POPULATION DYNAMICS OF CORTICOLOUS MITES OF THE GENUS *DAIDALOTARSONEMUS* (ACARI : TARSONEMIDAE) ON ELM COPPICE

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CORTICOLOUS
POPULATION
STUDY
ELM
TARSONEMIDAE

SUMMARY : The paper describes seasonal fluctuations in population density of two species of corticolous mites, *Daidalotarsonemus hewitti* Mahunka and *D. vandevriei* Suski on elm coppice poles. Eight sets of bark samples collected over one year showed population peaks for *D. hewitti* females in October and a second smaller peak in March. For *D. vandevriei* females, the highest population occured in January. *Daidalotarsonemus* larvae were also abundant at certain times of the year, particularly in January and to a lesser extent in June. Adult male mites were infrequent with a single population peak in June.

ÉTUDE DE
POPULATION
CORTICOLE
ORME
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RÉSUMÉ : Cet article décrit les changements saisonniers qui affectent la densité de population chez deux espèces d'acariens corticoles : le *Daidalotarsonemus hewitti* Mahunka et le *D. vandevriei* Suski vivant sur les rejets de rameaux d'ormes. Huit séries d'échantillons d'écorce prélevés sur une année ont montré des pics dans la population chez les femelles *D. hewitti* en Octobre ainsi qu'un second pic moins important en Mars. Pour les adultes femelles *D. vandevriei* la plus forte densité de population s'effectue en Janvier. L'abondance des larves *Daidalotarsonemus* s'est révélée notable à certaines époques de l'année, tout particulièrement en Janvier et, dans une moindre mesure en Juin. Le petit nombre d'acariens mâles avait un pic de population en Juin.

INTRODUCTION

The bionomics of corticolous mite populations have, until recently, been little studied except in relation to a limited number of important pest and predatory species found in orchards which may occur on the bark. In fact, the surface of tree bark and the associated epiphytes can provide a diverse range of microhabitats, and this is directly reflected in the wide range of mite species which can be found there. In terms of their abundance, mites are usually the dominant group of arthropods on the bark. Many are permanently 'resident' on the bark surface, something which distinguishes them from a number of other arthropod types which are only transient members of the bark fauna.

This paper describes part of a year long investigation (1980-81) of changes in populations of corticolous mites on elm coppice poles. Some addi-

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tional observations of mites on ash and hazel coppice are also reported. Although a range of mite species was found on the elm coppice bark, those species belonging to the family Tarsonemidae were collectively the most abundant. They represented 65.8 % of the 11,834 mites collected. The majority of these tarsonemids belonged to just one genus, *Daidalotarsonemus* De Leon, represented by two species, *D. vandevriei* Suski and *D. hewitti* Mahunka. Mites of the genus *Daidalotarsonemus*, adult females of which have a characteristic reticulated pattern embossed on the plates on their dorsal surface, appear to be fairly widespread in their worldwide distribution. Species have been reported from both tropical and temperate host plants (SMILEY, 1972). However, the actual number of reports of *Daidalotarsonemus* mites from Europe is still very limited and of the two species found during this study neither has previously been reported from a natural habitat in Great Britain. As well as recording the presence of these mites, this paper examines the seasonal fluctuations in population levels of the two species and speculates on some of the factors which may be important in determining these fluctuations.

METHODS

Samples for this investigation were collected from a block of elm coppice (*Ulmus minor* Miller) within the elm woodland of Overhall Grove, 12 km north-west of Cambridge (Ordnance Survey map reference TL 337628). Coppice poles represented convenient sampling units which could be easily felled with minimal disturbance and damage to the woodland. Most of the poles cut were 5 years old, but the age ranged from 4 to 6 years. The average maximum height of the poles sampled was 4.4 m.

Over a period of about one year, samples were collected on eight occasions. Only two poles were cut the first time, but subsequently the number was increased to four. Coppice stools from which the poles were taken were chosen randomly, but individual poles were selected 'by eye' to ensure relative uniformity of samples. Poles were felled to allow three, 12 cm long sections of stem to be cut from each pole at heights of 25 cm, 75 cm and 150 cm. Only on the first sampling occasion was the procedure varied when the second section was cut at 50 cm rather than 75 cm.

