THE FORESTS AND SCRUBLANDS OF THE TARAMAKAU AND THE EFFECTS OF BROWSING BY DEER AND CHAMOIS

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SUMMARY: The forests and scrublands of the Taramakau catchment can be divided into six sub-climax associations and two seral associations. The sub-climax associations are subalpine scrub, bushline, rata-totara, red beech, silver beech and mountain beech forest. Except for silver beech forest and mountain beech forest, which are largely restricted to the Otehake tributary, site differentiation between these associations is generally altitudinal. These sub-climax associations appear to be regenerating satisfactorily except, perhaps, for red beech forest where there is a slight regeneration gap.

The two seral associations, kamahi forest and short scrub-hardwood forest, generally occur on unstable soils. Both show marked regeneration gaps which can be related to the presence of terrestrial browsing mammals. These two associations comprise over half the forest in the upper Taramakau and lower north Taramakau, and consequently the condition of these two areas must be regarded as critical.

INTRODUCTION

A survey of the condition of the forest and scrublands of the upper Taramakau catchment, east of the Kelly Range, was made during January and February 1969. 243 sociological descriptions of stands throughout the area during this survey form the basis of the present report. A further 20 permanent plots will form datum points to aid in interpretation of future changes which may occur in the vegetation. The layout and measurement of these permanent plots will be described elsewhere.

The 243 sociological descriptions, or temporary plots, were located at 9-chain intervals along 34 altitudinal transects. The starting points of these transects were chosen in a restricted random fashion along the major streambeds, and the direction of the transect in each instance followed the compass bearing representing the shortest distance, plus 5 degrees from the random starting point to the top of the scrub belt.

Each temporary plot involved listing all species of vascular plants which occurred within each of the five tiers delineated by the following heights: stand top height, 40 feet, 15 feet, 6 feet, 1 foot and ground level. The lianes, epiphytes and parasites were recorded separately. The physiognomic dominant species and the density of each tier were indicated with the altitude, aspect, slope, physiography, parent rock, soil drainage and site stability of each plot. The species of plants which showed obvious evidence of having been browsed were noted with the degree of browsing being recorded as light, moderate or heavy.

ASSOCIATIONS

Composition and structure

The plots were divided into eight associations according to the species of vascular plants present. A classification procedure was adopted in which a group of 'nodal' plots was chosen for each association, and then an index of similarity, 'Sorensen's K' was applied to test closest affinities of all other plots. Each species in each plot or, in nodes, each group of plots, was assigned an importance rating which was the percentage frequency occurrence weighted 2:1 towards dominance. Comparisons were made according to the ratio of importance ratings shared to total importance ratings. The purpose of this was to simplify the placing of ecotonal plots and to introduce an element of objectivity into the classification.

The following descriptions of each of the eight associations include the mean complexity of all vascular species and the mean stand height. For each, the standard error for $P=0.05$ is given. The composition of each type is described by tiers. Within each tier, 'major species' refer to those vascular plants with percentage frequencies ranging from 60–100; 'minor species' refer to those with frequencies from 20–60; and species with frequencies less than 20 percent are ignored. The relative densities for each of the tiers is given in Table 1.

TABLE 1. *The relative densities for each stratum of each vegetation association*

Association	Density class	Height limits of strata within plots 6′+	40′+	15′–40′	6′–15′	1′–6′	<1′
Kamahi forest	Dense	24%	15%	13%	24%	18%	18%
	Moderate	56	41	77	44	32	64
	Open	20	44	10	32	50	18
Red beech forest	D	44	6	40	17	16	22
	M	47	56	55	42	32	39
	O	9	37	5	41	52	39
Rata-totara forest	D	33	—	30	21	13	30
	M	59	62	62	59	42	25
	O	8	38	8	20	45	45
Short scrub-hardwood forest	D	3	—	10	7	4	66
	M	34	—	54	57	20	17
	O	63	100	36	36	76	17
Bushline forest	D	15	—	11	45	28	15
	M	54	—	63	45	36	55
	O	31	100	26	10	36	30
Subalpine scrub	D	8	—	—	27	64	47
	M	20	—	—	53	24	24
	O	72	—	—	20	12	29
Silver beech forest	D	55	30	—	27	18	20
	M	36	20	64	55	27	60
	O	9	50	36	18	55	20
Mountain beech forest	D	40	—	50	50	50	—
	M	20	50	25	25	50	50
	O	40	50	25	25	—	50

The description of each association follows:

1. SUBALPINE SCRUB

No. of plots 28
Mean stand height 10.6 ± 1.7 feet
Mean complexity 22.8 ± 3.0 species
Tier composition
Tier 1 and 2: Absent.
Tier 3: (6–15 feet)
Major spp: Nil.
Minor spp: *Dracophyllum longifolium, Dracophyllum traversii, Olearia lacunosa, Dacrydium biforme.*
Tier 4: (1–6 feet)
Major spp: *Phormium colensoi, Dracophyllum uniflorum, Coprosma pseudocuneata, Podocarpus nivalis.*
Minor spp: *Phyllocladus alpinus, Olearia lacunosa, Dracophyllum longifolium, Olearia nummularifolia, Myrsine divaricata, Chionochloa pallens, Chionochloa cunninghamii, Archeria traversii, Olearia colensoi, Blechnum capense.*
Tier 5: (<1 feet)
Major spp: *Blechnum capense.*
Minor spp: *Podocarpus nivalis, Celmisia* spp., *Uncinia* spp., *Phormium colensoi, Gaultheria rupestris, Coprosma pseudocuneata, Phyllocladus alpinus, Dracophyllum uniflorum, Astelia nervosa, Senecio bennettii, Polystichum vestitum, Ranunculus hirtus, Ourisia macrophylla, Luzula picta, Hebe* spp., *Myrsine divaricata, Griselinia littoralis, Dracophyllum longifolum, Epilobium* spp., *Erechtites* spp., *Myrsine nummularia, Olearia lacunosa, Viola filicaulis, Blechnum fluviatile, Anisotome* spp., *Chionochloa cunninghamii, Chionochloa pallens, Coprosma parviflora, Hoheria glabrata, Acaena anserinifolia, Poa colensoi.*

2. BUSHLINE FOREST

No. of plots 47
Mean stand height 27.1 ± 4.1 feet
Mean complexity 26.1 ± 1.2 species
Tier composition
Tier 1: Absent.
Tier 2: (15–40 feet)
Major spp: Nil.
Minor spp: *Griselinia littoralis, Metrosideros umbellata, Libocedrus bidwillii, Podocarpus hallii, Phyllocladus alpinus, Dracophyllum traversii, Dacrydium biforme, Weinmannia racemosa.*
Tier 3: (6–15 feet)
Major spp: *Griselinia littoralis, Phyllocladus alpinus, Archeria traversii.*
Minor spp: *Dracophyllum traversii, Dracophyllum longifolium, Dacrydium biforme, Coprosma pseudocuneata, Myrsine divaricata, Podocarpus hallii, Pseudopanax lineare, Coprosma foetidissima, Metrosideros umbellata, Pseudopanax simplex, Olearia avicenniaefolia.*

