SEASONAL VARIATION IN THE POPULATION OF *ACRIDA EXALTATA* WALK. AT ALIGARH[1]

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(With seven text-figures)

The population level of *Acrida exaltata* over three years (1974-76) at Aligarh has been discussed. Information is furnished on seasonal variation, intra and inter year fluctuation and life cycle in natural conditions. Climatic conditions exert marked influence on the rise and fall of population. The timing of the various life history events (i.e. oviposition, hatching and maturation) varies widely from year to year depending upon the particular sequence of climatic conditions prevailing throughout the entire grasshopper cycle.

INTRODUCTION

Acrida exaltata Walk. is a serious pest of cotton and tobacco. Besides cotton and tobacco, it also attacks rice, sugarcane, potato and grasses. It has long been recognized that the wide fluctuations periodically occurring in acridid populations throughout the world are closely linked to weather conditions (Parker 1935, Dempster 1963). The major weather factors involved are apparently temperature and precipitation. In some characteristically very dry regions, rainfall may be the principal limiting factor in grasshoppers distribution through its influence on food (Scharff 1954), breeding behaviour (Uvarov 1956). Putnam (1954) said that grasshoppers outbreak usually coincide with extended period of hot, dry weather. Descamps (1975) studied factors influencing the distribution and abundance of acridid population in general.

Studies were made to note the seasonal variation in the population of *Acrida exaltata* Walk., due to various environmental factors at Aligarh.

MATERIAL AND METHOD

The field observations were undertaken for three years from January, 1974 to December, 1976, during different months of the year. The samples of hoppers and adults were obtained by sweeping. A standard net was used for collection. The insects were collected in the morning on every tenth day for an hour from the acridid field station (Scindia Fort, Aligarh). Meteorological records were obtained from the weather station, Department of Physics, Aligarh Muslim University, Aligarh. Data on peak density recorded each month in the area for the period (1974-76) were used for analysis. These monthly peaks were then analysed for the three months, each constituting four seasons, Winter (December to February), Spring (March to May), Summer (June to August) and Autumn (September to November). Only the mean values of various seasons were considered to reveal intra and inter year fluctuations. The reason for using

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seasonal instead of monthly population was to obtain 'nil' population values, invariably encountered for months at a time, specially during Winter and Spring seasons.

Inter year fluctuation was measured by the deviations of the seasonal mean from that of annual mean for three years. Comparative behaviour of two types of fluctuations was also studied.

Studies were made on the life history of *Acrida exaltata* Walk. under natural conditions.

Observations

Topography: The geographical position of Aligarh is 27° 53′ 38″N. Latitude and 78° 04′ 30″E. Longitude. The district of Aligarh lies in the upper Doab of the Ganga and Jamuna rivers.

Climate: Aligarh experiences tropical monsoon type of climate. The year is generally divided into the following three seasons —

1. The cold weather: Winter (Late October to February),
2. The hot weather season: Summer (March-June),
3. The season of general rains: (Mid-June-September).

During winter the temperature is generally low. The mean maximum temperature is 80°F, however, the mean minimum temperature remains around 50°F. The prevailing direction of wind during the season is from West and North-West to South and South-East. The winds are generally light with an average speed of 2 miles/hour. These winds are supposed to be of continental origin and are mostly dry. The month of December and January are the coldest and often register light rains due to western disturbance otherwise the weather is generally fine and pleasant due to bright and sunny days with clear sky. The month of May and June are the hottest with mercury shooting sometimes upto 115°F, however, the mean maximum temperature is 115°F and the mean minimum temperature 65°F. Strong dust raising hot and dry westerly winds during day time is common feature of the summer. The peculiar phenomenon of the summer is the frequent occurrence of dust and thunder storms with an average velocity of 30-40 miles/hour gales. The humidity sometimes falls to 2 or 3% whereas the general level is 20%.

With the onset of monsoon generally by late June, the direction of winds is reversed due to low pressure area developed in the north western India. With the arrival of the humid oceanic currents from the Arabian Sea as well as from the Bay of Bengal, the tempera-

Table 1

Average monthly rainfall at Aligarh (1974-76)

Year	January	February	March	April	May	June	July	August	September	October	November	December
						(in mm)						
1974	0.0	0.0	0.0	0.6	20.9	31.8	230.9	193.4	5.5	19.6	0.0	17.2
1975	19.4	10.0	0.7	0.0	23.7	74.1	247.9	146.4	312.6	68.1	0.0	0.0
1976	0.0	13.0	5.0	11.8	22.6	35.7	354.4	426.4	73.9	0.0	0.0	0.0

