

NATURAL REGENERATION OF KAURI.

By A. D. McKINNON.

In order to study the establishment of kauri (*Agathis australis*) by natural seeding a 0.5 acre experimental plot was demarcated in Waipoua State Forest under a typical stand of mature kauri. The species provided approximately 75% crown cover, and an understorey of taraire (*Beilschmiedia taraire*) and miro (*Podocarpus ferrugineus*) poles provided an additional 20% crown cover. Shrub growth was sparse and consisted of *Senecio kirkii*, *Alseuosmia macrophylla*, *Leucopogon fasciculatus*, *Coprosma robusta*, *Nothopanax arboreum*, and *Cyathea dealbata*. The forest floor was completely covered with dense kauri grass (*Astelia trinerva* and *Gahnia xanthocarpa*) averaging 4 ft. in height.

Treatment.

(a) In April, 1937, the kauri grass and shrubs were completely cut out and piled in three windrows, two on either side of the plot boundaries, and the third down the centre of the plot. A number of the taraire and miro poles were girdled.

(b) In August, 1940, the plot was subdivided into five 1/10th acre subplots numbered I to V. In subplot III seedlings of *Leptospermum ericoides* were planted at 8 ft. spacing, seedlings being obtained from the roadside.

(c) In February, 1941, twenty-one 4-square yard quadrats were demarcated over the full half acre, four in each subplot (and described as A, B, C and D) plus, in subplot I, quadrat B1 the boundaries of which were trenched to below the general root level.

(d) By February, 1941, the miniature tree fern, *Blechnum fraseri*, had become firmly established and aggressive over the entire plot area. Subplot No. 1 was accordingly cleared of all *Blechnum* and other second growth.

(e) In July, 1944, nursery grown kauri transplants were planted, 3 in quadrat IB1 and 3 in ID.

Results.

(a) Immediately after clearing a count was made of kauri seedlings on half the plot area, i.e. $\frac{1}{4}$ acre. These amounted to 1,340 and were pegged for subsequent identification. (An average of 1—2 per 4 square yards).

(b) In November, 1938, half the preceding area (i.e. 1/8th acre) was examined and seedlings pegged. These amounted to :—

125 survivors of the 1937 tally.

3,233 recently germinated seedlings from 1937 and 1938 seedfalls.

i.e. an average of 5—6 per 4 square yards.

(c) An examination of this 1/8th acre in March, 1939, (prior to the 1939 seedfall) showed that of the original 125 seedlings only 65 remained, while there were 1,981 survivors of the 1938 seedling crop.

(d) In February, 1941, this 1/8th acre was again examined and showed :—

Seedlings present in April 1937—7% or 45 remained.

November 1938—24% or 796 remained.

March, 1939—66% or 1,561 remained.

An average of 4 per 4 square yards.

(e) In February, 1941, a tally was made of kauri seedlings on each of the 4 square yard quadrats. All seedlings at that date were under 6 ins. in height. The numbers were as follows :—

IA	50	II A	67	III A	54	IV A	3	V A	47
B	67	B	88	B	17	B	6	B	103
C	56	C	34	C	41	C	1	C	16
D	137	D	79	D	44	D	5	D	19
B1	27								
Means	67		67		39		4		46

(f) In January, 1945, an examination was made with the following results :—

Subplot I.

Sparse cover of *Blechnum fraseri* either isolated or in small groups and up to 12 ins. high ; sparse *Senecio kirkii* to 24 ins., *Leucopogon fasciculatus* to 18 ins., seedling *Beilschmiedia taraire* to 12 ins., *Geniostoma ligustrifolium* to 48 ins., isolated small *Gahnia* and *Astelia*, and a few seedling *Coprosma* and *Alseuosmia* ; and a carpet of seedling kauri.

Quadrat	Total Seedlings	Seedlings 1 year and less	Seedlings 6 ins. and over
I A	138	4	—
B	153	3	—
C	168	7	1
D	318	14	5
B1	84	—	20
Means	172	6	5

Subplot II.

Dense *Blechnum fraseri* to 24 ins., scattered *Senecio* to 48 ins., isolated *Schefflera* to 24 ins., *Coprosma* to 36 ins., *Geniostoma* to 60 ins., *Olearia* to 24 ins., *Suttonia* to 12 ins., *Alseuosmia* and *Beilschmiedia* to 24 ins., *Gahnia* and *Astelia*.

Quadrat	Total Seedlings	Seedlings 1 year and less	Seedlings 6 ins. and over
II A	46	14	—
B	166	35	1
C	127	11	—
D	171	6	—
Means	127	16	0.1

Subplot III.

