

THE PINE SHOOT MOTH

AND RELATED SPECIES



Forestry Commission
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Fig. 1. Post-horn deformity of Scots pine caused by the pine shoot moth, *Evetria buoliana*.

THE PINE SHOOT MOTH

The pine shoot moth, *Evetria buoliana* Schiff., is best known to foresters by the curious "post-horn" deformities, resembling the curves of a musical horn, which the attacks of its larvae produce on the main stems of pine trees. [Fig. 1]. It is a common and important pest of young pine plantations in the southern half of the country but its range does not extend into Scotland, with the exception of the county of Dumfries. In Scotland, the closely related pine bud moth, *Evetria turionana* Hbn., whose attacks also cause deformities, but not of the post-horn type, takes its place. Less important forest insects are the pine resin-gall moth, *Evetria resinella* L., common in Scotland and less so in the south, which produces quite large nodules of resin on pine shoots; and the pine leaf-mining moth, *Evetria purdeyi* Dur., of restricted distribution, whose caterpillars live within pine needles.

This leaflet describes the main features of the life cycles and forest importance of these four species.

THE PINE SHOOT MOTH

This moth, *Evetria buoliana*, has a wingspread of slightly more than half an inch and is attractively coloured in bright orange-red with irregular silvery grey stripes. It is on the wing mainly in July and August and the female moths deposit their eggs, one or two at a time, on the current year's pine shoot, usually close to the terminal bud whorl. The eggs are almost circular in outline, measuring about 1 mm. across, and, being flattened and scale-like, are most inconspicuous. After two to three weeks a minute caterpillar hatches from the egg and bores through a needle sheath into the base of a needle under the cover of a small silken web. The caterpillar feeds in this site for rather more than a week and then moves to one of the side buds of the

whorl. It bores into this bud and feeds on its contents until the onset of hibernation. Sometimes, if the buds are small, the caterpillar may have to move to additional side buds to satisfy its appetite before hibernation, but the central bud is seldom attacked and hollowed out before this time. Throughout this period an attacked bud whorl can be detected by the exudation of resin from the buds and by the presence of a silken web spun between them.

After spending the winter in a hollowed side bud the caterpillar recommences feeding in the spring, at first again devouring bud contents and later, when the remaining buds flush, transferring its attentions to the young developing shoots. Feeding at

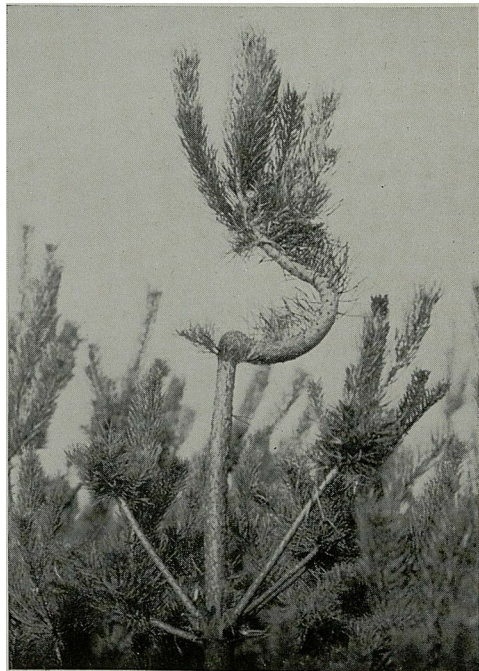


Fig. 2. Post-horn damage, two years old, caused by the pine shoot moth, *Evetria buoliana*, attack on young Scots pine.

this stage is voracious, and during this period most of the serious damage is caused. In June the caterpillar, which by then is about $\frac{3}{4}$ of an inch in length and brown in colour, pupates in one of the hollowed-out buds or shoots, and the adult emerges about three weeks later.

The attack on the bud whorl can produce differing results. The attack is, of course, most serious when it occurs, as frequently happens, on the leading shoot, although laterals are also infested.

(1) All the buds and shoots may be killed, terminating the growth of the shoot.

In this case, although adventitious buds often develop, the height growth is usually carried on by a lateral branch or branches from below the point of injury. Thus a permanent and serious deformation develops.

(2) A similar type of defect occurs when the central bud or shoot is killed without the death of all the side buds or shoots. Again, the height growth is continued by laterals and a more or less permanent distortion occurs, depending on the number and vigour of the side shoots competing with one another.



Fig. 3. Pupa of the pine bud moth, *Evetria turionana*, projecting from infested Scots pine bud whorl. Central bud hollowed and killed. Note resinous exudation at base of whorl.

