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Fluctuations in numbers and eventual collapse of a *Glossina palpalis* (R.-D.) population in Anara Forest Reserve of Nigeria

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Summary

Fluctuations in size of a *Glossina palpalis* (R.-D.) population for the years 1954–1976 were investigated along a fly-round path in Anara Forest Reserve. Parameters contributing to annual fluctuations in numbers caught and to the permanent decline in the population which commenced in 1971 were identified. Annual variations in population levels were related to seasonal changes in temperature and atmospheric humidity levels. Increases in population levels corresponded to periods (June–September) of decreases in the maximum and increases in the minimum daily ambient temperatures and increases in the maximum and minimum atmospheric humidity. The reverse occurred during November to April. Total rainfall and catch for one year were not related but the former was found to influence the size of catch in the succeeding year. Maximum daily temperature was relatively stable during the years of the study but the minimum daily temperature decreased from 1969, resulting in higher daily temperature fluctuations which coincided with the initial decline in the tsetse population. From 1971 also, minimum daily atmospheric humidity decreased with increasing daily humidity fluctuations. These annual climatic changes coupled with the increasing human activities in the reserve appear to have contributed to the final collapse of the population.

Key words: Glossina palpalis (R.-D.); seasonal and annual variations in numbers; collapse of the population; attempt at identification of possible natural factors involved.

Introduction

Between 1944 and 1950 inclusive, an investigation of the ecology of *Glossina palpalis* (R.-D.) was carried out in Anara Forest Reserve in Kaduna State

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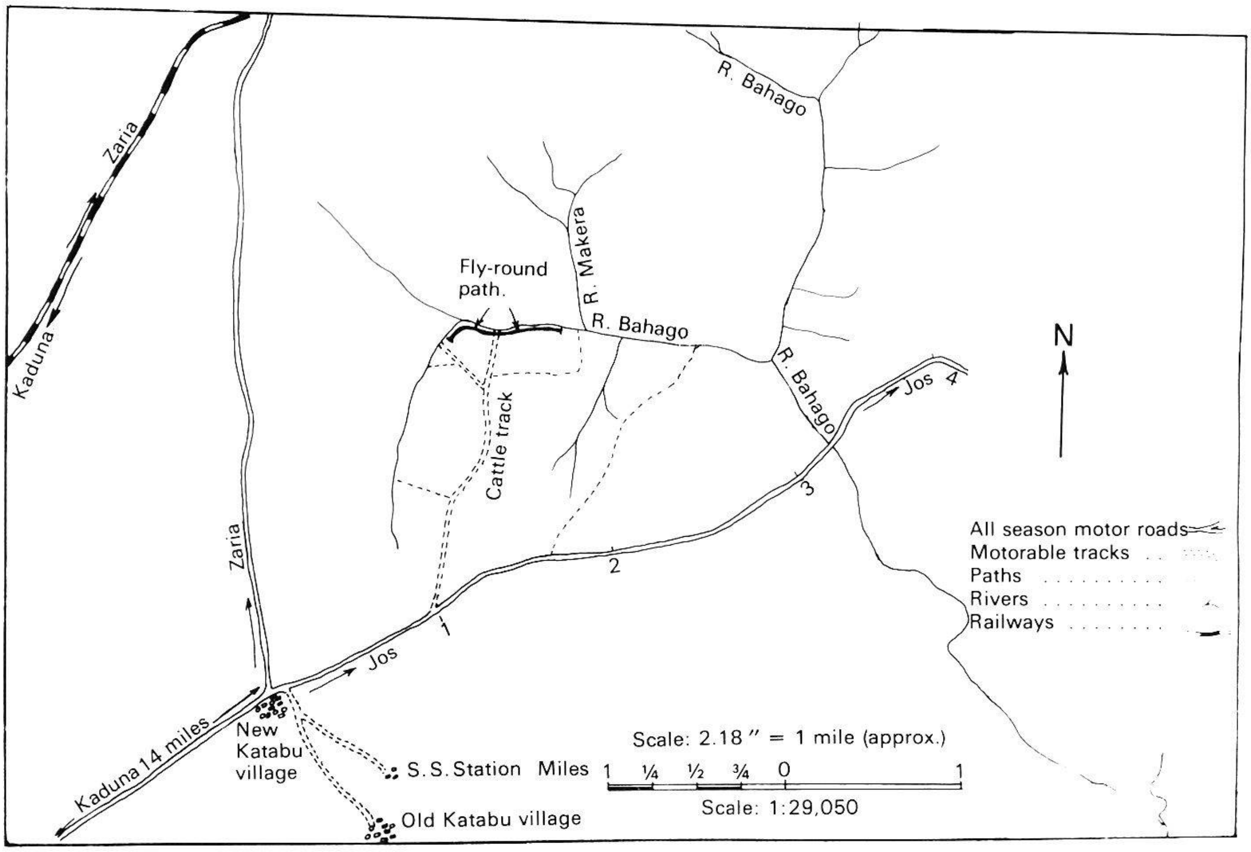

