sp. Synergistic work between parasites and bacterial infection was done by Uchechukwu (2015) in Enugu on *Clarias gariepinus.* Nematodes were the most prevalence which was followed by Platyhelminthes.

Salawu *et al.,* (2013) investigated parasites of *Clarias gariepinus* and *Clarias pachynema* from unpolluted region of Asejire River and polluted end of river Ogun at Isheri market end with prevalences of 28.4% and 62.6% respectively while 487, and 203 helminths were also recorded, respectively. 75.0% prevalence was recorded in *C. gariepinus* from Ogun River and 24.1% in Asejire Dam. Salawu *et al.* (2013) report was unique as *Procamallanus sp.* and *Wenyonia sp.* were reported for the first time in *Clarias pachynema* in Nigeria, whereas Ukoli (1972), Okaka (1998) Omoniyi and Olofintoye (2001) Oniye *et al*, (2004) never encountered helminth in *C. pachynema* in Nigeria. Omeji *et al.* (2014) investigations on *Malapterurus electricus* from upper river Benue reported 47% prevalence rate during the dry season with highest load of parasites in the intestine as 43.09% of which was based on digestion activity of the stomach and release of oval/oocyst by the parasite in the stomach, while Dan-kisiya *et al.* (2013) attributed the large number of parasites to large surface area of the intestine and churning of the stomach.

Akinsanya *et al.* (2007) had overall prevalence of 37.0% in *Malapterurus electricus* in Lagos, with males having 37.7%, and female 35.5% prevalence Tachia *et al.,* (2012) reported 33.3% prevalence in Makurdi amongst *C.gariepinus*, contrary to Omeji *et al.* (2013) and Omeji *et al.* (2014) with no record of leech-; *Pisciola* geometra and midge larvae,. Omeji *et al.* (2014) recorded 51.25% prevalence in *Clarotes macrocephalus* from river Benue with parasites sites of infection being mostly the intestine and skin. Ekanem *et al.* (2014) in Calabar, reported 81 specimens of endoparasites in *Chrysicthys nigrodigitatus, Clarias gariepinus, Synodotis clarias* and *B. soporato* with an overall prevalence

of 7.33%. Adeogun *et al.* (2014) carried out investigation among Claridae fish, and found 29.1% prevalence. Urukwu and Adikwu (2017) investigated the prevalence of parasites of Clarid fish in Lower River Benue and reported 22.33% prevalence, which was lower than 48.63% in Upper Benue by Omeji *et al.* (2014). Prevalence was 21.33% amongst *C.gariepinus* and 23.3% amongst *C. anguillaris* with no significant differences between the fish species. Their report was contrary to Adeogun *et al.* (2014) where no cestodes and *Ichthophthirius multifilus* were found. .Urukwu and Adikwu (2017) reported significance differences ($p < 0.05$) and seasonal variation in parasite infection in fish species that was higher in dry season compared to wet season. However, according to Lafferty and Kuris (1999) these differences were due to increase in invertebrate host population mostly crustacean, starting from the peak of rainy season till the start of dry season as a result of fish feeding on the intermediate host and maturing of parasites in the host.

Ashade *et al.* (2013) worked on adult and juveniles populations of *Oreochromis niloticus* in Epe, Ikorodu and Makoko areas of Lagos and reported prevalence of 26.1%, 33.6% and 40.3% respectively.

Reports on Various Causative Organisms of fish Parasitism

i. Nematode

They are commonly round in structure, unsegmented and cylindrical. They possess resistant cuticle (FAO 1996), they are of numerous species causing significant damage to the organ where they live, such as gastrointestinal tracts and gills and a common phenomenon in the utilization of intermediate hosts. Nematode infection in fish occurs world-wide especially those nematodes utilizing fish as intermediate hosts thereby affecting their organs especially in predatory fish which show heavier infections (FAO 1996; Klinger and Floyd 2002). The majority of nematodes such as *Oxyuris enterobius*, *Procamallanus* sp, *Spirocamallanus* sp, *Paracamallanus* sp parasitized alimentary canal leading to provoked inflammatory responses (Khalil 1971; Boomker 1982) with few species such as *Contracaecum* sp, *Eustrongyloides* sp and *Rhabdona* sp inhabiting inner cavities leading to localized tissue inflammation and fibrosis encapsulation (Moravec and Taraschewski 1988; Mbahinzireki 1980)

