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A NYMPHAL POPULATION DYNAMIC STUDY OF *DARTHULA HARDWICKII* GRAY (HEMIPTERA MEMBRACIDAE) ON *ACACIA DEALBATA* LINDL.

By

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INTRODUCTION

Darthula hardwickii Gray is a membracid, hemipterous insect that feeds on the sap of trees and herbaceous plants. In Shillong and its vicinity, this common tree-hopper is seen to profusely infest *Acacia dealbata* Lindl., which is an economically important plant, and in particular, its nymphs are known to be the cause of extensive damages. Earlier, Mandal and Biswas (1965) observed the biology of this insect from this area. It is known that with general reference to phytophagous insects and in particular forest trees inhabiting ones mostly do not reach infestation levels. Their number usually fluctuates well below the carrying capacity. It is only at certain season and some year that a pest status is reached. Cyclic changes associated with seasonal populations probably constitute the most important and the all-encompassing set of environmental variables that organisms encounter.

The present investigation was therefore, to evaluate the population dynamics of the nymphs, firstly, to observe the rise and fall of their numbers, and secondly to arrive at some relationship between their densities and other possible operative factors.

The Study Area

The study area was the Mayurbhanj Campus of the North-Eastern Hill University, Shillong (25°34'N ; 91°56'E). The area is about 1500m in altitude and predominated by ***Pinus kesiya*** Royle ex Gordon, A patch of the area at the School of Life Sciences is colonised by *Acacia dealbata* Lindl.

The climate of Shillong and its adjoining areas are controlled by the two seasonal winds, viz. the South-West monsoons and the North-East winter wind. Hence, the area may be divided into spring season (March to mid-April), dry summer season (late April to May), rainy season (June to mid-October), autumn season (late October to November) and winter season (December to February).

The average summer temperature of Shillong is 24-26°C and during the cold winter months the mercury drops as low as 1°-2°C. Frost is common, particularly in the mornings, during the winter period. Shillong and its adjoining areas enjoy an annual rainfall of 2500-3000mm.

Materials and Methods

Although the area was dominated by ***Pinus kesiya*** Royle ex Gordon, the insect, *Darthula hardwickii* Gray (Plate I) was found to colonise the *Acacia dealbata* Lindl. only. Therefore, three *Acacia* trees of unequal heights were chosen (Tree No. 1 = 1.5 m ; Tree No. 2 = 3.0m ; Tree No. 3 = 6.0m). Each tree was divided into three equal zones, viz. Zone A (bottom portion), Zone B (middle portion), Zone C (top portion). Thus, the height of each zone of the first tree was 0.5 m, that of the second tree 1.0m each and the third tree 2.0 m each. All the three trees were situated within the distance of one meter from each other.

The study period extended between 18th March, 1983 (when the population was in the early 1st nymphal stage) to 30th May, 1983 (when the adult emergence was completed). Sampling was done twice a day at 06.00 hrs. and 18.00 hrs. From each zone of the trees, the insects were counted from a quadrat, measuring 25 cm^2 in surface area. Counting of the insects were made from 10 such quadrats. Therefore, daily counts of insects were made from 20 quadrats for each zone of the trees. A total of 20×74 or 1480 quadrats of insect samplings were made from each zone of the trees and 1480×3 or 4440 quadrats for all the zones of each tree, during the whole investigation period. All the counts are represented in results as daily average per tree.

In addition to the population sampling of *Darthula*, single abiotic factor that has been considered in the present study was the atmospheric temperature. Thus, on every sampling occasion, the temperature was measured with an ordinary thermometer near the zone of sampling.

RESULTS

The three different zones in the three different trees undertaken was primarily to understand the aggregational behaviour and movement from zone to zone within the trees and also between the trees.

The movement between trees is seen from the graph (Fig. 1) where the maximum was seen at the beginning of the study period with 50 individuals in Tree No. 2, while it was only around 34 in Tree No. 3, and 20 in Tree No. 1.

In Tree No. 1, the population fluctuated around 20 ± 2 till the 10th of April when it reached nearly 27 and continued to be so for two days. Thereafter, it fell to half the level till the 30th of April and with a similar phenomenon as the initial stage, continued till 12th of May. This was seen to dwindle till all the nymphs emerged around 27th of May.

In tree No. 2, a more or less similar phenomenon was seen as in Tree No. 1, except in the magnitude of numbers which oscillated around 40 ± 2 till the 9th April. Thereafter, a reduction to nearly half was observed, which continued to be so till the 9th of May. The numbers in Tree No. 2, suddenly shot up to nearly 28 on the 10th May and continued to fluctuate around that till 16th May when a fall in the population was recorded till the 30th.

