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Endoparasites of fresh water fishes from rivers in Edo State, Nigeria

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Abstract

Parasites of fish constitute one of the major problems to fish health. Parasites of fish have been a great concern since they often cause disease conditions in fishes. This study described the parasitic faunas of eight fresh water bodies in Edo state (Ikpoba river, Ogba river, Ujogba river, Niger river at Illushi, Obe river, Gelegele river, Niger river at Agenebode and Osomegbe river). The duration of fish sampling was from October, 2017 to November, 2017.The fish samples (whole catch sourced from fishermen) were collected for identification, morphometric analysis and examination for the presence of parasites. One-way ANOVA and Tukey Honest Test were used to compare the data among size classes at the level of $p < 0.05$. Three orders (Lepidosirenformes, Siluriformes and Polyteriformes), eight families (Protopteridae, Clariddidae, Channiddae, Polypteridiidae, Melapteridae, Clarotidae, Cichlidae and Lorcariidae) and fourteen genera were examined. The study had an overall prevalence of 25.34%. The highest prevalence of fish parasitic infection was recorded in Niger river along Agenebode. Overall, parasite taxa recovered were nematodes (65.50%), trematodes (27.00%), cestodes (4.27%) and acanthcephalans (3.27%). The most infected fish species was *Clarias gariepenus* (13.77%). The helminth taxa (nematodes) had the highest prevalence of parasites (65.50%). The largest number of parasites isolated was *Camallanus cotti* (30.43%) and *Procamallanus laevionchus* (17.39%). This study showed river Niger at Agenebode with most parasitic prevalence, nematodes as the most prevalent parasitic taxa and *Clarias gariepenus* as the most infected fish species.

Keywords: Edo state, Freshwater fishes, Fish parasites, Helminths, Parasite taxa, Nigeria

Introduction

Freshwater fish serve as definitive, intermediate or paratenic (transport) host in the life cycle of many species of protozoan, metazoan and crustacean parasites (Skelton, 2001). Parasites of fish constitute one of the major problems to fish health. Parasites of fish have been a great concern since they often bring about a host of disease conditions in fishes. A parasite is an organism that lives on or within a part of another species from which it obtains nutrients. These diseases often produce a weakening of the hosts' immune system thereby increasing their vulnerability to other secondary infections (Eyo & Iyayi, 2014). The effects of these diseases result to nutritive devaluation of fish and fish loss. Parasites also result to fish's declining swimming ability, decrease in growth rate and increase in mortalities (Piaseck *et al*.,

2004). In order to obtain healthy and quality fish meat, it is necessary that the fish should be free from all types of pathogens like bacteria, algae, protozoans, helminths, annelids, arthropods and molluscs. However, studies have shown different parasite taxa have the potential to accumulate a large number of trace metals, heavy metals and organic pollutants thus serving as useful sentinels (Sures *et al*., 2017).

Studies have been done on parasites of fish in some water bodies in Nigeria (Okaka & Akhigbe, 1999; Onyedineke *et al*., 2010; Ekanem *et al*., 2011; Ejere *et al*., 2014; Kawe *et al*., 2016; Simon-Oke, 2017; Onyishi & Aguzie, 2018). These studies were restricted to parasites of fish from one river. This paper appears to be the first to provide information on the parasites of fish, their prevalence of infection, and mean abundance of fish species community across streams and rivers in Edo state.

Materials and Methods

Study area and setting

Fishes used for the study were sourced directly from fishermen operating with gill nets and cast nets from the eight rivers (river Niger at Agenebode, river Osomegbe, river Obe, Ikpoba river, Ogba river, Gelegele river, river Niger at Illushi and river Ujogba in the three senatorial districts (North, South and Central) of Edo state. The river Niger at Agenebode, a waterside town located by the bank of the river in Estako East local government area, Edo State located within latitude 6° 42'N and longitude 7° 06'E; river Osomegbe, a municipal river which lies between latitude 6° 44'N and longitude 7° 05'E in Ekperi, Estako Central local government area; river Obe in Estako Central local government area; Ikpoba river in Ikpoba-Okha local government area which lies between latitude 6º 13'N and longitude 5° 46'E; Ogba river in Oredo local government area located within longitude 6° 14'N and latitude 5º 29'E; Gelegele river located within latitude 6° 31'N and Longitude 5° 29'E in Ovia North-East Local Government Area; river Niger at Illushi which lies within longitude 6° 40'N and latitude 6° 37' E located in Esan South-East local government area; river Ujogba which lies within longitude 6° 52'N and latitude 6° 14'E located in Esan West local government area.