Camallanus sp and *Spironoura* sp have been found inhabiting intestine of *Tilapia zilli*, *T. mariae*, *Hepsetus odoe*, (Okoye *et al.*, 2014. Ekpo, (1982) and Oribhabor and Ogeibu, (2012) from their studies in River Ose, South west Nigeria supported Okoye *et al.* (2014) claim of nematode dominance. Nematodes were found in four species of fish namely *H. nilotius, C. nigrodigitatus, C.gariepinus* by Ekanem *et al.* (2011) and Onyedineke *et al.* (2010). Oniye *et al.* (2004) reported one nematode which was *Procamallus laevionchus.* However, Okoye *et al.* (2014) found five types of nematodes infecting fish. Ekanem *et al.* (2011) reported high prevalence of nematodes and high host specificity, which supported Ukoli (1965) Olurin and Somorin (2006), Akinsanya *et al.* (2007d). Nematodes infections cut across reports of Onyedineke *et al.* (2010), Okoye *et al.* (2014), Oniye *et al.* (2004), and Ekanen *et al.*, (2011) as all their reports cited *Procamallanus* and *Camallanus* as the most prevalent while *Gnathostoma.* sp, *Oxyuroid* sp, *Rhabduchona congolensis, Spinitectus guntheri* were variants in their reports. Biu *et al.* (2004) reported 42.9% incidence of *Paramacallanus* and 23.8% of *Contracaceum* in Maiduguri, similar to Iyaji *et al.*, (2015) report on studies along River Niger and Benue confluence.

Vincent *et al.* (2014) reported two genera of nematode not identified amongst the five genera encountered in their study. Ibiwoye *et al.*, (1999) reported the presence of nematodes in gut of fishes, while some are enclosed singly in the muscle of infected fishes. Ugbor *et al.* (2014) identified *Procamallanus laevionchus* (3.46%) and *Rhabdochona congolensis* (2.16%) as nematodes encountered in the intestines and stomach of the host fish. *Calculanus* sp (40.4%) was highest in the report of Alade (2015) with the highest prevalence in *Clarias anguillaris*. Although sites of parasitism were not mentioned, significant difference existed in the

occurrence of the parasites encountered (P≤ 0.05) such as *Monobothrium* sp, *P. clariae* and *N. ruitili*. Owolabi (2008) reported *Procamallanus laevionchus* and *Cuculanus* sp in Jebba Lake, with the highest prevalence of 2 7.81%.

Omeji *et al.* (2013) found *Eustrogylides* and *Camallanus* along Lower River Benue at Makurdi. The nematode reported by Aliyu and Solomon (2012) was *Procamallanus* sp which was regarded as the commonest infection, which came up as a result of the intermediate host inhabiting the bottom of the pond, on which the fish also feed, supporting Imevbore and Bakare (1970). Dauda *et al. (*2016) reported prevalence of nematode in *Tilapia zilli* as 17.70%. Hassan *et al.* (2010) recorded *Procamallanus* in *Clarias gariepinus* in Lagos. Ezenwaji *et al.* (2005) reported *Paramacallanus leavionchus* ranging from 3.8% to 20% in *Synodontis nigrita, S. xiphias*, with no infection in *S. filamentosus.* Uchechukwu (2015) reported 47.62% prevalence of *Procamallanus laevionchus* in homestead ponds in Enugu. Omeji *et al.* (2014a) in Makurdi Benue state reported *Camallanus* sp, *Capilaria* sp, *Contracaecum* sp, *Eustrongylides* sp and *Caenorhabditis briggsae* with 2.63% prevelance in the stomach, Akinsanya *et al.* (2007) found *Nilonema* sp in fish examined.

