TREES THAT COUNT TE RAHI O TĀNE

Tāne's Tree Trust
Native Trees for the Future

Planting and monitoring natives

Workshop on best-practice

David and Susan Bergin

Environmental Restoration Ltd

Who are we?...

TREES THAT COUNT TE RAHI O TĀNE

Established in 2016:

- Aim to encourage NZders to plant more native trees for multiple benefits
- A tree count register of planted natives – 33 million since 2016
- TTC Marketplace matches funded and gifted trees to planting groups
- User-friendly methods for monitoring success
- Network of regional advisors provide advice
- Promotes and links to technical resources.
- Website – www.treesthatcount.co.nz

Who are we?...

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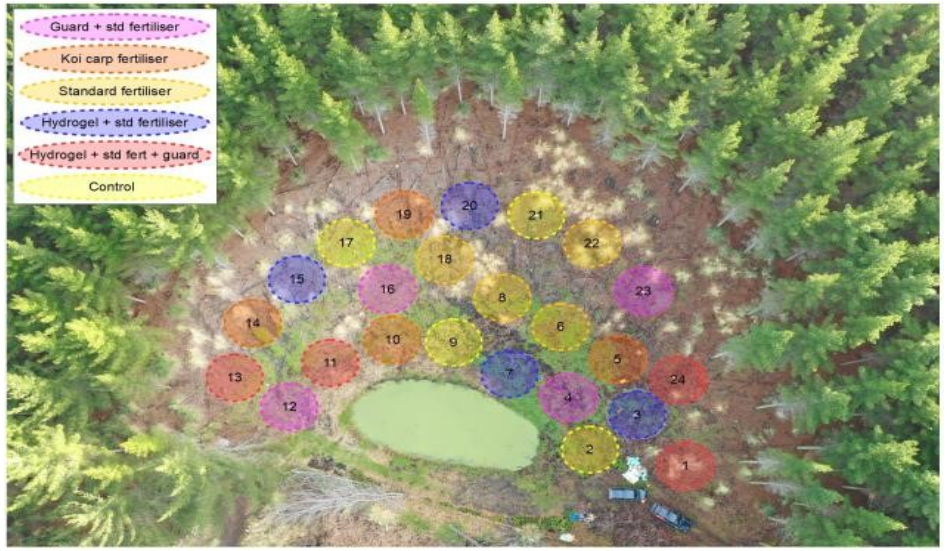

Established in 2000:

- Promote best practice establishment and management of native forestry
- Reduce impediments
- Identify information gaps and priorities
- Increase funding into applied research and tech transfer
- Develop and manage databases
- Dissemination of free information
- TTT provides technical support to TTC
- Website – www.tanestrees.org.nz

Current projects…

- The Tindall Foundation *Our Forest Our Future*
- Northland Tōtara Industry Project
- SFF Planted Toolkit – calculators…
- SFF Adaptive Management of Coastal Forestry Buffers
- Factsheets and planting plans for reducing costs
- Videos on best practice planting of native forestry
- Tane’s Tree Trust Databases

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Topics we are presenting today…

- **Planting and management of natives**
  - Striving for best practice
  - Planting database and toolkit
  - Regeneration and management

- **Monitoring**
  - Early performance of plantings
  - Long term performance of plantings
  - Coastal sand dunes
  - Wetlands, estuaries, riparian

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Planting and management of natives

Striving for best practice

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Why establish native forests?

- Reducing hill country erosion and sediment into rivers, estuaries, harbours
- Green infrastructure – help moderate the impact of severe weather events, including flood alleviation
- Riparian planting – improving water quality and creating ecological corridors across pastoral landscapes
- Continuous cover forestry – timber production
- Restoring indigenous biodiversity
- Improved aesthetics and property value
- Shade and shelter for stock
- Non-timber forest products
- Cultural values
- Carbon sequestration

Non-timber values (NTVs) – Ecosystem services

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- Growing awareness of importance (and vulnerability) of NZ's natural capital

- We heavily rely on forests for:
  - clean air and water
  - stable soils
  - providing habitat
  - meeting climate change commitments
  - outdoor recreation and tourism
  - distinct natural landscapes, cultural identity, spiritual wellbeing
  - maintaining NZ's international branding as a clean, green country

- Recognising NTVs as quantifiable assets would encourage afforestation

- Methods for determining monetary values still being developed

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High-value native timbers

Managed under Sustainable Forest Management (SFM) Plans

Red beech, sustainably managed from West coast

Farm grown totara, sustainably managed from Northland

Categories of NTVs

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- Non-timber forest products
- Environmental services
- Socioeconomic, spiritual & cultural services

Establishing native forests

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Options include:

- **Planting**
  - Restoration planting – riparian, urban areas, high profile sites
  - Blanket planting of recently retired pasture
  - Use of nurse cover species with inter-planted tree species
  - Native timber tree plantations
  - Conversion of exotic plantations

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

- **Direct seeding**
  - Viability on a large scale?
  - Weed competition an issue

Planting natives – small vs large scale

Small-medium scale

- Hundreds to several thousand natives planted per year
- Community-based planting by volunteers
- Supervision by experienced practitioners
- Large planting stock, costly
- Dense planting – 1.5m (4400 stems per ha)
- Commitment to timely weed and pest animal control
- Basic monitoring at least

