# *Polystoma galamensis* (Monogenea): Occurrence and ecological range in Nigeria

**Aisien, M. S. O.,* Ozemoka, H. J., Edo-Taiwo, O.** and **Enabulele, E. E.**
Laboratory of Parasitology Research, Department of Animal and Environmental Biology, Faculty of Life Sciences, University of Benin, P.M.B. 1154, Benin City, Nigeria
*Corresponding author: aisien@uniben.edu

**Abstract**

*Hylarana galamensis* collected from three biotopes in Nigeria were investigated for infection with the monogenean *Polystoma galamensis*. Of the 152 specimens examined, 19 (12.5%) were infected with the parasite. Prevalence in the guinea savannah was 21.4%, derived savannah, 15.1% and the freshwater creeks of Ase, 2.27%. The intensity of infection was generally low and this can be principally attributed to the solitary reproductive behaviour of the host. Excessive precipitation and flooding may additionally play limiting roles in the creeks of the Niger Delta. Irrespective of host habitat, parasites recovered from frogs in Nigeria showed close similarity with the type species from Togo in several aspects of their morphometrics. The parasite from Nigeria also had a low haptor/body ratio and the occurrence of prehaptoral intestinal anastomoses was infrequent. This close similarity between the parasites from Togo and Nigeria confirms *P. galamensis* as a valid species. This report from Nigeria is the second on the parasite, making Nigeria a new geographical record for the parasite.

**Keywords:** *Hylarana galamensis*; derived savannah; freshwater swamp; guinea savannah; *Polystoma galamensis*; Nigeria.

Accepted: 7 December, 2017.

## Introduction

*Polystoma galamensis* is a monogenean parasite of the urinary bladder of *Hylarana galamensis* (formerly *Rana galamensis*). To date, there is only one description of this parasite in the literature (Euzet *et al* 1974), based on specimens recovered from frogs collected in Klouto, located in the savannah of Togo. The parasite material from Togo was characterized by a low haptor-body ratio, large-sized hamuli, development of axial caeca and the presence of prehaptoral intestinal anastomosis in some specimens.

In three earlier publications on the helminth parasites of anurans from the savannah-mosaic and the guinea savannah of Nigeria, respectively (Aisien *et al* 2003, 2004a,b), we reported the occurrence of this parasite in *H. galamensis* examined from these biotopes. In subsequent investigations of the helminth parasite fauna of anurans from four other locations within the savannah-mosaic of southern Nigeria, we also encountered this polystome in the *H. galamensis* examined. In September and October of 2014, we examined specimens of *H. galamensis* collected from a freshwater creek of the Niger Delta and also recorded infection with *P. galamensis*.

In this paper, we describe the parasites recovered from frogs examined from three biotopes (derived savannah, guinea savannah and a freshwater creek) in Nigeria, comparing them with the type specimens from Togo.

## Materials and methods

*Hylarana galamensis* were collected from Igarra (7º17′N, 6º06′E), Agenegbode (7º06′N, 6º45′E), Ogbonna (7º07′N, 6º27′E), Agbede (06º50′N, 06º10′E) and Usen (6º45′N; 5º21′E) all in the derived savannah, New Bussa (10º15′N, 4º30′E) in the guinea savannah and Ase (5°.17′N; 6°.18′E) in the freshwater creeks of the Niger Delta of Nigeria.

The frogs were euthanized by immersion in Benzocaine solution and then dissected. The urinary bladders were removed and placed in Petri dishes containing 0.72% NaCl solution. The isolated parasites were flattened under cover slip pressure on microscope slides and fixed with 5% formol-saline for at least 48 hours. The parasites were washed free of the fixative in changes of tap water and then stained overnight in a dilute solution of acetocarmine. The parasites were washed with tap water to remove excess stain, dehydrated in alcohol series, cleared in xylene and permanent mounts made in Canada balsam (Aisien *et al* 2004a).

http://dx.doi.org/10.4314/tzool.v15i1.7

## Results

Of the 152 specimens of *H. galamensis* collected from seven locations in the three biotopes surveyed 19 (12.5%) were infected with *P. galamensis* of which only 16 specimens were mature and egg-producing. The other 15 specimens recovered from Usen and 2 from Agenegbode were sub-adults. Prevalence of infection in the guinea-savannah was 21.4%, derived savannah, 15.1% and the freshwater creek, 2.27%. The prevalence and mean intensity of infection among frogs from the respective locations is presented in Table 1. The morphometric characters of the mature and egg-producing *P. galamensis* from Nigeria and those of the type species from Togo are presented in Table 2 while those of some sub-adults from Usen are presented in Table 3.

