THE RE-ESTABLISHMENT OF RADIATA PINE AT KAINGAROA FOREST
2. TAILORING METHOD TO SITE

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SYNOPSIS

On the basis of past experience and experimental work, radiata pine cutovers at Kaingaroa Forest are divided into five site classes which require distinct re-establishment procedures to ensure effective and rapid re-stocking. These site types are defined, and the re-stocking procedures applied to each are described. In an environment subjected to frequent staff changes, the value of such a written system is noted, but it must remain flexible and capable of change in the light of new knowledge and changing conditions.

INTRODUCTION

In an organization as large and complex as that of Kaingaroa Forest, which must carry the added burden of a high staff turnover, there is a considerable danger that experience and knowledge gained during any particular period may leave the forest with the staff involved with developing it. There is value, therefore, in laying down definite procedures for the operations most commonly carried out which ensure that experience gained now is incorporated in future work until such time as conditions or increased knowledge indicate need for change.

The rapid spread of logging into Matea and other southern parts of the forest, and therefore the necessity for re-establishment operations to be carried out on all site types found in the forest, has complicated the re-stocking process. It became obvious that there was a need for standard procedures to ensure that re-establishment was always tailored to sites in order to achieve satisfactory levels of re-stocking. This paper describes the system that was developed to serve this purpose.

RE-ESTABLISHMENT SITE CLASSES

In an earlier paper (Page, 1970) the history of re-establishment methods at Kaingaroa up to 1966 was outlined, and studies carried out between 1966 and 1969 were described in some detail. Altitudinal limits for various re-stocking methods had been obtained to a considerable degree of accuracy; slope limits, however, were rather more difficult to quantify. The adverse effects on country of limited slope are the ponding of cold air and the creation of frost lakes and pockets. When

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these form early or late in the season there is a danger that seedlings will not be sufficiently "hard" to withstand the low temperatures on flats and hollows. If we visualize cold air behaving like a liquid, it becomes obvious that its ponding will be caused by a combination of degree of slope and the position of that slope relative to the surrounding country. In other words, ponding of cold air is related to the general topography of the area, and this is illustrated in Fig. 1.

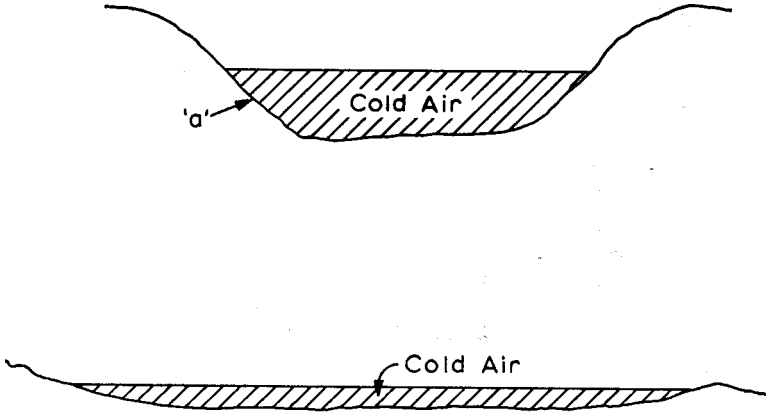

FIG. 1: *Two examples of ponding of cold air in plateau country.*

Thus, in certain circumstances, as illustrated by the point "a" in the upper diagram in Fig. 1, ponded cold air can lead to severe frost levels even where slopes are steep.

This whole question is basic to site classification in Kaingaroa Forest. In assigning a site class to a particular area of known altitude, likely air-drainage patterns are the main consideration. In the definition of classes a limit of 2½ degrees of slope has been adopted. This is intended rather as a guide than as an absolute limit, but it is noteworthy that Kirkland (1969) also considered this to be the minimum slope to allow adequate air drainage for successful establishment of Douglas fir seedlings.

For radiata pine, five re-establishment site classes have been recognized, and these are illustrated in Fig. 2, and described in the following section .

Class 1

Definition: Steep slopes (non-tractorable) logged by skyline, generally below 2,000 ft a.s.l. After logging these are typified by uneven scarification and distribution of slash; debris-filled gullies; and fast regrowth of competing vegetation. The old crop stocking was generally low, allowing establishment of an understorey of weeds. This, combined with the mild micro-climate, allows rapid re-establishment of shrubs and tree ferns.

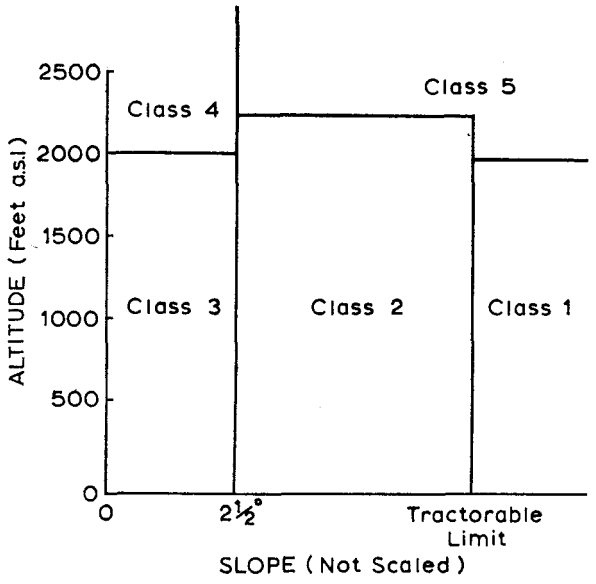

FIG. 2: *Site class definitions in terms of altitude and slope.*

Re-establishment procedure: Planting is undertaken as soon as possible after logging, using large tree stocks to ensure rapid growth and thus compete with other vegetation. Where no re-growth is evident, naturally occurring seedlings can be included as part of re-stocking. Aerial sowing has rarely been successful and is no longer carried out.

