NATURAL REGENERATION OF EXOTIC SPECIES IN HANMER SPRINGS DISTRICT.

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INTRODUCTION.

The following observations were made in March, 1940, in the Hanmer Springs district, North Canterbury.

In none of the areas investigated was any preparation made to procure or encourage regeneration; it had established itself in competition with the natural conditions obtaining. The fact that investigational areas had to be selected is because in the majority of places the conditions prohibit regeneration; e.g. very dense mats of twitch grasses on open spaces, swampy areas, regular ploughing of firebreaks, etc.

SPECIES INVESTIGATED.

No regeneration was found of the following: *Larix leptolepis*, *Picea stichensis*, *Pinus banksiana*, *P. murrayana*, *P. ponderosa* var. *scopulorum*, *P. strobos*, *Sequoia sempervirens*, *Thuja plicata* and *Tsuga heterophylla*.

Of the following, regeneration was found, but not in sufficient quantity to warrant a special study: *Chamaecyparis lawsoniana*, *Picea excelsa*, *Pinus austriaca*, *P. pinaster* and *P. ponderosa*.

Regeneration of the following was more or less profuse: *Abies pectinata*, *Larix decidua*, *Pinus laricio*, *P. muricata*, *P. radiata*, *P. sylvestris* and *Pseudotsuga taxifolia*.

THE DISTRICT.

Forty years ago the Hanmer plains were treeless with only patches of poor quality native *Nothofagus* forest in the gullies seaming the encircling hills. The plains are natural grasslands which have been grazed since 1858 by pastoralists. Broad shingly rivers meander across it, constantly changing the boundaries of the plant colonised areas.

The cover was tussock and other native grasses with the usual admixture of manuka (*Leptospermum scoparium*), wild irishman (*Discaria toumatou*), N.Z. flax (*Phormium tenax*), tutu (*Coriaria ruscifolia*) and bracken (*Pteridium aquilinum*). The advent of settlers naturally brought changes with the establishment of various English grasses and the intrusion of gorse, broom and sweet briar. All of these flourished and would have conquered but for continuous crushing by stock.

On such a site Hanmer State Forest was established.

CLIMATE.

The latitude of Hanmer plains is 42°S. and the altitude of the forested land ranges from 1,100 ft. to 2,800 ft. above sea level. The climate is similar to that of most inland plains on the east of the main divides, with slight modifications for latitude and altitude.
Rainfall is not excessive, being only 46 inches (average for 39 years) which falls on 140 days in the average year.

Snow falls on an average of 18 days and has reached as much as 25 days. The falls are sometimes sufficiently heavy to cause some snow-throw.

Humidity is 70% (average last 5 years) ranging from 58% to 82% (average of annual minima and maxima at 9 a.m.).

Temperature. The averaged annual minima and maxima (5 years) are 14.2°F. and 89.3°F. respectively. The former occurs usually in June—August and the latter in December to February. On an average of 139 days (in 5 years) frosts have been recorded.

Wind. The prevailing wind is from the north-west, but the number of calm days per annum is 150 (in 5 years). On an average of 9 days winds of gale force are registered. The most damaging gale on record occurred on the 9th August, 1938, when, coming after a heavy fall of snow just thawing, it caused considerable wind-throw.

Geology and Soil of Hanmer Plains.

The underlying rocks are greywacke. The soil is derived either from the decomposition of greywacke or from a superimposed gravelly alluvium.

The free soil is generally a light clay-loam frequently gravelly and varying up to 6 inches in depth. The subsoil is similar but more or less compacted. Humus is scarce and in some places absent.

The topography varies from flat to undulating and on to steep hilly country.

Ground Cover.

There are a few places so poor as to have little to no cover at all. These sites are equally uninviting to the regeneration of trees.

On the remainder, the types of cover are various ranging from accumulations of duff up to 4 inches thick with no plant components (under the denser stands) to very dense mats of twitch grasses with or without scrub (in the open spaces).

The competing plant growth was generally: grasses (sweet vernal, twitch, yorkshire fog, fescue, timothy, cockfoot, crested dogstail and danthonia), briar, manuka, discaria, bracken and leucopogon.

The degree of success against such conditions is amazing. All, except Douglas fir, were found coming away amongst partially open manuka scrub and also through fairly dense grass cover where there is no accumulation of previous years growth.