Tier 4: (1–6 feet)
Major spp: *Myrsine divaricata, Coprosma pseudocuneata, Phyllocladus alpinus, Podocarpus hallii, Archeria traversii.*
Minor spp: *Phormium colensoi, Coprosma foetidissima, Dacrydium biforme, Dracophyllum longifolium, Dracophyllum traversii, Coprosma parviflora, Pseudowintera colorata, Gahnia procera.*
Tier 5: (<1 feet)
Major spp: *Griselinia littoralis, Pseudopanax simplex, Blechnum capense, Podocarpus hallii, Coprosma foetidissima, Coprosma pseudocuneata.*
Minor spp: *Myrsine divaricata, Senecio bennettii, Phyllocladus alpinus, Grammitis billardieri, Blechnum minus, Archeria traversii, Coprosma ciliata, Coprosma parviflora, Hoheria glabrata, Weinmannia racemosa, Pseudopanax colensoi, Uncinia filiforme, Polystichum vestitum, Pseudopanax lineare, Phormium colensoi, Podocarpus nivalis, Metrosideros umbellata, Dracophyllum longifolium, Dacrydium biforme.*
Tier 6: (lianes, epiphytes, etc.)
Major spp: Nil.
Minor spp: *Hymenophyllum sanguinolentum, Grammitis billardieri, Griselinia littoralis.*

3. RATA-TOTARA FOREST

No. of plots 39
Mean stand height 52.3±5.6 feet
Mean complexity 24.8±1.8 species
Tier composition
Tier 1: (40 feet+)
Major spp: *Metrosideros umbellata, Podocarpus hallii.*
Minor spp: *Weinmannia racemosa, Nothofagus fusca.*
Tier 2: (15–40 feet)
Major spp: *Weinmannia racemosa, Podocarpus hallii, Griselinia littoralis, Quintinia acutifolia.*
Minor spp: *Metrosideros umbellata, Pseudopanax simplex.*
Tier 3: (6–15 feet)
Major spp: *Podocarpus hallii, Pseudowintera colorata, Weinmannia racemosa, Griselinia littoralis.*
Minor spp: *Myrsine divaricata, Quintinia acutifolia, Coprosma foetidissima, Coprosma pseudocuneata, Metrosideros umbellata, Pseudopanax simplex, Pseudopanax crassifolium.*
Tier 4: (1–6 feet)
Major spp: *Podocarpus hallii, Pseudowintera colorata, Myrsine divaricata.*
Minor spp: *Phyllocladus alpinus, Blechnum discolor, Coprosma foetidissima, Quintinia acutifolia, Coprosma rhamnoides, Weinmannia racemosa, Metrosideros umbellata, Pseudopanax simplex, Coprosma parviflora, Cyathea smithii, Coprosma pseudocuneata, Pseudopanax crassifolium.*
Tier 5: (<1 feet)
Major spp: *Coprosma foetidissima, Grammitis billardieri, Podocarpus hallii, Griselinia littoralis, Pseudopanax simplex, Weinmannia racemosa, Blechnum capense, Hymenophyllum* spp.
Minor spp: *Myrsine divaricata, Metrosideros umbellata, Pseudowintera colorata, Quintinia acutifolia, Blechnum minus, Polystichum vestitum, Coprosma pseudocuneata, Coprosma parviflora, Blechnum discolor, Phyllocladus alpinus, Blechnum fluviatile, Nertera dichondraefolia, Uncinia filiforme, Microlaena avenaceae, Pseudopanax colensoi, Coprosma ciliata, Nothofagus fusca, Pseudopanax crassifolium, Coprosma rhamnoides.*
Tier 6: (lianes, epiphytes, etc.)
Major spp: Nil.
Minor spp: *Coprosma foetidissima, Griselinia littoralis, Grammitis billardieri, Asplenium flaccidum, Hymenophyllum* spp., *Metrosideros umbellata, Weinmannia racemosa, Rubus cissoides, Pseudopanax simplex, Phymatodes diversifolium, Quintinia acutifolia.*

4. KAMAHI FOREST

No. of plots 41
Mean stand height 54.0±4.1 feet
Mean complexity 23.6±2.0 species
Tier composition
Tier 1: (40 feet+)
Major spp: *Weinmannia racemosa.*
Minor spp: *Metrosideros umbellata, Quintinia acutifolia, Podocarpus hallii, Podocarpus ferrugineus.*
Tier 2: (15–40 feet)
Major spp: *Weinmannia racemosa, Griselinia littoralis, Carpodetus serratus.*
Minor spp: *Quintinia acutifolia, Fuchsia excorticata, Aristotelia serrata, Pseudowintera colorata.*
Tier 3: (6–15 feet)
Major spp: *Pseudowintera colorata, Weinmannia racemosa.*
Minor spp: *Quintinia acutifolia, Cyathea smithii, Griselinia littoralis, Carpodetus serratus, Aristotelia serrata, Pseudopanax simplex, Schefflera digitata, Podocarpus hallii.*
Tier 4: (1–6 feet)
Major spp: *Pseudowintera colorata, Cyathea smithii, Blechnum discolor.*
Minor spp: *Coprosma rhamnoides, Histiopteris incisa, Myrsine divaricata, Podocarpus hallii, Quintinia acutifolia, Weinmannia racemosa, Aristotelia serrata, Coprosma parviflora, Coprosma foetidissima, Griselinia littoralis.*
Tier 5: (<1 feet)
Major spp: *Griselinia littoralis, Blechnum fluviatile, Pseudowintera colorata, Polystichum vestitum.*
Minor spp: *Weinmannia racemosa, Grammitis billardieri, Asplenium bulbiferum, Coprosma foetidissima, Hymenophyllum* spp., *Blechnum lanceolatum, Nertera dichondraefolia, Carpodetus serratus, Blechnum discolor, Pseudopanax simplex, Coprosma rhamnoides, Cyathea smithii, Quintinia acutifolia, Schefflera digitata, Aristotelia serrata, Todea superba, Myrsine divaricarta, Pseudopanax colensoi, Blechnum capense.*
Tier 6: (lianes, epiphytes, etc.)
Major spp: *Phymatodes diversifolium.*
Minor spp: *Asplenium flaccidum, Rubus cissoides, Metrosideros diffusa, Griselinia littoralis, Coprosma foetidissima, Grammitis billardieri, Weinmannia racemosa.*

