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Original Article

Ectoparasitic infestation of the Nile Squeaker, *Synodontis schall* (Bloch and Schneider, 1801) from the Cross River Estuary, Nigeria

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Abstract: The objective of this study was to determine the abundance, intensity and prevalence of ectoparasites of *Synodontis schall* from the Cross River Estuary, Nigeria. A total of 150 fresh samples were collected between May and October, 2013 from the catches of the artisanal fisheries at Nsidung beach. The skin, gill and fin scrapping were prepared from each specimen and examined following standard methods for microscopic analysis. The results showed that 21 specimens were infested with 77 ectoparasites belonging to five species, including *Trichodina* sp., protozoan cyst, *Ergasilius lizae*, *Dactylogyrus* sp. and *Gyrodactylus* sp. with an overall prevalence of 14.0%. Infestation rate was highest in 10-14.9 cm class size (53.55%), followed by 15-19.9 cm (34.00%), ≥20.0 cm (8.00%) and 5-9.9 cm (4.67%) size classes. Parasites were more prevalent in the gills (82%), followed by the skin (14%) and least (4%) in the dorsal fin. Prevalence and abundance of ectoparasites was highest (28.57% and 0.71) in 5-9.9 cm size class, followed by 10-14.9 cm (16.25% and 0.60), 15-19.9 cm (9.80% and 0.41) and ≥20.0 cm (8.33% and 0.25) classes. Prevalence and abundance of ectoparasites was higher in female (15.63% and 0.56) than male (11.11% and 0.43). *Dactylogyrus* sp., *Trichodina* sp., protozoan cyst and *E. lizae* exhibited organ specificity as they were specifically recovered from the gills whereas *Gyrodactylus* sp. was found in the skin and fin. However, it was concluded that to prevent zoonosis, *S. schall* should be washed with clean water and cooked properly before consumption.

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Introduction

The Nile Squeaker, *Synodontis schall*, belonging to the family Mockokidae is one of the valuable food fish for the inhabitants of Cross River Estuary. This is attributed to its excellent taste and meat quality. According to Steffens (2006), *S. schall* is rich in moisture, dry matter, protein, lipid, vitamins, minerals and caloric value, thereby increasing its acceptability and demand by fish consumers. This species is also popularly used in tropical aquaria due to its upside-down swimming nature (Otubisin, 1986; Teugels, 1996). According to Teugels (1996), *S. schall* is endemic to Africa and generally very common all year round. They also contribute a significant percentage in the catches of artisanal fisheries of the Cross River Estuary.

In fisheries science, abundance, intensity and prevalence of fish parasites is directly influenced by several factors such as size, age, sex, species, diet, season, climate change and environment of fishes. In Nigeria, parasitic diseases of fish pose a serious economic and public health concern in the fishing industry due to the risk of transmission of parasite from fish to fish consumers (zoonosis). In most aquatic ecosystems, ectoparasites are common and free living organisms that are capable of causing diseases (Madanire-Moyo and Barson, 2010). According to Ekanem et al. (2014), ectoparasitic diseases affects the normal health and physiological conditions of fish leading to poor growth, abnormal metabolic activities and subsequently, death of affected fish. Ectoparasites of some bonyfish species in the Cross River Estuary and other tropical waters have been documented (Obiekezie and Enyenihi, 1988; Obiekezie et al., 1987; Obiekezie, 1998; Ekanem et al., 2011; Olofintoye, 2006; Ekanem et al., 2013; Ekanem et al., 2014; Eyo et al., 2015). Presently, there is no specific report on ectoparasites

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of *S. schall* in the Cross River Estuary. Therefore, the objective of this study was to investigate the abundance, intensity and prevalence of ectoparasites of *S. shall* from the Cross River Estuary, Nigeria and to recommend safety measures to curb the risk of zoonosis among fish consumers.