Subjects and sample size determination

The sample size for the study was determined using the formula of Charan & Biswas (2013) for simple independent proportion with a mean prevalence of 36.4% from previous studies (Okaka & Akhigbe, 1999; Onyedineke *et al*., 2010; Ejere *et al*., 2014) in the study area. The calculated sample size was 354 but after adjusting for non-response rate, the sample size was increased to 363.

Sample collection and examination

The duration of fish sampling was from October 2017 to November 2017. The fish samples were kept in ice chest plastic coolers and transported live to the Laboratory. Dead fishes were not examined for parasites. In the laboratory the fishes were identified to species level using keys provided (Teugels *et al*., 1992; Olaosebikan & Raji, 1998). Fish standard length (SL – from the snout to the base of the caudal peduncle) was determined with a meter rule while body weight (BW) was determined using a weighing balance (Model DT, 1000).

The sexes of the fish were determined by either pressing the abdomen of each fish specimen for the extrusion of whitish milt (for males) or eggs (for females) in the case of matured fish, or the dissection of fish to check for the presence or absence of testes or ovaries or the excision and examination of gonads under the microscope for immature eggs or milt.

The gut of freshly caught fish specimen was cut into oesophagus, stomach, small intestine, large intestine and rectum. These were examined for endoparasites using clean implements to avoid transfer of parasites from one site to another. A special note was taken of any damage to tissues/organs of the host by recovered parasites. The sorted specimens were preserved in 4% formaldehyde.

Statistical analysis

The prevalence (number of individuals of a host species infected with a particular parasite species per number of hosts examined), mean intensity (total number of individuals of a particular parasite species in a sample of a host species per number of infected individuals of the host species in the sample) and abundance (total number of individuals of a particular parasite species in a sample of hosts per total number of individuals of the host species in the sample) of each parasite species were determined according to Bush *et al*. (1997). Shannon wiener index of diversity and evenness were determined according to Hennersdof *et al*. (2016). One-way ANOVA and Turkey Honest Test were used to compare the data among size classes at the level of 0.05, while the helminth infection in relation to sex was tested using the Chi-squared (χ^2). Data was analyzed using SPSS version 20.0 (IBM Corporation, Armonk, USA).

Results

A total of 363 fish samples belonging to three orders (Lepidosirenformes, Siluriformes and Polyteriformes), eight families (Protopteridae, Clariidae, Channidae, Polypteridiidae, Melapteridae, Clarotidae, Cichlidae and Lorcariidae) and fourteen species; 45 *Protpterus annectens*, 167 *Clarias gariepenus*, 12 *Heterobranchus longifilis*, 15 *Clarias anguilaris*, 12 *Parachanna obscura*, 18 *Malapterus electricus*, 3 P*terygoplichthys multiradiatus,* 37 *Tilapia zilli,* 2 *Erepetochthys calabarichus*, 4 *Auchenoglanis occidentalis*, 15 *Chromidotilapia guntheri,* 14 *Oreochromis niloticus,* 3 *Tilapia mariae* and 16 *Heterobranchus bidorsalis* were subjected to parasitological investigation.

The overall prevalence of the infection was 25.34%. The highest prevalence of infection was recorded in *C. gariepenus* (13.77%), *P. annectens* (3.58%) and *C. anguillaris* (2.48%). The highest parasitic index of diversity was recorded in *C. gariepenus* (1.88), *H. longifilis* (1.34) and *P. annectes* (1.15) (Table 1). *Acanthocephalus acutulus* (0.17) and *Camallanus cotti* (0.24) were observed to be relatively more abundant in *C. gariepenus* (Table 2). The recovered parasites presented by taxa were nematodes, trematodes, cestodes and acanthcephalans; each taxon had a prevalence of 65.50%, 27.0%, 4.27% and 3.27% respectively. Generally, the overall prevalence of parasites was higher in male fish specimens (15.30%) than in female fish specimens (10.64%). The overall mean abundance and mean intensity of parasites recorded in this study were 0.33 and 1.32 respectively, while the overall index of diversity and evenness was 1.54 and 0.67. The different species of examined fish showed variation in parasite prevalence when compared by sex. In *P. annectes* and *P. obscura* the male had a parasite prevalence of 8.89% and 8.33% respectively as against 20.00% and 16.67% respectively in the female. In *C. gariepenus, C. anguillaris, T. zilli* and *C. guntheri,* the male had a higher parasite prevalence of 19.16%, 40.00%, 5.41% and 13.33% respectively as against the female with parasite prevalence of 10.78%, 20.00%, 2.70% and 6.67% respectively. *H. longifilis* and *P. multiradiatus* had an even distribution of parasite prevalence of 25.00% and 33.30% respectively among the sex of the fish specimens examined. In *M. electricus* and *T. mariae*, only male fish specimens where infected with parasites 11.11% and 33.33% respectively (Table 3). The largest number of parasites isolated was *Camallanus cotti* (30.43%) and *Procamallanus laevionchus* (17.39%) (Table 4). These parasites occurred in the stomach and intestine of the infected fish species. River Niger at Agenebode harbored the fishes with the most parasitic prevalence (11.29%). The mean intensity of parasitic infection was higher in Edo North (river Niger along Agenebode, river Osomegbe and river Obe) with mean intensity value of 1.59, 1.2 and 1.4 respectively (Table 5). There was no record of parasites in the fishes collected from Gelegele river.