In case of Tree No. 3, the population rose and fell till a peak was seen on 29th March which was more or less maintained till 3rd April. Immediately following this, the number was more or less constant, around 30$\pm$3 till 30th April, when a decline in the population was seen till a minimum was reached at the end of the study period.

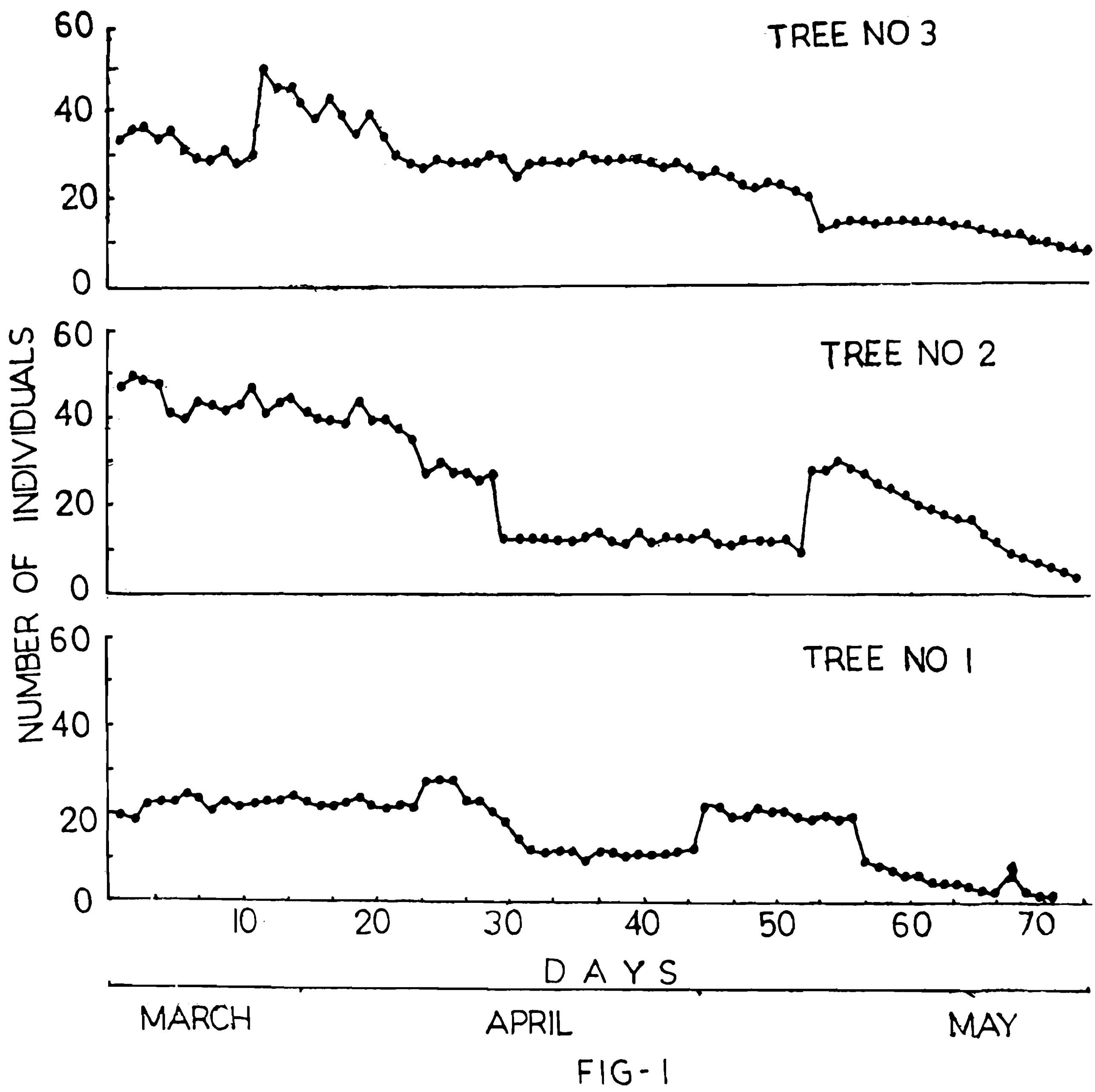


Fig. 1 : **Showing the average numbers of *Darthula hardwickii* Gray per day in the three experimental trees.**

The population dynamics of the insects between the zones of each trees were also observed. Thus, in Tree No. 1, the nymphs increased gradually from 18th March till the 21st, when a peak of 35 individuals was seen, and thereafter it declined gradually to a level of 20 individuals, till the 12th April in the zone A. However, no insects were observed at this zone after 12th April, and reappeared from the 1st May.

