Sokoto Journal of Medical Laboratory Science 2021; 6(2): 4 - 10

SJMLS - 6 (2) -001

Population Dynamics, Ecology and Infection Rate in Freshwater Snails in Shelleng Local Government Area, Adamawa State, Nigeria

Na'acha, F.E. * [1], Naphtali, S.R. [2], Chessed, G. [3] and Nassai, I. [4]

Department of Zoology, School of Pure and Applied Sciences, Modibbo Adama University of Technology, Yola, Nigeria [1], Department of Zoology, School of Pure and Applied Sciences, Modibbo Adama University of Technology, Yola, Nigeria [2], Department of Zoology, School of Pure and Applied Sciences, Modibbo Adama University of Technology, Yola, Nigeria [3] , Community Health Department of Gombe State College of Health Sciences and Technology Kaltungo, P.M.B. 042. [4]

Author for Correspondence: +2348166576496/ nachae25@gmail.com*

ABSTRACT:

The research on population dynamics, ecology and infection rate in freshwater snails was carried out in Kiri dam and Shelleng water bodies. Point A- Shelleng on GPS location N 9°54'17.78688" (Latitude) E 11°57'10.30284" (Longitude) and point B and C are on GPS location N 9°40'53.81508" (Latitude) E 11°59'51.33408" (Longitude). Monthly variation of physicochemical parameters was carried out from September 2018 to October 2019 and collection of snails was carried out to test for transmission dynamics of the snails. The snails were exposed to sunlight individually for 2 hours in a petri-dish that contains aged tap water. They were screened for cercarial shedding in the research laboratory under a dissecting microscope. There was significant difference between snail abundance and alkalinity; dissolve oxygen, pH and temperature of the water body and no significant difference between snail abundance with the turbidity and conductivity of the water. The highest abundance of snails was recorded in the month of June (20.5%) while the least was recorded in the month of December (2.5%). The infection rate of snails was (42.5%) of the 769 snails examined and *B. truncatus* had the highest infection (64.4%) while *B. forskaii* had the least infection (4.1%). The location of the study area has no effect on the distribution and abundance of snails but human activities and physicochemical parameters in this study supports freshwater snails.

Keywords: *Dynamics, Physicochemical, Parameters, Kiri, Shelleng.*

Introduction

In Nigeria, *Biomphalaria* and *Bulinus* species of snails are involved in the transmission of schistosomiasis (Idris and Ajanusi, 2002). Snail distribution is widespread throughout the country, where the physical landscape provides diverse habitat conducive to supporting established populations of *Bulinus globossus*, *B. truncates*, *B* senegalensis, and *Biomphalaria pfeifferi*. The Niger River and Benue River basins, the Lake Chad depression, and lakes dotting the region lend marshy, riparian environments suitable to snail intermediate hosts (Atlas of the Global Distribution of Schistosomiasis- Nigeria, 1987). The eggs of *Bulinus* and *Biomphalaria* species are deposited in mass on biotic and abiotic substrata in water. Hatching takes place under optimal conditions between 7-10 days. Snails of the two genera may reach sexual maturity in about 4-6 weeks. The anticipated increase or decrease in freshwater snail population could be due to temperature and other factors. Temperature influences fecundity, growth, survival and parasite development in snails and thus dictates the time it takes the parasite to complete the life cycle. This may have implications on transmission of schistosomiasis. The reproductive capacity is high and population of these species may undergo marked seasonal fluctuation in density and infection rate with rainfall and temperature being the main determining factors. Although, water is always present in most irrigation canals, which means constancy of water cancels rainfall effect, however, rainfall is presumed to facilitate transmission by washing the eggs of *S. mansoni* in faeces into water bodies (Idris and Ajanusi,

2002). Furthermore, environmental factors such as the physicochemical parameters of water bodies are also of concern in the distribution of the snail intermediate hosts of schistosomiasis. This parameter includes water current velocity, pH and water temperature (Idowu, 1996).