Large scale

- Tens of thousands of natives planted per year
- Professional contractor gangs
- Smaller stock, less cost, easier transport, etc
- Lower stocking – 2m spacing (2500 stems per ha)
- Resourced timely weed and pest animal control
- Quality control plots and sample monitoring plots

Some of the basics for planting and management of native forest (best practice)

Matching species to site
- Choose optimum sites for species

Nurse/shelter cover
- Use hardy shrub hardwoods as nurse cover (pioneers), mimic natural regeneration

Tree species
- Inter-planting in gaps/light wells - provides shelter, assists tree

Protection
- Fencing, pest animal control

Quality nursery seedlings
- Size, root to shoot ratio, eco-sourcing

Plant density and pattern
- Balance between density and quick canopy cover

Best practice establishment
- Site preparation, planting…

Monitoring and maintenance
- Regular inspections, timely weed control

Silviculture – tending
- Pruning and thinning

Start small
- Modest beginning, avoid difficult sites initially, build experience…

Free online resources on planting and management of natives including Tane's Tree Trust website www.tanestrees.org.nz

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Challenges with establishing native forestry

- Establishment costs are high
- Nursery stock – expensive, transport, etc
- Growth rates relatively slow compared to radiata
- Establishment of natives species are site specific
- Knowledge often lacking in ecological and successional processes
- Lack of commitment and resources to extended post-plant monitoring and maintenance
- Examples of failure deter uptake

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- Estimated cost for planting native forest on bare land $20,000/ha
- Range from $5,000/ha for manuka industry to >$40,000/ha on difficult sites
- Radiata-pine establishment cost average approx $2000/ha
- TTT is working to reduce the cost of establishing natives

Planting native forests

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Options

- **High density planting (high cost)**
  - Plant at 2500 (2m) to 4400 (1.5m) 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, e.g. average 3 groves per ha
  - Encourage natural regeneration – control of pest animals
  - Best for sites without major weeds (e.g. blackberry, tobacco weed)

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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.

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

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

Reducing cost of plants

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Large-scale production

Maintaining quality

Small community nurseries

Different propagation methods

Lower cost large scale planting scenarios – current research

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Options

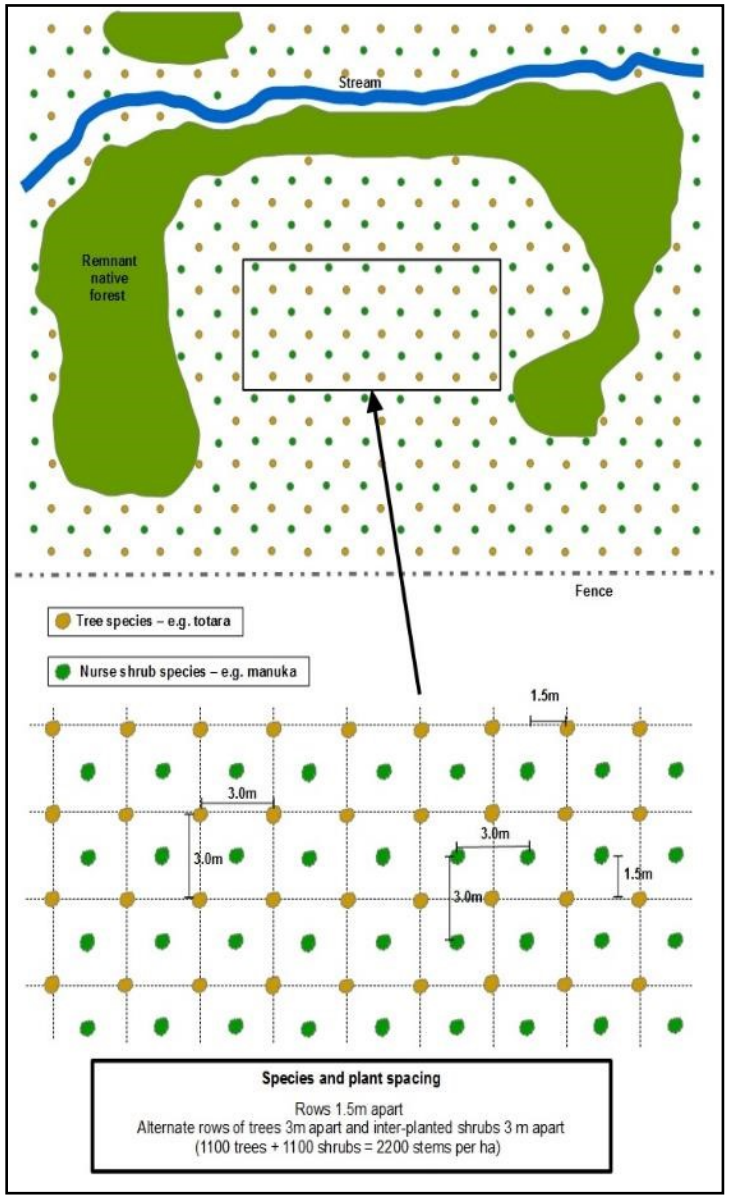
- Smaller vs large seedlings
- Lower vs higher density planting
- Nurse species with tree species
- Inter-planting existing native shrubland, exotics e.g. gorse
- New methods for weed control, e.g. herbicide over-spraying, grazing, zero maintenance, reversion…

Sites

- Riparian zones
- Steep marginal pastoral hill country
- Conversion of pine to natives

Project partners

- Farmers, e.g. Pamu Farms…
- Councils, forest managers…
- NGOs, community groups, iwi



Conversion of pines to native forest

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- Increasing interest replanting logged pine sites with natives.
- Regrowth of aggressive woody weeds and wilding pines a problem.
- Options for conversion of logged pines to natives:
  - Planting amongst slash difficult, including maintenance.
  - Natural regeneration depends on site, nearby seed source, selective weed control.
- Challenges are site specific.