Ekanem *et al. (*2014) gave account of *Camallanus kirandensis*, and *Clinostomium* sp in the stomach while *Pomphorphyncus laevis* was sighted in the intestine of fish examined, Urukwu and Adikwu (2017) in their investigation recorded 5.33% prevalence of *Procamallanus laevionchus*, in *C.gariepinus*, 3.67% in *C. angulliaris*, while *Eustrongylides* was 1.67% in each of the species.

ii. Trematodes

They are flattened in nature, while some cause small problems in fish, others can completely block the intestine.Their intermediate host include copepods and crustacean.It consists of the class monogenea and digenea types while the monogenea consist of *Dactylogyrus, Gyrodactylus,* species infecting fresh and brackish waters, its site of infections are gills, skin, stomach, causing hyperplasia of gills epithelium and dysfunction of respiratory system (Baker and Cone, 2000; (FAO, 1996). The class digenea infects *Clarias, Oreochromis* fish species causing rupture of gills epithelium, disruption of the heart, brain and eye as a result of infection on the fish organs (Agure-Macedo *et al.*, 2005).

Okoye *et al.* (2014) reported that *T. zilli*, *Hepsetidae fasciatus,* and *T. obscura* were infected with *Clinistomidae* sp, *Clinistomium tilapiae*, with the region of infection being the skin, fin, opercular, jaw, gill, and internal body walls which support the findings of Khalil (1971). Okoye *et al.* (2014) reported prevalence of 0.7% in *Clinostomium tilapiae* in *T.zilli*, trematodes found by Onyedineke *et al*. (2010) were *Paramphistomum* sp on gills of *Synodontis clarias*, while *Bacephalus* sp were found on *Distichondus engycepalus* Onyedineke *et al*. (2010). Iyaji *et al.* (2015) reported *Clinostomum* sp, *Allocreadium ghaensis* and *Phygidiopsi* sp, while *Clinistomium* sp was isolated from the muscle of *C. nigrodigitatus* by Vincent *et al*. (2014).

Olurin and Somorin (2006) have reported *Clinostomiun tilapiae* in Owa stream, South west Nigeria. Dauda *et al.* (2016) in Gombe recorded 13.7% prevalence rate in *Tilapia zilli.*, Amaechi (2014) reported *Euclinostomium heterostomium, Clinostomium tilapiae* while *Orechromis niloticus* had highest prevalence (35.9%) infected by *C. tilapiae.* This report was similar to Olurin and Somorin *et al.* (2006) because the two parasites were also found, while Paperna (1980) reported the parasites were widespread in Cichlids. Olurin *et al*. (2012) have implicated piscivorous birds as definitive host of *Clinostomium tilapiae*, while Ezenwaji *et al.* (2005) in their study of Anambra River reported *Sandonia sudanensis* as inhabiting the stomach, small and the large intestines of *Heterobranchus membraneceous*, Omeji *et al*. (2014) found *Henneguya* sp, *Clinostomium* sp along a lower Benue River at Makurdi.

Digenetic trematodes namely *Alloglosium corti* and *Polyoncobothrium clariae* had 9.5% and 4.7% prevalences respectively in Enugu as reported by Uchechukwu (2015), while Salawu *et* al. (2013) recorded *Clinostomium* sp. in *C. gariepinus* and *C. pachynema* from Ogun River. Ashade *et al.* (2013) reported *Gyrodactylidae* parasites in the skin of *O. niloticus*, while Adeogun *et al.* (2014) also found it in Claridae fish at 7.56% intensity. Ashade *et al.* (2013) gave account of *Bothriocephalus camallanus, Clinostomium* and *Contrecaecum* infecting the fish intestine. Ashade *et al. (*2013) found 3.24% intensity rate of prevelance of *Dactylogyrus* in *Clarias* sp.

iii. Cestode

They are tapeworms and are found to be widespread in water systems of Africa demonstrating a high degree of host specificity (FAO 1996), The two main forms of cestode include the monozoic represented by the *Caryophyllaeidae* and the amphilinid represented by the Pseudophyllideans and the Protocephalideans (Khalil, 1971; Van As and Basson 1984). Siluriform fish are the most common host of the two main groups (FAO, 1996), while the *Caryophyllaeidae* infect the digestive tracts of hosts, in addition the Pseudophyllideans infect the coelomatic cavity with symptoms being obstructions of intestines, nodules in gall bladder and tissue inflammation respectively(Khalil,1971; Van As and Basson 1984).

