Growing confidence in forestry's future Research Programme

SCION
FORESTS ▪ PRODUCTS ▪ INNOVATION

Impact of optimising final stand density on value of the New Zealand plantation estate

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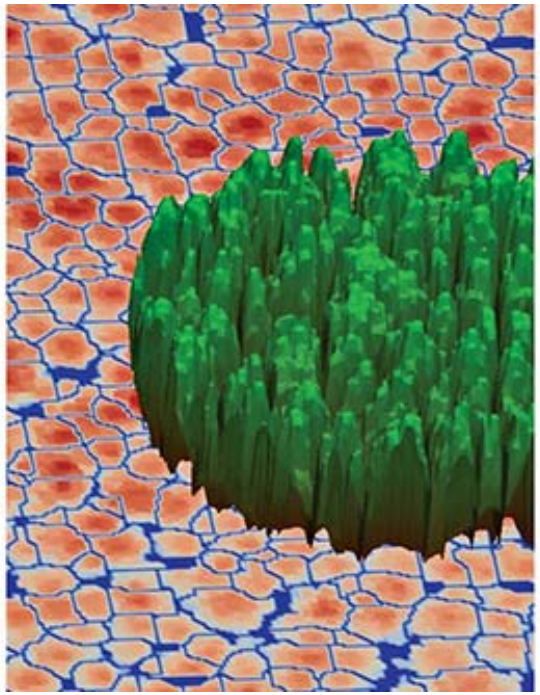


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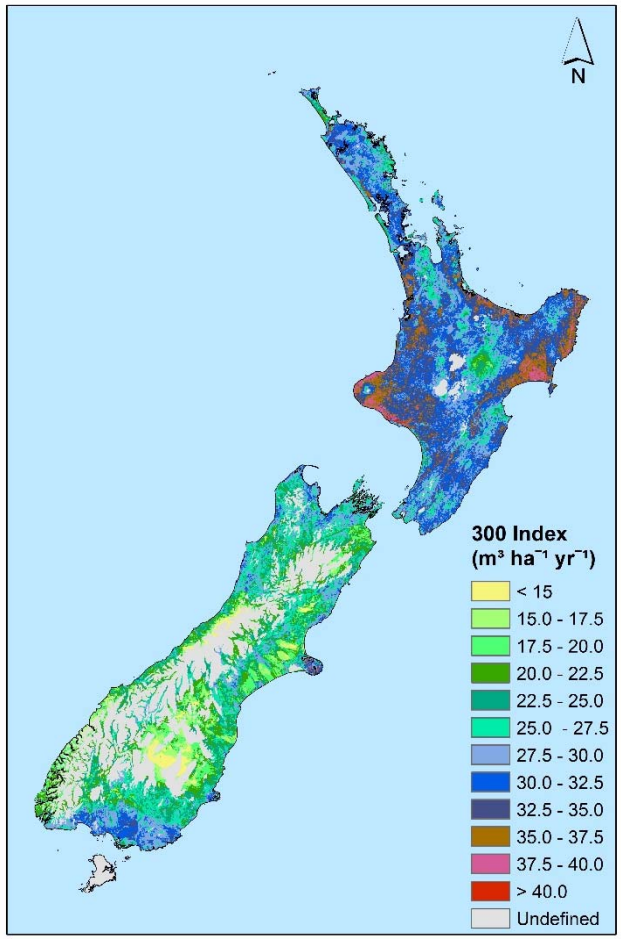
Introduction

- Structural grade regimes important for plantation forestry and currently occupy 47% of the estate (ca. 700,000 ha)
- Final stand density is an important determinant of structural grade crop volume and value
- Empirical models included within Forecaster widely used to predict optimal stand density at stand level

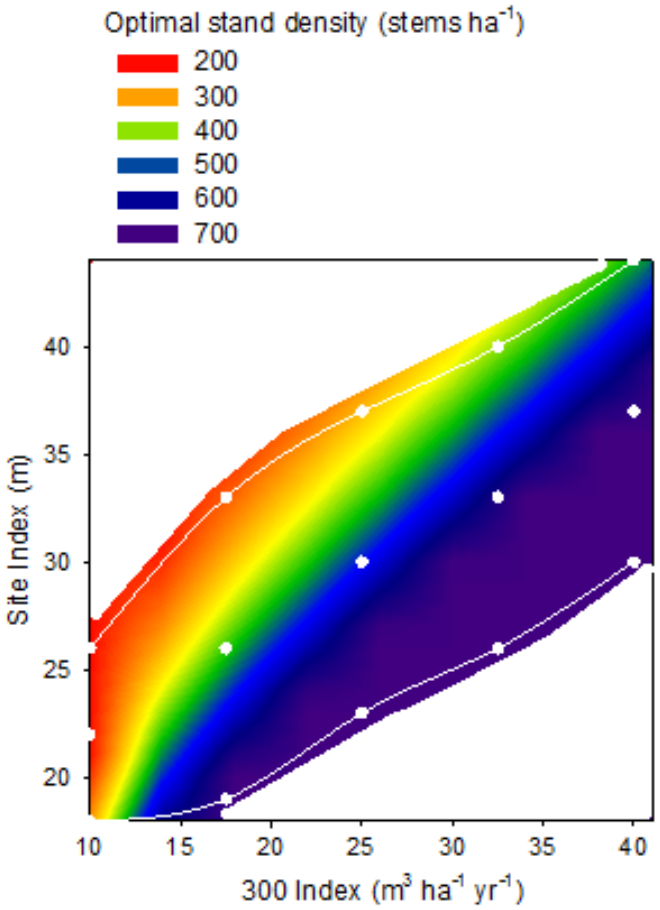
Introduction

- Recent research has developed a model to spatially predict optimal stand density
- Model optimises most valuable structural log grade; large diameter small branched sawlog
- Constructed from Forecaster simulations
- As inputs, model uses 300 Index, Site Index, rotation age



Introduction

- Model demonstrates wide range in optimal stocking across Site Index and 300 Index range
- Optimal stocking increases with increasing 300 Index and as Site Index declines
- Model accounts for mortality and predicts robust stocking