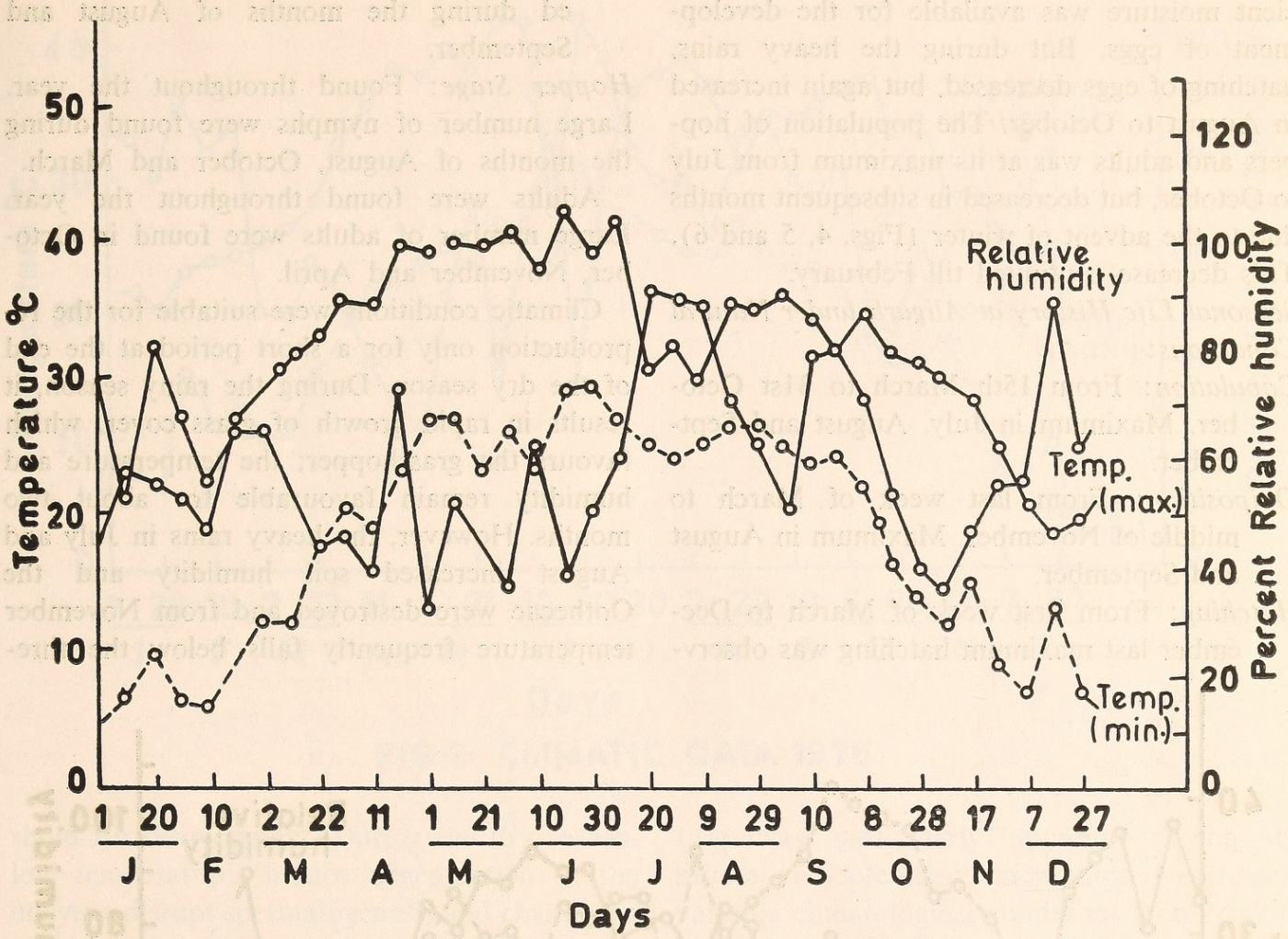

FIG.1 CLIMATIC DATA 1974

ture falls and the air becomes cool. The mean monthly temperature falls to 80°F in July. The relative humidity increases to 70-74% R.H. The sky is generally overcast in the rainy season. This season receives nearly 90% precipitation of the whole year and the mean seasonal ranfall is 25" (Table 1 and Figs. 1, 2 and 3).

Vegetation: Water penetration plays an important part in determining the distribution of vegetation. Scindia Fort is rich in green vegetation. Abundance of food is available for feeding by grasshoppers, and is surrounded by cultivated crop fields.