Okoye *et al. (*2014) have reported *Proteocephalus* sp, and *Camallanus* sp, infecting intestine of *Auchenoglanus occidentalis, Chrysicthys auratus, C. guntheri* and *H. fasciatus*. Also Ekanem *et al.* (2011), Onyedineke *et al.* (2010) reported *Diphyllobothrium* in the stomach and gills of *Chrysichthys nigrodigitatus*, while with *Protocephalus* sp in *Tilapia galilaeus* and *Ctenopoma kingleye*, while *Procamallus* sp inhabit *Hydrocymus vitatus* and *Mormymus rume* with *Neochinorhyncus* sp parasitized *Lates nilotius* according to Onyedineke *et* al. (2010). Akinsanya *et al.* (2007b) both reported high organ –host specificiity. Prevalence of cestodes in *Clarias gariepinus* was 19.17% according to Oniye *et al.* (2004), while the cestodes found were *Amonotaenia* sp, *Polyonchobothrium clariae,* with *Monobothrium* sp in the majority of (13.33%). Biu *et al.* (2014) in Maiduguri reported 33.3% of Pleurocercoid, and *Monobothroide woodlandi* (7.79%). And *Polyonchobothrium clariae* (8.23%) were reported by Ugbor *et al.* (2014), Owolabi (2008) reported *Polyonchobothrium* sp in Jebba Lake. Kawe *et al.* (2016) reported in Abuja *Polyonchobothrium clariae* as (10.8%), and Heterophyid fluke (2.4%). Aliyu and Solomon (2012) reported *Monobothrium* sp. which displayed high organ specificity as found in gall bladder supporting Paperna (1980) claim. Dauda *et al.* (2016) recorded 11.30% prevalence rate in *Tilapia zilli* in Gombe while Hassan *et al.* (2010) recovered *Wenyonia* spp., *Pseudophillidea, Pleuroceroid* larvae in *Clarias gariepinus.* Ezenwaji *et al.* (2015) reported *Wenyonia synodotis* in *Synodotis gobroni, Synodotis. ocellifer, Synodotis schall* and *Bothriocephalus bantesoda*, which ranged from 1.9% to 13.3% although *Wenyonia. Synodotis* was the most abundant while *Wenyonia* spp habit the small, large intestine and the stomach.

Omeji *et al.* (2014) found *Diphylobothrium latum* at 30.26% prevalence rate. Akinsanya *et al.* (2007) found *Proteocephalids* and *Electrotaenia malapteruri* in Lagos, Omeji *et al.* (2014) recorded *D. latum* as 22.16% and 24.37% in points A and B along river Benue, In addition to *Crytolobia lubilan* and *B. aengypticus* with 2.49% prevalence in each site. Urukwu and Adikwu have reported 1.0% and 2.67% prevalence of *D. latum* in *C. gariepinus* and *C.angullaris* respectively.

iv. Protozoa

The Parasitic types are common in fish (Klinger and Floyd 2002) and other aquatic products, causing severe diseases. They also have complex life cycle affecting vital organs and blood of fish. These include the ciliates, flagellates, microsporidians and myxozoans

building up to high numbers in crowded fish conditions, The parasitic effects are weight loss, debilitation and mortality (Klinger and Floyd 2002), while ciliates and the flagellates possess a direct life cycle, microsporidians are obligates and intracellular (FAO 1996).