5. RED BEECH FOREST

No. of plots 33
Mean stand height 70.8±5.9 feet
Mean complexity 23.0±2.1 species
Tier composition
Tier 1: (40 feet+)
Major spp: *Nothofagus fusca, Weinmannia racemosa.*

Minor spp: *Quintinia acutifolia.*
Tier 2: (15–40 feet)
Major spp: *Weinmannia racemosa, Nothofagus fusca, Quintinia acutifolia, Griselinia littoralis.*
Minor spp: *Carpodetus serratus, Fuchsia excorticata, Aristotelia serrata, Pseudowintera colorata, Pseudopanax crassifolium.*
Tier 3: (6–15 feet)
Major spp: *Weinmannia racemosa, Griselinia littoralis, Quintinia acutifolia.*
Minor spp: *Pseudowintera colorata, Podocarpus hallii, Pseudopanax crassifolium, Nothofagus fusca, Aristotelia serrata.*
Tier 4: (1–6 feet)
Major spp: *Pseudowintera colorata, Blechnum discolor.*
Minor spp: *Quintinia acutifolia, Weinmannia racemosa, Cyathea smithii, Myrsine divaricata, Coprosma rhamnoides, Coprosma parviflora, Histiopteris incisa, Podocarpus hallii, Coprosma foetidissima, Griselinia littoralis.*
Tier 5: (<1 feet)
Major spp: *Coprosma foetidissima, Weinmannia racemosa, Griselinia littoralis, Nothofagus fusca, Pseudowintera colorata.*
Minor spp: *Blechnum fluviatile, Blechnum discolor, Polystichum vestitum, Quintinia actutifolia, Nertera dichondraefolia, Coprosma parviflora, Metrosideros diffusa, Pseudopanax simplex, Blechnum capense, Carpodetus serratus, Histiopteris incisa, Asplenium bulbiferum, Microlaena avenaceae, Blechnum minus, Podocarpus hallii.*
Tier 6: (lianes, epiphytes, etc.)
Major spp: Nil.
Minor spp: *Rubus cissoides, Weinmannia racemosa, Griselinia littoralis, Asplenium flaccidum, Coprosma foetidissima, Metrosideros diffusa, Phymatodes diversifolium.*

6. SILVER BEECH FOREST

No. of plots 11
Mean stand height 62.3±8.4 feet
Mean complexity 18.8±3.6 species
Tier composition
Tier 1: (40 feet+)
Major spp: *Nothofagus menziesii, Nothofagus fusca.*
Minor spp: Nil.
Tier 2: (15–40 feet)
Major app: *Nothofagus menziesii.*
Minor spp: *Nothofagus fusca, Griselinia littoralis, Weinmannia racemosa.*
Tier 3: (6–15 feet)
Major spp: *Nothofagus menziesii, Nothofagus fusca, Griselinia littoralis.*
Minor spp: *Coprosma pseudocuneata, Myrsine divaricata, Weinmannia racemosa, Podocarpus hallii.*
Tier 4: (1–6 feet)
Major spp: *Nothofagus menziesii, Myrsine divaricata, Coprosma pseudocuneata.*
Minor spp: *Nothofagus fusca, Coprosma parviflora, Phyllocladus alpinus, Griselinia littoralis, Olearia lacunosa, Coprosma foetidissima, Pseudowintera colorata.*
Tier 5: (<1 feet)
Major spp: *Nothofagus menziesii, Coprosma parviflora, Polystichum vestitum, Myrsine divaricata, Coprosma pseudocuneata, Pseudopanax simplex, Uncinia rupestris, Uncinia ferrugineus, Nothofagus fusca.*
Minor spp: *Coprosma foetidissima, Griselinia littoralis, Blechnum fluviatile, Grammitis billardieri, Ourisia sessilifolia.*
Tier 6: (lianes, epiphytes, etc.)
Major spp: *Hymenophyllum* spp.
Minor spp: *Grammitis billardieri, Coprosma foetidissima, Griselinia littoralis, Asplenium flaccidum,.*

7. MOUNTAIN BEECH FOREST

No. of plots 5 (a minor type)
Mean stand height 36.0±16.1 feet
Mean complexity 23.0±6.0 species
Tier composition
Tier-1: (40 feet+) Absent
Tier 2: (15–40 feet)
Major spp: *Nothofagus cliffortioides, Phyllocladus alpinus.*
Minor spp: *Nothofagus menziesii, Libocedrus bidwillii, Nothofagus fusca.*
Tier 3: (6–15 feet)
Major spp: *Archeria traversii, Nothofagus cliffortioides, Phyllocladus alpinus, Griselinia littoralis, Myrsine divaricata, Pseudopanax lineare.*
Minor spp: *Dacrydium biforme, Dracophyllum longifolium, Nothofagus menziesii, Pseudopanax simplex, Podocarpus hallii.*
Tier 4: (1–6 feet)
Major spp: *Phyllocladus alpinus, Archeria traversii, Myrsine divaricata.*
Minor spp: *Nothofagus cliffortioides, Dacrydium biforme, Podocarpus hallii.*
Tier 5: (<1 feet)
Major spp: *Phyllocladus alpinus, Pseudopanax simplex, Coprosma pseudocuneata, Coprosma foetidissima, Nothofagus cliffortioides.*
Minor spp: *Dacrydium biforme, Blechnum capense, Griselinia littoralis, Myrsine divaricata, Archeria traversii, Dracophyllum longifolium, Podocarpus hallii.*
Tier 6: (lianes, epiphytes, etc.)
Major spp: Nil.
Minor spp: *Hymenophyllum sanguinolentum, Grammitis billardieri.*

8. SHORT SCRUB-HARDWOOD FOREST

No. of plots 39
Mean stand height 36.0±5.5 feet
Mean complexity 26.0±2.2 species
Tier composition
Tier 1: (40 feet+) Absent.
Tier 2: (15–40 feet)
Major spp: *Hoheria glabrata, Griselinia littoralis.*
Minor spp: *Fuchsia excorticata, Olearia ilicifolia, Myrsine divaricata, Aristotelia serrata.*
Tier 3: (6–15 feet)
Major spp: Nil.
Minor spp: *Myrsine divaricata, Pseudowintera colorata, Hoheria glabrata, Griselinia littoralis, Olearia ilicifolia, Aristotelia serrata.*
Tier 4: (1–6 feet)
Major spp: Nil.
Minor spp: *Olearia ilicifolia, Pseudowintera colorata, Myrsine divaricata, Coprosma parviflora, Histiop-*

teris incisa, Phormium colensoi, Polystichum vestitum, Aristotelia fruticosa, Coprosma ciliata, Coprosma pseudocuneata, Aristotelia serrata.

