Scolytus scolytus (F.) and the disease factor in the Neolithic elm decline

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The beetle Scolytus scolytus (F.) (=destructor Ol.) is the main carrier of Ceratocystis ulmi, the fungus which causes Dutch Elm Disease. Although a number of records of other Scolytus species which today occur in Britain have been made from fossil assemblages of insects from Flandrian, including archaeological deposits (eg[1,2]), S.scolytus had not previously been discovered. Now, elytra (wing-cases) of two individuals of S.scolytus have been found in prehistoric deposits at West Heath Spa, Hampstead Heath, London, 10 - 15cm below the level identified by Greig as the elm decline episode[3]. This find has important implications when considering the possible rôle of a disease such as Dutch Elm Disease in the Neolithic elm decline

The Scolytus elytra were initially separated from four British members of the genus on size and the presence of clear longitudinal striae. The remaining two possible candidates, S.ratzbergii Jans. and S.scolytus were more difficult to differentiate but on overall morphology, including the more parallel-sided shape behind mid-point of S.scolytus (unlike the convergence to apex of S.ratzbergii), concavity towards suture of S.scolytus, strial and interstitial puncturation and the elytral profile, the fossil elytra were identified as S.scolytus. The identification was checked against a wide range of specimens, especially in view of the fact that in prehistoric deposits, S.ratzbergii has been identified considerably south of its current British range in Scottish birch forests[4].

The Mesolithic site at West Heath Spa was excavated because of finds of worked flints in the thin soil overlying Bagshot Sands, exposed by walking and other recreational use of the Heath[5]. Paleaoecological analyses of deposits from a nearby spring-fed boggy area were carried out to provide possible environmental information for the site, with preliminary[6] and full[3,7] results indicating that the basal sediments were pre-elm decline age. The pollen results have been given in percentages based on a pollen sum using tree and shrub pollen (apart from Alnus, Salix and Corylus) and herb pollen (apart from mainly wetland taxa such as Cyperaceae).

The lowest part of the pollen diagram has mainly tree pollen (averaging 96% in the 5 samples below 100cm). The forest cover represented here, based on correction of the pollen values[8], would have been about 50% Tilia (lime), 30% Quercus (oak) and 15% Ulmus (elm) with smaller amounts of Betula (birch), seeds of which were also found, Pinus (pine) and Alnus (alder). Shrubs like Corylus (hazel) and climbers like Hedera (ivy) were also present. This forest was not completely undisturbed, as is shown by traces of pollen from herbs like Plantago lanceolata (ribwort plantain) and Artemisia (mugwort) and some cereal pollen, which suggest that there was some human activity then. Such signs of pre-elm decline farming are considered to represent early Neolithic agriculture[9].

At 95cm there is the first significant drop in Ulmus pollen values from an average of 9.0% for the preceding five samples to 1.0% for 95 - 75cm, a change which is used to define the elm decline here. Although there are no radiocarbon dates from the environmental sample series because of problems of fine rootlet penetration, other dated elm decline horizons have given a date range of 3300 - 2900 yrs bp[10]. At West Heath Spa the change at this horizon is reflected by the plant macrofssils, which increase in amount and variety, as well as the pollen records, which are summarised in Figure 1.

Related changes occur between the insect assemblages from these levels. Corresponding with pre-elm decline forest are faunas dominated by tree-dependent beetles which include the Tilia feeder Ernoporus caucasicus Lind. There is a large percentage of decayed wood inhabitants, amongst them two species of beetles which no longer occur in Britain; Isorhipis melasoides (Lap.) and Pycnomerus terebrans Ol., the whole component typical of very mature forest.

Coinciding with the reduction in elm pollen is the first appearance of dung beetles, present in most of the subsequent levels, and the reduction of tree-dependent beetles, although decayed wood inhabitants are recorded through the episode, (Fig. 2). S.scolytus occurs 10 - 15cm below the start of the decline, and this confirmation that it was living locally at this stage allows the not unreasonable suggestion that its presence continued during the elm reduction. The predominantly mineral sediments yielded low macrofossil totals which provided a limited representation of the contemporary biota. This poor productivity also dictated a 5cm sample interval which led to restrainsts in relating the beetle find to pollen events.

Fig. 1 Changes in the proportions of pollen from trees (with Ulmus shown in black) and dry land herbs (with Plantago lanceolata shown in black) for the elm decline.