Materials and Methods

Description of Study Area

Shelleng Local Government Area (LGA) of Adamawa State is situated on latitude 9˚53'5"N and longitude 12˚0'32"E. The LGA is centrally located in the state. The area has sedimentary rock, which is made up of shale, thin bands of limestone and lignite. Kiri dam is located in Shelleng LGA, it was built in 1982 and has a capacity of 615 million m^3 for hydroelectric generation, provision of water for irrigation of sugar cane for the Savannah Sugar Company (SSC); a large-scale sugar cane plantation and processing company set up as a joint venture between the Federal Government of Nigeria and the Commonwealth Development Corporation (CDC), London (USTDA, 2011). The major water supply to the dam is from Dadin Kowa dam in Gombe State, and it is a tributary to river Benue via River Gongola. Communities around the Kiri dam consists of clusters of compounds each surrounded by locally made mats and mud wall.

Collection of Freshwater Snails

Collection of snails was carried out from the month of September 2018 to October 2019 and it was done on monthly basis from Kiri dam and Shelleng water bodies to test for seasonal variation and transmission dynamics of the snails. Sampling sites were selected based on their distribution, extent of shoal habitat with depth less than one meter, and accessibility. Specific sampling localities were recorded by latitude and longitude using hand held Global Positioning System (GPS). Manual search with visual inspection and hand picking was employed. Collections were made in water bodies with visible water contacts and areas without apparent water contacts were also sampled. The snail sampling was also conducted using the scooping technique, utilizing a standardized scoop. Such scoop mainly based on a flat wire mesh size 1.5 mm of a metal frame (40 X 30 cm) mounted on a metal handle two meters long. The sampling technique was done by searching the edge of the shores, dipping to cover as large distances as possible. In each survey, 20 dips were taken perpendicular to the edge of the shore along the bottom, for distance of about two meters towards the middle of the shore. Each site was sampled for 20 scoops (2 scoops per 2 meters interval) per monthly survey and all collected snail samples were transferred to plastic containers and transported to the Laboratory. The snail species were washed, counted, photographed and identified using the keys of Adejumoke *et al.* (2016) and Zakaria *et al*. (2016).

Morphological Identification of Snails

The snails were identified using shell morphology according to Brown and Kristensen (1993). This was achieved by holding the snail shell with the apex (pointed edge) pointing upward. When the aperture (shell opening below the body whorl) opens to the right, it is termed dextral but when the aperture opens to the left it is termed sinitral. More so, the sculptural marking on the snail shell was considered during identification. Other shell components like the number of whorls, shape of the shell, type of apex (sharp or blunt) and shape of the peristome on the aperture was considered (Gabor *et al*., 2008).

Screening for Patent Infection

The snails were exposed to sunlight individually for 2 hours in a petri-dish that contains aged tap water. They were screened for cercarial shedding in the research laboratory under a dissecting microscope.

Physicochemical Parameters

The physicochemical parameters include dissolved oxygen, alkalinity, pH, conductivity and temperature, transparency and depth of the water body. Dissolved oxygen (DO) was determined using dissolve oxygen meter. Total alkalinity was determined by titration with standard sulphuric acid (N/50 H_2SO_4) using mixed indicators. pH and conductivity were determined using a pH comparator (Lovibond comparator) and an electric conductivity meter (Model 7020), respectively. Surface water temperature was measured directly with ordinary mercury in glass thermometer. Transparency and depth were determined with a

Secchi (Adejumoke *et al*., 2016). All the physicochemical parameters were measured between 9:00am to 11:30am and were recorded in the field survey sheets.

Data Analysis
Data was analyzed using SPSS version 22. Chi square (X^2), mean, percentage and standard deviation were also used to analyze the variables.

Ethical Clearance
Approval was obtained from the state ministry of health and village heads.

