THE INDIGENOUS FOREST TYPES OF NORTH AUCKLAND

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SYNOPSIS

From information gained on a recent primary survey, twenty ecological types have been distinguished in North Auckland indigenous forests. These are described briefly, with emphasis on structure.

Introduction

In the summer of 1956–57 a primary survey of the indigenous forests of North Auckland Land District, which extends from Waikato Heads and the Firth of Thames to North Cape, was made by the Forest Research Institute. That sampling has enabled the writers to stratify the forests into cover types, on an ecological basis. In addition, it has made possible the definition of structure in each type and of close approximations to their actual composition—density and frequency of occurrence of mature trees, stocking of advance growth or regeneration and abundance and variety of competing growth.

The following account of these types is meant to show the main forest pattern and to indicate the more obvious relationships between types and the main features of succession. A wealth of detailed botanical and pedological information gained on the survey has had to be omitted. Further consideration of the many abstruse ecological problems and the implications of forest management and land use have been deferred; it is intended that this brief essay will be the precursor of a comprehensive bulletin on North Auckland forests.

In all, 300 temporary sample plots were established and the composition and structure of the forest at each plot was recorded on field-tally sheets. Aerial photographs were used as field maps. The forest areas were first stratified into broad site classes and plots were then placed in each site class without bias and in approximate proportion to the area of each forest tract. All the major forest areas and selected minor ones were sampled so that an even geographical coverage was obtained. Analysis of the field data was then made by site classes for each type. On each one acre plot all individual trees 12 in. d.b.h. and over were tallied in broad diameter classes, then over a 1 chain × 1 chain sub-plot all trees or shrubs of pole size (4–12 in. d.b.h.) were tallied in finer diameter classes. On yet another sub-plot, 1 chain × ½ chain and falling within the two larger plots, all saplings (1–4 in. d.b.h.) and seedlings (over 6 in. in height and up to 1 in. d.b.h.) of tree species were enumerated. Also, a complete floristic list of all other plant

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species was compiled and a frequency symbol was assigned to each species. The structure of the forest at each plot was described in detail, a pit was dug and the soil profile recorded, animals present and their impact on the vegetation were noted, bird life was described, locality factors were recorded; in short, a full ecological description was made of the forest vegetation and environment. In the following type descriptions, average stocking-per-acre figures are given in parentheses where adequate sampling enabled this to be done with statistical confidence. Where stocking was markedly irregular a range of averages is given. More detailed quantitative data can be obtained only by more intensive sampling than was designed for this primary survey.

Acknowledgment is made to the Forest Research Institute for the use of the basic field data and to fellow field-party leaders, Forest Ranger R. B. Stevenson and Forest Ranger D. H. Widdowson, for collection of much of it, often under difficult conditions.

Geographical Thumbnail Sketch

In place of the former, unbroken tracts of forest there are scattered forested uplands separated by intervening fertile lowlands. These areas, totalling some 500,000 acres, have been preserved by reason of steep terrain, infertile soils, altitude, or high rainfall. Conveniently, the long axis of the Auckland peninsula separates lithologically different areas: andesitic and basaltic with derived clay loams west of it, and greywacke (a little Tertiary sandstone in the south) with derived less fertile clay loams east of it. There is also a climatic distinction, as the east is drier, having both a lower average rainfall and fewer rain days per year. In the north and to the west of the axis are the Raetea and Herekino forests, on steep terrain rising to 2,500 and 1,800 feet respectively, the latter a conspicuous land form because of its very steep, sometimes precipitous, flanks and flattish top. Ten miles south is the Warawara forested upland, in profile similar to Herekino, though higher (2,400 feet) and consequently more exposed to coastal blasts. Southwards, across the Hokianga Harbour, rises the very steep Ngapukehaua Range (highest point 2,500 feet). This in turn drops southwards to the easier terrain of the Waipoua, Marlborough and Tutamoe Plateaux, all reaching 2,000 feet. No part of Northland receives heavier precipitation than do those plateaux and the continual cloud cap is a feature of the district. A little eastwards is the very steep Tangihua Range (2,100 ft) and the Te Tarahioorahiri and Hikurangi Uplands just north of it, also reaching 2,000 feet. There is little forest then until the Waitakere Range, west of Auckland city and on the north shore of the Manukau Harbour. The highest (1,400 ft) central portion is flat or easily undulating but the periphery is dissected and steep.

Travelling in turn southwards down the eastern half of the peninsula, the first extensive forest one encounters is Omahuta-Puketi, on steep-sided uplands reaching 1,500 feet, which large streams have incised

Opposite page: Map showing location of indigenous forests.
leaving plateau remnants, often large, separated by steep-sided, deep valleys. Then, a little south and near the coast, is the extensive Russell Forest (up to 1,200 ft), in which the scars wrought by the conflagrations of the nineteenth century are now healed by vigorous regrowth. Farther down the East Coast the maps show a rash of small forest remnants which thins and almost disappears some thirty miles from Auckland. South of Auckland city and flanking the Firth of Thames is the deeply dissected, forested Hunua Range which reaches an altitude of 2,200 ft.