The general morphological characteristics of egg producing parasite from Nigeria is presented in Figure 1. Variations in intestinal arrangement in the parasites examined are shown in Figures 2A-F. While the lateral and medial diverticula were slender in some specimens (Figures 2A-D), they were broad and lobed in others (Figures 2E and F).

The overall occurrence of intestinal anastomosis among the specimens examined was 26.7%, but the frequency of occurrence varied among parasites recovered from the different biotopes. The occurrence of anastomoses was highest among the parasite specimens from the guinea savannah (75%), followed by Usen (22.2%) and Agenegbode (20%) in the derived savannah. None of the specimens from Agbede and the single specimen from Ase possessed this feature. The hamuli variation in terms of the separation of handle and guard is shown in Figure 3A-F. In most of the specimens examined, the handle and guard were well separated (Figures 2A-E) while in a few, the separation was not so distinct (Figure 2F). The marginal hook C1 in the Nigerian specimens had a mean size of 39.95±1.04 μm (39-41.6 μm). Of the 16 egg-laying specimens studied, 11 had one egg each in the uterus, one had three eggs, another one had four eggs while two had six eggs each.

**Table 1.** Prevalence of *Polystoma galamensis* in *Hylarana galamensis* from Nigeria.

| Location | No of hosts examined | No infected | Prevalence (%) | No of parasites | Mean intensity |
|---|---|---|---|---|---|
| **Derived Savannah** | | | | | |
| Igarra | 2 | – | – | – | – |
| Agenegbode | 21 | 3 | 14.2 | 04 | 1.3 |
| Ogbonna | 15 | 1 | 6.70 | 01 | 1.0 |
| Agbede | 41 | 8 | 19.5 | 08 | 1.0 |
| Usen | 15 | 3 | 20.0 | 15 | 5.0 |
| **Guinea Savannah** | | | | | |
| New Bussa | 14 | 3 | 21.4 | 09 | 3.0 |
| **Freshwater creek** | | | | | |
| Ase | 44 | 1 | 2.27 | 01 | 1.0 |

**Table 2.** Comparison of the morphometric parameters of *Polystoma galamensis* from Nigeria and the specimens from Togo.

| | ***Polystoma galamensis* specimens** | |
|---|---|---|
| **Parameters (μm)** | **Nigeria** | **Togo*** |
| Body Length | 8332±927.0(6933-9990) | 8000-10000 |
| Greatest width | 2885±551.31 (2200-3730) | – |
| Width at vaginae | 2045±299.80 (1667-2531) | 1900-2200 |
| Haptor length | 2013±297.10(1598-2500) | 1700-1900 |
| Haptor width | 2848±330.20 (2397-3463) | 2600-3200 |
| Haptor/length ratio | 0.24±0.03 (0.19-0.30) | – |
| Haptoral sucker diameter | 547 ±54.19.05 (439-692) | 550-650 |
| Oral sucker | 540±77.05 (412-644) | 550-600 |
| Lateral diverticula | 47±10.78 (30-62) | – |
| Medial diverticula | 20±2.76 (15-25) | – |
| Pharynx length | 346±34.40 (266-412) | 320-400 |
| Pharynx width | 325±32.14 (266-376) | 300-400 |
| Ovary length | 971±147.83 (738-1275) | 1000 |
| Ovary width | 357±88.25 (201-505) | 500 |
| Hamulus length | 569±69.24 (490-718) | 650-700 |
| Hamulus point | 91±10.15 (67-101) | – |

Table 2 cont'd

| | | |
|---|---|---|
| Genital bulb | 93.3±9.90 (67-106) | – |
| No of genital spine | 7-8 | – |
| Length of spine | 35±3.26 (33-43) | 35 |
| Egg length | 226 (206-242) | 190-220 |
| Egg diameter | 136±32.20 (120-160) | 140-150 |
| Marginal hook C1 | 35.8±0.45 (35-36) | 35 |
| Presence of anastomosis | (25%) | 20% |

*Euzet, Bourgat and Salami-Cadoux (1974).