Materials and Methods

Study area: The Cross River Estuary located in the southern part of Nigeria, lies approximately between latitudes 4º and 8ºN and longitude 7º30 and 10ºE. It origins from the Cameroon Mountain and meanders west wards into Nigeria and then south ward through high rainforest formation before discharging into Atlantic Ocean at the Gulf of Guinea (Akpan and Offem, 1993). The study area is rich in mangrove forest vegetation with climate characterized by long wet season from April to October and a dry season from November to March. It is also characterized by a cold, dry and dusty period between December and January which is known as harmattan season. Temperature ranges from 22ºC in the wet to 35ºC in the dry season with a relative humidity ranging from 60% (dry season) to above 90% during the wet season (Akpan and Offem, 1993).

Collection and identification of *S. schall* and their sexes: A total of 150 freshly caught *S. schall* were collected between May and October, 2013 from the catches of the artisanal fisheries at Nsidung Beach, Calabar (Fig. 1) which is a major landing point of the artisanal fisheries of the Cross River Estuary. Fish samples were transported immediately in ice-packed containers to Fisheries and Aquaculture Laboratory, Institute of Oceanography, University of Calabar, for further analysis. Identification of *S. schall* was based on identification key given by Fischer et al. (1981). Differentiation of sexes were be based on external features (anal opening) and internal features such as gonad (Eyo et al., 2013a).

Measurements of *S. schall* total length (TL-cm) and size class grouping: Total length of *S. schall* was measured from snout to the base of the caudal fin rays using a measuring board to the nearest 0.1 cm. The fish were grouped into four size classes, including 5-9.9, 10-14.9, 15-19.9 and ≥20.0 cm.

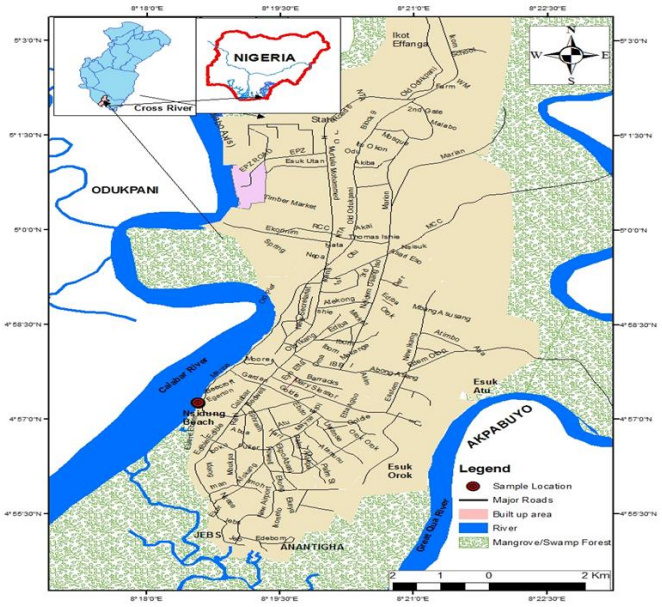

Figure 1. Map of the Cross River Estuary showing the sampling area (Nsidung Beach).

Examination of *S. schall* for ectoparasites: Each *S. schall* was carefully examined independently for ectoparasites. Scrapings from the gills, skin and fin of *S. schall* were smeared on clean glass slides, covered with cover slip and examined under light microscopes for ectoparasites. Ectoparasites recovered were fixed in 4% phosphate buffered formalin (PBF) for further processing and species identification (Paperna, 1980, 1996). Identification of ectoparasites was carried out according to Roberts (2000), Obiekezie and Engenihi (1988) and Obiekezie and Ekanem (1995).

Evaluation of parasitological indices: Parasitological indices evaluated include Dominance (D), Prevalence (P), Mean Intensity (I) and Abundance (A). The dominance of endoparasites was calculated according to Roohi et al. (2014) as given below:

$$\text{Dominance} = \left(\frac{N}{N\ Sum}\right)*100$$

Where N=abundance of endoparasite species and N sum=sum of the abundance of all endoparasite species found) and expressed as a percentage. The endoparasite were classified based on their dominance values according to Niedbala and Kasparzak (1993) as follows: eudominant (>10%), dominant (5.1-10%), subdominant (2.1-5%), recedent (1.1-2%) and subrecedent (<1.0%) of given species. Prevalence (%), mean intensity and abundance were calculated

Table 1. Number and percentage of fish examined, prevalence, intensity and abundance of ectoparasites recovered from *Synodontis schall* from the Cross River Estuary.