Ekanem *et al.* (2011) revealed Protozoan infection in fish stomach and intestines from Great Kwa River in Calabar. According to Oniye *et al.* (2004) Iyaji *et al.* (2015) protozoan infection known as trichodinids were recorded in the gills of fish, while Ekanem *et al.* (2011) recorded a cyst formation of Protozoan. Blood parasite, *Haemogreganie* was reported by Biu *et al.* (2014) with incidence rate of 57.1%, while *Trypanosoma* had 9.5% and Babesiosma 4.8%. Ugbor *et al.* (2014) reported *Tricodina acuta as* 13.4% and *Epistylis* sp 12.26% in Anambra River from the gills, skin of fish with the protozoan infection present throughout the year with the peak during the dry season, Omeji *et al* .,(2014) also found *Hexamita* and *Trypanosoma.* 67.33% fish were infected by protozoans. such as *Ichtoyobodo necator* 35.5% in the gills, *Cryptobia ubilans* 28.9%, in the stomach, *Eimeria chrisichthyii* 22.3% in the intestine, *Piscinoodinium pillulare* (5.0%) in the gills, *Chloronyxum auratum* (3.3%) in intestine *Chilodonella uncinata* (1.8%) in the gills *Hexamita intestinalis* and *Encephalitogoon intestinalis* (1.5%) occurring in the stomach, gills were mostly affected organ (42.1%), followed by stomach 30.5%, intestine 27.4%, while the most abundant and other least were of phyla *Euglena* and *Microspora* respectively Ashade *et al.* (2013) recorded *Tricodina* in fish in dry season, due to less rainfall, Adeogun *et al.* (2014) reported 0.91% of *Tricodina* sp. in *Clarias sp.* Urukwu and Adikwu (2017) reported in Benue river highest prevalence of 5.37% as protozoans than any other parasites which tallied with Adeogun *et al.* (2014).

v. Acanthocephalan

They have hooks arrangements on the proboscis (Kabata 1985), while according to (FAO 1996) the proboscis are evaginable with rows of recurved hooks, they lack alimentary canal, adults worms are gut parasites leading to laying of eggs in intestinal lumen which gets to the exterior via faeces, which are ingested by the first intermediate hosts such as copepods (FAO 1996), its pathogenicity is due to the attachments of hooks of adult parasites which is determined by the penetration of depth of proboscis, Oniye *et al.* (2004), and the encapsulation of larval stages in the tissue with the extent of damage proportionate to the depth of penetration of the proboscics, (FAO 1996), the worms are found in diverse African fish., Golvan,1965; Khalil 1971).

Okoye *et al.* (2014) reported *Neoechinorhynchus* sp in the intestine of *Tilipia guineesis* and duodenum of *Hepsetidae fasciatus* with prevalence of *Neochinorhycus* sp as 71.7% in *T. zilli.* Onyedineke *et al.* (2010) recorded *Pomporhynchus quadrigidae* and *Neochinorhyncus* in illushi which agrees with Olurin and Somorin (2006) recovering same from Fish in Owa Stream, South west Nigeria, Oniye *et al.* (2004) reported *Neochinorhyncus rutili* in Zaria contrary to Okoye *et al.* (2014) where two types of acanthocephalans were reported.

Vincent *et al.* (2014) reported *Neochinorhyncus, Pomphorhychus*, *Acanthocephalus* as three genera encountered in Warri, South south Nigeria, where high degree of parasitism were shown specifying 87.5% for *Synodontis clarias*, which supported Akinsanya *et al*, (2008), Biu *et al.* (2014). However Alade (2015) reported the least infection was *Neochinorhyncus rutili* in Inoyo town, Oyo.

vi. Annelida

Tachia *et al. (*2012) recorded leech; *Pisciola,*geometra as ectoparasites of *C. gariepinus* which accounted for 59.1% of parasites encountered, while midge larva had 40.9 % abundance.

CONCLUSION

This review has provided detailed information about some parasites affecting the different types of fishes in Nigeria water habitat, it may provide sufficient

information to all connected to aquaculture resources and assist in the optimal utilization and preservation of natural and man-made water bodies, it could also assist to develop a novel medication against drug resistant parasites through further research and development, ultimately leading to abundance of disease free fish and its seedlings. As a result of connectivity between parasitism and physico- chemical parameters of aquatic environment, the review if continually carried out can act as template to monitor the Nigerian water so as to keep vigilant in the case of pollution and toxicity and by extension use parasitism studies as a check indicator to ascertain the ecological impact assessment of the aquatic habitat, this review can provide adequate knowledge of fish parasites of Nigerian water, a suggestion of bioinformatics should be established by the authorities concerned which will serve as a data bank that will accommodate diversity of parasites of fish recorded as a reference to further investigation and environmental management studies. Constant survey of parasitism of Nigerian fishes should be a routine check to create awareness on public health, its implications on diseases transference to human and on economy implications on feed conversion ratio of fish

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