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Diversity of Helminth Parasites in *Sclerophrys maculata* of Degema and Ogoni, Rivers State, Nigeria

Amuzie, C.C. *, Akani, G.C. and Davies, E.L.

Department of Animal and Environmental Biology, Rivers State University, Port Harcourt, Nigeria.

Author for Correspondence *: nmaamuzie@gmail.com/ +234-803-672-9346**Abstract**

Environmental alterations affect the diversity of amphibian helminth parasites. This study was conducted to investigate differences in the helminth community structure of amphibians, *Sclerophrys maculata*, collected from locations in Rivers State, Nigeria. A total of 124 specimens of *S. maculata* were collected from Bakana and Old Bakana communities in Degema Local Government Area of Rivers State, Nigeria. Their snout-vent length ranged from 20-57mm for specimens from Bakana and 20-68mm for those from Old Bakana. Thirteen specimens were examined from Teka-Sogho, Ogoni, Rivers State, Nigeria, and they were of snout-vent length of 40-94mm. Environmental pollution resulting from illegal refinery of crude oil is presumed to have contributed to the shorter body length in amphibians of Bakana and Old Bakana. Six helminth parasites were recovered from the hosts from Bakana and Old Bakana and were comprised of four nematodes (*Amplichaecum africanum*, *Cosmocerca ornata*, *Rhabdias africanus* and ascaridida larvae), one pentastomid (*Raillietiella* sp.) and one trematode (*Mesocoelium monodi*). *Amplichaecum africanum*, *C. ornata* and *M. monodi* were common to both Bakana and Old Bakana locations; *R. africanus* was restricted to Bakana while *Raillietiella* sp. and ascaridida larvae were restricted to Old Bakana. On the other hand, only nematodes (*R. africanus*, *C. ornata* and ascaridida larvae) were recovered from hosts from Ogoni. Nematodes had higher prevalence rates than either pentastomids or trematodes. Over-dispersion of parasites was observed in hosts of Teka-Sogho, Ogoni, infected with *R. africanus* and ascaridida larvae. This is considered an adaptation to ensure successful completion of

parasite life cycles. Parasite prevalence did not differ significantly between locations and gender. Compared with studies from other locations in the State, the diversity of parasites in the communities investigated was low. Differences in parasite diversity could be due to differences in habitat quality and other factors influencing exposure of hosts to parasites.

Keywords: *Endo-parasites, amphibians, Degema, illegal refinery of crude, black soot, Rivers State, Niger Delta, Nigeria.*

Introduction

Helminth parasites are common members of the parasitic fauna of amphibians (Pough *et al.* (2001). Some of the species of helminths recovered from amphibian hosts in Nigeria include pentastomids (*Raillietiella* sp.), cestodes (*Cephalochlamys namaquensis*, *Cylindrotaenia jaegerskioeldi*), monogeneans (*Polystoma prudhoei*, *P. galamensis*), trematodes (*Metahaematoloechus micrurus*, *Diplodiscus fischthalicus*, *Progonimodiscus doyeri*, *Ganeo africana*, *Mesocoelium monodi*), nematodes (*Amplichaecum africanum*, *Chabaudus leberrei*, *Cosmocerca ornata*, *Camallanus dimitrovi*, *Batrachocamallanus xenopodis*, *Oswaldocruzia hoepplii*, *Rhabdias africanus*) (Aisien *et al.*, 2017a,b, 2004, 2001; Amuzie and Ekerette, 2017; Amuzie *et al.*, 2016; Iyaji *et al.*, 2015; Nworah and Olorunfemi, 2011; Ayodele and Akinpelu, 2004).

Investigations into the helminth parasites of *Sclerophrys* (syn. *Amietophrynus* sp.) have reported higher prevalence of nematode parasites than other helminths (Amuzie and Ekerette, 2017; Amuzie *et al.*, 2016; Iyaji *et al.*, 2015). Iyaji *et al.*

(2015) recovered four parasite species (one cestode, *Baerietta jaegerskioeldi* and three nematodes, *A. africanum*, *Cosmocerca ornata* and *Physaloptera* sp.) from *S. regularis* of Anyigba, Kogi State, Nigeria. Amuzie *et al.* (2016) reported seven helminth parasites species - five nematodes (*A. africanum*, *Rhabdias africanus*, *Oswaldocruzia hoeplii*, *C. ornata*, ascaridida larvae), and two trematodes (*M. monodi* and *D. fischthalicus*) - from *S. maculata* specimens of Rumuji-Emohua, Rivers State, Nigeria. In their report, Amuzie and Ekerette (2017) recovered five helminth parasites (one pentastomid, *Raillietiella* sp.; one trematode, *M. monodi*; and three nematodes, *A. africanum*, *C. ornata* and *R. africanus*) from *S. maculata*, Mgbuoba, Rivers State, and seven helminth parasite species from *S. camerunensis* of Choba, Rivers State, Nigeria. The parasites from Choba included these five nematode parasites reported for *S. maculata* and two others (*C. leberrei* and *O. hoeplii*).