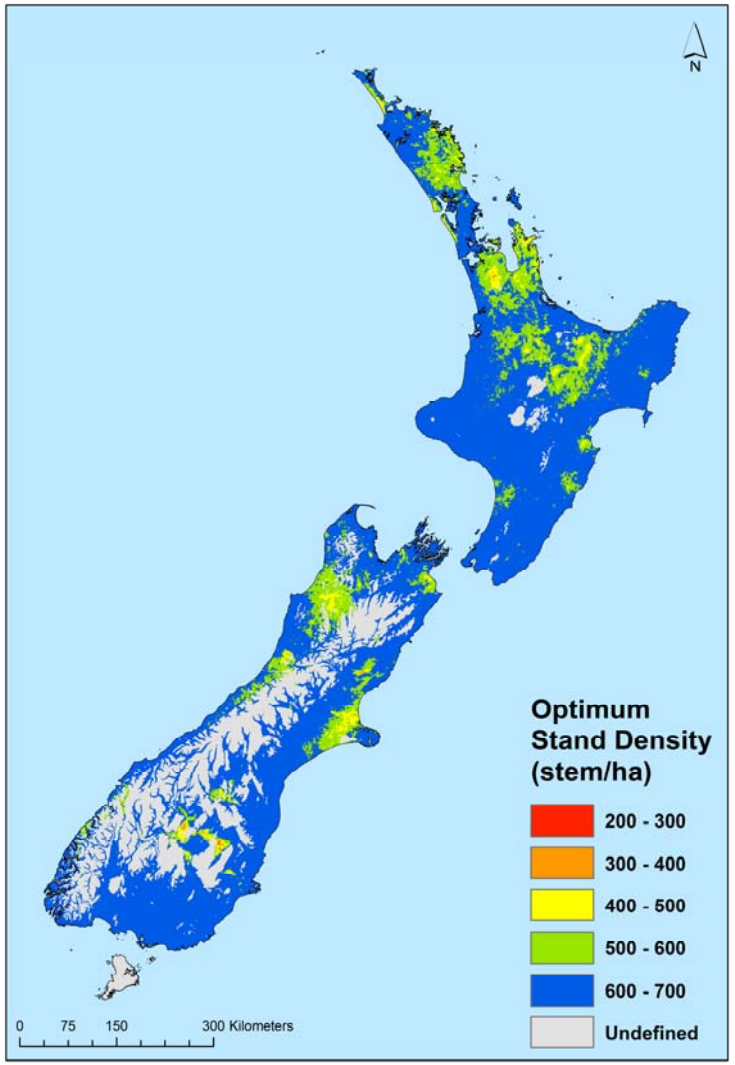
Source : Watt MS, Kimberley MO, Dash J, Harrison, D 2017.
Spatial prediction of optimal final stand density for even age plantation forests using productivity indices. Canadian Journal of Forest Research 47, 527-535.

Introduction

300 Index	SI	S_{opt}	S_{28}	Mort
$m^3\ ha^{-1}\ yr^{-1}$	m	stems ha^{-1}	stems ha^{-1}	%
10	18	290	285	0.21
	22	200	197	0.13
	26	200	197	0.14
17.5	19	700	604	1.53
	26	434	403	0.75
	33	253	243	0.43
25	23	700	598	1.38
	30	526	458	1.12
	37	319	294	0.71
32.5	26	700	609	1.10
	33	647	543	1.23
	40	398	350	0.89
40	30	700	621	0.84
	37	700	587	1.08
	44	451	385	0.90

Introduction

- Model predicts mean stocking of 614 stems ha^{-1} > than actual stocking of ca. 500 stems ha^{-1}
- Model predicts 88% of stands with stocking > 500 stems ha^{-1}
- This disparity of ca. 100 stems ha^{-1} suggests that greater value could be obtained from structural grade regimes
- Would be useful to quantify this potential gain in value



Objective

- Determine the accuracy of the optimal stand density surface
- Evaluate the economic impact of growing structural grade timber under a sub-optimal final crop stand density

Methods

- Forecaster runs undertaken for 15 combinations of SI and 300 Index covering productivity range
- Each run undertaken using optimal stocking and eight stockings below and above optimal stocking (range -200 to +200)
- Used current log prices and costs, benchmarked from several sources

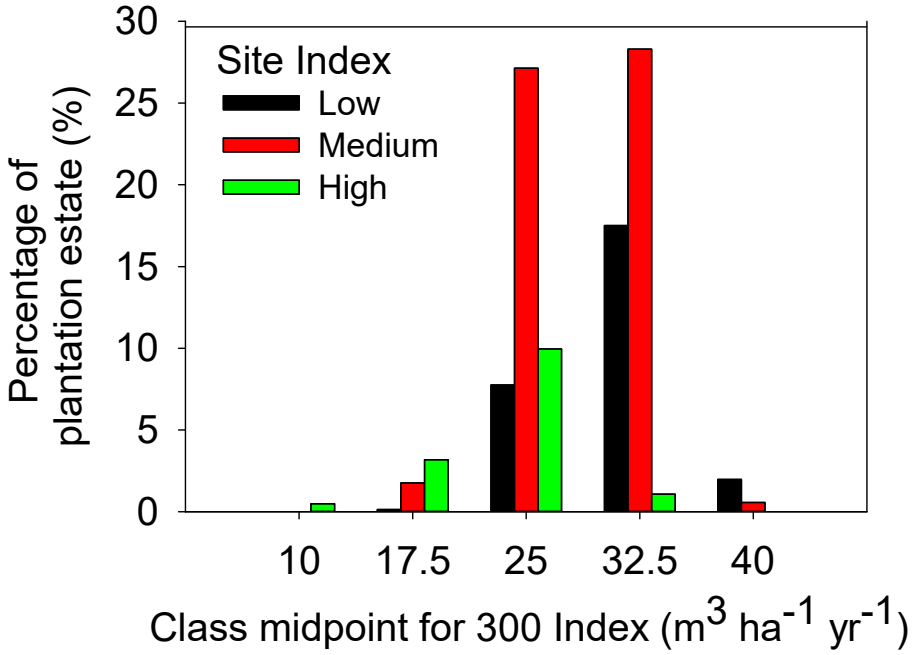
300 Index (m^3 ha^{-1})	Site Index (m)	S_{opt} (stems ha^{-1})
10	18	290
10	22	200
10	26	200
17.5	19	700
17.5	26	434
17.5	33	253
25	23	700
25	30	526
25	37	319
32.5	26	700
32.5	33	647
32.5	40	398
40	30	700
40	37	700
40	44	451

