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PARASITOFAUNA OF FIVE FRESHWATER FISHES IN A NIGERIAN FRESHWATER ECOSYSTEM

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ABSTRACT

The parasitic fauna of freshwater fishes of the Warri River, Delta State, Nigeria, with reference to their prevalence, intensity and differences in metazoan parasites between fish sexes, was investigated. A total of 85 fish samples comprising of 21 *Tilapia zillii* (Cichlidae: Perciformes), 23 *Synodontis clarias* (Mochokidae: Siluriformes), 23 *Chrysichthys nigrodigitatus* (Claroteidae: Siluriformes), 16 *Hepsetus odoe* (Hepsetidae: Characiformes) and 2 *Clarias anguillaris* (Clariidae: Siluriformes) collected from the Warri River, Delta State, Nigeria, were subjected to parasitological examination. The overall metazoan parasite prevalence was 32.9%. The metazoan parasites recovered were mainly the acanthocephalans: *Neoechinorhynchus prolixum*, *Pomphorhynchus* spp., *Acanthocephalus* spp. and unidentified acanthocephalan, and nematodes: *Camallanus polypteri, Capillaria pterophylli, C. cichlasomae, Procamallanus laeviconchus, Philometroides africanus* and *Railletnema synodontis.* Although the acanthocephalans constituted 75.6% and nematodes 22.2% of the parasites recovered, the nematodes had the highest prevalence (23.5%) compared to the acanthocephalans (9.4%). Similarly, variable prevalences were observed for the other metazoan parasite taxa recovered, namely trematoda; *Clinostomum complanatum* (1.2%), Leech; *Pisciola geometra* (2.4%) and Crustaceans (1.2%). The highest parasite prevalence (39.1%) was observed in *S. clarias,* while the least (23.8%) was observed in *T. zillii*. Generally, the prevalence of parasites was higher in female (35.7%) than in the males (31.6%), although statistically no significant difference was observed in the prevalence by sex (X^2 = 0.145, P = 0.807). The relatively high overall parasite prevalence in fishes inhabiting the Warri River may be attributed to the relatively high level of pollution.

INTRODUCTION

Parasites are a major concern to freshwater and marine fishes all over the world, and of particular importance in the tropics (Iyaji and Eyo, 2008; Bichi and Dawaki, 2010; Ekanem et al*.,* 2011). They constitute a major limiting factor to the growth of farmed fish in Nigeria (Bichi and Yelwa, 2010). The effects of parasites on fish include nutrient devaluation (Hassan et al*.,* 2010); alteration of biology and behaviour (Lafferty, 2008); lowering of immune capability, induction of blindness (Echi et al*.,* 2009 a, b); morbidity, mortality, growth and fecundity reduction (Nmor et al*.,* 2004) and mechanical injuries depending on the parasite species and load (Echi et al*.,* 2009 a, b). Most supply of fish in Nigeria comes from the riverine ecosystem (Ekanem et al*.,* 2011). Delta State, Nigeria, where the Warri River is located, is a traditional fishing district with a vast coastal land mass in the deltaic area of the Niger River, Nigeria. The rivers, creeks, streams and water reservoirs rich in freshwater fish are its endowment (Agbamu and Orhorhoro, 2007). *Tilapia zillii,*

