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Insects Infesting *Pinus radiata* in
New Zealand.

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INSECTS INFESTING *PINUS RADIATA* IN NEW ZEALAND.

By A. F. CLARK, Forest Entomologist, State Forest Service.

FROM the matter which follows it may at first be inferred that *Pinus radiata* Don. in New Zealand is in danger of extermination through the action of insect pests. The writer does not intend to convey any such impression. When it is considered that in this country *P. radiata* is occasionally poorly planted, established upon sites of wide diversity, and at times neglected so far as silvicultural measures are concerned, it is, for the great part, remarkably free from serious insect-attack. That this state of affairs can and will continue is a matter for conjecture, and is outside the scope of this paper, but the fact that as yet we have no quarantine or other measures designed to prevent the entry of insects infesting imported timber makes the chances of continuance for an indefinite period rather unfavourable. Many of the insects recorded infest only dead timber or trees which are in an unthrifty condition. Others, however, will attack trees which, so far as can be judged from superficial examination, are in an otherwise healthy state. The interaction of fungi and insects as yet has been but little studied in forestry practice in New Zealand, and it is certainly probable that in some cases the susceptibility of the tree to insect-attack has been increased primarily by the action of a fungus.

P. radiata is a native of Monterey, California, and has been widely planted not only in New Zealand, but also in Australia and South Africa.

The insects discussed are divided into two groups, the first of which consists of insects introduced into the Dominion, and the second of those indigenous to it. All the insects are described in literature, so that it is not intended to redescribe them in this paper. In many cases their association with *P. radiata* in this country has not, however, been previously noted.

INTRODUCED INSECTS.

Sirex noctilio Fabr.

Considerable perturbation was caused some three years ago by accounts of the depredations of a species of *Sirex* which was then considered to be *S. juvencus* L. It is now apparent that *S. noctilio* Fabr. is the common species in this country. The question of the identity of these two species is hardly in a satisfactory state, the characters being liable to great variation. Thus Chrystal and Myers(1), upon the authority of Waterston, state that *S. juvencus* is merely a variety of *S. noctilio*, but more recently Chrystal(2) includes a section by Waterston in which both are treated as distinct species and gives the following characters for their distinction:—

Females—

- | | |
|--|---------------------|
| Antennae wholly infuscated or black; cornus sub-equilateral; impression on tergite ix distinctly transverse; sheath distinctly shorter than tergite x | <i>S. noctilio.</i> |
| Antennae with scape (whole or part), pedicel, and 3-5 normal funicular joints clear testaceous or ferruginous; cornus elongate triangular; impression variable, never distinctly transverse; sheath and tergite x subequal | <i>S. juvencus.</i> |

Males—

- | | |
|---|---------------------|
| Apex of abdomen from the 8th segment black with (more or less) submetallic reflections; all femora darkened, and in the hind legs black except narrowly at apex; first transverse brachial nervure generally incomplete | <i>S. noctilio.</i> |
| Apex of abdomen and all femora ferruginous (the contrast between femur and tibia striking in the hind leg). Antennae basally rufescent or pale; 1st transverse brachial nervure incomplete | <i>S. juvencus.</i> |

From the above characters the whole of the writer's specimens are *S. noctilio* as are those in other collections which have been examined.

General accounts of the insect have been given by Miller(3) and Clark(4), and since that time the writer has carried out extensive field investigations in both Islands. *S. noctilio* is established in all parts of the Dominion, and attacks other exotic conifers in addition to *P. radiata*. The attack is noteworthy upon badly suppressed trees, and those which have suffered from breakage or fire. With regard to the latter, if the tree has been killed and thoroughly dried out, the attack does not appear to succeed. Other predisposing factors to attack are severe infestations of *Chermes pini* Koch, and, possibly, damage by a fungus. In the writer's experience, a thoroughly thrifty tree is not successfully attacked. However, the condition of many plantations is by no means good from a silvicultural viewpoint, and, as New Zealand possesses no Siricids itself, the activities of *S. noctilio* cannot be ignored. The nature of the infestation in a stand of *P. radiata* is often of a scattered nature, and it would appear that the condition of the tree, particularly as to moisture content and quality, is of considerable importance. A certain degree of moisture content is essential, and this in turn may be connected with a fungus similar to that isolated by Cartwright(5).

Of the insects parasitic upon *Sirex* sp., the introduction and distribution of *Rhyssa persuasoria* L. has already been carried out. Biological control, however, should not be looked upon as the sole means of checking the insect, but rather as an auxiliary measure, to be used in conjunction with careful management and timely silvicultural operations.

Chermes pini Koch.

