NORTH ISLAND PROTECTION FORESTS*

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Summary
The main protection forests lie in the Eastern and Southern half of the island. On the pumice lands west of the volcanoes forest is not continuous and it is necessary to give consideration to tussock and scrub lands outside forest proper. Vegetation types are broadly correlated with climate and soils, and evidence is given of long-term changes operating at the present day but differing on greywacke and on pumice. Superimposed changes due to man and introduced animals are extensive and are causing a general deterioration of protective cover, but there is some evidence of the adaptation of vegetation to browsing.

This paper suffers from two limitations. In the first place opportunity has limited me to the eastern and southern portions of the North Island, though this includes most of the higher forest country; in the second such work as has been done here is only just passing out of the exploratory stage. Most of the last 25 years has gone merely in finding out the main distribution of species and the main vegetation patterns—it is only recently that it has been possible to consider the reasons for them. In preparing this paper I have been forced to the conclusion that we are not likely to solve protection problems until we have grasped the ecological problems that lie at the back of them.

Structure
Apart from the volcanoes, the high country of the North Island consists of upfolds of greywacke, principally along an axis from Cook Strait to East Cape. This nowhere exceeds 6,000 ft., and is in varying stages of dissection, but with a tendency to steep scarps bordering the east coast fault troughs. Pumice from the various Taupo showers has blanketed the central area, destroying the previous vegetation as recently as 1800 years ago.

Main Communities
It is immediately obvious that forest is not the sole plant cover of importance. With a timber line at 4,000 to 4,500 ft., considerable areas lie above forest; below the forest, wide stretches of pumice land are in process of being recolonised. Not only are such areas highly vulnerable to erosion and present urgent problems of control, but many of them lie within the boundary of State forests. I am interpreting "protection forest" in the widest sense to include both sub-alpine and pumice land vegetation above and below forest.

Forest Dominants

There are five main forest dominants; mountain beech (*Nothofagus cliffortioides*), silver beech (*N. menziesii*), and cedar (*Libocedrus bidwillii*), above 3,500 ft.; below 3,500 ft., red beech (*N. fusca*), and to a limited extent kamahi (*Weinmannia racemosa*).

The distribution of mountain and silver beech is clearly affected by climate. In the belt of low rainfall (40 in.) which crosses the island in the latitude of Napier, mountain beech is dominant. Where the rainfall approaches or exceeds 100 in. silver beech dominates, in the Tararuas (200 in. plus), East Cape (100 in.), with an isolated block in the Northern Kaimanawas (Poronui, 77 in.). From the Huiau to East Cape, mountain and silver co-exist in a wide ecotone, but the Manawatu Gorge makes a complete gap between the two species. All beech species are absent from the Manawatu gap, where they are replaced by kamahi and subalpine (leatherwood*) scrub. This gap is of considerable interest, as it indicates that rainfall is not the sole factor. Excessive cloud is a feature here and appears to be the limiting factor for beech. The following percentages give a possible basis for estimating its light requirements:

- **Kaweka Range**—Mountain beech dominant, sunny days 34 per cent.
- **Ruahine Range**—Southern limit of mountain beech, sunny days 28 per cent.
- **Southern Ruahine Range**—All beeches absent, sunny days 12 per cent.
- **Tararua Range**—Silver beech dominant, sunny days 22 per cent.

Zotov (1938) has correlated lowered bush lines in the Western Tararuas with cloud, and the absence of mountain beech from the Western Ruahines appears due to the same cause in an intensified degree—the banking up of cloud along the slopes of the range in westerly weather.

Both silver and mountain are absent from part of the Ahimanawa Range. This appears to be an accident of recolonisation as both species are invading its flanks.

Ecotone

The narrow ecotone between silver and mountain beech dominant forest at the head of the Ngaruroro shows some strongly marked patterns which indicate considerable differences in the responses of the two species. Mountain beech pioneers the downward movement of forest on to red tussock (*Danthonia rigida*) grassland and is present in a narrow fringe below both pure silver and red beech forest. Mountain tends to replace silver at the highest altitudes on the

*Olearia colensoi* and *Senecio elegnifolius*, *Olearia* dominant.
eastern side of the ecotone, though not on the western, but at lower elevations there is definite evidence of silver beech saplings becoming dominant below a mountain beech canopy. This suggests an alternation of the two species, with a mosaic pattern developing in a belt below the maximum for mountain beech, but above that of red beech.