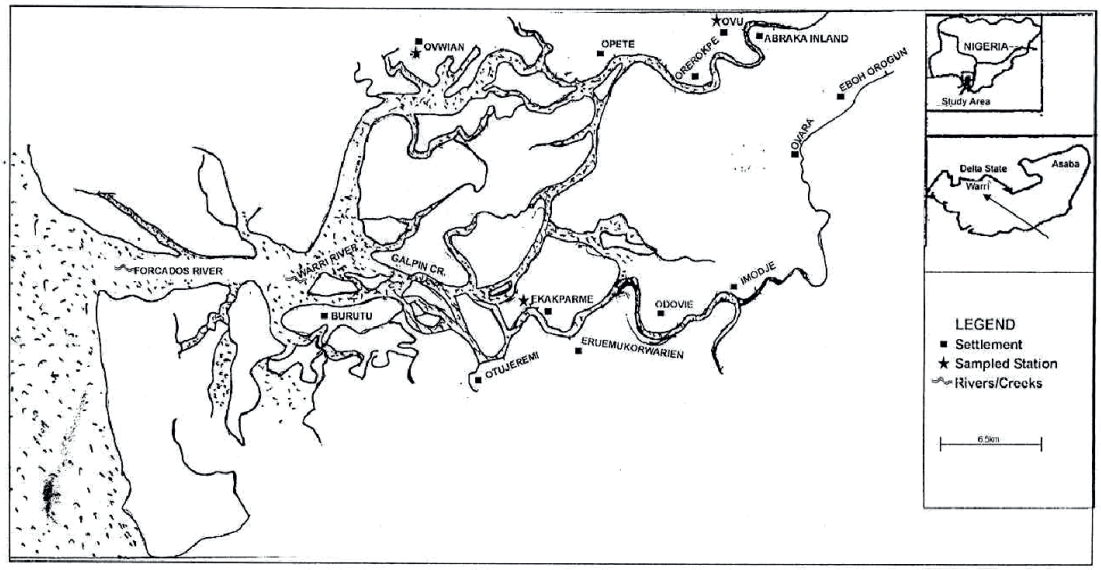

Fig 1. A map of the Warri River showing the study area (Ezemonye et al., 2008)

Hepsetus odoe, Synodontis clarias, Clarias anguillaris and *Chrysichthys nigrodigitatus* are among the several fish species found in the Warri River, Nigeria. They represent the most abundant fish species with the highest frequency of occurrence in the Warri River and are heavily harvested by fishers because of their high demand (Agbamu and Orhorhoro, 2007).

A review from Nigeria indicated that freshwater fish parasites belong to protozoans, trematode, nematode, cestode, acanthocephalan, copepod and hirudinea groups (Iyaji and Eyo, 2008). The presence of *Polyonchobothrium* and *Proteocephalus* (Cestoda); *Clinostomum, Allocreadium* and *Diplostomum tragena* (Trematoda); *Acanthogyrus* (Acanthocephala), *Camallanus, Procamallanus laeviconchus, Serradactnitis, Spironuora, Spirocamallanus* (Nematoda) in freshwater fish in the Osse River, Benin, Nigeria has been reported with 17.1% overall prevalence of parasite (Okaka and Akhigbe, 1999). Furthermore, the presence of *Acanthogyrus, Octospiniferoides, Camallanus, Cucullanus* and *Wenyonia* in freshwater cichlid fish of the Orogodo River, Delta State, Nigeria has been reported (Nmor et al., 2004). Data on freshwater fish parasite in the tropics are vast; the present research was an effort to contribute to existing data on metazoan parasites of freshwater fishes in the Warri River, Nigeria.

MATERIALS AND METHODS

Study area

The Warri River (Fig 1.) (Ezemonye et al., 2008) is a relatively large water body with the following geographic coordinates latitude 5°21' – 6°00' N and longitude 5°24' – 6°21' E, covering a surface area of about 255 km^2 and 150 km in length (Ezemonye et al., 2008). It derives its source from about 10 km from Utagba-Uno and flows into the brackish Forcados River that in turn empties into the Atlantic Ocean (Fig 1.). The Warri River is one of the most important coastal rivers of the Niger-Delta region, Nigeria (Olele, 2011).

Fish collection, identification, morphometry and sex determination

The fish species were obtained in May and June 2012 from fishers in the Makava river fish landing port along the Warri River, Nigeria. Fishes were identified to species level (Teugels et al., 1992; Idodo-Umeh, 2003; Olaosebikan and Raji, 2004). The weight of the fish was taken to the nearest 0.1 g using a triple beam balance, while the standard lengths were taken to the nearest 0.1 cm using a meter rule. The sex of fish was ascertained by both morphological examination and observation of the presence of testis and ovary using dissecting microscope upon dissection of the fish to expose the gonads (Ayanda, 2009).

