The Influence of Physico-Chemical and Ecological Factors on the Distribution of Freshwater Snails in Manchok Water Intake in Kaduna State, Nigeria.

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ABSTRACT

A survey was conducted to determine the influence of physico-chemical parameters on the distribution of freshwater snails in Manchok water intake, Kaduna State, Nigeria from January 2013 to December, 2013. A total of eight thousand, three hundred and forty one (8341) freshwater snails were collected using a long handled metal scoop net. The relative abundance of the various freshwater snail species recorded were Biomphalari pfeifferi (99.46%), Lymnaea natalensis (0.52%) and Melanoides tuberculata (0.01%). The seasons of the year were found not to significantly influence snail distribution in the water body. However, some physico-chemical parameters were found to influence the freshwater snail distribution. The public health and veterinary implications of these findings are discussed.

INTRODUCTION

Manchok water intake was constructed by Kaduna State Government in order to provide portable water supply for the communities around. The water was harnessed from Kajim water spring. A lot of human contact activities such as washing clothes, bathing, soaking and washing corn for local wine are taking place in the water body and this has helped in the proliferation and spread of fresh water snails[1.] Thus the construction of the water intake has altered the natural ecology of Kajim spring and has created a conducive environment for the breeding of fresh water snail species that serve as intermediate host of important human and animal diseases such as *Schistosomiasis*, *Fascioliasis*[2]. *Schistosomiasis* is one of the most important tropical diseases in the world and globally, it is second to malaria among parasitic diseases of socioeconomic and public health importance[3]. In Nigeria, it is estimated that 101.28 million people are infected with *Schistosomiasis*[4]. Fresh water snails are important ecological community and they play significant role in veterinary and public health[5]. Some freshwater snails are important intermediate hosts of trematods

(helminthes) and parasites of human and animal disease[6, 7]. Environmental factors like physico-chemical parameters are considered to affect the ecology of freshwater snails[8]. Similarly, Mustapha and Omostosho (2005)[9] reported that physico-chemical parameters of water play a significant role in composition, distribution and abundance of aquatic organisms. Hence, effective and efficient control of freshwater snails can only be achieved when their habitat and characteristics are well understood[10]. Manchok water intake has the potentials for the transmission of water borne diseases. Thus, the study was aimed at providing baseline data on the local distribution of freshwater snails in the water body and the influence of physico-chemical parameters on the distribution of freshwater snails.

MATERIALS AND METHODS

Study Area

Kaduna state lies within latitude 10º21'23"N and longitude 7º26'2"E. It has an area of 46053 km³ with two large rivers (Gurara and Kaduna) that are dammed at various locations. Manchok is a town in Kaura L.G.A of Kaduna State, Nigeria. Kaura has an area of 485km³ and a population of 222, 57911. It is bounded to the south by Plateau state. Newer Basalts occur in Manchok along the western edge of Jos plateau. A highly productive spring (Kajim Spring) emerges from the newer Basalt at Manchok. Kajim spring forms the head water of a tributary of the Kaduna River[12]. The Kajim spring is shaded by canopy of forest trees along most of its length. Occupational activities centered mainly on farming.

Snail Collections

The water intake was sampled once every month for a period of one year (January to December, 2011) as described by Opisa *et al.,* 2011 [13]. Snails were collected with a long handled scoop net and those observed visually were collected with forceps. Sample area per location was approximately $5m^2$ and a length of 10meters along the water body for 30 minutes. Each scoop was thoroughly searched and all snails seen were placed in labeled perforated plastic containers. Collected snails were transported to the department of Biological sciences laboratory Nigerian Defence Academy for Morphological identification using standard key[14].

Physicochemical parameters

Water transparency was measured with the aid of Sacchi disc with a calibrated cord. pH of each of the surface water body was determined with a Hanna instrument, a pocket size pH meter. Surface water temperature, electrical conductivity and total dissolved solids were determined on site with COMBO meter (model COM 100). The method by APHA[15] was used for the determination of dissolved oxygen (DO) and Biochemical oxygen demand (BOD).

Data Analysis

The SPSS statistical tools were employed for the data analysis with 1BM SPSS version 20. P values < 0.05 were considered significant. Values are presented as mean ±

SD. t-test was used to compare the relative abundance of fresh water snails, during the dry and wet seasons. Correlation coefficient was used to find the relationship between each of the physicochemical parameters on the relative abundance of freshwater snails.