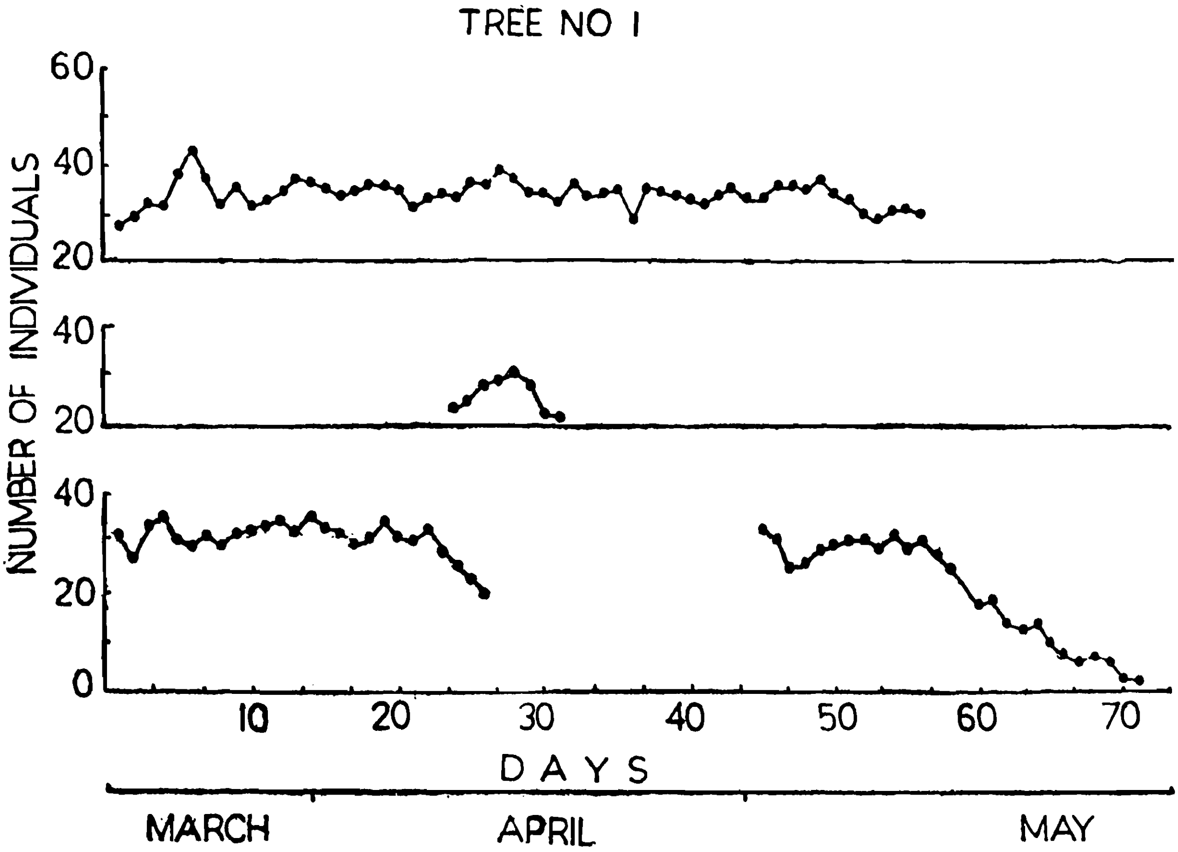


FIG - 2

Fig. 2 : Showing the average numbers of *Darthula hardwickii* Gray per day in three zones (A, B & C) of Tree No. 1.

In zone B of the same tree, nymphs were observed only from the 10th April till the 17th April. Between these days, the population fluctuated from 30 maxima to 20 $\pm$ 1 minima. In zone C, the nymphs were observed to oscillate between 44 to 26 individuals (Fig. 2).

Zone A of Tree No. 2 has a gradual increase in the nymphal populations from 18th March till the 24th when a peak of 48 individuals were counted. Thereafter, a gradual decline was seen till the 11th April when all the individuals were seen to disappear from that zone. The nymphs reappeared from the 10th May till the end of the study period, and the number during this period varied between 32 to 3 per day. Zone B of the same tree showed a peak population of 67 individuals on 20th March, and there after showed a decline till the 16th April. The insects reappeared from the 10th May till the end of the investigation. In zone C, the nymphs fluctuated between 42 individuals on 19th March to 4 individuals on 30th May (Fig. 3).