Parasitofauna analysis

External surface of the fish was grossly examined using a hand lens for ectoparasitic species, crustaceans and hirudineans. Smear of scrapings from the skin, fins and gills were also examined for ectoparasites. The fish were sectioned and the alimentary canal, liver, kidney, swim bladder and spleen examined for endoparasites. The excised gastrointestinal tract was carefully sectioned into portions such as oesophagus, intestine and rectum and each portion was then cut open, washed in Petri dish with 0.1% sodium chloride solution and further rinsed with 0.1% sodium bicarbonate to enhance parasite search (Paperna, 1996; Marcogliese, 2011). Trematode cysts from the muscle were manually teased to release the metacercariae, which were

Table 1. Overall prevalence of parasite in the fish examined from the Warri River, Nigeria

Fish species	Number (%) of fish examined	Number (%) of fish infected	Number (%) infected with Acanthocephala	Number (%) infected with nematode
T. zillii	21(24.7)	5(5.8)	(0.0)	4(4.7)
S. clarias	23(27.1)	9(10.6)	7(8.2)	4(4.7)
C. nigrodigitatus	23(27.1)	7(8.2)	(0.0)	7(8.2)
C. anguillaris	2(2.4)	1(1.2)	(0.0)	1(1.2)
H. odoe	16(18.8)	6(7.1)	1(1.2)	4(4.7)
Total	85(100)	28(32.9)	8(9.4)	20(23.5)
χ^2		1.671	16.890	2.124
P		0.796	0.002	0.713

Table 2. Parasite abundance in the fish examined from the Warri River, Nigeria

Fish species	Number fishes infected	Number of parasite per taxonomic group					Total
		Acanthocephala	Nematode	Trematoda	Hirudinea	Crustacea	
T. zillii	5	0	4	0	1	0	5
H. odoe	6	1	10	0	0	1	12
S. clarias	9	145	15	0	0	0	160
C. nigrodigitatus	7	0	11	1	1	0	13
C. anguillaris	1	0	3	0	0	0	3
Total	28	146	43	1	2	1	193
Percentage (%)		(75.6)	(22.2)	(0.5)	(1.0)	(0.5)	

fixed in hot alcohol-formal-acetate (AFA) and preserved in 70% ethyl alcohol. Digenean trematode metacercariae were stained in Haematoxylin and Eosin (Paperna, 1996). Cestodes from the intestinal tract were placed in 0.1% sodium chloride solution and refrigerated overnight; this caused the parasite to relax and the scolex to extrude. The resulting cestode was then fixed in hot AFA for 2 minutes and preserved in 70% ethyl alcohol. Cestodes were stained with aqueous acetocarmine solution (Khalil, 1971). The acanthocephalans were placed in a refrigerator overnight in Petri dishes containing 0.1% sodium chloride solution (this caused the proboscis of the acanthocephalans to extrude) and then preserved in 70% ethyl alcohol (Marcogliese, 2011). Leeches collected from fishes were kept in mentholic water to ensure complete relaxation before fixation in 95% ethyl alcohol (Khalil, 1971). Isolated nematodes, mostly from the gut, were fixed in warm (80^{0}C) 10% neutralized formalin, and preserved in 70% ethyl alcohol containing 1% glycerine (Kabata, 1985). The parasites were identified using earlier established identification guides to species level (Yamaguti, 1961, 1963; Soulsby, 1982; Paperna, 1996; Pouder et al., 2011). Voucher specimens of fish and parasites were deposited in the Museum of Natural History, Department of Zoology and Environmental Biology, University of Nigeria, Nsukka, Enugu State, Nigeria.

