FOREST REGENERATION PROBLEMS IN THE HUNUA RANGE, AUCKLAND

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The Hunua Range consists of approximately thirty square miles of dense mature rain forest and an equal area of scrub and second growth. It is situated nearly thirty miles south-east of Auckland City on the western edge of the Firth of Thames (Fig. 1.) The range comprises a group of deeply dissected, up-faulted blocks of Mesozoic greywacke. The upland region is sharply delimited from the rolling lowlands by four well-defined fault lines in the east, south and west. To the north the area dips gradually into the Tamaki Strait and the Papakura-Clevedon lowland.

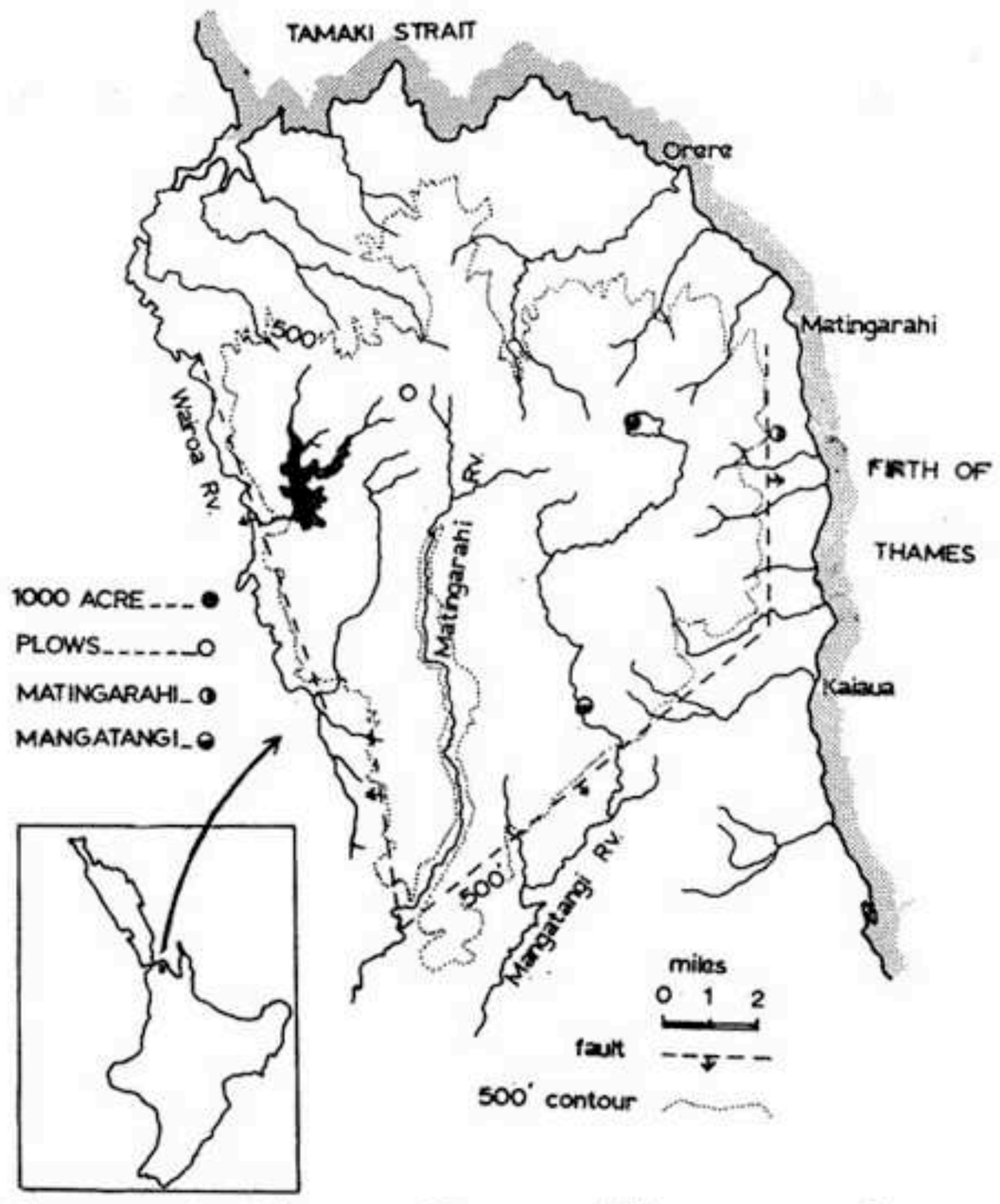

FIGURE 1. *Hunua Range. The areas chosen for study are indicated.*

VEGETATIONAL HISTORY

Prior to 1890 the foothills of the range were covered in kauri *(Agathis australis)* forest Exploitation began in the early 1890s and for the next fifteen years continued up the rivers to the limit of the kauri which appears to have been generally at 800 ft. While the hills were being milled a considerable amount of clearing was done on the alluvial flats and foothills. By 1913 most of the workable kauri had been removed and the lowlands were being successfully farmed. During the post-war boom period many of the marginal hillsides were cleared but the depression years of the early 1930s saw most of this land revert to second growth and no attempt has since been made to reclaim it.

Above the kauri forest there occurs a broadleaved forest, with occasional emergent podocarps, which has never been exploited for timber. This forest is unproductive and inaccessible, the podocarp element is overmature and failing to regenerate.

The range is drained by four major river systems (Fig. 1). To provide water catchments and fringe reserves for one existing and five proposed water supply dams the Auckland City Council has acquired 40,000 acres of the range. This includes much mature forest as well as almost equal amounts of farm land and second growth. To facilitate good infiltration and to reduce maintenance it is intended that the farmland regenerate as soon as possible to native forest. In the upland area a trend to dominance of broadleaved species can be followed, while at lower altitudes the trend is to kauri dominated forest. Four areas were chosen representing a wide variety of sites on which to study the early regeneration patterns which are of considerable interest.