Fire-resistant natives for planting green breaks

Climate change

- Expected impacts likely to include more and prolonged droughts and increased risks of fire
- Scope for mixed species plantings for green breaks with higher proportion of less flammable natives

Fire-resistant plants

- Fire-resistant plants aren't fireproof but don't readily ignite
- Moist, supple leaves; little dry, dead material accumulating; low levels of sap or resin

Highly flammable plants

- Contain fine, dry or dead material; leaves, twigs and stems with volatile waxes and oils
- Sap gummy or resinous; strong odour; loose or papery bark

Flammability classes by Scion and Rural Fire Research

- 42 native species in 5 flammability classes
- Low flammable natives – tree fuchsia, fivefinger, karamu, taupata, broadleaf…
- Moderate/high flammable natives – manuka, kanuka, totara, akeake, treeferns…

Sources

- https://www.scionresearch.com/__data/assets/pdf_file/0015/64140/31328-Flammability-Brochure.pdf
- https://fireandemergency.nz/farms-rural-properties-and-rural-businesses/landscaping-fire-safety/

Take home messages – planting natives (1-4)

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1. Planning

- What else has worked in your area
- Use local expertise and practitioners
- Start small if you don't know what is going to work
- Every site is different, every year is different

2. Seedlings

- Ecosourcing, avoid cultivars
- Use high quality plants – good root to shoot ratio
- Lower cost small natives offset by higher cost maintenance after planting

3. Site preparation

- Extra site preparation on weedy sites before planting pays off
- Site specific - spot or blanket spraying, rank grass can benefit

4. Planting

- Fertiliser not proven except dunes
- Hydrogel not proven
- Watering impractical on large scale
- Mulch expensive
- Use stakes to locate plants
- Plant autumn and deeper to beat droughts

Take home messages – planting natives (5-8)

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5. Planting layout and pattern

- For small high-profile sites or where major weeds plant dense at 1.5 m (community planting)
- Large scale plant at 2 m+ but site dependent (contractor planting)
- Flexible planting pattern targets best microsites

6. Maintenance

- All native planters must be committed to longer term maintenance
- Smaller seedlings cheaper but need more work at planting site
- Hand releasing time consuming
- Herbicide – some weeds need spraying, always some spray drift

7. Ecological principles

- Most sites and tree species do best within a nurse cover – planted or natural
- Most tree species will not grow if no overhead light – cut back overtopping vegetation
- Work with nature – what can you do to help natural regeneration (reversion)?

8. Exotics

- Some exotics useful e.g. tree lucerne
- Pines and eucalypts grow too fast and big
- 'Plant and forget' radiata pine – still not proven
- Weed issues with converting pines to natives

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Planting and management of natives

Planting database and toolkit

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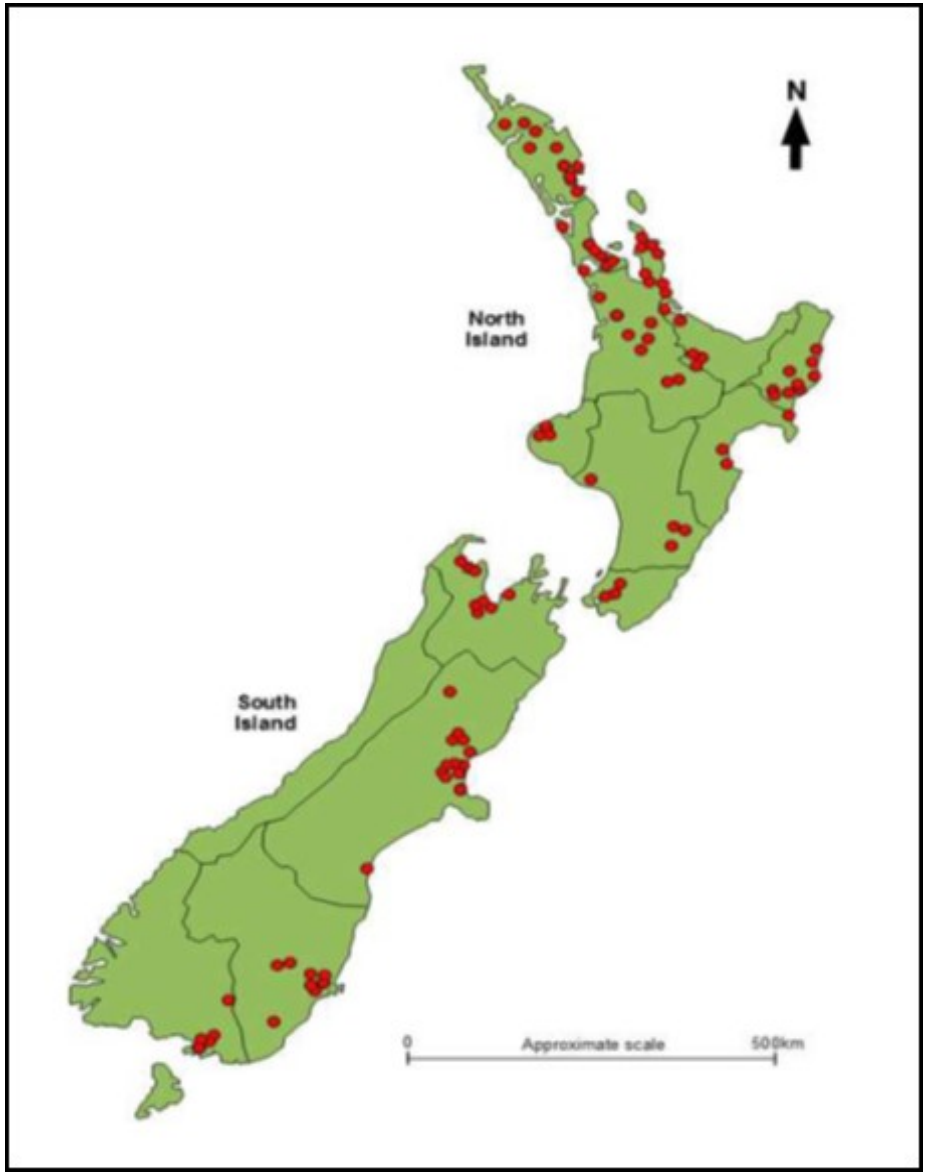
TTT Indigenous Plantation Database