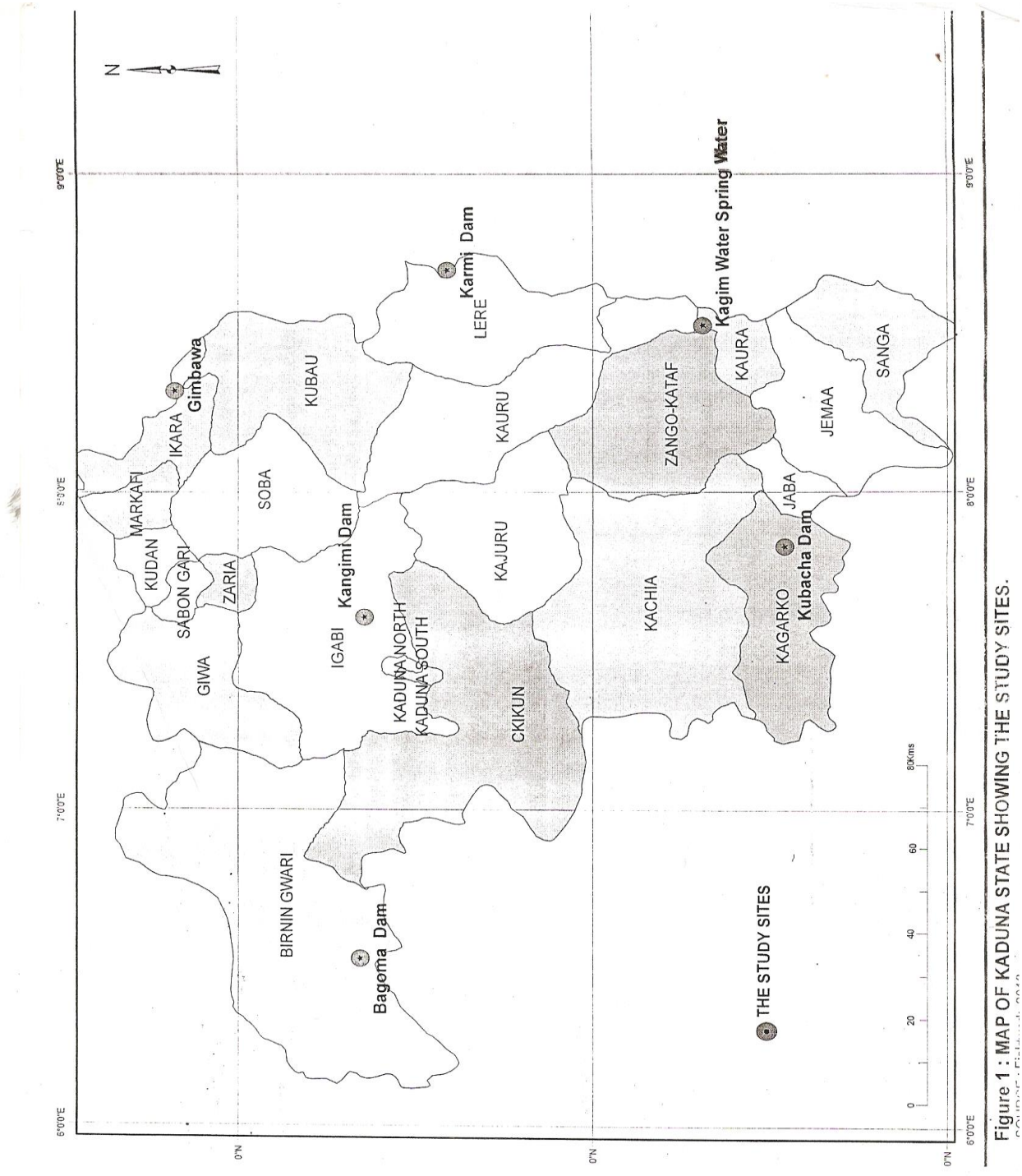

Figure 1 : MAP OF KADUNA STATE SHOWING THE STUDY SITES.

Plate 1: Manchok water intake

Mapping

The geographical location of the site was mapped with a handheld global positioning system (GPS) unit (Garmin 980 Ex series). The geographical location of Manchok water intake is indicated below.

