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Some limnological studies of an aquatic habitat used for fishing and irrigation in Ngala, Borno State, Nigeria

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ABSTRACT: The limnological characteristics of the aquatic habitat were studied with special emphasis on water temperature, calcium hardness and chlorine levels as they affect the abundance of *Bulinus globosus* and *Bulinus forskali* on one hand and their interfactorial effects on the other. The single regression analysis showed that calcium hardness was the only factor that showed direct significant ($P<0.05$) positive effect on abundance of *B. globosus* and *B. forskali*. Similarly, water temperature was significantly ($P<0.05$) negatively correlated with chlorine and calcium hardness levels. Water temperature levels were negatively correlated with the abundance of both snail species. The behavioural patterns of the fishermen exposed them to the risk of infection with schistosomiasis.

Key Words: Limnological studies; Aquatic habitat; Irrigation.

Introduction

The water scarcity afflicting the northern part of Borno State resulted in the construction of a 32km in-take channel from lake Chad (aquatic habitat used for fishing and agriculture) to Kirinowa with the main aims of providing water for irrigated agriculture and fishing which later gave rise to the South Chad Irrigation Project (SCIP) extending to Ngala Local Government Area in the mid-seventies and early eighties. Water was also pumped into the SCIP area from river Ebergi at two points (Jagarawaje and Gamboru). River Ebergi, which is a tributary of Lake Chad was also used for fishing and irrigation.

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These two sources of water (Lake Chad and River Ebergi) provided a network of water channels that stretched from Kirinowa to Gamboru, Ngala (a distance of over 50km). The Ngala sector of the water channel was maximally put into use by Lake Chad Research Institute and Chad Basin Development Authority and local farmers and fishermen for crop production through irrigation and fishing. Earlier studies (Gaud, 1958; Sturrock, 1965; Lewert *et al*., 1966; Chu *et al*., 1968; Egborge, 1971; Sturrock and Sturrock, 1972; Upatham, 1973; Ukoli, 1984) show that this situation creates favourable conditions for water-borne and water-related diseases and so this study of some of the limnological parameters of the water was carried out with emphasis on interfactorial effects of water, temperature, calcium hardness and chlorine on the abundance of *Bulinus globosus* and *B. forskali* (snail vectors of schistosomiasis).

Materials and Methods

Research Area

The research area is the South Chad Irrigation Project located within Ngala Local Government Area of Borno State. It is 140km North-east of Maiduguri, the capital of Borno State. The climate is of the arid and semi-arid characteristics with erratic unevenly distributed rainfall pattern with only two months of heavy and stormy rainfall in July and August. The top-soil type of the area is vertisol characterized by deep crack of the surface when dry and very sticky and slippery when wet. The research site was the lake Chad Research Institute Farm at Ngala, the headquarters of Ngala Local Government Area.

Water Temperature (°C).

The water temperature was measured direct from the site before other sample collections. A glass thermometer graduated in degrees centigrade (of the range: 10°C to 110°C) was dipped into the water to a depth of 8cm. The reading was recorded after five minutes (in °C).

Total chlorine

The water was collected in clean plastic bottles, filled completely and capped tightly. Care was taken to avoid excessive agitation and exposure to light especially sunlight. The samples were taken to the laboratory almost immediately upon collection where total chlorine content was determined by the DPD Colorimetric Method as described by the American Public Health Association (1976) using a spectrophotometer.

Total hardness

The water sample collection was similar to the method used for total chlorine described above. The calcium hardness was determined by the Low Range Calmagite Colorimetric Method using a spectrophotometer (Am. Pub. Hlth. Assoc., 1976).

Sampling of snail vectors

The aquatic habitat was sampled for *Bulinus globosus* and *Bulinus forskali* using standard sieves of 0.05 – 1mm mesh in accordance with the method of Ukoli and Asumu (1979). The activities and behavioural patterns of the fishermen in the reservoir were observed.