Tier 5: (<1 feet)

Major spp: *Polystichum vestitum, Hoheria glabrata, Cardamine debilis, Ranunculus hirtus.*

Minor spp: *Coprosma ciliata, Griselinia littoralis, Olearia ilicifolia, Blechnum fluviatile, Epilobium* spp., *Histiopteris incisa, Myrsine divaricata, Luzula picta, Fuchsia excorticata, Coprosma parviflora, Aristotelia serrata, Acaena anserinifolia, Uncinia ferrugineus, Hebe salicifolia, Blechnum penna-marina, Erechtites wairauensis, Ourisia sessilifolia, Urtica incisa, Pseudowintera colorata, Uncinia filifolium, Hypolepis millefolium, Coprosma cheesmanii, Hydrocotyle* spp., *Viola filicaulis, Coprosma foetidissima, Corybas triloba.*

Tier 6: (lianes, epiphytes, etc.)

Major spp: Nil.

Minor spp: *Asplenium flaccidum, Grammitis billardieri, Polystichum vestitum, Phymatodes diversifolium, Rubus cissoides, Coprosma parviflora, Griselinia littoralis, Hoheria glabrata, Hymenophyllum sanguinolentum.*

FIGURE 1. *Forest zonation in the upper Taramakau catchment. The forest in the gully is mainly short shrub hardwood. This gives way to rata–totara forest and bushline forest on the spurs and to subalpine scrub at the highest altitudes. Kamahi forest occurs on the lower slopes.*

The habitat

The eight associations described above have no hard-and-fast boundaries. Even the forest and sub-alpine scrub grade into each other so that there is usually no definable timberline. Similarly, the limits of the habitats are often hard to define. For this reason the habitat factors, altitude and slope for each association have been described by stating the means and one standard deviation around the means (see Table 2). The relative frequency of plots for each association occurring on ridge, face, gully and terrace sites is given in Table 3, and in Table 4 appears the percentage of plots occurring on stable and unstable sites. The criterion used for the definition of an unstable site is the proportion of the upper soil layers which is composed of shattered parent rock.

Most of the associations usually occur on stable sites. All the silver beech and mountain beech plots and nearly all the rata–totara, red beech, bushline and subalpine plots are found on these sites. These associations may be regarded as forming the sub-climax vegetation. The kamahi and short scrub hardwood forests, on the other hand, are strongly associated with unstable sites and may be regarded as being seral, following erosion. The short scrub hardwood is the main seral vegetation at higher altitudes and usually occurs in gullies and gully heads (see Table 3). It has a mean altitude of 2,600 feet. The kamahi forest is seral at low altitudes and has a mean of 1,570 feet. It often occurs on riparian slip sites and on river terraces. Red beech forest may also be successional at low altitudes on young river terraces.

TABLE 2. *The mean altitude and mean slopes (with 1 S.D.) for each of the eight associations.*

Association	Altitude	Slope
Kamahi forest	1570′ ± 460′	30° ± 11°
Red beech forest	1620′ ± 425′	28° ± 15°
Rata-totara forest	2265′ ± 304′	30° ± 10°
Short scrub-hardwood forest	2600′ ± 620′	30° ± 11°
Bushline forest	2190′ ± 420′	31° ± 11°
Subalpine scrub	3270′ ± 380′	32° ± 11°
Silver beech forest	2830′ ± 540′	35° ± 13°
Mountain beech forest	2665′ ± 300′	27° ± 8°

The sites of the sub-climax associations: subalpine scrub, bushline forest, rata–totara forest and red beech forest, are usually separated by altitude. The mean altitude for these is respectively 3,270, 2,910, 2,265, and 1,620 feet. The bushline association tends to be restricted to spur sites (see Table 3), because most sites other than the spurs at the higher levels are unstable and, in consequence, are occupied by the seral short scrub hardwood forest.

TABLE 3. *The relative frequency of plots from each association in each of the 4 physiography classes.*

Association	Physiography class *Spur*	*Face*	*Gully*	*Terrace*
Kamahi forest	4.3	19.6	14.0	23.5
Red beech forest	—	16.2	—	29.0
Rata-totara forest	19.6	15.0	14.0	17.7
Short scrub-hardwood forest	6.5	17.3	43.0	17.7
Bushline forest	41.3	15.6	14.0	—
Subalpine scrub	21.7	9.8	14.0	—
Silver beech forest	6.5	4.0	—	5.9
Mountain beech forest	—	2.3	—	5.9

The species which dominate the seral sites, such as broadleaf and ribbonwood (*Hoheria glabrata*) at higher altitudes and kamahi at lower altitudes, are probably able to do so because they have rapid initial growth rates and reach maturity comparatively early. Little information is yet available on the growth patterns of these species, but Wardle (1963), quotes the total life span of one of these species, *Hoheria glabrata*, as only 150 years. Three other species, *Dracophyllum traversii*, *Libocedrus bidwillii*, and *Dacrydium biforme*, which occupy more stable bushline sites have life spans of 400, 600, and 1,000 years respectively (Wardle 1963).

TABLE 4. *Percentage of plots in each association occurring on stable and unstable sites.*

Association	*Stable*	*Unstable*
Kamahi forest	30	70
Red beech forest	85	15
Rata-totara forest	90	10
Short scrub-hardwood forest	20	80
Bushline forest	80	20
Subalpine scrub	70	30
Silver beech forest	100	—
Mountain beech forest	100	—

The silver beech and mountain beech associations are rather localised. Both are virtually restricted to stable sites in the Otehake tributary of the Taramakau catchment. Both may form a timberline at about 3,400 feet, but generally the mountain beech forest is restricted to local sites of poor drainage or to where the parent rock is slow weathering and close to the surface.

THE CONDITION OF THE FOREST AND SCRUBLAND

The height tier most affected by red deer (*Cervus elaphus*) and chamois (*Rupicapra rupicapra*) is from 1 to 6 feet, as the vegetation occurring between these limits is nearly always within the browsing zone. At least some of the vegetation in the less-than-one-foot tier and 6–15 foot tier is beyond the normal browsing range as it is either too close to the ground or too high. The ratio of occurrence of a species inside the 1–6 foot tier relative to its occurrence outside has been used as an indicator of its relative susceptibility to browsing; and on the basis of this ratio the main vascular species occupying the forests and scrublands of the Taramakau have been divided into three groups: 'Group 1' includes those species which are relatively rare within the 1–6 foot tier as compared with outside it and are thus likely to become minor components of the vegetation with continued animal pressure. 'Group 3' includes species which do not seem to be greatly influenced by animal pressure and include many of those species which have been referred to as 'increaser species' in the past. 'Group 2' includes species of intermediate susceptibility. Throughout the remainder of this report the Group 1 species are referred to as 'extinction' species and the Group 3 species as 'animal-tolerant' species.

