Growth models, spatial surfaces, and decision support tools for commonly grown exotic plantation species

Michael Watt, Mark Kimberley, Jamie Heather, Danielle Gatland

Introduction – justification for diversification

- Currently radiata pine dominates the plantation resource
- Recent events such as Cyclone Gabrielle and brown spot needle blight (in Spain) have highlighted the value of diversification
- Diversification provides a means of protecting against disease, wind and fire
- Underpinning research showing site suitability for many different exotic species is required to provide confidence around establishment of alternative species
- Although modelling of growth for alternative exotics has been undertaken, this has been very piecemeal and not standardised

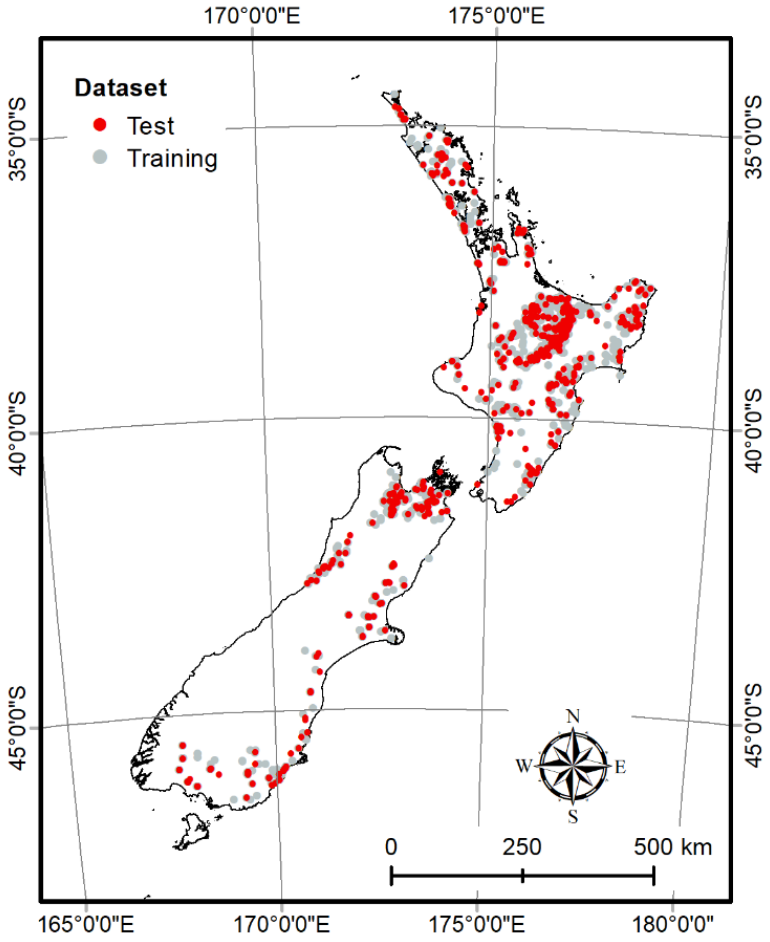
L. acicola on *Pinus radiata* in Spain
Image: Juan Manuel Pérez de Ana

Introduction – 300 Index model

- The 300 Index model offers a way of standardising predictions allowing species comparisons
- More robust than most growth modelling approaches as it is based on a volume index to characterise impacts of site, silviculture on growth
- Once growth models have been fitted surfaces of productivity can be developed
- This presentation reports on the development of growth models and surfaces for 11 of the most common exotic species
- Models and surfaces developed for radiata pine, Douglas-fir, two cypresses, five eucalypts, redwood and blackwood

Growth modelling approach

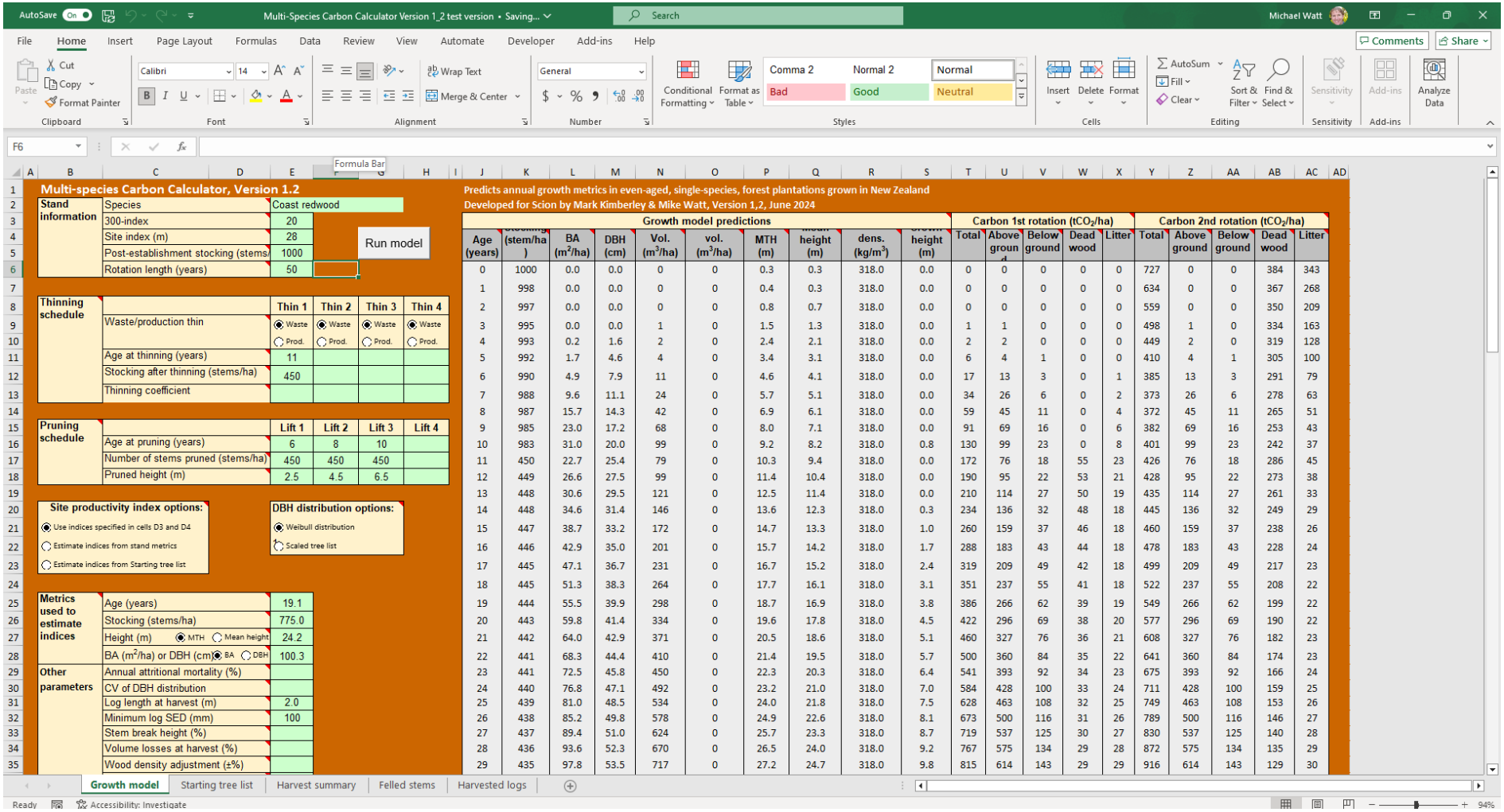
- Permanent sample plot (PSP) data is acquired for the species of interest
- Growth models fitted to PSP data
- The growth models include functions to predict mean top height, 300 Index, mortality, volume
- Carbon predictions made using a combination of growth models, wood density, allometric equations and carbon partitioning



Growth model for exotic plantation species

- The growth and yield functions previously described have been integrated into a simple to use multispecies growth model
- Available at the FGR website: https://fgr.nz/tools/multi-species-carbon-calculator/
- Can be used for predictions of growth and carbon for 11 exotic plantation species
- Can be run off either plot data or productivity surfaces
- Simulates growth and carbon for a given silviculture and has a module which gives log outturn

Multi-species carbon calculator



Multi-species Carbon Calculator, Version 1.2

Predicts annual growth metrics in even-aged, single-species, forest plantations grown in New Zealand

Developed for Scion by Mark Kimberley & Mike Watt, Version 1,2, June 2024

Stand information	
Species	Coast redwood
300-index	20
Site index (m)	28
Post-establishment stocking (stems/	1000
Rotation length (years)	50

Run model

Thinning schedule	Thin 1	Thin 2	Thin 3	Thin 4
Waste/production thin	Waste / Prod.	Waste / Prod.	Waste / Prod.	Waste / Prod.
Age at thinning (years)	11			
Stocking after thinning (stems/ha)	450			
Thinning coefficient				

Pruning schedule	Lift 1	Lift 2	Lift 3	Lift 4
Age at pruning (years)	6	8	10	
Number of stems pruned (stems/ha)	450	450	450	
Pruned height (m)	2.5	4.5	6.5	

Site productivity index options:

- (•) Use indices specified in cells D3 and D4
- ( ) Estimate indices from stand metrics
- ( ) Estimate indices from Starting tree list

DBH distribution options:

- (•) Weibull distribution
- ( ) Scaled tree list

Metrics used to estimate indices	
Age (years)	19.1
Stocking (stems/ha)	775.0
Height (m) (•) MTH ( ) Mean height	24.2
BA (m^2/ha) or DBH (cm) (•) BA ( ) DBH	100.3

Other parameters	
Annual attritional mortality (%)	
CV of DBH distribution	
Log length at harvest (m)	2.0
Minimum log SED (mm)	100
Stem break height (%)	
Volume losses at harvest (%)	
Wood density adjustment (±%)	

Growth model predictions											Carbon 1st rotation (tCO_2/ha)					Carbon 2nd rotation (tCO_2/ha)				
Age (years)	(stem/ha)	BA (m^2/ha)	DBH (cm)	Vol. (m^3/ha)	vol. (m^3/ha)	MTH (m)	height (m)	dens. (kg/m^3)	height (m)	Total	Above ground	Below ground	Dead wood	Litter	Total	Above ground	Below ground	Dead wood	Litter
0	1000	0.0	0.0	0	0	0.3	0.3	318.0	0.0	0	0	0	0	0	727	0	0	384	343
1	998	0.0	0.0	0	0	0.4	0.3	318.0	0.0	0	0	0	0	0	634	0	0	367	268
2	997	0.0	0.0	0	0	0.8	0.7	318.0	0.0	0	0	0	0	0	559	0	0	350	209
3	995	0.0	0.0	1	0	1.5	1.3	318.0	0.0	1	1	0	0	0	498	1	0	334	163
4	993	0.2	1.6	2	0	2.4	2.1	318.0	0.0	2	2	0	0	0	449	2	0	319	128
5	992	1.7	4.6	4	0	3.4	3.1	318.0	0.0	6	4	1	0	0	410	4	1	305	100
6	990	4.9	7.9	11	0	4.6	4.1	318.0	0.0	17	13	3	0	1	385	13	3	291	79
7	988	9.6	11.1	24	0	5.7	5.1	318.0	0.0	34	26	6	0	2	373	26	6	278	63
8	987	15.7	14.3	42	0	6.9	6.1	318.0	0.0	59	45	11	0	4	372	45	11	265	51
9	985	23.0	17.2	68	0	8.0	7.1	318.0	0.0	91	69	16	0	6	382	69	16	253	43
10	983	31.0	20.0	99	0	9.2	8.2	318.0	0.8	130	99	23	0	8	401	99	23	242	37
11	450	22.7	25.4	79	0	10.3	9.4	318.0	0.0	172	76	18	55	23	426	76	18	286	45
12	449	26.6	27.5	99	0	11.4	10.4	318.0	0.0	190	95	22	53	21	428	95	22	273	38
13	448	30.6	29.5	121	0	12.5	11.4	318.0	0.0	210	114	27	50	19	435	114	27	261	33
14	448	34.6	31.4	146	0	13.6	12.3	318.0	0.3	234	136	32	48	18	445	136	32	249	29
15	447	38.7	33.2	172	0	14.7	13.3	318.0	1.0	260	159	37	46	18	460	159	37	238	26
16	446	42.9	35.0	201	0	15.7	14.2	318.0	1.7	288	183	43	44	18	478	183	43	228	24
17	445	47.1	36.7	231	0	16.7	15.2	318.0	2.4	319	209	49	42	18	499	209	49	217	23
18	445	51.3	38.3	264	0	17.7	16.1	318.0	3.1	351	237	55	41	18	522	237	55	208	22
19	444	55.5	39.9	298	0	18.7	16.9	318.0	3.8	386	266	62	39	19	549	266	62	199	22
20	443	59.8	41.4	334	0	19.6	17.8	318.0	4.5	422	296	69	38	20	577	296	69	190	22
21	442	64.0	42.9	371	0	20.5	18.6	318.0	5.1	460	327	76	36	21	608	327	76	182	23
22	441	68.3	44.4	410	0	21.4	19.5	318.0	5.7	500	360	84	35	22	641	360	84	174	23
23	441	72.5	45.8	450	0	22.3	20.3	318.0	6.4	541	393	92	34	23	675	393	92	166	24
24	440	76.8	47.1	492	0	23.2	21.0	318.0	7.0	584	428	100	33	24	711	428	100	159	25
25	439	81.0	48.5	534	0	24.0	21.8	318.0	7.5	628	463	108	32	25	749	463	108	153	26
26	438	85.2	49.8	578	0	24.9	22.6	318.0	8.1	673	500	116	31	26	789	500	116	146	27
27	437	89.4	51.0	624	0	25.7	23.3	318.0	8.7	719	537	125	30	27	830	537	125	140	28
28	436	93.6	52.3	670	0	26.5	24.0	318.0	9.2	767	575	134	29	28	872	575	134	135	29
29	435	97.8	53.5	717	0	27.2	24.7	318.0	9.8	815	614	143	29	29	916	614	143	129	30

