Branching Patterns in *E. regnans* Second Logs

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Reference

Nicholas, I.D. 1999: THE EFFECT OF SPACING ON *E. REGNANS* BRANCH CHARACTERISTICS - IMPLICATIONS FOR FOREST MANAGERS"

A thesis submitted in partial fulfilment of a Master of Philiosophy degree, Waikato University, Hamilton, NZ.)

Objective: To identify the potential influences of silvicultural regimes on crown formation (branch size and distribution) and branch shedding.

STUDY SITES

- *E. regnans* regime trial, age 16 years, Kaingaroa Forest, incorporating 11 silvicultural regimes (3 regimes evaluated)
- *E. regnans* fertiliser trial, age 12 years, Kaingaroa Forest, incorporating thinning and no thinning treatments
- *E. regnans* agroforestry demonstration planting, age 22 years, Esk Forest

Stand characteristics

Trial	Nominal stocking Stems/ha	Mean DBH cm	Mean height m	Crown height m
Regime	50	48.1	28.7	11.3
Regime	200	35.9	28.4	15.9
Regime	800	28.5	28.2	19.5
Fertiliser	500	18.6	17.6	11.3
Fertiliser	1500	15.9	18.4	12.3
Agroforestry	120	64.7	36.4	10.0
Mean	-	35.3	26.3	13.4

Methodology to assess second logs (6-12 m)

- Regime trial, trees climbed using ladders and ropes
- Fertiliser trial, trees felled and destructively sampled
- Agroforestry planting, felled trees used in a sawing study were assessed
- Total of 73 trees evaluated

Assessing defects using ropes allowing freedom to move around the tree

Data collection

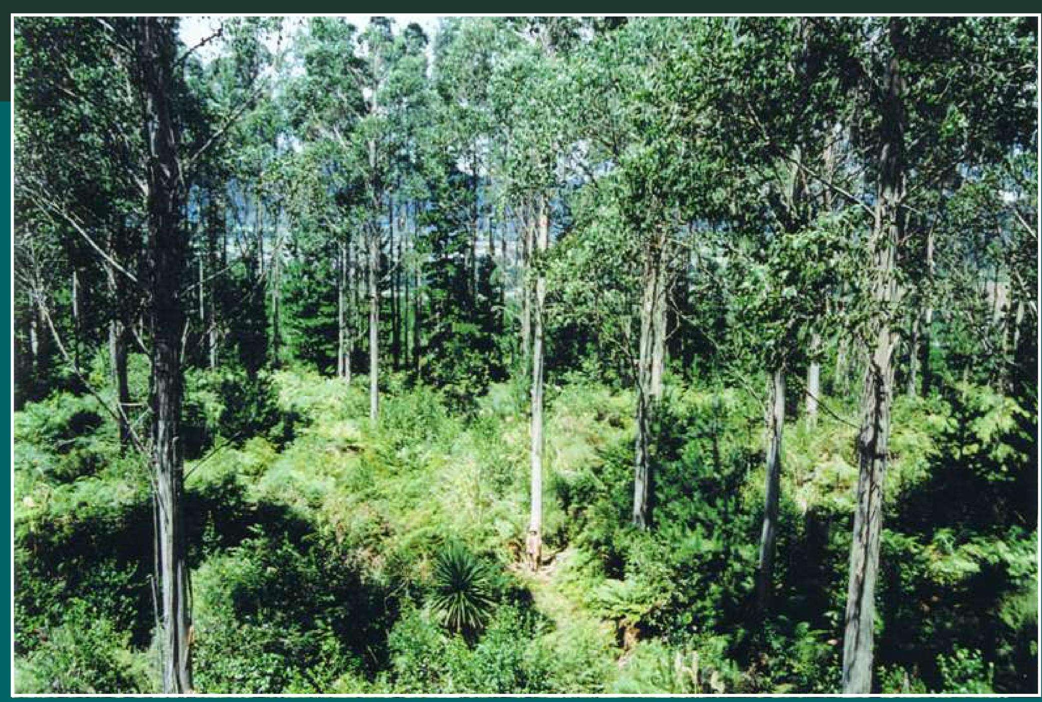
- Branch diameter
- Branch angle
- Branch distribution
- Phyllotaxis (arrangement around the stem)
- Crown characteristics, height and length

Analysis

- Clear length Index calculated
  *(the sum of all lengths between defects >60cm in every 36° wedge/60)*100*
- Use of AUTOSAW to simulate sawing
- Crown characteristics
- Branch characteristics
- Branch Index calculated
  (average of the four largest branches, one from each radial quadrant from 6-12 m)