- The Planting Toolkit is generated from the TTT Indigenous Plantation Database
- NZ's only national database on planted natives
- Comprises 15,000 native trees and shrubs ranging from 5 to 110 years old
- Over 120 planted stands of native trees and shrubs surveyed nationwide in 1986 and 2010



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Species planted in TTT plantation database

- Over 60 different native tree and shrub species measured
- Species have been classified into 4 groups
  - conifer trees
  - beeches
  - other hardwood trees
  - shrubs and small trees

Species group	Common or Maori name	Botanical name
Conifers	Kauri	*Agathis australis*
	Rimu	*Dacrydium cupressinum*
	Kahikatea	*Dacrycarpus dacrydioides*
	Kawaka	*Libocedrus plumosa*
	Tanekaha	*Phyllocladus trichomanoides*
	Totara	*Podocarpus totara*
	Miro	*Prumnopitys ferruginea*
	Matai	*Prumnopitys taxifolia*
Beeches	Red beech	*Fuscospora fusca*
	Silver beech	*Lophozonia menziesii*
	Black beech	*Fuscospora solandri*
Other tree hardwoods	Taraire	*Beilschmiedia tarairi*
	Karaka	*Corynocarpus laevigatus*
	Kohekohe	*Dysoxylum spectabile*
	Rewarewa	*Knightia excelsa*
	Puriri	*Vitex lucens*
Small trees and shrubs	Wineberry, makomako	*Aristotelia serrata*
	Karamu	*Coprosma robusta*
	Cabbage tree, ti kouka	*Cordyline australis*
	Akeake	*Dodonea viscosa*
	Broadleaf	*Griselinia littoralis*
	Lacebark, houhere	*Hoheria* species
	Kanuka	*Kunzea* species
	Manuka	*Leptospermum scoparium*
	Mahoe, whiteywood	*Melicytus ramiflorus*
	Mapou, red matipo	*Myrsine australis*
	Akiraho	*Olearia paniculata*
	Rautawhiri	*Pittosporum colensoi*
	Lemonwood, tarata	*Pittosporum eugenioides*
	Kohuhu	*Pittosporum tenuifolium*
	Lowland ribbonwood, manatu	*Plagianthus regius*
	Fivefinger, whauwhaupaku	*Pseudopanax arboreus*

TTT Planting Native Forestry Toolkit

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Web-based decision-support system under development – 3 components:

1. National planted native forestry calculators:

- **Growth and yield calculators -** Species-specific growth and yield models to develop growth calculators
- **Carbon calculator –** Prediction of carbon sequestration of planted natives up to 100 years
- **Economic models –** calculator for income options – long term timber, non-timber benefits

2. Customised planting design and costing tools:

- **Plant spacing calculator -** Easy to use method for calculating spacing vs per ha rates by species
- **Planting budget calculator -** Calculate costs of planting including nursery stock, planting scenarios, etc…
- **Case studies and examples -** Selection of planting scenarios with planting layout, nurse vs trees, etc…