Methods

<u>Two types of analyses to look at volume and value:</u>

- 1. Focus on six most widespread combinations of 300 Index and Site Index, that encompass 92% of estate

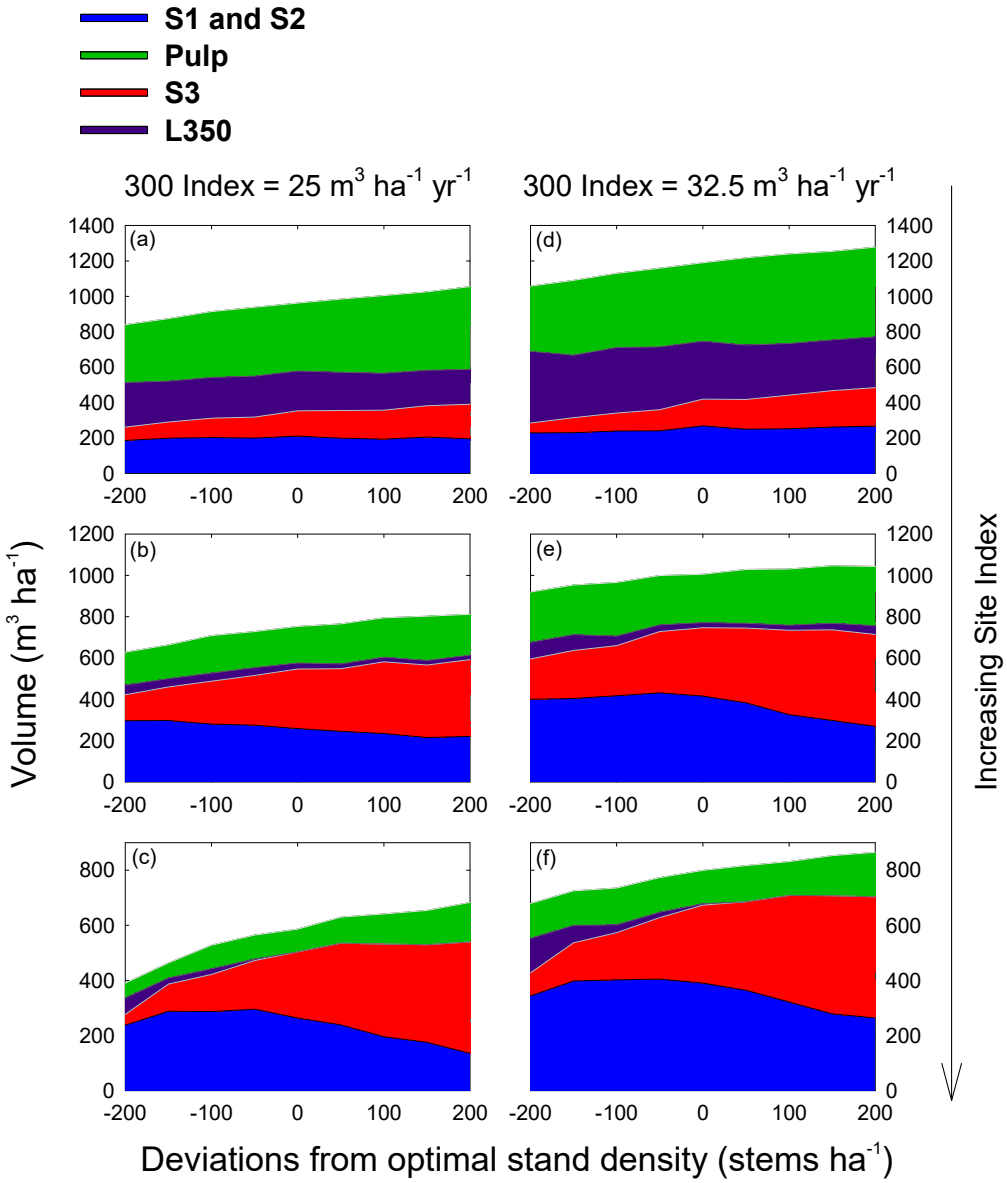
- 2. Averages weighted across NZ plantations by accounting for proportion in each productivity class.