Fig. 1. Map of study area.

(Nash and Page, 1953). Katabu, a village, is situated (10°42′ N, 7°31′ E) at the Kaduna-Zaria-Jos road junction, 22.5 km northeast of Kaduna. In 1954, regular fly-rounds were reactivated, designed to investigate the long-term fluctuations in the population size of the species in the area. Jordan (1964) reported the findings of the first ten years (1954–1964) of the investigations.

This paper deals with the following years, 1964–1976, and summarizes the information obtained throughout the whole twenty-two year period (1954–1976). Factors which may have contributed to the elimination of the tsetse population in this area are discussed.

Materials and method

The study area (Fig. 1) has been described by Nash and Page (1953). The river Bahago, 457–914 m above sea level, has its source within the reserve and flows southeasterly to join the main R. Kaduna.

The area is within the northern Guinea woodland savannah zone; *Isoberlinia* spp. are the dominant trees. *G. palpalis* is restricted to, and linearly distributed along, the fringing riverine vegetation of R. Bahago and its tributaries. *Vitex doniana* and *Khaya senegalensis* are interspersed within the narrow forest which contrasts sharply with the adjacent woodland savannah.

In 1944 Nash marked out a fly-round path through 1,646 m (1,800 yds) of the fringing forest along the southern bank of R. Bahago. The path was divided into three convenient sections: "red" (914.4 m or 1,000 yds), "white" (457.2 m or 500 yds) and "blue" (274.3 m or 300 yds), the first being nearest the river source. Each section was further subdivided into 91.4 m (100 yds) units, giving a total of 18 units.