FOREST TYPES

The broadleaved forest of the higher altitudes has been classified by McKelvey and Nicholls (1957 and 1959) as kohekohe, northern rata, rimu, tawa forest. However, the dominant and continuous cover is supplied

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by broadleaved species, rimu and rata seldom attaining a stocking greater than two stems per acre. The common broadleaved species are tawa *(Beilschmiedia tawa)*, kohekohe *(Dysoxylum spectabile)*, rewarewa *(Knightia excelsa)*, hinau *(Elaeocarpus dentatus)*, and pukatea *(Laurelia novae-zelandiae)*. On the northern slopes there may be small amounts of taraire *(Beilschmiedia tarairi)* and puriri *(Vitex lucens)* both of which are absent from the rest of the range.

In the past the lowland areas have been dominated by kauri and small pockets remain. The kauri is commonly associated with tawa, kohekohe and tanekaha *(Phyllocladus trichomanoides)* and in isolated places with hard beech *(Nothofagus truncata)*.

ANIMALS

1. *Goats*

Goats were introduced into the northern part of the range soon after the turn of the century. By 1912 they had thoroughly infested the complete Hunua block. Although their numbers have been considerably reduced in recent years by shooters their destructive influence is still very obvious and they remain the greatest menace to the preservation of the forest. Their activities result in the complete removal of the forest understory of shrub hardwoods and regenerating forest hardwood species. At present, because of reduced numbers, their activities are local but in the past they have had a profund effect on forest composition.

2. *Pigs*

The rooting activities of pigs at the bases of forest trees in the more remote areas of the range accelerate erosion and subsequent windthrow of forest trees. They may be densely concentrated near regenerating pasture where they tend to eliminate bracken fern (*Pteridium aquilinum* var. *esculentum)* and thus affect succession. In forest, however, pig damage is much less serious than that of goats.

REGENERATION PATTERNS

To illustrate the diversity and complexity of regeneration four areas were chosen for study, two in broadleaved forest and two in kauri forest (Figs. 1 and 2). In each area succession has been induced by man and thus a knowledge of the history of each allows a close comparison to be made between human activities and subsequent succession.