Methods – log grades and values

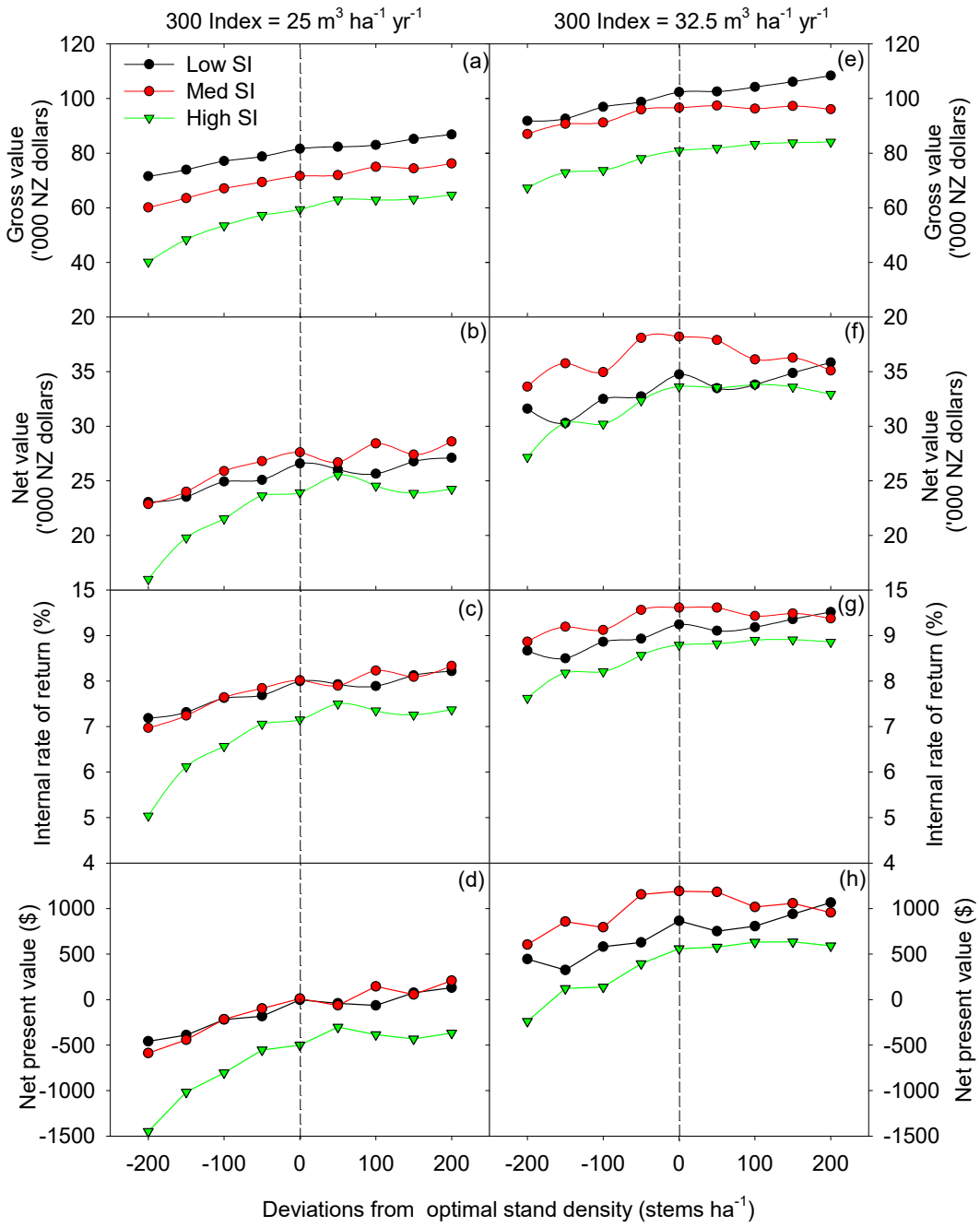
Log type	SED	Largest branch	Log Length	Value
	mm	mm	mm	$ m^{-3}
S1	≥ 400	≤ 60	4.8 – 6.1	115.08
S2	300 - 400	≤ 60	4.8 – 6.1	115.08
S3	200 - 300	≤ 60	3.7 – 4.7	102.99
L350	≥ 350	≤ 130	4.9 – 6.1	99.55
Pulp	≥ 100	no limit	3.7	52.66

Results – volume, log grade



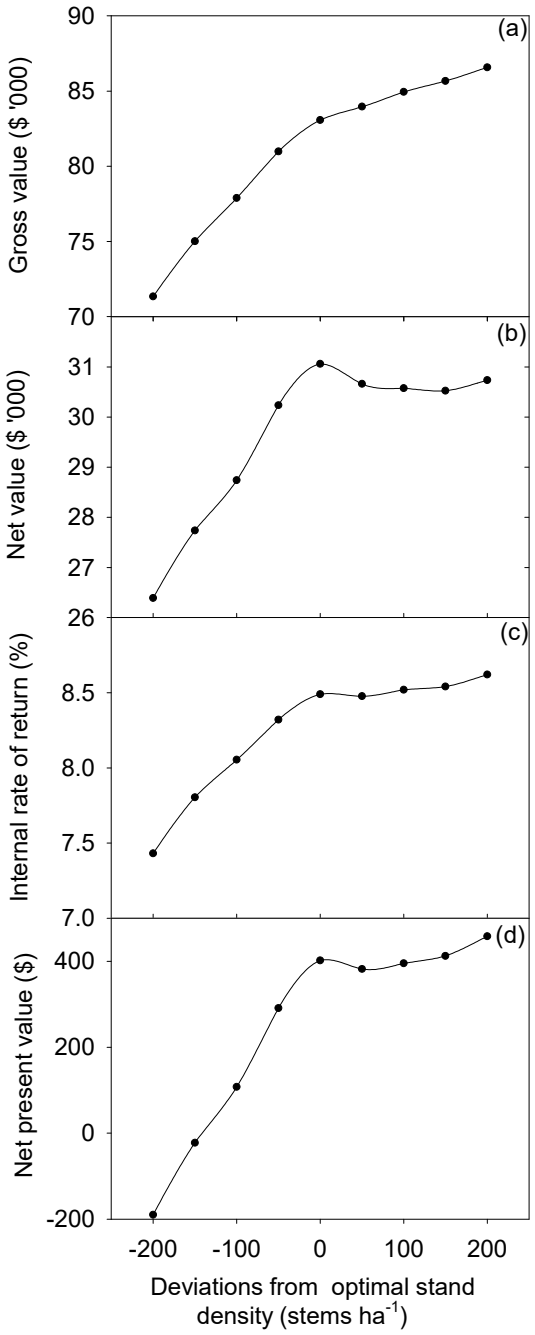
Results – value

- Gross value increases across stand density range
- Net value, IRR and NPV increase to optimum, then threshold
- Gains in value with stocking tend to be greater for high SI sites



Results – composite value

- Increases in gross value with stocking across range
- Increases in other metrics to optimum
- Marginal increases/reductions after optimum