For transport to the laboratory, stem sections were placed individually in capped plastic containers together with a small volume of 70 % ethanol to kill the mites. In the laboratory, the samples were shaken with 70 % ethanol to dislodge mites on the bark surface. After allowing mites and debris in the washings to settle, excess ethanol was siphoned off. The washings could then be examined in Petri dishes, with the addition of near-saturated sodium chloride solution to float mites to the surface. Mites were removed individually and cleared on slides in warm lactophenol before being examined.

Measurements of the average stem diameter and length of each sample section allowed calculation of an approximate bark surface area for the sample. Population numbers are thus expressed in terms of numbers of mites per 100 cm^2 of bark surface.

Growth of bark epiphytes was not measured in any exact way. However, a visual assessment of each coppice sample on a scale of 0 (no growth) to 3 (extensive growth) gave an approximate indication of the degree of colonization by algae (*Pleurococcus* sp.) and lichens (mainly *Lecanora conizaeoides* Nyl. ex Crombie).

Some additional bark samples were collected from hazel and ash coppice in Hayley Wood, Cambridgeshire (Ordnance Survey map reference TL 293532) in mid-January 1983. Samples of mites from both tree species were examined for *Daidalotarsonemus* species.

RESULTS

The results of the study show that the two species. *D. vandevriei* and *D. hewitti* can be abundant on the bark of elm coppice poles. While no precise quantitative assessment was made of the population density of *Daidalotarsonemus* on hazel and ash coppice, both *D. vandevriei* and *D. hewitti* were present on the bark of both tree species. *D. vandevriei* was the more abundant of the two in mid-January in the ratio of 2 : 1 to 3 : 1.

On elm, populations of *Daidalotarsonemus* fluctuated seasonally. Abundance also varied in relation to the height of the bark sample above ground level and there were differences in the timing of peak abundance for adult male, adult female, and larval mites. Variation in numbers within a set of four samples was often quite marked but general trends were clearly discernible.

Adult female mites of *D. hewitti* (Fig. 1) showed a broadly similar pattern of population change at 25, 75 and 150 cm above ground level, with peaks in August or October 1980 and a second peak in March or May of the following year. Overall numbers were highest at 150 cm and declined down to 25 cm. Results for adult female *D. vandevriei* mites (Fig. 2) were rather different. There was no summer peak in 1980 but numbers rose in late autumn or winter to reach a maximum in January 1981 for the 150 cm sample, but not until May 1981 for the two lower sets of samples. Again, the 150 cm bark samples had by far the highest population density.

If data for the two species are put together, a clear difference is seen in the timing of population peaks at the three sampling heights (Fig. 3). At 150 cm, the *Daidalotarsonemus* populations reached a peak in January 1981 whereas at the two lower sampling points the population peak occurred in May 1981. An overall mean population density calculated by combining data for the three sampling heights shows that population levels of *Daidalotarsonemus* adult females were high on coppice poles throughout the period August 1980 to May 1981 (Fig. 3).

Numbers of adult male tarsonemids were generally low. Only at 150 cm were the numbers sufficiently high to give any convincing pattern of seasonal fluctuation. Fig. 4 shows clearly that numbers of adult male tarsonemids reached their peak during the summer of 1980 and were absent