**Table 3.** Morphometric parameters of subadult *Polystoma galamensis* specimens from Usen, Nigeria.

| **Parameters (µm)** | **Speciemens from Usen, Nigeria** |
|---|---|
| Body Length | 6321±803(5594-7026) |
| Greatest width | 2113±229 (1732-2431) |
| Width at vaginae | 1428±125 (1198-1565) |
| Haptor length | 1565±113(1399-1732) |
| Haptor width | 2305±253 (2098-2931) |
| Haptor/length ratio | 0.25±0.02 (0.21-0.27) |
| Haptoral sucker diameter | 439 ±23.72 (399-479) |
| Oral sucker | 334±46.28(292-433) |
| Lateral diverticula | 51±7.49 (38-59) |
| Medial diverticula | 23±1.86 (20-26) |
| Pharynx length | 232±40.77 (186-279) |
| Pharynx width | 222±42.38 (160-279) |
| Ovary length | 653±73.40 (532-758) |
| Ovary width | 286±33.92 (239-335) |
| Hamulus length | 529±43.98 (439-599) |
| Hamulus point | 22±1.63 (19.8-23.1) |
| Genital bulb | 83±16.73 (66.5-106.4) |
| No of genital spine | 7-8 |
| Length of spine | 9.73.±3.92 (33.3-42.9) |
| Egg length | – |
| Egg diameter | – |
| Marginal hook C1 | ? |
| Presence of anastomosis | (27.3) |

**Table 4.** Size range of hamuli in some African polystomes.

| Parasite | Hamuli size (µm) | Authority |
|---|---|---|
| *P. aeschlimanni* | 378-495 | Bourgat and Murith (1980) |
| *P. africanum* | 335-452 | Aisien and Du Preez (2009) |
| *P. baeri* | 330-420 | Maeder *et al* (1970) |
| *P. channingi* | 327-385 | Du Preez (2013) |
| *P. dawiekoki* | 285-485 | Du Preez *et al* (2002) |
| *P. ebriensis* | 270-404 | Dupouy (1978) |
| *P. lamotei* | 336-395 | Bourgat and Murith (1980) |
| *P. makereri* | 390-425 | Tinsley (1973) |
| *P. mangenoti* | 470-530 | Maeder *et al*. (1970) |
| *P. okomuensis* | 325-456 | Aisien *et al*. (2011) |
| *P. perreti* | 347-402 | Maeder (1973) |
| *P. ragnari* | 360-400 | Maeder *et al* (1970) |
| *P. sodwanensis* | 407-442 | Du Preez and Kok (1992) |
| *P. testimagna* | 334-442 | Du Preez and Kok (1993) |

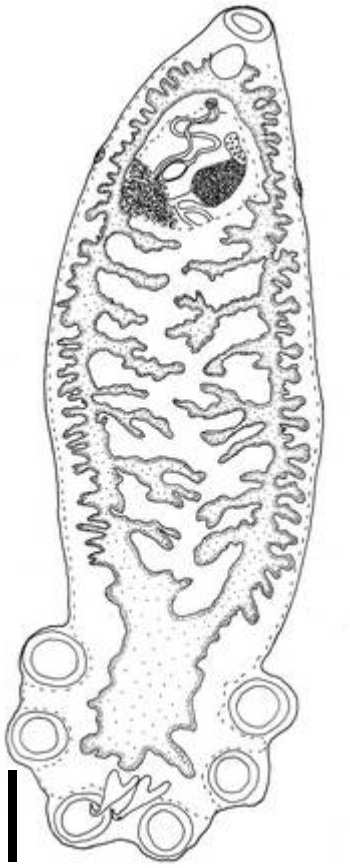
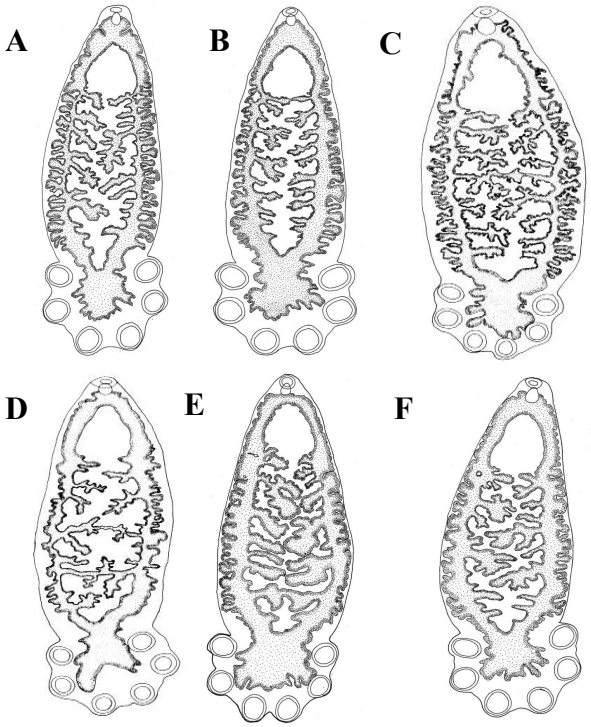