The major species are listed below in their respective groups. The susceptibility rating (S.R.) is shown in parenthesis beside each. This rating was calculated by the following formula for species which normally grow from 1 to 6 feet in height:

$$\text{S.R.} = \frac{\%\ \text{frequency 1–6 ft. tier}}{\%\ \text{Frequency} < 1\ \text{ft. tier}}$$

This was refined for species that normally grow taller than six feet by applying the following formula:

$$\text{S.R.} = \frac{\%\ \text{Frequency 1–6 ft. tier}}{\frac{1}{2}(\%\ \text{freq.} < 1\ \text{ft.} + \%\ \text{freq. 6–15 ft. tier})}$$

Group 1: *Asplenium bulbiferum* (0.12), *Polystichum vestitum* (0.23), *Senecio bennettii* (0.24), *Fuchsia excorticata* (0.25), *Hoheria glabrata* (0.25), *Pseudopanax colensoi* (0.26), *Griselinia littoralis* (0.28), *Coprosma ciliata* (0.36), *Pseudopanax simplex* (0.37).
Group 2: *Nothofagus fusca* (0.41), *Coprosma foetidissima* (0.47), *Weinmannia racemosa* (0.47), *Carpodetus serratus* (0.56), *Metrosideros umbellata* (0.82), *Coprosma parviflora* (0.82), *Aristotelia serrata* (0.83), *Pseudopanax crassifolium* (0.85), *Quintinia acutifolia* (0.85).
Group 3: *Dracophyllum longifolium* (0.98), *Coprosma pseudocuneata* (1.00), *Histiopteris incisa* (1.00), *Olearia ilicifolia* (1.02), *Dacrydium biforme* (1.06), *Dracophyllum traversii* (1.07), *Podocarpus hallii* (1.11), *Archeria traversii* (1.28), *Myrsine divaricata* (1.35), *Phyllocladus alpinus* (1.35), *Pseudowintera colorata* (1.35), *Coprosma rhamnoides* (1.49), *Blechnum discolor* (1.52), *Phormium colensoi* (2.15).

The expected changes and relative susceptibility of each association to browsing has been deduced by consideration of the susceptibility of the individual species. The associations are described as being critical or non-critical on the basis of susceptibility and the stability of the site (see Table 4). The relative susceptibility of the various associations to browsing is demonstrated in Figure 2, where, for simplification, the major canopy species in each association have been grouped together and the percent frequency of these groups throughout the tiers has been plotted. When the percent frequency remains similar throughout the tiers in an association, the implication is that at least some of the major canopy species are not susceptible to browsing and thus the association has eventually a chance of adapting itself. But where there is a marked reduction in the 1–6-foot tier the implication is that the association is unable to retain its present status and progressive deterioration must occur.

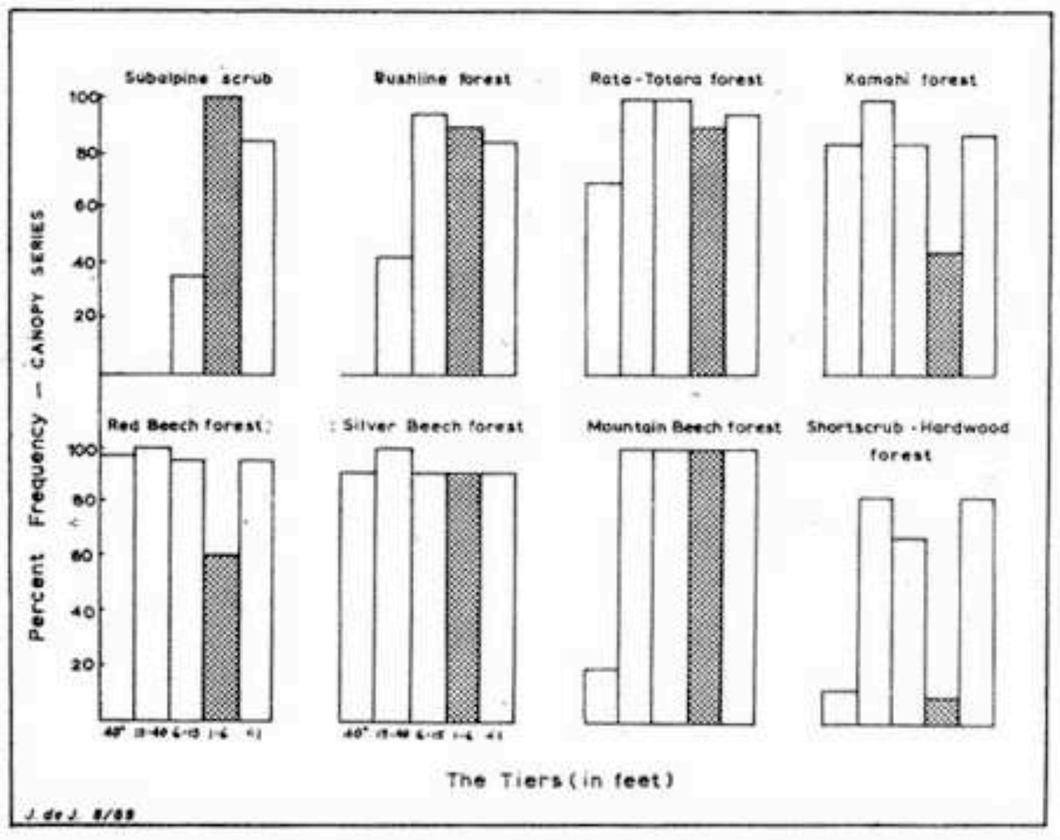

FIGURE 2. *Relative susceptibility of associations as indicated by reduction of frequency of canopy species in the 1–6-foot tier relative to the <1-foot and 6–15-foot tiers.*

A weighted index, for which three points have been scored for heavy browsing, two for moderate and one for light browsing was calculated for the most commonly browsed species. This index which is given below will assist in the search for indicator species for future measurement of trend:

Species	Browsing index
Griselinia littoralis	148
Polystichum vestitum	118
Weinmannia racemosa	97
Myrsine divaricata	74
Coprosma pseudocuneata	64
Coprosma ciliata	55
Coprosma parviflora	52
Coprosma rhamnoides	45
Quintinia acutifolia	41
Phormium colensoi	38
Archeria traversii	37

Some species such as *Myrsine divaricata*, *Coprosma pseudocuneata*, *Coprosma rhamnoides*, *Phormium colensoi* and *Archeria traversii* have a high index but appear in the animal-tolerant group on account of their susceptibility ratings. These species may well prove useful in measurement of future trends since even though they are desired fodder for deer and chamois, they are unlikely to become extinct.

The condition and relative susceptibility of the individual associations to use by deer and chamois is discussed below:

1. *Subalpine scrub*

This association occurs at high altitudes where growth is probably slow and the potential for regeneration of some of the major species is probably poor. On the other hand none of the major species are very susceptible to browsing so that few important changes in composition should be expected. *Coprosma pseudocuneata* and *Phormium colensoi* are two of the main fodder species but are apparently fairly tolerant of browsing. There is evidence from the Tararua Range that trampling by animals may cause the death of subalpine scrub, but this type of damage is likely to be confined to spur crests and gentle slopes which are usually relatively stable sites.