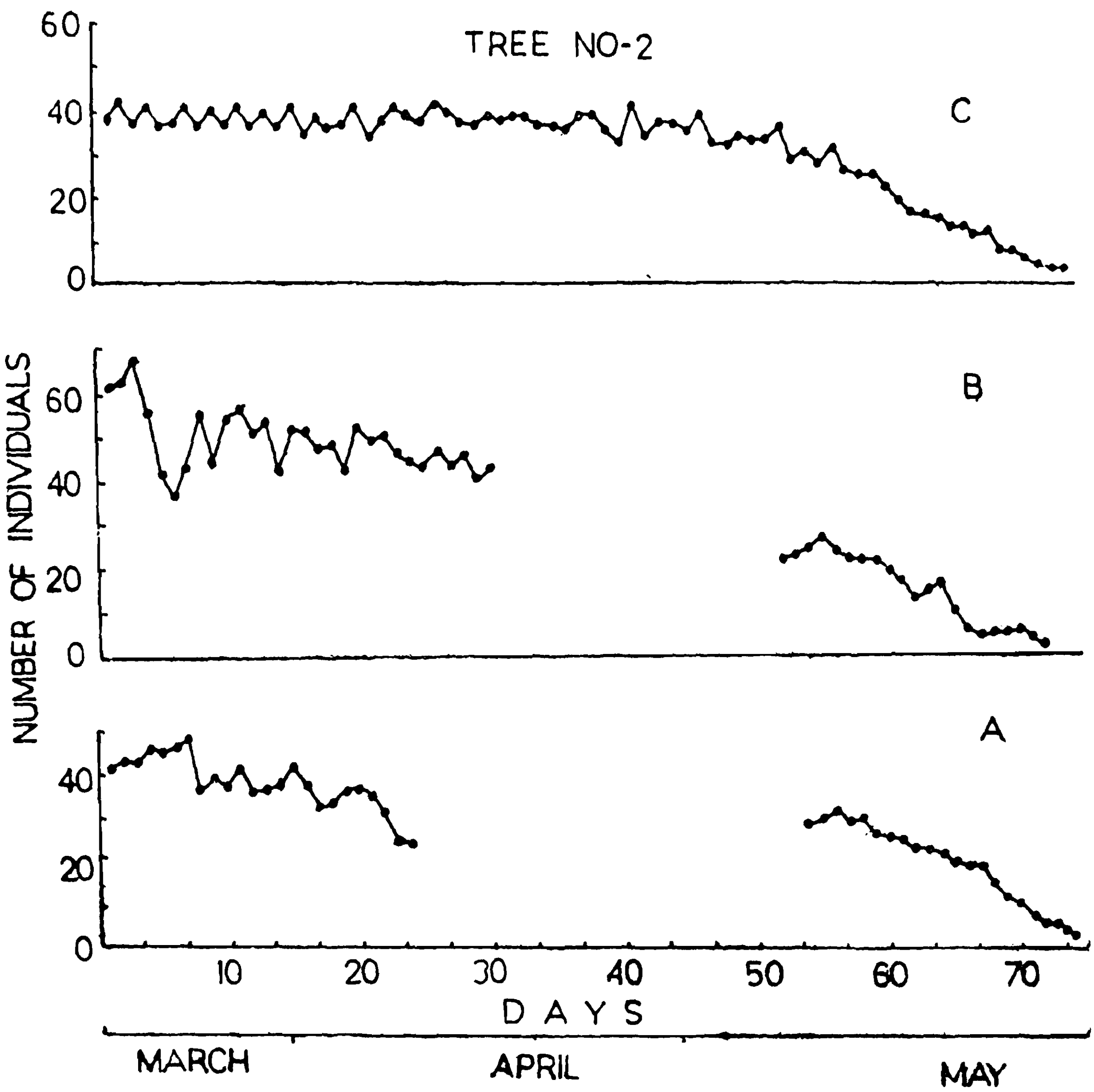


FIG - 3

Fig. 3 : Showing the average numbers of *Darthula hardwickii* Gray per day in three zones (A, B & C) of Tree No. 2.

In Tree No. 3, zone A recorded nymphal population fluctuations from 60 individuals on 29th March to 23 individuals on 7th April. Thereafter, no insects were recorded at this zone. The zone B recorded a maximum population 64 individuals on the 20th March and a minimum of 23 individuals on the 9th May. Zone C showed a gradual decline from 53 individuals on the 18th March to 22 individuals on the 30th May (Fig. 4).