It was found that hoppers and adults were most abundant during and after the monsoon period (July-October) due to the optimum ecological conditions, particularly temperature, relative humidity and food for their development and biological activities. As is evident from Figs. 4, 5 and 6 the population was lowest in winter (December-March) and summer (May-June). This is due to slow reproductive activities during this period. Copulation was observed to be higher in July to October, Oviposition was also higher.

Egg pods laid during April to June, hatched after the monsoon showers in July since suffi-

cient moisture was available for the development of eggs. But during the heavy rains, hatching of eggs decreased, but again increased in August to October. The population of hoppers and adults was at its maximum from July to October, but decreased in subsequent months due to the advent of winter (Figs. 4, 5 and 6). This decrease continued till February.

Seasonal Life History at Aligarh under Natural Conditions:

Copulation: From 15th March to 31st October. Maximum in July, August and September.

Oviposition: From last week of March to middle of November. Maximum in August and September.

Hatching: From first week of March to December last maximum hatching was observed during the months of August and September.

Hopper Stage: Found throughout the year. Large number of nymphs were found during the months of August, October and March.

Adults were found throughout the year. Large number of adults were found in October, November and April.

Climatic conditions were suitable for the reproduction only for a short period at the end of the dry season. During the rainy season, it results in rapid growth of grass cover, which favours the grasshopper; the temperature and humidity remain favourable for about two months. However, the heavy rains in July and August increased soil humidity and the Oothecae were destroyed and from November temperature frequently falls below the thre-