Growth model | Starting tree list | Harvest summary | Felled stems | Harvested logs

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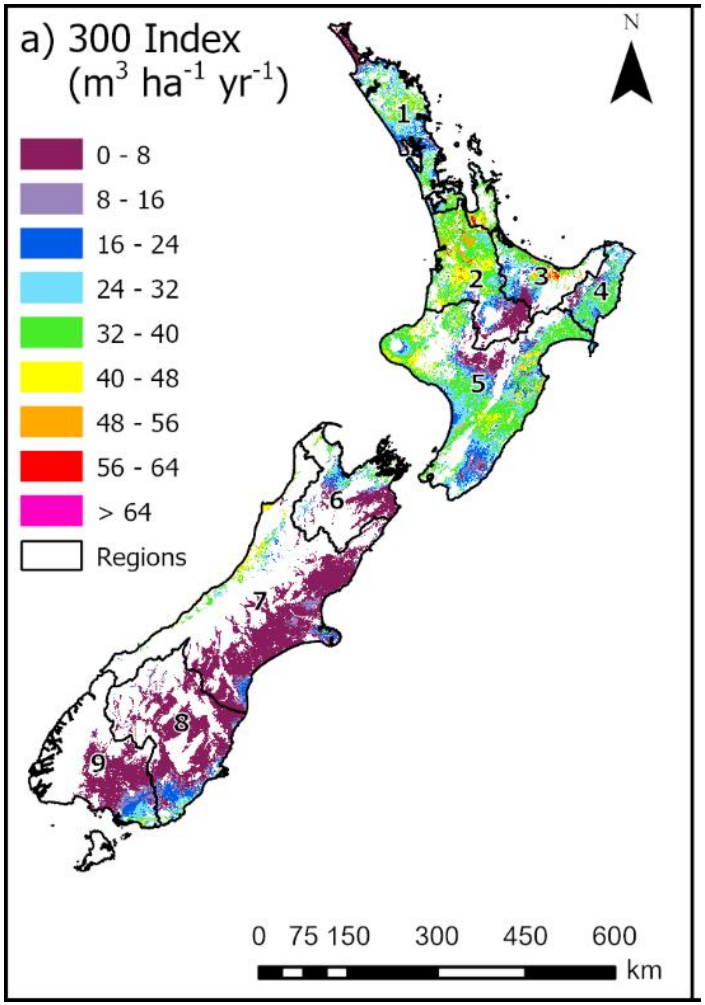
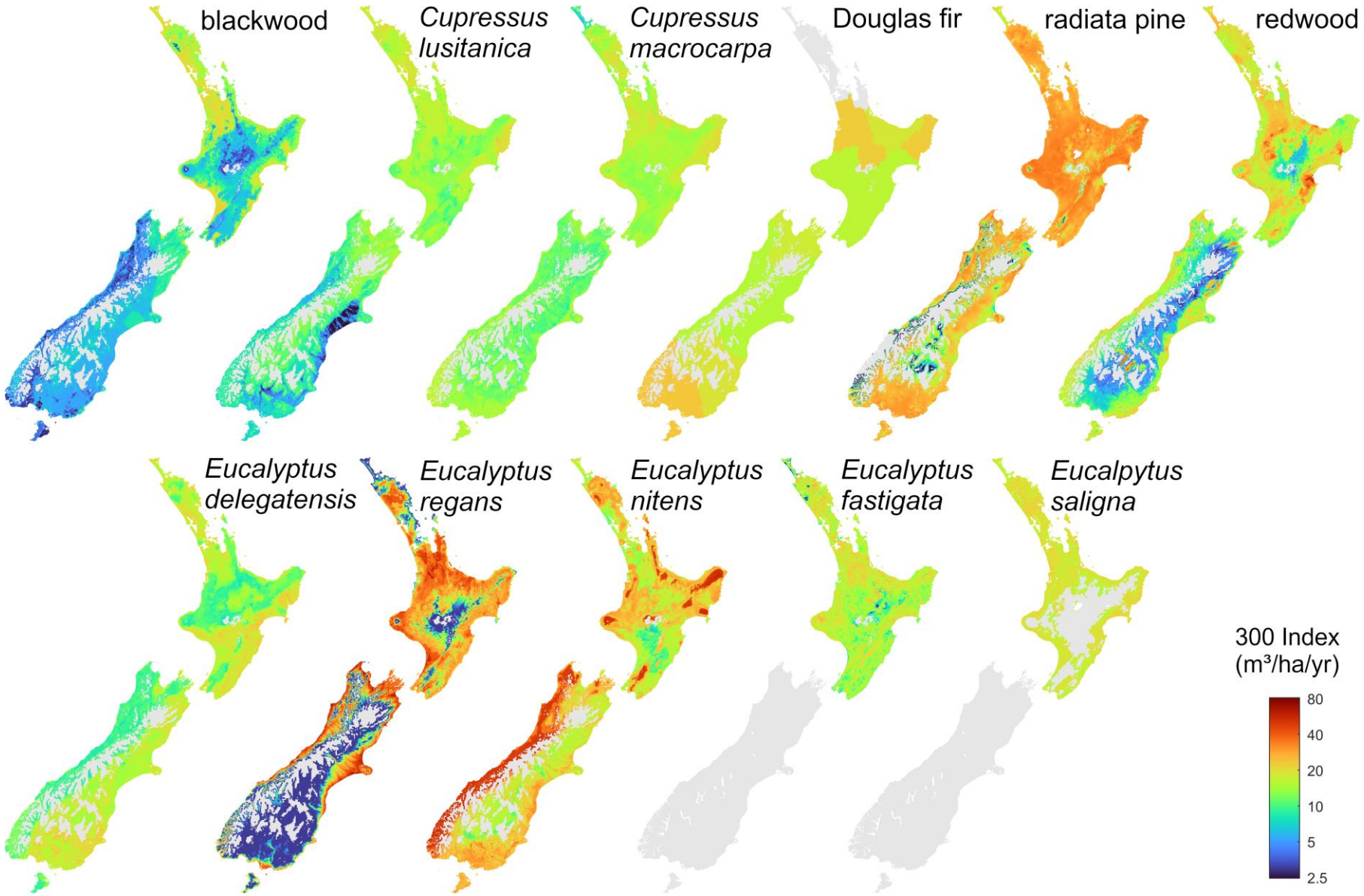
General approach to surface development

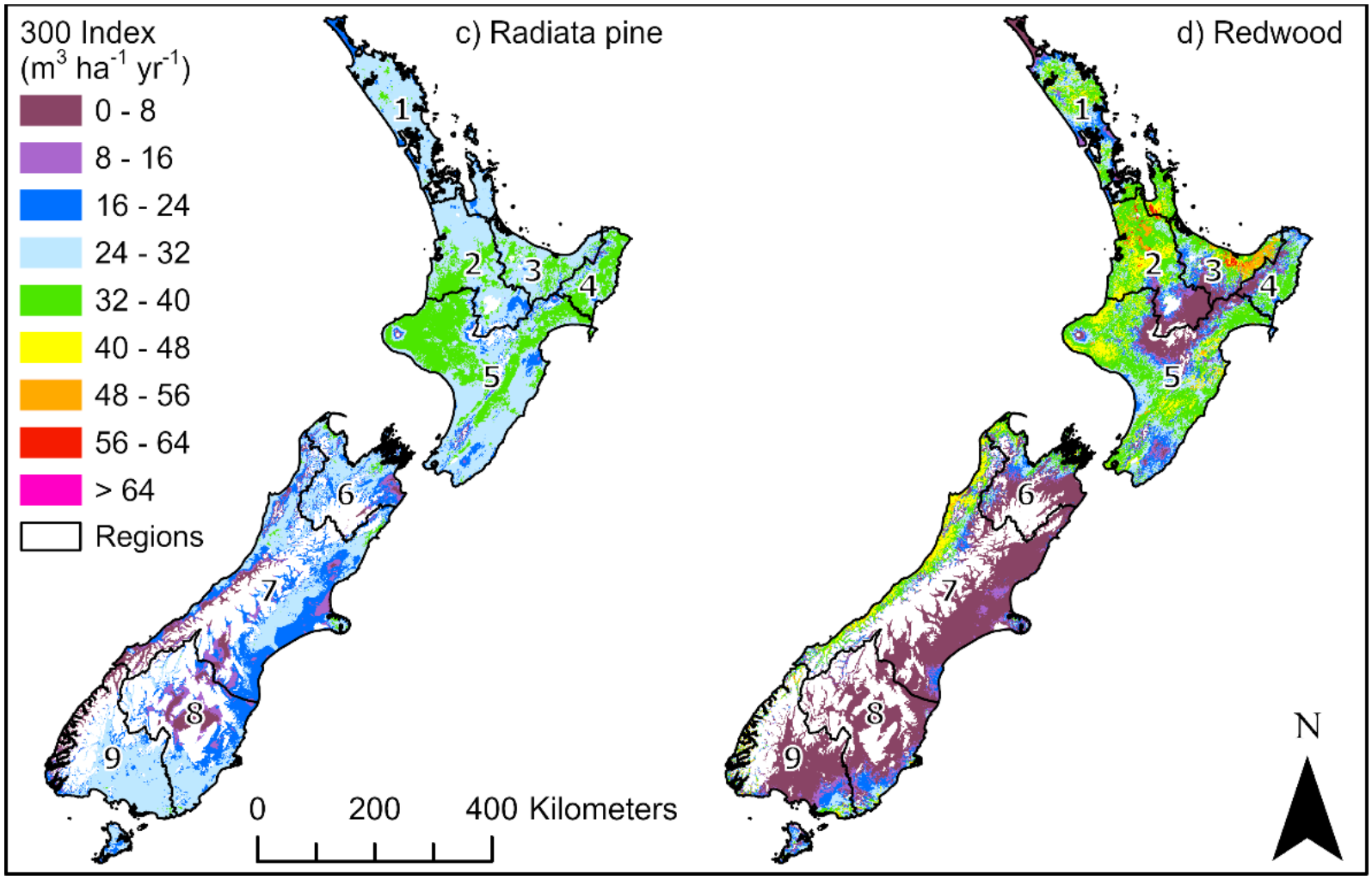
- Once growth models developed, 300 Index and site index extracted for all plots
- The extracted productivity index is then matched with climatic, edaphic and topographic information
- Models developed using a range of methods from multiple regression to machine learning
- Predictions then made using environmental surfaces at a fine spatial resolution
- Predictions masked to areas with mean annual air temperature > 8 °C
- Results reality checked with domain experts