Analysis of result data

The data obtained were statistically analysed using regression and correlation analysis to predict the degrees of the variation of the parameters and the type of association existing within and between them.

Results and Discussion

The single regression analysis revealed that water temperature had a significant (P.0.05) direct negative effect on the abundance of both *Bulinus globosus* and *B. forskali* with the following regression equations:

$Y_1 = 136.59 – 3.67\ X_1 \pm 7.81$ (point 1) and
$Y_2 = 33.65 - 1.11\ X_2 \pm 0.91$ (point 2)

(where Y_1 = *B. globosus*, Y_2 = *B. forskali*, X_1, X_2 = water temperature).

The equations indicate that *B. globosus* was probably more tolerant to the temperature levels than *B. forskali* and that high water temperatures were deleterious to both snails. By extrapolation from the equations, the upper critical water temperatures for both snails ranged between 30.60°C and 37.6°C. These results corroborate the report opf earlier workers (Sturrock and Sturrock, 1972, Upathan, 1973) that water temperature affects the biology of aquatic snails.

Calcium hardness shows a significant ($P < 0.05$) direct positive regression effect with both snails as shown by the following single regression equations:

$Y_1 = -101.39 + 18.15\ X_1 \pm 7.10$ (point 1) and
$Y_2 = -21.87 + 3.41\ X_2 \pm 1.47$ (point 2)

(where Y_1, Y_2 = *B. globosus* and *B. forskali*, respectively and X_1, X_2 = calcium hardness).

Calcium hardness is a major factor in the snail biology as calcium ions are used in the formation of shells and other mechanical structures in aquatic invertebrates especially snails and clam shells (Ezeugwu and Obiamiwe, 2002) and skeletal structures of vertebrates including fishes. This scenario poses a problem to the health of the fishermen using the reservoir as they are liable to be infected with schistosomiasis vectored by these snails (Ezeugwu and Okaka, 2001). The fishermen immerse the greater part of their exposed bodies into the infected water channels and reservoir. Small children fish and swim within the reservoir with bare foot.

The interfactorial relationship existing among the factors studied are clearly shown by the regressional and correlational analysis. Figure 1 shows the scatter diagram with regression line and 95% confident belt of chlorine and calcium hardness against water temperature. The figure shows that water temperature exhibited significant ($P<0.05$) negative effects on each of calcium hardness and chlorine levels as shown by their respective single regression equations:

$Y_1 = 12.922 – 0.0195\ X_1 \pm 0.20$ (point 1)
$Y_2 = 0.0289 – 0.0078\ X_2 \pm 0.010$ (point 2)

(where Y_1, Y_2 = water temperatures, X_1 = calcium hardness and X_2 = chlorine).

Figure 1 and Table 1 revealed that the limnological factors in addition to having effects on the abundance of *B. globosus* and *B. forskali* also had significant ($P < 0.05$) effects on each other. This tends credence to the fact that the limonological factors of an aquatic environment do not only act in isolation but also in conjunction with each other (Hira and Muller, 1966; Firck and Hillyer, 1966).

Conclusion

The limnological factors affected snail abundance as well as the variation of each other. The fishermen activities and behaviour exposed them to the possibility of schistosomiasis infection. Calcium hardness is a major factor in the formation of the rigid structures of aquatic fauna.

