

The diary showed a decrease in average weight of from 2.7 lb. in 1888-9 to 1.05 lb. in 1891-2 and a fairly continuous decline from 0.94 lb. in 1903-4 to 0.54 lb. in 1929-30.

A similar history is found in those forested regions which are being opened up, and is clearly due to improved access enabling a greater death-rate of the fish which reduces average age, and, consequently, average weight.

The conclusion which is forced on the student is that, whatever effects deforestation has had upon streams, it has not significantly brought about starvation of trout through destruction of aquatic organisms and their habitat. It has, however, acted on the fish stock in places by allowing access to the streams and settlement of human populations, both of which play an important part in bringing about changes in the character of fish stocks.

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PINHOLE AND SHOTHOLE BORERS.

By A. F. CLARK.

The writer does not intend to give an account of any one particular investigation but rather to give information regarding these borers which has resulted from more detailed work.

The term "pinhole" or "shothole" borer is applied in this Dominion to those insects responsible for the formation of small round tunnels, often in living trees, and which are lined with blackish material, the immediately surrounding wood being discoloured to a greater or lesser extent.

The damage caused by these borers has been noted for many years but has lately become of increased importance as the export trade in native timbers, particularly beech, has developed. Fortunately the number of species of insects responsible for the damage is not large but their concentration in relatively small areas and in large numbers, causes the occurrence of considerable loss.

Description of Borers.—The insects responsible for the damage are small, brown beetles which belong to the genus *Platypus*. Elongate and varying in size from 3-16 to $\frac{1}{4}$ inches in length, they are shiny, highly polished and their ability to fly long distances is noteworthy. In some localities the beetles are known as “flies.” The hind wings are used for flight, the front wings being hard and merely stretched out horizontally and serve as covers for the hind wings when the beetles are at rest. The jaws are very stout, toothed, and well adapted for boring, and the neck very flexible. The feet are slender and as the name of the beetles states, somewhat flattened.

The sexes vary considerably in some species, both the formation of the head and the development of the elytra or wing covers showing marked differentiation. This has led, unfortunately, to the male and the female being described and named as different species in some cases.

The Tunnels.—The tunnels bored by the beetles are usually straight but they may curve and it is possible for two tunnels thus to become connected. The diameter of the tunnels, which varies with the species of beetle concerned, is usually from 1-16 to $\frac{1}{8}$ inches, and is sufficiently large to allow the insects to move about freely inside. As a general rule the sexes work together, the female preceding the male and doing the actual boring, the male coming behind keeps the tunnel clear by ejecting the borings, pushing them out with the feet and with the ends of the wing cases which are adapted for this purpose. Thus during boring operations a fine stream of shredded wood is thrown out and the presence of this material which is very conspicuous is a certain indication of *Platypus* attack. Female beetles will be found at times boring alone, but pairs are generally the rule. The length of the tunnel varies but it will extend from the outside of the tree through to the heart even in large trees.

General Life-history.—The female insect deposits her eggs loosely in the tunnel, often in clusters at the far end and upon hatching a very tiny, legless larva is produced. The newly hatched larvae are very active and crawl up and down the tunnel with a peculiar head-and-tail movement, feeding within the tunnel. Growth is fairly rapid and when fully fed the larvae bore short tunnels at right angles and on either side of the mother tunnel. These short tunnels are situated towards the end of the mother tunnel and are just sufficiently long comfortably to accommodate the fully fed larva which now turns to the pupa. The pupae are found with the head pointing

inwards and upon completion of pupation the newly emerged beetles crawl out into the main tunnel. From the main tunnel they emerge usually in bright sunny weather and disperse. It is not known exactly where mating takes place ; it may be in the tunnel or upon the outside bark. The main emergence period of the adults is in the three months, December, January and February.

Fungal Association.—The borers are known as “Ambrosia” beetles in that they do not feed upon wood but upon a fungus. The fungus which is carried into the main tunnel by the parent beetles, grows upon the walls ; the actual method whereby the fungus is transported appears to vary, but it may be transported upon the bristles of the head, the mouth, or the feet, the wood providing the fungus with a suitable medium for growth. The young larvae in their wanderings up and down the tunnel crop the fungal growth thus obtaining food and preventing blockage of the tunnel. Occasionally broods of the insect are killed by a too rapid and profuse growth of the fungus which completely fills the tunnel. In order to provide a suitable medium the wood must contain a fairly high percentage of moisture in the form of sap, and thus thoroughly dry timber is not a suitable medium.

In many cases it is found that the wood tissue in the vicinity of a tunnel is discoloured, and when seen in section the tunnel is in the centre of a lens shaped area. This discolouration is caused through the presence of fungal hyphae in the wood. The discoloured zone varies in extent according to several different circumstances. There is evidence that one species of native *Platypus* can develop without the aid of a fungus association and in this case the form of tunnel differs very widely from that usually constructed ; this, however, is an exceptional and rare occurrence and may be due to excessive quantities of available sap in the timber.