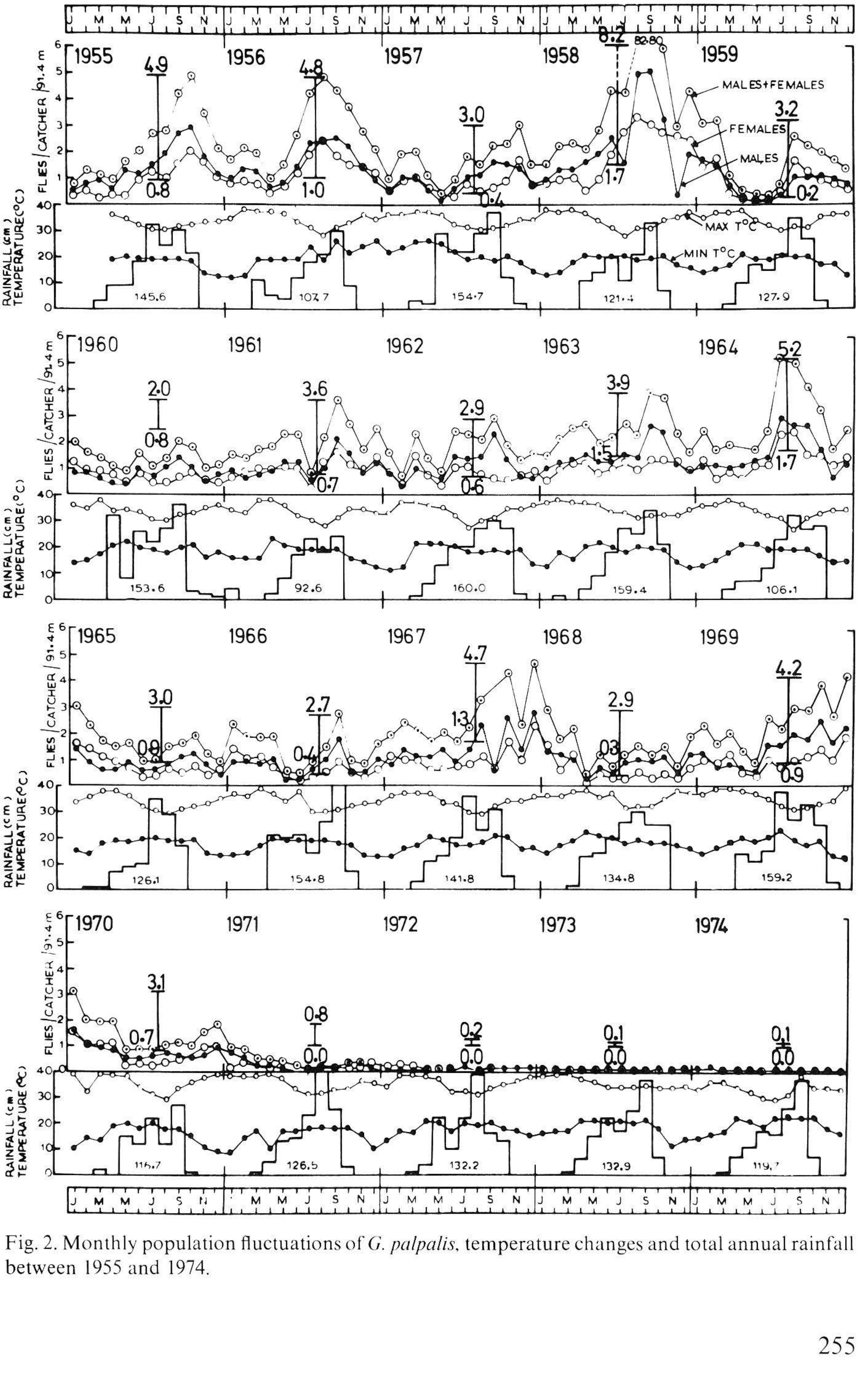

Fig. 2. Monthly population fluctuations of *G. palpalis*, temperature changes and total annual rainfall between 1955 and 1974.