_Type Descriptions_

Twenty forest types have been recognised in North Auckland, defined in accordance with the provisional classification of North Island forests outlined in a recent number of this Journal (McKelvey and Nicholls, 1957). They are described briefly, and their whereabouts indicated below.

In this review the types have been arranged under six headings. Firstly, there are the types containing kauri: stands of dense mature kauri or kauri poles, forests which are mosaics of scattered groups of kauri and podocarp/hardwood forest, and the kauri/hard beech association. The second assembly consists of dense-podocarp types. Then there are large tracts consisting mainly of hardwoods but with scattered to locally frequent podocarps: under one heading are presented the types distinguished by the presence, and prominence, of taraire; under another, those in which taraire is absent. Finally, there are the coastal forest and the scrub types. For the reader's convenience a brief summary of types is appended.

_Kauri Types_

_Type A1_. Unexploited stands of dense kauri still exist in North Auckland but are of appreciable extent on only the remote uplands of Omahuta, Puketi, Herekino and Warawara and in the Waipoua sanctuary. They have been designated type A1. Nearly all occur at about 1,000 ft above sea level, either on ridge crests and steep upper valley sides or on undulating country where there is a rather high water table. The inland kauri forests of Omahuta-Puketi occur on greywacke. On the western basaltic country, however, kauri stands are confined to the coastal side of the uplands. Soil evidence suggests that they represent the eastern fringe of a past concentration on the west coast sand dunes (Taylor, N. H., _pers. comm._).

Almost throughout, the larger, dominant kauri are of uniform size, mature but healthy, with dead or dying trees remarkably rare. An exception is Warawara where there are stunted and stag-headed kauri, and where dead trees are fairly frequent. Probably, however, the trees are of comparable age to those elsewhere, their poorer form being due to a higher, more exposed situation than is general and death being often induced by bleeding for gum. At scattered points through-
out the land district there are pockets of abundant poles or small trees, young stands developing into replicas of the older forests. These are most common on the east coast.

In typical forest of type A1, there is an almost complete canopy at 120–140 ft, formed by the massive heads of very large kauri (15), 40–80 in. d.b.h., with a high stocking of smaller, more slender trees (30), 12–40 in. d.b.h. and 80–120 ft tall. (In the densest stands the lesser kauri may have diameters from 8 in. upward.) Below, there is usually a scattering of small-diameter, obviously suppressed, totara (7—many dead or dying), miro (7), rimu (3) and tanekaha (1). *Dacrydium kirkii* may be prominent in this tier but more often than not it is altogether absent. Small *towai* (3) are usually present; tawa (2), taraire (2) and *Ixerba brexioides* (3) are rare to locally frequent. From 5 to 30 ft there is a varied assemblage of poles, saplings and large shrubs, sparse generally but dense under the occasional breaks in the high kauri tier. The commonest species are *towai, tawa, Ixerba brexioides*, taraire, hinau, rewarewa, totara, miro, quintinia, tree ferns, lancewood, *Dracophyllum latifolium, Suttonia australis* and Coprosma spp. On the ground is a profusion of huge “tussocks” of *Gahnia* spp. and *Astellia trinervia*, plus frequent clumps of kiekie, tangles of *Lygodium articulatum* and patches of *Blechnum fraseri* and *Dicksonia lanata*. Here and there, small shrubs such as *Alseuosmia* spp., *Leucopogon fasciculatum, Senecio kirkii, Suttonia australis* and *Coprosma* spp. emerge together with occasional tree seedlings. Such seedlings occur in greater abundance beneath the sedges and tuft lilies, taraire and tawa being very frequent while *towai, totara* and *miro* are quite common. Kauri seedlings and saplings do occur, mainly in light pools along ridges.

**Type A2.** The few remnants of heavily stocked kauri stands on the Waitakere Range are in many ways the same as the forest just described. However, they have been separated as a type, A2, because of the absence there of both *towai* and taraire.

“New” kauri forest. Where scrub dominated by *Leptospermum* spp. (type R1, described in subsequent text) occurs within or marginal to forest containing kauri, it is on ridges and spurs frequently the nursery of abundant kauri regeneration. In a few places kauri has, comparatively recently, achieved dominance; where this is so the stands have been included in type A1 (type A2 on Waitakere Range). The kauri stocking ranges from 50 to 150 large poles or small trees per acre. Tanekaha very often is present in equal numbers but is less aggressive, invariably being outstripped by the other species. The largest kauri are about 60 ft tall, developing their adult crowns and slightly emergent above a mixture of smaller kauri and tanekaha. Among these sub-dominants, totara and rimu are sometimes present, the latter, often very “busby” and multi-leadered, entering the stands down slope, off the ridge crests. A few kanuka (obviously remnants), *towai, and rewarewa* are in addition scattered throughout. Below, the stands are
still composed largely of kauri, tanekaha, rimu, totara, and rewarewa, small poles (4–8 in. d.b.h.), saplings, and large seedlings occurring in abundance, kauri (350) and tanekaha (250) remaining the most prominent. Miro, invariably absent above, also may be present. Otherwise, there are clumps of _Cyathea dealbata_ and a few large shrubs, such as towai, _Suttonia australis_, and _Persoonia toru_. The ground cover varies from the fern/club-moss-dominant vegetation typical of _Leptospermum_ scrub to a complex of sedges, scramblers, and small shrubs characteristic of type A1, with small taraire, tawa, and maire seedlings appearing.