**Figure 1.** *Polystoma galamensis* infecting *Hylarana galamensis.* Scale bar: 1 mm.




**Figures 2A-F.** Variation in the intestinal arrangement of *P. galamensis* from Nigeria. Parasite without intestinal anastomoses (A); with one intestinal anastomosis (B, C, E); with two intestinal anastomoses (D); with slender lateral and medial diverticula (A-D); with broad lateral and medial diverticula (E, F).

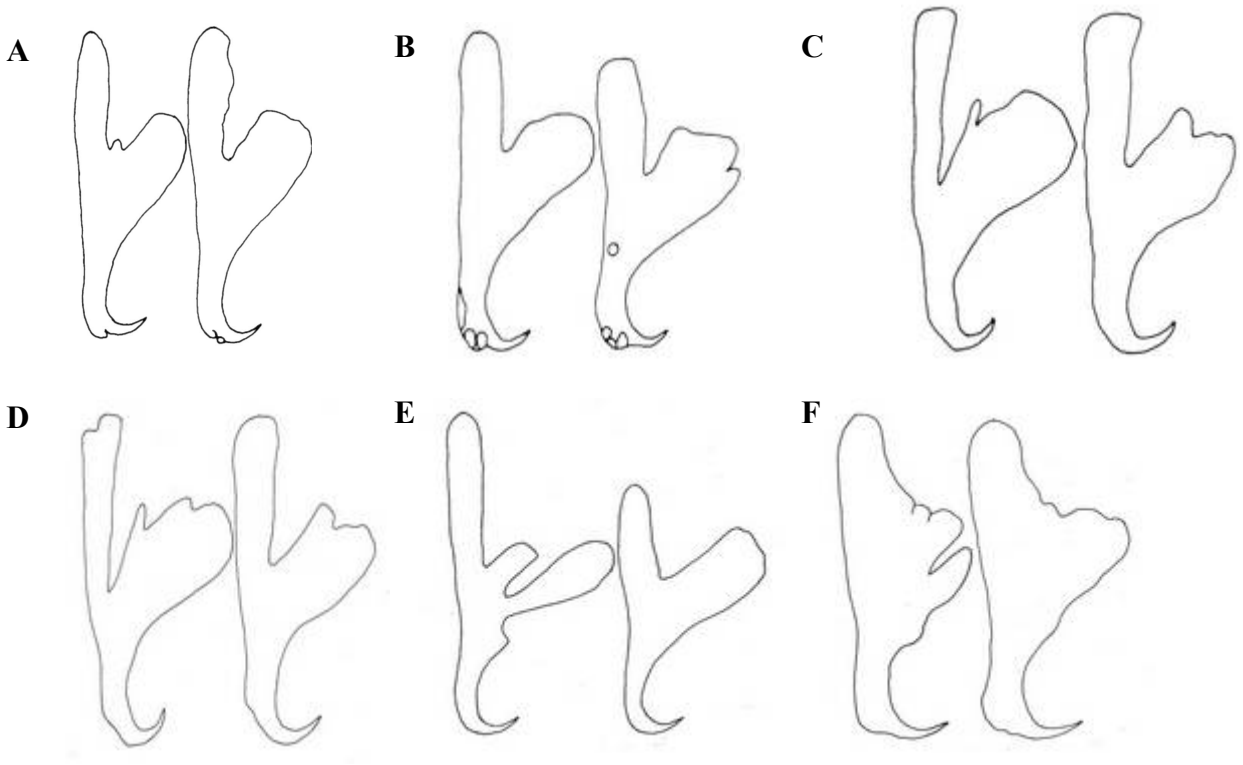



**Figure 3A-F.** Variation in the hamuli shape of *P. galamensis* from Nigeria.
Hamuli with handle well separated from the blade (A-E); hamulus with indistinct separation of handle and blade (F).

## Discussion

*Polystoma galamensis* was first described by Euzet *et al* (1974) from *Rana galamensis* (now *Hylarana galamensis*) from Klouto, Togo, located in the savannah biotope of the country. Frogs from which this parasite were recovered in Nigeria were mostly collected from the savannah biotope, with Igarra, Agenegbode, Ogbonna, Agbede and Usen located in the derived savannah and New Bussa in the guinea savannah. For this reason this polystome was thought to be a parasite of frogs inhabiting drier environments as obtains in the savannah (Aisien *et al* 2004b). It was therefore an interesting find when we recovered this parasite, albeit a single specimen from *H. galamensis* collected from the very humid environment of the freshwater creeks of the Niger Delta, where the rainy season spans over nine months of the year. It therefore seems that humidity is not a restricting factor in the distribution of the parasite since it infects hosts in the drier environment of the savannah as well as the humid environment of the Niger Delta.

Except for Igarra, *P. galamensis* was recorded from other locations in the derived savannah. The non-recovery of parasites from frogs collected at Igarra is most likely due to the small number of host specimens examined rather than the absence of *P. galamensis* from this location. While the frogs from Ogbonna and Agenegbode had parasite prevalence values less than 15% (6.70% and 14.20%, respectively), frogs from Agbede and Usen had prevalence values in the range of the 21.3% reported from Togo by Euzet *et al* (1974). So also was the prevalence recorded in the frogs from the Guinea savannah at New Bussa. The