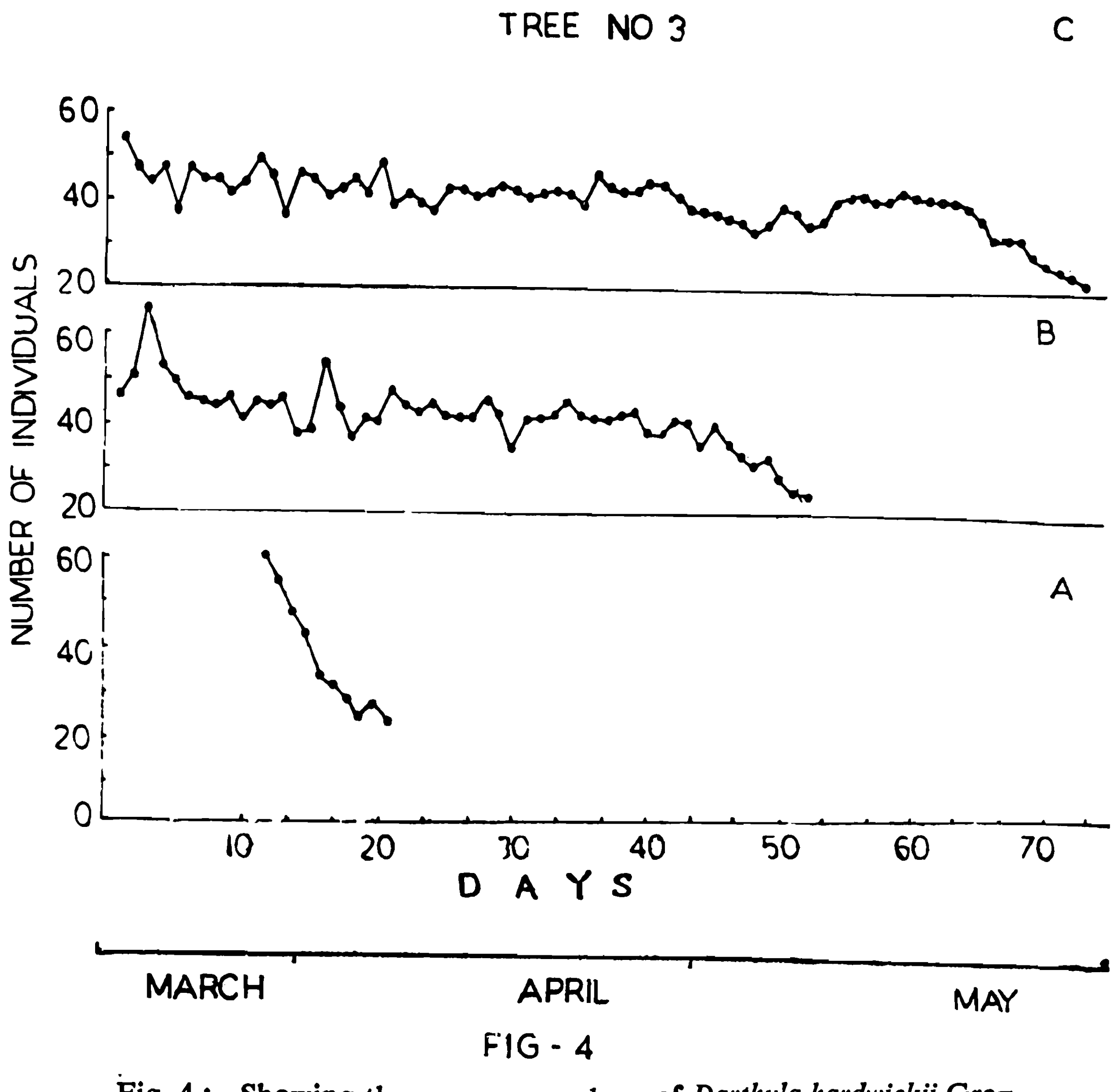
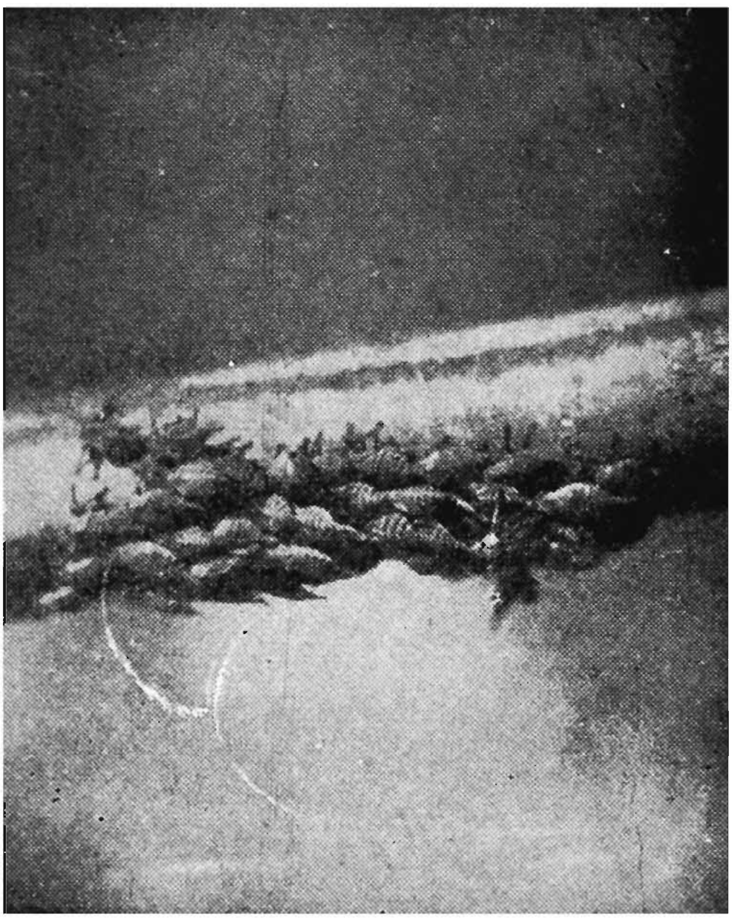