Results
In this study, we investigated the population dynamics, ecology and infection rate in freshwater snails in Kiri dam and Shelleng water bodies. Table 1 show that there was significant difference between snail abundance and alkalinity; dissolve oxygen, pH and temperature of the water body as ($p<0.05$). There was no significant difference between snail abundance with the turbidity and conductivity of the water as ($p>0.05$). The highest abundance rate was recorded in the month of June (20.5%), followed by May and July with (13.5%) and (13.4%) respectively. The least recorded was in the month of December (2.5%).

Five snail species were observed namely: *Bulinus globosus*, *Bulinus truncates*, *Bulinus forskaii*, *Melanoides tuberculata* and *Biomphalaria pfeifferi*. The infection rate of snails was (42.5%) of the 769 snails examined. Out of the 769 snails examined, *B. truncatus* had the highest infection (64.4%), followed by *B. globosus* (42.4%), while *B. forskaii* had the least infection (4.1%) in table 2.

In table 3, *B. truncatus* recorded highest abundance of 38.0%. The break down are: November, (51.7%), December (52.6%), March (42.1%), April (44.6%), May (34.6%) and June (33.5%) followed by B. *globosus* (37.5%) abundance rate; in the month of August (36.2%), September (35.3%), October (41.9%), January (55.6%), February (47.9%) and July (40.8%). This was also followed by *B. forskaii* with 12.6%. The least recorded in all the months was *M. tuberculata* with 1.4% abundance rate.

Table 4 shows the sampling point A- Shelleng on GPS location N 9°54'17.78688" (Latitude) E 11°57'10.30284" (Longitude) and the human activities that take place include landing for canoes conveying passengers, fishing and swimming. The bottom of the water body is sandy with silt, substrate and detritus. Site B and C are on GPS location N 9°40'53.81508" (Latitude) E 11°59'51.33408" (Longitude) and the human activities that take place include swimming, bathing, washing and fishing. Site C is surrounded by farmland and has muddy dark brown sediment with detritus while site B has sandy, stony bottom with detritus.

Table 1: Monthly Variation of Snails and Physico-chemical Parameters of Shelleng Water Bodies

Months	Snails	Alkalinity	Turbidity	DO	Conductivity	pH	Temp.
Aug	69(9.0)	6.70±0.45	10.87±0.54	5.13±0.82	119.00±1.63	7.27±0.41	32.67±1.25
Sept	51(6.6)	10.67±3.63	7.70±2.48	7.20±2.68	117.00±2.83	7.10±0.50	32.00±2.83
Oct	31(4.0)	10.27±2.99	6.10±0.14	5.60±1.22	106.00±4.08	7.23±0.42	31.67±1.70
Nov	29(3.8)	4.63±0.37	7.33±0.45	5.13±2.19	103.00±5.10	7.63±0.12	32.33±2.36
Dec	19(2.5)	6.80±0.33	8.13±1.41	10.70±2.19	112.67±7.59	7.60±0.16	25.67±2.05
Jan	27(3.5)	5.43±0.26	10.37±1.80	15.30±1.71	120.67±8.38	7.97±0.37	24.33±2.87
Feb	48(6.2)	6.33±0.73	9.97±0.59	16.30±1.30	130.33±6.94	7.50±0.50	27.00±2.94
Mar	57(7.4)	10.70±1.78	13.97±2.51	12.50±0.96	134.33±6.94	7.43±0.40	28.67±3.30
Apr	74(9.6)	11.33±2.10	13.77±2.38	7.97±4.38	148.33±17.33	7.57±0.33	30.00±0.82
May	104(13.5)	10.57±1.96	11.77±1.18	11.03±1.27	180.67±10.66	7.90±0.51	28.00±0.82
June	158(20.5)	10.67±0.24	12.67±2.15	11.30±0.62	164.67±11.26	7.63±0.12	29.33±0.94
July	103(13.4)	9.80±0.22	11.93±2.09	10.93±0.33	167.33±10.66	7.70±0.29	29.00±2.16
P-value	769(100)	*	**	*	**	*	*