FIGURE 3. *Subalpine scrub in the Otehake valley. The composition is not likely to be greatly influenced by browsing but trampling may possibly cause deterioration.*

2. *Bushline forest*

This association also occurs at high altitudes so that growth rates and potential for regeneration of the major canopy species are probably poor. However, it usually occurs on stable soils on spur sites (see Tables 3 and 4) and is, therefore, one of the less critical of the associations. It has probably suffered a high degree of modification in the past as broadleaf, which is still a major canopy species, is almost completely lacking in the susceptible 1–6-foot tier. With continued animal use this species could be expected to become rare. However, many of the major species in this association are tolerant of browsing. Figure 2 shows that most of the temporary plots have a representation of at least one of the major canopy species in the 1–6-foot tier. As with the subalpine scrub, this association has a number of major shrub species which are fairly heavily browsed but tend to be tolerant, i.e. *Myrsine divaricata, Coprosma pseudocuneata* and *Archeria traversii.*

3. *Rata–totara forest*

The only major species in this association in the 'extinction' class is broadleaf, which shows a definite regeneration gap in the 1–6-foot tier. Kamahi also appears to be fairly susceptible to browsing but the other major species, which include the trees: rata, Hall's totara and *Quintinia acutifolia,* the shrubs *Myrsine divaricata* and pepperwood, and the ground species, *Blechnum capense,* are reasonably tolerant to damage by deer and chamois. In nearly all the plots there is some regeneration of at least one of the major canopy trees in the susceptible 1–6-foot tier (Fig. 2). The association usually occurs on stable soils. It is, however, one of the association's most susceptible to canopy damage by opossums (*Trichosurus vulpecula*). In addition, the older trees of Hall's totara are suffering from severe defoliation which often leads to death caused by an unknown agency.

4. *Kamahi forest*

The kamahi association must be regarded as being critical. It usually occurs as a seral forest on old slips and is in most instances associated with unstable soils (see Table 4). Further, it is strongly influenced by browsing mammals and less than 50 percent of the plots in this association show any regeneration of the major canopy species within the 1–6-foot tier. From this point of view it is the second most susceptible association in the forest and scrublands of the Taramakau (Fig. 2).

The major tree species are kamahi, broadleaf and *Carpodetus serratus.* Of these, broadleaf is the only one which falls into the 'extinction class', but the other two have susceptibility ratings in the vicinity of 0.5 and thus do show strong regeneration gaps. The understorey of this association is fairly resistant to browsing; the major shrub species is pepperwood with *Blechnum capense* and *Blechnum fluviatile* important on the ground. The only major change which could be expected in the understorey of this association is a reduction in the *Polystichum vestitum* which is a major species at present but is very susceptible to browsing.

5. *Red beech forest*

Red beech forest is usually associated with stable soils. However, it shows a regeneration gap of the major canopy species in the 1–6-foot tiers, though not to the same extent as kamahi forest (Fig. 2). The understorey is almost invariably dominated by pepperwood and *Blechnum discolor* and is thus unlikely to show much change with continued browsing. *Coprosma foetidissima* was probably once a major shrub species which has been considerably reduced by browsing and is

now only important as a seedling in the less-than-1-foot tier (see Part 2.1). With continued animal pressure in this association there would probably be virtual extinction of broadleaf and a gradual replacement of the other major species, kamahi and red beech, by *Quintinia acutifolia*, which is a vigorous species at the low altitudes occupied by this association.

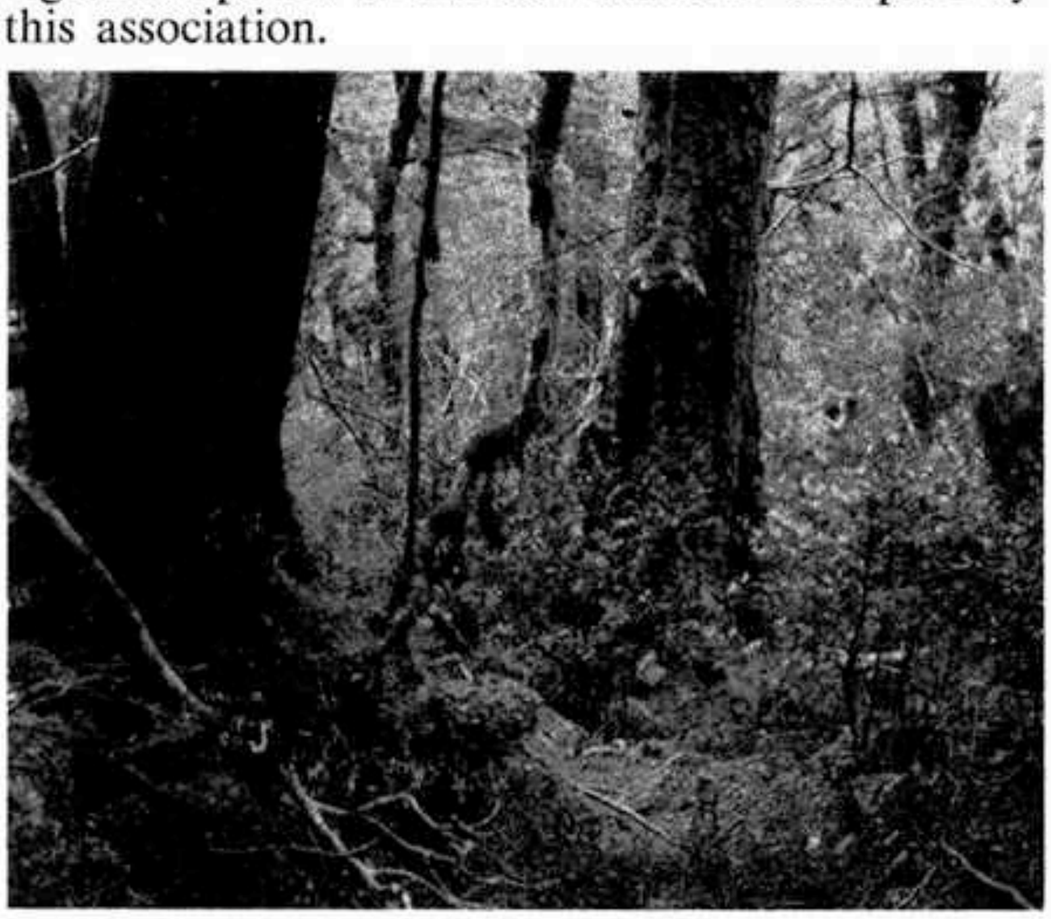

FIGURE 4. *Red beech forest, Otehake valley. Note understorey of unpalatable pepperwood.*

6. *Silver beech forest*

This is a minor association. A regeneration gap of the major canopy species is not yet apparent in the lower tiers (Figure 2). Silver beech, the main tree species, is abundant throughout each tier even though it can show signs of heavy browsing pressure within the 1–6-foot tier. The major shrub species, *Myrsine divaricata* and *Coprosma pseudocuneata*, both of which are important fodder species also show strong tolerance to browsing. The major ground cover species is *Polystichum vestitum*. In view of its susceptibility, *Uncinia* species which are also important in the understorey may ultimately replace it. Though this association is in good condition at present it could be expected to receive a greater amount of animal pressure in future since it contains a number of species which are major fodder. However, it will remain a relatively non-critical association for the following reasons:

(1) it is almost always associated with stable sites;
(2) the major species, silver beech, is relatively long-lived; and
(3) the main fodder species are usually tolerant to browsing.