The effect of *Chermes pini* is particularly marked when combined with poor or unfavourable site conditions. A severe attack leads to marked diminution in growth, malformation of the stem and branches, defoliation, and in some cases the death of the tree. The infestation is, as a general rule, very scattered, and is particularly noteworthy at times in connection with newly planted stands. The fact that a severely infested tree may be frequently found in close proximity to other non-infested trees would show that the ability of the insect to spread is not great. The biology of the insect under New Zealand conditions has not been intensively studied, and the writer has not (with one exception) been able to record its presence on any tree other than a species of the genus *Pinus*. It has not been found upon *Picea*, and the cycle embracing *Picea* and *Pinus* does not at present occur in New Zealand. The behaviour of the winged forms of *Chermes* is receiving attention.

Predatory insects associated with *Chermes pini* are *Micromus tasmaniae* Walk. *Protobiella zelandica* Till, and *Syrphus novae-zelandiae* Macq. Their occurrence is infrequent.

Hylastes ater Payk.

This European bark-beetle will be the subject of a separate paper to be published by the writer. The beetle breeds in the roots, stumps, and logs of *P. radiata*, and in the adult stage attacks and kills newly planted trees by eating the bark tissues, mainly in the region of the ground-level (fig. 1). It is a serious pest in one district, and is found in both the North



[E. S. Kirby, photo.

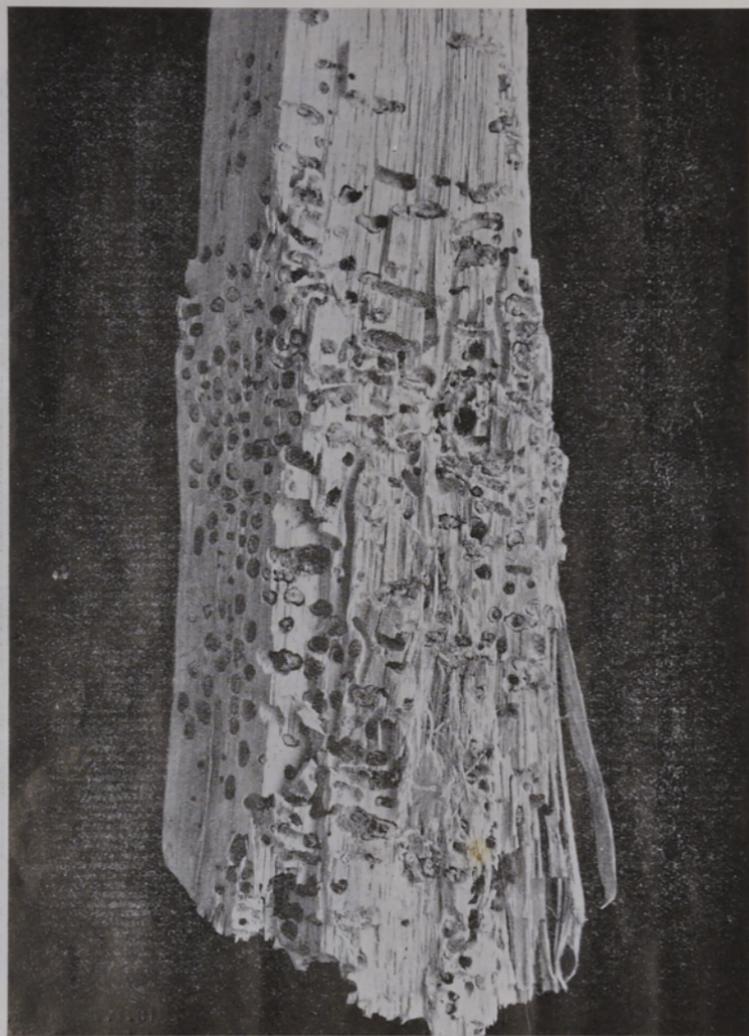
FIG. 1.—Newly planted tree killed by *Hylastes ater*.



[W. C. Davies, photo.

FIG. 2.—Burrows and exit-holes of *Ernobius mollis*.

Inset—Insects.

FIG. 3.—Damage by *Pachycotes ventralis*.

[W. C. Davies, photo.]

and South Islands. Owing to the fact that most of the stands are pure, and it is proposed to clear cut and replant them, on a very short rotation in some cases, the insect is likely to be of serious importance in the future.

Ernobius mollis L.

Ernobius mollis, a European beetle, is found in the bark of dead standing trees in both Islands, and is particularly prevalent in burned timber. The larvae construct burrows solely in the bark, or occasionally, when the bark is thin, also in the outer surface of the wood (fig. 2). After pupation the adult cuts a small round exit-hole in the surface of the bark. The status of this insect in Europe appears to vary considerably; so far in New Zealand it has not been of anything but a secondary nature.