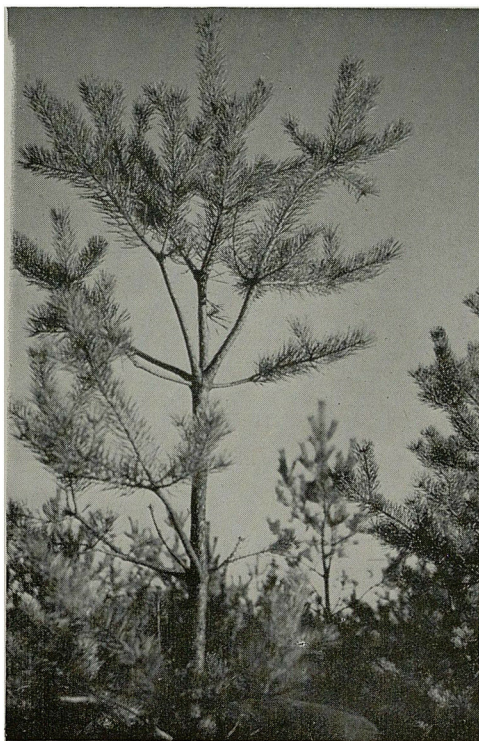


Fig. 4. Forking of eight-year-old Scots pine produced by attacks of the pine bud moth, *Evetria turionana*.

(3) The post-horn type of deformation occurs where the developing leader is damaged at its base, recovers, regains dominance, and continues the height growth of the tree. The leading shoot, when injured, falls over at an angle and then curves strongly upwards to leave a well-marked and permanent bend in the main stem. [Fig. 2].

THE PINE BUD MOTH

This moth, *Evetria turionana*, has a wingspan of half an inch, and the wings are brown in colour with irregular pale silvery

grey streaks and an apical spot of rusty red. The life cycle is generally similar to that of *E. buoliana* in that it consists of an annual generation with hibernation taking place in the larval stage in a hollowed out bud. It differs, however, in that the stages occur earlier in the year than do those of *E. buoliana*. For example, the adults are on the wing in May and June. The essential difference is that the caterpillars pupate before the buds flush [Fig. 3] so that feeding damage to the developing shoots does not occur; consequently the posthorn type of damage is not caused by *E. turionana*. The distortions produced by attack consist,



Fig. 5. First year gall of the pine resin gall moth, *Evetria resinella*, at base of Scots pine bud whorl. Winter appearance.



Fig. 6. Mature second year gall on the pine resin gall moth, *Evetria resinella*, showing empty pupal case projecting through wall. Note vigorous shoot growth above point of attack.

therefore, of some type of forking [Fig. 4], often quite severe since the caterpillar of the pine bud moth, unlike that of the pine shoot moth, almost invariably enters and hollows out the central bud of the whorl before it hibernates.

THE PINE RESIN-GALL MOTH

The adult *E. resinella* is about the same size as *E. buoliana*, and is chocolate brown in colour with irregular pale silvery streaks. The moths are on the wing in June and deposit their eggs singly on the current year's shoots. The caterpillar, which hatches from the egg in about three weeks, bores into the base of a needle under cover of a small silken web and later excavates a groove on the surface of the shoot between the attacked needle and the bud whorl. This groove it roofs over with silk and resin until, by the time of hibernation, a small resinous gall about the size of a pea has been formed immediately beneath the bud whorl. [Fig. 5]. In the following summer the larva continues to feed and grow, and enlarges the resin-gall until it measures just over an inch in diameter. The second year's resin actually encloses most of the first year's gall, so that the final structure is divided into two distinct chambers. By the second autumn the light brown larva measures about half an inch in length and is fully grown. It pupates next spring and the pupa forces its way through the side of the gall to release the adult. [Fig. 6].

The damage caused by this insect is insignificant. On weakly shoots it may terminate their growth or cause some distortion of the shoots from the bud whorl above the point of attack; but on normal shoots, since the buds themselves are not directly attacked, it has but little effect. Galls often occur on leading shoots without affecting their subsequent growth,

except that a minor point of weakness is formed in the main stem. Wind or snow-break may occasionally take place at this weakened point.

THE PINE LEAF-MINING MOTH

This species, *Evetria purdeyi*, is much smaller than the three already mentioned. The adult, which is dark brown with irregular greyish markings and has a rusty red spot at the wing tips, measures only two-fifths of an inch in wingspan; and the fully grown larva, which is reddish brown in colour, is only one-fifth of an inch in length. The moths are on the wing in late July and August, and the females lay their