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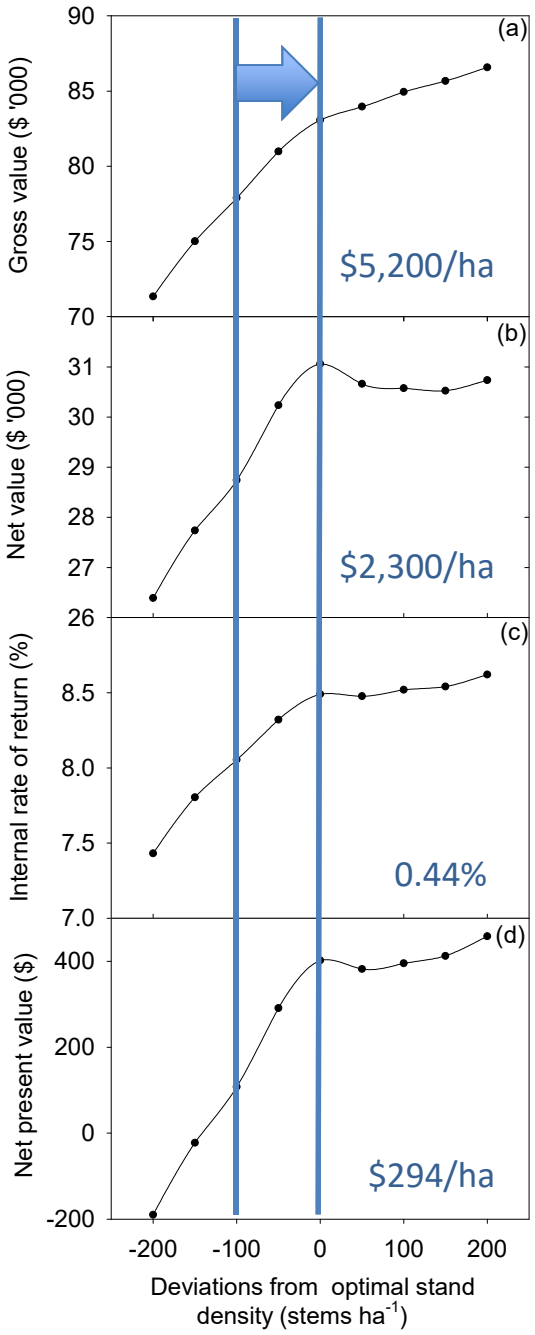
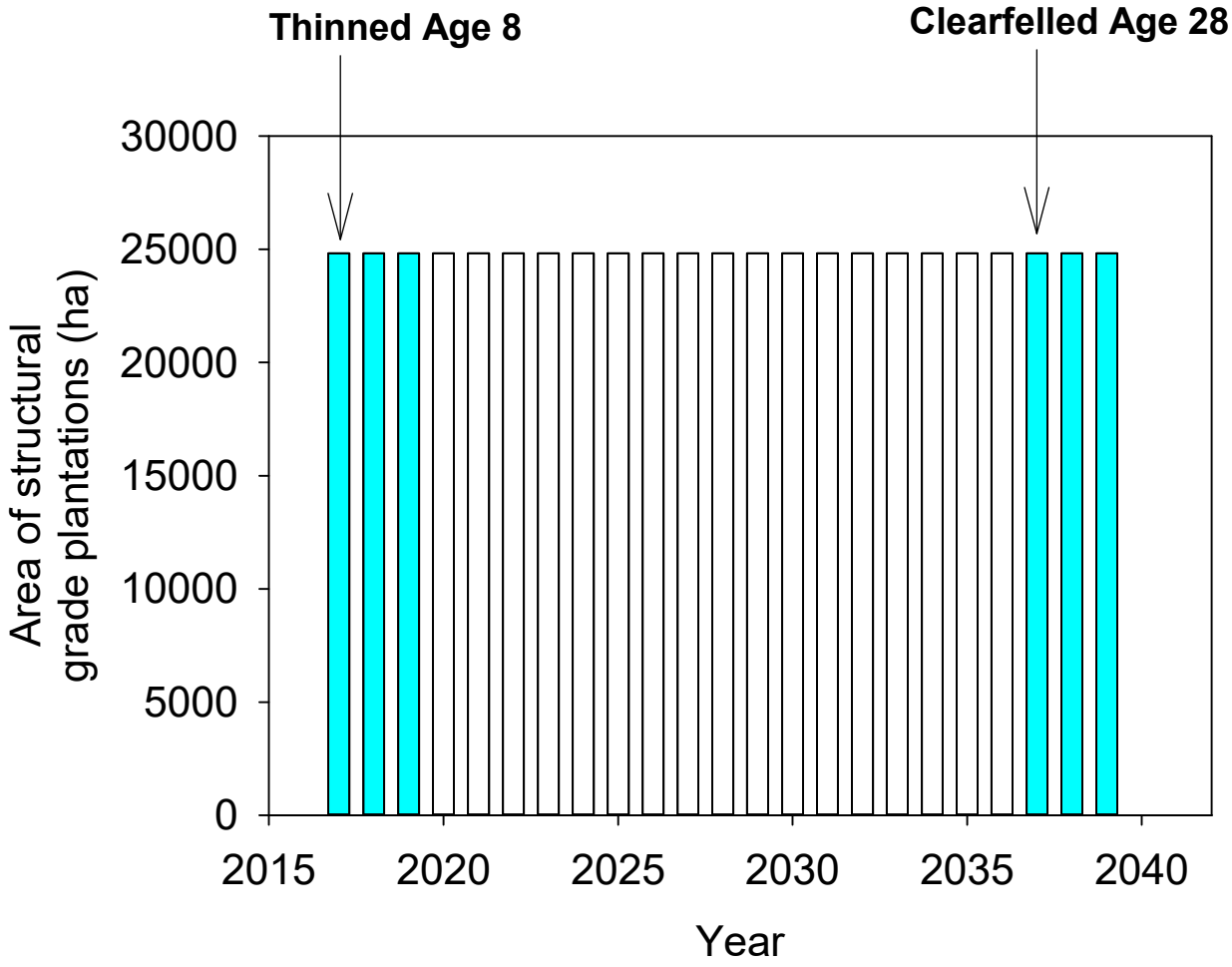