Desiantha maculata Blackb.

An isolated case of the attack by this weevil upon seedling plants in a nursery is recorded. The weevil is recorded from fruit-trees and vines in Australia, but has not been reported attacking orchard stock in New Zealand. Its occurrence in the Auckland District, however, was undoubtedly due to the presence of a large orchard close to the nursery site. The orchardist had noticed the weevil, but, owing to the very slight damage caused, had not reported its appearance. The adult weevils attacked the seedling pines at ground-level, causing slight loss; the larvae also were found in the seed-beds, but were causing little or no damage.

Heliothrips haemorrhoidalis Bouché.

Feeding on a very wide variety of plants, this introduced thrip occasionally attacks the young needles of *P. radiata*. Its occurrence is confined to warm districts of the North Island. A second species of thrips is found beneath the bark of dead trees, especially in moist situations, where it feeds on decaying material. This species is awaiting identification.*

INDIGENOUS INSECTS.

Psepholax coronatus White.

This weevil is found attacking dead standing and fallen trees in the North Island. Its entrance burrow appears not unlike the exit-hole of a small specimen of one of the *Sirex* species at a glance, but closer investigation soon determines the point.

Pachycotes ventralis Sharp.

A common native bark-beetle, *P. ventralis*, is found, particularly in the Rotorua district, infesting fallen timber, in which it occurs in large numbers at times. Timber of a high moisture content is chosen, and a complete honeycombing effect is found with a severe infestation (fig. 3). So far the damage has been secondary, but the insect may become of more serious importance owing to the ease with which it appears to have adapted itself to new conditions.

Platypus douei Reich.

P. douei is found in both Islands, but is more plentiful in the North. It attacks standing dead and dying trees and fresh stumps. Burned timber is favoured, a particularly severe infestation being noted in the Wairakei

* Dr. G. D. Morison, of Aberdeen, Scotland, has provisionally identified this species as *Haplothrips corticis* DeGeer.

FIG. 4.—Damage by *Calotermes brouni*.

[W. C. Davies, photo.]

district. The fine shredded material resulting from the boring of the entrance-tunnel collects in heaps at the base of the tree or lodges in the crevices of the deeply fissured bark, and is a characteristic feature of the attack by this insect.

Pycnomerus sophorae Sharp; *Ulonotus antarcticus* White.

The connection of these insects with *P. radiata* is of particular interest in that beetles of the family Colydiidae are associated with the native forest and tend to die out as the forest is destroyed. Imms(6), in discussing this family, states: "Sharp remarks that the species exhibit great diversity of sculpture and clothing, and are mainly restricted to the primeval forests. They disappear entirely when these are destroyed. New Zealand has produced 170 species, as compared with 19 found in Britain."

P. sophorae is found, plentifully at times, under the bark of stumps in both Islands; *U. antarcticus* is less common, and it will be of interest to note how many species of this interesting family will escape destruction by changing their association from the native to the exotic forests.

Torostoma apicale Broun., *Phloeophagosoma* sp., *Inosomus rufopiceus* Broun., and *Euophryum porcatum* Sharp.

These small weevils are found under the bark of dead or dying standing trees, or in stumps or logs. They occur, at times, plentifully, and mainly in the North Island.

Prionoplus reticularis White.

The largest of the native Cerambycids is commonly found in dead standing trees, logs, and stumps. It is popularly known as the huhu beetle, and is often found in burned timber, the charring of the bark being no deterrent to attack. The eggs are laid in batches beneath the bark, and the large yellowish larvae construct galleries in the wood. The insect is beneficial to a certain extent, in that its extensive feeding materially assists the decay and disintegration of dead timber. The insect will attack the dead portions of living trees. This dead tissue occurs in trees which are over-mature, and are consequently dying. The habit of the insect in attacking these portions gives rise at times to the erroneous idea that the insect is the prime factor responsible for the condition of the tree.

Navomorpha sulcatus Fabr.

The attack of this longhorn beetle has been noted fully by Miller (*l.c.*), and occurs mainly in the North Island. The wide range of hosts, including native trees, apple-trees, and *P. radiata*, is of interest.

Hexatricha pulverulenta Lac.

For the definite connection of this insect with *P. radiata* the writer is indebted to Mr. L. J. Dumbleton, who will be publishing an account of his observations. The beetle is found in dead standing and fallen timber, and is particularly plentiful in the Nelson District of the South Island.

Oeceticus omnivorus Meyr.

