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Application of biostatistics to the effects of water velocity on the distribution of *Bulinus globosus* and *Bulinus forskali* in an irrigation scheme in Borno State, Nigeria

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ABSTRACT: The distrubution of *Bulinus globosus* and *Bulinus forskali* in relation to the water velocities in the research site was investigated. Station 6 had the highest mean velocity of 22.82 cm sec. The analysis of variance for all the stations showed a very highly significant ($P<0.01$) defined as negative. Station 4 with a zero velocity (stagnant) had the highest number of both snails indicating an inverse relationship between velocity of water flow and abundance. The regression analysis indicated that increase in water velocity had a non-significant negative effect on the distribution of *B. globosus* and *B. forskali.*

Key Words: Irrigation scheme; Water velocity; Snail vectors.

Introduction

The uneven distribution of the available natural water bodies in Nigeria has resulted in their concentrations in the southern parts of the country. Water is the driving force of nature and therefore has been put to so many uses some of which include its use to generate electricity (hydroelectric dams), produce food (irrigation dams) or provide potable water (water treatment plants). The arid and semi-arid zones of Nigeria supplemnent their food production through irrigation activities and this system has created suitable aquatic habitats for snail vectors of diseases such as *Bulinus globosus* and *Lymnaea natalenses* that are vectors of urinary schistosomiasis and hepatic fascioliasis respectively (Ukoli, 1984, Yoloye, 1988).

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The physical and chemical characteristics of the aquatic habitats (rivers, streams, pools, ponds, dams, reservoirs, irrigation channels, lakes) affect the establishment and distribution oif the aquatic flora and fauna therein (Madsen and Monrad, 1981). Water velocity is one of the physical factors that influences the establishment of snail vectors but not much attention has been given to the type of effect it has on the snail vectors of schistosomiasis. Webbe (1967) and William and Hunter, 1968 mentioned that slow-flowing habitats are preferred by the snails although there were no indebt biostatistical proof to explain the relationship. This study provides the indebt biostatistical proof to explain the relationship. This study provides the indebt biostatistical approach to the effect of water velocity on the distribution of *Bulinus globosus* and *Bulinus forskali* in an irrigation scheme in Ngala, Borno State.

Materials and Methods

Study Area

The research area is Ngala located 140km North-East of Maiduguri, the capital of Borno State, Nigeria. It lies at Long. 14° 10'E and Lat. 12° 21'N with arid, semi-arid and desert characteristics and located within the sahel and sudano-savannah ecological zone (Ezeugwu and Okaka, 2004) often experiencing a drought-prone climate with only about two months of stormy rainfall with aggregated heavy rains in July and August.

Measurement of water velocity

The floatation method was used to measure the water velocity. A piece of cork was dropped on the water surface and by the use of a stop-watch and a tape, the distance travelled by the cork per second was recorded. To minimize experimental error, the measurements were replicated three times and the mean distance per second was calculated.

Sampling of snail vectors

The research site was divided into seven (7) stations in relation to the observed differences in their velocities of water flow. The snails were samples using standard sieves of 0.05mm-1mm mesh in accordance with the Olivier and Schneiderman's sieve method (1956).

Results and Discussions

The velocities of water in the various stations are shown in Fig. 1. Station 6 had the highest mean velocity of 22.82 cm per second as against stations 4 and 5 that were stagnant with zero mean velocities. The analysis of variance (F-test) for all the stations showed that there were very high significant differences ($P<05$) in the velocities of water in the stations (Table 1). The same Table also showed that there were significant differences ($P<05$) between the abundance of *Bulinus globosus* and *Bulinus forskali* in the stations. Stations 6, 3 and 4, in ascending order, had the highest mean snail abundance of 30.58, 40.00 and 110.17 respectively for *Bulinus globosus*. The result also shows that *B. globosus* was consistently, comparatively and significantly ($P<0.5$) more abundant than *B. forskali* in stations 3, 4 and 6.

A posteriori testing by Duncan's multiple range test for all the stations (Table 1) showed that there were significant differences ($P<0.05$) between their mean abundance of *B. globosus* in stations 1, 2, 5 and 7 on one hand and stations 3, 4 and 6 on the other. Similarly, there were significant differences between the velocities of water in stations 4 and 5 on one hand and 1, 2, 3, 6 and 7 on the other. The multiple range test also showed that at 95% level; of significance, there is no difference in the mean abundance of *B. forskali* in stations 5 and 2, 2 and 3, 3 and 6.