situation was however very different in the creek environment at Ase, where only one (2.27%) of the 44 frogs examined was infected, despite the fact that *H. galamensis* was the dominant frog species encountered at Ase; occurring on land near the water front and several other locations inland. The reason for this low prevalence is unknown and can therefore only be a matter of conjecture. According to Roedel (2000), *H. galamensis* does not form breeding aggregations and in all the locations where we have encountered this frog, we did not observe any amplectant pair, even though the males make advertisement calls. This solitary tendency of individual frogs effectively reduces their chances of transmitting infection to new hosts. This assumption is supported by the prevalence of polystome infection in other frog species from Ase that form aggregations (*Ptychadena bibroni*, 12.5%; *P. mascareniensis*, 9.1% and *P. pumilio*, 40%), (Aisien *et al* 2017). Another possible explanation for the low prevalence of *P. galamensis* in this location may be the level of precipitation. The rainy season is this region lasts from February to October and is accompanied by run-offs that possibly wash off the eggs of the parasite laid in inland puddles. At the later part of the rainy season (September and October), the area is often inundated and the ensuing flood results in egg/larval dilution that again limit the chances of oncomiracidia/tadpole interaction. This assumption is supported by the observation that the highest prevalence of infection (21.4%) was recorded in the guinea savannah where the wet season is much shorter and level of precipitation smaller, affording the parasites better reproductive success.

The intensity of infection with *P. galamensis* seems generally low with most frogs harbouring at most two parasites. This may not be unconnected with the generally large sizes of the parasites. The parasites recovered from the frogs examined in Togo ranged from 8 mm to 10 mm in body length while egg-producing specimens from Nigerian frogs ranged from approximately 6.93 mm to 9.99 mm (mean 8.33±0.93 mm). Even in a case from Usen where a frog harboured 11 sub-adult parasites, they were only marginally smaller, measuring 5.59 mm to 7.03 mm (mean 6.32±0.80) in total body length (Table 3).