300 Index surfaces for 11 exotic species

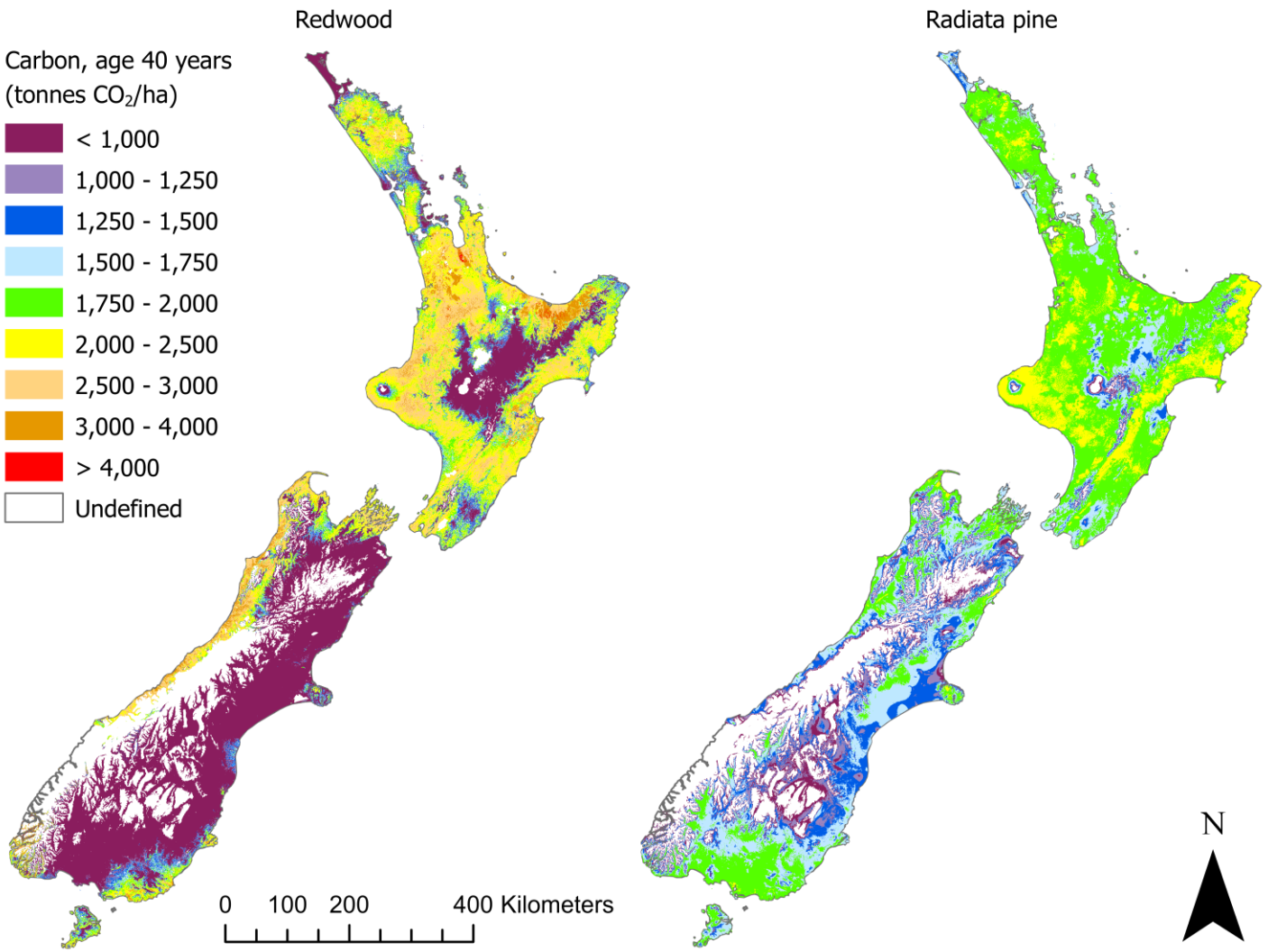


Comparisons of 300 Index for radiata pine and redwood



Watt, M. S., Kimberley, M. O., Rapley, S., & Webster, R. (2021). Comparing volume productivity of redwood and radiata pine plantations in New Zealand. *Forest Ecology and Management*, 500, 119628.

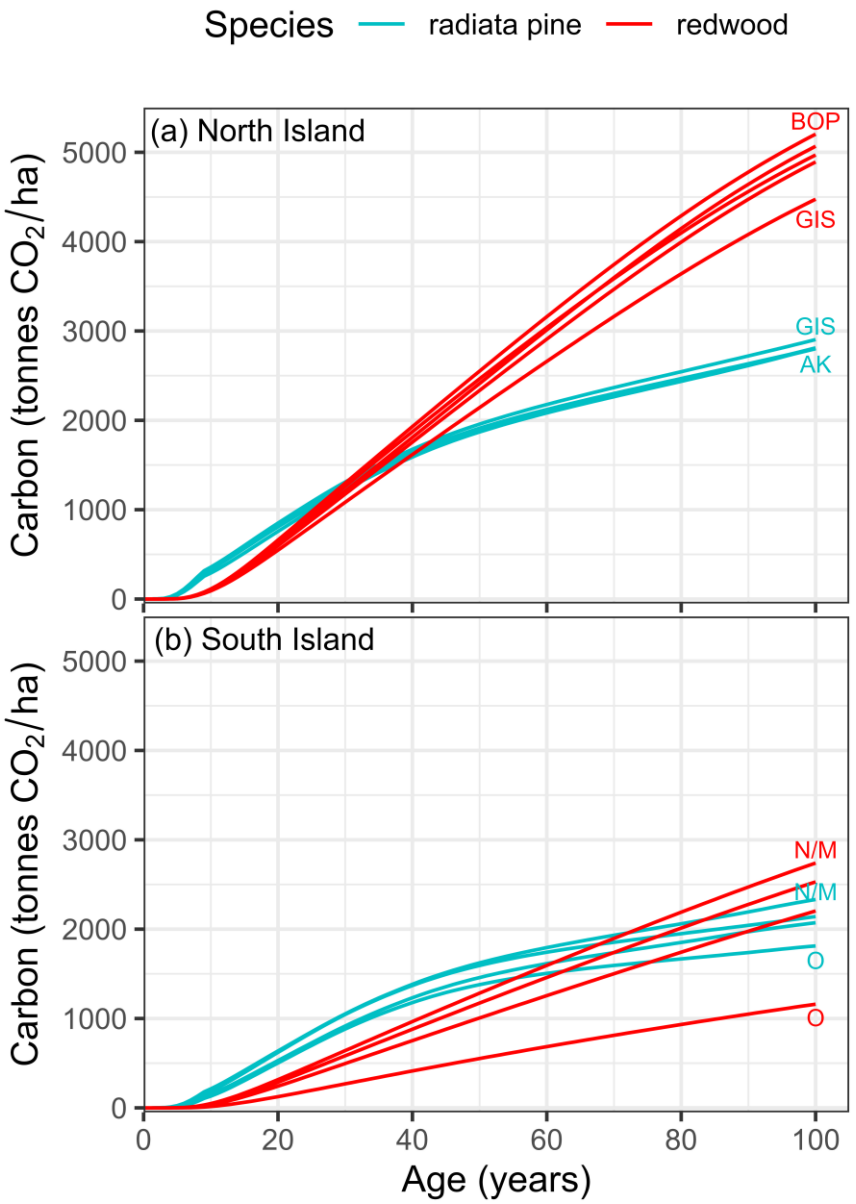
Spatial predictions of productivity indices underpin spatial predictions of carbon



Watt, M. S., & Kimberley, M. O. (2022). Spatial comparisons of carbon sequestration for redwood and radiata pine within New Zealand. *Forest Ecology and Management*, 513, 120190.

Financial comparisons

- Productivity surfaces provide useful input for financial comparisons
- IRR comparison between redwood and radiata pine carbon/timber regimes undertaken
- Used regional carbon and volume values derived from surfaces



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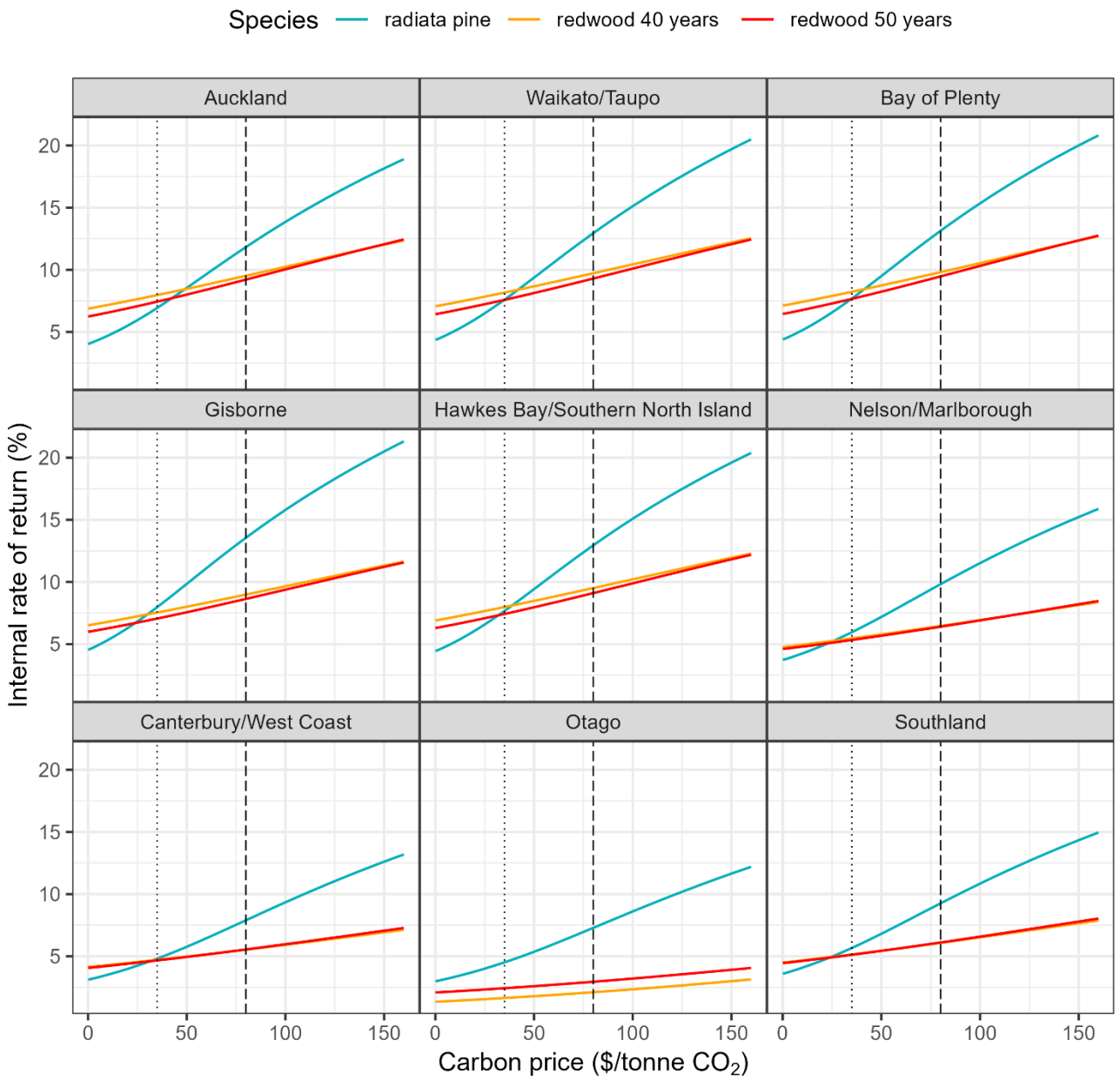
- Redwood IRR higher in North Island, highest for rotation lengths 40 – 45 years
- Redwood IRR exceeded that of radiata pine at low carbon values, except Otago
- Redwood IRR higher than radiata pine for pure timber regimes in all regions except Otago



Multispecies dashboard

- The multispecies dashboard is a free interactive web-based DSS developed by Scion and Carbon Critical
- Dashboard is underpinned by all models and spatial surfaces previously described and has links to the Multispecies Carbon Calculator
- This dashboard make species-specific growth models more accessible
- Platform allows users to visualise, compare and evaluate long term outcomes of establishing different exotic species, across New Zealand