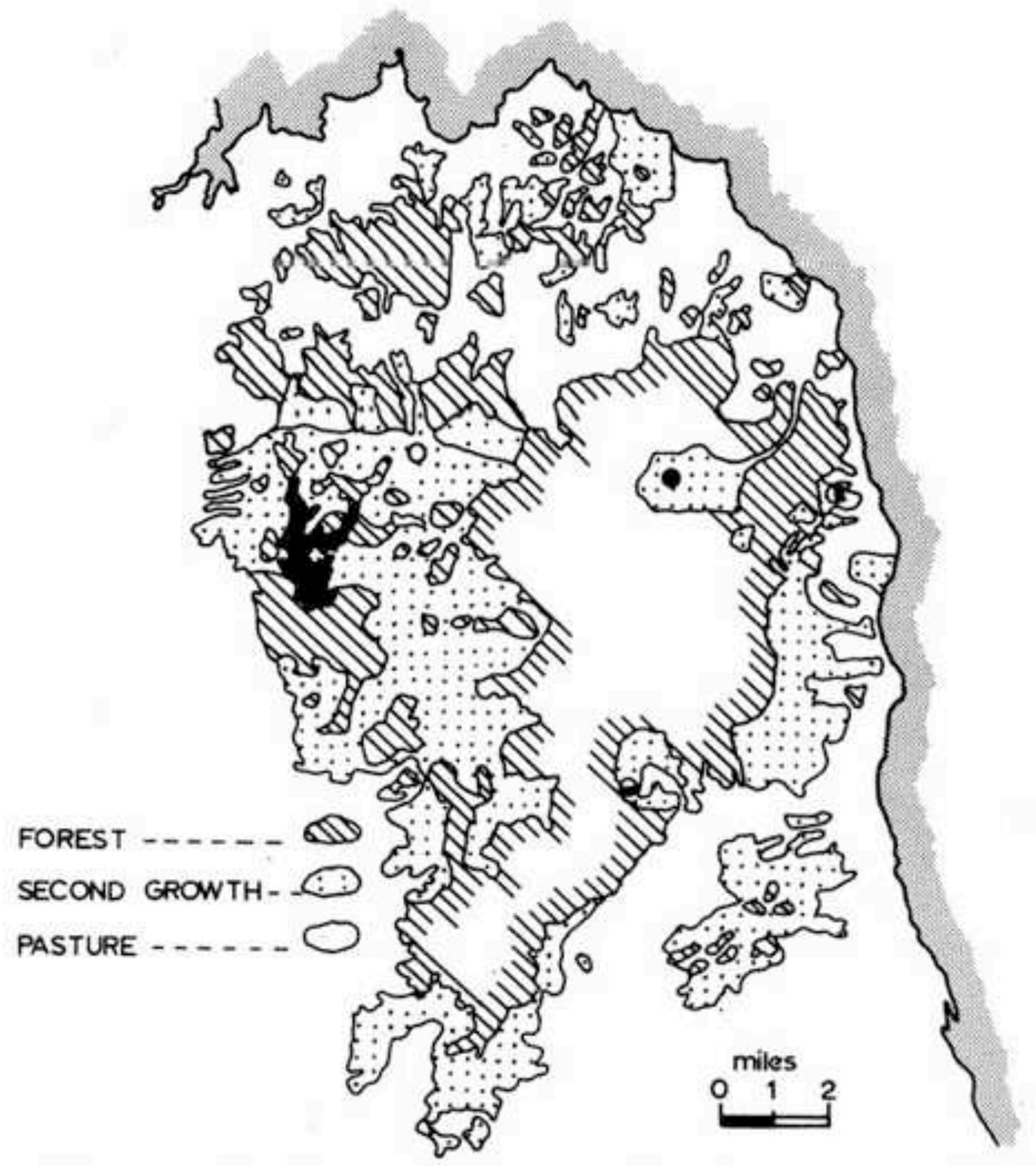

FIGURE 2. *Hunua Range, showing vegetation. (Study areas as in Fig.* 1.*) Based on N.Z. L. & S. one mile series.*