Size class (cm)	No. and % of fish examined	No. of fish infested	No. of parasites collected	Prevalence	Intensity	Abundance
5 -9.9	7 (4.67)	2	5	28.57	2.50	0.71
10-14.9	80 (53.33)	13	48	16.25	3.69	0.60
15-19.9	51 (34.00)	5	21	9.80	4.20	0.41
≥ 20.0	12 (8.00)	1	3	8.33	3.00	0.25
Total	**150 (100)**	**21**	**77**	**14.00**	**3.67**	**0.51**

Table 2. Prevalence, intensity and abundance of parasites recovered from *Synodontis schall* in relation to sex.

Sex	No and % of fish examined	No of fish infested	No. of Parasites Collected	Prevalence	Intensity	Abundance
Female	96 (64)	15	54	15.63	3.60	0.56
Male	54 (36)	6	23	11.11	3.83	0.43
Total	150 (100)	21	77	1.0	3.67	0.51

according to Upadhyay et al. (2010) given below:

Prevalence (%) = $\left(\frac{No.of\ infected\ fish}{Total\ No.of\ fish\ examined}\right)*100$

Mean Intensity = $\frac{No.of\ collected\ parasites}{No.of\ infested\ fish}$

Abundance = $\frac{No.\ of\ parasites}{No.of\ fish\ examined}$

Results

Number of examined fish, infested and parasites recovered from *S. schall*: Out of 150 examined samples, 21 samples were infested with 77 ectoparasites. In 5-9.9 cm size class, 2 out of 7 (4.67%) examined samples were infested with 5 ectoparasites. In 10-14.9 cm size class, 13 out of 80 (53.33%) were infested with 48 ectoparasites. In 15-19.9 cm size class, 5 out of 51 (34.00%) were infested with 21 ectoparasites. In ≥20.0 cm size class, only 1 out of 12 (8.00%) was infested with 3 ectoparasites. Table 1 shows the number of examined fish, number of fish infested and number of ectoparasites recovered.

Prevalence, intensity and abundance: The result obtained for prevalence (%), intensity and abundance of ectoparasites in relation to size class (cm) is shown in Table 1. Prevalence was highest (28.57%) in 5-9.9 cm size class, followed by 10-14.9 cm (16.25%), 15-19.9 cm (9.80%) and ≥20.0 cm (8.33%) classes. Intensity was highest (4.20) in 15-19.9 cm size class, followed by 10-14.9 cm (3.69), ≥20.0 cm (3.00) and 5-9.9 cm (2.50) classes. Abundance was highest (0.71) in 5-9.9 cm size class, followed by 10-14.9 cm (0.60), 15-19.9 cm (0.41) and ≥20.0 cm (0.25) classes.

Prevalence, intensity and abundance in relation to sex: Out of 150 examined specimens, 96 were females (64%) and 54 males (36%). Out of 96 examined females, 15 specimens were infested with 54 ectoparasites with prevalence of 15.63%, intensity of 3.60 and abundance of 0.56. Out of 54 examined males, 6 specimens were infested with 23 ectoparasites with prevalence of 11.11%, intensity of 3.83 and abundance of 0.43. Table 2 shows the number of fish examined, prevalence, intensity and abundance of parasites recovered from *S. schall* in relation to sex.