Cedar has a limited and curious distribution in an arc round the western side of the volcanic plateau and across the Inland Patea to the Ruahine Range, where it is present throughout and dominates the timber line in the absence of mountain beech. This is as far south as it grows in the North Island.

Red beech is generally distributed from Cook Strait to East Cape, but there are two distinct gaps. One is the Manawatu gap, as I have already mentioned, though red beech extends further into the gap on either side than the silver or mountain; the other is the central forest of the Kaimanawa Range. This also appears to be a historical accident of the process of recolonisation, as it flourishes on pumice on three sides of it.

Changes in Forest

These patterns are not fixed and evidence is accumulating not only of past changes but of changes going on at the present day. It is not going to be easy to unravel these, but there appear to be two major trends—one a retreat of forest due to climatic changes, the other an advance of forest on pumice land. Retreat of the timber line is clearly evident in mountain beech along the axis ranges from as far north as Maungawaro Range off the Raukumara to as far south as mountain beech goes in the Ruahines. Stumps and logs under snow-grass (*Danthonia flavescens* vars.) are exposed at numerous points in the Ruahines above the present forest limits, and the existing timber line is dying back and being replaced by scrub and tussock, indicating that change has been continuing within the last 200 years. This is not so obvious in silver beech bush-lines, as for example in the Tararuas, but here recent observation and checking against 20 year old photographs shows that changes are taking place, probably in the same direction as in mountain beech forest. As the life span of silver is about three times that of mountain the development will be slower—at any rate it is no longer safe to regard the Tararua forests as a stable climax. (Retreating silver beech forest margin has recently been reported at Taratihi in the Raukumara Range by R. Cresswell—pers. comm.)

Examination of the plateau at about the maximum altitude for timber in the Ruahines shows a drowning out of mountain beech forest and its replacement by peat bogs. Examination of these bogs has located a couple of pumice showers with logs above, between, and below them to a depth of 30 in. Samples of wood are being identified.
and carbon dated from excavations in the Northern Ruahines and some work done on similar bogs in the Western Ruahines. Subject to general confirmation, the general picture is of an alternation of forest and bog, possibly with two or three forest cycles, over the last 4,000 years with much the same tree species as are present today. Mountain beech probably extended further west and south since the last pumice fall.

At the present day, regeneration of mountain beech in the Ruahines tends to be confined to ridges and scarps, and trees are being replaced by tussock and scrub in hollows and gullies.

Forest on Pumice

This is emphatically not the case on pumice soils. The contrast between mountain beech forest in aerial photographs of, say, Western Kawekas and Central Ruahines is striking, the canopy on pumice soils being dense and even. On the ground there is no evidence of a retreat of the timber line, though timber lines are high and may be exceptionally high (up to 4,800 ft.).

Whatever the reason for this, it applies to the Kaimanawas generally and to the western Kawekas. This is approximately the area over which the vegetation was destroyed by eruptions leaving charred remains in the subsoil. The most likely connection between past charring and present day regeneration seems to be the depth of pumice, and is probably a matter of drainage.

It may have a bearing on this that in 1947 large numbers of recently dead trees were conspicuous in a number of forest islands on either side of the Ngamatea Plateau, and they can be seen in aerial photographs over a wider extent, from near the Desert Road to the Ngaruroro. All that have been examined are on the flatter ground towards the foot of forest clumps where the pumice is generally deeper and there appears to have been a consequence of the 1946 drought. It appears likely that adequate (or over-adequate) drainage is a factor on pumice soils.

Status of Cedar

Cedar occurs throughout the Ruahines in a zone intermediate between mountain and red beech, forming the timber line where mountain beech is absent. It too shows the same pattern. At its upper limit it forms an irregular belt of mostly overmature trees with saplings and seedlings almost absent. These appear lower down, but the trees tend to cluster on knobs and sharp spurs, giving a comb-like pattern. Cedar appears to be a relic of a former forest type now being supplanted by beech.