Table 1: Prevalence, mean intensity, abundance and diversity of parasite in examined fish species

S/N	Fish species	Number examined	Number infected	Parasite collected	Prevalence	Intensity	Abundance	Diversity	Evenness
1	*P. annectens*	45.00	13.00	29.00	3.58	2.23	0.64	1.15	0. 83
2	*C. gariepenus*	167.00	50.00	60.00	13.77	1.20	0.36	1. 88	0.78
3	*H. longifilis*	12.00	6.00	7.00	1.65	1.17	0.58	1.34	0.97
4	*C. anguillaris*	15.00	9.00	12.00	2.48	1.33	0.80	0.99	0.71
5	*P. obscura*	12.00	3.00	4.00	0. 83	1.33	0.33	0.64	0.92
6	*M. electrichus*	18.00	2.00	1.00	0.55	0.5	0.06		
7	*P. multiradiatus*	3.00	2.00	2.00	0.55	1.00	0.67	0.68	0.98
8	*T. zilli*	37.00	3.00	3.00	0. 83	1.00	0.08	0.64	0.92
9	*E. calabaricus*	2.00	0.00						
10	*A. occidentalis*	4.00	0.00						
11	*C. guntheri*	15.00	3.00	3.00	0. 83	1.00	0.20	0.64	0.92
12	*O. niloticus*	14.00	0.00						
13	*T. mariae*	3.00	1.00	1.00	0.28	1.00	0.33		
14	*H. bidorsalis*	16.00	0.00						
	Total	363.00	92.00	122.00		1.32	0.33	1.54	0.67

Table 2: Mean intensity, abundance and index of diversity in the examined fish samples

Fish species and the amount examined	Infected per fish Species	Number of parasites	Parasite species	Prevalence	No recovered	Mean intensity	Abundance
P. annectens 45	13	1	*C. polypteri*	2.2	2	2.0 ± 0.08	0.04
		2	*M. woodland*	4.4	2	1.0 ± 0.15	0.04
		3	*C. marginatum*	6.7	16	5.0 ± 0.23	0.36
		7	*P. laevionchus*	15.6	9	1.0 ± 0.54	0.20
C. gariepenus 167	50	2	*E. vermicularis*	1.2	2	1.0 ± 0.04	0.01
		6	*A. occilatum*	3.7	8	1.0 ± 0.12	0.05
		5	*D. tetumi*	3.0	5	1.0 ± 0.10	0.03
		22	*C. cotti*	13.2	28	1.4 ± 0.44	0.17
		3	*A. acutulus*	1.8	4	1.3 ± 0.06	0.24
		2	*Gyrodactylus*	1.2	2	1.0 ± 0.04	0.01
		4	*P. laevionchus*	2.4	5	1.3 ± 0.08	0.03
		1	*D. dendriticum*	0.6	1	1.0 ± 0.02	0.01
		1	*C. species*	0.6	1	1.0 ±0.02	0.01
		3	*D. latum*	1.8	3	1.0 ± 0.06	0.02
		1	*T. pirifomis*	0.6	1	1.0 ± 0.02	0.01
H. longifilis 12	6	1	*D. tetumi*	8.3	1	1.0 ± 0.17	0.08
		2	*C. cotti*	16.7	2	1.0 ± 0.33	0.17
		2	*P. laevionchus*	16.7	3	1.5 ± 0.33	0.25
		1	*D. latum*	8.3	1	1.0 ± 0.17	0.08
C. anguillaris 15	9	6	*Capillariaspp*	40.0	9	1.5 ± 0.67	0.60
		1	*M. woodland*	6.7	1	1.0 ± 0.11	0.07
		1	*Taeniaspp*	6.7	1	1.0 ± 0.11	0.07
		1	*P. laevionchus*	6.7	1	1.0 ± 0.11	0.07
P. obscura 12	3	1	*D. tetumi*	8.3	2	1.5 ± 0.67	0.17
		2	*C. cotti*	16.7	2	1.0 ± 0.67	0.17
M. electrichus 18	2	2	*C. cotti*	11.1	1	1.5 ± 1.00	0.06
P. multiradiatus 3	2	1	*D. tetumi*	33.3	1	1.0 ± 0.50	0.30
		1	*D. dendriticum*	33.3	1	1.0 ± 0.50	0.30
T. zilli 37	3	1	*C. tilapia*	2.7	1	1.0 ± 0.33	0.03
		2	*P. laevionchus*	5.4	2	1.0 ± 0.67	0.05
E. calabaricus 2				0.0			
A. occidentalis 4				0.0			
C. guntheri 15	3	2	*C. osculatum*	13.3	2	1.0 ± 0.67	0.17
		1	*B. appendiculatum*	6.7	1	1.0 ± 0.33	0.13
O. niloticus 14				0.0			
T. mariae 3	1	1	*S. siluri*	33.3	1	1.0 ± 1.00	0.3
H. bidorsalis 16				0.0			
363	92	92		25.3	122		