Results – potential gains in value to plantation resource



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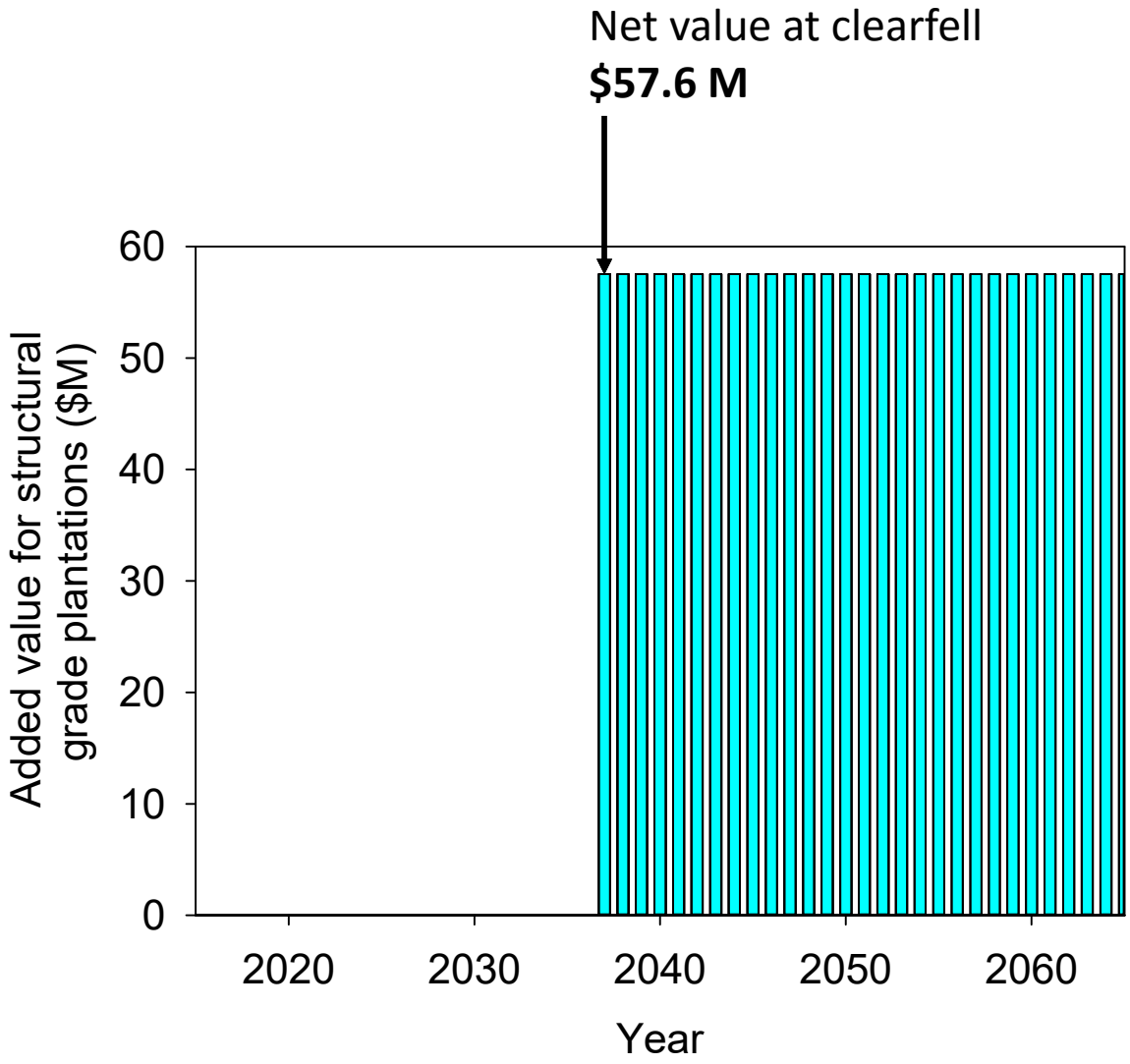

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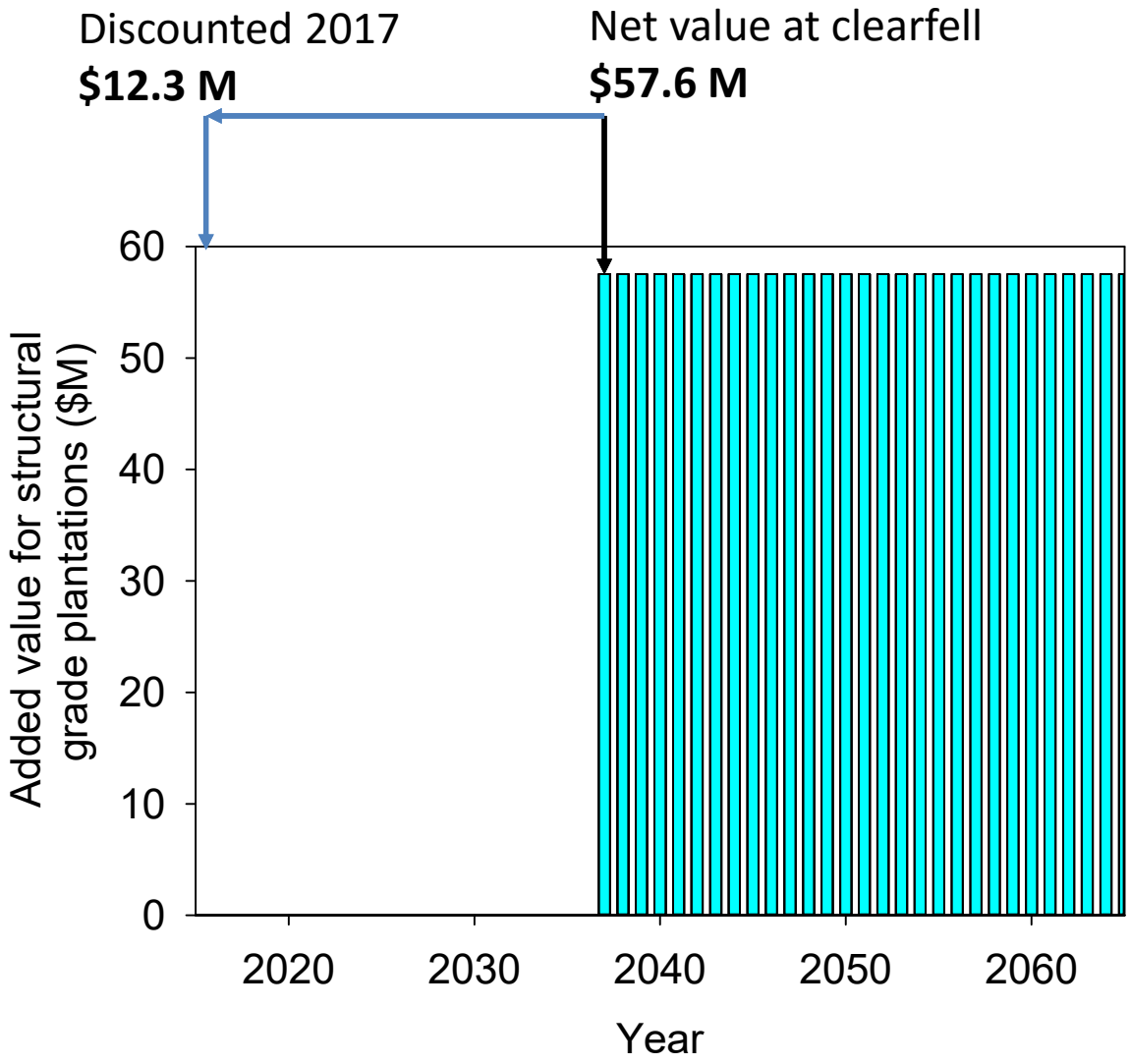