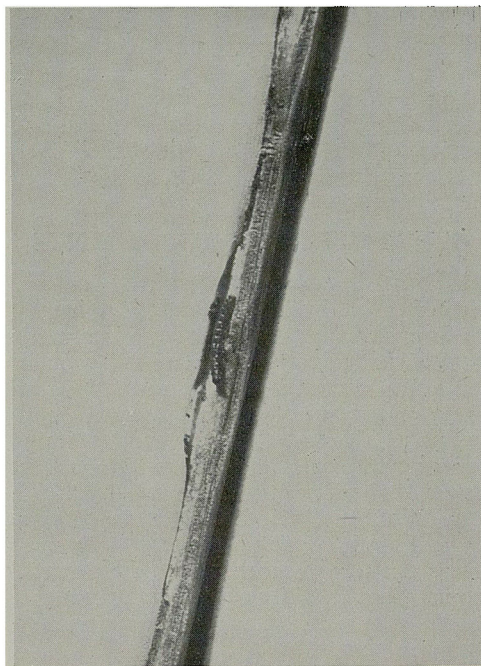


Fig. 7. Second stage larva of the pine leaf-mining moth, *Evetria purdeyi* mining in Corsican pine needle, sectioned to show attack.

eggs singly on the pine needles, usually close to the apex. The tiny larva, which emerges from the egg in about three weeks, bores into the needle and mines its contents until hibernation occurs in October. [Fig. 7]. In the following spring the caterpillar again feeds within the needle and later, when the buds flush, migrates to the new shoots and feeds by boring through the needle sheaths into the needle bases. The needles are severed and fall, leaving the sheaths empty. Each larva destroys several needle clusters in this way. Feeding continues until late June or early July, and pupation occurs amongst the remaining needles, the pupa being attached to them by a few strands of silk.

The result of attack is partial defoliation of the infested shoots. The early leaf-mining activities appear to have little effect on the tree, but the later more voracious feeding reduces the needle density markedly. This frequently results in a distinct decrease in the linear growth of the shoot and occasionally in the death of the shoot.

GENERAL FOREST IMPORTANCE

The first three species referred to are characterised by having a distinct height preference for attack. This zone is usually between three and ten feet above ground level, and consequently the infestations of these species are of greatest importance in young pine crops. All three species, however, can also exist at low population levels at greater heights in older crops, and in the case of *E. buoliana* the staminate flowers as well as the buds and shoots are sometimes used as feeding sites. These small populations in older crops often form the nuclei from which attacks spread to nearby younger plantations.

Pine Shoot Moth. The pine shoot moth frequently reaches very great numbers in young crops and causes numerous dis-

tortions of the young trees. The largest and best known infestations of *E. buoliana* which have occurred in this country are those which affected the East Anglian plantations in the 1920's and 1930's. It is recorded that in these epidemics only a small proportion of the leaders escaped damage. For example, at Swaffham only 11.8 per cent. and at Wangford only 26.6 per cent. of the leaders escaped uninjured after eight years of attack.

E. buoliana is known to infest a great number of pine species. In this country it attacks lodgepole pine (*Pinus contorta* Dougl. ex Loud.), Scots pine (*P. sylvestris* L.), and Corsican pine (*P. nigra* var. *calabrica* (Loud.) Schneid.) in that order of preference. Monterey pine (*P. radiata*, D. Don) and maritime pine (*P. pinaster*, Dougl.) are also attacked, whilst the Weymouth or Eastern white pine (*P. strobus* L.) appears to be free from attack.

Pine Bud Moth. The pine bud moth, *Evetria turionana*, does not cause such severe damage or reach such high numbers in young crops as does *E. buoliana*. The numbers of leaders deformed by its attacks in infested crops is normally between fifteen and twenty-five per cent. and has never been recorded to exceed thirty-five per cent. The silvicultural effect of such a level of damage is not great since the attacked trees are distributed at random throughout the crop. Thus, a sufficiency of unattacked trees, or of trees showing good recovery from attack, is left to constitute the crop.

The most common host tree is Scots pine; lodgepole pine is also attacked but to a lesser extent. In a recent study of this pest in the north of Scotland it was found that Corsican pine, Maritime pine and *Pinus ponderosa* were free from attack even when growing near to plantations of Scots pine infested by the moth.

Pine Resin-Gall Moth. As has already been indicated, *E. resinella* is of negligible forest importance. Scots pine is its usual host.

Pine Leaf-Mining Moth. The pine leaf-mining moth, *E. purdeyi*, is known as a forest pest from only one small outbreak in Britain. This occurred in the 1940's in the Bawtry and Laughton forest areas on the borders of Nottinghamshire and Lincolnshire, and on this occasion the moth attacked trees of from ten to fifteen years of age at heights of from twelve to fifteen feet. The normal host tree was Corsican pine. Scots pine, even when in mixture with attacked Corsican pine, was free from attack. The main feature of the attack was the preference of the moth for sheltered situations and sunlight. Marginal trees exposed to sunlight were more heavily infested than shaded trees; and under adverse climatic conditions of wind and rain the females were forced to oviposit on sheltered lateral branches rather than on the leading shoots, which they preferred if the weather was favourable.