A comparison of the parasites from Nigeria and those from Togo (Euzet *et al* 1974) showed close similarity in several aspects of their morphometry (Table 2). The characteristics of *P. galamensis* we recovered in Nigeria fit very closely into the description given by Euzet *et al* (1974), thus confirming *P. galamensis* as a valid species. The values obtained for some of the measured parameters either overlapped or were in the same range for parasites collected in both countries (Table 2). The occurrence of intestinal anastomoses was also infrequent in parasites recovered from frogs in Nigeria although slightly higher (26.6%) than the value recorded in the specimens from Togo (20%). It however needs to be mentioned that parasites from the guinea savannah tended to have a greater frequency of occurrence (75%) of this feature than those from the derived savannah. The hamuli of *P. galamensis* are indeed very large when compared with those of some African polystomes (Table 4), whose upper range seldom exceeded 500 μm in length. In the Nigerian specimens, the hamuli size ranged from 490-718 μm (mean 569±69.24 μm) while in those from Togo the range was from 650-700 μm.

As was observed in the parasites from Togo, there was also variation in the hamuli shape of parasites recovered from frogs in Nigeria. While most hamuli in the Nigerian materials had handles which were well separated from their guards (Figures 3A-E), the separation in a few of them was not so distinct (Figure 2F). Whereas Euzet *et al* (1974) reported the size of the C1 marginal hook to be 35 μm, the C1 marginals of *P. galamensis* from Nigeria were consistently longer, with a mean length of 39.9±1.04 μm and ranged from 39.0-41.6 μm. A re-examination of the type specimen may be necessary to clear this point. While the lateral and medial diverticula in the parasites from Togo were all shown to be slender, those from Nigeria did not share this uniformity: some were slender (Figures 2A-D) with highly branched medial diverticula (Figure 2C and D); others were broad and lobed (Figures 2E and F).

In the original description of *P. galamensis*, Euzet *et al* (1974) observed intra-uterine egg development, a phenomenon which had previously been reported in two European *Polystoma* species (*P. integerimum* and *P. pelobatis*) by Combes (1968). Although we did not observe this phenomenon in the parasites we collected from Nigeria, it is important to note that this phenomenon is now known to be widespread among members of the Polystomatidae studied in Africa and elsewhere. For members of the genus *Polystoma*, this reproductive strategy occurs in *P. africanum* (Salami-Cadoux, 1979), *P. grassei* (Dupouy and Combes, 1977; Murith *et al* 1977), *P. mashoni* (Beverley-Burton, 1962), *P. natalensis* (Combes and Channing, 1979), *P. nearticum* (Paul, 1938), and *P. togoensis* (Bourgat, 1977; Murith, 1981). For *Eupolystoma* spp. intra-uterine development is known to occur in *E. alluaudi* (Combes *et al* 1973; Salami-Cadoux, 1975; Tinsley, 1975), *E. anterorchis* (Tinsley, 1978) and *E. vanasi* (Du Preez *et al* 2003). This process is also known to occur in *Metapolystoma brygoonis* (Euzet and Combes, 1964), *M. cachani* (Murith *et al* 1977), *M. porrosissima* (Du Preez and Kok, 1992), *Kankana manampoka* (Raharivololoniaina *et al* 2011) and *Madapolystoma biritika* (Du Preez *et al* 2010). In summary, we have described here *Polystoma galamensis* recovered from *Hylarana galamensis* in Nigeria. This is the second description of this parasite in Africa. Whereas previous reports until now have confined the parasite to frogs in the drier environment of the savannah, this report has shown that *P. galamensis* also infects frogs occurring in the very humid environment as occurs in the Niger Delta region of Nigeria. Parasites from Nigeria and Togo share many common morphometric characteristics, which confirm *P. galamensis* as a valid species. The low prevalence of the parasite may be generally connected with the solitary reproductive behaviour of the host while in the Niger Delta, excessive precipitation and flooding may additionally play limiting roles.

**References**


Aisien, S.O., Ajakaiye, F.B. and Braimoh, K. 2003. Helminth parasites of anurans from the savannah-mosaic zone of south-western Nigeria. *Acta Parasitologica, 48(1):* 47-54.

Aisien, S.O., Ayeni, F. and Ilechie, I. 2004a. Helminth fauna of anurans from the guinea savanna at New Bussa, Nigeria. *African Zoology, 39(1):* 133-136.