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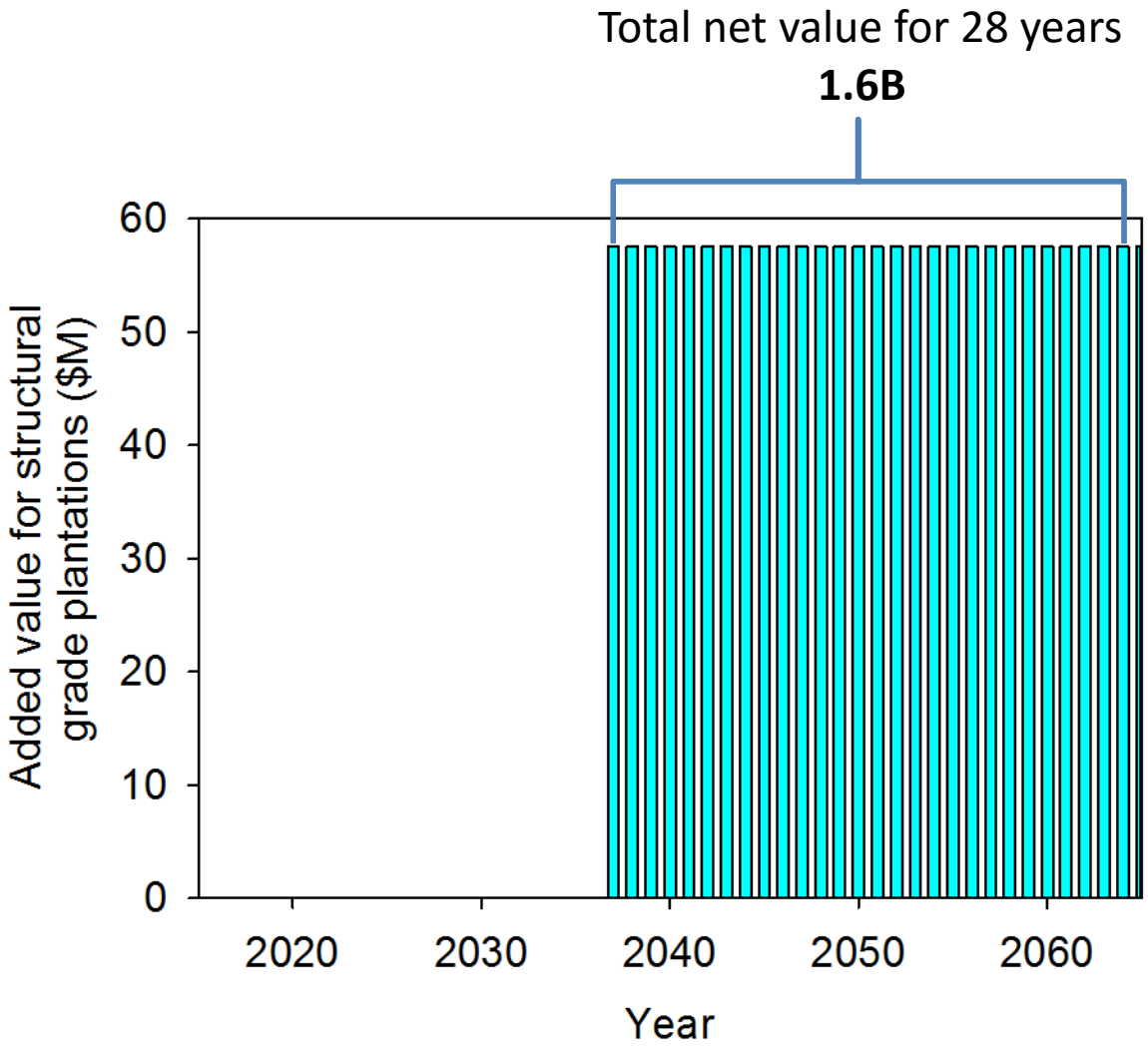

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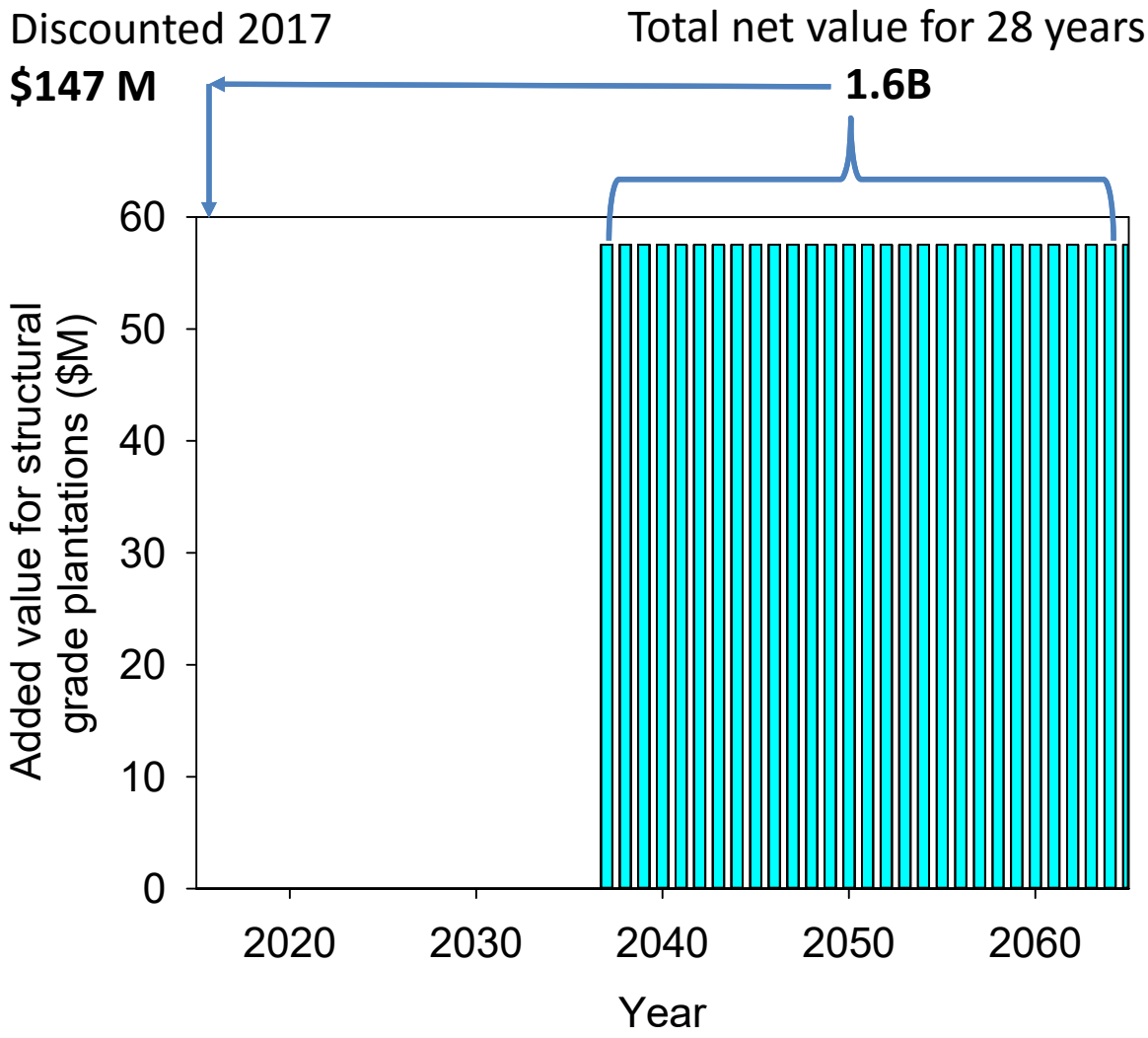