3. Best practice planting information:

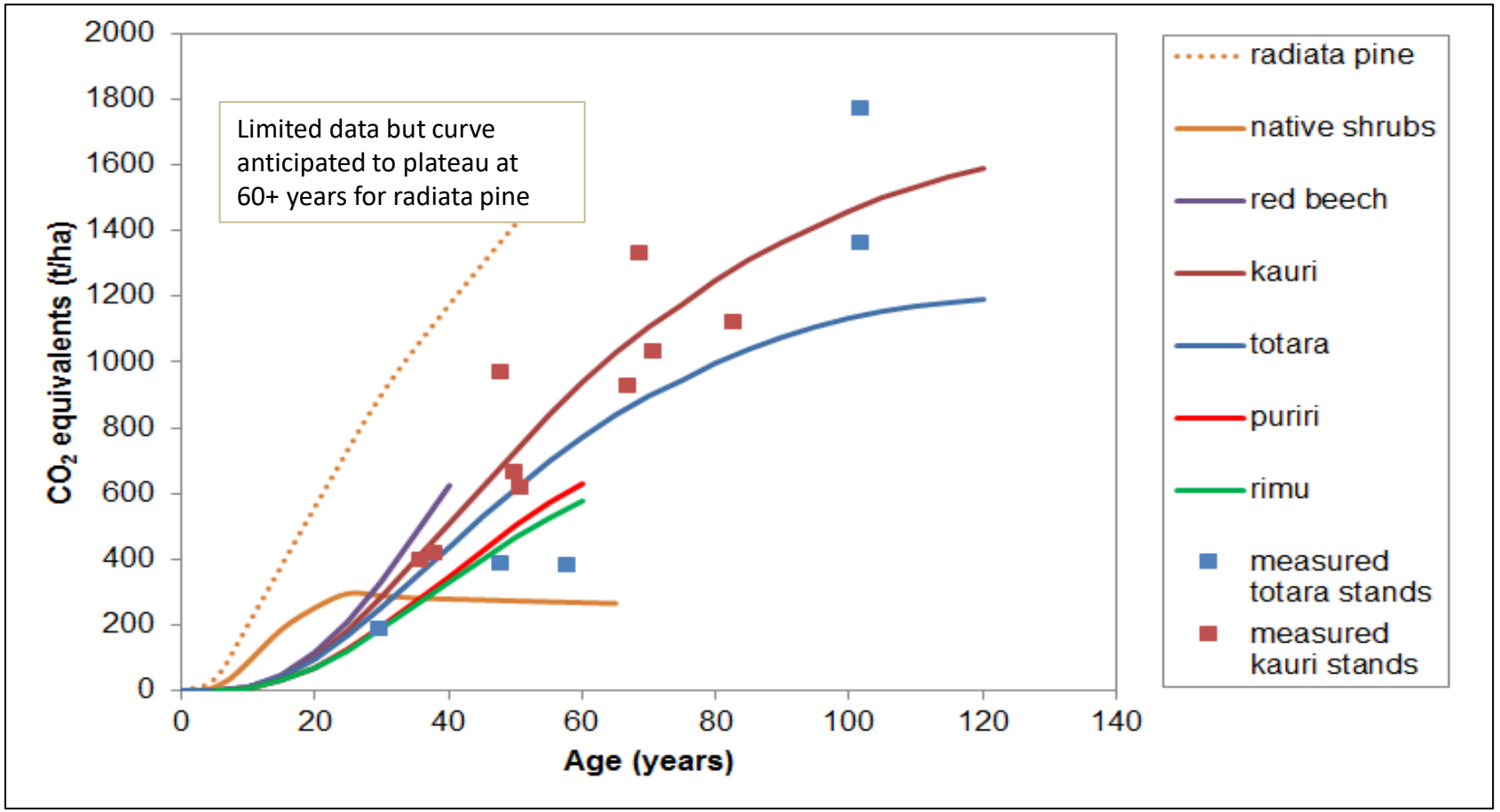
- **Planting and management -** Links to revegetation and planting guidelines
- **Survey of native plantings -** Updating coverage for the TTT Indigenous Plantation Database
- **Indigenous planting reference database –** Archive and latest references on planting and management of natives

4. Monitoring and mapping (planned):

- **Developing monitoring system –** Inter-active user-based monitoring of restoration plantings and plantations
- **Mapping and recording –** Links to mapping options, planting plans and data recording systems
- **Automated results –** Inter-active display of performance, growth rates by species and region

Carbon sequestration – planted native trees and shrubs

Based on Tane's Tree Trust Indigenous Plantation database



- **Planted natives sequester carbon more slowly than pine**
- **Shrubs initially accumulate carbon faster than trees but slow after 20 years**
- **This coincides with when planted native tree species accelerate in growth**

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TTT carbon calculator for planted native forestry