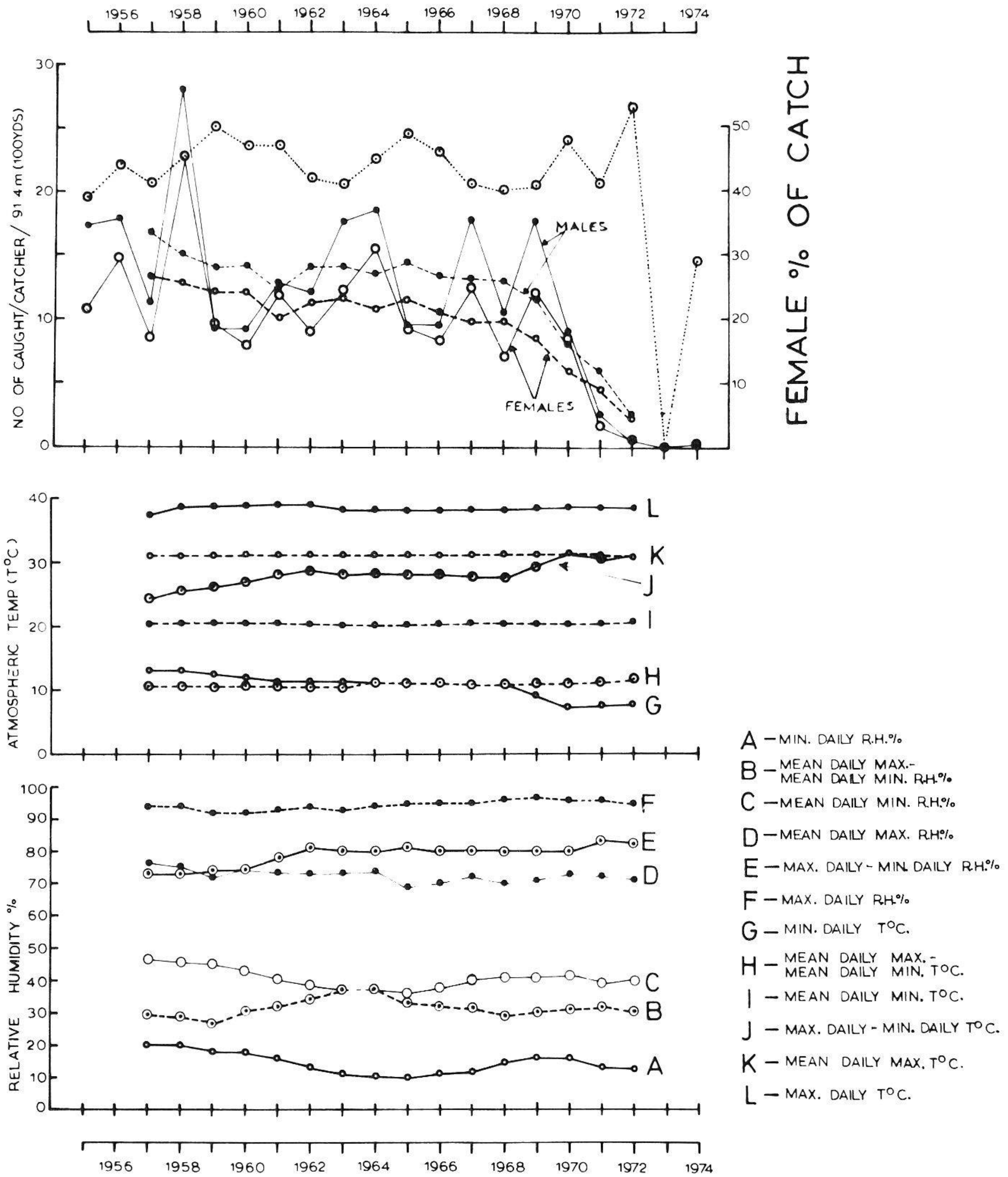

Fig. 3. Annual trends in the *G. palpalis* population levels, and atmospheric temperature and humidity as determined by the 5-year moving averages technique (1955–1974).