In one stand of mixed P. laricio and P. ponderosa was a dense crop of P. laricio seedlings up to 3 inches high but protruding from the duff only 1 inch. There was no sign of any advance from this stage, which may be an annual occurrence. The seed bed was suitable for germination but not for survival, the contributary causes being
insufficient light, or inability of the roots to get deep enough in the soil before the dry conditions developed.

**Density and Spread.**

Densities in the plots counted were various but all were above normal for planted stock. They ranged up to 6,520 per acre for *P. muricata* in Hanmer S.F. and to 20,420 per acre for *P. sylvestris* at Glynn Wye. In Hanmer S.F. the average number of years taken to reach the densities quoted was 5 to 6 years. Ages were read by counting the number of distinct whorls in the case of pines and in larch by the number of nodes.

The spread of regeneration varied with the species and was in the following order, commencing with the greatest: *Larix decidua, Pinus laricio, Pseudotsuga taxifolia, Pinus sylvestris, P. muricata, P. radiata* and *Abies pectinata.*

In the plots investigated, the distance from parents over which serviceable regeneration was found, can be summarised as follows:

- *Larix decidua* 2 chains. (Limited by cliff-edge).
- *P. laricio.* 3 chains.
- *P. muricata.* 2.5 chains.
- *P. sylvestris.* 7 chains. (Parents on knob—regeneration on slight down slope).
- *Ps. taxifolia.* 2 chains. (Under shelter where success was limited by occurrence of gaps).

**Health.**

All species were free of disease and also of pests, except *Chermes,* which was found on *P. sylvestris* badly and on *P. muricata* and *P. laricio* slightly. However, since this can frequently be regarded as a "childhood" disease, the two species last named may be expected to overcome it.

A small proportion, rarely exceeding 2%, had double-leaders, or were otherwise malformed. In view of the excessive stocking found in most places investigated these malformed specimens would be removed in the first thinnings, leaving a clean healthy stand.

**Seed Years.**

Almost no data are at hand on the occurrence of seed years. However, there would seem to have been one in 1937, which is deduced from the large quantity of 3 year stock found. By the same deduction there may also have been one in 1931 or 1932; there is a large number of 8 or 9 year trees.

**Details of Species.**

*Abies pectinata.*

There is none of this species in Hanmer S.F., but there are a number scattered here and there on the Conical Hill Reserve overlooking Hanmer. The trees are about 40 years old and are fairly widely spaced, being planted for scenic effect.
Regeneration is profuse and is estimated to be at least 15,000 per acre. It has become established in competition with low-growing weed growth; only here and there is the soil exposed. The quantity of duff is low because of the somewhat wide spacing of the trees, which are of mixed species.

No cones are present on the parents this year.
The soil is a clay-loam 6 inches deep. The subsoil is clay.

**Larix decidua.**

Natural regeneration of this species is to be found everywhere in Hanmer S.F. wherever there has been or is sufficient light and dry ground. It has travelled as far as \( \frac{3}{4} \) mile in a S.E. direction from the nearest possible parent. Between this and the parent there occurs varying degrees of densities of stocking and success has been achieved through several types of ground cover. The latter include: (a) fairly dense mats of grasses, including twitch and (b) moderately thick manuka and discaria scrub. Where it has become established it is exceeding all others in height growth.

Densities per acre on plots examined: (a) 4,680 on a firebreak, (b) 2,332 on a firebreak (with 484 self-sown *P. laricio*) and (c) 640 invading an acre planted with 680 *P. ponderosa*, the former now overtopping the latter by several feet.

**Pinus laricio.**

This species is the most prolific regenerator in Hanmer S.F. and is second only to *Larix decidua* in distance away from parents at which regeneration occurs. It is to be found everywhere including planted areas where complete canopy has not yet been formed. In the latter areas it is becoming aggressive and promises to beat such species as *Pinus ponderosa* (both true and var. *scopulorum*) and *Picea excelsa*. In height growth it is itself being beaten by *Larix decidua* but since it is more shade tolerant it will probably survive this competition. Cone bearing is profuse and the cones open on the trees. The species seems remarkably suited to Hanmer.

Density per acre, 2,320 amongst grasses, manuka, discaria and brier.

