Understory and biodiversity changes following thinning in regenerated totara stands

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Does thinning for timber production also enhance biodiversity in dense naturally regenerated totara forests? A recent study confirms previous field observations that areas of thinned and pruned totara forest have greater development of understory vegetation than the areas not thinned.

One of the features of native forest is its capacity to provide and combine multiple value and benefits. These include soil and water conservation, carbon sequestration and storage, biodiversity, landscape and recreational values, as well as sustainable timber yields on private land. Managing forests to maximise these benefits makes sense in today's world. If timber production from natural forests in New Zealand is intended, then the Forests Act requires that it be carried out on a sustainable yield basis, and that all the natural values of the forest are also maintained in perpetuity. This raises many questions – especially for silvicultural intervention within stands of naturally regenerating totara on farms.

Widespread regeneration

Totara is a light-demanding, pioneer tree species and ecologically suited to colonising disturbed environments. Its comparative resistance to livestock browsing is another attribute. These characteristics, combined with bush clearance and farming activities, have led to its widespread regeneration on farms and in reverting scrubland in many regions.

However, and particularly due to the influence of livestock grazing, many of these second-growth forests have a modified species composition and character. In some places dense, almost mono-culture stands of pole-sized totara trees have established. Significantly, these dense stands often appear to have a bare understory – even where grazing has been excluded.

In contrast, during measurement of totara silvicultural trial plots consisting of pairs of thinned with not thinned control plots, significant differences in the development of understory vegetation have been noted. These observations raise questions on the relationship between silviculture for timber production and the management of biodiversity within the stands.

Sample plots

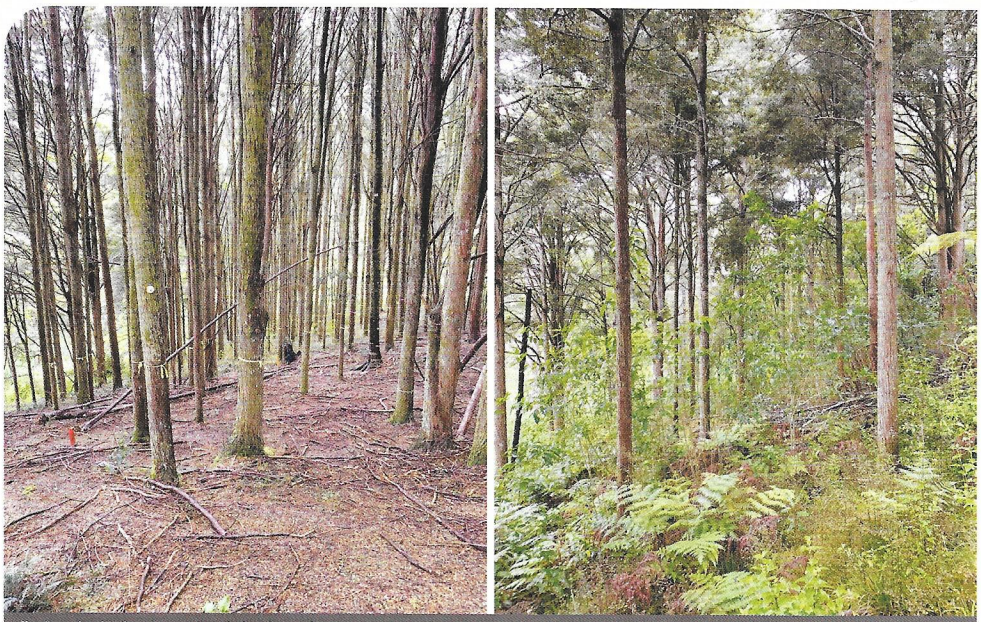
From 2005, one of the authors and the Northland Totara Working Group established a network of permanent sample plots within developing stands of naturally regenerated totara on farms in the Northland region. The permanent sample plots were established to enable the comparison of one or two specified thinning treatments with an adjacent control plot. These were designed to test growth response to thinning and pruning for timber production.

In 2012, further permanent sample plots were established on a farm site near Titoki. These also produced some benchmark data on the understory vegetation with and without a combination of thinning the totara-dominant canopy trees and fencing out livestock. Further measurement of the plots took place in 2020 and included an assessment of understory development in terms of indigenous biodiversity of each plot.