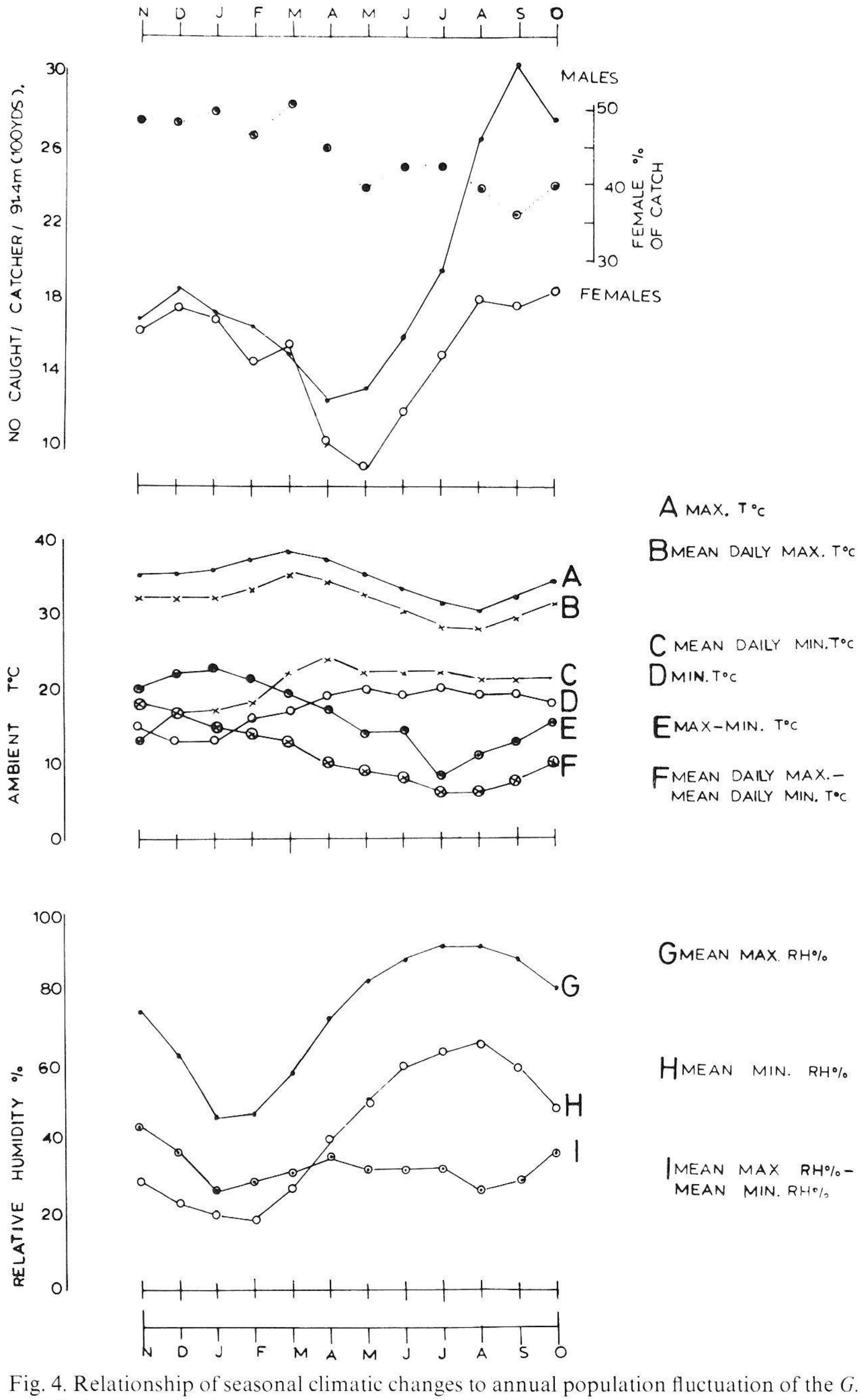

Fig. 4. Relationship of seasonal climatic changes to annual population fluctuation of the *G. palpalis* population.

