Bull. zool. Surv. India, 5 (1) : 57-65, 1983

SOME OBSERVATIONS ON THE POPULATIONS OF *NALA NEPALENSIS* (BURR) AND *FORCIPULA QUADRISPINOSA* (DOHRN) (DERMAPTERA : INSECTA) COINHABITING A SUBAQUATIC HABITAT

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ABSTRACT

Data gathered during the period June 1978—May 1979 indicate certain seasonal fluctuations in the populations of *Nala nepalensis* (Burr) and *Forcipula quadrispinosa* (Dohrn) inhabiting under stones on the bank of a hill stream in Himachal Pradesh, India. The correlation between these fluctuations and rainfall, average minimum and maximum temperature and average relative humidity are tested statistically. Populations of both the species show two annual peaks and consist of more females than males.

INTRODUCTION

Though some information is available on the seasonal abundance, sex ratio and seasonal history of a few earwig species in Europe and U. S. A. (Brindley, 1912, 1914 ; Jones, 1917 ; Goe, 1925 ; Beall, 1932 ; Fox-Wilson, 1940 ; Crumb *et al.* 1941 ; Guppy, 1946 ; Behura, 1956 ; Walker and Newman, 1976), such studies on the Indian Dermaptera are known only through the recent work of Mishra and Dash (1980) on *Nala lividipes* (Dufour). An attempt has been made to study the seasonal abundance and sex ratio of *Nala nepalensis* (Burr) and *Forcipula quadrispinosa* (Dohrn) inhabiting under stones on the bank of a perennial hill stream in Himachal Pradesh, India. The possible relation of seasonal abundance of these species to climatic factors are also discussed.

STUDY AREA

The sampling was carried out on the right bank of a perennial hill stream in the vicinity of a road bridge at Sadhupul (alt. *ca.* 1100 m), about 35 km from Solan on way to Chail. The right bank of the stream is sandy with a number of stones, devoid of vegetation and with a gradual slope to the water-line. On the contrary, the left bank is a steep wall of rock with some grasses and shaded by tall trees.

MATERIALS AND METHODS

Except in October 1978, population estimates were made every month from June, 1978 to May, 1979. An area of 65 m length and 4 m width from the water-line on the right bank of the stream was selected for the present studies. It was established from

earlier intensive collecting that the earwigs were mostly found in this area. An effort was made to standardize the individual collection by visiting the same specified area each month and collecting intensively by upturning randomly selected 200 stones of 250-300 cm diameter. Though, admittedly, this method may not give precise quantitative analysis of absolute abundance, it is considered adequate for the present investigations.

The climatic (abiotic) factors such as temperature, rainfall and relative humidity were recorded with the help of the local College of Agriculture, Himachal Pradesh Krishi Vishva Vidhyalaya. Estimation of soil moisture under stones was made by oven-drying to a constant weight of soil at 105°C.

Observations

There are four distinct seasons viz., spring (late February to April), summer (May to August), autumn (September to middle of November) and winter (middle of November to middle of February). The seasonal fluctuations in the abiotic factors such as rainfall, average minimum and maximum temperature, and average relative humidity are depicted in Fig. 1. Temperature increased gradually from February till June, which was the hottest month of the year with an average maximum temperature of 30.9°C. From then onwards, it steadily decreased till November but with a slight rise in October. Thereafter, the decrease was very rapid. The coldest part of the year was from the end of December to January with minimum temperature occasionally falling below the freezing point of water. The monthly rainfall ranged from 3-200 mm. The chief amount of rainfall was received during the south-west monsoons from late June to the middle of September (130-200 mm). In association with western disturbances some rains occurred from the end of December to February (20-70 mm), often accompanied by hail and occasionally by snow flakes. Rainfall was moderate during spring (50-90 mm). The average relative humidity ranged from 35.5% in January to 91% in July-September. The average soil moisture under stones varied from 1.1 to 10.3.

Seasonal Abundance

Nala nepalensis (Burr).—The monthly changes in the numbers of *N. nepalensis* are shown in Fig. 1. Beginning in June, the number increased rapidly to a maximum in July, followed by a sharp decline in August. The population built up again in September, but did not reach the previous level. The number dropped to the lowest level in November. From December, the population rose gradually till May.