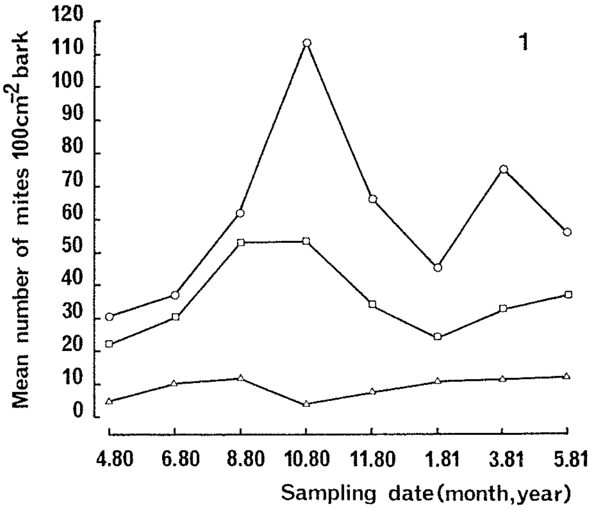

FIG. 1 : Seasonal variation in population density of adult female *Daidalotarsonemus hewitti* mites on elm coppice bark. The densities given are the means of four bark samples (except 4.80 — only two samples) at each of three sampling heights. (o—o = 150 cm above ground level, □—□ = 75 cm (except 4.80 = 50 cm), Δ—Δ = 25 cm).

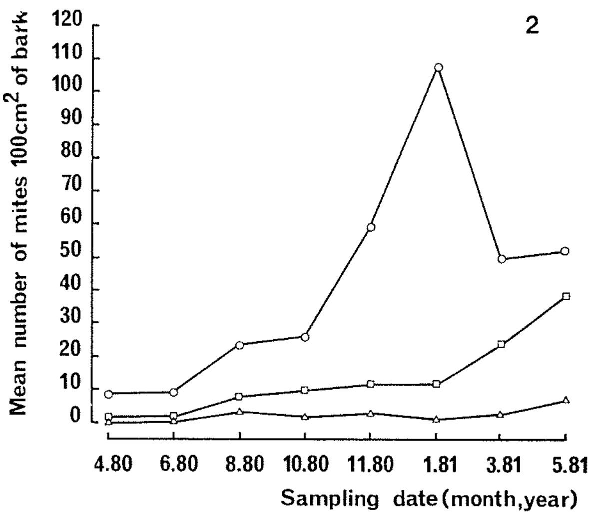

FIG. 2 : Seasonal variation in population density of adult female *Daidalotarsonemus vandevriei* mites on elm coppice bark. The densities given are the means of four bark samples (except 4.80 — only two samples) at each of three sampling heights. (Key to symbols given in Fig. 1).

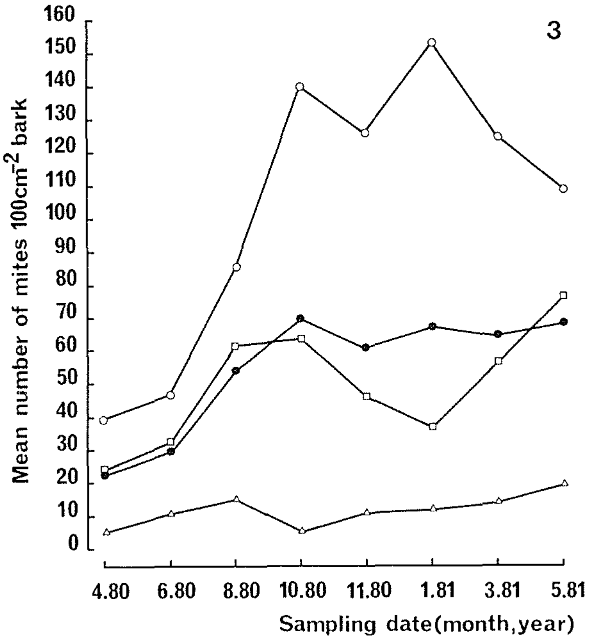

FIG. 3 : Seasonal variation in population density of adult female *Daidalotarsonemus* mites. Mean densities for each sampling height derived from the combined data for the two species. (Open symbols, for key see Fig. 1). Also shown are the overall mean values for population density obtained by combining species and sampling height data (•——•).