Fig. 4 : **Showing the average numbers of *Darthula hardwickii* Gray per day in three zones (A, B & C) of Tree No. 3.**

As mentioned earlier in the results, the population appears to be univoltine, and that all the nymphs possibly hatched out from the same set of eggs laid at one time, is clear from the moulting of these nymphal stages and also from the emergence of adults. Irrespective of the zones or the trees, the first moulting occurred on the 30th March and the second moulting on 13th May. The former showed significant increase in the size of nymphs while the latter revealed the adult emergence.



Showing a colony of *Darthula hardwickii* Gray (nymphs) on *Acacia* branch.

Even though three trees were taken into consideration, the adults emerged were primarily from Tree Nos. 1 & 2 (Fig. 5). After the 13th of May in Tree No. 1, the adults

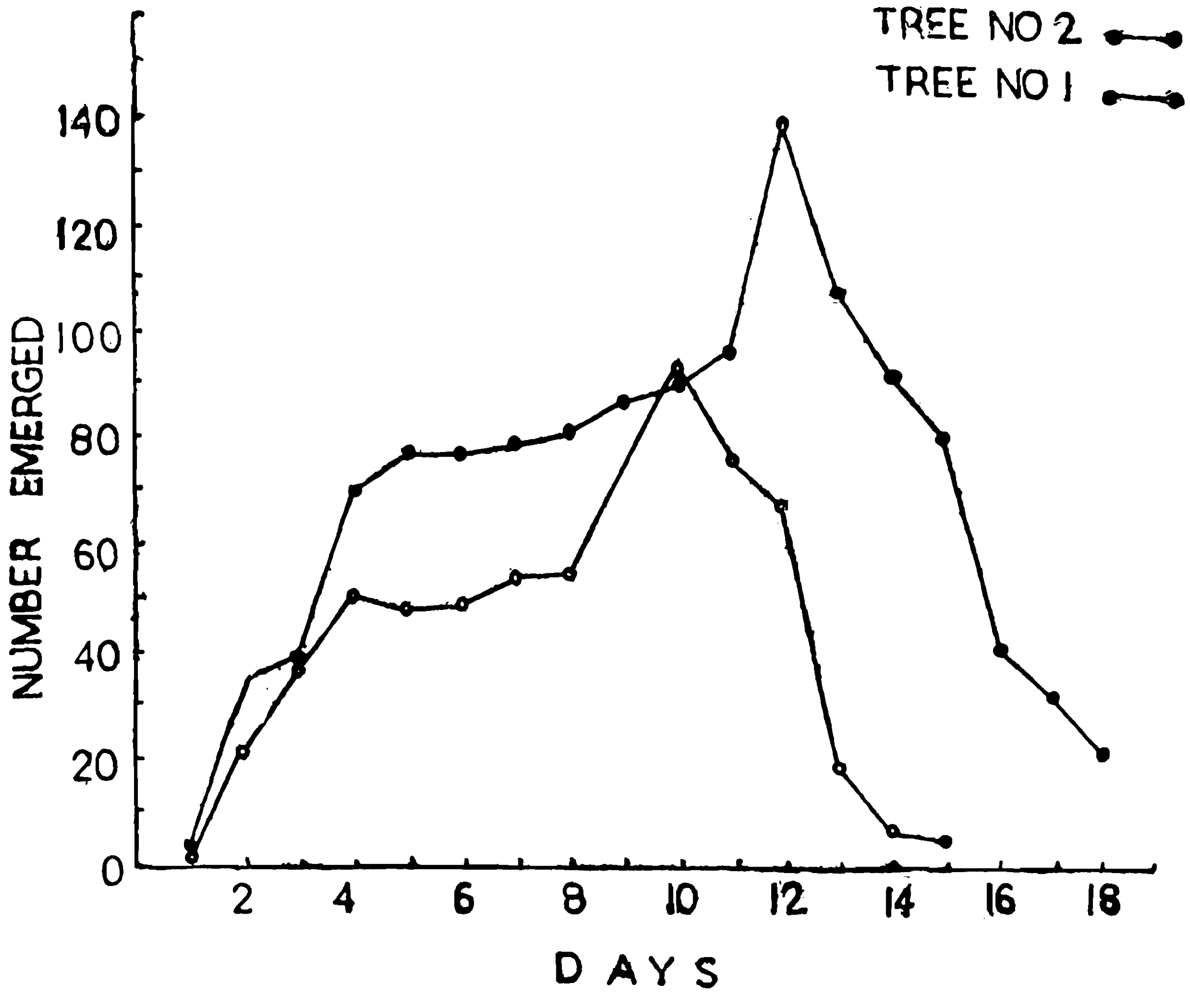


FIG - 5

Fig. 5 : Showing the total numbers of adults emerged per day in Tree No. 1 (13th-27th May) and Tree No. 2 (13th-30th May).

slowly emerged in larger numbers and continued till the 20th May, oscillating around 50 and the next day reaching a peak of nearly 95. Subsequently it fell, though not drastically but slowly, when all emerged by the 27th May. A more or less similar phenomena was seen in Tree No. 2 in case of adult emergence except that the numbers emerged were more daily in comparison to Tree No. 1. In this Tree No. 2, the adults started emerging again steadily in larger numbers till a peak was reached on 24th May which subsequently declined till the study period when all the nymphs had totally emerged.

The temperature fluctuations during the study period is shown in Fig. 6. The temperature appeared to fluctuate from 11.8°C in the beginning of the study period to 20°C at the end of the investigation.