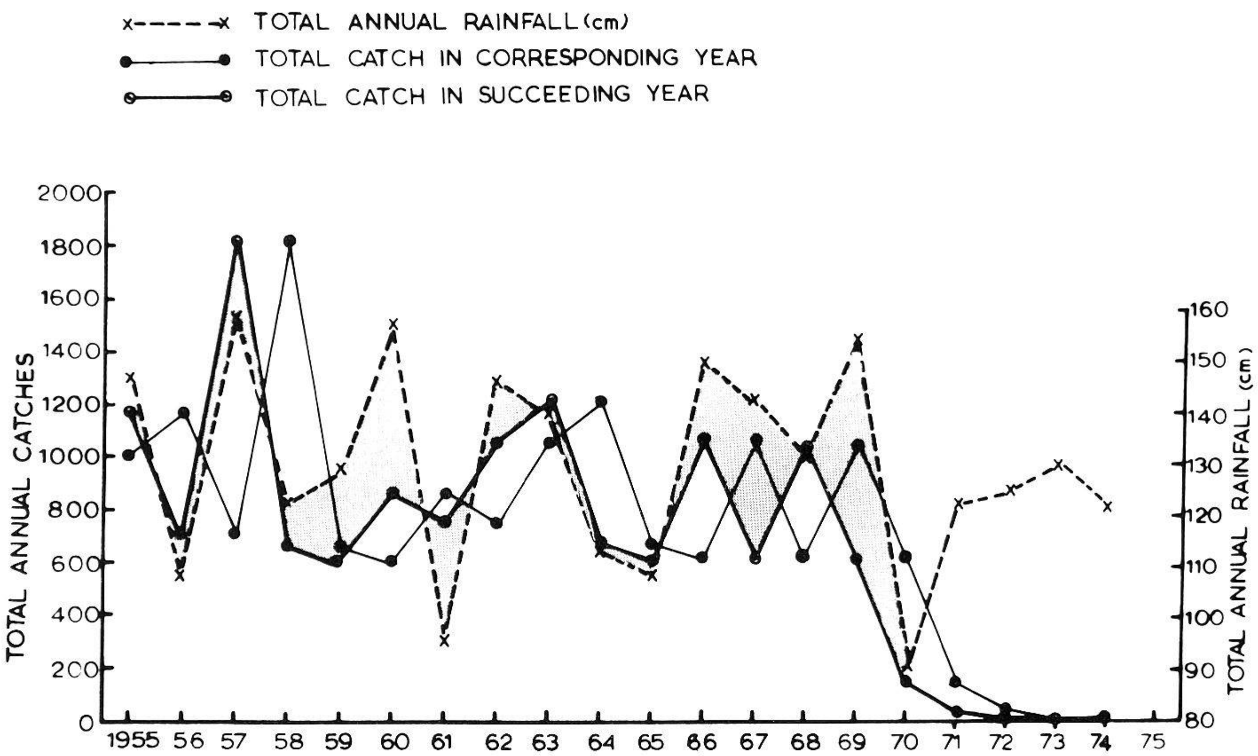

Fig. 5. Comparison of annual total rainfall and catch of *G. palpalis*.

The fly-round technique as described by Nash in 1944 was maintained. An investigating team consisted of two catchers and a recorder. Catches were made at forthnightly intervals, the starting points being alternated between subsections 0–1 and 17–18. After recording the sex and nutritional state, caught flies were released at the point of capture. Records of game observed and presence of water in the riverbed were kept for each subsection.

Results

A total of 14,877 (8,329 males and 6,548 females; se-ratio, 1 male: 0.79 females) *G. palpalis* were caught in the study period. 1958 and 1964 were the most productive years with an annual total of 50.7 and 34.1 flies/catcher/91.4 m (100 yds) of fly-round path respectively. The permanent decline in fly density commenced in 1971 and no flies were encountered in 1975 and 1976.

Figs 2–5 summarize the results of the investigations from 1954 to 1976.

It is clear that the annual fluctuation cycles of the *G. palpalis* population were determined by seasonal changes in atmospheric temperature and humidity levels. Increase in size occurred between June and September when daily fluctuations in temperature and humidity were minimal (Figs 2 and 4). Climatic conditions were reversed during the period October to April (or May) with a corresponding decrease in population size. Decreases in the minimum daily temperatures (from 1969) and minimum daily relative humidity % (from 1971) coincided with a decline in total annual catches which led to a permanent reduction of the population (Fig. 3).

The rainy season in this area lasts from April (or March) to October, the mean total annual rainfall (1955–1974) being 129.2 cm. While there is no correlation between yearly total rainfall and catch, Fig. 5 indicates a relationship between the total rainfall of one year and total catch during the following year.

The habitat

The "red" section of the fly-round path has a fringing vegetation of between 4.6 m and 27 m in width with about 37 m high emergent trees which form a canopy over tangled undergrowth. The "white" section contains thickets with widely dispersed emergents. The undergrowth in some parts is almost open. Vegetation of the "blue" section is deciduous, with grass occurring in places. High emergents are widely distributed with limited canopy formation.

The riverbed holds water along each section during the rainy season but only pools remain between subsections 4–5 and 9–10 in the "red" section during the dry season. A cattle track transverses the fly-round path between subsections 9–10 and 10–11. In the harsh dry season, the presence of water in the "red" section provides suitable climatic conditions to encourage the concentration of flies (Nash and Page, 1953). Subsection 9–10 was the most productive in total numbers of flies caught, with the sexes almost equal throughout the length of the "red" section but males were predominant in both "white" and "blue" sections.

Flies in the three nutritional stages gorged, intermediate and hungry occurred in highest numbers in subsection 9–10. Hungry flies were more common throughout the study.