Prevalence, intensity, abundance and dominance in relation to organ specificity: The prevalence in relation to organ specificity (Table 3) showed that in 5-9.9 cm size class, ectoparasites were most prevalent in the gills and least in the skin. Three *Trichodina* sp. was recovered from the gills, whereas 2 *Gyrodactylus* sp. was recovered from the skin. *Trichodina* sp. recovered from the gills had a dominance value of 60.00 (eudominant parasite), prevalence (14.29%), intensity (3.00) and abundance (0.43). *Gyrodactylus* sp. recovered from the skin and fin had a dominance value of 40.00 (eudominant parasite), prevalence (14.29%), intensity (2.00) and abundance (0.29).

In 10-14.9 cm size class, ectoparasites were most prevalent in the gills and least in the skin. Eighteen *Trichodina* sp. was recovered from the gills with a dominance value of 37.50 (eudominant parasite), prevalence (6.25%), intensity (3.60) and abundance

Table 3. Dominance, prevalence intensity and abundance of ectoparasites in relation to organ specificity.

Size Class (cm)	No. of fish	No. of fish infested	Parasite species	No. of parasites	Organs	Dom	Pre	Int	Abn
5-9.9 cm	7	1	*Trichodina* sp.	3	Gills	60.00	14.29	3.00	0.43
		1	*Grrodactylus* sp.	2	Skin	40.00	14.29	2.00	0.29
Total	7	2		5		100.00	28.57	2.50	0.71
10-14.9 cm	80	5	*Trichodina sp*	18	Gills	37.50	6.25	3.60	0.23
		2	*Grrodactylus sp*	9	Skin	18.75	2.50	4.50	0.11
		3	*Protozoan cyst*	15	Gills	31.25	3.75	5.00	0.19
		3	*Ergasilus lizae*	6	Gills	12.50	3.75	2.00	0.08
Total	80	13		48		100.00	16.25	3.69	0.60
15-19.9 cm	51	1	*Ergasilus lizae*	6	Gills	28.57	1.96	6.00	0.12
		3	*Trichodina* sp.	12	Gills	57.14	5.88	4.00	0.24
		1	*Dactylogyrus* sp.	3	Gills	14.29	1.96	3.00	0.06
Total	51	5		21		100.00	9.80	4.20	0.41
≥20.0 cm	12	1	Grrodactylus sp.	3	Dorsal fin	100.00	8.33	3.00	0.25
Total	12	1		3		100.00	8.33	3.00	0.25

*Dom = Dominance, Pre = Prevalence, Int = Mean Intensity and Abn = Abundance

Table 4. Numerical abundance and percentage of ectoparasites from *Synodontis schall* in relation to Organ.

Organs	Percentage of Parasites in	Parasite Species	Number of Ectoparasite
Gills	82	*Trichodina* sp.	33
		Protozoan cyst	15
		Ergasilus lizae	12
		Dactylogyrus sp.	3
Total			63
Total			11
Total			3
Overall	100		77

(0.23). Nine *Gyrodactylus* sp. was recovered from the skin with a dominance value of 18.75 (eudominant parasite), prevalence (2.50%), intensity (4.50) and abundance (0.11). Fifteen protozoan cyst was recovered from the gills with a dominance value of 31.25 (eudominant parasite), prevalence (3.75%), intensity (5.00) and abundance (0.19). Six *Ergasilus lizae* was recovered from the gills with a dominance value of 12.50 (eudominant parasite), prevalence (3.75%), intensity (2.00) and abundance (0.08).

In 15-19.9 cm size class, ectoparasites were only prevalent in the gills. Six *E. lizae* was recovered from the gills with a dominance value of 28.57 (eudominant parasite), prevalence (1.96%), intensity (6.00) and abundance (0.12). Twelve *Trichodina* sp. was recovered from the gills with a dominance value of 57.14 (eudominant parasite), prevalence (5.88%), intensity (4.00) and abundance (0.24). Three *Dactylogyrus* sp. was recovered from the gills with a dominance value of 14.29 (eudominant parasite), prevalence (1.96%), intensity (3.00) and abundance (0.06). In ≥20.0 cm size class, only 3 *Gyrodactylus* sp. was recovered from the dorsal fin with a dominance value of 100.00 (eudominant parasite), prevalence (8.33%), intensity (3.00) and abundance (0.25).