_**Type B1.**_ The most extensive by far of the types containing kauri is type B1, in which kauri occurs consistently but only in small clumps or as widely spaced single trees. Most of this type lies below 1,000 ft altitude on the broken terrain of maturely dissected greywacke or of younger sandstone rocks. Thus, it forms the bulk of the forest at Omahuta, Puketi, and Russell, occurs on the eastern edge of Raeta forest, and is the main type of the remnants on the east coast. It is present also on the north and west of Herekino upland and on the west of Warawara and the Ngapukehaua Range, that is, the distribution on basalt parallels that of type A1. Because of continual variation in site, of selective extraction of kauri at intervals over the past 100 years or more and, especially in the east, because of the effects of fire, the type is an intricate composition of sub-types. These can be distinguished quite readily in the field but their delimitation on aerial photographs has proved impracticable. For the purpose of primary survey, at least, the complex aggregation must remain the unit.

Kauri is, almost invariably, restricted to sharp knolls and to steep ridges and spurs. Where unexploited, the stands closely resemble type A1, but they are mere fragments of true kauri forest, seldom occupying as much as one acre of ground. However, these pockets are frequent; the result is an average stocking along the ridges of 3 kauri per acre. There is an accompaniment of occasional to locally frequent towai (10), taraire (5), totara (5), miro (4), tanekaha (2) and rimu (1). The undergrowth is essentially the same as that of type A1, with a comparable scarcity of kauri and podocarp advance growth other than fair amounts of totara and miro. But wherever logging or fire has broken the canopy and reduced the lower tiers there has been regeneration. Thus, on ridge crests and spurs there are well stocked pole stands of kauri (100), tanekaha (300) and totara (100) with occasional rimu, kanuka, towai, and other hardwoods. In places more recently disturbed, thickets of kauri seedlings or saplings continue to appear. However, it is stressed that most areas of regeneration are of pocket-handkerchief size and are widely scattered.

On the more rounded ridge tops, in saddles, and on the usually steep valley sides, the forest changes to a dense mixture of hardwoods, mainly small, and stunted if at all exposed, with a sprinkling of emergent podocarps and northern rata. _Taraire_ (15) is usually
dominant, towai (10) locally so. Throughout, there are frequent kohekohe (5), tawa (3) and puriri (3). Occurring occasionally as a rule but locally concentrated are northern rata (2), totara (1–2), miro (1–2), tanekaha (1), and rimu (1), while there is a regular stocking of rewarewa (2), hinau (1), and karaka (1). In gullies and valley bottoms, pukatea (3) enters the forest, rimu becomes larger, totara and tanekaha disappear, while very occasional kahikatea and rare matai are present. Largely unexploited and rarely damaged by fire, these valley-side and valley-bottom associations are altogether very similar to type E1, which is described in subsequent text. Suffice it to mention here that in type B1 advance growth of all hardwoods appears adequate, with the exception of hinau, pukatea and puriri. The last, much more common in this “kauri country” than in type E1 proper, is a vigorous tree, frequently continuing to grow though uprooted and prone, yet regeneration is hardly ever to be found.

Type B2. On the Waitakere Range there occurs a like complex of kauri, podocars, and hardwoods, also with a long history of fires and logging (for many species besides kauri). That forest has been differentiated as type B2 on account of a complete lack of towai and the virtual absence of taraire and puriri. Although there is a wide range of sites the type differs from type B1 again in that a considerable part lies on undulating land, where low ridges alternate with rather swampy depressions. In these depressions kauri occurs on the hummocks, but there has been scant regeneration in the wake of logging. But on the comparatively exceptional, elevated, narrow, dry ridges, poles, saplings and seedlings may be as abundant as in the farther north. The same is true of rimu, tanekaha, totara, and miro. On the undulating terrain, the type consists of scattered, usually small kauri (2), sparse to locally frequent podocars (10), and a dense mixture of hardwoods, chiefly northern rata, tawa, rewarewa, hinau, and pukatea. Below these prominent, pole kohekohe and tree ferns and nikau emerge from a luxuriant undergrowth, the commonest members of which are Olearia rani, Geniostoma ligustrifolium, Coprosma grandifolia, Alseuosmia spp., mahoe, supplejack, kiekie, Lygodium articulatum, Blechnum fraseri and Asplenium spp. Saplings and seedlings of kohekohe (300) and tawa (150) are frequent to locally abundant, but regeneration of the other hardwoods is rather sparse, that of hinau and pukatea in particular being, as far as has been ascertained, less than adequate.