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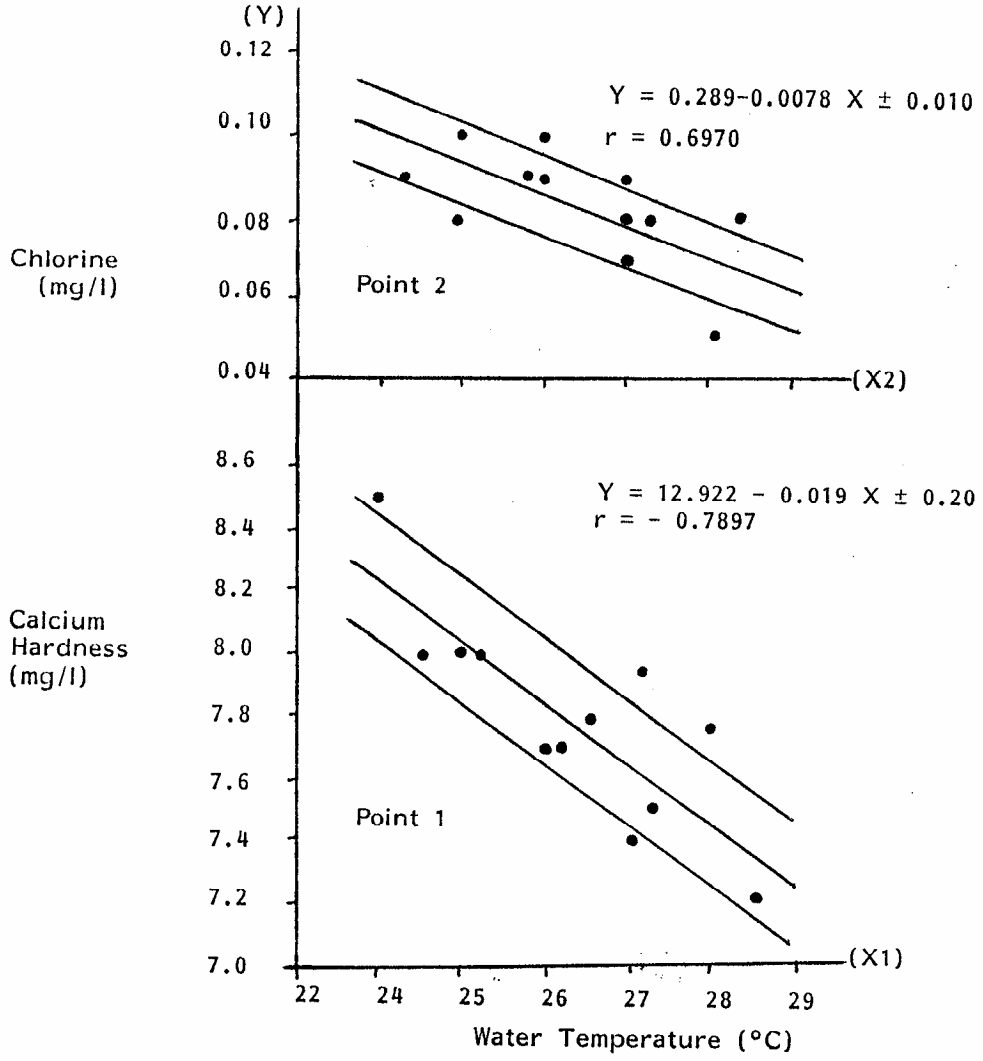

Fig.1: Scatter-diagram with regression line and 95% confidence belt of calcium hardness and chlorine against water temperature.

Table 1: Correlation coefficients of some of the parameters studied

Parameters	Corr. Coef. – Point 1					Corr. Coef. – Point 2				
WT										
CL	** -0.8117					** -0.6970				
CH	** -0.7897	* 0.5952				-0.5564	0.1967			
BG	-0.5212	0.3956	* 0.6348			-0.3622	0.0359	0.2022		
BF	-0.0409	0.0128	0.0472	0.4339		** -0.6846	0.3438	* 0.6510	-0.0223	
Parameters	WT	CL	CH	BG	BF	WT	CL	CH	BG	BF

Key

WT = Water temperature
CL = Chlorine
CH = Calcium hardness
BG = Bulinus globosus
BF = Bulinus forskali

* Significant at P≤0.05
** Significant at P≤0.01

Critical Values:

P≤0.05 = 0.553
P≤0.01 = 0.683

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