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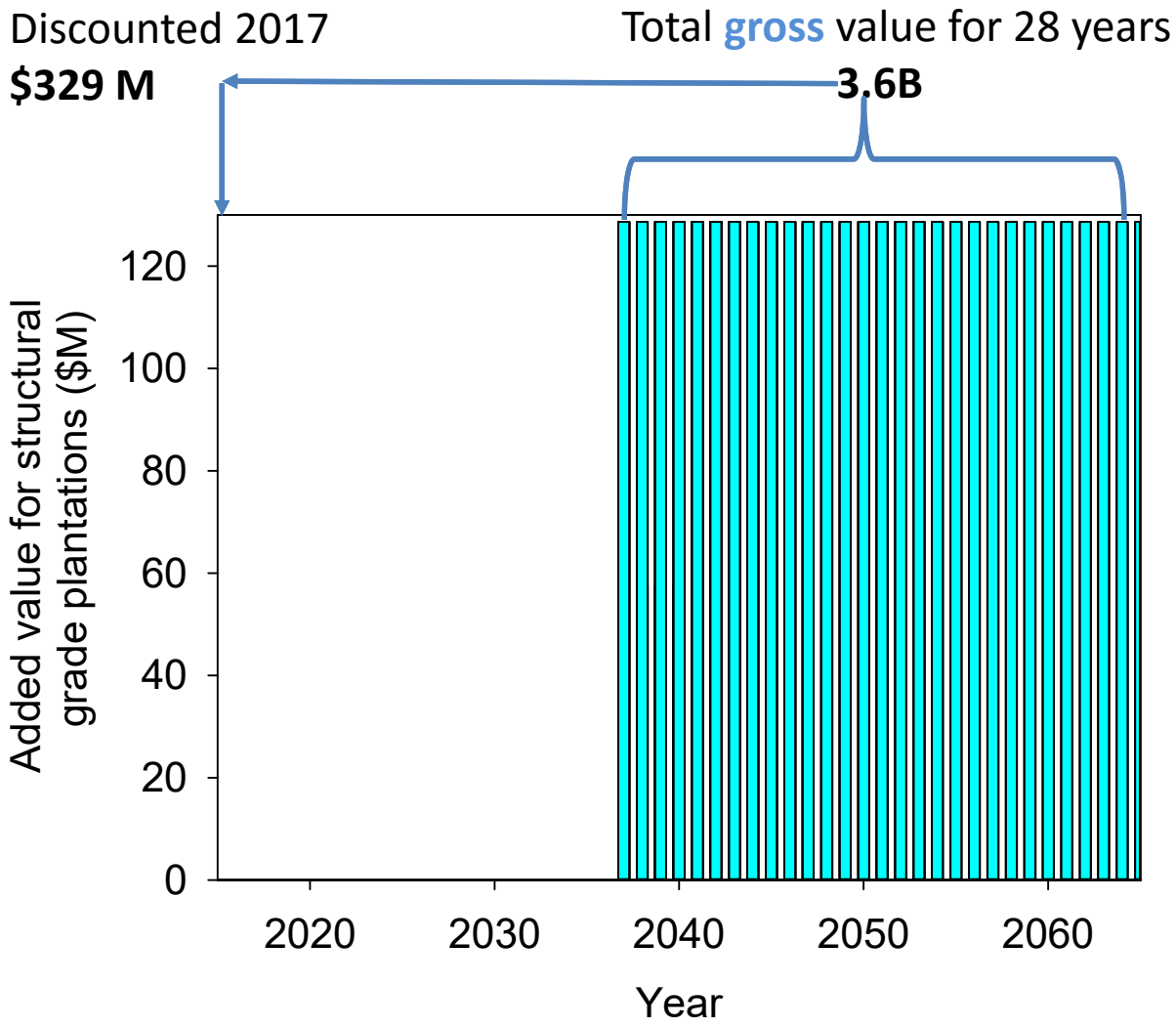

Conclusion

- Total recoverable volume increases across stocking range for all simulations

- Gains in the volume of valuable log grades increased by on average 22% and 9.5% for increases of 200 and 100 stems ha^{-1}. Gains above this were far smaller (3.3%)

- As measured by value the spatial model provided reasonably accurate predictions of optimal stocking

Conclusion

- There were significant gains in value as stocking increased for the six most important site productivities

- Increasing stocking by 100 stems ha^{-1} should result in gains of ca. \$5,200 ha^{-1}, \$2,300 ha^{-1}, 0.44%, \$294 ha^{-1}, respectively, for gross value, net value, IRR and NPV

- These equate to percentage gains of 6.6% and 8.0%, respectively, for Gross and Net Value

- Increasing stocking across the plantation estate by 100 stems ha^{-1} could result in discounted gross and net gains of 329M and \$147M over 28 year period

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