Type C1. In North Auckland, hard beech is very rare but locally it occurs in significant numbers, in association with kauri. The total extent of kauri/hard beech forest is today probably less than 1,000 acres and it has for the most part been worked for large kauri and sometimes for beech. The chief areas of this type, type C1, occur on broken country in the Omahuta hinterland and on similar terrain on the fringes of the Hunua Range. In virgin stands, the kauri are frequent (20) but large trees are uncommon, the majority being under
30 in. d.b.h. and 80–100 ft high. Beech occur in similar numbers but very rarely exceed 20 in. d.b.h., are everywhere subdominant and usually have deep, rather ragged crowns. Occasional tanekaha (3), towai (2—present at Omahuta only), totara (1), rewarewa (1), and sparse rimu, miro, and hinu mingle with the beech. Taraire, tawa, and kohekohe appear at the margins of the type, down slope. From 20 to 50 ft there are often numerous to locally abundant beech poles (100), less frequently occurring clumps of kauri (50) and tanekaha (50), with a few poles of the other tree species. Shrubs and ground plants are sparse to moderately dense; the most common probably are rangiora, five-finger, tree ferns, Leucopogon fasciculatum, Dracophyllum latifolium, Senecio kirkii, Blechnum discolor, B. procerum, Astelia trinervia and kiekie. Seedlings of the major trees (including taraire and tawa) are all frequent to abundant, but of these as a rule only beech (sometimes kauri, tanekaha, totara, and rewarewa) are advancing through the sapling to the pole stage.

**Dense-podocarp Types (L Types)**

*Type L5.* Over the Auckland peninsula there are small fragments of forest dominated by dense podocarps. These stands represent comparatively recent forest colonisation and have developed on land which hitherto, permanently or temporarily, did not carry forest. The forests of the drier East Coast have been subjected to indiscriminate burning, the immediate reaction being development of *Leptospermum* scrub (type R1). This association, as described below, acts as nurse to the incoming podocarp species and where, because of fortuitous lack of a kauri seed source, the podocarps alone emerged from the scrub to close canopy, a distinct type, L5, must be recognised. Tanekaha tends to dominate spur and ridge crests and rimu and totara to dominate broad interflutes and ridge shoulders. Because insufficient time has passed since the major conflagrations that induced these stands, the podocarps are rarely mature and frequently have not developed past the pole stage. In many places spindly and moribund or dead manuka and kanuka under the podocarp canopy provide evidence of a former type R1 phase.

Another variant of type L5 is found on areas of poor drainage, sometimes peripheral to open swamps, and represents forest colonisation following a lowering of the water table. Large mature rimu (35) with rare large kahikatea form a closed canopy at about 100 feet and drawn up under them are scattered *Eugenia maire*, pukatea, taraire, *Ilex brexioides*, towai and a few rimu poles. A scattered shrub tier is composed of mahoe, smaller towai and *Ilex brexioides*, *Nothopanax edgerleyi*, pate, *Coprosma grandifolia*, *Melicytus macrophyllus*, *Olearia rani*, lancewood and tree ferns, while kiekie, *Gahnia xanthocarpa*, *Blechnum procerum* and mosses form a moderately dense ground cover. Taraire and tawa regenerate vigorously on the drier parts of the forest floor and there are also occasional seedlings of
rimu, miro, mangeao and pokaka. But the occasional large gaps in the rimu canopy, due to wind throw, are not being filled by that species. This and the development of vines of northern rata on a few of the rimu suggest a gradual transition from type L5 to type E2. Yet another variation, though at the present inexplicable and probably atypical in that it may not represent recent forest colonisation, is found on small slow-draining areas in Type B1 where kauri is locally absent. It takes the form of concentrations of mature rimu, totara, miro and Dacrydium kirkii. Further intensive ecological study will be necessary to elucidate the relationship between these enclaves of type L5 and the surrounding type B1.

Type L3. Another variation in the dense-podocarp group, this time warranting the status of another type, L3, is evident where dense kahikatea forms the podocarp component. This type, once widespread on low-lying swampy terrain, has long since disappeared save for minute remnants, and drainage has transmuted the type habitat to fertile farm land. Associated species are rather similar to those of the other swampy stands, taraira, Eugenia maire, and pukatea, although there is sometimes a little kohekohe. On a few swampy stream terraces in the heart of the forest tracts young stages of this type are evident where the stocking of kahikatea poles may reach 2,000 per acre. Here, too, Leptospermum remnants indicate a transition from type R1 to type L3.

Podocarp/Hardwood Types with Taraire (E Types)

Type E1. A major Northland type, E1, forms the bulk of lowland forest where kauri or kauri/podocarp/hardwood-mosaic forests are absent. Essentially, it consists of scattered northern rata and rimu emergent over dense kohekohe, taraira, tawa, and towai through which are interspersed hinau, pukatea, rewarewa, and miro. Puriri and totara occur sporadically, the latter in local concentrations.