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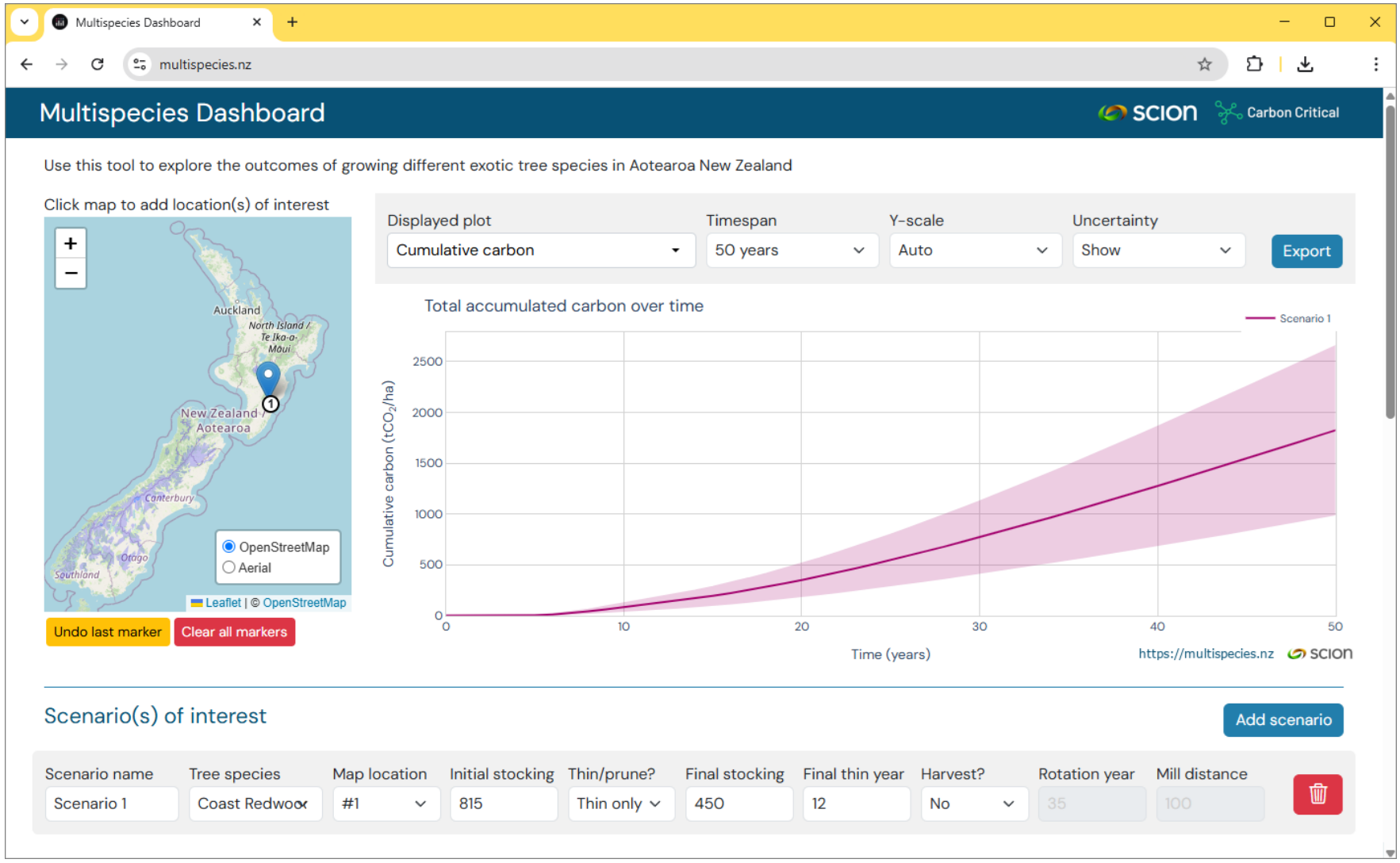
Multispecies dashboard



Multispecies dashboard - features

- Users can:
  - Select from 11 exotic species and specify a silvicultural regime
  - View projected stand development metrics over time
  - Compare results across species and sites
  - Export results for further offline analysis.
- For radiata pine and redwood, users can:
  - Model projected cash flows over a rotation
  - Calculate NPV and IRR under different carbon prices and cost assumptions;
  - Explore trade-offs between silviculture, financial returns, and carbon sequestration
- Can be accessed at: https://multispecies.nz/
- Now includes an embedded tutorial

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Multispecies dashboard - assumptions

- **Carbon accounting rules** – applies stock change accounting to permanent forestry scenarios, and averaging accounting to production forests
- **Carbon pricing** – financial projects shown across a range of prices (from NZ $10 to $150/tonne CO_2)
- **Real-Term Calculations** – Inputs and outputs in today's dollars
- **Uncertainty Ranges** – range reflects +/- 1 SD expected productivity index
- **Geographic coverage** – some areas excluded as not enough data
- **Land purchase cost** – assumes $10,000/ha
- **Log prices and cost parameters** – typical industry values following Watt and Kimberley, 2023

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Conclusion

- Developed robust, species-specific growth models for 11 exotic forestry species
- Used these growth models to develop productivity surfaces
- These models underpin the Multispecies Dashboard, an accessible and intuitive DSS, allowing growers to compare growth, carbon sequestration and financial outcomes
- The dashboard has been designed to balance rigour and usability
- Integrated financial modelling provides context for financial decisions
- The platform highlights the potential for alternative species to play a greater role in NZs forestry future and encourages more quantitative decision making around species selection

Acknowledgements

- Forestry companies for supplying PSP datasets
- Simon Rapley, Rob Webster, Paul Silcock for information around redwood costs and log values
- Bill Liley and David Nicoll whose analysis underpinned redwood log values
- Vaughan Kearns for information around cypresses
- Scion Strategic Science Investment Fund

Thank you

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Tāne's Tree Trust

NATIVE FORESTS FOR OUR FUTURE

Hereherea te Wao-nui-a-Tāne

Native Afforestation

David Bergin & Jacqui Aimers, Tane's Tree Trust

NZIF CPD Napier

25th June 2025

Tāne's Tree Trust
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Topics presented

1. Tāne's Tree Trust (TTT) – *Who are we?*
2. Why establish native forest?
3. TTT's R&D programme.
4. TTT's resources & databases.
5. Native forest establishment & management.

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Tāne's Tree Trust – *Who are we?*

- A nation-wide charitable trust.
- Established in 2000, with the following aims:
  - —Promote best practice establishment & sustainable management of native forests for multiple benefits.
  - —Reduce impediments to planting & management.
  - —Identify info gaps & priorities for applied research.
  - —Increase funding **->** research & tech transfer.
- Committed to scientific research **->** best practise.

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- **Our trustees** are scientists, foresters, farm foresters, conservationists, + 1 rongoa practitioner.
- Between us, many decades of experience.
- Hands-on experience in native forest establishment and management, and R&D.
- Our resources are freely available via our website https://www.tanestrees.org.nz/
- Keen to collaborate with like-minded organisations.
- Always on lookout for collab projects & funding!

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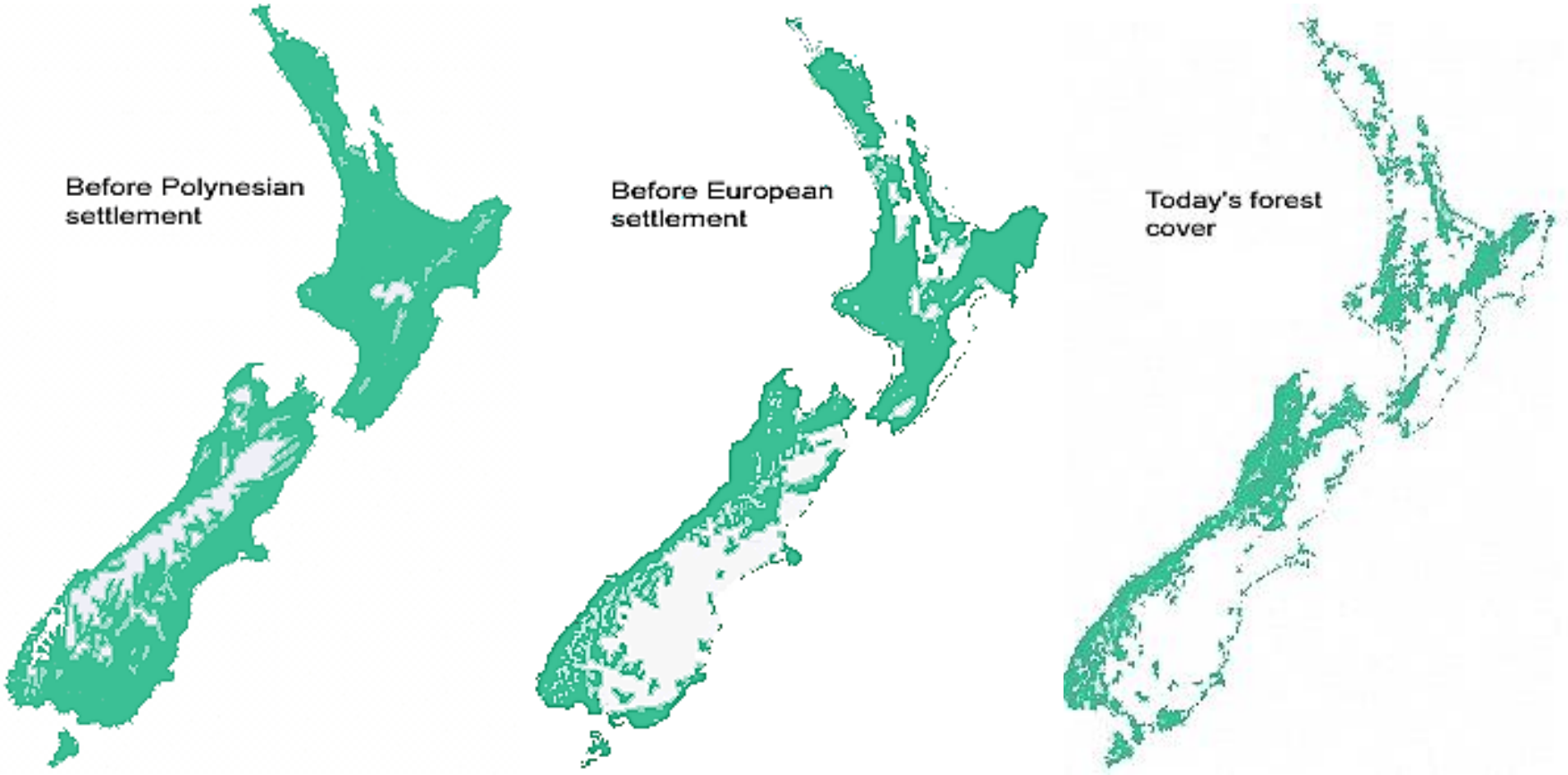
Our Vision

To see the majority of NZ land owners successfully establishing & sustainably managing native trees for multiple uses

History of massive deforestation in NZ

→ *loss of ecosystems services*



What we have lost

- Before humans arrived, NZ was heavily forested.
- 70% loss in NZ's original forest cover, with deforestation worse in lowlands.
- Our native forests:
  - stabilised soils
  - maintained clean waterways
  - harboured huge biodiversity
  - provided food, resources, medicine
  - stored massive amounts of Carbon
  - helped form our unique landscapes
  - Turangawaewae – sense of place

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Most Native Forest Ecosystem Service Values are hard to monetarise

other than timber, honey, and carbon

100% PURE NEW ZEALAND EXPERIENCE

What is the VALUE of clean water, stable land, & our unique biodiversity?