Data analysis

Parasite mean intensities and prevalence were calculated as defined by Margolis et al. (1982). The prevalence, abundance and intensity of parasite species in hosts examined were analyzed using SPSS (version 17.0). Chi-square test was used to determine significant difference in parasite prevalence between the sexes.

RESULTS

A total of 85 fish, comprising of 21 *Tilapia zillii* (Cichlidae: Perciformes), 23 *Synodontis clarias* (Mochokidae: Siluriformes), 23 *Chrysichthys nigrodigitatus* (Claroteidae: Siluriformes), 2 *Clarias anguillaris* (Clariidae: Siluriformes) and 16 *Hepsetus odoe* (Hepsetidae: Characiformes), were sampled. *T. zillii* comprised of 11 males and 10 females, *S. clarias* of 14 males and 9 females, *C. nigrodigitatus* of 16 males and 7 females, *C. anguillaris* of 2 males, and *H. odoe* of 14 males and 2 females.

A total of 193 parasites were recovered from the fish examined. The overall parasite prevalence was 32.9% (Table 1). There was no significant difference in parasite prevalence for fish species (χ^2 = 1.671, df = 4, P = 0.796). The prevalence of infection by fish species were 23.8%, 39.1%, 30.4%, 50.0% and 37.5% for *T. zillii, S. clarias, C. nigrodigitatus, C. anguillaris* and *H. odoe,* respectively.

The recovered parasites presented by taxa indicated that the Acanthocephalan represented 75.6% of the isolated parasites, while nematode constituted 22.2%. Although acanthocephalan were the most abundant, the prevalence of nematode (23.5%) was higher than the prevalence of acanthocephalan. The identified acanthocephalans belonged to three genera, namely *Neoechinorhynchus* Blumenbach, 1779, *Pomphorhynchus* Monticelli, 1905 and *Acanthocephalus* Anderson, 1867 (Table 2).

Table 3. Parasite species composition, their prevalence and intensity in fish species collected from the Warri River, Nigeria

Taxa	Parasite species	Fish host	Number Examined	Number infected	Total Number of parasite recovered	Prevalence (%)	Mean abundance	Mean intensity
Acanthocephala	*Neoechinorhynchus prolixum*	*S. clarias*	23	2	8	8.7	0.35	4.0
	Pomphorhynchus spp			5	31	21.7	1.35	6.2
	Acanthocephalus spp			3	14	13.0	0.61	4.7
	Unidentified acanthocephalan			8	92	34.8	4.00	11.5
Nematoda	*Camallanus polypteri*			3	3	13.0	0.13	1.0
	Capillaria pterophylli			1	3	4.3	0.13	3.0
	Procamallanus laeviconchus			2	2	8.7	0.09	1.0
	Railletnema synodontis			1	6	4.3	0.26	6.0
Acantocephala	Unidentified acanthocephalan	*H. odoe*	16	1	1	6.3	0.06	1.0
Nematoda	*Camallanus polypteri*			4	9	25.0	0.56	2.3
	Philometroides africanus			2	2	12.5	0.13	1.0
Crustacea	Unidentified crustacean			1	1	6.3	0.06	1.0
Nematoda	*Procamallanus laeviconchus*	*T. zillii*	21	2	2	9.5	0.10	1.0
	Capillaria cichlasomae			1	1	4.8	0.05	1.0
Hirudinea	*Pisciola geometra*			1	1	4.8	0.05	1.0
Nematoda	*Camallanus polypteri*	*C. nigrodigitatus*	23	5	6	21.7	0.26	1.2
	Capillaria pterophylli			2	2	8.7	0.09	1.0
	Procamallanus laeviconchus			1	4	4.3	0.17	4.0
Trematoda	*Clinostomum complanatum*			1	1	4.3	0.04	1.0
Hirudinea	*Pisciola geometra*			1	1	4.3	0.04	1.0
Nematoda	*Camallanus polypteri*	*C. anguillaris*	2	1	2	50.0	1.0	2.0
	Capillaria pterophylli			1	1	50.0	0.5	1.0