CONTROL

Artificial Control Measures. The pine shoot moth, *Evetria buoliana*, has been accidentally imported on nursery stock to North America from Europe. There, much work has been done on the insecticidal control of this pest, the chemical measures being directed against it in the early larval stages before the caterpillar enters the buds. Some of these treatments have produced satisfactory results. In this country, however, there appears to be little justification or necessity for such chemical control methods, and none has been attempted. This is mainly because British attacks tend to be less severe than those in America; and because under British conditions attacked plantations generally show good recovery from attack. The only control

method tried in this country has been the removal of side buds in autumn when, in theory, the infested buds can be destroyed and the central uninfested bud allowed to grow on. This method proved to be unsuccessful in practice, principally because the caterpillars in the spring are able to migrate if they have exhausted the bud whorl on which they are working. In this way, the single remaining bud on the leader was frequently infested by caterpillars from lower parts of the tree.

Although direct control of *E. buoliana* is neither recommended or practiced in Britain, the scale of attack can be influ-

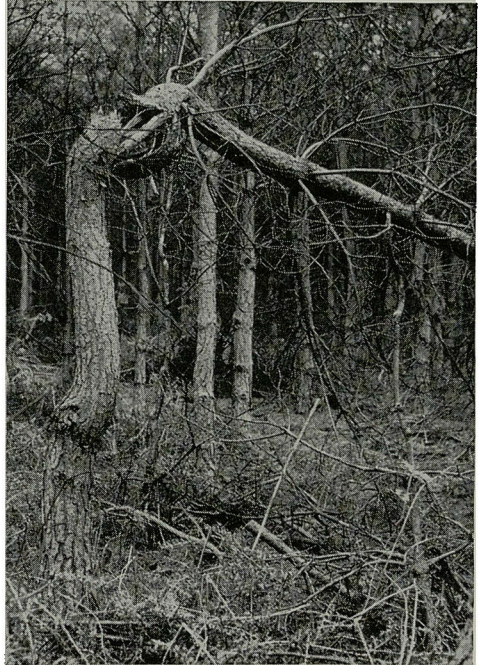


Fig. 8. Windbreak on 31 year-old Scots pine at point of post-horn damage produced by attack of the pine shoot moth, *Evetria buoliana*.

enced by choice of species, and much can be done to ameliorate the results of attack by correct silvicultural treatment in later years.

Firstly, in areas where attacks are serious one can consider the possibility of planting the more resistant Corsican pine in preference to Scots pine. Secondly, and very obviously, thinning should be so carried out as to ensure the removal of deformed stems as early as possible in the rotation. However, no undue importance should be attached in the earlier stages to the removal of "post-horn" trees. The posthorn type, although subject to windbreak at the bend [Fig. 8], does not interfere with other trees in the crop and, despite the deformity, does yield some lengths of saleable produce. It is more important to remove heavily forked stems as quickly as possible since they frequently develop into "wolves" and interfere with smaller unattacked stems which should go forward into the later life of the crop. Experience in East Anglia has shown that if such a thinning regime is carried out a reasonably satisfactory crop can be obtained even from the most heavily damaged stands.

Similar methods to assist recovery can be applied in the case of attacks by the pine bud moth, *E. turionana*.

It is unnecessary to consider artificial control methods against either the pine resin-gall moth or the pine leaf-mining moth.

Natural Control Measures. The *Eyetria* species mentioned in this leaflet are parasitised by many species of Ichneumon and

other flies. For example, *E. buoliana* in Britain is parasitised by a total of almost fifty insect species. In general, however, the attacks of these parasites develop too tardily to exercise an effective level of natural control during the susceptible years in the crop's life, and in consequence various suggestions have been made for enhancing the usefulness of these agencies. The most common suggestion is that infested bud whorls should be cut from the trees and stored in cages in the plantations. The cages themselves should be constructed of mesh of such a size as will permit the smaller parasites to escape whilst retaining the adult moths. Alternatively, infested material can be collected in plantations where the attacks of the moths are almost over and where the number of parasites is high, and can be taken to plantations where the moth infestations are just commencing and the percentage of parasitism is low. These suggested methods have not been tried in practice and it is not known if they would have the desired effect.

Predation does not appear to be a potent factor in natural control, mainly because of the enclosed and protected feeding sites occupied by the larvae for most of their lives. Spiders, bats and some birds do, however, prey upon these species either in the adult or in the very early larval stages.

ACKNOWLEDGMENT

The Commission is indebted to Professor H. M. Steven, of the Forestry Department, University of Aberdeen, for Figures 3 to 7 inclusive.

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Printed in Great Britain by Joseph Wones Ltd., West Bromwich
and published by

HER MAJESTY'S STATIONERY OFFICE: 1956