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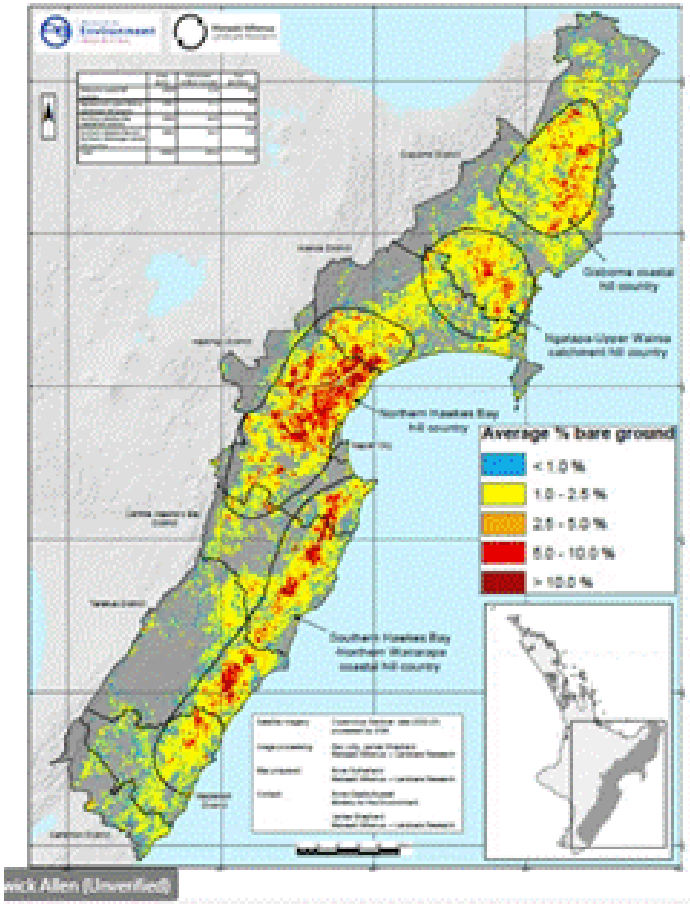
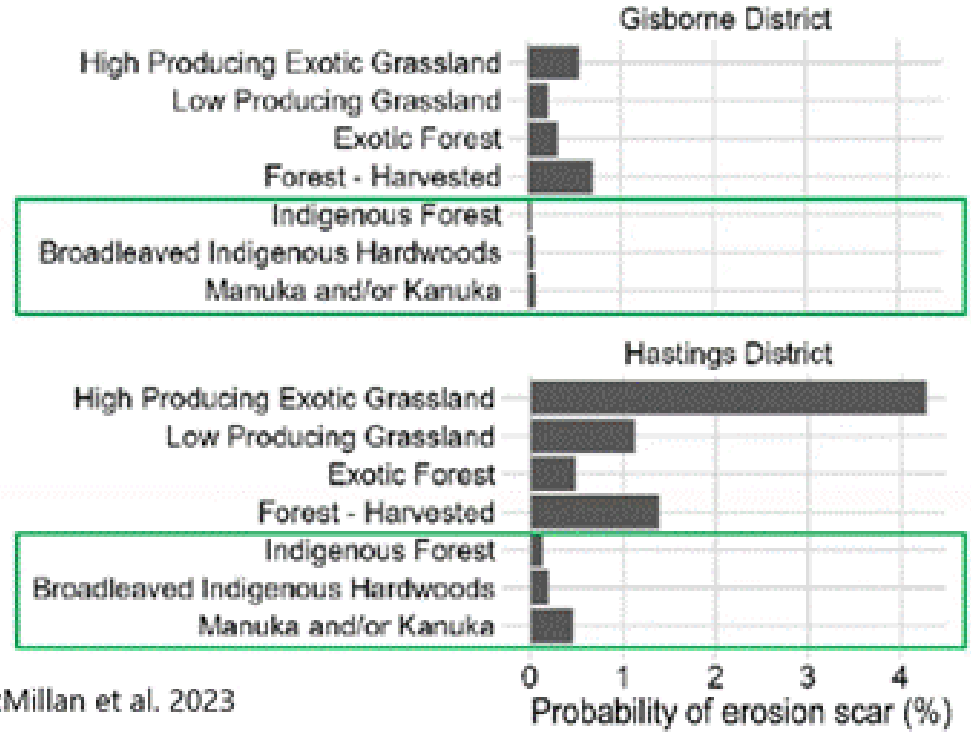
Rapid assessment of land damage – Cyclone Gabrielle

MWLCR report *McMillan et al. 2023*

Where did damage to land occur?



- ~300 million tons of sediment



McMillan et al. 2023

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TTT's Current R&D Programme

Native Forests for Resilient Landscapes

funded by The Tindall Foundation

4 Workstreams:

1) **Working with Nature** - Native afforestation at landscape scale.
2) **Making a case for native forestry - timber values, CCF** (continuous cover forestry).
3) **Making a case for non-timber values,** education, promotion, advocating for incentives for native forest establishment & management.
4) **Improving our records and databases**, and database development.
5) **Survey of native plantings** - Good data is essential for developing our tools and modelling.

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TTT's Current R&D Programme (continued)

- **Northland Tōtara Working Group -** Managing totara on farms. Continuous cover forestry (CCF).
- **Transitioning project –** transitioning standing radiata-pine plantations to permanent native forest - on our vulnerable, highly erodible steeplands.
- **Ecosystem Services** – Valuing services provided by NZ's indigenous ecosystems on private land. Multi-agency SFFF project in conjunction with Pamu Farms.
- **Seed Island Demonstration sites**. Collab with TTC (Trees That Count). Funded by Z Energy.

+ other projects … More info in Annual Report on TTT's website

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TTT's Recently Completed work

- **Planted Toolkit** - Calculators on planting & budgeting, carbon sequestration, productivity, and economics (returns & benefits).
- **Native Plant Monitoring System -** Online tool jointly developed with TTC, and other project partners.
- **TUR - Fact sheets** on forest establishment.
- **Videos on best practice** establishment & management.
- **A practical guide to management of tōtara on private land**, co-funded by Te Uru Rākau.
- **Adaptive management of coastal forestry buffers**, with the Coastal Restoration Trust.
- **+ more projects … *see*** *Annual Report on TTT's website*

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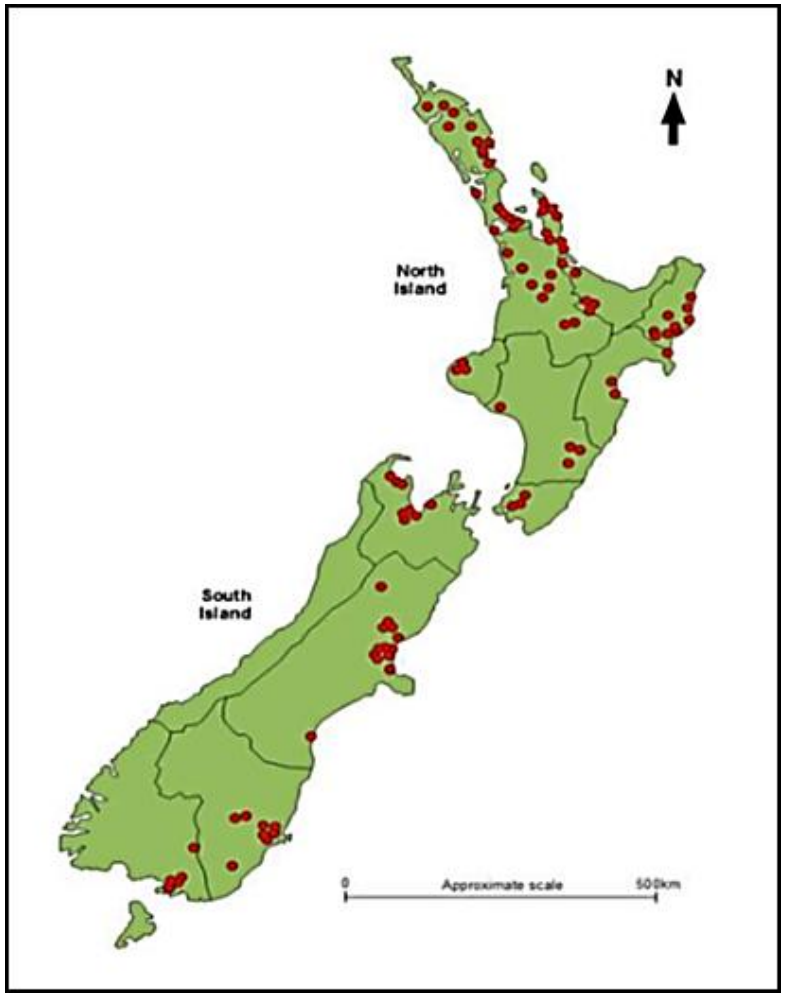
TTT Indigenous Plantation Database

- Our resources are based on scientific data.
- TTT manages NZ's only national database on planted native forest.
- Comprises over 15,000 native trees and shrubs ranging from 5 to 110 years old.
- Over 100 planted stands surveyed nationwide.
- Over 60 different native tree & shrub species.



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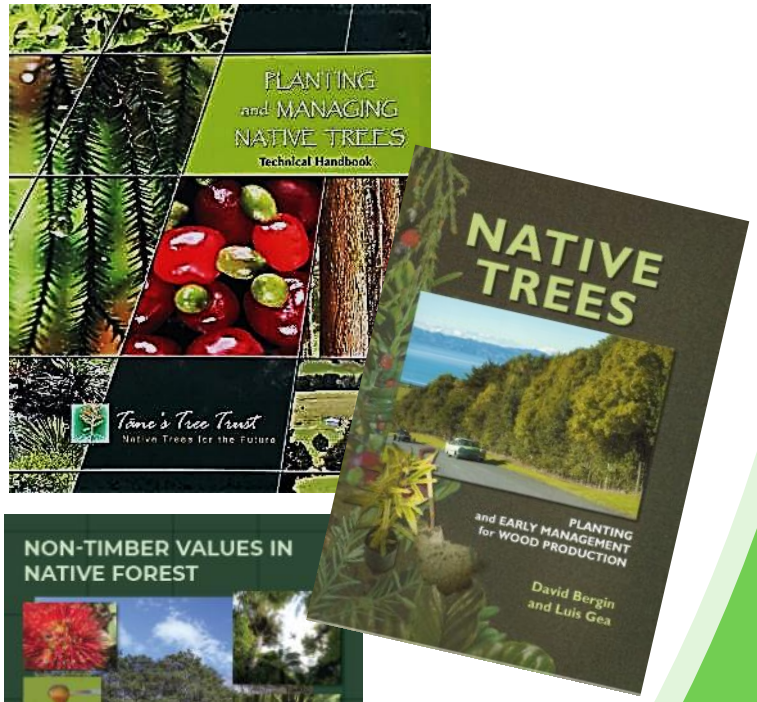
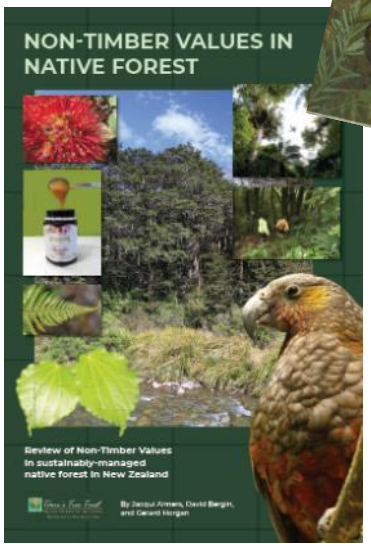