Research into the parasites of amphibians of Rivers State is still on its early stage and is hampered particularly by security concerns. However, a few reports have been made including those of Amuzie *et al.*, (2016), Aisien *et al.*, (2017a,b) and Amuzie and Ekerette, (2017). This research reports the prevalence of helminth parasites of *S. maculata* from Bakana and Old Bakana communities in Degema Local Government Area, and from Teka-Sogho, Ogoni, all in Rivers State, Nigeria.

Materials and Methods

The study locations (Bakana and Old Bakana) were urbanizing settlements in the Niger Delta region of Nigeria. Predominant occupations of the residents were fishing and subsistence agriculture. However, illegal refinery of petroleum products, locally referred to as “Kpo-Fire” was common practice. This was associated with security issues due to the presence of cult groups and youth restiveness. The climate is tropical and both locations form an island. Though the water body is generally marine, there are farm-lands and pockets of fresh water habitats which support amphibian life.

Sclerophrys maculata specimens were collected from two communities in Degema Local Government Area (LGA), Rivers State, Nigeria: Bakana (E6° 96', N4° 73') and Old Bakana (E6° 58',

N4° 44'). In the course of the research some specimens were received from collectors in Teka Sogho (E4° .68', N7° .83') in Ogoni land. Sampling was done weekly at both communities (i.e., Bakana and Old Bakana) from January, 2018 to April, 2018, and achieved through the search and capture techniques between the hours of 7.00pm to 7.45pm, for security reasons. Captured specimens were transported in wet, perforated containers to the Parasitology Laboratory of the Rivers State University for identification and dissection. They were all dissected within 24hours of capture.

The amphibian species was identified using keys from Rodel (2000). They were euthanized in chloroform vapour, weighed using a weighing balance (Denver Instrument, Model TP-512A) and their snout-vent length (SVL) measured using a meter rule. Afterwards they were longitudinally dissected and the internal organs (oesophagus/stomach, small intestine, large intestine/rectum, lungs) were excised into Petri dishes filled with 0.92% laboratory saline per organ. Each organ was cut open to expose contents and release helminth parasites when present.

Parasites were identified according to Prudhoe and Bray (1982). Nematode and trematode parasites were processed according to Amuzie *et al.* (2016). The parasite quantitative measures (prevalence and mean intensity) were computed according to Bush *et al.* (1997).

Group-average clustering was used to develop a cluster analysis of the locations based on the presence/absence data of the helminth parasites. Student t-test was used for comparing the prevalence of infection in Bakana and Old Bakana locations. This was accomplished using Microsoft Excel.

Results

A total of 62 *S. maculata* specimens were collected from each of Bakana and Old Bakana communities. In both communities, also, the catch was comprised of 56 male and six female specimens. Specimens from Bakana had SVL ranging from 20 -57mm with a mean value of 33.93±1.45mm; the total body weight ranged from 1.87g - 18.17g having a mean value of 5.55±0.86g. Those from Old Bakana had mean SVL 30.37±1.05mm which ranged from 20-68mm. In this community, the total body weight of the

specimens ranged from 0.93g-14.97g with a mean value of 3.72 ± 0.40 g. A total of 13 specimens were received from collectors in Teka-Sogho, Ogoni, in February, 2018. The SVL ranged from 40-94mm, having a mean value of 63.77 ± 4.16 mm. The total body weight of specimens from this location ranged from 8.0-70.0g, with a mean value of 25.5 ± 5.03 g.