1. ONE THOUSAND ACRE CLEARING

This clearing, approximately 2 square miles in extent, lies at the headwaters of the Mangatangi R. and ranges in altitude from 900 to 2000 ft. It is surrounded on all sides by broadleaved forest. The area was cleared from forest in 1925, sown in 1926 and stocked with sheep. Initial overstocking and subsequent mismanagement during the depression years resulted in the loss of the original sward and the entry of many weeds. The area is very steep and slips were exceedingly common. The grass has always been allowed to run rank and this has from the beginning hampered the establishment of native species. In 1962 there still remained, especially on the ridges, a large area of grassland, lacking the original ryegrass and clover elements and consisting of browntop, sweet vernal, cocksfoot, Yorkshire fog and paspalum. Associated with this sward are a number of plants which are propagated by runners and rhizomes; *Centella uniflora*, *Acaena novae-zelandiae*, *Hydrocotyle novae-zelandiae* and *Dicksonia squarrosa*. Occupying circular or oval patches throughout the grassland, on the margins of scrub and as remnants within it, is the scented fern *(Paesia scaberula)*.

Large areas of scrub hardwoods are to be found, especially along the valley floors and sides where the initial burn was less successful. The scrub ranges from 8 to 20 ft. in height and higher up the slope occurs as circular patches surrounded by *Paesia*. The scrub consists of *Fuchsia excorticata*, wineberry *(Aristotelia serrata)*, *Cyathea spp.*, *Dicksonia*, mahoe *(Melicytus ramiflorus)* and putaputaweta *(Carpodetus serratus)*.

Succession. The grass and *Paesia* grow up to 3 ft. high, both having a very dense ground layer of dead and dying leaves which is impenetrable to seedlings. The small amount of dying back of *Paesia* in the winter is not sufficient to open up the cover. These conditions of impenetrable ground clover have prevailed almost since the land was cleared and especially since 1945 when the clearing was taken over by the City Council.

Entry of Paesia. *Paesia* was first noted in the 1000 acre clearing in 1931 and by 1934 it had become a considerable menace. Cockayne et al. (1932) rate *Paesia* as one of the worst indigenous-induced weeds of exotic grassland. Its thin superficial rhizomes spread from all sides of the circular patches so characteristic of the fern. Moore (1942) has demonstrated that the conditions for sporeling growth of *Paesia* are critical. As sporelings must have light and moisture in abundance, a grass sward prevents germination of *Paesia* spores and growth of gametophytes. In the broken moist clay of the slips which were so prevalent both in the forest and after clearing, and beneath fallen logs, ideal conditions of high light, high humidity and lack of angiosperm competition were created.

Entry of Dicksonia. Dingley (1942) established that the clumping and colonial habit of *Dicksonia squarrosa* is due to its ability to reproduce vegetatively by runners arising from submerged adventitious buds. She stated that, in regenerating areas in the Hunua region, the second growth associations do not show any variety, manuka *(Leptospermum scoparium)* being always dominant. This is true for the areas marginal to the range but in the 1000 Acre and Plows clearings it is *Dicksonia* alone which is opening up the cover for further colonisation. In other parts of the range *Dicksonia*, if present, is limited to the river flats and gentle lower slopes.

As *Dicksonia* gametophytes have the same requirements as those of *Paesia* the reasons adduced for the presence of *Paesia* apply to *Dicksonia* and account for a strong association between the two. Throughout the clearing the emergence of *Dicksonia* through either grass or *Paesia* is a common sight. The spread and formation of *Dicksonia* groves if not a rapid process is a characteristic one. As the *Dicksonia* plants become taller, groves form and the lower leaves are lost, smothering and shading the ground vegetation. This is the only method whereby the ground cover may be opened, a slow process highly dependent on the rate of growth of *Dicksonia* and its ability to spread. Native birds, notably tui and pigeon, eat the fruits of wineberry, fuchsia and mahoe and commonly roost in the fronds of *Dicksonia*. These species therefore have an extremely effective method of dispersal as only beneath *Dicksonia* are the conditions adequate for their seedling growth. Vegetation islands emerge and subsequently fuse to give hardwood scrub. Beneath this scrub there is more than adequate regeneration of forest hardwoods, tawa, rewarewa and hinau. Podocarp regeneration is sparse. This sequence is summarised in Figure 3.