Game at the reserve

Estimates of populations of game species were not undertaken but frequencies of observations were recorded during each fly-round operation.

The commonest game species were duicker *(Sylvicapra grimmi coronata* and *Cephalophus rufilatus)* 36.8%, cattle (zebu) 18.4%, monitor lizard *(Varanus niloticus nilotus* and *V. exanthematicus)* 12.0% and baboon *(Papio anubis choras)* 10.5%. Other occurring species include monkey *(Erythrocebus patas* and *Cercopithecus aethiops sabaeus)* 7.7%, man 3.9%, waterbuck *(Kobus defassa unctuosus)* 3.5% and wart hog *(Phachochoerus africana)* 3.2%.

A summary of observation trend during 1955 to 1976 is given in Table 1.

Subsections 9–10 ("red" section) and 10–11 ("white" section) were most productive.

Human activities

Although the study area is in a forest reserve and is therefore protected by law from poachers, the area is still subject to a lot of poaching. Game animals form the primary source of animal protein for surrounding villagers and earn additional income, which has resulted in a reduction in both the numbers and type of game animals. Thus the natural hosts of the tsetse population have been steadily reduced.

Table 1. Observation trend

Date	Total game observations	%
1955–1959	385	36.9
1960–1964	215	20.6
1965–1969	280	26.9
1970–1974	133	12.8
1975 and 1976	30	2.9
Total observations	1,043	

Illegal felling of trees for fuel, by local inhabitants, firewood traders and more recently by government authorized agents, has destroyed the environment for the game animals and so interfered with the ecosystem on which the flies depend.

Katabu, formerly a road junction village, is developing fast with an increasing human population. Major road construction has taken place and farming activity has increased so that the area has changed drastically in recent years.

Discussion

Work by Nash and Page (1944–1950) showed that *G. palpalis* survival in Anara Forest Reserve depended on a characteristic ecoclimate within the fringing vegetation of R. Bahago. Both Nash and Page (loc. cit.) and Jordan (1964) found annual variations in the population size were minimal.

From 1954–1971, the apparent fly density varied both within and between years but during the terminal years little fluctuation occurred. Similar annual fluctuations were observed on *G. swynnertoni* in Shinyanga, Tanganyika over a 23-year observation period (Glasgow and Welch, 1962).

As no meteorological data were kept for the study area after 1950, records at N.I.T.R. in Kaduna and from the Kaduna State Water Board were used to determine whether changing weather factors influenced annual or long-term variations in the population size of the flies. Jordan (1964) used similar meteorological data but was unable to correlate it with the increased population size of 1958.

The present survey has shown that annual fluctuations in population size were essentially due to the effects of seasonal changes in climatic conditions; the severity of the dry season determined the number of flies surviving the following rainy season when a build up in the population would take place. Reduction in size was associated with periods of stress caused by wide fluctuations in daily temperature and humidity. During the rainy season, the atmospheric humidity increased and the total annual precipitation raised the water table which in turn determined the severity of the adult and pupal microclimate of the following dry season. Thus, the high population levels in 1958 and 1964 could have been due to the heavy rainfall in 1957 and 1963 respectively. In both years it seemed the dry season was mild due to greater availability of water evaporating from the soil resulting in the greater survival of flies. Throughout the study period, the programme did not provide for searches for puparia.

Decreases in the minimum daily temperature from 1969 and minimum daily relative humidity from 1971 onwards undoubtedly contributed to the eventual collapse of the tsetse population in this area. The cold dry harmattan of the dry seasons from 1969 onwards produced comparatively harsher weather conditions which are associated with the drought experienced in the northern states of Nigeria during the period. This situation was aggravated by the increasing human activity in the area. Tree felling, bush burning and destruction caused by construction works could have had similar effects to those produced by the partial clearing control methods successfully used against *G. tachinoides* and *G. palpalis* in Gadau (Nash, 1940) and Anchau (Nash, 1948). Game on which the flies depended on for their food supply have been considerably reduced in numbers and types in the reserve.

Although the population of *G. palpalis* has now disappeared from the study area due to the factors discussed above, surveillance of the area will continue so that any re-invasion can be monitored.

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