Acanthocephalans with invaginated proboscis were all grouped as unidentified acanthocephalan. The nematodes were of five genera, *Camallanus* Bailliet and Henry, 1915, *Procamallanus* Baylis, 1923, *Capillaria* Zeder, 1800, *Philometroides* Yamaguti, 1935 and *Railletnema* Prod´hon, 1968. Two groups of nematodes were unidentified. In addition, one trematode parasite of the genus *Clinostomum* Leidy, 1857 was isolated from the muscle of a *C. nigrodigitatus* male; as well as a leech - *Pisciola* de Blainville, 1818 from the buccal cavity and a crustacean. There was no significant difference (p>0.05) in nematode prevalence in examined fish species. There was, however, significant difference (χ^2 = 16.890, P = 0.002) in acanthocephalan prevalence with high degree of specificity, having 87.5% prevalence for *S. clarias* and just 12.5% prevalence for *H. odoe*. Acanthocephalans showed strong specificity for *S. clarias* (Table 3), but with preference for the intestine (Table 4).

Generally, the prevalence of parasites was higher in female fish specimens (35.7%) than in males (31.6%), although no significant difference was observed in the prevalence by sex (χ^2 = 0.145, df = 1, P = 0.807). Similarly, the overall mean abundance and mean intensity of parasite was also higher in female (3.86 and 10.8, respectively) than in male (1.49 and 4.7, respectively) of the examined fishes (Table 5).

The different species of examined fish showed variation in parasite prevalence when compared by sex. In *T. zillii,* the male had a parasite prevalence of 18.2% as against 30.0% in the female, and no significant difference (p>0.05) was observed in the prevalence of parasite by sex in that fish species (Table 5). In *H. odoe,* no female had parasite while the prevalence for male was 42.9%; no significant difference was observed in the prevalence of parasite by sex (χ^2 =1.371, P= 0.500). Although 28.6% and 55.6% parasite prevalence were recorded in male and female *S. clarias* respectively, the parasite prevalence with sex was not significant (P>0.05). The 31.3% and 28.6% parasite prevalence in males and females of *C. nigrodigitatus* respectively, was not significant either (p>0.05).

DISCUSSION

The overall prevalence of parasites (32.9%) was low compared to 59.2% recorded for fishes in the Niger River at Illushi, Edo State, a Niger Delta area in Nigeria (Oyedineke et al., 2010). It was, however, higher when compared with records by other investigators in the rivers from the same region who reported overall parasite

Table 4. Prevalence and intensity of parasite in relation to habitat in fish host examined from the Warri River, Nigeria