N. nepalensis probably possesses two annual generations—a first of summer (March to July) generation and a comparatively long, second or overwintering (August to February) generation with a diapause in the nymphal and adult stages. The over-wintered females lay the first generation eggs in March-April which hatch in late April to May. This is suggested by the fact that an appreciable increase in the total population of *N. nepalensis* in May is mainly due to a significant, rise in its nymphal population (Figs. 1 and 2). The nymphs become adults in July as indicated by a sharp increase in the adult population and a decrease in the nymphal population during this month. The second generation eggs are laid sometime in August. The hatching of these eggs in September corresponds to rise in the number of nymphs in that month.

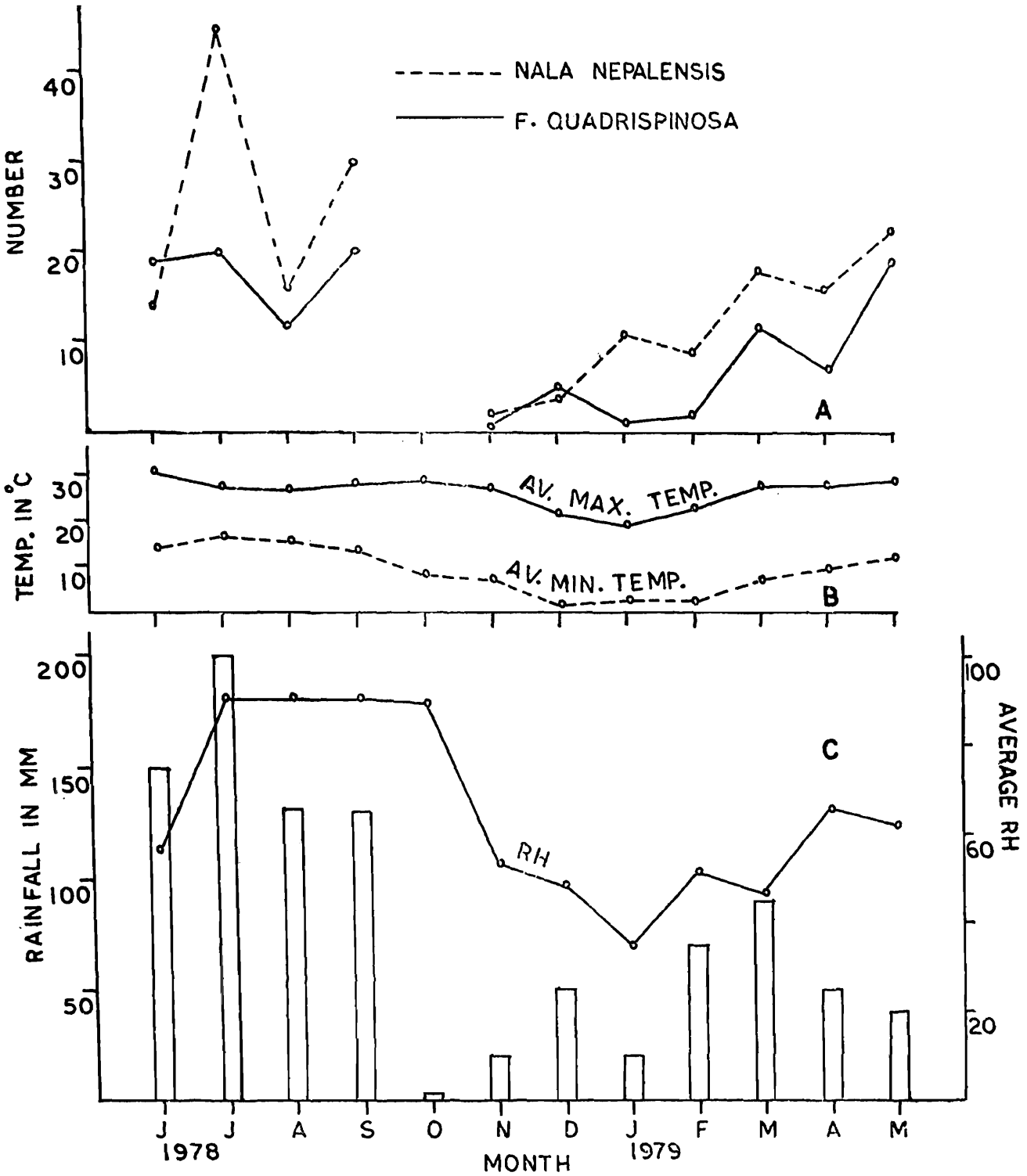
NALA NEPALENSIS
F. QUADRISPINOSA
NUMBER
40
30
20
10
A
TEMP. IN °C
30
20
10
AV. MAX. TEMP.
AV. MIN. TEMP.
B
RAINFALL IN MM
200
150
100
50
C
RH
AVERAGE RH
100
60
20
J
1978
J
A
S
O
N
D
J
1979
F
M
A
M
MONTH