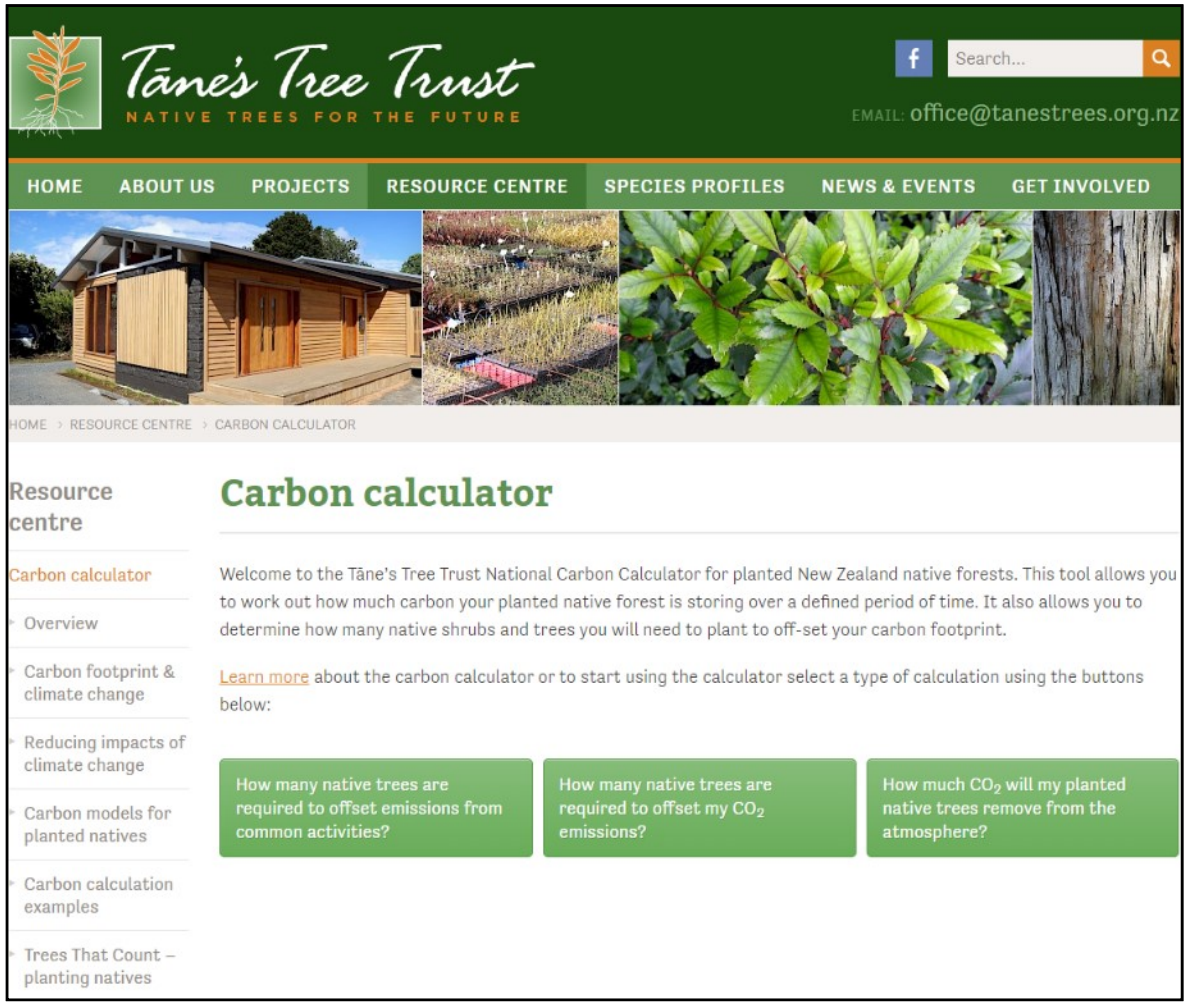
How many native trees and shrubs to plant to offset carbon emissions?

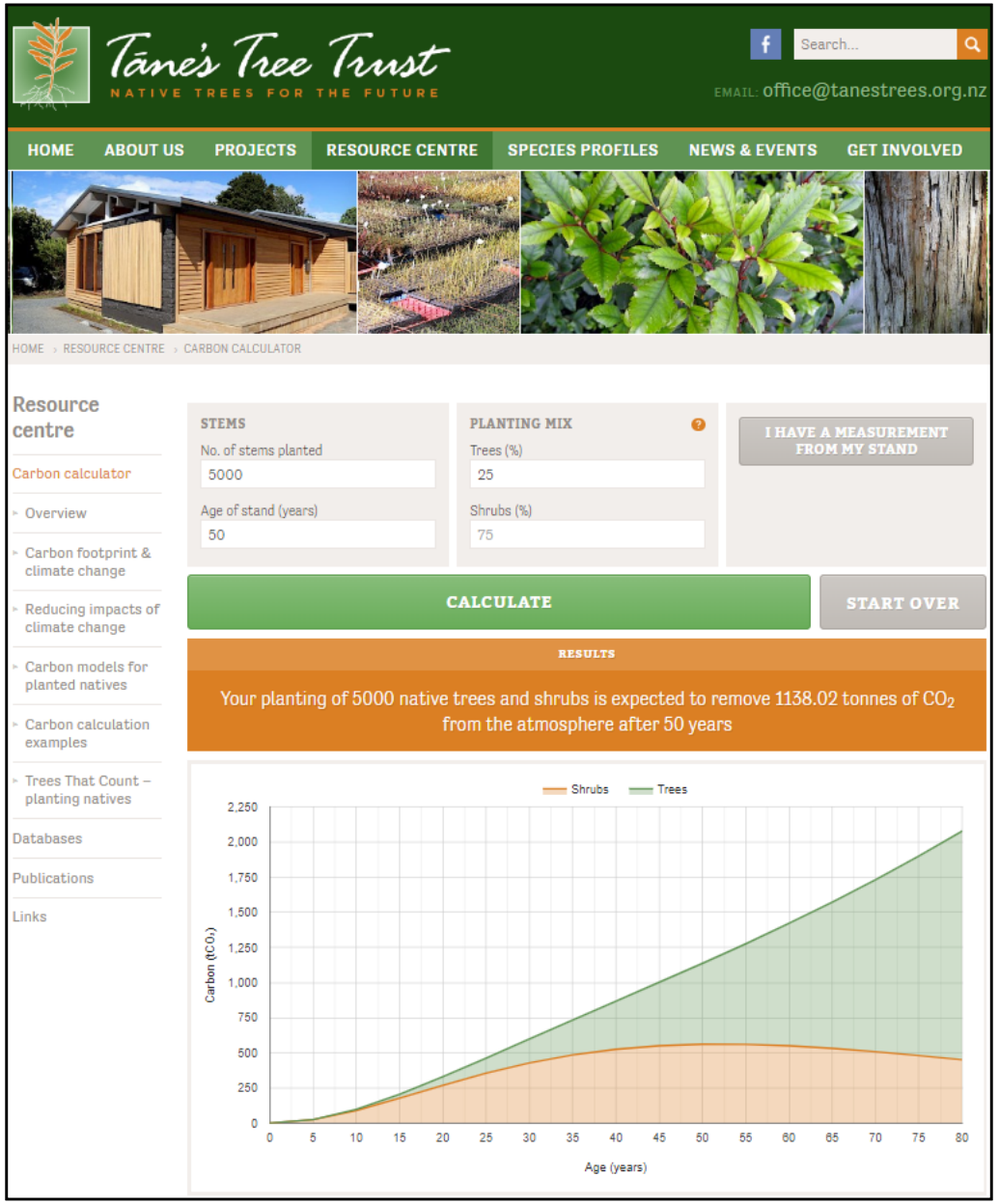
- Household - average family
- Family car
- Large corporate
- Car company
- Travel – domestic or overseas plane trip