Four helminth parasites were recovered from the hosts from Bakana- three nematodes (*Amplichaecum africanum*, *Cosmocerca ornata* and *Rhabdias africanus*) and one trematode (*Mesocoelium monodi*). Two of the nematodes (*A. africanum* and *C. ornata*) and the trematode are parasites of the intestinal tract, while *R. africanus* infects the lungs. In hosts from Old Bakana, three nematode parasites were also recovered: *A. africanum*, *C. ornata*, and ascaridida larvae (whose predilection site is the body cavity). The trematode, *Mesocoelium monodi*, was also recovered and a single specimen of the lung pentastome, *Raillietiella* sp. As such, *A. africanum*, *C. ornata* and *M. monodi* were common to both locations; *R. africanus* was restricted to Bakana while *Raillietiella* sp. and ascaridida larvae were restricted to Old Bakana.

Only nematode parasites were recovered from hosts from Teka Sogho, Ogoni. They were comprised of the lung nematode, (*R. africanus*) ascaridida larvae and *C. ornata*. Group-average clustering of all locations investigated based on the presence/absence of the helminth parasites showed that Bakana was more similar to Old Bakana than were both locations to Teka-Sogho, however, the difference was not significant (Pi: 6.86 Sig (%): 63.5; Figure 1).

It was observed at Teka-Sogho, Ogoni, that both ascaridida larvae and *R. africanus* were over-dispersed. In one host specimen, as many as 25 ascaridida larvae were present in the body cavity. Similarly, up to 30 *R. africanus* specimens were recovered from another host. Other hosts were infected with between one to three ascaridida larvae, and one to seven *R. africanus* specimens.

This phenomenon was not observed in hosts from other locations.

In hosts of Bakana and Old Bakana, the most prevalent helminth parasites were *A. africanum* (Bakana, $p = 59.68\%$; Old Bakana, $p = 38.71\%$) and *C. ornata* (Bakana, $p = 43.55\%$; Old Bakana, $p = 50.00\%$). In those from Teka-Sogho, *R. africanus* (38.46%) and ascaridida larvae (38.46%) were more prevalent than *C. ornata* (15.38%) (Tables 1 and 2).

Prevalence of infection was also computed in reference to the gender of the host specimens (Tables 3 and 4). In specimens from Bakana, four parasites (*M. monodi*, *A. africanum*, *C. ornata* and *R. africanus*) were recovered from males and three (*A. africanum*, *C. ornata* and *R. africanus*) from the females. Conversely, four parasites (*Raillietiella* sp., *A. africanum*, ascaridida larvae and *C. ornata*) were recovered from the female hosts from Old Bakana and three (*M. monodi*, *A. africanum*, *C. ornata*) from the males. In specimens from Teka-Sogho, all three nematodes (*R. africanus*, ascaridida larvae and *C. ornata*) were recovered from the male hosts and two (*R. africanus* and ascaridida larvae) from the females. Generally, prevalence rates of helminth parasites were about the same in both gender in hosts from Bakana ($t_3 = 0.225$, $p = 0.418$); higher in male than in female hosts from Old Bakana ($t_4 = 0.21$, $p = 0.422$); and higher in female hosts from Teka Sogho, Ogoni ($t_2 = 0.24$, $p = 0.416$). However, there were no significant differences between the pairs compared as shown by the student t-test results.

The overall prevalence of the three parasites common to both Bakana and Old Bakana (*A. africanum*, *C. ornata* and *M. monodi*) were subjected to t-test for statistical differences, but they were not significantly different ($t_3 = 0.3$, $p = 0.39$). There were also no significant differences between the prevalence of helminth infections common to Bakana and Teka-Sogho ($t_2 = 0.01$, $p = 0.50$), and Old Bakana and Teka-Sogho ($t_2 = 0.04$, $p = 0.485$).

Table 1: Overall Prevalence (P%) and mean intensity (MI) of helminth infection in *S. maculata* of Bakana and Old Bakana, Rivers State, Nigeria

Parasite	Bakana P (%) (no. of infected hosts)	MI±sem	Old Bakana P (%) (no. of infected hosts)	MI±sem
Pentastomida				
<i>Raillietiella</i> sp.	-	-	1.61 (1)	1.0±0.00
Trematoda				
<i>M. monodi</i>	6.45 (4)	2.0±0.71	1.61 (1)	1.0±0.00
Nematoda				
<i>A. africanum</i>	59.68 (37)	3.81±0.52	38.71 (24)	2.79±0.59
<i>C. ornata</i>	43.55 (27)	2.70±0.28	50.00 (31)	3.37±0.53
<i>R. africanus</i>	9.68 (6)	2.17±0.60	-	-
Ascaridida larva	-	-	1.61 (1)	4.0±0.00

Key: sem=standard error of the mean

Table 2: Overall Prevalence (P%) and Mean Intensity (MI) of helminth infection in *S. maculata* of Teka Sogho, Ogoni, Rivers State, Nigeria