	Longitude	latitude
Manchok water intake	08º30'82"'E	09º40'85"N

RESULTS AND DISCUSSION

Eight thousand, three hundred and forty one (8341) freshwater snails belonging to three genera and three species were collected from the water intake from January 2011 to December 2011. The freshwater snails identified were *Biomphalaria pfeifferi* (Krauss, 1848), *Lymnaea natalensis* (Krauss, 1848), and *Melanoides tuberculata* (Muller, 1774)[14].

The distribution of freshwater snails in Manchok water intake is depicted in Table 1. From the results obtained, Manchok is rich in freshwater snail intermediate hosts. The spring was characterized with rocky Newer Basalt substratum that is rich in alluvial soil with organic matter and weeds (ferns and water lettuce) among others. The water table was high during dry season(November-April) and low during rainy season (May-October). The presence and abundance of the freshwater snails show little biodiversity with *Biomphalaria pfeifferi* (99.46%). This was followed by *Lymnea natalensis* with 0. 52% while *Melanoides tuberculata* was recorded only once during the survey period. Hence vast majority of freshwater snails in Manchok water intake are of B.*pfeifferi* species.

Melanoides tuberculata

Biomphalaria pfeifferi

Lymnaea natalensis

Table 1: The distribution of freshwater snails in Manchok water intake, Kaduna state

Freshwater snail species	Number snails collected	Relative percentage
Biomphalaria pfeifferi	8341	99.46
Lymnaea natalensis	44	0.53
Melanoides tuberculata	1	0.01
Total	**8394**	**100**

Below is the t-test to compare seasonal abundance of fresh water snail.

t	df	sig.	x difference	SE Difference
0.875	10	0.402	-523	608.9

A total of two thousand five hundred seventy two (2572) and five thousand, seven hundred and sixty nine (5769) fresh water snails were collected in dry and rainy season from the Manchock water intake respectively. More snails were observed during rainy season, however when compared statistically, no significant difference ($p < 0.05$) was observed. From t-test above $P=0.402>0.05$. This implies that fresh water snails are equally abundant in manchock water intake.

Table 2 shows the mean seasonal value of the physico-chemical parameters in manchock water intake. The mean dissolved oxygen in dry season was 6.73mg/l while it was 18.85mg/l in the rainy season. The results of other physico-chemical parameters are shown in the table.

Table 2: Seasonal variation of physico-chemical parameters

Mean value Physico-chemical	Mean Values ± SD Season	
	Dry	**Rainy**
Dissolved oxygen (mg/l)	6.73±2.77	7.08±5.87
Biochemical oxygen demand (mg/l)	2.02±2.29	2.64±4.36
pH	8.05 ±0.55	7.97±1.50
Water temperature (^{o}C)	25.83 ±0.98	25.83±0.41
Total dissolved solids (mg/l)	86.67±2.91	89.33±14.72
Conductivity (µs)	147.50 ±2.07	151.33±19.39

Statistically, no significant difference was observed in the physico-chemical parameters of the water body during dry and rainy season.

In other words, physico-chemical parameters were averagely the same in the water intake.

P = 0.696 > 0.05 for DO, P=0.762>0.05 for BOD

P = 0.432 > 0.05 for pH, P=1.000>0.05 for t

P = 0.640 > 0.05 for TDS, P=0.746>0.05 for conductivity

Similarly correlation coefficients were used to analyse the influence of physico-chemical parameters on snail distribution. Significant relationship (P<0.05) was observed between the relative abundance of fresh water snails and DO, BOD, pH and TDS with p values of 0.001,0.001,0.006,0.035 respectively while no significant relationship was observed in water temperature (p = 0.619 > 0.05) and conductivity(p=0.398>0.05)

The present study is the first of its kind to observe the presence of fresh water snails in Manchok water intake. Surprisingly the water intake was found to harbour fresh water snails of public health and veterinary importance. Intense human contact activities such as washing clothes bathing has led to high level of pollution in the water body and this consequently helped in the increase in snail abundance[1,10]. Abundance of organic matter also lead to algal growth that serves as food for fresh water snails and thus makes the environment favourable for their proliferation. High abundance of fresh water snails were collected from the water body of which vast majority were *B.pfeifferi* which accounted for 99.46% of total snail collection during the period of study. Also the alluvial soil and rich forest vegetation and domestic pollution which characterized the site allow for high density of pulmonate snail[16] of which *B.pfeifferi* and *L.natalensis* are inclusive.