How much carbon is my planted forest sequestering?

- Native forest owner
- Community planting
- Local authority
- Corporate

TTT Carbon Calculator for Planted Native Forest





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Planting and management of natives

Regeneration and management

Encouraging natural regeneration

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- Estimated 1 million ha of marginal hill country would benefit from afforestation – exotic or native.
- Practical for large-scale native afforestation of erosion-prone pastoral hill country.
- Blanket planting far too expensive at this scale.
- Landowners required to assist or manage reversion including:
  - Fencing and removal of grazing stock
  - Control of pest animals
  - Control of aggressive weeds
  - Supplementary planting of natives to fill gaps, introduce seed sources
- Monitoring success of reversion over time.

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Natural regeneration

Managing natural regeneration is a much more cost-effective way of establishing native forest in NZ

The Northland totara example

200,000 ha + of reverting country may be representative of many other hill country areas in NZ

Management of planted and naturally regenerating forest

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Pruning and thinning

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Northland Totara Industry Project

Collaboration between Tāne's Tree Trust, MPI, Te Tai Tokerau, Northland Inc, & Scion.

Continuous Cover Forestry (CCF)

- Demonstrating an alternative to clear felling for totara, (& native beech species, etc.....)
- Only single trees or small groups of stems are removed.
- Retention of high-forest values, i.e., CCF minimises impact on biodiversity, environmental & aesthetic landscape values.

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Totara log after releasing

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Continuous Cover Forestry

Retention of high-forest values

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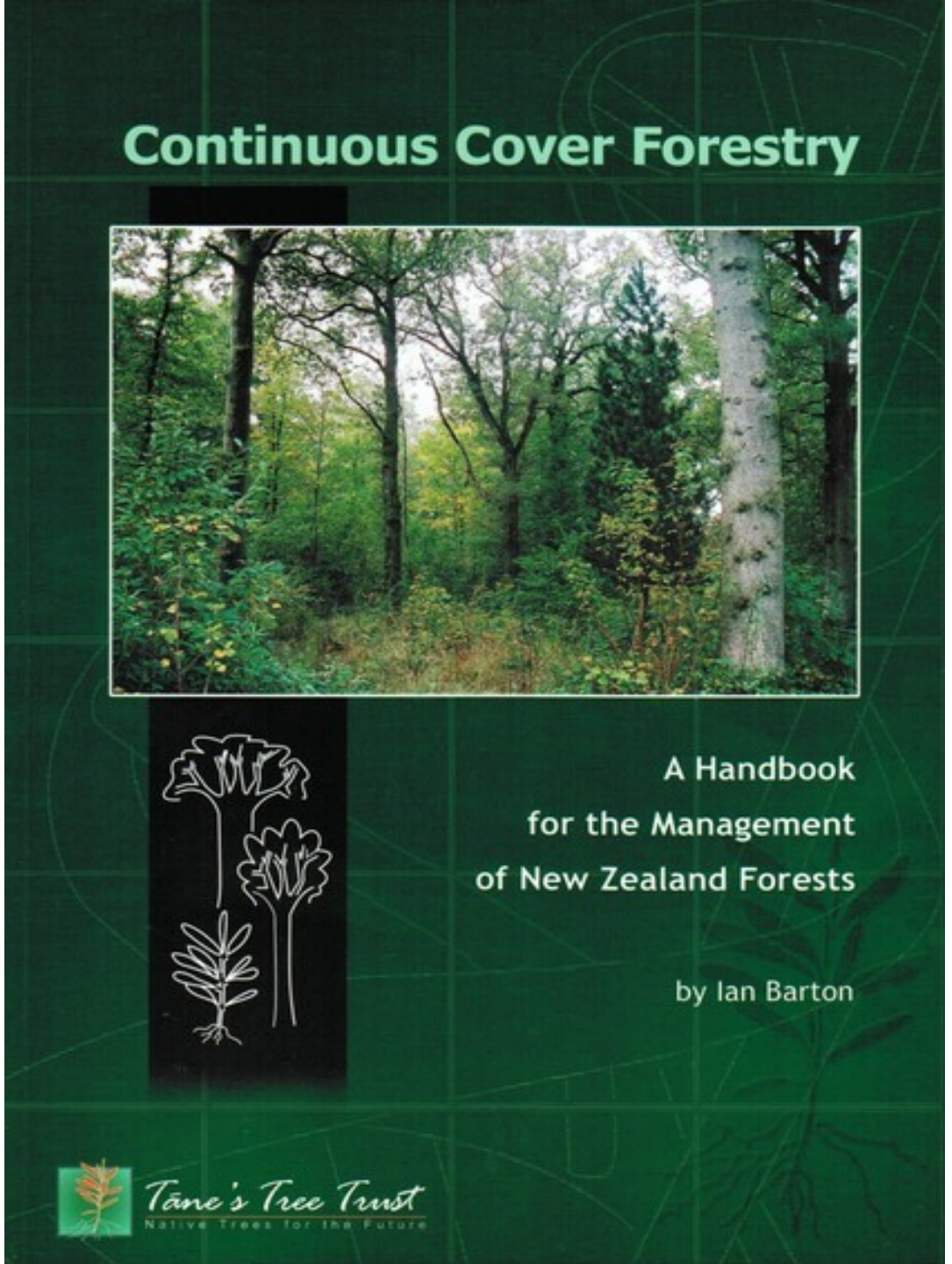
TTT Handbook on Continuous Cover Forestry (CCF)