Changes in Red Beech

The only equivalent evidence for red beech is a tendency at its southern Ruahine limit to retreat northwards and downwards. There
are considerable areas in both Kawekas and Ruahines where red beech forest is opening up into scattered overmature trees with an absence of replacement saplings and seedlings, but these are on sunny north facing slopes, so that the same climatic influences are unlikely to apply.

Subalpine Vegetation

Leatherwood scrub is of particular importance in high rainfall areas of low sunshine as it thrives under just those conditions that are hostile to beech. Leatherwood drops out to the north of the Ruahines and only re-appears in the Huiarau Range; that is, it is absent from the area of lowest rainfall and highest sunshine; though it must be remembered that this is also the area of heavy pumice fall; so that the chemistry or texture of pumice soil may quite well be a deciding factor. Its absence may be a matter of chance (as with red beech and several other species)—at any rate rainfall is not the sole factor, otherwise the silver beech areas of the Kaimanawas would be well within its range.

Its absence is of importance as erosion problems (both innate and induced) are most acute in the central area where discontinuous forest has encouraged burning and grazing. The first stage of recovery here on steep country between 3,000 and 5,000 ft. is the entry of subalpine vegetation, and it is doubtful whether this would ever be completely replaced by forest on the eastern side, as the earliest descriptions suggest that scrub and tussock were already tending to replace forest before European settlement began.

Three main forms of subalpine vegetation may be considered; there is snowgrass meadow, scrub, and the scattered vegetation of rock and scree. The last group are of especial importance as they are a group of highly specialised plants of mat, cushion, or rosette form together with a few true scree plants with fantastic root systems, which are the first colonisers of bare ground. Those of sprawling form are prominent in binding the fragments at the foot of mature scree.s. I should like to comment that the natural process of arresting a scree starts at the foot with a sequence of mat plants, scrub, and even trees, while the upper portion is still in loose shingle and apparently active.

In the Kawekas where conditions are most arid a conspicuous plant in colonising steep faces of loose rock is a sprawling mountain daisy (Celmisia incana) whose grey colonies cover hundreds of acres in one badly stripped basin, like an outsize scabweed.

In the Ruahines an aggressive shrub is conspicuous at a later stage of scree regeneration—an unnamed koromiko (Hebe sp.), probably a natural hybrid, which forms dense thickets on scree.s, river terraces, and burns.
Snow Tussock

Snowgrass meadow, except on exposed ridges, gives a close cover preventing frost heave and holding pumice topsoil, even on steep slopes, as can be seen on the Kawekas. Its recolonisation of old screes at high altitudes and its replacement of retreating forest indicate that it has some ability to occupy new ground, but no recent evidence of snow tussock regeneration has been seen.

Red Tussock and Manuka

A considerable proportion of pumice land lying between 2,000 ft. and 4,000 ft. is at the present day in tussock or scrub with scattered islands of forest. Red tussock is the commonest cover, a xerophytic Danthonia species which seems to have a much wider tolerance than snowgrass and to be much more aggressive, thriving both on arid pumice terraces and on peat bogs. Tussock shades off into the sparse open scrubland of the Kaingaroa Plains on the one hand and into bracken on the other, but on the eastern side and to some extent in the Inland Patea, is being replaced by manuka (Leptospermum scoparium) scrub. This is an induced association connected with burning and overgrazing.

Protection Problems

Where forest is advancing into tussock, or the timber line is retreating, one closed association is replacing another, and this in itself does not constitute a protection problem. The problems arise where other factors interrupt the processes of adjustment. The gale of February 1936 has made widespread changes in the Tararuas which are still apparent and will be for a long time to come. Earthquake damage is a continual possibility along the East Coast. But the effect of man and introduced animals is more widespread.