The altitudinal range is up to 2,000 ft, though 1,800 ft is seldom exceeded. The type is neatly restricted to clay loams derived from andesitic and basaltic parent rock and thus occurs, on variable terrain, on the wetter western half of the Auckland peninsula. It is absent from the coastal margins of Herekino, Warawara, Ngapukehaua Range, and Waipoua, where concentrations of kauri exist, but is present farther east in these areas as a lowland-forest matrix. The Marlborough and Tutamoe plateaus are above its altitudinal limit, while in Waipoua it is confined to the shallow valleys dissecting the plateau and to the lower plateau flanks. Again, it covers extensive areas at lower altitudes at Raetea and occurs similarly, though in small pockets, on the Tangihua Range and the adjacent forested uplands north of it.

Over the greater part of the type area, on all sites except ridges and gully bottoms, predominantly large-diameter rimu (1–2) and northern
rata (2–3) (the latter often on pukatea hosts) and rare large kahikatea reach to heights between 70 and 100 ft above a moderately dense 40–60 ft tier of mature hardwoods. This latter is dominated by taraire (20), towai (11), kohekohe (10), and tawa (6), and contains in addition pukatea (2), rewarewa (2), hinau (1–2), miro (1), rare karaka, northern rata, puriri, and large *Cyathea medullaris*. Totara occurs too sporadically for an average-per-acre figure to be significant; it is absent over large areas but an acre plot which was measured carried 34 trees. Then from 6 ft up to 40 ft there is a dense, variable aggregation of shrub species, immature tree species, tree ferns and lianes: *Cyathea* and *Dicksonia* spp. (50–100), kohekohe saplings and poles (100–200), nikau palms (40), rewarewa saplings and poles (37), tawa saplings and poles (28), taraire saplings and poles (42), towai poles (20), pukatea saplings and poles (2), hinuau poles (2), totara saplings and poles (1), miro saplings and poles (1), and wineberry, mangleo, *Olea* spp., pigeonwood, mahoe, fuchsia, *Coprosma grandifolia*, pate, *Olearia rani*, and toro, the whole often festooned with supplejack, kiekie, and epiphytes. Between ground level and 6 ft is the moderately dense seedling, shrub, and ground-cover tier, locally depleted by wild cattle. Seedlings are well represented: kohekohe (250–500), rewarewa (100–500), taraire (50–200), tawa (50–300), pukatea (up to 200), miro (40), totara (up to 30), rimu (up to 15), hinuau (up to 10), *Olea* spp. (5). Other prominent species are *Geniostoma ligustrifolium*, young nikau palms and tree ferns, mahoe, *Coprosma grandifolia*, climbing ratas, supplejack, pate, *Hymenophyllum* spp., *Rhabdodiamnus solandri*, towai, *Lygodium articulatum*, toro, *Alseuosmia macrophylla*. A variable forest floor cover is formed by *Dryopteris pennisetra*, kiekie, *Blechnum* spp., *Elatostema rugosum*, *Hymenophyllum* spp., and forest litter.

On ridges, the stocking of kohekohe, taraire, tree ferns and nikau decreases sharply, and on steep dry crests these species are frequently absent. There is a concomitant increase in stocking of rimu, miro, and rewarewa, while mangleo, *Cardiomanes reniforme* and *Austelia trinervia*, less common on other sites, appear in profusion. In gullies and narrow valley bottoms the stocking of pukatea increases and there is thick *Hoheria populnea*, mahoe, pate, and *Elatostema rugosum*.

A feature of the type is the paucity of podocarp regeneration. On the 35 sample plots examined in the type no saplings nor poles of rimu were tallied and only a few seedlings. Miro regeneration is sparse, as mentioned above, only one sapling or pole and about 40 seedlings per acre, except on ridges where the former class increases approximately sevenfold. There is a similar ridge stocking for the sapling and pole stages of totara. Regeneration of other podocarps is negligible.

*Type E2* differs from the more extensive type E1 in that it lacks mature kohekohe, though scattered seedlings may be present, and puriri, karaka, and mangleo are absent; otherwise the general structure and composition are similar. It occurs generally at higher altitudes.
than type E1, up to 2,100 ft, or on wet sites which preclude the development of kohekohe; here the pattern of type distribution is small pockets of type E2 on slow-draining sites in a matrix of type E1. Hence it is found on soils derived from andesite and basalt at Raetea, Warawara, Waipoua, Tutamoe, and Marlborough and on the Ngapukehua Range, though it does not reach the exposed plateau tops or watershed crests; it is absent from Herekino as this upland does not rise above the altitudinal limit of kohekohe. The stocking of taraire is appreciably lower than in type E1, but towai, *Eugenia maire* and *Ixerba brexioides* are much more prominent. *Ackama rosaefolia* and *Nothopanax edgerleyi* are conspicuous. Kohekohe, taraire, tawa, and towai are regenerating vigorously but podocarp regeneration is scant.