Key: *values are expressed as means ± SEM for the Physico-chemical; * means $p<0.05$; ** means $p>0.05$.*

Table 2: Freshwater Snails Species and Cercarial Shedding in the Study Area

Snail Species	No. of Snails Examined (%)	No. of Collected Snails Infected (%)
Bulinus globosus	288(100)	122(42.4)
Bulinus truncates	292(100)	188(64.4)
Bulinus forskalii	97(100)	4(4.1)
Melanoides tuberculata	11(100)	0(0.0)
Biomphalaria pfeifferi	81(100)	13(16.0)
Total	769(100)	327(42.5)

Table 3: Freshwater Snail Species and Monthly Abundance in the Study Area

Months	*B. globosus* (%)	*B. truncates* (%)	*B. forsklii* (%)	*M. tuberculata* (%)	*Biom. Pfeifferi* (%)	Total (%)
Aug	25(36.2)	24(34.8)	08(11.6)	01(1.4)	11(15.9)	69(9.0)
Sep	18(35.3)	16(31.4)	11(21.6)	00(0.0)	06(11.8)	51(6.6)
Oct	13(41.9)	11(35.5)	05(16.1)	01(3.2)	01(3.2)	31(4.0)
Nov	11(37.9)	15(51.7)	03(10.3)	00(0.0)	00(0.0)	29(3.8)
Dec	08(42.1)	10(52.6)	00(0.0)	00(0.0)	01(5.2)	19(2.5)
Jan	15(55.6)	11(40.7)	00(0.0)	01(3.7)	00(0.0)	27(3.5)
Feb	23(47.9)	21(43.8)	04(8.3)	00(0.0)	00(0.0)	48(6.2)
Mar	21(36.8)	24(42.1)	06(10.5)	00(0.0)	06(10.5)	57(7.4)
Apr	30(40.5)	33(44.6)	07(9.5)	01(1.4)	03(4.1)	74(9.6)
May	33(31.7)	36(34.6)	11(10.6)	01(1.0)	23(22.1)	104(13.5)
June	49(31.0)	53(33.5)	31(19.6)	04(2.5)	21(13.3)	158(20.5)
July	42(40.8)	39(37.9)	11(10.7)	02(1.9)	09(8.7)	103(13.4)
Total	288(37.5)	292(38.0)	97(12.6)	11(1.4)	81(10.5)	769(100)

Table 4: Shows Sampling Points, GPS Location, Bottom Sediment and Human Activities at each Point

Sampling Points	GPS Location	Human Activities	Bottom Sediment
A – Shelleng	N 9°54'17.78688" (Latitude) E 11°57'10.30284" (Longitude)	1. Landing for canoes conveying passengers. 2. Fishing, buying and selling of fish, sweet potato. 3. Swimming.	Sandy bottom with silt, substrate and detritus.
B – Kiri	N 9°40'53.81508" (Latitude) E 11°59'51.33408" (Longitude)	1. Washing, bathing and swimming. 2. Fishing. 3. Fetching water for domestic activities.	Sandy, stony bottom with detritus.
C – Kiri (Sabon Pegi)	N 9°40'53.81508" (Latitude) E 11°59'51.33408" (Longitude)	1. Swimming, bathing, and washing. 2. Fishing. 3. Surrounded by farmlands.	Muddy dark brown sediment with detritus.