However, some researchers[13] have reported the absence of fresh water snails in spring water. Differences in environmental

conditions may explain this[17]. The presence of *B.pfeifferi* and *L.natalensis* in the water intake which have been indicated as intermediate host of *schistosome* in Nigeria[18] and fasciola in many parts of Africa[6,19] respectively suggest the possible outbreak of *schistosomiasis* and *Facioliasis* in the community.

This study observed low fresh water snail species biodiversity (Table 1). This agrees with the general reports on fauna of the tropical fresh waters[16].

In Manchok water intake, more freshwater snails were collected during rainy season. In the spring water, heavy rain helps in establishing the habitat with consequent reactivation of snails, hence the higher number observed[20]. The study also observed that during this period, the water table was low which could have offered a stable environment for the fresh water snails to proliferate. However no significant difference ($p<0.05$) was observed in both seasons. Thus fresh water snails were available irrespective of the season. This could be attributed to the year round water contact activities on the site resulting in rich supply of particular organic matter from which they feed[16].

Similarly, no significant ($p<0.05$) seasonal difference was observed on the influence of physico-chemical parameters on snail distribution. This shows that physico-chemical parameters are averagely the same during both seasons therefore; rainfall does not really affect the relative abundance of fresh water snails in Manchok water intake. However, Camara *et al.,* (2012)[16], and Mohamed *et al.,* 2011[21] observed seasonal variation in snail densities. The result also showed that DO, BOD, pH and TDS are the main factors influencing distribution in the water body while temperature and conductivity do not have impact on snail distribution in the water body. The high abundance of snail collected in rainy season could contribute to the higher DO observed in the same period. High DO is important as it makes oxygen available to the snails immediately below the dense floating vegetation and prevents them from reaching the surface where there is shortage of DO[6]. High BOD indicated high domestic pollution resulting in high number of snails. pH indicated water quality and the extent of pollution in the water body.

This research found that pH on the alkaline side was more favourable for the growth of snails. This is further substantiated by Agi and Okwuosa (2001)[22] who reported that pH on alkaline side was more favourable for survival of snails. So high DO, BOD and pH promoted the growth of fresh water snails which consequently led to high number of snails.

Observed abundance of *B.pfeifferi* could be attributed to the low constant temperature of the spring water (25.83±0.41). This agrees with the findings of Opisa *et al.,* (2011)[13] who demonstrated that *B.pfeifferi* grow and survive better at 25ºC. Similarly, there is high occurrence of *B.pfeifferi* due to low temperature of 22.6ºC. Several researchers in Nigeria have demonstrated the usefulness of these parameters in the increase or decrease of snail population[19,23,24]. Therefore activities

in and around Manchok water intake predispose the local communities to associated risk of active transmission of water borne diseases and the presence *B.pfeifferi* suggest possible endemicity of intestinal *schistosomasis* in the community.

CONCLUSION

Manchok water intake harbours fresh water snails of public health and veterinary importance. *B.pfeifferi* is the predominant snail species followed by *L.natalensis* thus there is urgent need to sensitize the local inhabitants on the potential risk associated with the constant contact with the water body.

REFERENCES

1. Ngele, K.K., Kalu E.O., Ukwe, M.C. and Onyeuwu, C. N (2012). A survey of freshwater snails: the intermediate hosts of *Schistosomiasis* in Bende L.G.A Abia state. *International Journal of Science and Nature*. **Vol. 3**(4): 879 – 882.

2. Ofoezie I.E (2002). Human health and sustainable water resources development in Nigeria: *Schistosomiasis* in artificial Lakes. *Nat. Human Res. Forum* **261**:150 - 160.

3. WHO (1996). Report of the WHO informal consultation of *schistosomiasis* control. *Geneva* December. 1998 WHO/CDS/SIP/99.2.

4. Chitsulo, L; Engela D; Montresor, A; Savioli, L (2000). The global status of *Schistosomiasis* and its control. *Acta Tropica* **77**:41-51.

5. Supian, B. and Ikhwannuddin, A. M (2002). Population dynamics of freshwater molluscs (gastropod: M.tuberculata) in Crocker range park, Sabah *ASEAN Rev. Biodiv. Environ. Conserve*. (ARBEC) Pp. 1 – 9.