Effects of Borer Attack.—It is a matter of frequent comment that apparently healthy, well-growing trees when fallen and sawn up show at times more or less extensive borings, which do not reach the outside of the tree. During the long life of a forest tree the chances of its becoming damaged, or, for a period, unthrifty, are very large. During periods where unfavourable conditions within the tree itself exist, particularly where injury takes place, attack by the borers is common. The tree recovers its normal vigour and successfully resists the attack, but nevertheless the tunnel left by the adult beetle remains. Larval tunnels which show that the beetles were able to use the tree as a breeding place are generally absent.

It is not possible to tell for certain whether a standing tree will show pinhole or shothole borings in many cases. If the attack is recent the frass or ejected wood is clearly visible, but in the case of an old attack where the bark has completely reformed, there is no means of detection.

Summary.—Pinhole and shothole borers must be looked upon as forest insects whose great increase in numbers is inevitably brought about by milling operations, particularly in Southland. The type of damage and method of attack is described and the loss caused is serious. An improvement in stacking methods which will isolate the timber for the most dangerous months of the year appears to be the most promising method of dealing with the problem.

SILVICULTURAL NOTES ON AN OVERMATURE BEECH FOREST.

By T. T. C. BIRCH.

The suppression of regeneration by overmature seed-bearers is well illustrated in the mixed beech forests on the slopes of Mt. Ruapehu. In Provisional State Forest No. 74, at an altitude of approximately 2,750 ft. a silvicultural unit was established during 1936 to coincide with a good seed year*. An area of 8.64 acres was demarcated, stock-mapped and classified as follows :—

	ac.	%
Area under canopy of overmature red beech ...	7.74	77.6
Area of beech pole-stands	1.36	22.4
Total area of virgin forest in Unit ...	6.08	100.0
Cut-over area prepared for seed reception ...	2.56	
Total area of unit	8.64 ac.	

This unit is typical of the surrounding forest which is dominated by 10-15 overmature red beech (*Nothofagus fusca*) per acre, fairly evenly spaced and forming a dense canopy. The almost complete absence of the middle age classes of merchantable red beech is characteristic of this forest. Beneath the veteran canopy trees (average D.B.H. 50-60 ins. and 100-150 ft. high), a lower storey of suppressed and malformed silver beech (*Nothofagus Menziesii*) usually occurs ; in this locality silver beech, unlike red beech, is outside its optimum range and by reason of its heavily branched and short-boled form, is usually an undesirable component of regeneration groups. Matai (*Podocarpus spicatus*) miro (*Podocarpus ferrugineus*) and Hall's totara (*Podocarpus Hallii*) also occur sporadically.

Although the shade cast by the upper canopy of veteran red beech is considerable, it is rarely sufficient to prevent the germination of beech seed, young seedlings being found in varying densities throughout the stand, usually beneath a dense ground covering of *Coprosma tenuifolia* and *C. foetidissima*. Groups of regeneration

* A note on the 1936 Seed Year appears elsewhere in this issue. [Ed.]

occasionally reach the pole stage but become suppressed and stagnant as they approach the upper canopy ; more commonly, however, beech regeneration, in all but the seedling stage, is absent and *Coprosma* thicket completely dominates the forest floor. The proportion of virgin forest in this experimental unit, dominated by overmature red beech, is 77.6 per cent ; the remaining 22.4 per cent. being occupied by sapling or pole groups which develop rapidly in the gaps created by the fall of veteran seed-bearers ; these regeneration groups are approximately even-aged and are of great density, suppressing all other ground vegetation.

The above proportions are probably representative of the greater part of this forest which may be described as in a stagnant condition.

Assuming that maximum productivity is the object of future management, it is evident that the slow natural process of displacement of veterans by wind and decay must be accelerated by silvicultural treatment, the guiding principle being the release from suppression of young regeneration. Alternative measures are :—

(1) Improvement fellings, involving the removal of veteran seed-bearers.

(2) Killing of veteran seed-bearers *in situ*. (ring-barking or poisoning).

Portions of the unit were subjected to (1) and (2) respectively, and although no discussion on the merits and demerits of these treatments would be complete without reference to the utilization of improvement fellings (and alternatively the waste of produce inseparable from ring-barking or poisoning), these preliminary notes will, on the plea of brevity, be confined to a few silvicultural issues.

(1) **Improvement fellings.**—The felling of ten overmature red beech in an area of approximately 2 acres did not cause a great deal of harm to surrounding regeneration due partly to careful selection of the direction of fall and partly to the stagheaded nature of the crowns. In spite of all reasonable precautions, however, splitting, stacking and the extraction of timber by caterpillar tractor caused very considerable damage to the undergrowth, in many sites laying bare the mineral soil. Consequently it was decided to leave standing a small proportion of the seed-bearers to restock the denuded areas ; this precautionary measure was fully justified for in the following spring a dense crop of beech regeneration was in evidence in the clearings. It appears to be certain that in the absence of a seed year immediately following an improvement felling of this type, serious obstacles are placed in the way of an adequate restocking of beech regeneration. Thus, adjoining the unit a number of large red beech were felled for firewood in 1932 ; at the present time (4 years after this operation) the clearings are occupied by a dense thicket of fern (*Pteridium esculentum*) lawyer (*Rubus australis*), Californian thistle and many other exotic weeds, whilst beech regeneration is scarce and