Discussion

The results obtained from the study shows that physicochemical parameters have influence on the decrease number and increase or abundance of snails (Table 1). There was significant difference between snail abundance and some ecological parameters like alkalinity, dissolve oxygen, pH and temperature of the water body. This finding is similar with the report of Gabriel *et al.* (2014). Alkalinity in this study ranges between 4.6-11.3mg/l, this result is similar to the report of Obande *et al.* (2012) who recorded a value range of 4.0-15.4mg/l in River Uke, Nassarawa State, Nigeria. Dissolve oxygen ranges between 5.1-16.3mg/l. The pH value in this study was between 7.0 - 7.9, this agrees with the result of Usman *et al.* (2017) who measured pH value of 7.0 – 8.5 with most of the snails found from the water body within the pH value of less than 8.0. Ntonifor and Ajayi (2007) reported that snails prefer base, alkaline pH water at that range but it seem to have no effect on snail's population and abundance. Although the findings of Spyra (2017) revealed that acidic pH is unfavorable to the occurrence of snails. A lot of findings have been established that a pH range of 6.5-9.0 for surface water favors the breeding of fresh water fish, which can also attract fishermen thus sustaining a high level of water contact. Yokogawa Electric Corporation (2020) also reported that fish cannot survive in waters below pH 4 and above pH 11 for long periods. The

optimum pH for fish is between 6.5 and 9.0. The water temperature for the period of study ranged between 24^{O}C– 32^{O}C, this favors the abundant of freshwater snails. World Health Organization [WHO] (1993) and Jordan *et al*. (1993) reported that, the optimal temperature for snail reproduction is 22^{O}C – 26^{O} C and the higher the temperature the lower the dissolve oxygen. The lower dissolve oxygen of less than 1% caused the suffocation of snail WHO (1990). Low population of snails were recorded in the month of August, September and November 32^{O}C and October 31^{O}C, and also in December 25^{O}C which had the lowest population of snails. WHO (1990) reported that at the tail end of dry season, the oxygen tension falls below1% and snails tends to suffocate. Most of the snails recorded in this study tend to tolerate the minimum/maximum temperature of 24^{O}C – 32^{O}C in their natural habitat. This finding agrees with the result of Usman *et al*. (2017) and Njoku-Tony (2011). There was no significant difference between snail abundance with the turbidity and conductivity of the water as ($p^{>}0.05$). The fluctuation in turbidity and conductivity shows no effect on the abundance of snails. This is in line with the result obtained in the survey of Auta *et al*. (2019), which revealed a positive correlation of snail species, with transparency and also agrees with the findings of Sharma *et al*. (2013). The turbidity in dry season range between 6-10cm and in rainy season it ranges between 10 -13cm, this result disagrees with the value recorded by Obande *et al*. (2012) who recorded 50-60cm in dry season and 4-7cm in rainy season. Conductivity varies between 103-180µs/cm. The different snail species populations were not affected by conductivity and turbidity of the water; however, there were high population of snails in the raining season than in the dry season. This finding disagrees with the result of Njoku-Tony (2011) who recorded higher population of freshwater snails in the dry season 1,961 and low population in the rainy season 419. The physicochemical parameters in this study were however adequate and support freshwater snails.

Conclusion

The physiochemical parameters in this research area favor the abundance of fresh water snails and the socio cultural behavior of the people might promotes the spread of *S*chistosomiasis due to the cercarial shedding by the intermediate host snails.

Acknowledgment

We are grateful to Mr Aitiya Emina, who was the field coordinator and used his vehicle throughout the field work. Thanks to Dr. Joshua Zira for his assistance with the water quality tools to enable us get accurate reading.

Conflict of Interest

The authors declare that they have no competing interest.

References

Adejumoke, O.O., Samuel, O.A., and Ifeanyi, E.O. (2016). Ecology of *schistosoma* snail vectors in Ado-Ekiti Local Government Area, Ekiti State, Nigeria. *International journal of pure and applied Zoology*; 4(1): 77-84.

Auta, T., Alkali, E. and Michael, E. (2019). Population dynamics, diversity and distribution of freshwater snails in Zobe Dam, Dutsin-Ma, North-Western Nigeria. *Asian Journal of Environment and Ecology*; 8(4): 1-7.

Brown, D.S. and Kristensen, T.K. (1993). A guide to freshwater snails. *DK-2920, Danish Bilharziasis Laboratory,* Charlottenlund, Denmark.

