



CHAPTER 8 - GROWTH MODEL and REGIME EXAMPLE

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The increasing popularity of redwood forestry in New Zealand means an escalating need for predicting growth and yield, to provide greater confidence for those investing in redwood. First-generation models have been developed.

NZ Forestry in association with the New Zealand Redwood Company has been instrumental in initiating the development of a Redwood Growth Model and new volume and taper equations for redwood in New Zealand. The growth model predicts basal area (BA) and mean top height (MTH) for redwood grown in New Zealand. The model was developed using data from stem analysis (felling trees, cutting into discs and reconstructing growth by growth-ring analysis) of trees from eight stands supplemented with data from 32 PSPs (Permanent Sample Plots). Most of the PSPs have only recently been established and they therefore only provide an estimate of yield at a single point in time. Stem-analysis data were therefore used to characterise growth trajectories and determine appropriate model equation forms, while the PSP data were used to calibrate this model to actual-plot measurement data representative of the species and covering a reasonable range of New Zealand sites.

The Site Index for New Zealand redwood is defined as MTH at age 40 years. Basal area productivity is based on a “400 Index” measure (BA40/400) defined as BA at DBH at age 40 years and a stocking of 400 stems/ha. The models, along with a stem volume function, have been implemented in a Microsoft Excel spreadsheet-based application.



Performance within New Zealand

The New Zealand Redwood Growth Model has been derived from stands established with genetically unimproved seed. Hence predictions for stands now being established from imported seed orchard material or select clones are likely to be under-predicted.

Table 5 presents data from a number of sites within New Zealand. The table presents estimated site index and BA40/400 for each site and growth model predictions at age 35 years for the specified targets of final crop stocking.

Table 5: Growth model estimations in growth of selected stands.

Location	Site Index m@ 40 yrs	BA m ² /ha	Target stocking stems/ha	Predicted DBH cm	Predicted BA m ² /ha	Predicted Volume m ³ /ha	Predicted MAI vol m ³ /ha/yr
Bay of Plenty	47	213	450	73.5	184.2	1871	53
East Coast	43	202	400	71.4	154.6	1445	41
Hawkes Bay	49	132	350	59.5	93.9	975	28
Taranaki	40	154	350	64.9	115.8	1036	30
East Coast	40	150	350	64	112.8	1008	29
Taranaki	39	128	325	59.6	87.5	754	22
Rotorua	35	145	350	62.3	103.2	808	23
King Country	40	118	325	57.2	80.8	712	20
Taranaki	36	110	325	55.2	75.2	604	17
Wellington	29	145	350	62.3	103.2	682	19
Wanganui	35	110	325	55.2	75.2	590	17
Otago Coast	32	120	325	57.7	82	598	17
Reporoa	37	101	300	53.9	66.1	542	15
Mean	39	141	348	61	103	894	26

It is clear from these estimations of yield that redwood on good sites is capable of at least matching the average yield of radiata pine on many sites.

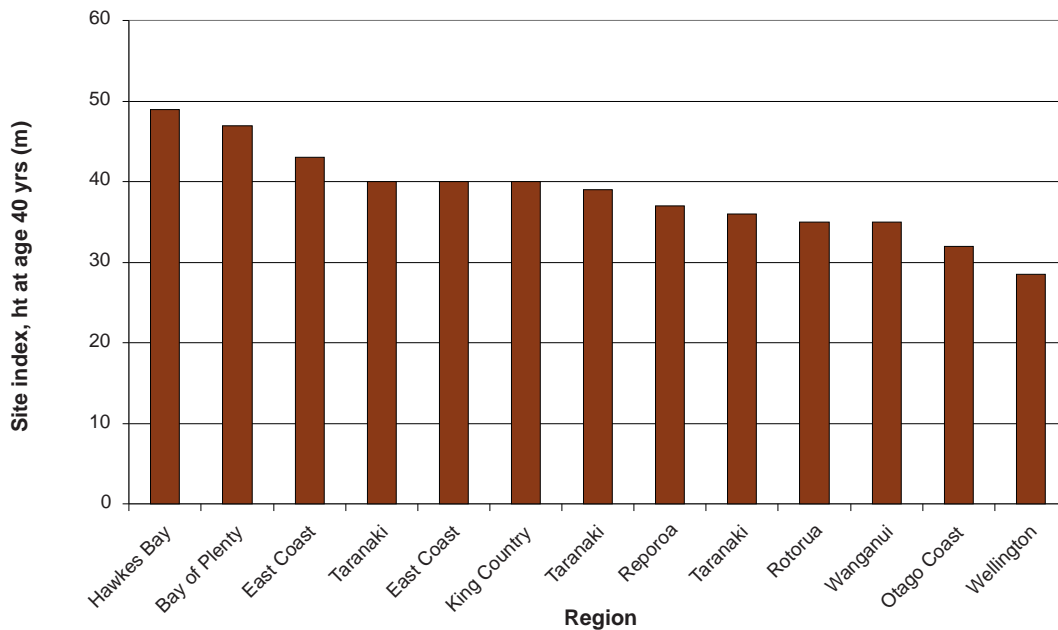


Figure 19: Site Index of cross section of New Zealand stands



Rotorua's Long Mile Redwood Grove in Whakarewarewa Forest

In Whakarewarewa Forest planting began in 1899. With 170 tree species planted, it was one of the first large experimental forests to help guide the afforestation of New Zealand. The most famous remnant of these early plantings is the Redwood Grove.

The stand when planted in 1901 originally covered 32 ha. Apart from scattered trees surrounding the grove the area is now about 6 ha. A feature of the stand is the many mature tree ferns and other native flora present throughout the Grove.