FIG. 1

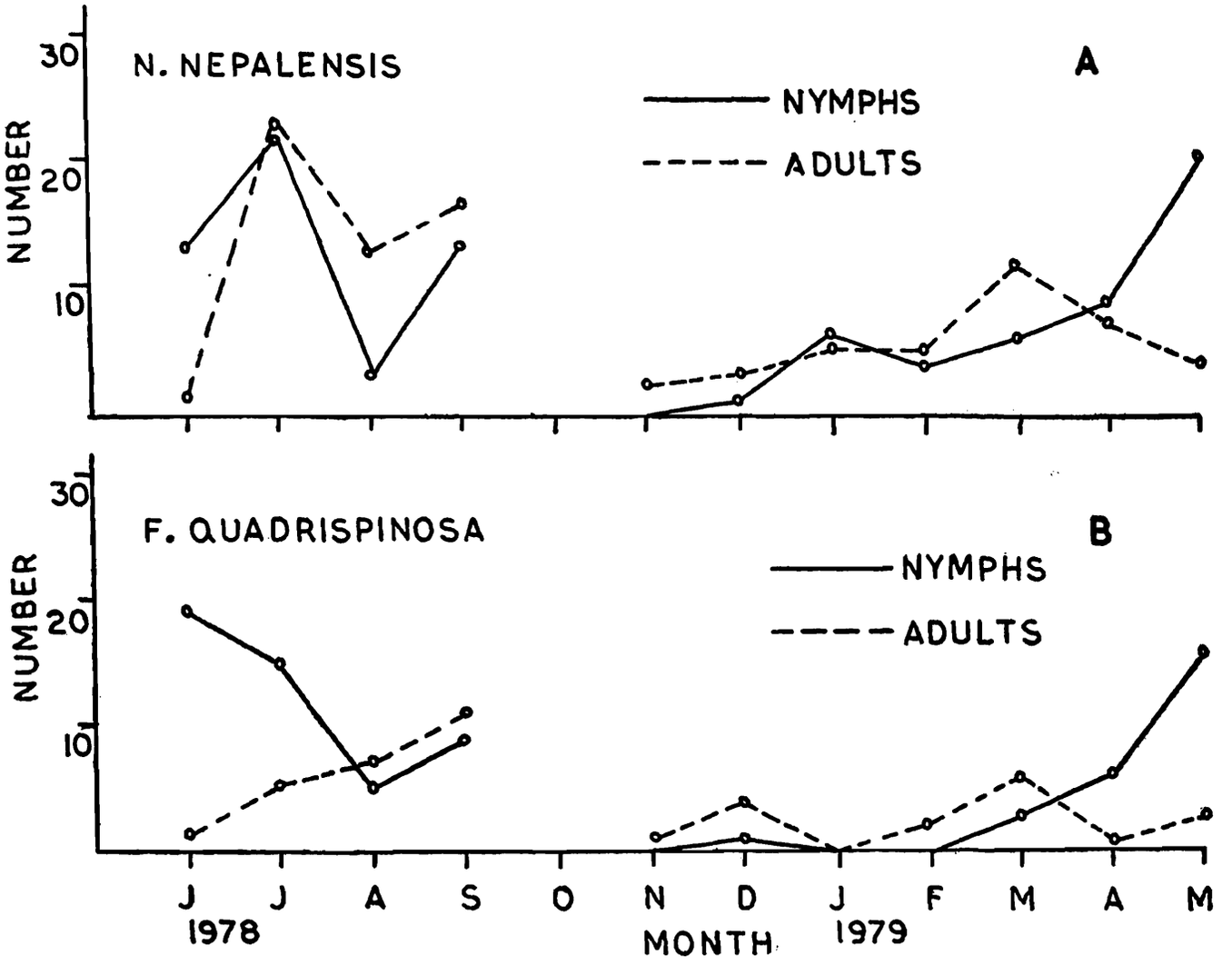

FIG. 2

Forcipula quadrispinosa (Dohrn).—The seasonal fluctuations in the population of *F. quadrispinosa* followed a pattern as in *N. nepalensis* but with some modifications (Fig. 1). The population was at a higher level in June and reached the peak in July. This level was maintained till September but with an appreciable decline in August. The number dropped to the lowest level in November and remained at about that level till February but with a slight increase in December. From March, the population rose steadily and followed a similar trend as in *N. nepalensis*.

Like *N. nepalensis*, *F. quadrispinosa* has also possibly two annual generations, but the duration of the first and second generations differ slightly from that of the former (Figs. 1 and 2).

Sex Ratio

The relative proportions of males and females in the populations of *N. nepalensis* and *F. quadrispinosa* are given in Table 1, a perusal of which shows that there is preponderance of females over males. The data were subjected to statistical treatment by means of 'Chisquare Test' under the hypothesis

TABLE 1. *Sex ratio in the population of Nala nepalensis and Forcipula quadrispinosa.*

Species	Total	Males	Females	Ratio	Chisquare value	Significance (p)
N. nepalensis	92	42	50	1 : 1.2	0.7	—
F. quadrispinosa	45	15	30	1 : 2	5	*ca* 0.05

that 1 : 1 ratio exists between the males and females. In *N. nepalensis*, a low chisquare value of 0.7 is obtained which is not of any significance at one degree of freedom. On the contrary in *F. quadrispinosa*, a high chisquare value of 5 just reaches the 5% level of significance which suggests some difference from 1 : 1 ratio of males and females in its population.