**Type E3.** On the mainland and extending from near Omaha Forest (8 miles north-west of Warkworth) southwards to and including most of the Hunua Range is a “Weinmannia gap” where neither towai nor kamahi exists. The absence of towai as a physiognomic prominent represents a significant type difference and accordingly the minor type E3 has been separated from type E1. It occurs on sandstone soils in pockets of forest north of Auckland and on clay loams on the northern flanks of the greywacke Hunua Range, usually well below 1,200 ft. There is much similarity in both structure and composition with type E1, save for the absence of towai from the hardwood tiers below the emergent rimu and northern rata. There is a marked diminution of taraire (the type occurs at the southern limit of this species), and hinau, miro, and totara are less prominent than in type E1. Concomitantly the stocking of rewarewa and puriri increases and tree ferns are much more abundant. There is profuse regeneration of kohekohe and good regeneration of taraire, rewarewa, tawa, and hinau. Podocarp advance growth is again scarce, comprising a few poles of rimu and totara, mainly on ridges and spurs, but little else save scattered seedlings of rimu, totara, miro, and kahikatea.

**Type N6.** A further minor type, type N6, characterised by the co-prominence of kohekohe, taraire, towai, tawa, rewarewa and occasionally northern rata and hinau, by the profusion of scrub hardwoods (hoheria, *Coprosma grandifolia*, mahoe, *Olearia rani*, pate, *Geniostoma ligustrifolium*) and by the virtual absence of podocarps, is a composite one. On steep exposed valley sides such a hardwood association, of scrubby form, occurs as an expression of severe conditions. Also, preferential exploitation of podocarps in type E1 has induced a similar assemblage of species which differs only in having a higher forest canopy and in the prevalence of puriri, often of coppice origin, which was probably favoured by the cultural interference. In both sub-types there is little podocarp regeneration—the trend is towards perpetuation of the hardwood cover. The distribution of type N6 is similar to that of type E1 but it occurs as small scattered pockets instead of in broad tracts.
Podocarp/Hardwood Types without Taraire (D Types)

There are four podocarp/hardwood associations in which taraire is lacking; two occur only on highlands in the north and the others only on the Hunua Range, in the very south of the Land District. A low but regular stocking of rimu and northern rata is a common feature but otherwise there are some clear-cut differences in composition.

Type D6 occurs on the Waipoua, Marlborough and Tutamoe Plateaux, between 1,500 and 2,000 ft altitude. There are further small areas of it on Warawara Upland and other high points in the north. Typically, scattered medium-sized to large rimu (4) and northern rata (3), 80–100 ft tall, are conspicuous above occasional miro (2), rewarewa (2), and pukatea (2) and rare totara, which in turn stand out above a dense 40 to 60 ft high tier of very frequent small towai (34) and occasional to locally frequent tawa (7), Ixerba brexioides (4) and hinau (3). Eugenia maire (1) occurs on the wetter sites, while Ackama rosaefolia (1) also is locally prominent. Quintinia is present only at Warawara and in central North Auckland. There are moderately dense to dense lower tiers, the principal species are tree ferns, mahoe, pigeonwood, Olearia rani, Coprosma grandifolia, supplejack, kiekie, Blechnum spp. and Asplenium spp. Towai poles or shrubby aggregates are abundant (120), and occasional to locally frequent are poles of tawa (20), hinau (10), Ixerba brexioides (10) and pukatea (4). Towai and tawa seedlings are common, while rimu and miro seedlings occur in scattered patches. It is noteworthy that in this type hinau seedlings (70) are in places abundant while rewarewa regeneration is sparse throughout.

Type F2. In the central, highest portions of the plateaux, at 2,000 to 2,200 ft above sea level, are stretches of undulating country, usually very poorly drained. On this land occurs type F2, fundamentally similar to type D6 but differing significantly in that tawa is absent. The numbers of miro, rewarewa, pukatea, and hinau are halved, with a concomitant increase in Eugenia maire (5). Ixerba brexioides (5) remains common but Ackama rosaefolia is never prominent. There are a few kahikatea widely scattered through this forest. All trees tend to be more stunted and malformed than in type D6. Then, in type F2 there is a great increase in the underwood of fuchsia, pate, toro, Nothopanax edgerleyi and filmy ferns. Poles of towai (120), Ixerba brexioides (20), Eugenia maire (10), and hinau (5) are prominent but advance growth of other trees is very rare and there are few seedlings of any size towai.