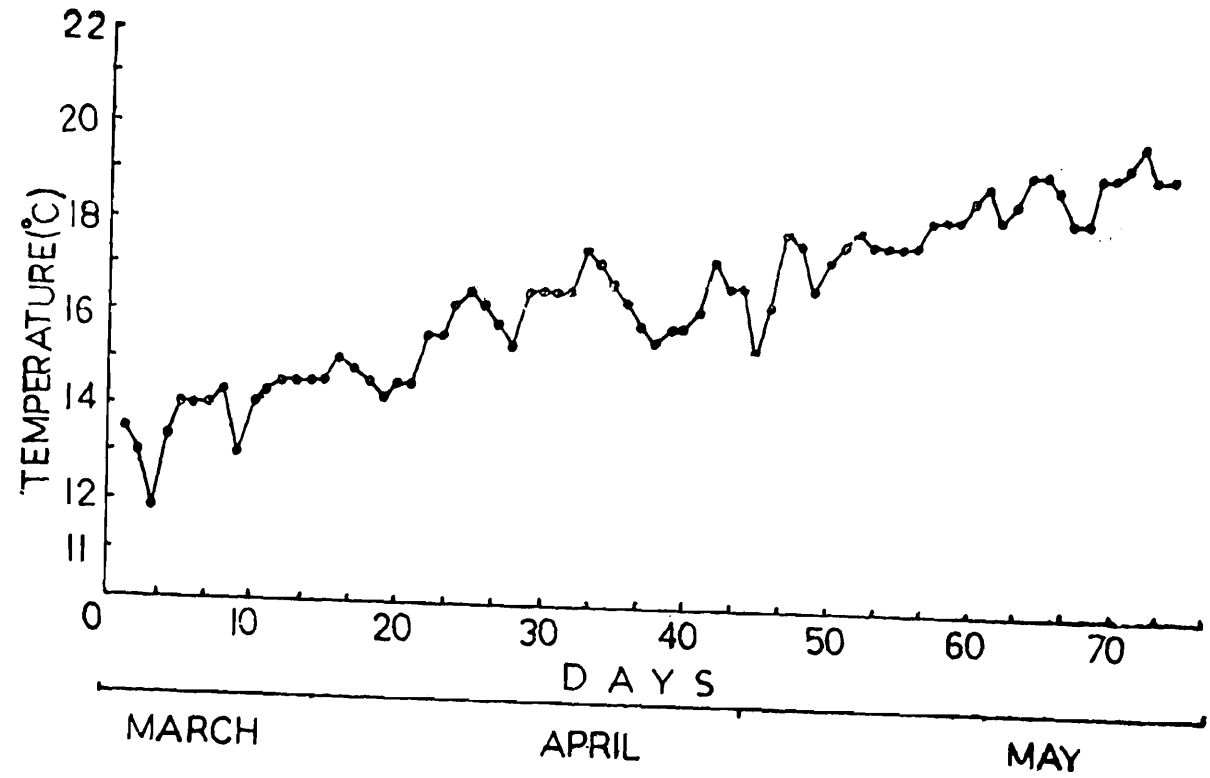


Fig. 6 : Showing the average temperature per day of the study site.

DISCUSSION

From the results obtained, it is seen that when the total trees were taken into consideration the maximum aggregation of the population occurred in the middle of the growth stage of these insects in Tree No, 1, while it was in the beginning in the other two trees. Further, it was seen that the numbers in Tree No. 1 was nearly half of that of the other two even at its peak. This could possibly be explained by the fact that Tree No. 1 was smallest in relation to others and possibly nesting grounds and feeding places could have been subsequently reduced.

However, an interesting phenomenon is seen when the different zones of the different trees are considered. Here one observes from the results that irrespective of the trees, zonewise maximum aggregation of populations were shown during the earlier part of the study. This further confirms the above contention that a single species population had possibly laid eggs in the different zones of the trees irrespective of the carrying capacity of that tree or zone. On emergence and when active feeding started these nymphs moved from tree to tree till they occupied the right ecological niches.

In addition, while counting, it was observed that such movements could also be enhanced by other insects and in particular by ants which try to prick the abdomens of these nymphs and feed on the exudates that come out. A near to similar phenomena of analogy is an aphid colony tended by ants, where aphid aggregation is controlled by ants (Dixon, 1977). The movements of individuals within a population or community may be influenced by the presence of the other individuals of the same species or by other species. This relationship among individuals obviously affects the patterns of movements and the areas traversed. One of our many unsolved problems concerned is the absence of information on the expected frequencies of distance between two individual fauna which share the same area (Siniff & Jesson, 1969). In a closely knit fauna, on the same host plant, it seems surprising to find no evidence of intraspecific competition, but it seems to be more usual than is generally supposed although its effects are difficult to prove conclusively. Many species are known, as seen in the present case to have a preference for young bushes or for the current year's green shoot. But on the whole, any succession that occurs in this life system is mainly in the densities of population in young and old bushes rather than their complete absence (Waloff, 1968).