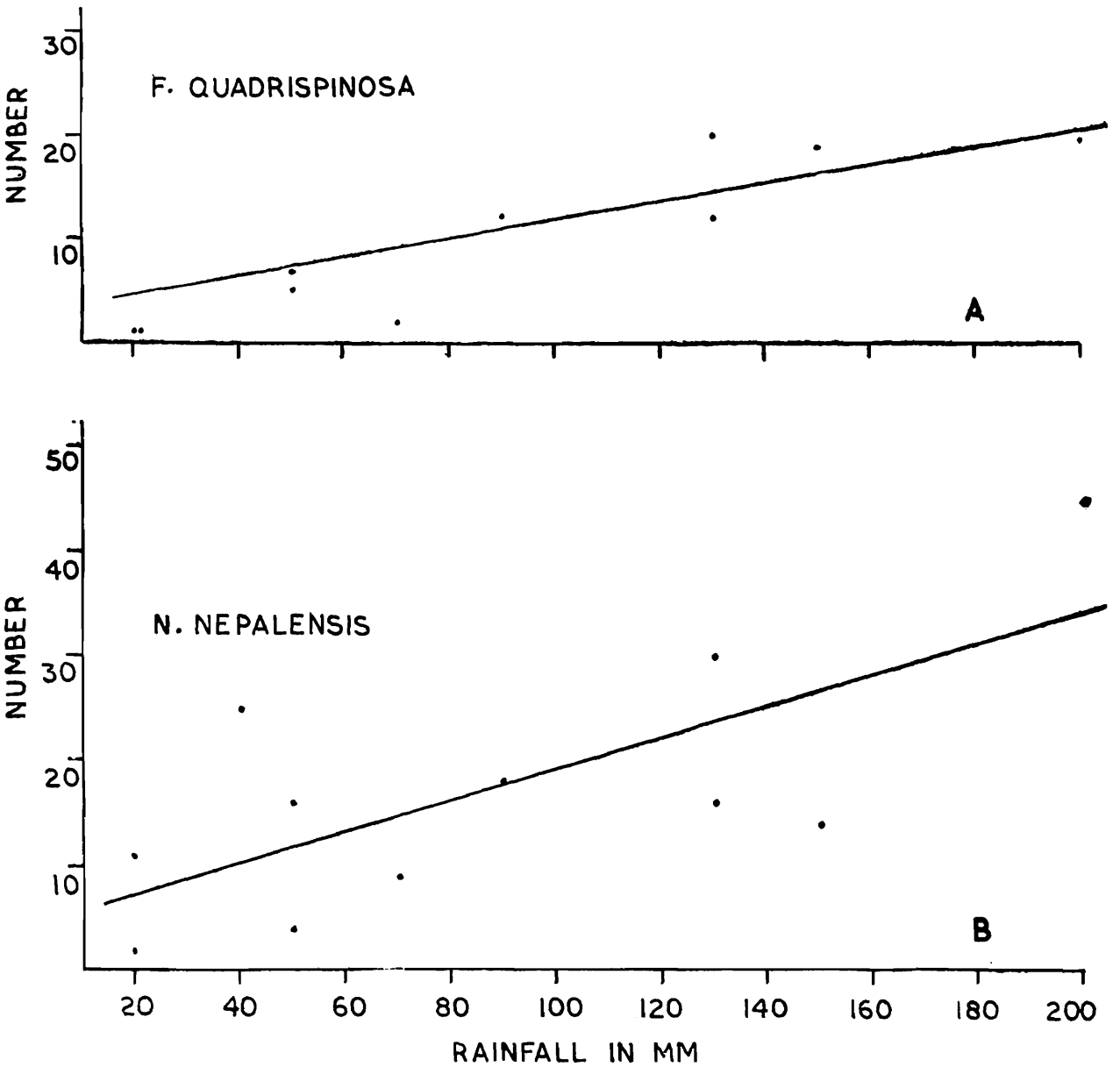

FIG. 3

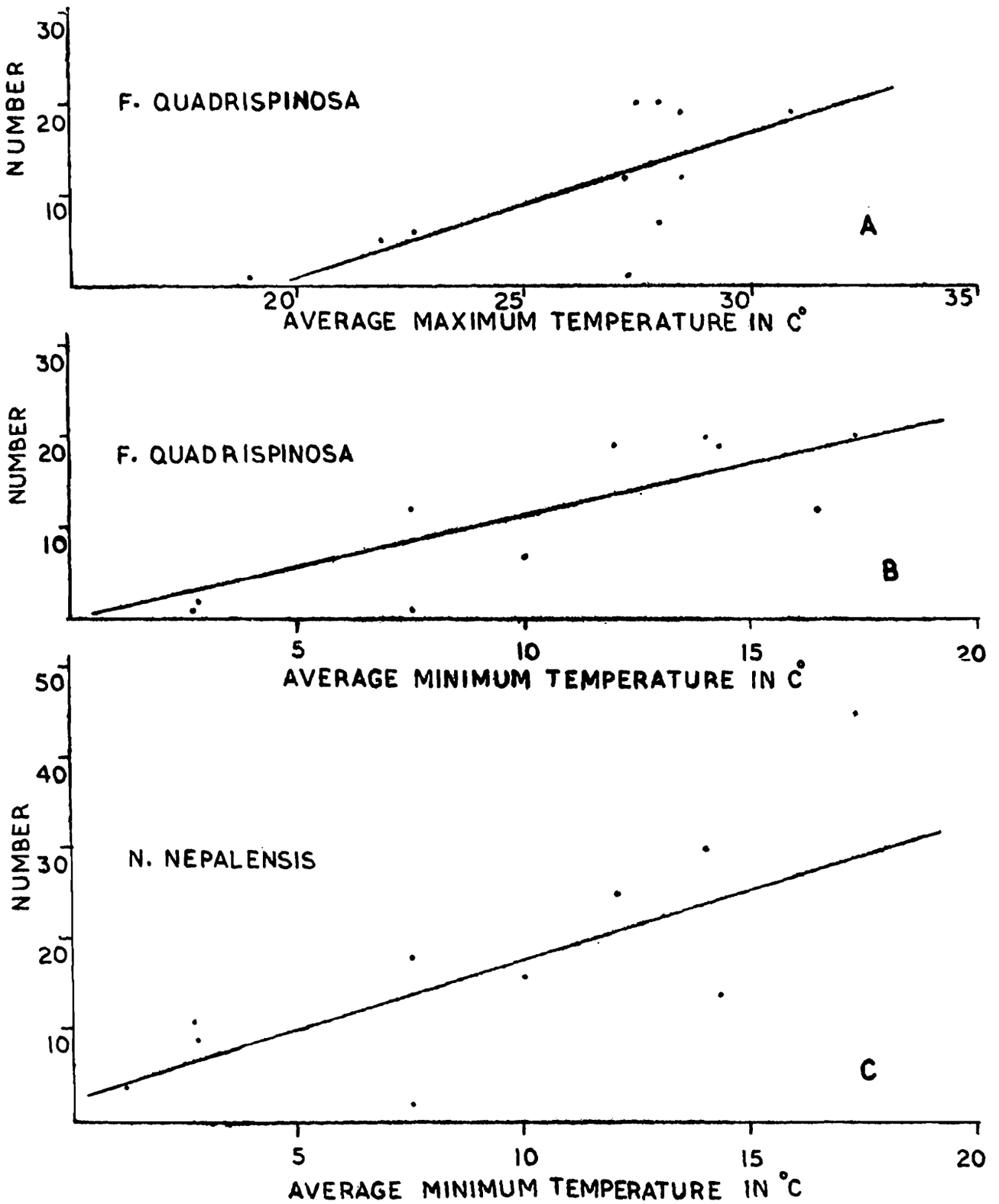
NUMBER
F. QUADRISPINOSA
A
AVERAGE MAXIMUM TEMPERATURE IN C°
F. QUADRISPINOSA
B
AVERAGE MINIMUM TEMPERATURE IN C°
N. NEPALENSIS
C
AVERAGE MINIMUM TEMPERATURE IN °C