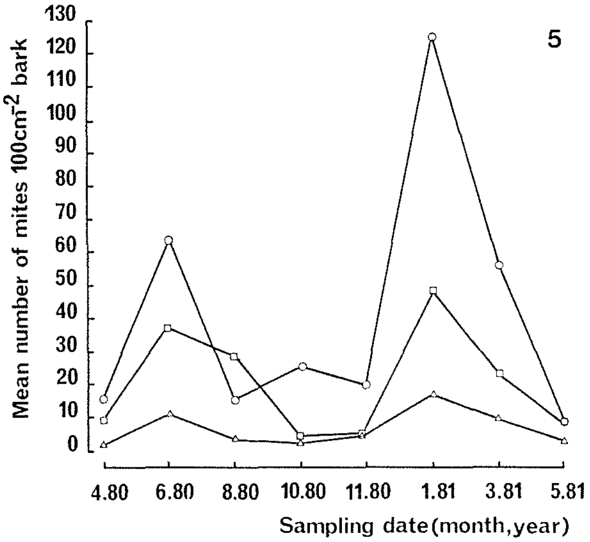

FIG. 5 : Seasonal variation in the population density of *Daidalotarsonemus* larvae on elm coppice bark. The densities given are the means of four bark samples (except 4.80 — only two samples) at each of three sampling heights. For key see Fig. 1.

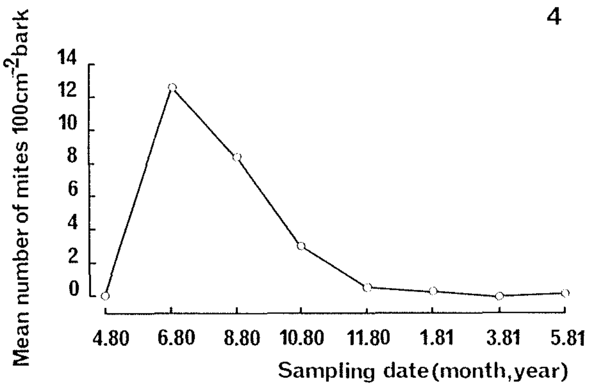

FIG. 4 : Seasonal variation in population density of adult male *Daidalotarsonemus* mites on elm coppice bark. The densities given are the means of four bark samples (except 4.80 — only two samples) at a sampling height of 150 cm above ground level.

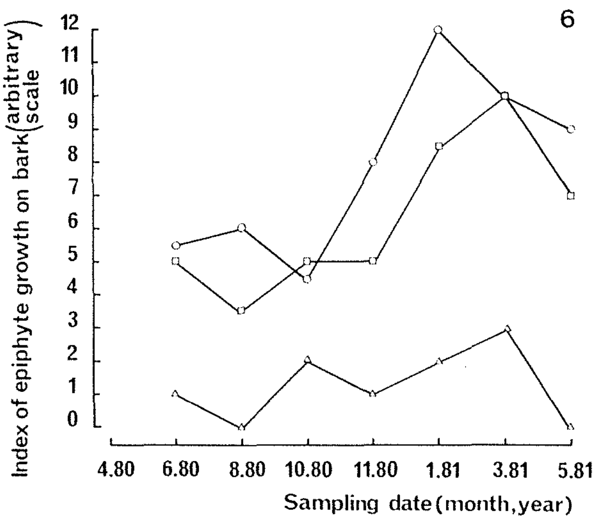

FIG. 6 : Seasonal variation in the extent of epiphyte growth (lichens and algae) on elm coppice bark. Assessed visually for each sample on a scale of 0 (minimum) to 3 (maximum). The resulting 'index' is the combined score for four samples at each sampling height. For key see Fig. 1.

during the following spring (March 1981). Numbers were low in autumn and winter.

Numbers of tarsonemid larvae showed a particularly clear pattern of seasonal fluctuation (Fig. 5) indicating two distinct population peaks. The first peak occurred in June 1980 and the second in January 1981.

Figure 6 illustrates the changes in the cover of bark epiphytes (lichens plus algae) based on a visual assessment of abundance.

It is clear from the results presented that mean population densities of *Daidalotarsonemus* varied markedly during the period of the study. Such variation is even more marked if numbers of mites on individual bark samples are considered. For *D. hewitti* adult females, the highest density for any one bark sample was 238.7 mites per 100 cm^2 (150 cm sample, March 1981). For *D. vandevriei*, the equivalent maximum was 211.5 mites per 100 cm^2 (150 cm sample, January 1981). *Daidalotarsonemus* adult males had a maximum population density of 32.7 mites per 100 cm^2 (150 cm sample, June 1980) while these values for *Daidalotarsonemus* larvae was 437.2 mites per 100 cm^2.