Parasite	P% (no. of infected hosts)	MI ± sem
Nematoda		
Ascaridida larva	38.46 (5)	6.6±4.62
<i>C. ornata</i>	15.38 (2)	1.00±0.00
<i>R. africanus</i>	38.46 (5)	8.40±5.51

Key: sem=standard error of the mean

Table 3: Gender-related Prevalence (P%) and Mean Intensity (MI) of helminth infection in *S. maculata* of Bakana and Old Bakana, Rivers State, Nigeria

Parasite	Bakana				Old Bakana			
	Male P% (no. of infected hosts)	MI±sem	Female P% (no. of infected hosts)	MI±sem	Male P% (no. of infected hosts)	MI±sem	Female P% (no. of infected hosts)	MI±sem
Pentastomidea								
<i>Raillietiella</i> sp.	-	-	-	-	-	-	16.67 (1)	1.00±0.00
Trematoda								
<i>M. monodi</i>	7.14 (4)	2.0±0.71	-	-	1.79 (1)	1.00±0.00	-	-
Nematoda								
<i>A. africanum</i>	58.93 (33)	3.73±0.55	66.67 (4)	4.50±1.90	39.29 (22)	2.68±0.63	33.33 (2)	4.00±1.00
Ascaridida larva	-	-	-	-	-	-	16.67 (1)	4.00±0.00
<i>C. ornata</i>	46.43 (26)	2.73±0.29	33.33 (2)	3.50±1.50	51.79 (29)	3.03±0.46	33.33 (2)	7.00±5.00
<i>R. africanus</i>	8.93(5)	2.40±0.68	16.67 (1)	1.00±0.00	-	-	-	-

Key: sem = standard error of the mean

Table 4: Gender-related Prevalence (P%) and mean intensity (MI) of helminth infection in *S. maculata* of Teka Sogho, Ogoni, Rivers State, Nigeria

Parasite	Male P% (no. of infected hosts)	MI ±sem	Female P% (no. of infected hosts)	MI ±sem
Nematoda				
Ascaridida larva	25.00 (2)	2.00±1.00	60.00 (3)	9.67±7.69
<i>C. ornata</i>	25.00 (2)	1.00±0.00	-	-
<i>R. africanus</i>	37.50 (3)	11.33±9.35	40.00 (2)	4.00±3.00

Key: sem=standard error of the mean

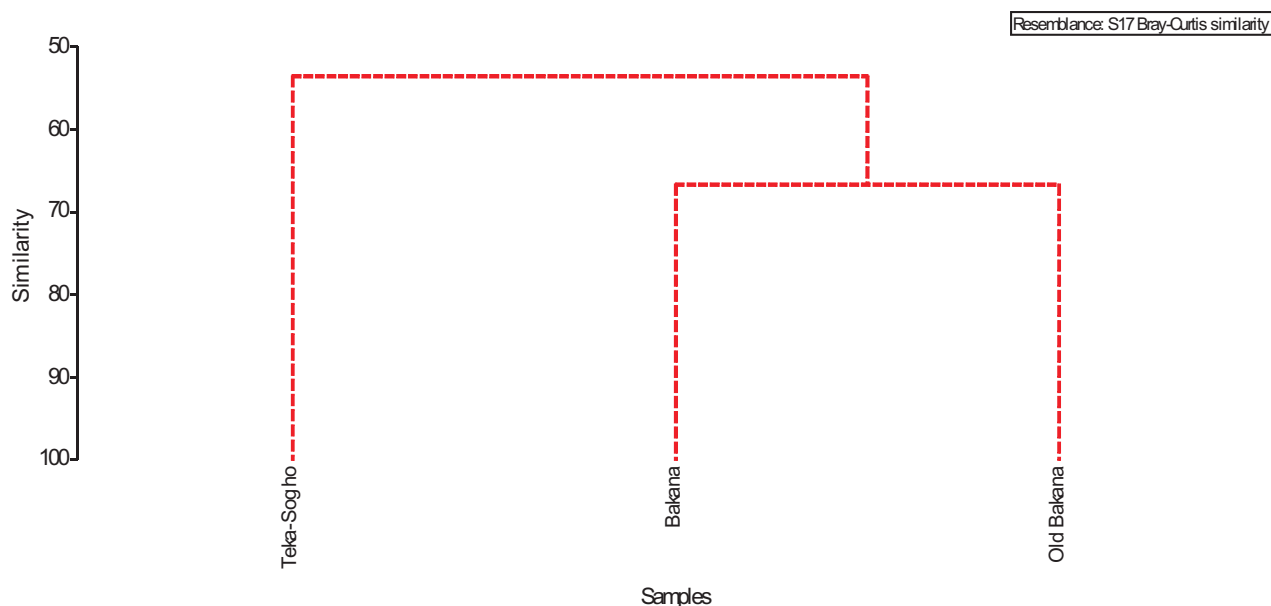


Figure 1: Group-average cluster of research locations based on presence/absence of helminth parasites