Parasites	Fish host	Parasite habitat	Number examined	Number infected	Total number of parasite recovered	Prevalence (%)	Mean abundance	Mean intensity
Neoechinorhynchus prolixum	*S. clarias*	Intestine	23	2	8	8.7	0.35	4.0
Pomphorhynchus spp	*S. clarias*	Intestine	23	5	31	21.7	1.35	6.2
Acanthocephalus spp	*S. clarias*	Intestine	23	3	14	13.0	0.61	4.7
Unidentified acanthocephalan	*S. clarias*	Intestine	23	7	91	30.4	3.96	13.0
	H. odoe	Stomach	16	1	1	4.3	0.04	1.0
		Intestine	16	1	1	6.3	0.06	1.0
Camallanus polypteri	*T. zillii*	Stomach	21	1	1	4.8	0.05	1.0
		Intestine	21	1	1	4.8	0.05	1.0
	H. odoe	Stomach	16	2	2	12.5	0.13	1.0
		Intestine	16	2	7	12.5	0.44	3.5
	S. clarias	Intestine	23	1	1	4.3	0.04	1.0
	C. nigrodigitatus	Stomach	23	3	4	13.0	0.17	1.3
		Intestine	23	1	1	4.3	0.04	1.0
		Buccal cavity	23	1	1	4.3	0.04	1.0
	C. anguillaris	Stomach	2	1	1	50.0	0.50	1.0
		Intestine	2	1	1	50.0	0.50	1.0
Capillaria cichlasomae	*T. zillii*	Intestine	21	1	1	4.8	0.05	1.0
Capillaria pterophylli	*S. clarias*	Intestine	23	1	3	4.3	0.13	3.0
	C. nigrodigitatus	Intestine	23	2	2	8.7	0.09	1.0
	C. anguillaris	Intestine	2	1	1	50.0	0.50	1.0
Procamallanus laeviconchus	*S. clarias*	Intestine	23	1	1	4.3	0.04	1.0
		Stomach	23	1	1	4.3	0.04	1.0
	C. nigrodigitatus	Intestine	23	1	4	4.3	0.17	4.0
Railletnema synodontis	*S. clarias*	Intestine	23	1	6	4.3	0.26	6.0
Philometroides africanus	*H. odoe*	Stomach	16	2	2	12.5	0.13	1.0
Clinostomum complanatum	*C. nigrodigitatus*	Muscle	23	1	1	4.3	0.04	1.0
Pisciola geometra	*T. zillii*	Buccal cavity	21	1	1	4.8	0.05	1.0
	C. nigrodigitatus	Buccal cavity	23	1	1	4.3	0.04	1.0
Crustacea	*H. odoe*	Skin	16	1	1	6.3	0.06	1.0

prevalence of 17.1% in the Osse River, 6.9% in the Okhuo River and 3.3% in the Great Kwa River (Okaka and Akhigbe, 1999; Edema et al., 2008; Ekanem et al., 2011). These variations in the rate of parasitism could be attributed to abiotic and biotic conditions of the environments where the studies were carried out (Koskivaara, 1992; Thompson and Larsen, 2004). Unfavourable conditions may offset fish physiology favouring parasite infestation and invasion. Rohlenova et al. (2011) has reported that unfavourable temperature may alter fish physiology including immune function favouring parasite invasion. Pollution of the fish environment also contributes to parasitizing of fish significantly (Kelly et al., 2010). The relatively high prevalence of parasites in the examined fish in this study may be attributed to the relatively high pollution of the Warri River, Nigeria (Aghoghovwia, 2011; Olele, 2012). The high prevalence of acanthocephalan and nematode parasites may be attributed to the presence of appropriate intermediate host (Nmor et al., 2004), trophic linkage with the fish (Lagrue et al., 2011) and efficiency in transmission of parasite to fish host (Iyaji et al., 2009). It is important to note that even though *C. anguillaris* had parasite prevalence of 50.0%, its prevalence may not represent the exact prevalence of parasite in *C. anguillaris* in the Warri River because only two specimens of this fish species were encountered during the fish collection. The highest prevalence of parasites in *S. clarias* may be due to several factors which include feeding habit and diet of fish (Rolbiecki, 2006), habitat (Koskivaara, 1992), immuno-competence of the fish (Folstad and Karter, 1992), as well as the behavioural pattern of the fish. Feeding on gastropods, worms, crustaceans and detritus by *S. clarias* may facilitate infection by parasites (Lagrue et al., 2011). *Neoechinorhynchus, Pomphorhynchus, Acanthocephalus* and the unidentified acanthocephalans showed the highest abundance in the Warri River, and were limited almost to

Table 5. Overall prevalence and intensity of parasites in the different fish species examined from the Warri River, Nigeria in relation to sex