Table 3: Prevalence of parasite infection in examined male and female fish samples

S/N	Fish species	Number examined	Number infected	Male	Female	Prevalence
1	*P. annectens*	45.00	13.00	4 (8.89)	9 (20.00)	28.89
2	*C. gariepenus*	167.00	50.00	32 (19.16)	18 (10.78)	29.94
3	*H. longifilis*	12.00	6.00	3 (25.00)	3 (25.00)	50.00
4	*C. anguillaris*	15.00	9.00	6 (40.00)	3 (20.00)	60.00
5	*P. obscura*	12.00	3.00	1 (8.33)	2 (16.67)	25.00
6	*M. electrichus*	18.00	2.00	2 (11.11)	0	11.11
7	*P. multiradiatus*	3.00	2.00	1 (33.33)	1 (33.33)	66.67
8	*T. zilli*	37.00	3.00	2 (5.41)	1 (2.70)	8.11
9	*E. calabaricus*	2.00	0.00			
10	*A. occidentalis*	4.00	0.00			
11	*C. guntheri*	15.00	3.00	2 (13.33)	1 (6.67)	20.00
12	*O. niloticus*	14.00	0.00			
13	*T. mariae*	3.00	1.00	1 (33.33)	0	33.33
14	*H. bidorsalis*	16.00	0.00			
	Total	363.00	92.00			

Table 4: Prevalence of parasites from the rivers

S/N	Names of Parasites	Number of hosts	Parasites recovered	Prevalence
1	*C. polypteri*	1	2	1.09
2	*M. woodlandi*	3	3	3.26
3	*C. maginatum*	3	16	3.26
4	*P. laevionchus*	16	20	17.39
5	*E. vermicularis*	2	2	2.17
6	*A. occilatum*	6	8	6.52
7	*D. tetumi*	8	9	8.70
8	*C. cotti*	28	33	30.43
9	*A. acutulus*	3	4	3.26
10	*Gyrodactylus*	2	2	2.17
11	*D. dendriticum*	7	2	7.60
12	*C. species*	4	10	4.35
13	*D. latum*	1	4	1.09
14	*T. pirifomis*	1	1	1.09
15	*T. species*	1	1	1.09
16	*C. tillapia*	1	1	1.09
17	*C. osculatum*	2	2	2.17
18	*S. siluri*	1	1	1.09
19	*B. appendiculatum*	1	1	1.09
	Total	92	122	

Discussion

The overall prevalence of parasitic infection (25.34%) was low compared to 67.5% recorded in Abuja, Nigeria (Kawe *et al*., 2016), 65.0% recorded in Ebonyi river, Enugu state, Nigeria (Onyishi & Aguzie, 2018), 60.23% recorded in Elemi river, Ado Ekiti, Ekiti State, Nigeria (Olofintoye, 2006), 59.20% recorded for fishes in Niger river at Illushi Edo state, Nigeria (Onyedineke *et al*., 2010), 57.34% recorded in Eleyele dam, Ibadan, Nigeria (Simon-Oke, 2017), 48.40% recorded in water reservoir, Ado Ekiti, Ekiti State (Omoniyi & Olofintoye, 2001) and 32.90% recorded in Warri river, Delta state (Ejere *et al*., 2014).