Testing of hypotheses

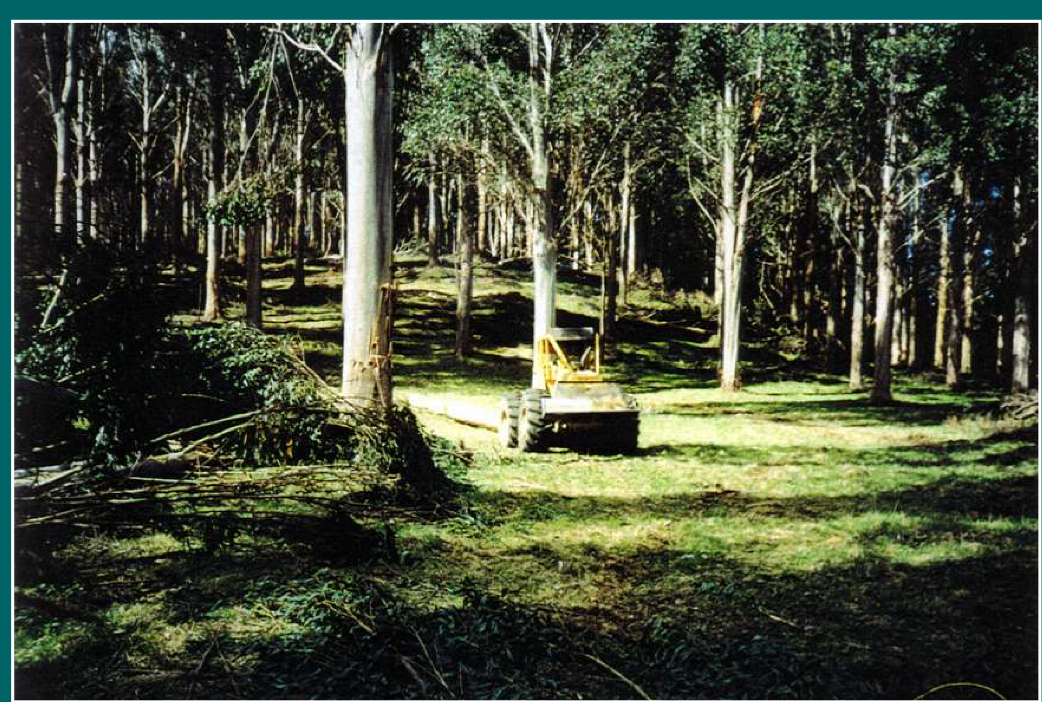
Null hypothesis	Outcome
In *E. regnans* plantations, **the number of branches** formed is not influenced by tree spacing	NOT REJECTED
In *E. regnans* plantations, **the branch condition** is not influenced by tree spacing	REJECTED
In *E. regnans* plantations, **the branch diameter** is not influenced by tree spacing	REJECTED
In *E. regnans* plantations, **the branch angle** is not influenced by tree spacing	PARTIALLY REJECTED
In *E. regnans* plantations, **the spatial distribution of branches** is not influenced by tree spacing	NOT REJECTED



Regime trial 50 stems/ha, age 16 years

Regime trial 800 stems/ha, age 16 years

Regime trial 200 stems/ha, age 16 years



Agroforestry planting 120 stems/ha, age 22 years

CONCLUSION

The study indicates that the utilisation potential of *E. regnans* stands is best improved by silvicultural regimes that grow large logs rather than attempt to restrict branch growth. The natural branching pattern of eucalypts ensures substantial amounts of clear cuttings from unpruned logs.

IMPLICATIONS FOR FORESTRY MANAGERS

Forest managers of *E. regnans* plantations should develop silvicultural sysyems that promote diameter growth.

Pruning should be undertaken, certainly higher than 6 m.

The forest manager should attempt to induce branch shed above the pruned butt log to control the knotty core, but not at the expense of diameter growth.

Models developed

- Live branch diameter growth very strongly related to DBH
  Mean diameter of the live branches = $8.96\,(1-e^{-0.0279DBH})^{1.26}$
- Dead branch diameter growth strongly related to DBH
  Mean diameter of the dead branches = $18.54\,(1-e^{-0.0005DBH})^{0.50}$
- BIX = 0.0994DBH + 0.6098
- Total all branch basal area/tree = 7.1511DBH-65.334
- Crown length = 0.4053DBH-1.4006

RESULTS

Branch Formation

The results show that the number of defects per tree (on average 55 per 6 m stem section) were very consistent across five of the six stocking levels indicating that stocking had no influence on branch initiation. The type of defect was, however, different between treatments; the number of dead branches, partly occluded branches, traces and total number of defects all varied significantly. The study also confirmed previous Australian reports stating that eucalypt crowns contain a mixture of both live and dead branches.

Branch Size

The size of live and dead branches was strongly influenced by stocking, but had a relationship with stem DBH (1.4 m) that was much stronger. Models based on stem diameter were developed to predict mean branch diameter for live and dead branches.

Branch Index

Branch index (mean of the four largest branches one from each radial quadrant), branch basal area, particularly total branch basal area/tree and crown length also showed a strong relationship with diameter.

Branch Distribution

Graphical analysis of the spatial distribution of branches showed that eucalypt branches have a pattern of branching which naturally creates clear lengths between knots, both longitudinally and radially within the stem. Attempts to identify a regular pattern in this were unsuccessful. To compare defect distributions among treatments, a Clear Length Index (CLI) was developed which assessed the length of clear stem between defects compared with a defect free stem. This identified very high percentages, means of 82% free and 95% free for all defects and for branch defects respectively. CLI values for stem sections free of branch defects indicated a stocking effect.

Sawing Simulation

In a preliminary analysis, the computer sawing simulation model AUTOSAW was used to describe clear distances between defects among a range of stockings. Output from this evaluation indicated that the percentage of defect free lengths related only moderately to mean stem diameter of the treatment.

E. regnans recommended regime

- **Initial stocking 800 stems/ha**
- **200 stems/ha pruned to 6 m at age 6 years**
- **Thin to 200 stems/ha at age 6 years**
- **200 stems/ha pruned to 10 m at age 10 years**