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26. THE SUBCORTICAL FAUNA OF OAK; SCOLYTID BEETLES AS POTENTIAL VECTORS OF OAK WILT DISEASE

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By now, the havoc wrought by Dutch elm disease, caused by the fungus *Ceratocystis ulmi*, is obvious to us all. Although it can spread locally from tree to tree through root grafts, dissemination over longer distances depends upon the bark-beetles, *Scolytus scolytus* and *S. multistriatus* in the UK We are becoming increasingly aware of another threat, this time to our native oaks. At present oak wilt disease, whose casual fungus *Ceratocystis fagacearum* is also transmitted by bark-beetles, is restricted to N America. To minimise its chances of being introduced into the UK, legislation prohibiting the importation from North America of live oak, oak bark and oak timber with bark attached has been enacted—the first line of defence.

In the United States, *C. fagacearum*, like *C. ulmi*, can be transmitted through root grafts. For its dispersal over longer distances it is dependent upon scolytid beetles of the genus *Pseudopityophthorus* which is not represented in the UK. Nevertheless it is suspected that the UK native oak bark-beetle *S. intricatus* might prove to be an effective vector should *C. fagacearum* be introduced to the UK. For this reason, studies are being made of the biology and ecology of *S. intricatus*, and other scolytids of oak, to assess their potential as oak wilt vectors and to provide a basis for their control if the need arose. Observations have been made on *S. intricatus* breeding in oak logs in Monks Wood National Nature Reserve in the expectation of more intensive studies being made in oak woodland in the New Forest (Plate 18).

The biology and ecology of *S. intricatus* is being analysed against 2 sets of criteria: (i) the potential suitability of *S. intricatus* as a vector of *C. fagacearum*, and (ii) its population dynamics.

1. Suitability of *S. intricatus* as an insect vector of *Ceratocystis fagacearum*

If *S. intricatus* is to be a vector it must:

(i) regularly visit diseased trees,

(ii) leave diseased trees carrying propagules, spores or mycelial fragments of *C. fagacearum*,

(iii) visit healthy oaks in conditions enabling inoculation and successful infection.

The evidence suggests that *S. intricatus* is likely to fulfil the first criterion as it breeds in the bark of dead oaks, and there is little reason to doubt that wilt-killed oaks will provide breeding sites. Branches cut from healthy oaks *(Quercus robur)* and logged during coppicing operations in Monks Wood during spring 1977 proved to be suitable breeding sites for *S. intricatus* which infested the logs during summer 1977 and produced a new generation of adult beetles in the following June. Other oak logs, cut in February 1978, were infested in July and August 1978, but logs first attacked in 1977 were not reinfested during 1978, a series of observations suggesting that oak is suitable for oviposition and breeding only for periods of 12-18 months after death. From North America it seems that *C. fagacearum* competes poorly against saprophytic fungi after killing its host. This being so, beetles attacking oak soon after being killed by *C. fagacearum* are more likely to give rise to emerging beetles contaminated with propagules of *C. fagacearum* than later colonizers. In some respects *S. intricatus* might be a more effective vector than *Pseudopityophthorus* spp. In North America the latter breeds only in small diameter branches (up to 10 cm) which are rarely colonized by *C. fagacearum*, whereas at Monks Wood *S. intricatus* seems to favour thicker branches 10-40 cm diameter which, from American experience, would also be more readily colonized by *C. fagacearum.*

During July 1978, when adult *S. intricatus* were emerging from oak logs in Monks Wood, the lower branches of nearby live oaks were regularly examined. It was found that male and female *S. intricatus* feed on twigs, particularly those at the join between the preceding and current seasons' growth, also in leaf axils and bud axils on current growth. This is termed as 'crotch-feeding'. Feeding wounds made in these positions by *Pseudopityophthorus* species are known in N America to facilitate entry and subsequent infection by *C. fagacearum.* Doubtless similar wounds produced by *S. intricatus* would also favour inoculation of *C. fagacearum* (Plate 19).

The seasonality of crotch-feeding is an important factor influencing the transmission of oak wilt. The susceptibility of North American oaks to *C. fagacearum* is seasonally maximal during springwood formation in spring and early summer. But, because crotch-feeding by *S. intricatus* reaches its seasonal peak in Britain during late-wood formation, disease incidence may be minimised because the phases of maximal insect feeding and tree susceptibility are unlikely to coincide.

2. Population dynamics of *S. intricatus*

From sequentially sampled oak logs infested with *S. intricatus*, records are being made of endo- and ectoparasitic hymenoptera, parasitic mites, predatory larvae of Dolichipodidae (Diptera), and of nematodes and fungi parasitising bark-beetle larvae. Subsequently it is hoped to identify, with key-factor analyses, the relative importance of these different agents on the development of successive generations of *S. intricatus.* Additionally, the effects on larval survival of climatic and environmental influences, such as the insulative properties of bark, will be assessed in field and laboratory experiments and in the development of life tables.

For the future, factors affecting the location and aggregation of breeding populations of *S. intricatus* and the dispersal of resulting populations of emerging adults will be investigated. Studies concerning the involvement of host attractants and pheromones are also planned. The effects of threshold temperatures on the flight of adults will be investigated in the field using oak logs as lures, while mark-recapture methods are being considered for field assessments of the extent (distance) of dispersal.