Aisien, S.O., Salami, L.A, Obaro, F.E. and Erakpoweri, S.O. 2004b. The influence of climate on the distribution of monogeneans of anurans in Nigeria. *Journal of Helminthology, 78:* 101-104.

Aisien, M.S.O. and Du Preez, L.H. 2009. A redescription of *Polystoma africanum* Szidat, 1932 (Monogenea: Polystomatidae). *Zootaxa* 2095: 37-46.

Aisien, M.S.O., Du Preez, L.H. and Imasuen A.A. 2011. *Polystoma okomuensis* (Monogenea: Polystomatidae) from Boulenger's striped frog, *Phlyctimantis boulengeri* (Perret, 1986) in Nigeria. *Journal of Helminthology, 85:* 153-159.

Aisien, M.S.O., Ugbomeh, A.P. and Awharitoma, A.O. 2017. Parasitic infections from a freshwater creek community in Delta State, Niger Delta of Nigeria. *Helminthologia, 54(2):*132-144.

Beverley-Burton, M. 1962. Some monogenetic trematodes from amphibia in Southhern Rhodesia including a new species *Polystoma mashoni*, sp.n. from *Bufo regularis* (Reuss). *Journal of Parasitology, 48:* 752-757.

Bourgat, R. 1977. Étude comparative des polystomes (Monogenès) de ranidé (Anoues) du sud Togo. Description of Polystoma togoensis n. sp. *Bullettin du Museum National d'Historie Naturelle Zoologie (Paris), 3:* 447-476.

Bourgat, R. and Murith. D. 1980. *Polystoma lamottei* n.sp. et *P. aeschlimanni* n. sp., duex Polystomes (monogènes) de la meme espèce d'Amphibien: *Ptychadena pumilio* (Boulenger, 1920). *Zeischrift für Parasitenkunde, 62:* 293-301.

Combes, C. 1968. Biologie, écologie des cycles et biogéographie de digenes et monogénes d'Amphibiens dans l'est des Pyrénées. *Memoires de Museum d'Histoire Naturelle Serie A Zoologie, 51:* 1-95.

Combes, C., Bourgat, R. and Salami-Cadoux, M.-L. 1973. Biologie des Polystomatidae: Le cycle interne direct chez *Eupolystoma alluaudi* (de Beauchamp, l9l3). *Zeitschrift für Parasitenkunde, 42:* 69-75.

Combes, C. and Channing, A. 1979. Polystomatidae (Monogenea) d'Amphibiens d'Afrique du Sud: *Polystoma natalensis* n. sp. parasite de *Strongylopus grayi* (Smith, 1849). *Vie et Milleu* sér C, *28-29:* 61-68.

Du Preez, L.H. and Kok, D.J. 1992. Syntopic occurrence of new species of *Polystoma* and *Metapolystoma* (Monogenea:Polystomatidae) in *Ptychadena porosissima* in South Africa. *Systematic Parasitology, 22:* 141-150.

Du Preez, L.H. and Kok, D.J. 1993. Polystomatidae (Monogenea) of Anura in southern Africa: *Polystoma testimagna* n. sp. parasitic in *Strongylopus f. fasciatus* (Smith, 1849). *Systematic Parasitology, 25:* 213-219.

Du Preez, L.H., Vaucher, C. and Mariaux, J. 2000. Polystomatidae (Monogenea) of African Anura: *Polystoma dawiekoki* n. sp. parasitic in *Ptychadena anchietae* (Bocage). *Systematic Parasitology, 52:* 35-41.

Du Preez, L.H., Tinsley, R.C. and De Sa, R. 2003. Polystomatidae (Monogenea) of Southern African Anura: *Eupolystoma vanasi* n. sp. parasitic in *Schismaderma carens* (Smith, 1848). *Systematic Parasitology, 54(1):* 71-79.

Du Preez, L.H, Raharivololoniaina, L., Verneau, O. and Vences, M. 2010. A new genus of polystomatid parasitic flatworm (Monogenea: Polystomatidae) without free-swimming life stage from the Malagasy poison frogs. *Zootaxa, 2722:* 54-68.

Dupouy, J. 1978. *Polystoma ebriensis* Maeder, 1973 (Ver Monogène) Parasite de l'Amphibien anoure *Ptychadena equiplicata* au Cameroun. Description de

l'adulte. *Revue de Zoologie Africaine, 92(3):* 775-785.