6. Brown, D.S (1994): Freshwater snails of Africa and their medical importance. 2nd Edn. London Taylor and Francis, Pp 609.

7. Mostafa, O.M.S (2009). Effect of salinity and drought on the survival of Biomphalaria arabica, the intermediate host of S. mansoni in Saudi Arabia. *Egyptian Acad. J.Biol. Sci.* **1**(1): 1-6.

8. Garg RK, Rao RJ, Saksena DN (2009). Correlation of molluscan diversity with physicochemical characteristics of water of Ramsagar reservoir. *India. Int. J. Biodivers. Conserv*. **6**:202-207.

9. Mustapha, M.K and Omostosho, J.S (2005). An assessment of the physico-chemical properties of Maro Lake. *African Jour. Of App Zoology and Environment Bio* **7**:73-77.

10. Owojori, O.J; Asaolu, S.O and Ofoezie, I.E (2006). Ecology of freshwater snails in Opa Reservior and Research Farm Pond at Obafemi Awolowo University Ile Ife. *Nigeria Journal of Applied Sci*. **6**(15):3004 – 3015.

11. National population commission (2006)

12. Eduvie M.O. and Olaniyan I.O. (2003) Ground water quality appraisal in

southern part of Kaduna State Nigeria. *American Journal of Environmental Engineering.* **Vol. 3**(1):77-83.

13. Opisa, S; Odiera, M. Walter, G.Z. O; Jura Karanja, D.M.S and Munjinzi, R.N.M (2011). Malocological survey ad Geographical distribution of vector snail for *Schistosomiasis* within informal settlement of Kisumu City, Western Kenya. *Parasites and Vector* **4**:226.

14. DBL –WHO (1978). A field guide to African freshwater snails. West African species. WHO snail identification centre.

15. APHA (1992). American public health. Association standard methods for the examination of water and waste water. APHA, Washington, D.C.

16. I.A. Camara, Y.K. Bony, D. Diomandé, O.E. Edia1, F.K. Konan, C.N. Kouassi, G. Gourène and J.P. Pointier (2012). Freshwater snail distribution related to environmental factors in Banco National Park, an urban reserve in the Ivory Coast (West Africa)
African Zoology **47**(1): 160–168.

17. Ayanda, O.I (2009). Prevalence of snail vector of *schistosomiasis* and their infection rates in two localities within A.B.U Campus Zaria, Kaduna State, Nigeria. *Journal of Cell and Animal Bio.* **Vol. 3**(4)Pp. 58 – 61.

18. Adewumi, C. O; Furu P; Christensen, N.O; Marquis, B.B and Fagbola, M (1990). Endemicity and Seasonality of transmission of human *Schistosomiasis* in Ile-Ife Southwest Nigeria. *Trop.Med.parasitol* **14**:443-444.

19. Njoku- Tony, R. F.(2011). Effect of some physico-chemical parameters on abundance of intermediate snails of animal trematodes in Imo state, Nigeria. *Researcher*, **3**(4) Pp.15-21.

20. Yirenya-Tawiah. D.R,; AbdulRashid, A,; Futagbi, G; Aboagye, I and Dade, M; (2011): Prevalence of snail vectors of *Schistosomiasis* in the Kpong Head Ghana. West African *Journal Of App. Ecology* 1839-45.

21. Mohamed A. Hussein, Ahmad H. Obuid-Allah, Amal A. Mahmoud and Heba M. Fangary (2011). Population dynamics of freshwater snails (Mollusca: Gastropoda) at Qena Governorate, Upper Egypt. *Egypt. Acad. J. Biolog. Sci.*, **3**(1): 11 -22.

22. Agi, P. I. and Okwuosa V.N. (2001). Aspect of water quality of freshwater system harbouring snail vectors of schistosomes parasites in Jos. *Nigeria Journal of aquatic Science* **16**:13-17.

23. Oguoma, R.M, Ugorji, ND, Okolo, K.V, mbanefo, E.C and Umeh, J.M. (2010) Aquatic snail species of two adjoining rivers in Owerri, Imo state, South Eastern Nigeria. Animal research international. **7** (1): 1125-1128.

24. 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. *Int. J. Biol. Chem. Sci.* (2): 121-127.