Burning and Grazing

This started some 400 years ago on the eastern slopes of Taupo with the burning of fern land to encourage the growth of fern root. A good deal of forest was burnt, mostly podocarp outliers, and fern was largely replaced by manuka. Generally the natural advance of forest has been halted here, and along the Taupo Road. Nearly a hundred years ago, when sheep were brought into the tussock of the Inland Patea, tussock burning started. Most of the smaller islands of beech forest from Waiouru to Kuripapango now consist of even aged stands of mountain beech from 60 to 90 years old, and have presumably regenerated after fire. All the outer margins of the Kaimanawa forests have been checked from their natural advance by fire.

Sheep are still grazed on the Inland Patea, the Ngamatea Plateau, and on Poronui, with periodic burning of tussock, but a good deal of the outlying tussock is not stocked at the present day.
The most serious effects have been on the Kaweka Range and the adjacent Blowhard Plateau where sheep were run from about 1870 to 1905. Extensive fires, some apparently accidental, ran through most of the bush east of the Kawekas from the Mohaka to the Ngaruroro. Overgrazing was probably considerable, as this was alternative pasture for the enormous mobs needed in Hawke's Bay for fern crushing.

Rabbits came in about the time sheep were being mustered off, the total effect being the removal of a large proportion of the pumice soil on steep, and even on some easy slopes, and of the vegetation holding it.

Stragglers on the higher slopes of the Kawekas have built up small mobs of wild merinos which still persist, and from their preference for open ground and sidlings on steep faces appear to do damage out of proportion to their numbers.

**Deer**

Deer were first reported about the time that sheep were being mustered off, and some interesting beech regeneration near one of the main mustering tracks suggests that there was a gap of a few years in which some recovery was possible.

I cannot claim to know a great deal about deer, so my comments will be brief. They have been established for a long time in the Kaimanawas and Kawekas, for a shorter time in the Ruahines and Tararuas, have only entered the Huiarau within the last 20 years (apart from early Waikaremoana liberation), and had not reached the Maungawaro Range five years ago.

They had passed their peak without human interference in the Kaimanawas 25 years ago, in the Ruahines (probably due to shooting) five years ago, and have recently built up to a high intensity in the Huiarau. In the western Kaweka, beech regeneration is 15 years ahead of browsing, but in both Ruahines and Tararuas deer are turning to the leatherwood belt, which is a vital zone in heavy rainfall areas. Large numbers of recent slips in steep forested country, chiefly in the Ruahines and Tararuas, are definitely due to deer. Some of these have been watched through their main stages of development. These are, so to speak, superimposed on the main scree system which seems to have been tectonic in origin.

The recent spread of Japanese deer from a focus at the head of the Mohaka appears to present a more difficult problem of control than red deer, as they are more confined to forest and very shy.

Pigs are long established, and goats are spreading slowly.

**Opossums**

The most recent large scale change has been the death of kamahi forest in the Southern Ruahines; the cause seems to be defoliation by opossums. In this heavy rainfall area it is followed by dense
second growth which will presumably support a larger deer population.

Manuka Blight

A further change which is imminent is the arrival of manuka blight into the extensive area of pumice land, much of it already denuded and mainly held by manuka scrub, to the east of the Kawekas. In Hawke’s Bay, the blight is moving with the prevailing wind towards the south-east and has been identified well inside the problem area. It is probable that a good deal of the ground will revert to its original state of fern land, and there is a considerable proportion of kanuka (*Leptospermum ericoides*) present and a certain amount of mixed vegetation under the manuka. It is doubtful, however, whether the recuperative powers are sufficient to meet this attack, and it would be prudent to expect considerable changes in the next few years. We have made a beginning with scrub quadrats in anticipation of changes. There is a theory that manuka inhibits succession and that its death is followed by a rush of alternative growth, but I suspect that this is wishful thinking.

Conclusion

To summarise, the high country of the North Island is at present in forest, alpine vegetation, and scrub, all of which show considerable though not inexhaustible powers of recuperation from climatic changes and the impact of introduced animals and man. The most important need at the moment is the study of the processes of recuperation in order to further them.

From the point of view of protection, the long term changes such as replacement of forest by scrub and tussock are continuous processes and not necessarily a deterioration. Problems arise when these processes are abruptly interrupted, as for instance by deer or by man.

Reference