The Grove has been formally dedicated as a memorial to those who lost their lives in the two World Wars.

Apart from being Rotorua's most popular walking and running track the Redwood Grove has also been used for many unique activities ranging from wedding party photos, dawn church services (NZ Forest Service reunion), orchestral music (FRI 50-year jubilee) to the resting place of the ashes of Mr Bob Burstall (the father of notable trees in New Zealand).

The Grove is recognised as a historic tree site by the Royal NZ Institute of Horticulture, and is protected under the Rotorua District Scheme.

Since 1948, a 0.4 ha sample plot has been measured regularly (see measurements below).

Table 6: Growth measurements from Redwood Grove Permanent Sample plot

Age yrs	MTD cm	MTH m	Volume m ³ /ha	BA m ² /ha	MTD in	MTH ft	Volume ft/ac	BA ft ² /acre
54	97	41.8	879	85.1	31.8	137.1	2883.9	370.7
57	100	45.9	1014.8	90.7	32.8	150.6	3329.4	395.1
65	107.1	48.3	1214.2	104.4	35.1	158.5	3983.6	454.8
68	109.6	49.2	1291.3	109.4	36.0	161.4	4236.5	476.5
71	111.3	51.8	1397.5	113.2	36.5	169.9	4585.0	493.1
78	115.3	52.5	1524.3	122.4	37.8	172.2	5001.0	533.2
82	117.8	55.1	1658.3	127.9	38.6	180.8	5440.6	557.1
86	120.4	57.4	1795.5	133.8	39.5	188.3	5890.7	582.8
90	123.5	57.9	1890.8	140.8	40.5	190.0	6203.4	613.3
95	126.2	60.1	2048.7	147.3	41.4	197.2	6721.5	641.6
99	128.3	59.7	2103.0	152.6	42.1	195.9	6899.6	664.7
100	128.8	59.4	2109.0	153.5	42.3	194.9	6919.3	668.6

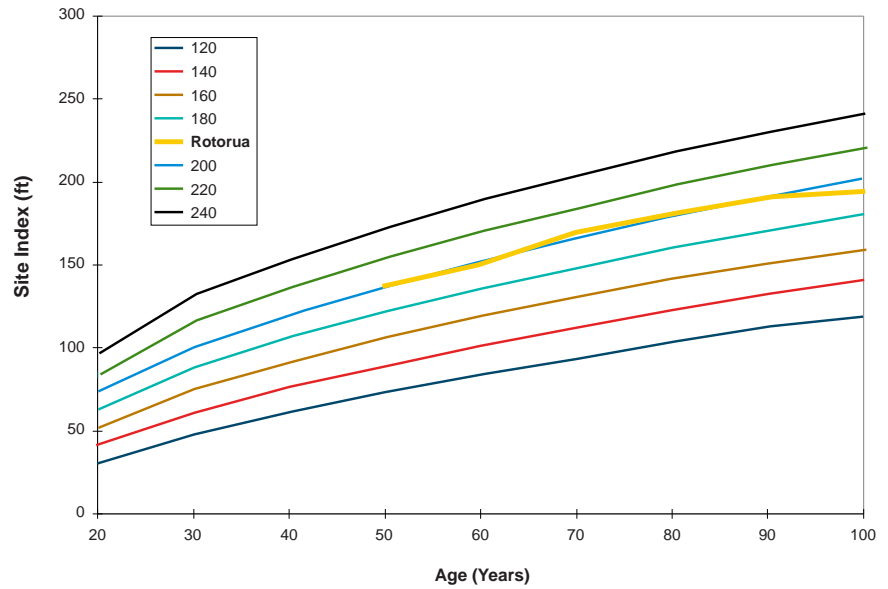


Comparison with growth in the United States

Height growth in forest stands is measured by Site Index (the expected height of trees at a given age). For redwoods in the United States, the Site Index is quoted as expected height in feet at 100 years. Measurements

from the Redwood Grove show that the stand has a Site Index of 200 feet. This is double the lowest Site Index used in US site tables of 100 feet, but less than the two best Site Indices used of 240 and 220 feet.

Figure 20:
American Site
Indices with
Redwood Grove
data highlighted



Suggested Regimes

Regimes for redwood are in their infancy, with many theories as to the best options. The following reflects the current thinking on potential regimes (Table 7). This can be expected to change as more data and experience is gained. (Check for updates via this electronic handbook).

Table 7: Suggested regime for redwood sawlogs

Operation	Age (yrs)	Comment
Pre-plant weed control		
Establish 800 stems/ha	0	Alternate rows of clones and seedlings
Release	0-1	Fertilise if required
Prune 420 stems/ha 0-2.5m	6	Calliper prune to 12 cm diam in August
Prune 385 stems/ha 2.5-4.5	7.5	Calliper prune to 12 cm diam in August
Prune 350 stems/ha 4.5-6.5 m	9	Calliper prune to 12 cm diam in August
Thin 800-350	11	August
Clearfell	35	Target DBH 60 cm or greater

Prune in 2 or 3 lifts (depending on site productivity) with a 12 cm calliper to 6 metres in autumn. This should result in a DOS of 12-15 cm and will reduce the incidence of epicormic shoots. Timing of thinning will depend on the incidence of epicormic shoots in the crop, exposure and green crown condition.



Key Points

- Well sited redwood grows very well with high volume production figures.
- A regime is suggested, with 800 stems/ha, up to 3 pruning lifts, one thinning to final crop of 350 stems/ha for a rotation length of 35 years

Suggested reading:

Berrill and O'Hara 2007
Dean 2007
Knowles and Miller 1993
Nicholas 2007
Tomblason 2004