FIG. 4

DISCUSSION

In the complex of interdependent biotic and abiotic factors governing the seasonal abundance of earwigs, abiotic factors viz., rainfall, temperature and relative humidity appear to be important, since these insects are abundant during the months when the rainfall, temperature and relative humidity are maximum. Behura (1956) also states that temperature is a limiting factor and the growth-rate in earwigs is directly proportional to fluctuation of temperature. The effect of abiotic factors viz., rainfall, average minimum and average maximum temperature, and average relative humidity on the seasonal fluctuations in the population of *N. nepalensis* and *F. quadrispinosa* was analysed statistically. Regression lines were obtained between the population density and four abiotic factors as

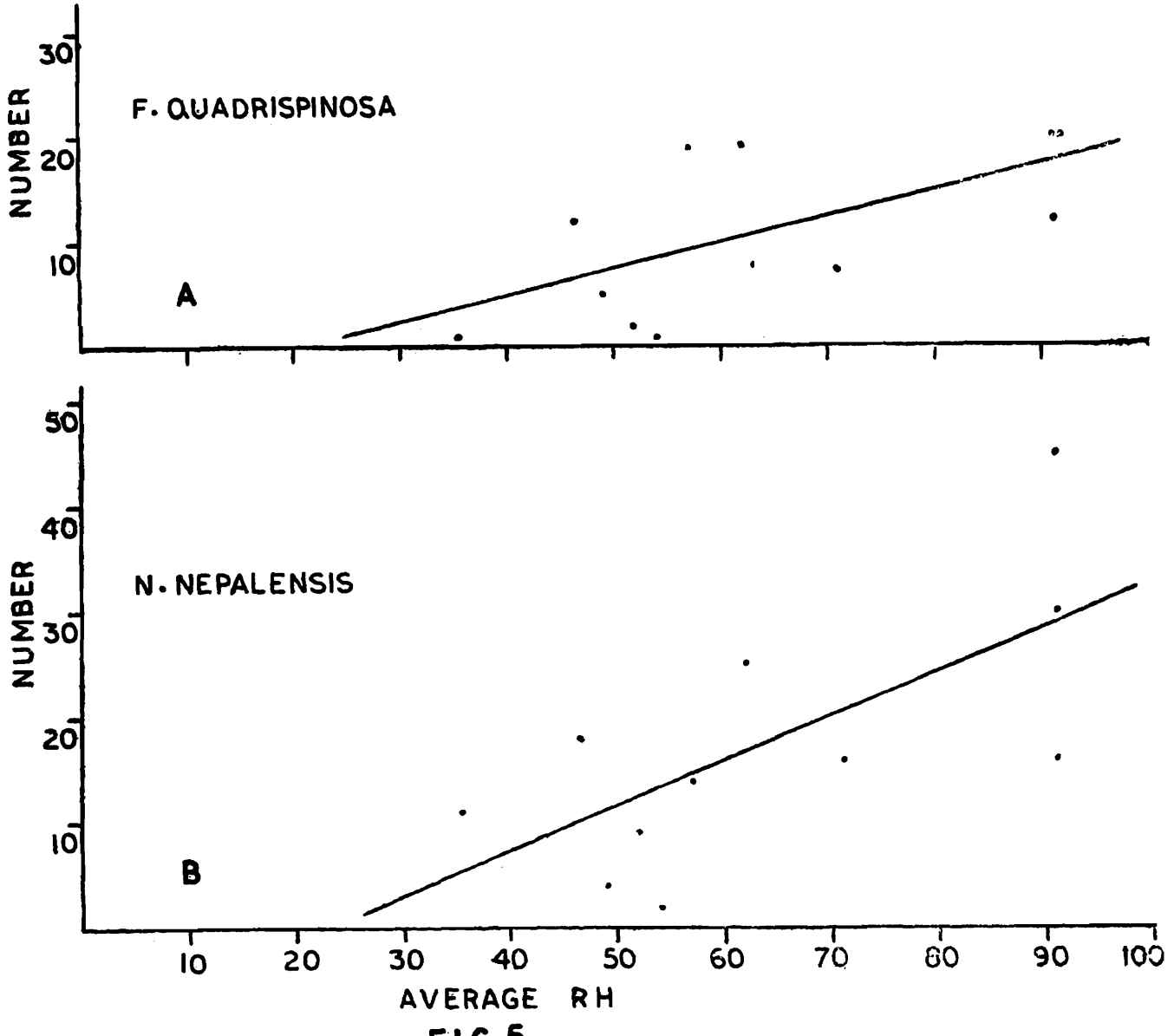

FIG. 5

enumerated above (Figs. 3-5). A study of the coefficient of correlation shows that significant positive correlation exists between the population density and rainfall, average minimum temperature and average relative humidity in both *N. nepalensis* and *F. quadrispinosa* (Tables 2 and 3). Average maximum temperature has no significant effect on the population build-up of *N. nepalensis* but is quite significant in the case of *F. quadrispinosa.*