Discussion

Rodel (2000) reported adult specimens of *S. maculata* to have SVL ranging from 38-60mm, and cited other authors including Poynton and Haacke (1993) who reported specimens of *S. maculata* ranging in SVL from 45-85cm. The specimens collected in this research ranged in size from 20-57mm in Bakana, and from 20-68mm in Old Bakana which are similar to the reports of Rodel (2000). However, those from Teka-Sogho, Ogoni ranged in size from 40-94mm. It is presumed that the smaller size in specimens from Bakana and Old Bakana is due to the level of air pollution in the communities caused by the illegal refinery of petroleum products locally referred to as “Kpo-fire”. Luiselli *et al.* (2006) had reported environmental pollution of Bakana resulting from petroleum industry activity, and Sparling *et al.* (2000) noted that pollution of amphibian habitats could lead to shorter body length and lower body mass. This illegal activity is thought to be the major cause of the black soot air pollution in both Bakana and Old Bakana, which has also been reported for communities in other parts of Rivers State, Nigeria (Nubari, 2018; Yakubu, 2018; Tawari and Abowei, 2012). Notable, also, Stadnichenko *et al.* (1995) stated that parasitic infections may reduce the immune status of host organisms thereby making them more adversely affected by

toxic chemicals in their environment.

The parasites recovered in the present research are similar to those reported by previous researchers (Amuzie and Ekerette, 2017; Amuzie *et al.*, 2016; Iyaji *et al.*, 2015). Compared with other reports from Rivers State, Nigeria, the diversity of helminth parasites infecting *S. maculata* of Bakana, Old Bakana and Teka-Sogho, Ogoni, is rather low with only four helminth parasite species. Amuzie *et al.* (2016) reported seven helminth species; though Amuzie and Ekerette (2017) reported five species in hosts from Mgbuoba, they also reported seven in hosts from Choba, both in Rivers State. The absence of some of the parasite species reported from other locations may be due to unfavourable environmental conditions which break parasite life cycles (Aisien *et al.* 2017a).

Although *R. africanus* was restricted to Bakana while *Raillietiella* sp. was restricted to Old Bakana, both parasites do not exclude each other. Amuzie *et al.* (2016) and Amuzie and Ekerette (2017) recovered both parasites from lungs of *S. maculata* of Rumuji-Emohua and Mgbuoba, respectively. Amuzie and Ekerette (2017) stated that anthropogenic alterations of the environment that could affect the parasite life cycle (such as, use of insecticides to destroy cockroaches, the intermediate hosts of



Raillietiella sp.) may have contributed to the presence or absence of the lung parasites.

Over-dispersion was observed in infections with *R. africanus* and ascaridida larvae in hosts from Teka-Sogho, Ogoni. This could be explained as a parasitic adaptation to ensure the successful transmission to hosts in altered habitats (Aisien *et al.*, 2017a).

Prevalence did not differ significantly between location and gender. However, the parasite diversity at Bakana was closer to that at Old Bakana, than to that of Teka-Sogho. This could be due to the similar habitat conditions in both Bakana and Old Bakana. Both Amuzie *et al.*, (2016) and Amuzie and Ekerette (2017) reported insignificant differences in helminth parasite prevalence between gender. Conversely, Nworah and Olorunfemi (2011) reported that prevalence of helminth parasites in *S. regularis* was significantly higher in male specimens. This may be attributed to differences in exposure of individuals of both gender to infective stages of parasites in the habitat.

Conclusion

This research has established the presence of helminth parasites in *S. maculata* specimens from Bakana and Old Bakana, as well as those of Teka-Sogho, Ogoni, all in Rivers State, Nigeria. It was found that specimens from Ogoni were relatively larger than those from both communities in Degema hereby investigated. This research has contributed to the information pool of amphibian parasites of Rivers State and the Niger Delta region, Nigeria.

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