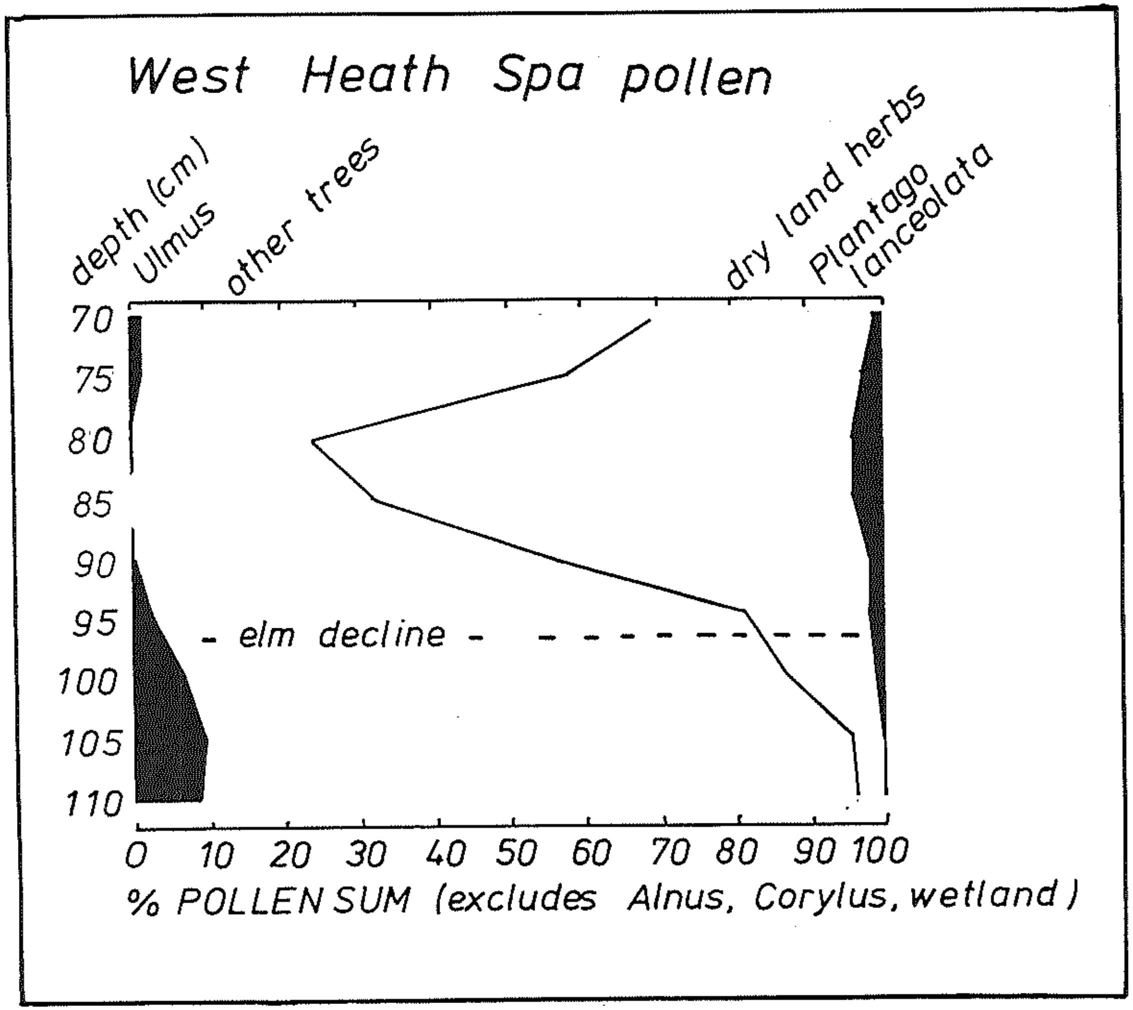

Fig. 1

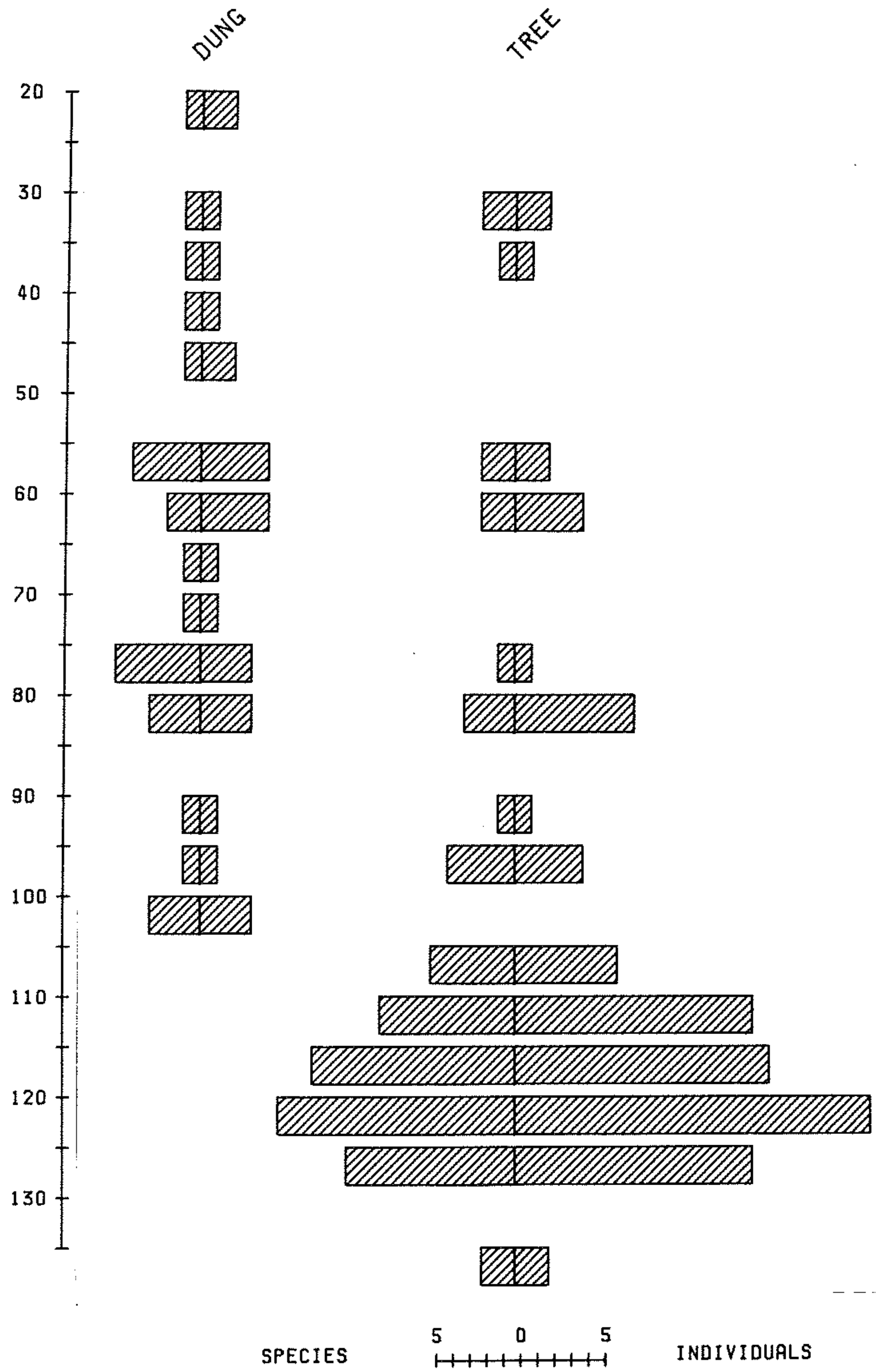

Fig. 2 Histogram showing numbers of species (left) and individuals (right) of dung and tree-dependent beetles.

A number of hypotheses have previously been proposed about the Neolithic elm decline which approximately halved elm pollen values. These include climatic, edaphic and anthropogenic causal factors[11,12] (the latter due to tree felling for cultivation or foliage removal for livestock feed). As the effects of the most recent outbreak of Dutch Elm Disease (late 1960's to present) become clear, the further hypothesis postulating Neolithic elm disease is finding increasing[13], but not universal[9, 14] favour. Recent work is also criticising a wholly anthropogenic cause because projected population figures for both Neolithic man[13] and livestock[15] appear unacceptably high for the archaeological evidence from this period.

Records of the beetle carrier of Dutch Elm Disease at this critical stage of prehistory again draw attention to the possible link with the elm decline. Although Ceratocystis ulmi does not have to be the fungus involved, it is a likely candidate; Dutch Elm Disease is reputed to have spread from Asia to Europe early this century, and subsequently to Britain in 1927, but Rackham has suggested that 19th. century and perhaps Shakespearian references are of earlier outbreaks in Britain and that Venetian plays of the 1500's could refer to the same disease[13]. Ceratocystis is genetically unstable, mutations accounting for renewed attacks of the disease, and it is possible that the high elm mortality of the present outbreak is due to lack of resistance to the introduction of a virulent strain which had arisen in Canada[16].

In the light of the Hampstead record of S.scolytus and our existing knowledge of archaeological and palaeoecological information on the late Mesolithic/ early Neolithic, a number of alternative events can be postulated to explain the elm decline:

1. S.scolytus could have been absent from Britain until the Neolithic. Arguing against this, the beetle is a strong flier and disperses rapidly, but in support, it is typically an inhabitant of clearings, hedges and isolated trees and would not have been favoured by the original, dense forest cover.

2. Pathogenic fungi could have been absent until Neolithic or more recent times This would be difficult to confirm because the chances of finding diseased wood from archaeological contexts (mostly preserved by waterlogging) are remote as the fungal spores block channels in the sapwood, usually resulting in the death of the affected bough or entire tree, and sapwood rarely survives. Also, the dark staining in tree-

rings when a tree survives an attack might not be visible when preserved in peat bogs, an important source of archaeological wood.

3. Neolithic farmers may have introduced or encouraged the spread of the beetle, fungus or both by using infected timber.

4. Frequent foliage stripping or pollarding for animal feed and timber (which subsequently stimulates rapid growth) by early farmers could have left the trees more susceptible to disease.

5. Similarly, the elm stumps and trunks, if left <u>in situ</u> after felling because of the difficulties of removing them[13], could have provided foci for the disease to take hold and spread, because <u>S.scolytus</u> breeds in decayed wood.

6. Any combination of the above could have happened, and an anthropogenic plus disease cause agrees well with evidence about the nature of the elm decline and Neolithic populations.

<u>S.scolytus</u> records from this period, rather than helping to identify the sequence of elm decline events, add a further line of evidence to the debate, but it is important to record the presence of a known beetle carrier of elm disease fungus during a southern British elm decline episode.

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