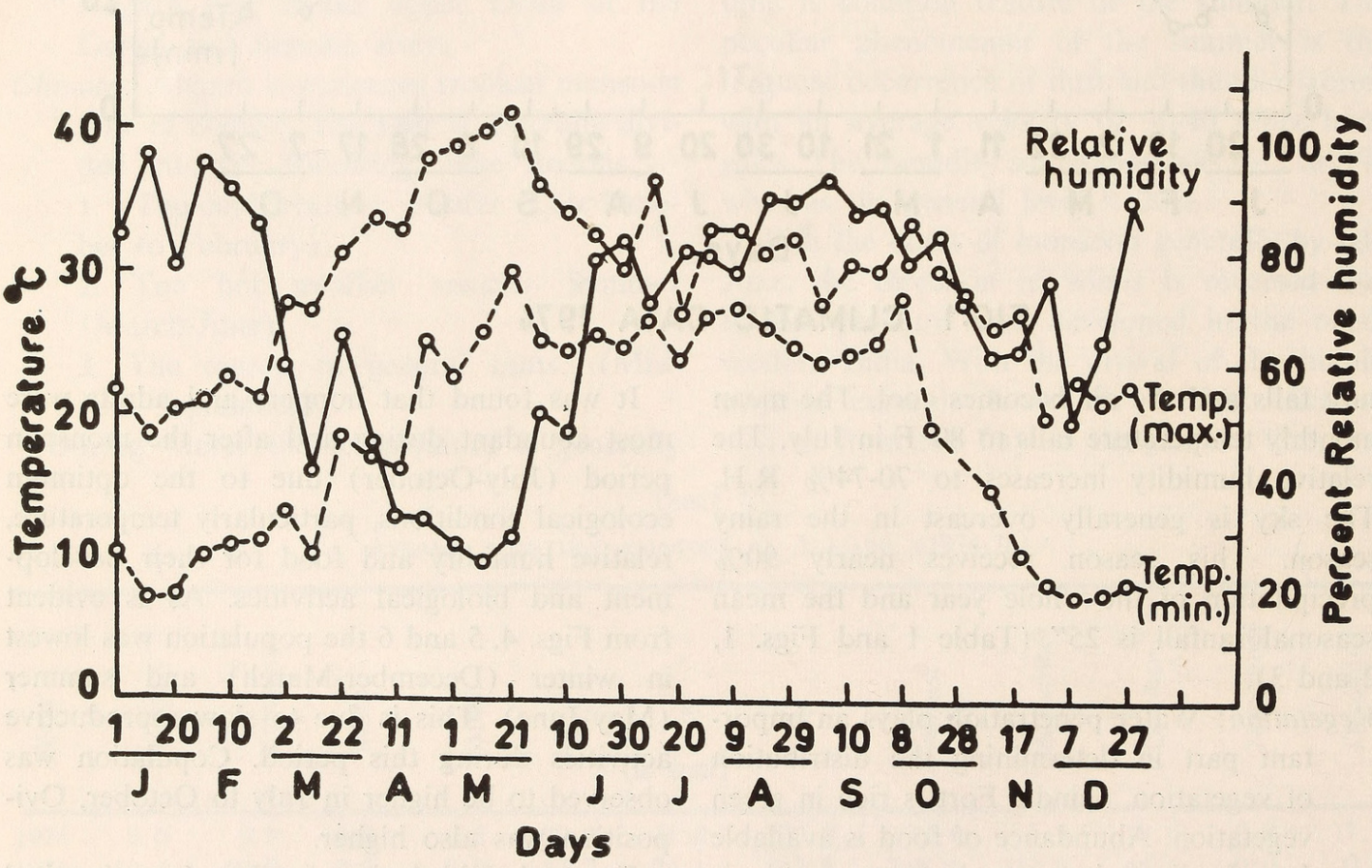

FIG. 2 CLIMATIC DATA 1975

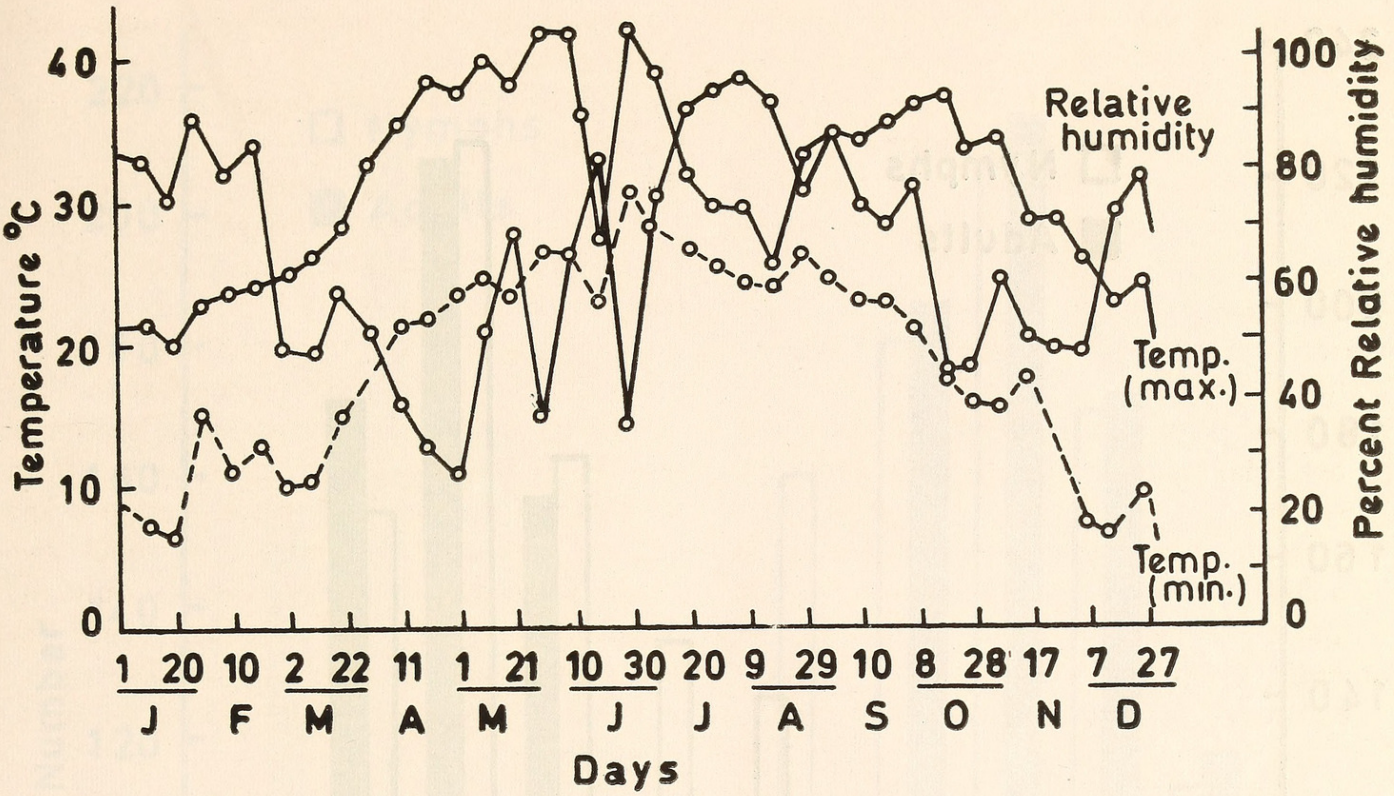

FIG. 3 CLIMATIC DATA 1976

shold for development. During the dry season, low temperatures induce degeneration of the oocytes, disrupt spermatogenesis and change the sex ratio in adult populations. It was found that the populations in the area was maintained only by migration from other localities.