Class 2

Definition: Undulating or sloping country, with minimum slope of 2½°, below 2,200 ft a.s.l., logged by tractor or mobile hauler.

Re-establishment procedure:

(a) Felled in winter, when no natural regeneration can be expected; April to September inclusive. Areas are aerially seeded in the October immediately following logging. Supplementary planting is carried out during the first season after sowing, with the following prescription: Trees are to be planted at 6 ft × 6 ft except where a seedling is already present within 3 ft of a planting position. Some note must be taken of the size of existing seedlings, and the minimum size acceptable depends on local knowledge of sites. Where regrowth of potentially competitive vegetation is already present, or in frost hollows, seedlings under 3 in. in height are ignored. Some site preparation may be required in frost hollows, slash-filled gullies, etc.

(b) Felled in summer (October to March inclusive) when some natural regeneration can be expected. Supplementary planting is necessary to obtain desired stocking, and is undertaken in the following winter for areas felled in October to December, and in the second winter when areas are felled in January to March. Prescriptions used are those given under winter felling above.

Class 3

Definition: Flat country (less than 2½° slope) below 2,000 ft a.s.l. logged by tractor or mobile hauler.

Re-establishment procedure: The success of natural regeneration on these sites is difficult to predict; similarly for aerial sowing. Should there be any adverse factors such as grass invasion, poor logging clean-up, or complete enclosure of the cutover area by standing forest (forming thus a frost pond), these areas are treated as for Class 4. Where conditions are favourable they are treated as Class 2.

Class 4

Definition: Flat country (less than 2½° slope) above 2,000 ft a.s.l. logged by tractor or mobile hauler.

Re-establishment procedure: Slash is windrowed using crawler tractor with brush rake, and the area is planted with well-conditioned (wrenched) 1½/0 or 2/0 seedlings.

Class 5

Definition: Sloping country (more than 2½° slope) above 2,200 ft a.s.l.

Re-establishment procedure: Firm prescriptions have not yet been drawn up because little of this class of country has yet been logged. Results from natural regeneration and aerial sowing have been very variable, probably because of variations in weather at different seasons. Planting may be required, preferably after burning or mechanical preparation of the site, except in favourable years when natural regeneration may form at least part of the crop.

SIZES OF AREAS CLASSIFIED

When this system was introduced at Kaingaroa Forest, the problem immediately arose as to what was the minimum size of area which could be defined as an individual re-establishment site class. Frost hollows and flats range in size from several hundred acres to as small as one-tenth of an acre. It would be impracticable to treat individual areas as small as one-tenth of an acre individually but in practice quite small areas of site class 4 can be windrowed economically. Landings have to be deep-ripped to restore pro-

ductivity, and the machine that is used for this operation, since it is in any case transported to the site, can be used to prepare very small areas.

Perhaps the greatest danger from fragmentation of any particular cutover area into various site classes is the possibility of producing very small areas of a different age from the surrounding stand, thus complicating subsequent silvicultural operations. As a rule of thumb, a complete logging setting is perhaps the most practical measure of the minimum practical size of any age class. This does, of course, involve predicting the logging system that will be used 25 to 30 years hence — perhaps a dubious task.

DISCUSSION

Although the usefulness of such a prescribed system, where staff changes are frequent, has been stressed already, there is also a need for the system to remain flexible. It must be allowed to evolve as new data become available, and as conditions change due to the introduction of more intensive silviculture and new logging methods.

It is already possible to see the inevitable replacement of natural regeneration and aerial sowing with planting, so that the genetical quality of the crop may be improved by the use of orchard seed. Increased utilization of wood, and clear-felling of stands which have received intensive silvicultural treatment will result in cleaner cutovers (although there may be complications due to greater growth of understoreys). Soil cultivation is always likely to be required on the harder sites to obtain full even stocking and rapid early growth, but greatly reduced amounts of slash could allow the use of faster and cheaper machines than the present heavy crawler tractors and brush rakes.

Fire is already being used for clearing cutover land in Kaingaroa Forest and could prove a valuable tool, at least on the untractorable Class 5 sites. However, even if the technical and administrative problems were overcome, fire should be used with caution. In some countries where fire has long been used for slash burning, it is coming increasingly under criticism from people and organizations concerned with its effects on soil properties and atmospheric pollution (Dell and Green, 1968; Knight, 1964).

There is an urgent need for closer liaison between logger and forester, particularly if logging n New Zealand follows overseas trends towards complete mechanization and the use of integrated timber harvesters. Too often the cost and effectiveness of logging and re-establishment systems are considered in isolation. At some stage the two must be married, and cost and effectiveness evaluated for the combined operation and future silviculture. A new cheaper logging method is of little value if the savings are more than offset by expensive re-stocking. The effect of windrowing slash on future extraction thinning is an example of an interaction in the opposite direction.

The procedures outlined in this paper satisfied a current need at Kaingaroa but should in no way be regarded as anything but a stage in the development of more efficient forestry — a process which probably has no end.

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