Second growth in isolated groups. Six scattered *Dicksonia squarrosa* to 54 ins., solitary *Senecio* and *Alseuosmia* to 48 ins., *Coprosma spp.* to 40 ins., *Suttonia australis* to 36 ins., *Blechnum discolor* to 48 ins.; scattered *Phyllocladus trichomanoides*, *Dacrydium kirkii* and *Melicytus ramiflorus*. Planted *L. ericoides* to 36 ins.

Quadrat	Total Seedlings	Seedlings 1 year and less	Seedlings 6 ins. and over
III A	101	6	—
B	52	16	—
C	68	8	2
D	52	5	—
Means	68	9	0.1

Subplot IV.

Second growth heavier than in previous subplots. Consists of *Rubus spp.*, *Coprosma spp.*, and *Senecio* up to 60 ins.; isolated clumps of *Dicksonia squarrosa*; dense covering of *Alseuosmia*, *Suttonia* and *Geniostoma* to 12 ft. Seedling *miro* and *Myrtus*.

Quadrat	Total Seedlings	Seedlings 1 year and over	Seedlings 6 ins. and over.
IVA	12	5	—
B	1	—	—
C	6	4	—
D	obliterated	—	—
Means	6	3	Nil

Subplot V.

The second growth consists of a dense tangle of *Coprosma*, *Dicksonia*, *Ackama*, and *Leucopogon* up to 20 ft.; *Gahnia* and *Astelia*; *Schefflera*, *Melicytus* and *Pseudopanax* up to 15 ft.; seedlings of above plus taraire, rimu and totara; *Rubus spp.*

Quadrat	Total seedlings	Seedlings 1 year and less	Seedlings 6 ins. and over
VA	64	3	3
B	105	6	2
C	16	—	1
D	52	4	—
Means	59	3	1.2

Summary of Subplot Means.

Subplot	Total Seedlings	Seedlings 1 year and less	Seedlings 6 ins. and over
I	172 (67)	6	5
II	127 (67)	16	0.1
III	68 (39)	9	0.1
IV	6 (4)	3	—
V	59 (46)	3	—

N.B.—Figures in brackets are results of 1941 examination.

Discussion of Results.

- The plot slope moderately from Subplot I, through II, eases in Plot III and tends to level off in Subplots IV and V. Subplots IV and V benefit therefore by additional moisture and development of second growth has been more vigorous.
- All subplots show an increase in the number of seedlings since 1941, the greatest increase being in Subplot I, which was cleared of *Blechnum fraseri* and other second growth at that date.
- With increase in ground cover conditions for the establishment of additional seedlings has become difficult as is evidenced by the small number of seedlings 1 year old and under, i.e., an average of 9 such seedlings per plot.
- The greatest number of seedlings 6 ins. and over in height occurred in quadrat IB1, the boundaries of which were trenched in 1941 to reduce root competition.

Conclusions.

- Viable seed has been produced by the seed trees on and adjoining the plot sufficient in quantity to enable some 18,000 to 25,000 seedlings per acre to germinate from a single seedfall.
- Clearing of the forest floor enables such seed to reach the soil and germinate.

- (c) Owing to the depth of the litter layer and the fibrous humus layer of the soil, heavy mortality occurs amongst seedlings during prolonged dry weather, roots not having penetrated to the A1 horizon of the soil.
- (d) Second growth, particularly *Blechnum fraseri*, is aggressive and seedlings have benefitted by removal of second growth four years after initial clearing, this being reflected in density of stocking and vigour of released seedlings.
- (e) Root competition has been keen and kauri seedlings on a quadrat whose boundaries were trenched to below the general root level have shown a significant improvement in size and vigour as compared with an adjoining control quadrat. Further quadrats are to be trenched for confirmation of this point.

TIMBER FOR COAL MINES IN THE WAIKATO DISTRICT.

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To make this discussion intelligible it is first necessary to describe briefly the layout of a mine and to explain some of the terms used. We will therefore commence with coal and the methods of mining it.

Coal occurs in layers called *seams* of varying thickness from a few inches to many feet and there may be several seams, one above the other, separated by rock. Thus, under the Waikato River at Huntly, there is an aggregate of 80 feet of coal in several seams.

The coal may be reached by a *shaft* which descends vertically, by a sloping drive called a *dip* or *dip heading*, or by a *drive* which enters the coal horizontally. However, once the coal is reached the method of working is much the same in every case in New Zealand; the same conditions apply and the same terms are used.

A mine is set out with one or more *main headings* or main roads and these are of a permanent nature and may be expected to last up to 50 years or so, according to the amount of coal and the rate of extraction. The length of these main roads may be miles and, as an example, there is the main road in the Renown Mine in the Waikato three miles long, with probably much unexplored coal beyond.

From the main headings which are usually driven on the *full dip* (maximum slope) of the seam, pairs of development or *panel headings* run at right angles. These are of course driven on the floor of the seam and, being on the *strike* or level course of the seam, are them-

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