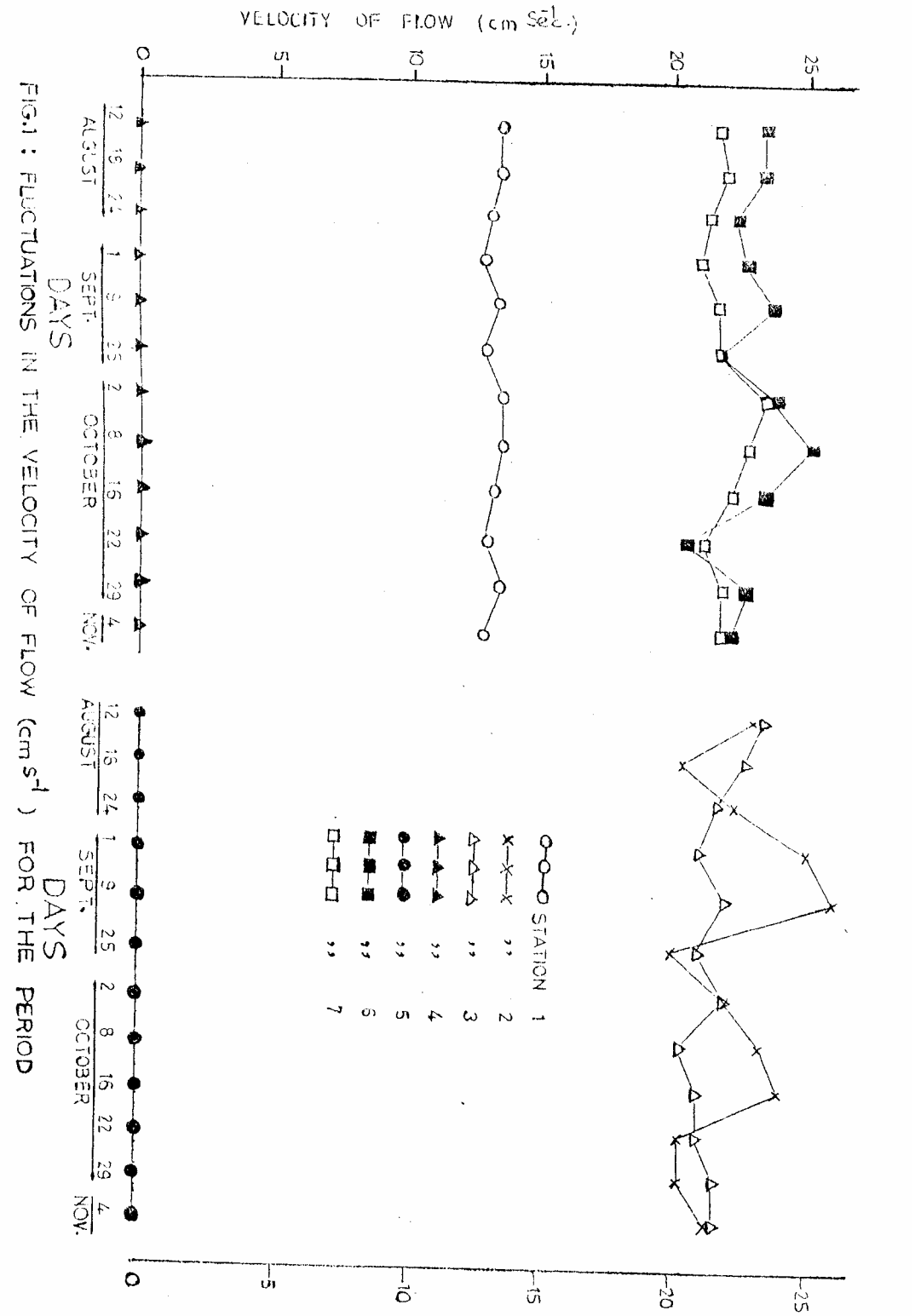

FIG.1 : FLUCTUATIONS IN THE VELOCITY OF FLOW (cm s^{-1}) FOR THE PERIOD

Table 1: F-test* and Duncan's Multiple Range test for the snail distribution and water velocity in the study statios (1-7)

FACTORS	RESULT OF DUNCAN'S MULTIPLE RANGE TEST								Level Sig. For Duncan's	Calculated F-value	Level of Sig. For F-values.
	Stations (S)	7	1	5	2	6	3	4			highly
Abundance of **Bulinus globosus**	Means (M)	0.25	0.42	2.00	3.17	30.58	40.00	110.17	p≤0.05	52.30	significant at
	Result (R)	———							p≤0.01		p≤0.01
	(S)	1	7	5	2	3	6	4			significant
Abundance of **Bulinus forskali**	Mean (M)	0.08	0.17	0.75	2.25	3.08	4.33	7.17		27.60	p<0.01
	R_1				———	———	———		p≤0.05		
	R_2	———	———	———					p≤0.01		
Velocity of water (cm sec^{-1}.)	S	4	5	1	3	7	2	6			
	M	0	0	12.98	21.55	21.77	22.32	22.82			highly significant
	R_1		———		———	———	———		p≤0.05		P≤0.01
	R_2		———		———	———	———		P≤0.01	1365.78	

*Critical (tabular) F-value = 2.22 (p<0.05): 3.05 (P<0.01)