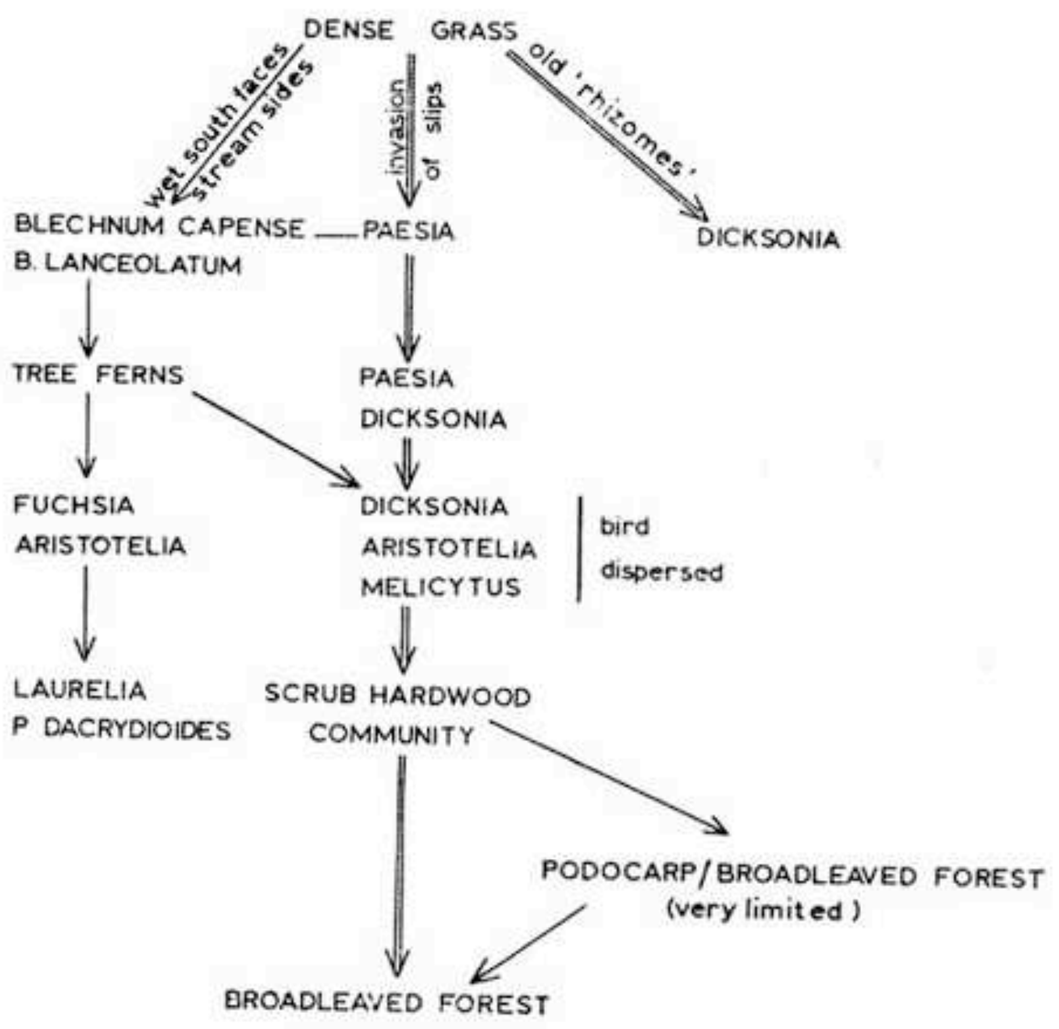

FIGURE 3. *Sequence of plant communities in the* 1000 *Acre Clearing. Double arrows indicate the more common sequence.*

2. PLOWS CLEARING

This area is a tableland of several thousand acres west of Mt. Kohukohunui. It was cleared before the turn of the century and successfully farmed until the City Council acquired the area during the last decade. The area, a weakly dissected peneplain lying between 1200 and 1400 ft., has posed far fewer problems than the inaccessible and much steeper 1000 Acre Clearing.