Table 5: Prevalence, mean intensity, abundance and diversity of the eight rivers examined

Rivers	Fish examined	Fish Infected	Parasite recovered	Prevalence	Mean intensity	Abundance	Diversity	Evenness
Gelegele	29	0	0	0	0	0	0	
Ikpoba	65	6	5	1.65	0. 83	0.08	1.68	0.98
Ogba	42	7	8	1.93	1.14	0.19	0.98	0.89
Illushi	35	17	17	4.68	1	0.49	0.55	0.79
Ujiogba	21	1	1	0.28	1	0.05	0	0
Agenebode	114	41	65	11.29	1.59	0.57	1.52	0.78
Obe	28	10	12	2.75	1.2	0.42	0.96	0. 87
Osomegbe	29	10	14	2.75	1.4	0.48	1.18	0. 85
Total	363	92	122	25.34	1.32	0.33	1.45	0.75

It was however higher compared to the 17.10% prevalence of infection recorded in Osse river, Okhuo river (6.90%) and 3.30% prevalence recorded in Great Kwa river by Okaka & Akhigbe (1999); Edema *et al*. (2008) and Ekanem *et al*. (2011), respectively. It can be inferred that infection prevalence therefore, seems to vary greatly from one locality to another. This variation in the endoparasitic communities may be due to shift in the host's feeding behavior as well as the available food items from one location to another. Prevalence can also be due to the life history patterns of parasites, differences in environmental fluctuation as well as the parasitic intermediate host available (Marcogliese, 2005). The sanitary condition of the river prior to increase in the nutrient status of the river by anthropogenic activities may also define the rate of parasitic prevalence (Onyedineke *et al*., 2010).

This study recorded a high nematode prevalence of 65.50% which was the highest as represented by taxa in this study. The result is also in line with the report of Okaka & Akhigbe (1999) and Onyedineke *et al*. (2010) who stated a high prevalence of nematode in Osse river in Benin and Niger river in Illushi respectively, both in Edo state. The high prevalence of nematode parasites may be attributed to the presence of appropriate intermediate host (Khan, 2012), efficiency in transmission of parasite to fish host (Iyaji *et al*., 2009) and trophic linkage with the fish (Lagrue *et al*., 2011). Branciari *et al*. (2016) reported that piscivorous birds feed on nematode and trematode infected fish and when they defecate the eggs are released in the water, this in turn develop into the infective stage which infects other fishes. Trematodes were recorded as the second most prevalent parasite taxa. This is in line with the report of FAO (1996) who asserted that trematodes are heteroxenous with multiple host life cycles involving both bivalves and gastropod molluscs as intermediate host. The result of these findings buttresses the assertions of Koprivnikar (2006) who opined that the prevalence of trematodes as parasites of fishes correlates with the presence of surrounding forest areas rather than urban or agricultural areas. Most of the rivers studied are relatively pristine and located in the rural environment.

The most occurring parasite was *C. cotti* with prevalence of 30.43%, *P. laevionchus* (17.39%) and *D. tetumi* (8.69%). Wiliam & Jones (1994) reported that due to the activities of these parasites the nutritive values of the host fish may depreciate.

The study reflects a high index of parasitic diversity in Edo North and Edo Central (especially in the river Niger at Agenebode) which are relatively classified as rural settlements.

The high index of parasitic diversity in this study could be attributed to varying factors. Hudson *et al*. (2006) reported that an ecosystem is considered to be healthy if she also poses a rich index diversity of parasitic organisms. The index of diversity of the parasitic fauna of the fishes in Edo south (mainly the industrial hub of the state) recorded 0.22 while the intensity of infection was 1.11. The study shows that the value recorded for parasitic intensity is relatively higher than the value recorded for index of diversity. If the life functions of a parasitic host are perturbed (due to factors such as longer duration of exposure and or high level of concentration of pollutants) such

may lead to either mortality or reduction in the reproduction of the said parasitic host. The result is a rapid increase in the amount of host of other parasites due to relatively less competition. The implication of the increase in the amount of the host of other parasites may lead to an increase in the transmission of their parasites. Thus, the proliferation of certain parasites of direct life cycle is due to impaired host response in polluted condition (Marcogliese, 2005). Pérez-del (2007) stated that pollutants reduce the diversity of parasites with indirect life cycle and the parasites with direct life cycle are less affected by the presence of pollutants. The implication of this record indicates that the rivers in Edo south may be relatively polluted. However, studies involving parasites alone as an indicator should be interpreted cautiously as factors such as the presence of the natural environment and their collective hosts may be more important in shaping the parasitic population structure.

In conclusion, the study shows the prevalence of endoparasitic faunas in fresh water fishes of eight rivers. The rivers showed a relatively high overall prevalence of parasitic infection with most infections from the taxa of nematodes. The need to investigate more rivers and longer duration of time to cover wet and dry season is necessary for proper monitoring. The need to inculcate proper monitoring of anthropogenic activities in and around our aquatic environment should be encouraged.

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