Type D5. The most extensive forest association of the Hunua Range is type D5. The dominant trees are rimu and northern rata. There are seldom more than 1 or 2 of each per acre but they are usually very large, with far-spreading crowns. Many rimu are overmature and many rata dead or dying; wind throw of both has occurred frequently.
in recent years. Smaller miro and totara occur sparsely, except for occasional groups on sharp ridge crests. From 40 to 70 ft there is a rather irregularly developed tier of hardwoods (mainly small), the canopy being broken by frequent minor gullies or small slips and wind falls. The most common trees are tawa (25), dominant, and kohekohe (10), sub-dominant generally but co-dominant on lower valley sides. Rewarewa (4) and hinau (2) occur regularly while pukatea is a frequent minor emergent in gullies. From 10 to 30 ft, tree ferns, nikau, mahoe, pigeonwood, *Olearia rani*, *Coprosma grandifolia* and supplejack are prominent, pate and fuchsia locally so. Kohekohe poles are abundant and tawa usually frequent while there are occasional poles of the other hardwoods. Podocarp poles (and saplings and seedlings) are generally rare but are to be found in small groups on some old slip faces or on the forest margins. The smaller shrubs and ground plants have been much reduced by goats and cattle; animal damage is more severe than elsewhere in North Auckland. However, hardwood saplings and seedlings (the most profuse being kohekohe, tawa, and rewarewa) have been little affected. Kohekohe seedlings appear to be paid little attention by possums, which are numerous and have defoliated much adult kohekohe and fuchsia.

*Type D8* covers a much smaller total area than does type D5, being confined to the narrow terraces and lower valley sides above the major streams. In many respects it is virtually identical with type D5 but it contains neither kohekohe nor nikau, while kahikatea and matai are present (though few and far between). In the lower tiers there are occasional quintinia and very rare towai. Despite the absence of kohekohe and nikau the stocking of other trees or of shrubs does not increase. There is, however, a superabundance of tree ferns; on all sites there are from 300 to 600 of these per acre.

Coastal Types (Q Types)

*Type Q1*. Within half a mile of the coast, forests are characterised by the presence of frequent pohutukawa, some ngaio and kowhai, and local abundance of karaka. On cliffs, scattered pohutukawa are the only trees present; otherwise they may occur in dense stands, as many as 50 large trees per acre, with multi-branched, arching crowns, overshadowing an equally dense lower tier of small karaka. Such distinct forest is, however, rather restricted in extent. Usually, many of the lowland hardwoods, especially puriri and kohekohe, are present, and sometimes kauri and podocarps, which both in places grow within a stone's throw of the sea. The natural variability of this broad coastal type, type Q1, has almost universally been increased by fire, axe, and Maori propagation of karaka. It is nowhere extensive, consisting mainly of remnants about the bays of the East Coast and the coastwise gulches and spurs of the western Waitakere Range. Nothing can be said here of succession in general as most stands are farmland.
pockets much frequented and modified by stock. In some reserves, however, there is profuse regeneration of kauri and podocarps amid patches of *Leptospermum* scrub.

*Type Q3.* In the estuaries and creeks so common in North Auckland, tidal mud flats are overgrown with mangrove scrub, dense *Avicennia officinalis* 10–30 ft high, type Q3. Though of undoubted importance in the spheres of harbour engineering or land reclamation these stands are not likely to become a direct concern of the forester. To date, they have not been sampled by the National Forest Survey; for further information the reader may consult Cockayne (1928).

Scrub Types (R Types)

The total area of scrub is probably twice that of forest. The two major scrub types are most distinctive, though occasionally they do merge. On the one hand is the *Leptospermum* association, type R1, widespread below 1,000 ft altitude on the degraded gumlands and ironstone soils, bordering the main forest tracts in lower-rainfall or drought-subject localities or where there have been repeated fires, and forming an intricate patchwork with forest remnants along the entire east coast. When fire and stock are excluded, and where the soil has not been utterly impoverished by centuries of burning, these *Leptospermum* stands may shelter juvenile forest, eventually to be dominated by kauri, podocarps, towai, or rewarewa, depending on circumstances. Such seral associations have well defined structures and easily discerned stages of development. On the other hand is the less common mesophytic scrub, type R2. The outcome of abandoned farming ventures or intensive logging, the type occurs mainly at 1,500–2,000 ft above sea level on the very wet soils of the Waipoua, Marlborough, and Tutamoe plateaux and on similar but lower sites of the central and western Waitakere Range. Elsewhere, it may occur fragmentally in gullies below ridges carrying type R1. There is no consistent composition; this scrub is a welter of scrub hardwoods, tree ferns, shrubs, lianes, and scramblers, with no kauri and typically a low irregular stocking of podocarp and major-hardwood regeneration. In the north it seems that towai will ultimately dominate; a few small stands clearly have developed from type R2 to type P2, the latter a forest of towai with rewarewa the only regular associate. Where towai is absent, as it is on the Waitakere Range, it appears likely that *Pittosporum tenuifolium* and mahoe or, in the long run, perhaps kohekohe, will take its place.