Succession. The subdued topography ensured that there were far fewer slips with a resultant decrease in the amount of *Paesia*, and the presence of four farm houses in the vicinity with their associated human activity has discouraged pigs. As a result brackern fern has invaded in recent years following the removal of stock. In the 1000 Acre Clearing bracken is of very local occurrence and I attribute its failure to gain a foothold to the continued activities of pigs; on the disturbed ground *Paesia* with an unpalatable rhizome quickly takes over and succession is deflected.

Dicksonia is of less importance at Plows for the same reasons as adduced for *Paesia* and also because there are fewer alluvial flats and thus fewer forest sites where *Dicksonia* would normally be found. Fern invasion of grassland by such species as bracken on dry north slopes and *Paesia*, *Blechnum lanceolatum*, and *B. capense* on wet slopes is, however, intense. These are often followed by stands of tree ferns.

Within the fern groves hardwood species invade, e.g. lancewood *(Pseudopanax crassifolium)*, *Lophomyrtus bullata*, putaputaweta and *Coprosma australis*. As in the 1000 Acre Clearing there is scanty regeneration of manuka. Wineberry, the common invading species in the 1000 Acre Clearing, is virtually absent from Plows, the converse being true for *Lophomyrtus*. In general the invading hardwoods tend to be wind dispersed rather than bird dispersed. This sequence is summarised in Fig. 4.