Measurement and methods

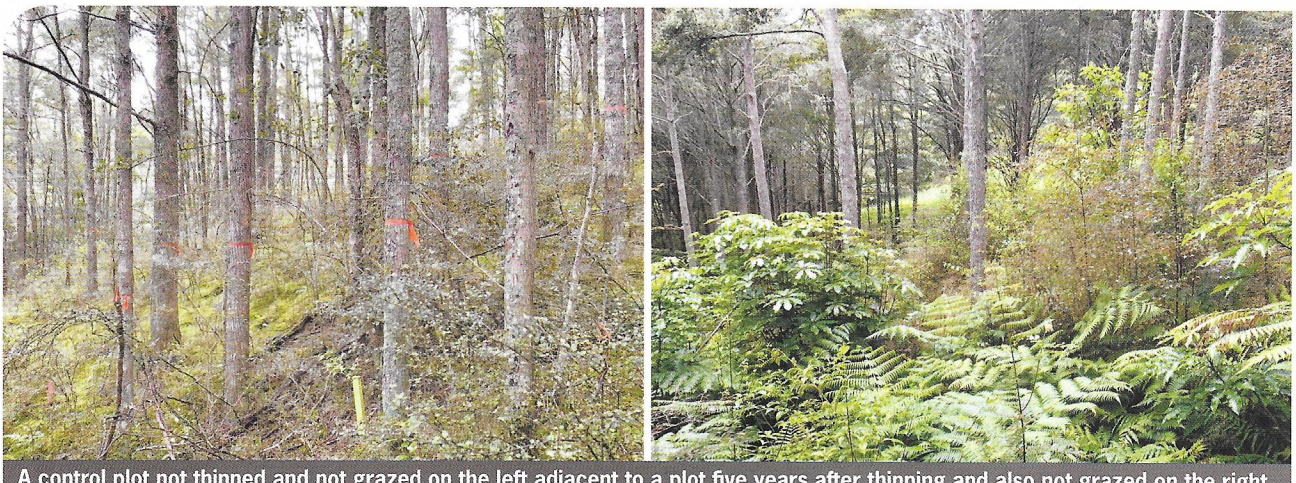
Data from a total of 21 thinned plots and 18 control plots has been used to assess the comparative difference in understory development. A scoring system was used to assess each plot. Scores used a scale of one to five. One is low biodiversity or understory development with five being high biodiversity or understory development.

The mark is a subjective assessment of the volume of understory vegetation and the diversity of native species observed and recorded, the values appearing to be closely related. The presence or absence of grazing or browsing was also noted. The biodiversity score was analysed to determine whether thinning affected biodiversity and development of a vegetative understory, and whether this was higher with evidence of grazing or browsing.



Paired silvicultural trial plots in an area where grazing was excluded. The control plot where no thinning was undertaken is on the left and the thinned plot is on the right. There is a marked contrast in understory development and indigenous biodiversity.

The photograph on the left shows a control plot not thinned in a grazed area. It was immediately adjacent to a thinned plot above on the right, also grazed, which shows an increase in ground cover and understorey vegetation, mostly natives.



A control plot not thinned and not grazed on the left adjacent to a plot five years after thinning and also not grazed on the right. A dense and biodiverse understory has developed in the thinned plot over the five years.

Stand characteristics of control with thinned and pruned plots in regenerating totara stands measured in 2020

Treatment	Stand density in stems per hectare	Diameter at breast height in centimetres	Mean top diameter in centimetres	Mean top height in metres	Basal area in square metres per hectare	Volume in cubic metres per hectare	Carbon sequestration in tonnes per hectare	Stand density index	Totara as a percentage of species
Control	2,323	18.1	33.1	15.7	52.4	330	441	484	85
Thinned and pruned	1,143	22.6	33.6	15.3	38.5	252	326	326	95

The mean density of the thinned stands at 1,143 stems a hectare was half that of the control plots at 2,323 stems a hectare. Thinning also reduced the mean basal area and total tree volume of the thinned plots. Thinning significantly increased diameter at breast height of the residual totara trees, but it had no significant effect on mean top diameter or height. Totara trees comprised 85 per cent of the trees within the control plots and 95 per cent within the thinned plots.

Results

The mean biodiversity score was significantly higher in thinned than in the control permanent sample plots not thinned. They were also significantly higher in plots in fenced-off forest areas compared with those with evidence of grazing.

Mean biodiversity score

Treatment	Biodiversity score
Control	2.05
Thinned	3.62
Evidence of grazing or browsing	1.89
No grazing or browsing	3.78

The higher biodiversity scores in thinned and non-grazed or browsed plots of an understorey vegetation tier are clearly illustrated in the range of photographs taken during the 2020 measurement.

Implications and discussion

The results confirm observations that even when livestock is excluded from dense totara stands, the understory usually remains relatively bare, with little vegetation or species diversity. In contrast, a luxuriant understory tends to develop within five years following thinning. This suggests that silvicultural management for timber production may be compatible with management to enhance indigenous biodiversity within the forest.

The growth of the understory vegetation in thinned plots is likely to be a response to increased light levels. However, the precise factors are not determined by this study and it does not indicate whether the boost in understory development will be maintained in the long term.

Will the regenerating plants and seedlings survive and succeed as the residual totara trees grow and their crowns expand to form a dense canopy? Or will further thinning or selective harvesting as part of a continuous cover forestry regime be required to maintain increased biodiversity within these totara dominant stands?

In addition, the implications for managing the regenerated forests subject to Sustainable Forest Management Plans are unclear. The provisions of the Forests Act were envisaged as being applied to remnant natural forests rather than highly modified second-growth forests. The current interpretation is that maintenance of the species composition of totara dominant forests is required, rather than inducing an increasing species diversity and enhanced natural character which may be at the expense of the dominant species.

Conclusion

It seems that thinning and pruning as part of silvicultural tending dense developing totara forests opens opportunities for wider management objectives which include enhancing biodiversity and natural character. How these can be maintained in the future as the stands mature should be the subject of further study. However, indications are that management for timber production and continuous cover forestry may be compatible with managing developing totara forests for multiple benefits and value.

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