The results on the sex ratio point to a slight male deficiency in the population of both *N. nepalensis* and *F. quadrispinosa* which agree with the observations made by Behura (1956) on *Forficula auricularia* Linnaeus.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta for providing necessary facilities. They are also thankful to Dr. Asket Singh, Officer-in-Charge, High Altitude Zoology Field Station, Zoological Survey of India, Solan for encouragement.

TABLE 2. *Relationship between N. nepalensis population and climatic factors.*

	Correlation coefficient (r)	Significance with 10 d. f. (p)	Regression line of no. of *N. nepalensis* (y) on climatic factors (x). y=a+bx
Rainfall	0.7133	<0.01	y=4.361+1.495x
Average minimum temperature	0.7169	<0.01	y=2.389+1.549x
Average maximum temperature	0.3984	—	—
Average relative humidity	0.6891	<0.02	y=−10.218+0.432x

TABLE 3. *Relationship between F. quadrispinosa population and climatic factors.*

	Correlation coefficient (r)	Significance with 10 d. f. (p)	Regression line of no. of *F. quadrispinosa* (y) on climatic factors (x). y=a+bx
Rainfall	0.6815	<0.02	y=2.829+0.915x
Average minimum temperature	0.8210	<0.01	y=−0.129+1.136x
Average maximum temperature	0.7105	<0.01	y=−30.841+1.580x
Average relative humidity	0.6285	<0.05	y=−5.309+0.252x

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