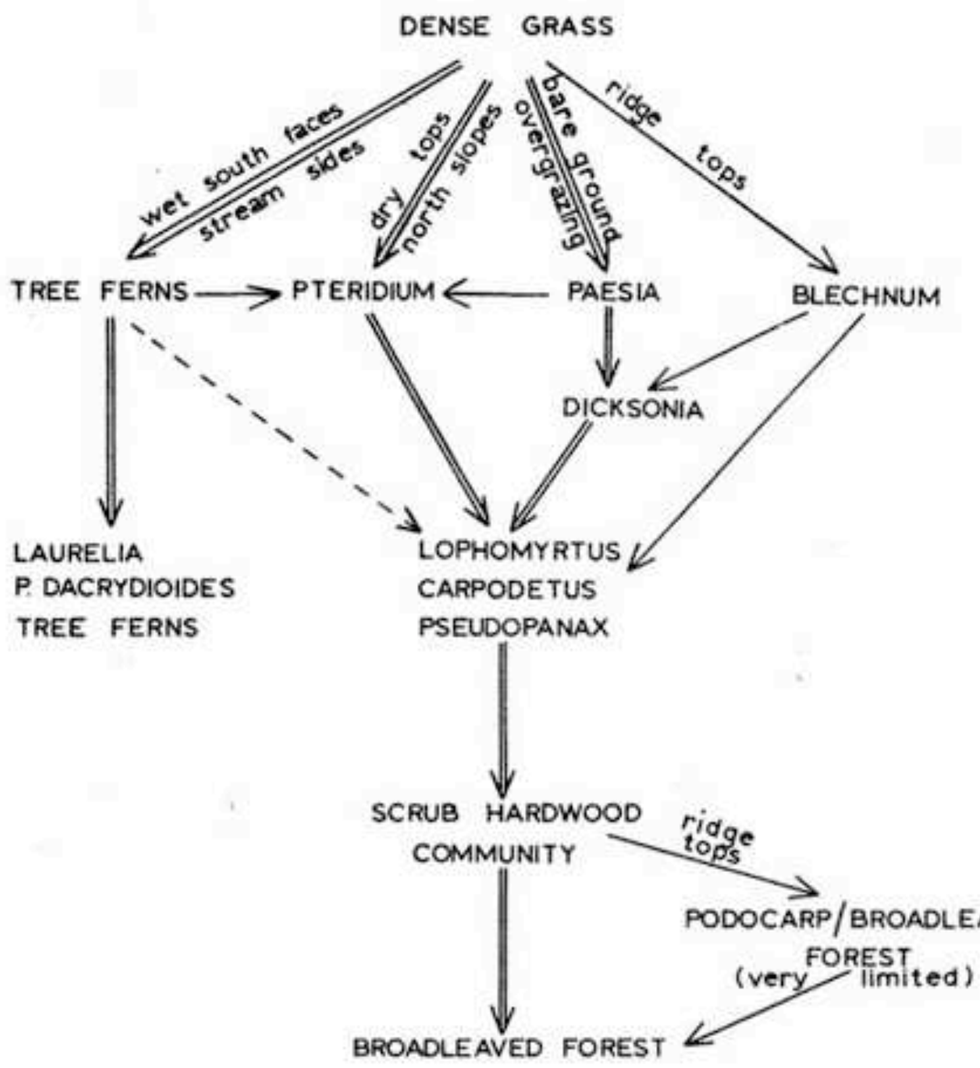

FIGURE 4. *Sequence of plant communities in Plow's Clearing.*

3. MANGATANGI

Kauri logging in the early part of this century initiated much of the regeneration in this area. On the easier slopes the logged areas have been converted to farmland but a great deal of this has proved uneconomic or has been mismanaged and is now reverting to forest. The depredations of goats are probably at their worst in the Mangatangi area and have deflected the sequence from mixed gymnosperm/broadleaved forest to almost pure gymnosperm stands. The area lies below 700 ft.

Succession. On the poor pastures of the steep marginal hillsides and after logging, manuka has invaded. Beneath this dense thicket, scrub hardwood species such as *Olearia rani*, *Geniostoma ligustrifolium*, *Neopanax arboreum*, and *Cyathodes fasciculata* establish well, but, owing to the constant browsing of goats, never survive for long. Towai *(Weinmannia silvicola)*, although virtually absent from the rest of the range, grows here in great profusion and may in some places survive to give a manuka—towai community. Tanekaha regenerates well beneath this cover as does kauri at a later stage, neither of these species being browsed. In many areas this results in pure pole stands of kauri and tanekaha, the scrub and forest hardwood species being almost completely eliminated. The sparsity of sawn stumps and the absence of extensive podsolisation in the lower Mangatangi forest indicate that the former kauri forest was sparse when compared with the present emerging forest.

The regeneration of hard beech is limited by its large seed and the fact that seedlings may be heavily browsed. However, where there is an adequate seed source and where goat infestation is slight, wetter slopes show very good advance growth of beech.

4. MATINGARAHI

The Matingarahi lowland comprises the narrow eastern coastal strip adjacent to the Firth of Thames on the eastern boundary of the Hunua Range. The area has been intensively farmed for over fifty years; however, the over grazing of even flat pasture land has led to an even more severe infestation of manuka than at Mangatangi. Hundreds of acres of once good pasture now lie useless. On the foothills where regeneration has progressed the lower goat density has allowed establishment of such palatable species as tawa and rewarewa. Later stages in succession are very similar to those of Mangatangi.

The sequence at Matingarahi and Mangatangi is summarised in Figure 5.