Discussion

Comparatively little is known about the biology or ecology of either *D. vandevriei* or *D. hewitti*, apart from the limited information published in the original descriptions. Suski (1967) described *D. vandevriei* from specimens collected from apple tree bark in Holland and Poland. He suggested that the mites were feeding on lichens (*Lepraria* and *Xanthoria* spp.) and/or algae (*Pleurococcus* sp.) which were present on the bark.

The original paper on *D. hewitti* (Mahunka, 1974) was based on a mite isolated from a child's clothing in England. That paper implied that this mite could be the cause of the skin rash suffered by the child. In view of the apparent abundance of such mites on the bark of trees, occasional casual transfer of mites to human 'hosts' is certainly possible and in the case of children could be frequent. There appears to be no hard evidence that such mites can evoke any kind of allergic skin reaction. It is perhaps of interest to note that Samšiňák *et al.* (1976) have cast doubt on reports of *Tarsonemus* mites which have in the past been referred to as parasitic on humans. The only previous reference to *Daidalotarsonemus* mites in their natural habitat in Britain comes from MacQuillan (1967) who reported finding two species of *Daidalotarsonemus* on the shoots and trunk bark of apple trees in Co. Armagh, Northern Ireland. Neither of the species corresponded exactly with any of the species of *Daidalotarsonemus* described up to that time. It has not been possible to obtain MacQuillan's original slides to check the identity of the mites.

The current study shows the two species of *Daidalotarsonemus* to have population peaks at different times of the year. This would make sense for two closely related species in terms of differential resource exploitation. One resource common to both species is the bark epiphytes which undoubtedly represent their main food source. Figure 6 shows that epiphyte colonization was at a maximum in January 1981 (150 cm) and March 1981 (25 cm and 75 cm). This corresponded exactly with the pattern of population peaks recorded for *D. vandevriei*, but was out of phase with *D. hewitti*. The bulk of the changes in the points score during the season was accounted for by changes in the growth of *Pleurococcus* which was particularly extensive during the winter months. This related to the timing of leaf fall from the elm.

During 1980, leaf fall began around the middle of October. From then onwards, light levels at the bark surface would have increased slowly with an accompanying increase in *Pleurococcus* colonization. It seems likely that *D. vandevriei* was able to exploit this situation and so show a population peak coinciding with increased growth of *Pleurococcus*. It is possible that *D. hewitti* adult females were perhaps better adapted to the environmental conditions and the exploitation of bark epiphytes (especially lichens) during the summer months. Nevertheless, this species did also show a second, smaller population peak in March

(Fig. 1). Both species showed a marked increase in numbers from the 25 cm samples to the 150 cm samples. At 25 cm in particular, growth of bark epiphytes was very much less thant at 75 cm, which in turn was less than at 150 cm (see Fig. 6). So, it seems probable that the differences in abundance of epiphytes are an important factor in influencing numbers of these tarsonemid mites on the bark.

The larvae of *Daidalotarsonemus* showed two population peaks ; a pattern rather similar to the combined data for the adult females of the two *Daidalotarsonemus* species. Although larvae were not identified to species, it seems probable that the first peak represented mostly larvae from reproducing *D. hewitti* females and the second from *D. vandevriei* females.

The situation with adult male mites was a little different. Only a single population peak was apparent. The majority of these male mites were not identified to species although mites corresponding to the *D. vandevriei* males described by SUSKI (1976) were present. MAHUNKA (1974) did not describe males of *D. hewitti* so that the presence of males of this species could not be similarly confirmed. Nevertheless, it is assumed that males of both species were present. The reason for the lack of a second peak in the male population is unclear.

To conclude, the limited data presented here suggests some difference in the way that these two closely related species of *Daidalotarsonemus* mites exploit a common habitat with a shared food resource. To confirm that this is the case would require further data on seasonal fluctuations in numbers and verification of differences in feeding and environmental preferences.

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