Numerical abundance and percentage of ectoparasites in relation to organ: Numerical abundance and percentage of ectoparasites in relation to organ (Table 4, Fig. 2) showed that 63 ectoparasites (82%) were recovered from the gills (33 *Trichodina* sp., 15

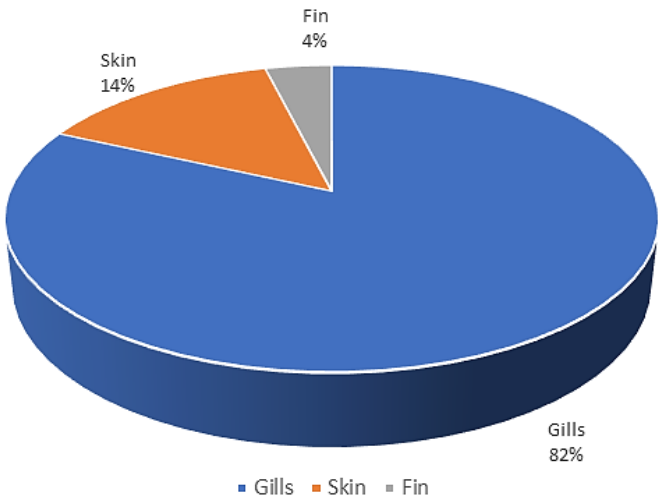

Figure 2. Numerical abundance and percentage of ectoparasites of *Synodontis schall* relation to organs.

protozoan cyst, 12 *E. lizae* and 3 *Dactylogyrus* sp.), 11 ectoparasites (11 *Gyrodactylus* sp.) from the skin (14%) and 3 *Gyrodactylus* sp. (4%) from the dorsal fin.

Discussion

The results showed that out of 150 examined specimens, 21 specimens were infested with 77 ectoparasites belonging to five parasitic species, including *Trichodina* sp., protozoan cyst, *E. lizae, Dactylogyrus* sp. and *Gyrodactylus* sp. with an overall prevalence of 14.0%. This overall parasite prevalence is quite lower than prevalence of 72.6% reported by Eyo et al. (2013b) for *S. batensoda* from Rivers Niger-Benue Confluence, Nigeria, 85.2% reported by Auta et al. (1999) for *Synodontis* sp. in Zaria dam, Nigeria. However, the overall prevalence reported in this study is higher than 3.33% reported by Ekanem et al. (2011) for parasites of landed fishes from the Great Kwa River, Nigeria and 13.6% reported by Ugwuozor (1987) in Imo River. This indicates that parasite prevalence in wild fish vary according to location. Ekanem et al. (2011) attributed such variation to the river sanitary condition, the location of the river from residential areas, and the number of people visiting the river and their purposes.

According to Eyo et al. (2013b), occurrence of parasites are common in some localities although with variation in prevalence. In this study, the occurrence of *Trichodina* sp., protozoan cyst, *Dactylogyrus* sp. and *Gyrodactylus* sp. in *S. schall* in the Cross River Estuary agrees with findings of other authors (Ekanem et al., 2011; Ekanem et al., 2014) and this indicates that these ectoparasites are common in the estuary. Comparing the prevalence of ectoparasites according to class size, 10-14.9 cm had the highest infection rate of 53.55%, followed by 15-19.9 cm (34.00%), ≥20.0 cm (8.00%) and 5-9.9 cm (4.67%) size classes. This indicates that *S. schall* of 10-14.9 cm size class are more susceptible to ectoparasite infection in the Cross River Estuary. This observation corroborates with findings of Anderson (1974) and Ekanem et al. (2011) that fishes of lower class size are more susceptible to ectoparasites. Generally, fish length is directly correlated to age and body size. According to Poulin (2000), older fishes have longer time span to accumulate parasites than younger fishes and may provide more internal and external space for parasite to establish with a larger surface area for gill and skin-attaching parasites. This could be the reason for a higher parasite intensity (4.20) observed in 15-19.9 cm. However, prevalence and abundance of ectoparasites were highest (28.57% and 0.71) in 5-9.9 cm size class, followed by 10-14.9 cm (16.25% and 0.60), 15-19.9 cm (9.80% and 0.41) and ≥20.0 cm (8.33% and 0.25). This findings agrees with Ekanem et al. (2011) that fish of a lower class size are more susceptible to parasites because they have a weaker immune system compared to fishes of higher size class. Abundance was highest (0.71) in 5-9.9 cm size class, followed by 10-14.9 cm (0.60), 15-19.9 cm (0.41) and ≥20.0 cm (0.25).