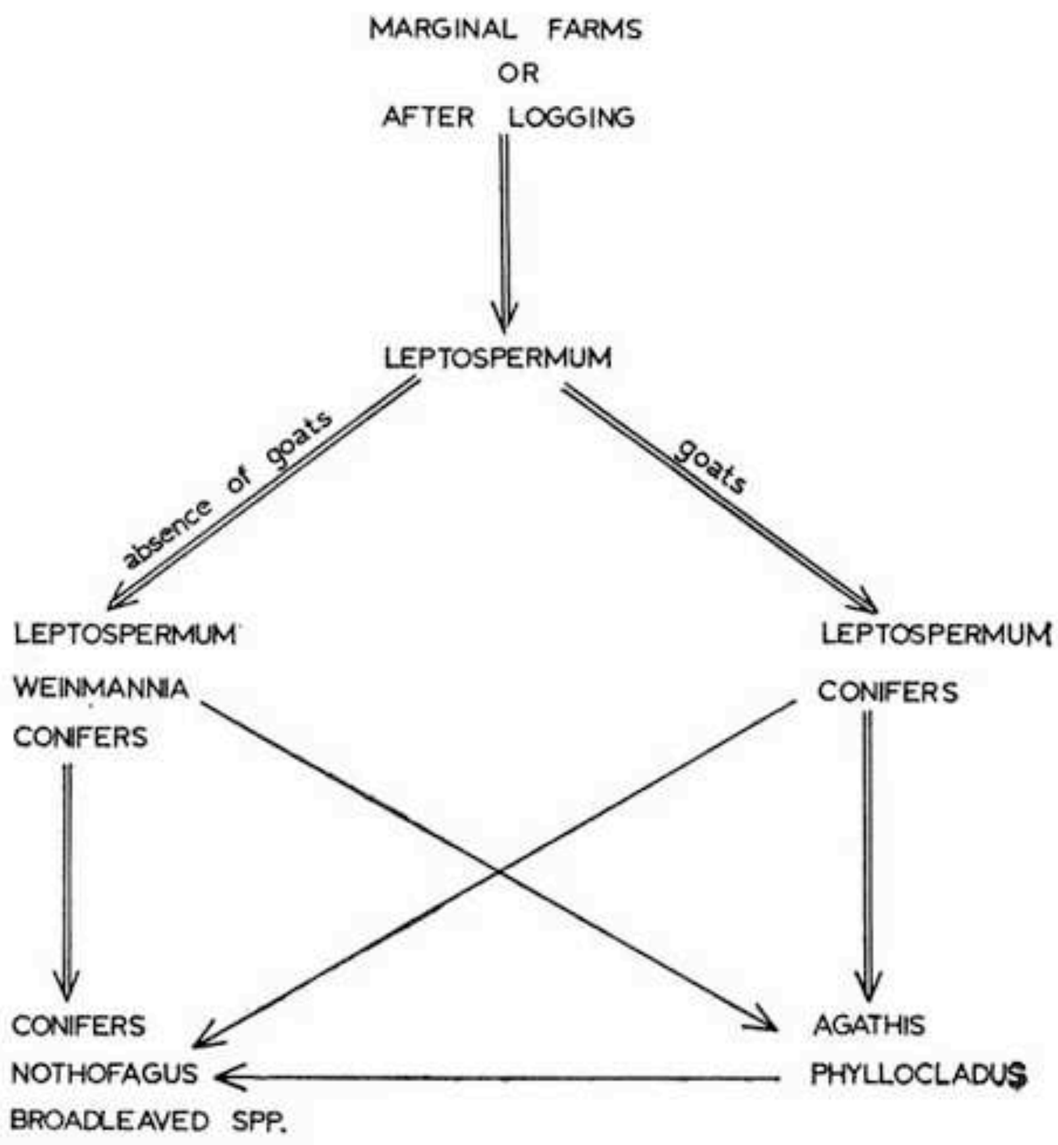

FIGURE 5. *Sequence of plant communities at Matingarahi and Mangatangi.*

CONCLUSIONS

The study of regeneration in the Hunua Ra. has revealed the following:—

1. The pace and sequence of regeneration but not the final product, are highly dependent on the way the areas have been managed by man.

2. In the upland region regeneration has been slow. The development of a dense ground cover has precluded the high-light-demanding *Leptospermum*, whereas in lowland areas *Leptospermum* has in most instances initiated very rapid succession.

3. The intervention of animals has done much to alter the sequence of regeneration, e.g., the elimination of bracken in the 1000 Acre Clearing and the production of a pure gymnosperm forest in the Mangatangi area. The preferential browsing of broad-leaved species may in this latter case prove desirable, as long as these activities do not aggravate or precipitate other problems such as erosion.

4. Podocarp regeneration has largely failed in the upland region despite adequate seed supply.

5. Apparent anomalies in distribution occur in the presence of hard beech, the occurence of puriri and taraire only in the north of the range, and of towai only in the south.

As a result of the recent annexation the Hunua Ra. will remain an ideal area for the study of regeneration of native forest species over the next few decades.

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