Fish sex	Number (%) of fish examined	Number (%) of fish infected	Number (%) of parasite recovered	Mean abundance	Mean intensity
T. zillii					
Male	11(52.4)	2(18.2)	2(40.0)	0.18	1.0
Female	10(47.6)	3(30.0)	3(60.0)	0.30	1.0
Total	21(100)	5(23.8)	5(100)	0.24	1.0
	χ^2=0.403,	p=0.635*			
H. odoe					
Male	14(87.5)	6(42.9)	12(100)	0.86	2.0
Female	2(12.5)	(0.0)	(0.0)	0.00	0.0
Total	16(100)	6(37.5)	12(100)	0.86	2.0
	χ^2=1.371,	p=0.500*			
S. clarias					
Male	14(60.9)	4(28.6)	58(36.3)	4.14	14.5
Female	9(39.1)	5(55.6)	102(36.3)	11.33	20.4
Total	23(100)	9(39.1)	160(100)	6.96	17.8
	χ^2=1.675,	p=0.383*			
C. nigrodigitatus					
Male	16(69.6)	5(31.3)	10(76.9)	0.63	2.0
Female	7(30.4)	2(28.6)	3(23.1)	0.43	1.5
Total	23(100)	7(30.4)	13(100)	0.57	1.9
	χ^2 = 0.017,	p=1.000*			
C. anguillaris					
Male	2 (100)	1(50.0)	3(100)	1.50	3.0
Female	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Total	2(100)	1(50.0)	3(0.0)	1.50	3.0
Total (General)					
Male	57 (67.1)	18(31.6)	85(44.0)	1.49	4.7
Female	28 (32.9)	10(35.7)	108 (56.0)	3.86	10.8
	χ^2 = 0.145	P = 0.807*			

**P values determined by chi square test*

S. clarias. The high prevalence for *S. clarias* may be attributed to the suitability of the fish host in provision of appropriate ecological requirements of the parasite (Akinsanya et al., 2008; Lagrue et al., 2011). Similarly, the high nutritional content of the *S. clarias* intestine may possibly account for their preference, restriction and abundance in them (Akinsanya et al., 2008). Two parasite genera, *Camallanus* and *Capillaria,* were present in all fish species. Thus they show no generic specificity for fish species but may show species specificity thus; *Capillaria cichlasomae* in *Tilapia zillii* and *C. pterophylli* in other fish species. Furthermore, *Capillaria* unlike *Camallanus* exhibited site-specificity with preference for the fish intestine. The very small size of *Camallanus* and, possibly, less nutritional demand may have necessitated their non-site specificity. Specificity generally is a product of adaptation (Lively and Dybdahl, 2000). Nematodes of the genera *Railletnema* and *Philometroides* were only recorded in *S. clarias* and *H. odoe,* respectively, maybe indicating species specificity of these parasites. *Philometroides africanus* has been reported to parasitize the freshwater African pike (*H. odoe*) from Botswana (Moravec and Van-As, 2001).

Parasitism in fish has been reported to be sex biased, with males suffering greater susceptibility. This sex linked parasitism has been explained as resulting from difference in reproductive investment by male and female fish (Skarstein et al., 2001; Simkova et al., 2008). Immuno-suppression by steroid hormone during spawning in males has been suggested as a major factor contributing to the greater susceptibility of males to parasite invasion (Folstad and Karter, 1992). Other factors suggested include competition for mate (Folstad and Karter, 1992) and cost of territorial defense (Reimchen, 2001). But contrary to these aforementioned observations, parasite prevalence obtained in the present study for female *T. zillii* (30.0%) and *S. clarias* (55.6%) were higher than in males (18.2% and 28.6%, respectively). Numbers of females in *H. odoe* were only two and so may not be suitable to ascertain for parasite prevalence due to sex. The overall parasite prevalence in females (35.7%) was also higher than that in males (31.6%). The observed higher overall parasite prevalence in females may be suggestive of difference in ecological requirements between male and female fish (Iyaji et al., 2009) and greater susceptibility of ovigerous females to parasite (Simkova et al., 2008). However, the present observed difference in parasite prevalence according to sex was not significant (p>0.05). The non-significant difference in parasite prevalence stratified by sex supports an earlier observation by Akinsanya et al. (2007) who recorded a non-significant (p>0.05) difference in the infection rate of male (37.7%) and female (35.5%) of *Malapterurus electricus* in Lekki Lagoon, Lagos State, Nigeria. In Bagauda Fish Farm, Kano, female *Clarias gariepinus* had higher occurrence of both the gill (20.7%) and gastrointestinal tract (34.6%) of parasites than that of the gill (11.8%) and gastrointestinal tract (23.6%) of males, although the difference was not significant (p>0.05) (Bichi and Yelwa, 2010). Similarly,