According to Eyo et al. (2013b), high infection of trichodonids in the skin and gills of fish hosts with mucus secretion in their gills could lead to irritation and breathing problems. Similarly, Klinger and Floyd (2002) reported that these parasites cause serious skin and gill irritation, and infected fish are displayed some behavioral abnormalities such as flashing, rubbing, rapid breathing and excessive mucus secretion in gills. Monogenean trematodes recovered in this study including *Gyrodactylus* sp. and *Dactylogyrus* sp. are also reported to cause behavioral abnormalities,

including flashing, rubbing and rapid breathing (Eyo et al., 2015).

In this study, prevalence and abundance of ectoparasites in relation to sex revealed that female *S. schall* were more infected than male. Female *S. schall* had prevalence of 15.63% and abundance (0.56) while males had prevalence of 11.11% and abundance (0.43). This findings agrees with Eyo et al. (2015) for farmed *Clarias gariepinus* and Alam et al. (2010) for *Channa punctatus*, that female fishes were more infected than the male fishes. This could be attributed to ecological habitat and sex hormones which are responsible for depressing the level of parasites infestation (Alam et al., 2010). Also, Aloo et al. (2004) reported that differences in parasitic infestation in relation to sex is physiological.

Organ specificity of ectoparasites in *S. schall* showed that *Dactylogyrus* sp., *Trichodina* sp., protozoan cyst and *E. lizae* were specifically recovered from the gills whereas *Gyrodactylus* sp. was found in the skin and fin. Apart from *Trichodina* sp. which are also found in the skin and fin of fish, Paperna (1996) reports that *Dactylogyrus* sp. and *E. lizae* are gill specific parasites. Eyo et al. (2015) reported a similar findings on monogenean parasites in farmed *C. gariepinus.* The preference of *Dactylogyrus* sp. in fish gills is related to feeding and attachment activities of the parasites while *Gyrodactylus* sp. specificity on the skin and fins is linked to reproductive reasons (Reed et al., 1996). Generally, parasites were more prevalent in the gills (82%), followed by the skin (14%) and least (4%) in the dorsal fin indicating that the gills of *S. schall* is the most affected organ in the Cross River Estuary. In this study, single infestation of ectoparasites was dominant with few occurrence of multiple infestations. Single infestation of parasites in fish will result in weakening the resistance of the host increasing its susceptibility to multiple parasitic infestation. According to Amare et al. (2014), multiple infestations of parasites in fish is related to favorable environmental conditions which supports several parasites species thereby exposing the host to multiple infection.

Conclusion

Synodontis schall from the Cross River Estuary is infested by ectoparasites, including *Dactylogyrus* sp., *Trichodina* sp., protozoan cyst, *E. lizae* and Gyrodactylus sp. although with a low infestation rate of 14%. Parasites were more prevalent in the gills, followed by the skin and least in the dorsal fin indicating that the gills of *S. schall* is the mostly affected compared to other external organs. Fish in a lower class size are more susceptible to ectoparasites which could lead to breathing problems in infested fish. In conclusion, *S. schall* from the Cross River Estuary should be properly cooked to avoid zoonosis (transfer of diseases from animals to humans) even with the low infestation rate reported in this study.

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