Inter and Intra Year Fluctuations:

Apparent intra year fluctuation of the mean peak density populations in respect of the Winter, Spring, Summer and Autumn seasons are shown for three years from 1974-76 in Fig. 7. The highest peak usually occurs during the Autumn season with the characteristic sharp fall in the next winter. However, for the years 1975-76 Summer peaks were maximum.

Discussion

In the present three year study, the relationship between egg production and temperature was particularly apparent during the month of September which showed extremely variable climatological conditions from year to year. September is a transitional period between Summer and Winter, when rapid change in temperature again occur. In order, grasshoppers may take advantage of the optimum egglaying periods during mid Summer and so attain their maximum reproductive potential, it is essential that they mature early in the season. Early maturation is dependent upon a continued sequence of high temperatures through all stages of development extending even back to the previous fall following deposition of eggs. Continued high temperatures permit rapid development of nymphs to the adult stage followed by advanced maturity, early mating and oviposition. On the other hand, a complete reversal of the weather patterns just outlined, with consistently low

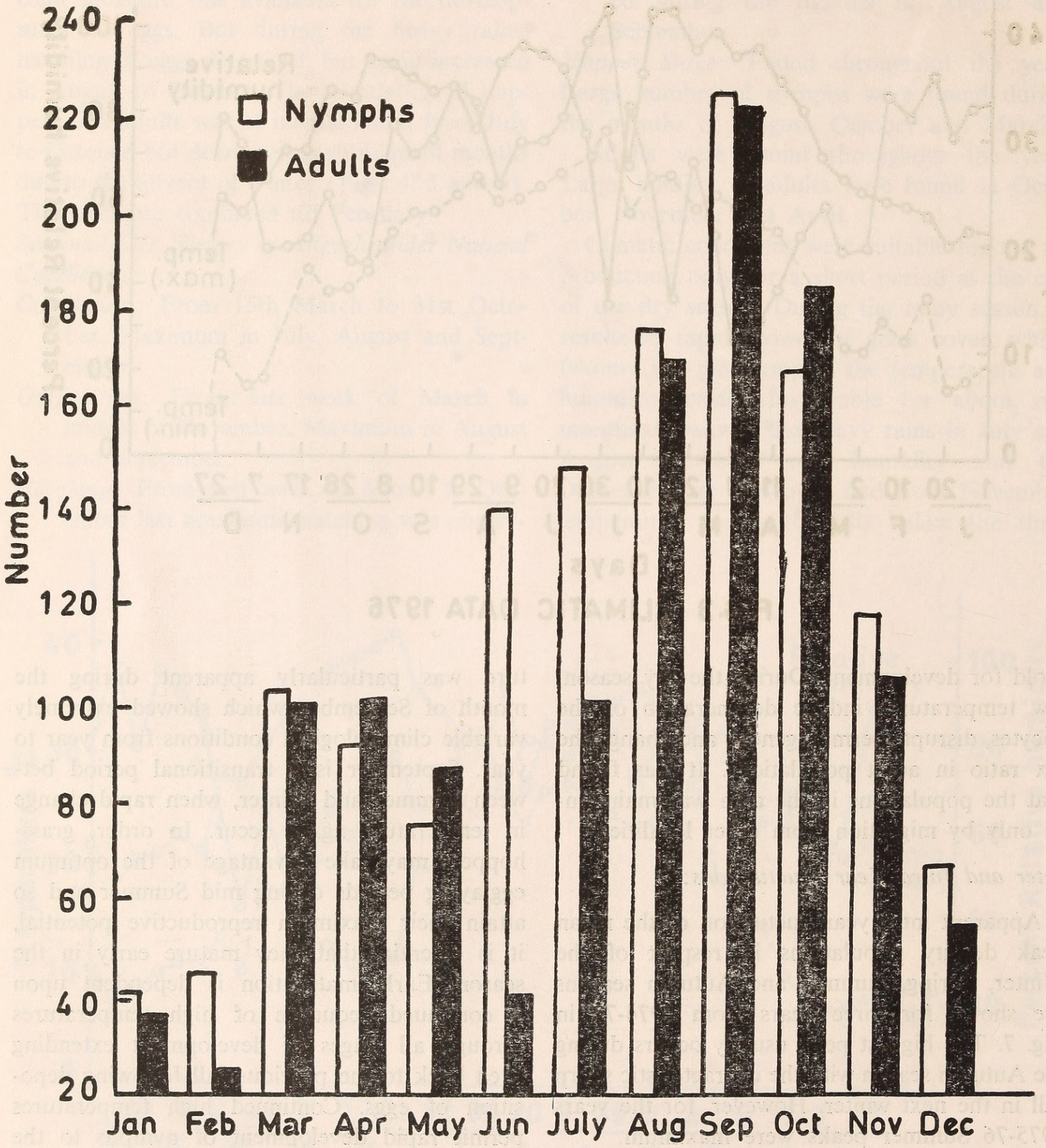

FIG. 4 MONTHLY POPULATION—1974

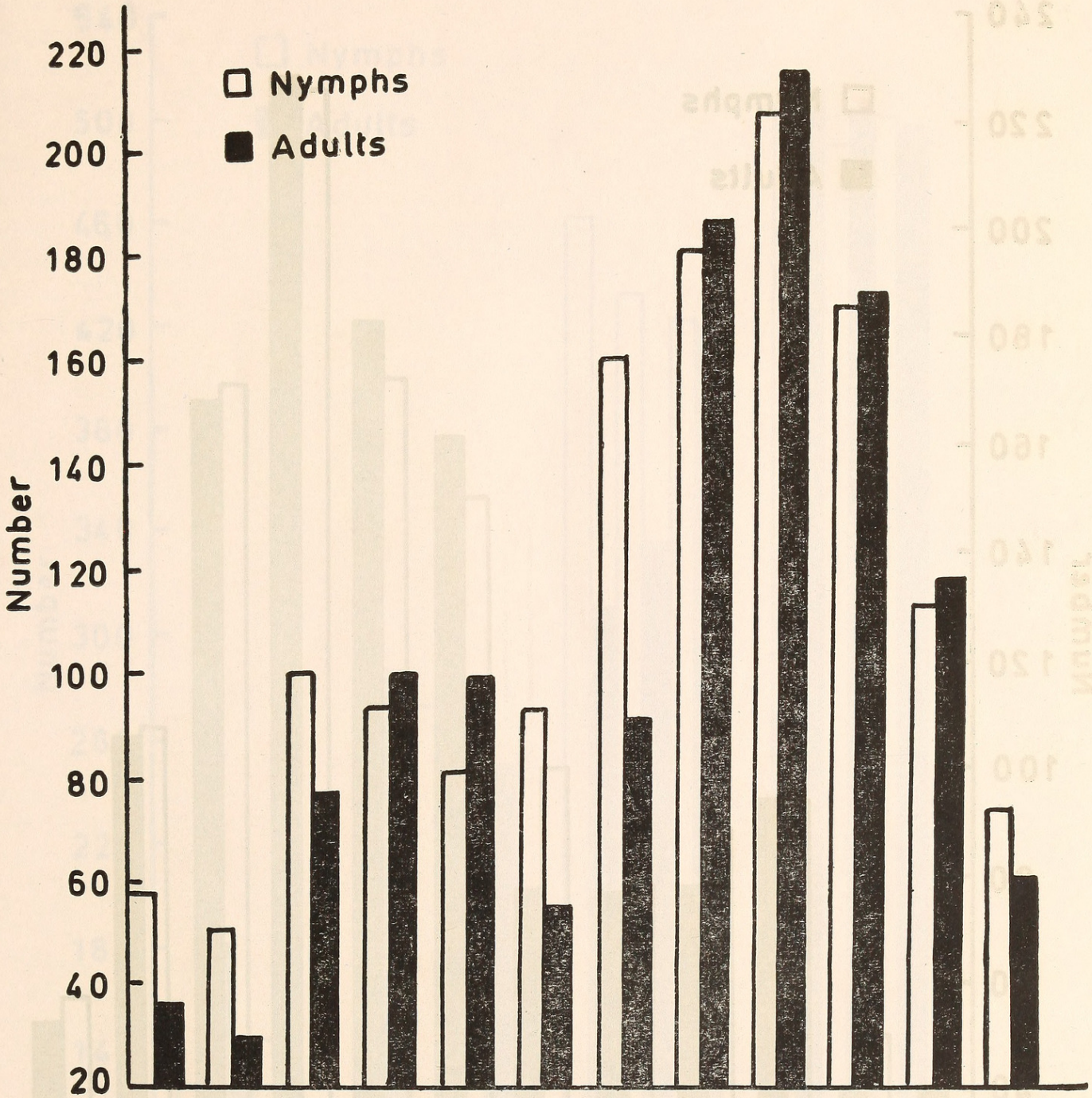

FIG. 5 MONTHLY POPULATION — 1975

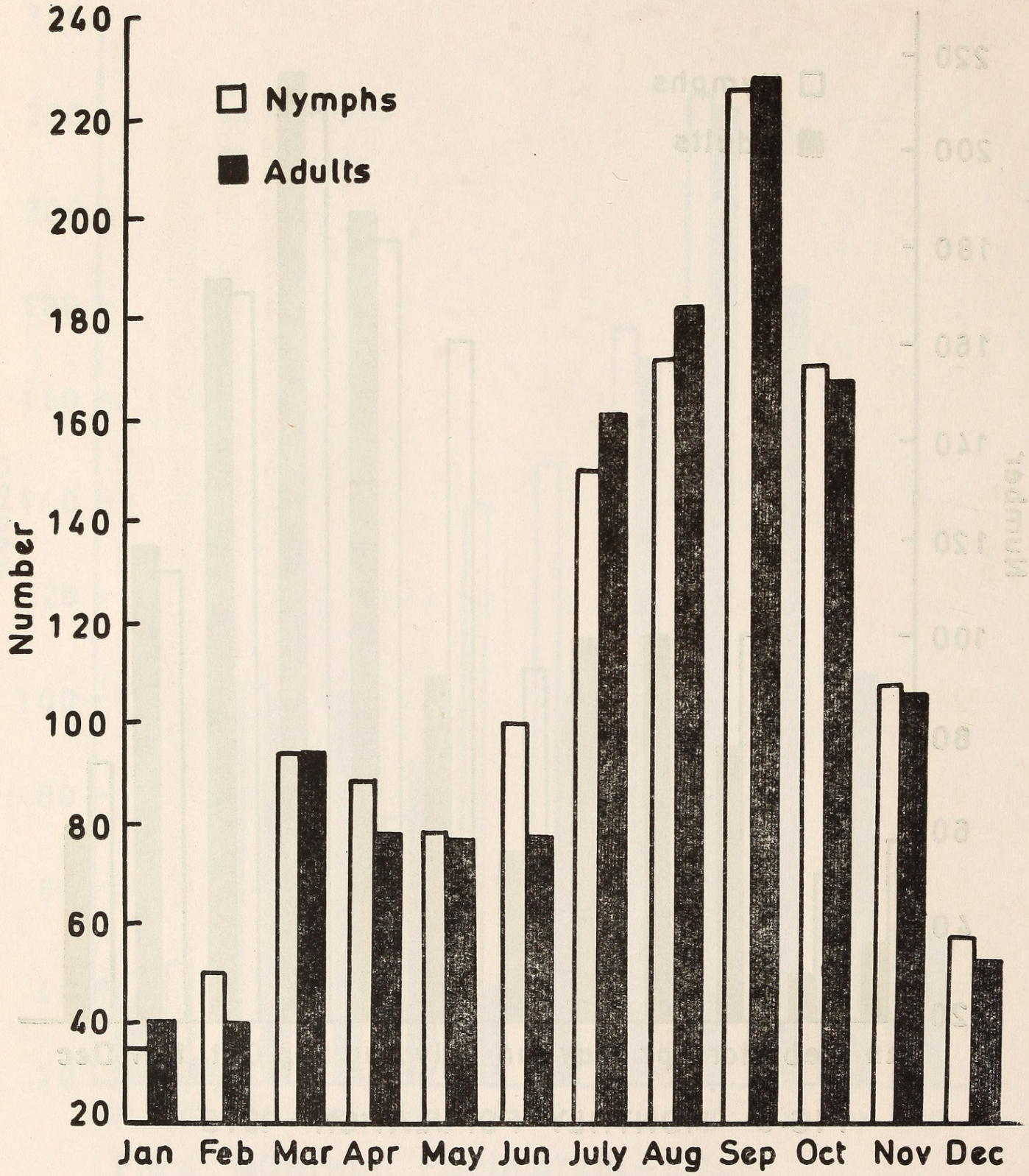

FIG. 6 MONTHLY POPULATION—1976

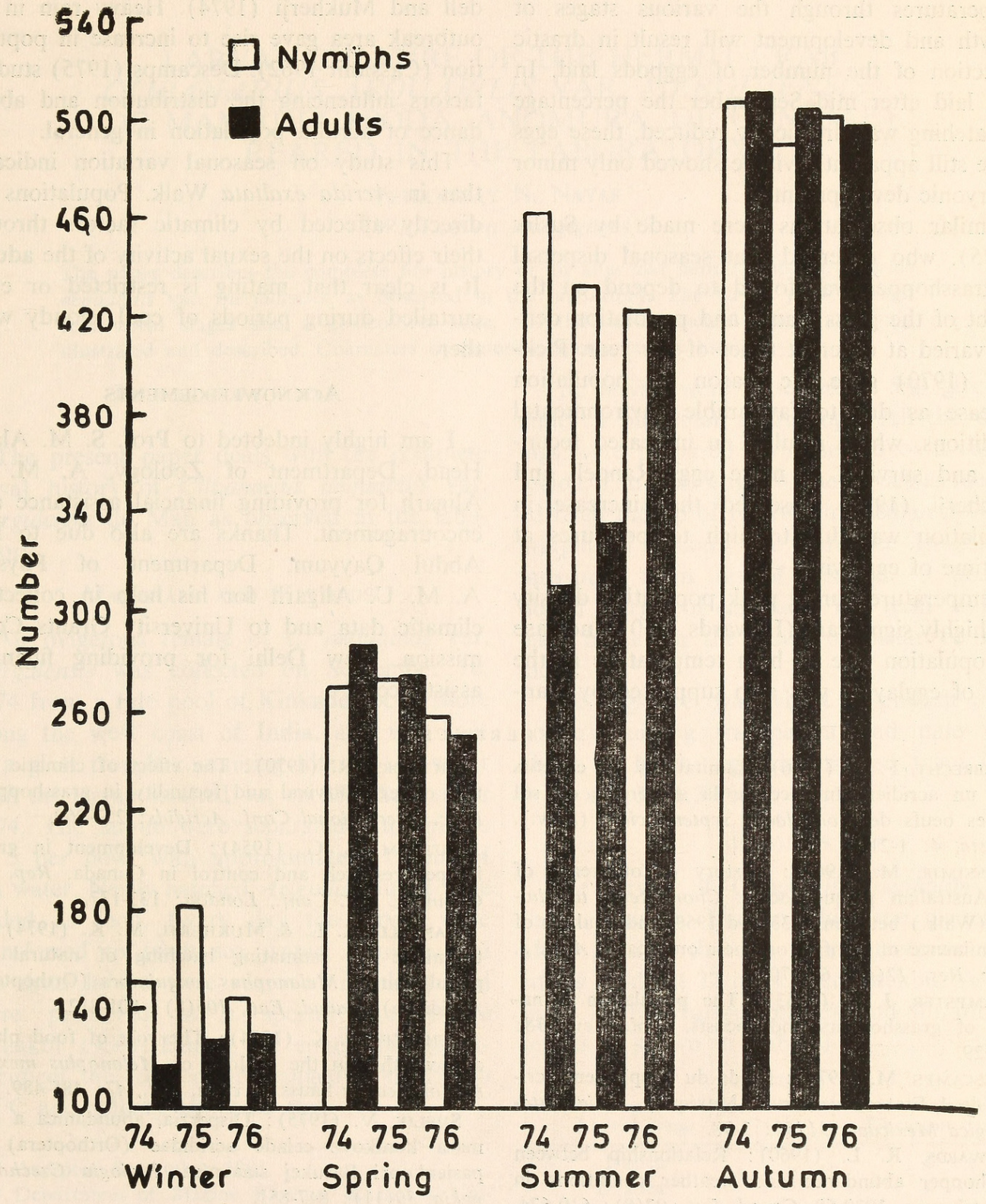

FIG. 7 SEASONAL POPULATION (1974–76)