a non-significant difference (p>0.05) in the infection rate of females and males of four fish species (*Puntius schwanenfeldii*, *Puntius gonionotus*, *Hampala macrolepidoata* and *Notopterus notopterus*) examined at Tasik Merah, Perak, Peninsular, Malaysia have been reported (Rahman and Saidin, 2011).

The high prevalence of parasites in the Warri River, Nigeria is a setback to fish productivity in the zone. Parasite invasion and establishment in a fish compromise the efficiency of the fish in preventing further infection, lowering the fish reproductive efficiency and feed utilization. Thus, to ensure optimal productivity of fish in the Warri River, further studies need to be undertaken in order to ascertain the major causes of the high rate of infection, and the appropriate measures to be taken to ameliorate it.

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Sažetak

PARAZITOFAUNA PET SLATKOVODNIH RIBA U NIGERIJSKOM SLATKOVODNOM EKOSUSTAVU

Ovo istraživanje bavi se proučavanjem parazitofaune slatkovodnih riba iz rijeke Warri u državi Delti u Nigeriji s obzirom na zastupljenost, intenzitet pojave i razlike u višestaničnim parazitima kod različitih spolova. Parazitološkom pregledu podvrgnuto je ukupno 85 jedinki ribe iz rijeke Warri u državi Delti u Nigeriji: 21 *Tilapia zillii* (Cichlidae: Perciformes), 23 *Synodontis clarias* (Mochokidae: Siluriformes), 23 *Chrysichthys nigrodigitatus* (Claroteidae: Siluriformes), 16 *Hepsetus odoe* (Hepsetidae: Characiformes) i dvije *Clarias anguillaris* (Clariidae: Siluriformes). Ukupna zastupljenost višestaničnih parazita bila je 32,9%. Otkriveni višestanični paraziti uglavnom su bili akantocefali, *Neoechinorhynchus prolixum*, *Pomphorhynchus* spp., *Acanthocephalus* spp., a isto tako i neidentificirani akantocefali i nematode, *Camallanus polypteri*, *Capillaria pterophylli*, *C. cichlasomae*, *Procamallanus laeviconchus*, *Philometroides africanus* i *Railletnema synodontis*. Među otkrivenim parazitima akantocefala je bilo 75,6%, a nematoda 22,2%, no usprkos manjem postotku, nematode su imale veću zastupljenost (23,5%) u usporedbi s akantocefalima (9,4%). Isto tako, praćena je i zastupljenost drugog višestaničnog parazita – trematoda (metilja): *Clinostomum complanatum* (1,2%), zatim pijavica (Leech); *Pisciola geometra* (2,4%) i račića (Crustaceans) (1,2%). Najveća zastupljenost parazita zabilježena je kod *S. Clarias*, a najmanja (23,8%) kod *T. zillii*. Sveukupno gledajući, zastupljenost parazita bila je veća kod ženki (35,7%) nego kod mužjaka (31,6%), iako statistički nema velike razlike u zastupljenosti parazita po spolu ($\chi 2 = 0,145$, $P = 0,807$). Relativno visoka ukupna zastupljenost parazita kod riba može se pripisati relativno visokoj razini onečišćenja.

Ključne riječi: paraziti, slatkovodna riba, tropska rijeka, zastupljenost, intenzitet, spolni dimorfizam

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