Gabor, M., Zoltan, F., Tamas D. and Gabor, F. (2008). Establishment of *Biompalaria tenagophila* snails in Europe. *Emerging Infectious Disease*; 14(11): 1812-1814.

Gabriel, O.D., Frank, B.G., Douglas, N.A., Ally-Said, M., Paul, O.A, Samson, O.A., Collins, O., Canisius, K.K., Philip, O.O. Ayuba, V.O.O. (2014). Distribution and abundance of schistosomiasis and fascioliasis host snails along the Mara River in Kenya and Tanzania. *Infection Ecology and Epidemiology*. 4:10.3402/iee. v4.24281.

Idris, H.S. and Ajanusi, O.J. (2002). Snail intermediate hosts and the etiology of human schistosomiasis in Katsina State, Nigeria. *The Nigerian Journal of Parasitology*; 23:145-152.

Idowu, S.A. (1996). Studies on metabolic

reserves in aestivating and nonaestivating three snail intermediate hosts of schistosomiasis Kano, Nigeria. *Acta tropica*: 7-10.

Jordan, P., Webbner, G. and Sturrock, R.F. (1993). Human schistosomiasis, 3rd ed oxford, CAB International 1993.

Njoku-Tony, R.F. (2011). Effect of some physicochemical parameters on abundance of intermediate snails of animal trematodes in Imo State, Nigeria. *Researcher*; 3(4):15-21.

Ntonifor, H.N. and Ajayi, J.A. (2007). Studies on the ecology and distribution of some medically important freshwater snail species in Bauchi State, Nigeria. *International Journal of Biological and Chemical Sciences*; 1(2): 121-127.

Obande, R.A., Dauda, K.P and Adah, P.M. (2012). Influence of physicochemical parameters on the distribution of freshwater snails in River Uke, Nasarawa State, Nigeria. In: 27th annual conference and biennial general meeting of the fisheries society of Nigeria (FISON): 246-249.

Sharma, K.K., Bangotra, K. and Saini, M. (2013). Diversity and distribution of mollusca in relation to the physicochemical profile of Gho-Manhasan Stream, Jammu (J&K). *International Journal of Biodiversity and Conservation*; 5(4): 240-249.

Spyra, A. (2017). Acidic, neutral and alkaline forest ponds as a landscape element affecting the biodiversity of freshwater snails. *The Science of Nature*; 104: 9-10.

United States Trade and Development Agency [USTDA] (2011). Princeton energy resources international (peri). Feasibility study for Nigeria: *Kiri dam hydroelectric power plant*. Task J Report: Final Report. www.perihq.com/TDAReports/KiriDam_FINAL. Accessed 20th June, 2015.

Usman, A.M., Babeker, E.A. and Malann, Y.D. (2017). Effect of some physicochemical parameters on prevalence of animal trematodes in Bauchi State, Nigeria. *Science World Journal*; 12(4): 1597-6343.

WHO (1990). Health education in the control of schistosomiasis. World health organization working committee; 56:810.

WHO (1993). The control of schistosomiasis, second report of the WHO Expert Committee WHO Technical Report Series, No. 830.

Yokogawa Electric Corporation (2020). pH in fish farming. 9-32, Nakacho 2-chome, Musashino-shi, Tokyo 180-8750, Japan. www.yokogawa.com, http://www.yokogawa.com/an/. AN10B01R20-01E.

Zakaria, A.M., Afifi, A., Sulieman, Y. and Pengsakul, T. (2016). Some micro-ecological factors influencing the popultion dynamic of *Schistosoma* intermediate host snails in Khartoum State, Sudan. *International Journal of Research-Granthaalayah;* 4(8): 147-151.

Citation: Na'acha, F.E., Naphtali, S.R., Chessed, G. and Nassai, I. Population Dynamics, Ecology and Infection Rate in Freshwater Snails in Shelleng Local Government Area, Adamawa State, Nigeria. *Sokoto Journal of Medical Laboratory Science; 6(2): 4 -10.*