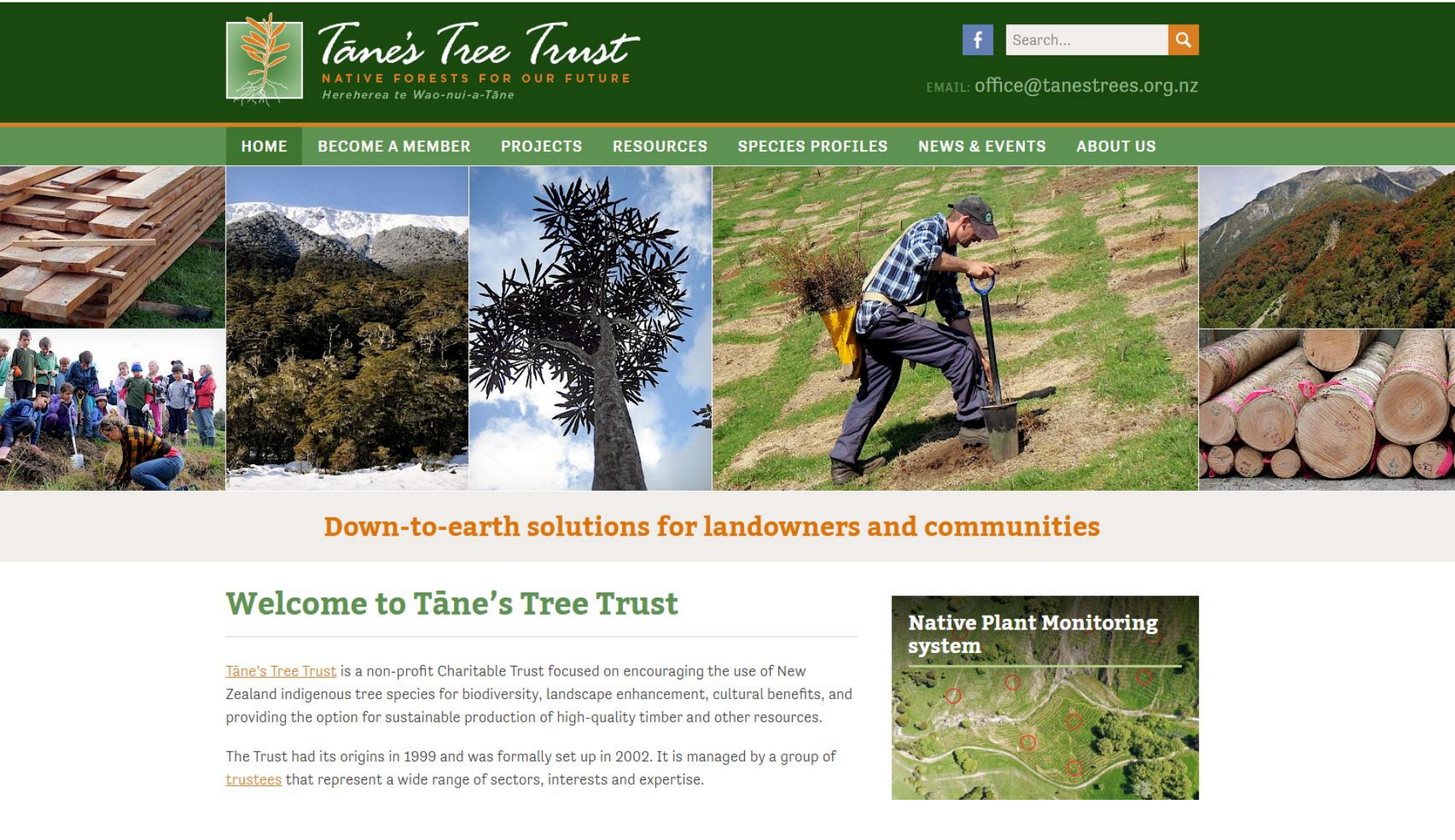
TTT Resources

Free info on best practice establishment and management of native forests:

- Indigenous Tree Bulletin series.
- TTT Technical Handbook – 33 articles available online.
- Continuous Cover Forestry (CCF) Handbook.
- Non-timber values bulletin.
- Practical guidelines for managing tōtara on private land.

Digital copies of resources are available:
https://www.tanestrees.org.nz/resource-centre/

TTT Website https://www.tanestrees.org.nz/



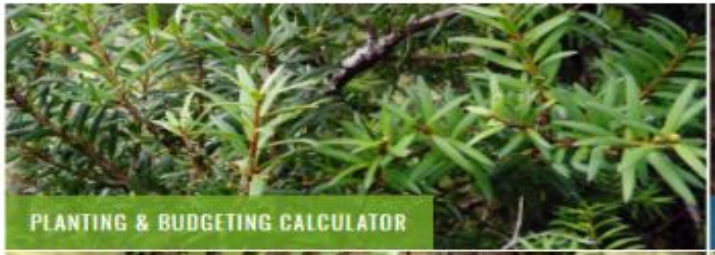
TĀNE'S TREE TRUST

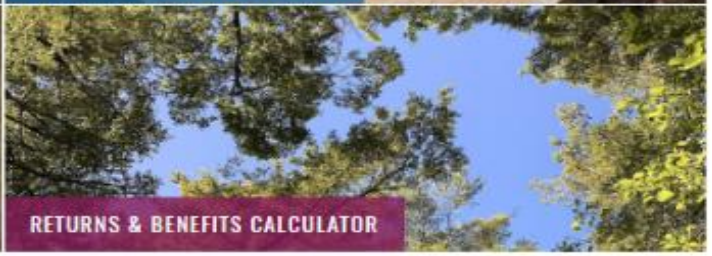
NATIVE FOREST TOOLKIT

ABOUT CONTACT

PLANTING & BUDGETING | GROWTH & YIELD | CARBON | RETURNS & BENEFITS ← *toolkit calculators*

Tāne's Tree Trust has developed this calculator toolkit for those planting and managing native trees to meet multiple objectives from environmental restoration to sustainable production. The toolkit draws on scientifically robust data from the Tāne's Tree Trust Indigenous Plantation Database to provide foresters, farmers, iwi, environmental NGOs, community groups and invididuals with realistic expectations for their plantings.





Choosing a calculator...

I want to plant natives | What species do I plant and how? | I want to calculate the area of my planting on a map | How many plants per species do I need?

Where do I get native seedlings from? | What is the cost of planting my native project? | How fast are my natives going to grow?

What income and benefits can I expect from planting native forest? | I would like to estimate carbon sequestration in my planted forest

How many natives do I need to plant to offset my carbon emissions?

Major funders

Ministry for Primary Industries
Manatū Ahu Matua

The Tindall Foundation

TREES THAT COUNT
TE RAHI O TĀNE

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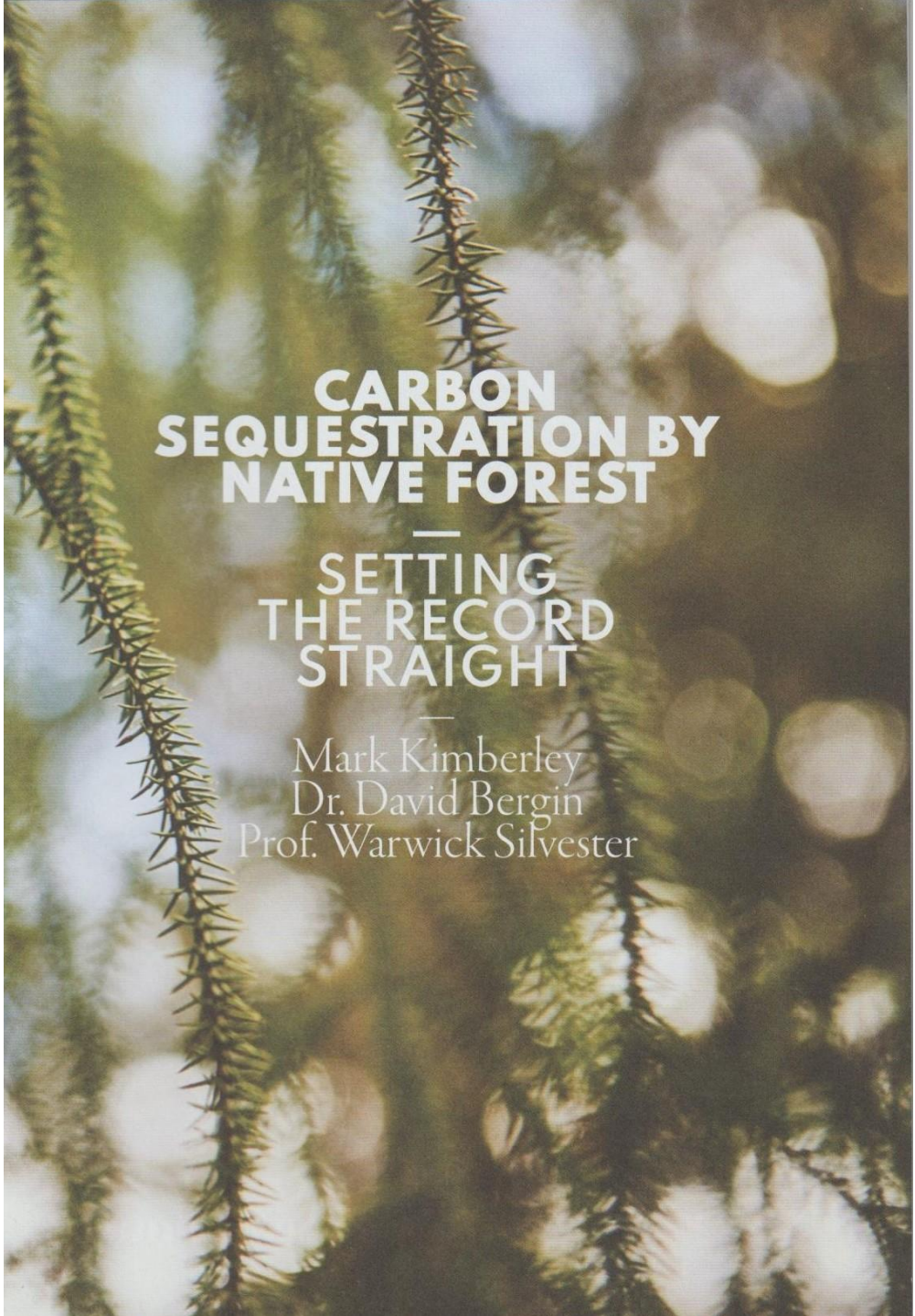
TTT's carbon publication

- Available online https://pureadvantage.org/carbon-sequestration-by-native-forest-setting-the-record-straight/
- Based on TTT's database.
- Well-managed, planted native forest is better at sequestering carbon than commonly considered.
- The current Look-up Table for natives is based on naturally regenerating kanuka/manuka shrubland.



Native trees can grow fast & sequester C!

32-year-old kahikatea (L) & 34-year-old kauri (R) on well-managed, good farm sites.

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Establishing native forests

Options include:

- **Planting**
  - Blanket planting of recently retired pasture
  - Focus often only on early successional species
  - Use of nurse cover species with inter-planted trees
  - Trees-only options for timber plantations
  - Conversion of exotic plantations

- **Managing natural regeneration**
  - Fencing, animal and weed control*
  - Bird predator control*
  - Planting seed islands
  - Inter-planting tree species within existing shrubland

- **Direct seeding**
  - Collecting vast quantities of seed
  - Weed competition an issue
  - Viability on a large scale has not been demonstrated

* Relevant to all options

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For revegetation & nurse cover for native trees

Use hardy native shrub hardwoods along riparian revegetation and first step to establishing native forestry species

SOME EXAMPLES

Key shrub hardwoods

- Karamu
- Kanuka
- Manuka
- Kohuhu
- Five finger
- Koromiko
- Wineberry

Monocots

- Flax/Harakeke
- Cabbage tree/Ti kouka
- Toetoe

Others shrubs/small trees

- Ribbonwood
- Mahoe
- Ngaio
- Karo
- Taupata
- Houpara
- Lemonwood

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Planting of native trees

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Depending on site and species, planting with (exposed sites) or without a nurse cover (sheltered sites)

SOME EXAMPLES

Main timber tree species

- Totara
- Kauri
- Rimu
- Puriri
- Kahikatea
- Tanekaha
- Beeches

Other tree species for diversity

- Kohekohe
- Mangaeo
- Miro
- Matai
- Taraire/Tawa
- Northern rata
- Pukatea
- Hinau
- Rewarewa
- Karaka
- Titoki
- Pohutukawa

Planted Kahikatea, Te Puna BOP

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Native Trees for the Future

High establishment costs for native forest on bare land

- Estimated cost for establishing native forest on bare land is typically $20,000/ha, but ranging from $5,000/ha - $40,000/ha.
- Radiata-pine establishment costs average approx $1800 – $2000/ha.
- TTT is working to reduce the cost of establishing natives.

Approximate cost per hectare

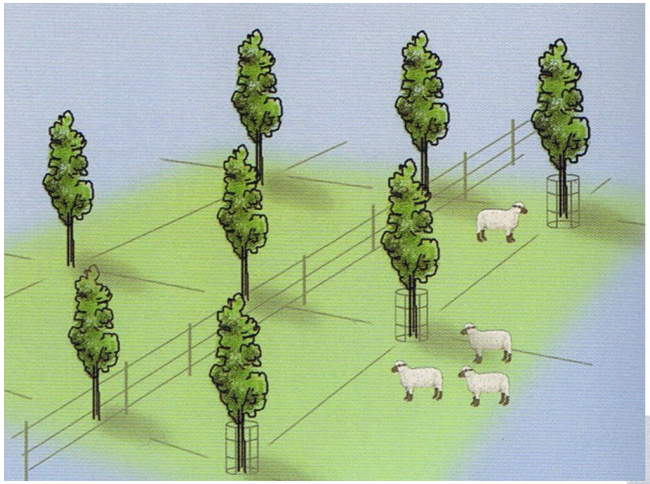
- Planting & early management of nursery-raised natives on an open site.
- Best planting options must be determined on a site-specific basis.