The bag-moth is commonly found upon *P. radiata* in both Islands. The biology of the moth is of interest, and has been described by Hudson(7). Parasitic insects associated with the moth have been listed by Gourlay(8),



who records *Phorocera feredayi* Hutt., *Phorocera marginata* Hutt., *Phorocera nefaria* Hutt., and *Echthromorpha intricatoria* Fabr.

Some damage is caused by the larvae feeding upon the needles, but the amount of the damage is slight in all cases.

Tortrix excessana Walk. ; *Otenopseusis obliquana* Walk.

These two tortricid moths cause considerable damage at times to young stands in both Islands. The webbing-together and destruction of the foliage, in severe cases, leads to the death of the young tree. Particularly marked is this in newly planted stands which are not yet thoroughly established and are contending with temporarily unfavourable local conditions. The attack upon larger trees is of frequent occurrence, but is of less serious consequence. Sporadic outbreaks of both species occur when local climatic conditions are favourable to the moths. *Trichogramma minutum* Riley has been reared by Gourlay from the egg-masses of *Tortrix excessana*, while other undetermined parasites of both species occur.

Tortricid larvae are also found boring into the stems of young shoots, and probably one or both of these species are concerned. The point, however, requires to be determined definitely, as a third species may also be involved.

Calotermes brouni Frogg.

This species of indigenous termite attacks standing timber which is dead or partly dead (fig. 4). The attack has been noted in the North Island, where, owing to the similarity of the damage, it is confused with the more dangerous Australian termites which are sometimes brought into New Zealand in timber. *C. brouni* is found infesting many native and at least two other introduced timber trees. Over-mature trees and those having dead portions of the trunk or limbs are subject to attack.

Eucolaspis brunnea Fabr.

Popularly known as the bronze beetle, this native Chrysomelid is well known as an orchard pest. The larvae live in the soil, and the adults, which have a wide host range, occasionally feed upon the needles of young *P. radiata*, causing at times severe defoliation. The damage is most commonly met with in the North Island, where small localized outbreaks occur at times.

Odontria sp.

Species of *Odontria*, or grass-grubs, cause some loss in nurseries, where the larvae attack seedling plants. The total annual loss, however, is usually not large, although sporadic outbreaks have caused alarm. Seedlings of other exotic conifers are also attacked. The beetles oviposit in the seed-beds, and the larvae feed upon the roots of the young plants. They are common, and at times serious, agricultural pests, when their control upon a large scale is by no means simple. The adult beetles are found, upon occasions, attacking the needles of older trees.

Stethaspis suturalis Hope.

The larvae of this large green chafer beetle have been found damaging roots of newly planted trees, particularly where the site is of a sandy nature. No serious loss has been occasioned, however, by this insect.

CONCLUSION.

From the foregoing brief notes, which record the commoner insects associated with *P. radiata*, the two types found—namely, the indigenous insects which have extended their host range to include this tree, and the introduced insects—are clearly defined. With regard to the former group, it is due in part to the fact, perhaps, that the native flora includes only two pinaceous forest trees, and neither of these in the genus *Pinus*, that the list is not greater; and, further, that some groups usually found in forested areas, such as the Ipoidea, are very poorly represented in New Zealand, and others, such as the Tenthredinoidea, are entirely absent. On the other hand, the list of introduced insects is growing steadily, as may be expected. The Dominion, while enjoying a large degree of geographic isolation, must, through its volume of trade with other countries, from time to time unwittingly import insects infesting both raw and manufactured products, not all of these introduced insects, fortunately, becoming established. The forester can do a great deal to help safeguard the exotic forests, and much will depend in the future upon the wisdom and promptness with which the various phases of forest-management are carried out. Forest entomology is closely linked with silviculture, and neglect of the latter may produce problems in the future with which the forest entomologist is unable to deal without scrapping the whole of the working-plan which should form the basis of management.

The fact that *P. radiata*, in common with many other trees which are taken from their native habitat and planted in a new environment, maintains a fast rate of growth upon many sites is well known. The apparent adaptability of this tree, which has been established upon sites the soil of which ranges from pure sand to impacted glacial shingle, has led in some cases to a belief that, so far as the usual methods of silviculture are concerned, this tree can succeed with the minimum of attention. Such an attitude, especially in dealing with large pure stands, is one that cannot be adopted with safety. Already the loss of increment in some areas, due solely to neglect, is severe; and, further, the condition of some stands has been rendered such that an outbreak of a serious forest insect pest would be a difficult matter with which to cope. Measures designed to minimize the chance of such an outbreak should be adopted where future forest operations are concerned.

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