temperatures through the various stages of growth and development will result in drastic reduction of the number of eggpods laid. In eggs laid after mid September the percentage of hatching was drastically reduced, these eggs while still apparently viable showed only minor embryonic development.

Similar observations were made by Suslik (1975), who observed that seasonal dispersal of grasshopper was found to depend on the height of the grass stand, and population density varied at different times of the year. Pickford (1970) gave the reason for population increase as due to favourable environmental conditions, which resulted in increased fecundity and survival of more eggs Randell and Mukherji (1974) observed that increase in population was due to high temperatures at the time of egglaying.

Temperature during peak population density was highly significant (Edwards 1960). Increase in population due to high temperature at the time of egglaying was also supported by Randell and Mukherji (1974). Heavy rain in an outbreak area gave rise to increase in population (Cassimir 1962). Descamps (1975) studied factors influencing the distribution and abundance of acridid population in general.

This study on seasonal variation indicates that in *Acrida exaltata* Walk. Populations indirectly affected by climatic factors through their effects on the sexual activity of the adults. It is clear that mating is restricted or even curtailed during periods of cool, cloudy weather.

ACKNOWLEDGEMENTS

I am highly indebted to Prof. S. M. Alam, Head, Department of Zoology, A. M. U. Aligarh for providing financial assistance and encouragement. Thanks are also due to Mr. Abdul Qayyum, Department of Physics, A. M. U. Aligarh for his help in collecting climatic data and to University Grants Commission, New Delhi for providing financial assistance.

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