Plant Spacing	1 x 1 m	1.5 x 1.5 m	2 x 2 m	3 x 3 m	4 x 4 m
Stocking (stems/ha)	10,000	4444	2500	1100	625
Estimated time to canopy closure (years)	2 (shrubs) 4 (trees)	3 (shrubs) 6 (trees)	4 (shrubs) 8 (trees)	6 (shrubs) 12 (trees)	8 (shrubs) 16 (trees)
Establishment cost (shrubs)	$45,600	$20,898	$12,450	$6,450	$4,313
Establishment cost (trees)	$66,200	$30,386	$17,750	$8,650	$5,563

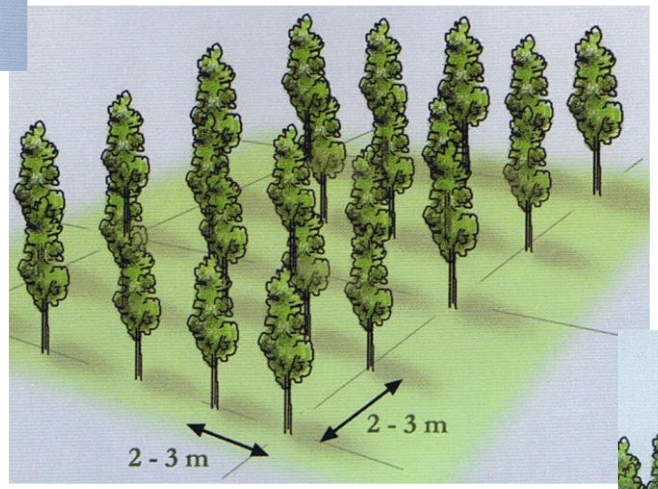
High density → → → → → → → → → → → → Low density

Tree-only scenarios

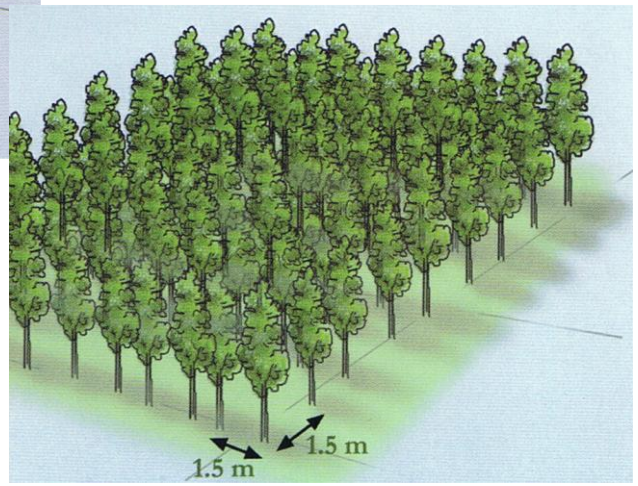
Planting scenarios for native trees



low density



moderate density



high density

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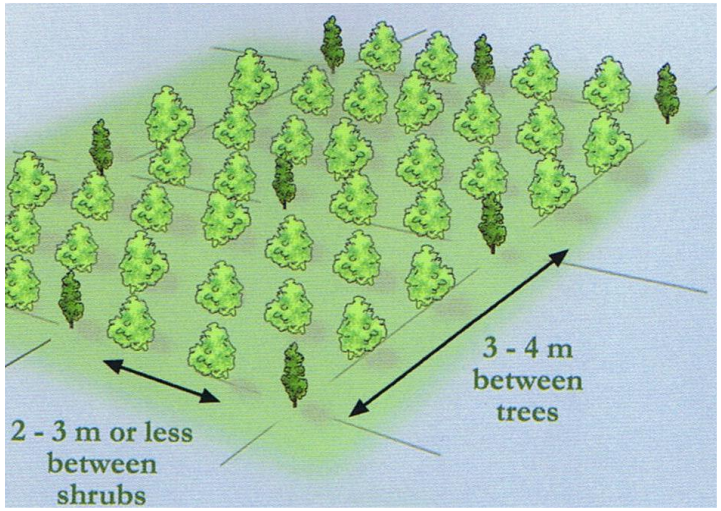
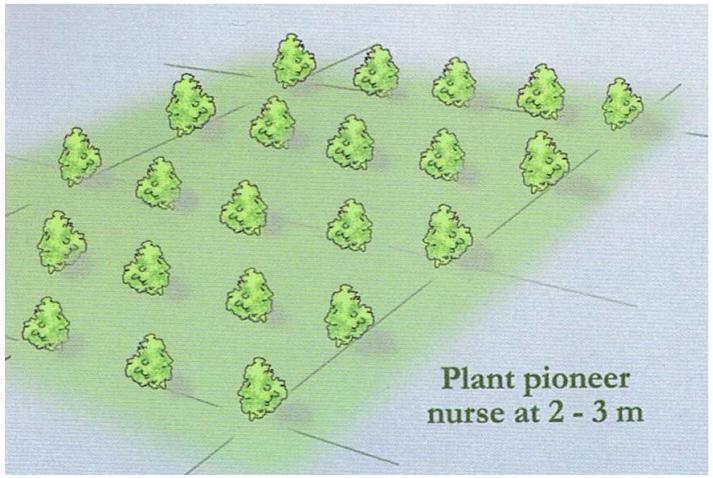
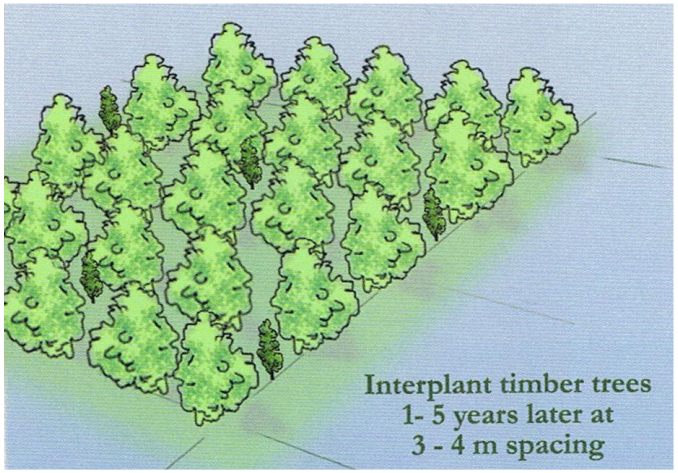
Using nurse crops

Inter-planting tree species



concurrent mix of trees and shrubs





nurse crop first, then interplant trees

Planting native forests

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Options

- **Higher density planting (high cost)**
  - Plant at 2500 (2 m) to 4400 (1.5 m) stems per ha
  - Mix of 75% hardy shrub species, 25% inter-planted native trees
  - Essential for weedy sites, e.g., blackberry, etc
  - Aim for rapid canopy cover to reduce weed control
- **Lower density planting (cheaper but more risk)**
  - Plant hardy nurse shrubs at 1100 stems per ha, e.g., manuka
  - Plant 'seed islands' of native trees – small groves throughout
  - Encourage natural regeneration – control of pest animals
  - Best for sites without major weeds (e.g., blackberry, tobacco weed)

Native afforestation at scale

- **Large-scale planting**
  - –Estimated 1 million+ ha marginal pastureland could be in forests
  - –Natives often promoted
  - –Blanket planting natives at this scale unrealistic – too epensive
  - –Sites are remote, exposed, no topsoil, slow growing
  - –Planting natives 5-10x cost of radiata pine planting
- **Potential for reversion - cost-effective option - Assisted natural regeneration**
  - –Native forest - remarkable ability to regenerate naturally
  - –Working with nature - regenerate at scale
  - –Requirements for natural regeneration
    - Remove grazing stock, fencing
    - Control pest animals
    - Undertake selective weed control
    - Enhance existing remnants
    - Integrate with predator control
    - Boost local seed sources

But assisted natural regeneration takes time! Patience is needed

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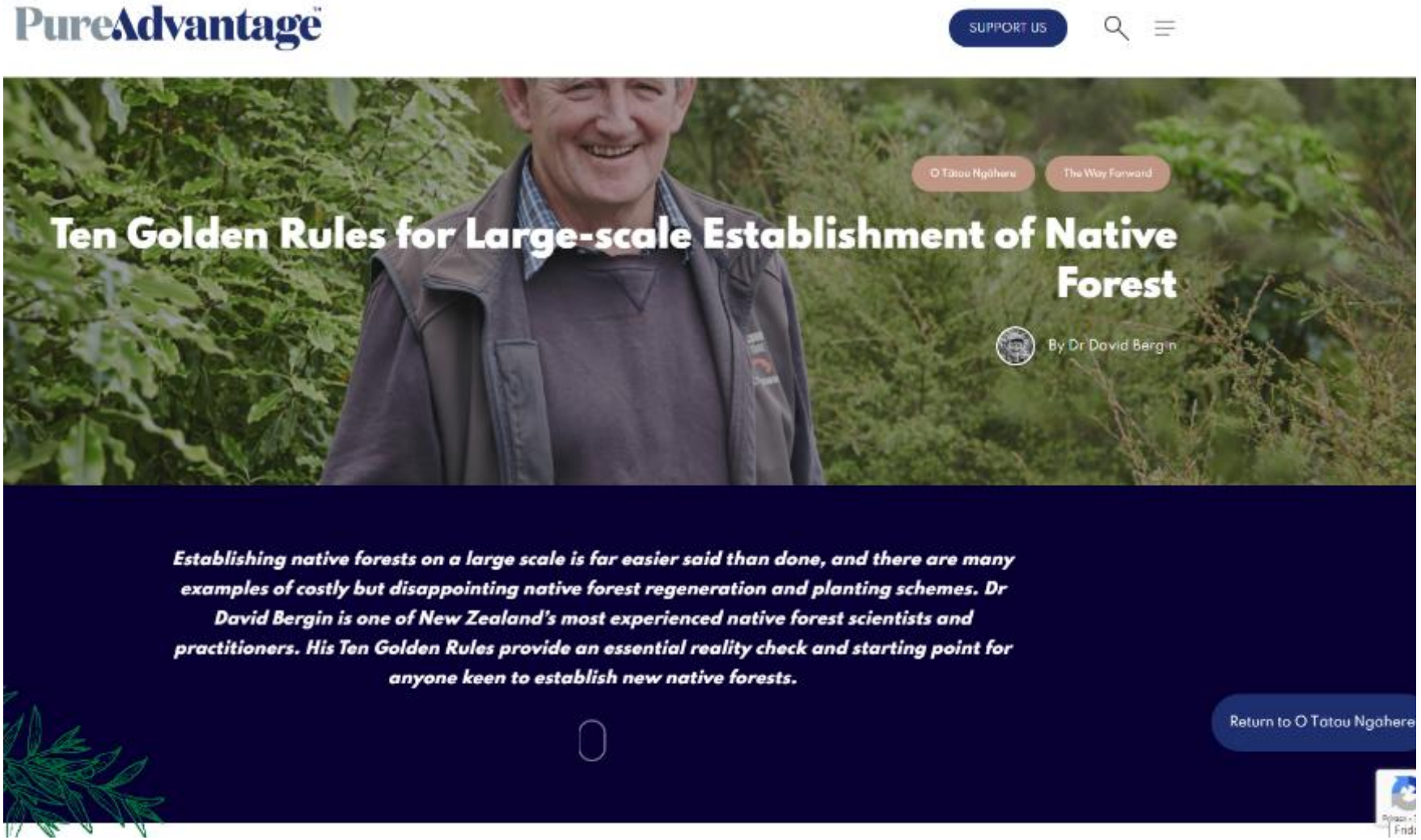
O Tātou Ngāhere OUR FOREST

https://pureadvantage.org/ten-golden-rules-for-large-scale-establishment-of-native-forest/



TTT Fact Sheets

Available on TTT website

TTT Fact Sheets

- The basics of planting natives
- Ecosourcing of native species for planting
- Site preparation for planting natives
- Getting ready for planting
- How to plant native seedlings
- Natural regeneration of native forests
- How to establish “seed islands” of natives
- Planting nurse species – the concept of succession
- Establishing a woodlot of native trees
- Environmental values of native forests
- Cultural and social benefits of native forests
- Economic potential of native forests
- Planting native forest – selecting the right species for the right site
- Monitoring success of planted natives
- Collecting and handling seed of native trees and shrubs
- Resilient native forest in an era of climate changes
- Converting clear-felled exotic plantation forest to native
- Selecting the right nursery-raised seedlings for planting