7. *Mountain beech forest*

This is a minor association which at present shows little sign of modification other than maybe a reduction in the importance of *Pseudopanax simplex* in the upper tiers. Most of the species are either tolerant to browsing or not browsed at all and the association occupies stable sites (Table 4). It can therefore be regarded as being non-critical.

8. *Short scrub-hardwood forest*

This is the most critical association in the forest and scrublands of the Taramakau catchment. It nearly always occurs where the soils are unstable (see Table 4), especially in gully sites which are subject to repeated erosion (see Table 3). The three most important canopy species: ribbonwood, broadleaf and fuchsia are all 'extinction' species and in only four out of the 39 stands which were measured in this association was there any regeneration of these species in the 1–6-foot tier (Fig. 2). In the understorey the *Polystichum vestitum* fern is usually being replaced by moving shingle or a turf of *Cardamine debilis, Ranunculus hirtus, Epilobium* spp. and *Histiopteris incisa*. In the occasional area too steep or difficult of access for red deer it forms a dense waist-high cover. Even with a much lower population of deer and

FIGURE 5. *Short scrub-hardwood forest, upper Taramakau. This association is dominated by ribbonwood and broadleaf. Note virtual absence of an understorey.*

chamois than at present, much of the tree and shrub cover would ultimately disappear. Already this association is the most open of the forests and scrublands of the Taramakau catchment (Table 1). In some restricted sites, *Olearia ilicifolia*, *Myrsine divaricata* and *Aristotelia serrata*, which are more tolerant to browsing but are at present only minor species, may tend to replace the present canopy and pepperwood may increase in importance to form a stable understorey; but such a change is unlikely to become widespread. The species in this association are too shortlived and sites too unstable to allow gradual replacement of one tree or shrub species by another on anything but a minor scale.

VARIATION OF CONDITION THROUGHOUT THE CATCHMENT

It is apparent that the most critical associations are the short scrub hardwood forest and the kamahi forest. The susceptibility of each of the four areas defined in Figure 6 would largely

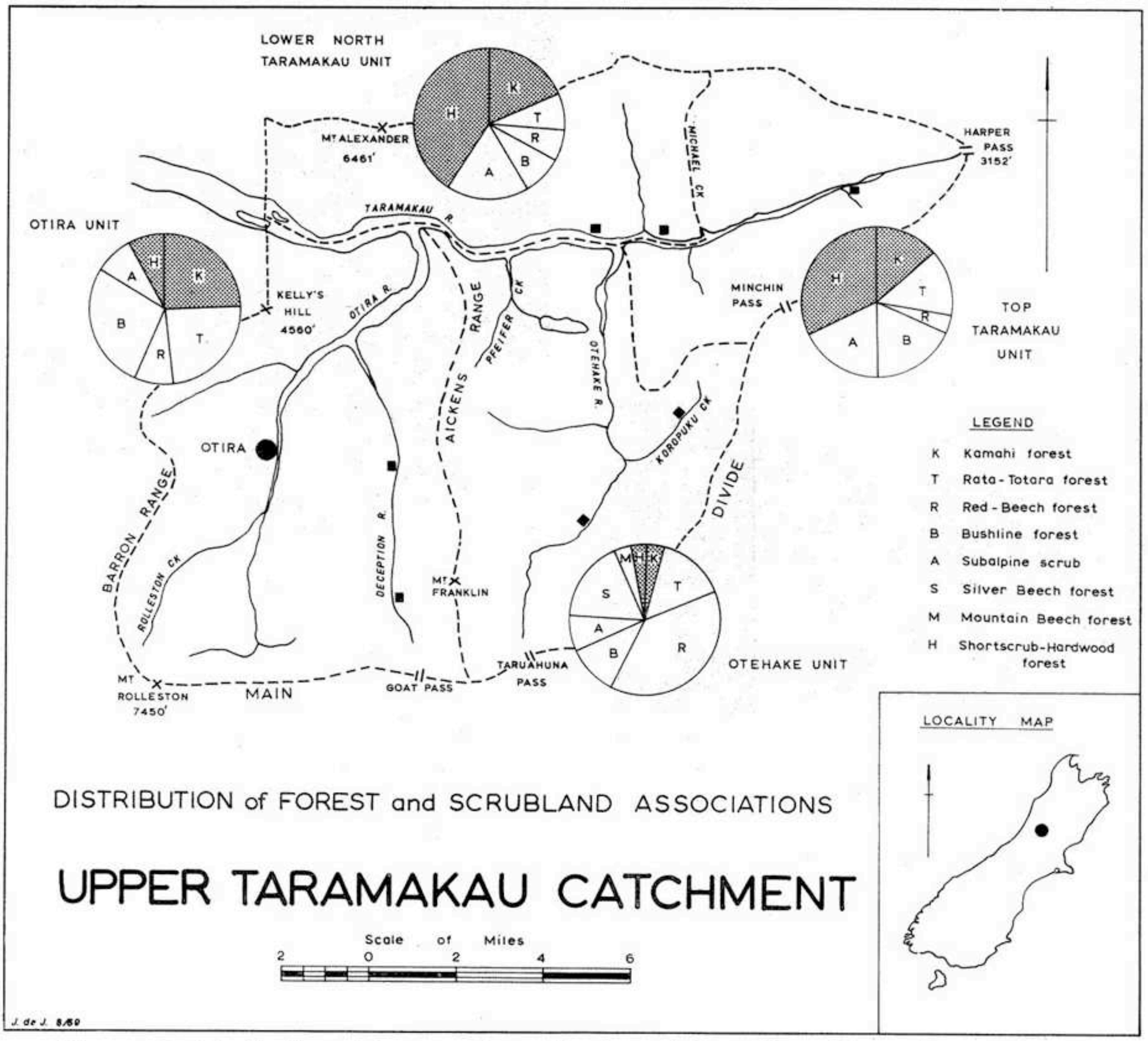

FIGURE 6. *Distribution of forest and scrubland associations. Upper Taramakau catchment.*

depend on the extent to which their forests and scrublands are composed of these two associations. The approximate proportion of each of the associations in each of the four areas is given in the same Figure. These have been calculated from the frequency of temporary plots in each association.