**Pinus muricata.**

There are two types present in Hanmer S.F. where this species has been used chiefly in marginal rows. The regeneration present in some parts seems to be chiefly of the better or "blue" type. It shows very aggressive tendencies, promising in one instance to smother a crop of *Ps. taxifolia* planted 10 years ago when the ground was clear. It forms the densest crop of regeneration present in Hanmer, but is quite localised. The species cones profusely but only those of the "blue" type seem to open readily on the tree in this district.

Density per acre on the plot examined was 6,520 (among 320 planted *Ps. taxifolia*).
**Pinus radiata.**

In spite of the widespread presence of this species in marginal rows in Hanmer S.F. there is generally remarkably little regeneration. On the firebreaks there are only a few scattered seedlings. However, there is one area where regeneration is profuse and that is at the scene of a windthrow. The windthrown trees have been extracted and converted into firewood, leaving the brush on the ground. No burning was done. The surface duff has been disturbed by these operations and the soil is exposed here and there all over the area. In places a ground cover of Sorrel (Rumex) and thistle has sprung up, but the young trees are showing through it.

The parents were 23 years old at the time of the August, 1938, blowdown. Cones of this species in this district frequently remain closed on the trees for a number of years, presumably because of insufficient heat to open them. But when the brush was left on the ground the higher ground temperature must have been sufficient to open them.

Densities per acre on plots: (a) 2,960, (b) 4,320 and (c) 3,520. The heights of these 1 year seedlings ranged up to 20 inches and averaged 3 to 4 inches.

**Pinus sylvestris.**

This species does not occur in Hanmer S.F., but a small plantation about 24 miles away on the western extremity of Hanmer plains was examined. The trees are of a poor type and no attempt should be made to perpetuate them; nevertheless they form an interesting colony.

The plantation has seeded profusely and there is now a larger area of regeneration than of parent trees. The young trees are in some cases white with *Chermes* and malformed trees are frequent. There is no regeneration under the parents where the ground cover is dense cocksfoot and other lush grasses. This area looked as though it was used as a holding-paddock for stock. The majority of the regeneration lies to the S.E. of the parents and most of it is fenced off from stock. The ground cover here contains notably the heath *Leucopogon fraseri*, which is absent under the parents. Cone bearing is profuse and the cones open on the trees. There is a good example of the increased spread of regeneration owing to the increase in height of the parents.

Density per acre: 20,420.

**Pseudotsuga taxifolia.**

Regeneration of this species occurs occasionally in many parts, some of them surprisingly remote from parent trees. There are, however, not many old stands in Hanmer S.F. and they are too dense for regeneration to survive under them. Also this denseness has a retarding effect on seed production.

One area is very interesting. It is almost surrounded by *P. austriaca* which has been thinned and, where there is still an
opening in the canopy, the Douglas fir seedlings have succeeded even through a cover of up to 2 inches of duff. Cones are fairly profuse on marginal trees.

Densities per acre: 2,880.

Silviculture.

From this investigation the use of natural regeneration for the re-establishment of the following species seems practicable and desirable:

* Larix decidua, Pinus laricio, P. radiata and Pseudotsuga taxifolia.

*Larix decidua, P. laricio and P. radiata* could be clear-felled in strips, commencing on the lee side of stands and progressing towards the north-west. None of these species require shelter and their seeds can be relied upon to spread across 2-3 chains strips. Since the seeding is to come from adjoining trees, the brush from the clear-felled strips can be piled over the stumps and burnt. This will reduce the population of *Hylastes* and incidentally add potash to the soil. The next strip in the compartment could not of course be felled for perhaps the next 5 or 6 years, until the first strip had been fully regenerated.

The incidence of *Armillaria mellea* may also prove to be an important factor in the future treatment of these species.

In the case of *Ps. taxifolia* a shelterwood is desirable and it is suggested that our poorer species (experiments or accidents, whichever they be) such as *Pinus austriaca* and *P. ponderosa v. scopulorum* could well be converted to the more valuable Douglas fir. Regeneration fellings (heavy thinnings) would have to be made and when the new crop was established then the remainder of the old crop (shelterwood) could be removed in one or two fellings as deemed most desirable. Some, at least, of the thinnings would be suitable either for firewood or for creosoted fencing material.

In each case, natural regeneration may have to be supplemented by some plantings in order to complete the stocking but on the evidence at present available the percentage of artificial regeneration would not be high.