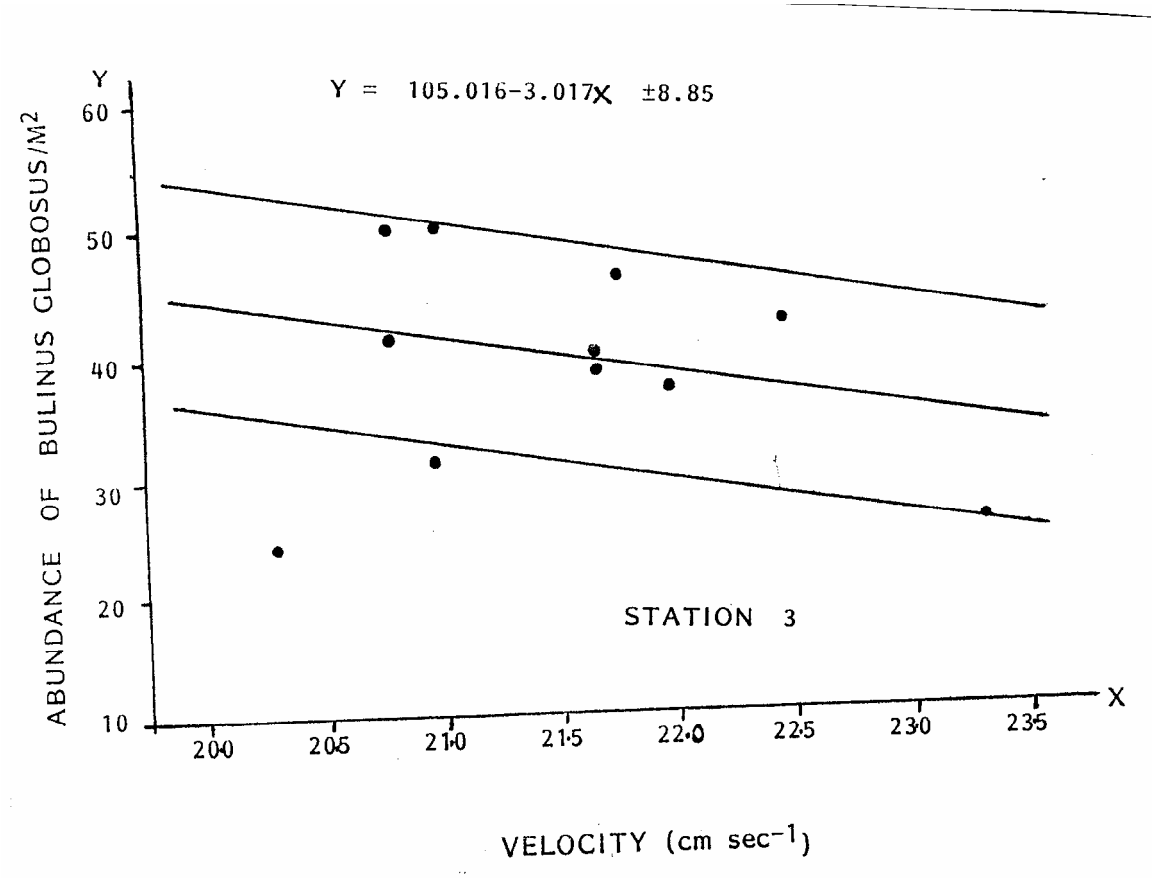

FIG. 2: SCATTER DIAGRAM WITH REGRESSION LINE AND 95% CONFIDENCE LIMIT FOR B. GLOBOSUS (Y) AGAINST WATER VELOCITY (X).

The effect of water velocity on the distribution of *B. gl;obisus* and *B. forskali* in this study couyld not be clearly stated as positive or negative for all the stations. However, station 4 that had a zero velocity had the highest number of *B. globosus* and *B. forskali* indicating a negative or inverse relationship between water velocity and snail distribution. The single regression analysis however clearly showed a negative effect of water velocity on snail distribution with a single regression equation:

$$Y = 105.016\text{-}3.017\ X \pm 8.85$$

(Where Y = *B. globosus* and X = water velocity).

Figure 2 shows the scatter-diagram with regression line and 95% confidence belt of water velocity against the abundance of *Bulinus globosus* in station 3. The figure clearly indicates that water velocity has a negative slope implying a probable deleterious effect of increase in water velocity on snail abundance. The two species of snails therefore preferred the stagnant and slow-flowing waters of stations 4 and 3 to stations with relatively higher velocities (stations 2 and 7). This result is in agreement with those of earlier workers (Williams and Hunter, 1968, Mousa and El-Hassan, 1972) who working on the effect of water velocity on the distribution of six species of snails including *Bulinus truncates* and *Bulinus forskali* reported that microhabitats, where the water flow is nearly stagnant or slow-flowing, are preferred by snails for breeding.

The correlation coefficient of velocity of water with the distribution of *B. globosus* (-0.2580) and *B. forskali* (-0.1614) in station 3 were non-significantly negative whereas the similar analysis for station 6 showed a non-significantly positive correlation of water velocity with *B. globosus* (0.4111) and *B. forskali* (0.4118). The deleterious effects of increased water velocity and turbulence manifest in dislodgement of the snails from their attachments to water-weeds and are subsequently washed away to unfavourable locations. This result corroborates the observation of Paulinyi and Paulini (1967) who reported that a greater number of *Biomphalaria glabrata* snails were dislodged and swept away by the water flow and that the percentage of the snails dislodged increased in proportion with the linear velocity of water flow.

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