These things have been suggested by Aynne-Edwards (1962) that such mechanisms have evolved by natural selections of social adaptations, with the result that the disadvantageous effects of over-exploitation of the environmental resources are avoided. Living at such stage is advantageous to the population but not so much of the individuals composing the population (Klomp, 1966). Wynne-Edwards (1962), therefore, introduces the concept of group selection, a type of selection concerned with the viability and survival of the population as a whole.

The growth of these nymphal stages do not seem to be directly controlled by the atmospheric temperature. This is obvious since both the first and second moulting were not controlled by the temperature phenomena. However, during the later period of May, the temperature shot up and there is every indication to believe that there is a synchronisation of the temperature and emergence of adults.

The conspicuous absence of select insect groups at certain times of the year suggests that many tropical insects, like their temperate zone relatives, have developed strategies for escape during particular seasons. Restricted periods of abundance may be directed by periodic food supply as well as advantages in predator avoidance and enhancement of mating success. Migration into more suitable environment (Kainy, 1951 ; Brown & Swaine, 1966 ; Janzen & Schoener 1968) offers a viable strategy for maintaining a continuously active population, but seasonal occurrence of a species in a particular area also could be achieved by coordinating periods of dormancy and development with appropriate environmental signals.

SUMMARY

A preliminary study of the nymphal population dynamics of *Darthula hardwickii* Gray was conducted. Although temperature appeared to influence the time of emergence and moulting of the nymphal stages, their population fluctuations seemed to be regulated by the emigration-migration, triggered by certain biotic factors. The concept of aggregation and group phenomena in such univoltine single species population has also been discussed.

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