Think strategically about establishment

- **Mosaic pattern of land use & management**
  - Match land use to the most appropriate site
- **Staged implementation**
  - Start small, learn as you go
  - Tackle impediments - pest animal control, selective weed control …
  - Work with Nature
- **Multiple establishment methods**
  - Planting will likely continue to be a component
  - Enrichment planting
  - Boosting seed sources, e.g., plant seed islands
  - Grazing as tool for reversion of less palatable species, e.g., kanuka, manuka, totara
  - Reversion through exotics

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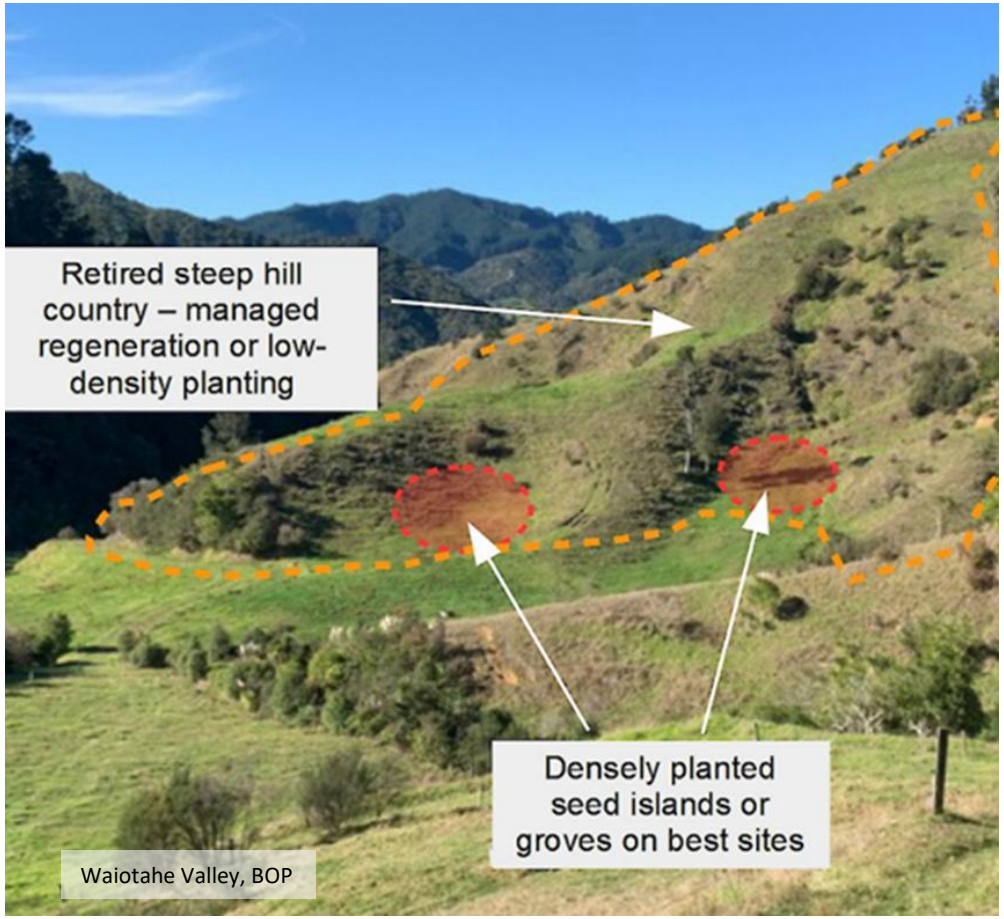
The concept of ‘Seed Islands’ - biodiversity stepping stones

- Assists natural regeneration at scale
- Boosts scarce or locally extinct canopy tree species
- Plant small clusters of natives targeting best growing sites, e.g., sheltered lower slopes
- Seed island sites need to be accessible for monitoring & maintenance
- They act as ‘stepping stones’ to attract birds to roost, feed and spread seed across the wider landscape
- A practical method to establish corridors of natives across farmland, exotic forest & urban landscapes



Let the ‘natural drones’ of wind & birds spread seed

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Planting & Budgeting Calculator

1. Introduction
2. Area
3. Spacing
4. Shrubs/trees
5. Species
6. Proportions
7. Seedling cost
8. Site preparation cost
9. Planting cost
10. Consumables cost
11. Weed control cost
12. Fencing cost
13. Other site costs
14. Silviculture costs
15. Report

Introduction

This calculator allows you to calculate the number of plants you will require for your restoration project, and the costs of the project. The calculator can be used for any restoration project and by anyone who wants to do planting. Click the "Next" button to work through the steps.

Note that costs in the calculator should exclude GST. See the tip in the website footer for how to convert a GST inclusive cost to a GST exclusive cost.

Planting & Budgeting Report for planting 20 ha

Area 20 ha
Plant spacing 2 m (2500spha)
Species ratio 3 shrubs : 1 tree
Total 50,000 seedlings (12,500 trees)

Total cost $286,000 **($14,300/ha)**

Includes:
- Pre plant spot spray
- Planting
- Post plant releasing x3
- Stake beside each tree

Other considerations:
- Long-term weed & pest animal management
- Fencing off site from stock
- Tracks and access
- Blanking

Planting & Budgeting report

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NATIVE FOREST TOOLKIT
https://toolkit.tanestrees.org.nz

Note: costs exclude GST

Planting site name: Top block 20ha
Planting site area: 20 hectares
Plant spacing: 2m
Plants per hectare: 2500
Shrubs to trees ratio: 3:1

Shrubs

Species	Proportion	Quantity	Cost/plant	Total
Aristotelia serrata (Makomako/Wineberry)	7.5%	3750	$3.50	$13,125.00
Coprosma robusta (Karamū)	7.5%	3750	$3.50	$13,125.00
Cordyline australis (Ti kouka/Cabbage tree)	7.5%	3750	$3.50	$13,125.00
Dodonaea viscosa (Akeake)	7.5%	3750	$3.50	$13,125.00
Hoheria populnea (Houhere/North Island lacebark)	7.5%	3750	$3.50	$13,125.00
Leptospermum scoparium (Mānuka)	7.5%	3750	$3.50	$13,125.00
Phormium tenax (Harakeke/flax)	7.5%	3750	$3.50	$13,125.00
Pittosporum eugenioides (Tarata/Lemonwood)	7.5%	3750	$3.50	$13,125.00
Pittosporum tenuifolium (Kōhūhū)	7.5%	3750	$3.50	$13,125.00
Pseudopanax arboreus (Whauwhaupaku/Five finger)	7.5%	3750	$3.50	$13,125.00

Trees

Species	Proportion	Quantity	Cost/plant	Total
Dacrycarpus dacrydioides (Kahikatea)	5%	2500	$4.50	$11,250.00
Kunzea robusta (Rawirinui, Kānuka)	5%	2500	$4.50	$11,250.00
Podocarpus totara (Tōtara)	5%	2500	$4.50	$11,250.00
Prumnopitys ferruginea (Miro)	5%	2500	$4.50	$11,250.00
Prumnopitys taxifolia (Matai)	5%	2500	$4.50	$11,250.00

Costs

Item	Quantity	Cost
Total plants	50000	$187,500.00
Plant delivery		$500.00
Grass spot-spraying		$25,000.00
Vegetation clearance		$1,000.00
Planting		$25,000.00
Year 1 weed control	2 operations	$30,000.00
Year 2 weed control	1 operations	$15,000.00
Pest animal control		$1,000.00
Long-term weed control		$1,000.00
Total cost		**$286,000.00**

Can we have our cake & eat it too?

Can timber be extracted from native forest without compromising other ecosystem services?

Continuous Cover Forestry

- Alternative to clear felling.
- Not old growth, secondary forest only, on private land.
- Only single trees or small groups of stems are removed.
- Retention of high-forest NTVs, i.e., minimal impact if done well.

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Low impact, CCF harvesting systems

High-value native timbers can be obtained from forests managed under Sustainable Forest Management (SFM) Plans.

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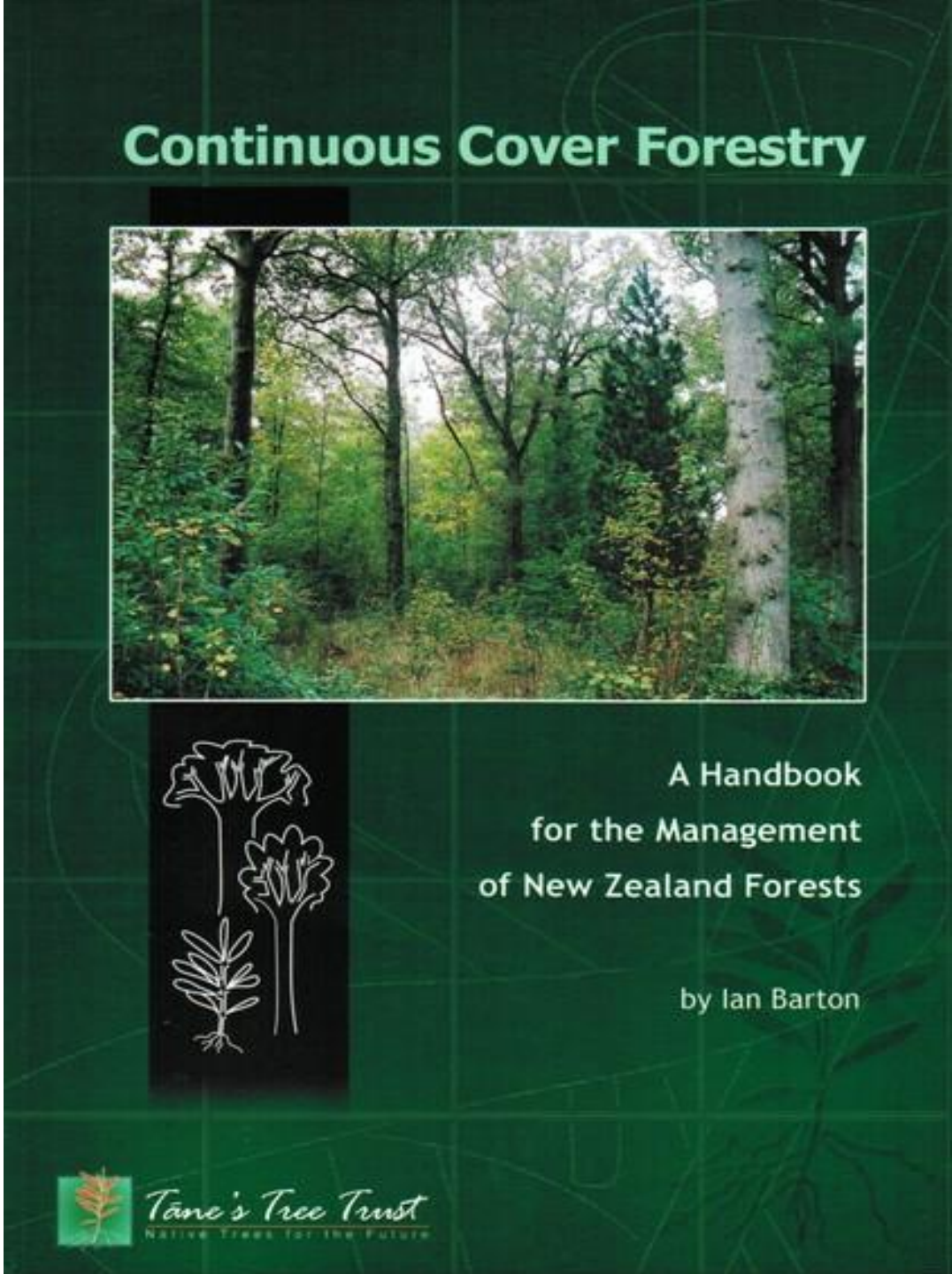
TTT Handbook on Continuous Cover Forestry (CCF)

- Written by Ian Barton & published in 2008.
- One of the Trust's many handbooks.
- Available from Tāne's Tree Trust: www.tanestrees.org.nz/resource-centre/



Practical guidelines for managing Tōtara on private land

Chapters and videos include:

- Planting & establishment
- Pruning
- Thinning
- Sustainable harvesting

Newly released booklet on native tall-tree species

- Joint project between TUR & TTT.
- Available in hard copy (at this conference) and online.
- Written more for a forestry audience.

Kia ora!

Questions?

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