Dupouy, J. and Combes, C. 1977. Existence d'un cycle interne de reproduction chez *Polystoma grassei* Euzet, Combes et Knoepffler, 1966 (Monogenea, Polystomatidae) en Afrique Equatoriale. *Annales des Sciences Naturelles, Zoologie, Paris* 12º Série, Tome, *19:* 39-400.

Euzet, L. and Combes, C. 1964. Sur un Polystomatidae (Monogenea) récolté Madagscar chez *Rana mascareniensis* Duméril et Bribon. *Bullettin de la Société Zoologique de France, 89:* 392-401.

Euzet, L., Bourgat, R. and Salami-Cadoux, M.-L. 1974. *Polystoma galamensis* (Monogenea) parasite de *Rana galamensis* Dumeril et Bibron, 1841, au Togo. *Annales de Parasitologie Humaine et Comparee, 49:* 63-68.

Maeder, A.M. 1973 Monogènes et Trématodes parasites d'Amphibiens en Côte d'Ivoire. *Revue Suisse de Zoologie, 80:* 267-322.

Maeder, A.M, Euzet, L. and Combes, C. 1970. Espèces nouvelles de genre *Polystoma* (Monogenea) en Afrique occidentale. *Zeitschrift für Parasitenkunde, 35:* 140-155.

Murith, D. 1981. Contribution a l'étude de la systématique des polystomes (Monogénes: Polystomatidae) parasites d'amphibiens anoures de basse Côte d'Ivoire. *Revue Suisse de Zoologie, 88:* 475-533.

Murith, D., Vaucher, C. and Combes, C. 1977, Coexistence de la néoténie et du cycle interne chez un Polystomatidae (Monogenea). *Comptes rendus de l'Académie des Sciences (Paris), D284:* 187-190.

Paul, A.A. 1938. Life history studies of North American freshwater polystomes. *Journal of Parasitology, 24:* 489-510.

Raharivololoniaina, L., Verneau, O., Berthier, P., Vences, M. and Du Preez, L.H. 2011. First monogenean flatworm from a microhylid frog host: *Kankana*, a new polystome genus from Madagascar. *Parasitology International, 60:* 465-473.

Roedel, M.-O. 2000. *Herpetofauna of West Africa. Vol. 1: Amphibians of West African Savannah*. Chimaera, Frankfurt, 335pp.

Salami-Cadoux, M.-L. 1975. Transmission et développement du monogène réno-vésical *Eupolystoma alluaudi* (de Beauchamp, 1913), Euzet et Combes, 1967. *Bulletin de la Société Zoologique de France, 100:* 283-92.

Salami-Cadoux, M.-L. 1978. Les stades larvaires de *Polystoma africanum* Szidat, 1932 (Monogenea : Polystomatidae) parasite de *Bufo regularis* Reuss. *Bulletin du Museum National d'Histoire Naturelle Zoologie, 353:* 221-226.

Salami-Cadoux, M.-L. 1979. Cycles et épidemiologie de Polystomatidae parasites de I'amphibien *Bufo regularis* Reuss au Togo. Thèse de Doctorat d'Etat, Université de Perpignan.

Tinsley, R.C. 1973. Observations on Polystomatidae (Monogenoidea) from East Africa with a description of *Polystoma makereri* n. sp. *Zeitschrift für Parasitenkunde, 42:* 251-263.

Tinsley, R.C. 1975. The correlation between the life-cycle of *Eupolystoma alluaudi* (Monogenea) and the ecology of its host *Bufo regularis*. *Parasitology, 71:* 16-17.

Tinsley, R.C. 1978. Oviposition, hatching and the oncomiracidium of *Eupolystoma anterorchis* (Monogenoidea). *Parasitology, 77:* 121-132.

**Citation: Aisien,** M. S. O., Ozemoka, H. J., Edo-Taiwo, O. and Enabulele, E. E. *Polystoma galamensis* (Monogenea): Occurrence and ecological range in Nigeria. http://dx.doi.org/10.4314/tzool.v15i1.7

*The Zoologist, 15:* 43-49 December 2017, ISSN 1596 972X.
Zoological Society of Nigeria.