It will be appreciated that there is much variation throughout both scrub types. Only very generalised descriptions are attempted here. In type R1, manuka usually is initially dominant, then gives way to kanuka, the latter finally predominating as spindly poles (200), 30–50 ft high, with light, fan-shaped crowns. If there are seed sources, on ridges and spurs, kauri, tanekaha, and towai seedlings will appear in great abundance while the leptospermums are still hardly 10 ft
high, associated with a dense ground cover consisting mainly of \textit{Leucopogon fasciculatum}, \textit{Senecio kirkii}, \textit{Gleichenia} spp. and \textit{Lycopodium} spp. As the kanuka reaches maximum height and manuka dies out, kauri and tanekaha poles start to overtake them, kauri in the van. There are usually less than 100 kauri poles per acre; tanekaha often is denser, with up to 400 stems. Saplings and seedlings of these persist below, with bushy aggregates of towai, emerging from a ground cover enriched by the incoming of \textit{Alseuosmia} spp. \textit{Cytisus} \textit{dealbata}, \textit{Asterol} spp., \textit{Gahnia} spp. and so on. Characteristically, rimu and totara are present in appreciable numbers just off the dry ridge crests and there may be as many as 100 poles and saplings of either per acre. Down slope, the subsidiary growth is more luxuriant and varied. \textit{Geniostoma ligustrifolium}, \textit{Suttonia australis}, \textit{Coprosma} spp., pigeonwood and tree ferns, for instance, become profuse; there is a marked reduction of kauri and podocarps. Hardwoods other than manuka, kanuka and towai are rarely prominent, with the exception of rewarewa, which occurs sparsely, though consistently, in the north and becomes common and “aggressive” in the south. Puriri regeneration is a very local feature. Seedlings and saplings of kohekohe, taraire, tawa, and maire appear in fair numbers (about 100 per acre) in places, most frequently on lower valley sides. To sum up, however, it must be stressed that redevelopment of forest is localised. There are very extensive areas of stunted \textit{Leptospermum}, with varying admixtures of \textit{Pomaderris} spp., \textit{Dracophyllum} spp., \textit{Epacris} spp., \textit{Schoenus} \textit{tendo}, \textit{Gleichenia} spp. and \textit{Lycopodium} spp.

On the high plateaux east of Waipoua, type R2 consists principally of a dense mixture of 20–40 ft high towai, toro, \textit{Eugenia maire}, \textit{Ixerba brexioides}, \textit{Ackama rosalifolia} and \textit{Dicksonia squarrosa}, supporting tangles of kiekie and supplejack. Below, \textit{Coprosma grandifolia}, \textit{Nothopanax edgerley} and various other shrubs grow in profusion. Of merchantable species, rimu and rewarewa are most common. On the average, there are about 2 poles of each per acre and a dozen or so saplings and seedlings. Locally there is a similar amount of tawa regeneration, and here and there a very little of kaikatea, miro, pukatea, and hinuau. On the Waitakere Range, the scrub is dominated by abundant tree ferns and nikau, with \textit{Pittosporum tenuifolium} very frequent and with much mahoe, \textit{Olearia rani}, and lancewood. There is a comparable density of smaller shrubs—here such species as \textit{Geniostoma ligustrifolium}, \textit{Suttonia australis} and \textit{Nothopanax arboreum} are prominent—while often the ground is covered by kiekie and \textit{Gahnia} spp. Small, or large but moribund rimu, northern rata, and lowland major hardwoods, unwanted by the loggers, occur occasionally but there is scant regeneration other than seedlings, usually infrequent. Kohekohe regeneration alone may be locally abundant.

REFERENCES
SUMMARY OF FOREST TYPES

Kauri Types

A1 Dense kauri over scattered rimu, miro, totara, and towai and local tanekaha, Dacrydium kirkii, tawa, taraire, and Ixerba brexioides.
A2 Similar to A1 but towai and taraire absent.
B1 Intricate mosaic of small kauri stands similar to A1 and podocarp/hardwood forest similar to E1.
B2 A complex similar to B1 but towai and taraire absent.
C1 Kauri and hard beech dominant; varying admixtures of podocarps and hardwoods.

Dense-podocarp Types

L5 Dense podocarps with rimu dominant; totara and tanekaha locally prominent on drier sites.
L3 Remnants of kahikatea swamp forest.

Podocarp/Hardwood Types with Taraire

E1 Scattered northern rata and rimu emergent over dense hardwoods dominated by kohekohe, towai, taraire, and tawa.
E2 Similar to E1 but kohekohe absent.
E3 Similar to E1 but towai absent and less taraire.
N6 Selective exploitation or exposure has eliminated rimu and induced dense hardwoods dominated by kohekohe, towai, taraire, tawa, rewarewa and scrub hardwoods.

Podocarp/Hardwood Types without Taraire

D6 Scattered northern rata and rimu emergent over dense hardwoods dominated by towai, tawa, hinau and Ixerba brexioides.
F2 Similar to D6 but tawa absent and Eugenia maire prominent.
D5 Scattered northern rata and rimu emergent over dense hardwoods dominated by tawa and kohekohe; towai absent.
D8 Similar to D5 but kohekohe absent.

Coastal Types

Q1 Mainly hardwood forest with pohutukawa, karaka, puriri, and kohekohe dominant.
Q3 Estuarine mangroves.

Scrub Types

R1 Leptospermum dominant; young kauri, podocarps, towai, and rewarewa occur locally.
R2 Scrub hardwoods and tree ferns dominant; other hardwoods occur locally.
P2 Hardwood forest with towai or rewarewa dominant; developed from R2.
<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Common Name</th>
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<tr>
<td>Five-finger</td>
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