It is apparent that the two units most susceptible to damage from deer and chamois are the 'top Taramakau' and the 'lower north Taramakau'.

In the former, short scrub hardwood forest covers approximately one third of the total forest area and in the 'lower north Taramakau' even more. A combination of the two seral associations, short scrub hardwood and kamahi, form almost half of the forest and scrub in the 'top Taramakau' and well over half in the 'lower north Taramakau'. The remainder of the forest and scrub in these two units is composed of subalpine scrub, bushline forest and rata-totara, all of which are relatively unaffected by ground browsing animal pressures.

FIGURE 7. *The forest and scrublands of the main Taramakau valley. Notice frequency of slips and width of shingle riverbed.*

The present condition of these two areas is rather similar. Frequent slips and open running screes occur in the headwater of the main stream and tributary streams and many of these show signs of having recently supported short scrub-hardwood forest. Revegetation of these slips is rare and where it was observed, usually only a short turf cover had developed. Much of the short scrub-hardwood with the canopy still intact has

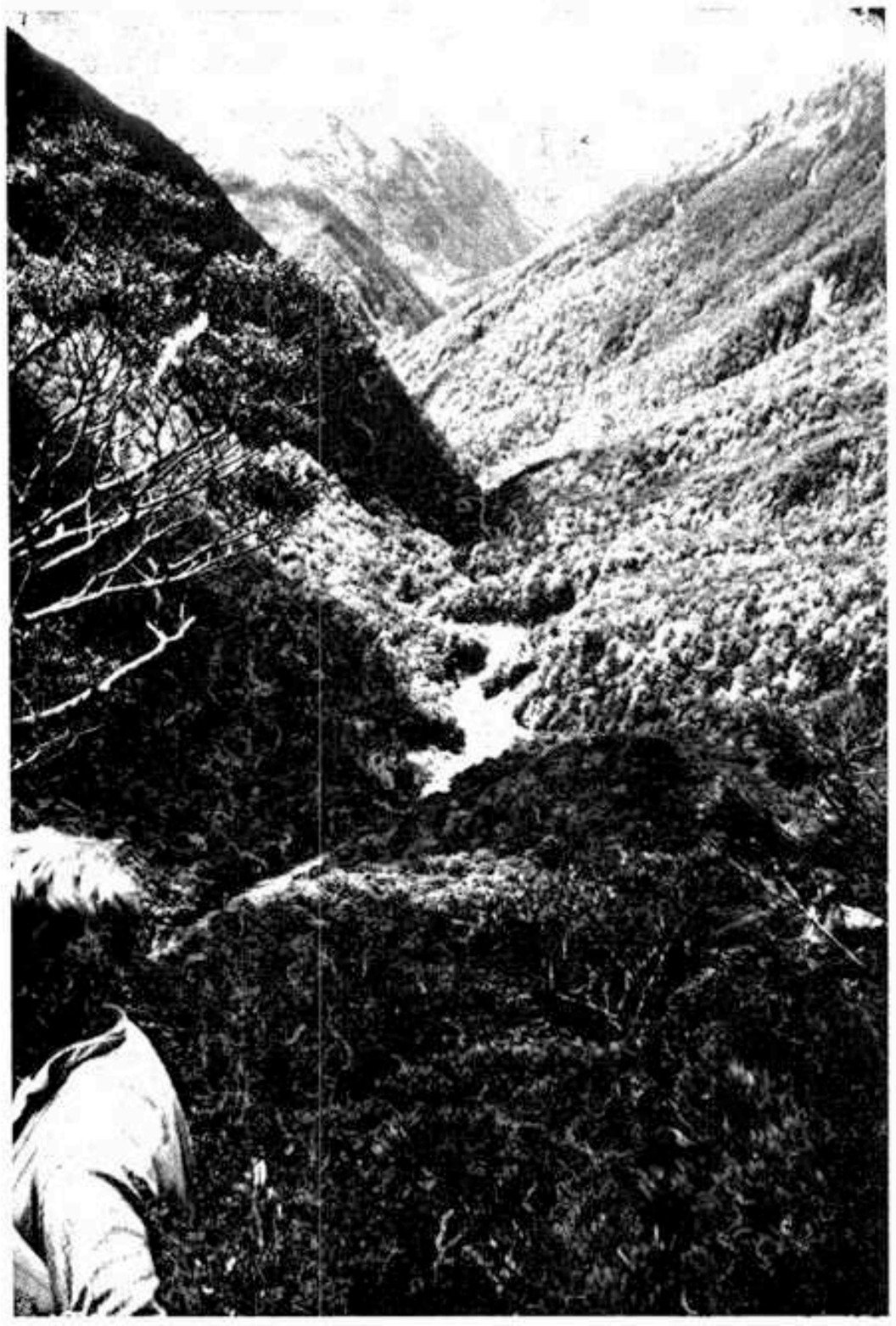

FIGURE 8. *The forest of the Otehake Valley. Note stable nature.*

running shingle underneath and it is only a matter of time before these areas will also become open scree. The kamahi forest in general appears to be more intact, but where riparian slipping has opened it up there is little sign of recovery.

In the 'Otira unit' seral short scrub hardwood forest and kamahi forest are still important, though not nearly to the same extent. The major associations are bushline forest and rata-totara forest which suggests a much more stable geological history. The vegetation is in much better condition than in the previously-discussed areas. Slips are not as numerous and species with high susceptibility to browsing, such as broadleaf, are sometimes very common in the 1–6-foot tier. In the upper forest of Rolleston Creek, the bushline and short scrub hardwood associations appear

to be in an almost primeval condition. The undergrowth is dense, with broadleaf and even *Pseudopanax simplex* common throughout all tiers. The presence of avalanche chutes probably prevents red deer and chamois from browsing here in winter.

In the Otehake unit very little of the forest is short scrub hardwood or kamahi (see Fig. 6). The most important association here is red beech forest, though silver beech, rata–totara and bushline forest are also moderately important. Slips are few and the forest and scrublands of this unit are in better condition and potentially more stable than in any other area in the upper Taramakau (see Fig. 8), though the red beech forest does have quite a marked regeneration gap.

NOTE

Botanical nomenclature

Botanical names used in this report are according to Zotov (1963) for the grass sub-family *Arundinoideae*, Edgar (1966) for the genus *Luzula*, Edgar (pers. comm.) for the genus *Uncinia*, Cheeseman (1925) for the remainder of the indigenous Monocotyledones, Philipson (1965) for the genera of the *Araliaceae*, and Allan (1961) for all remaining species.

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