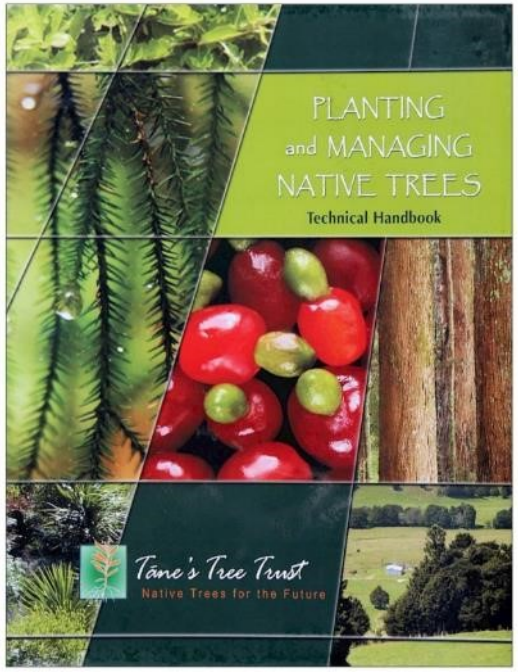
- Written by Ian Barton and published in 2008.
- One of the Trust's many handbooks.
- Available from Tāne's Tree Trust: www.tanestrees.org.nz/resource-centre/

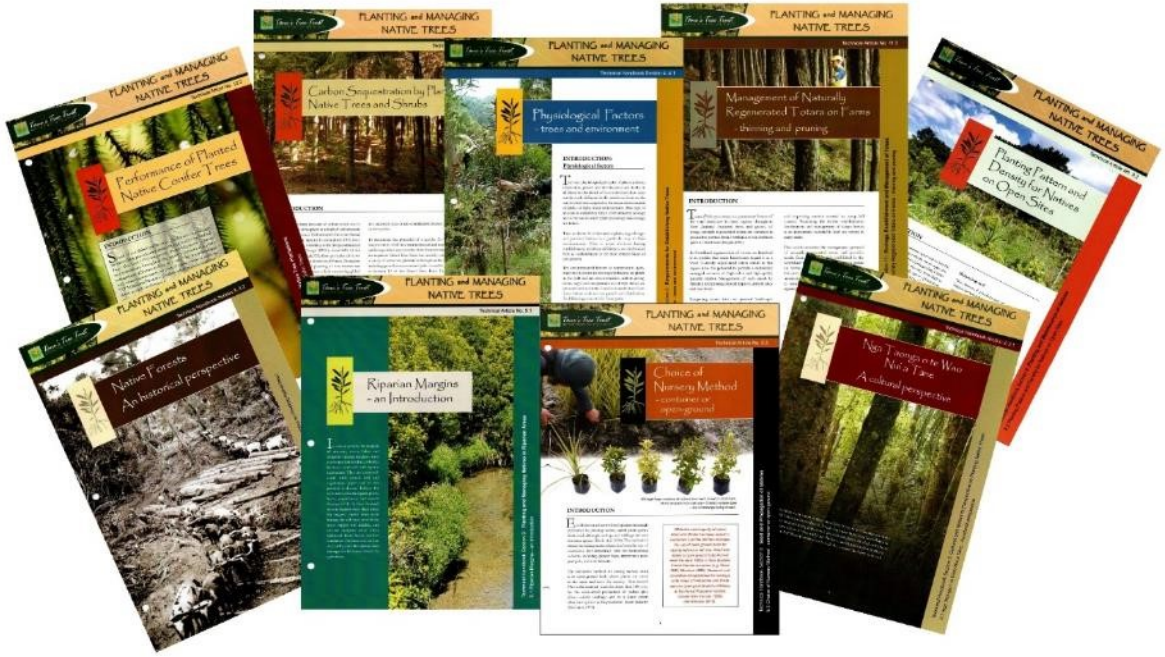


TTT resources & project work

- **Free information on best practice establishment and management of native forests:**
  - Indigenous Tree Bulletin series.
  - TTT conference proceedings 1999 and 2009.
  - Ian Barton's publication on Continuous Cover Forestry.
  - Our Forest Our Future Phase 2 report online.
  - Non-timber values paper and multiple outputs (in prep and in press).
  - TTT Technical Handbook – 33 articles to date available online.
  - TTT project updates.

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





Billion Trees Programme

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Tree Fund

- $4000 per ha for planting natives
- Top ups for fencing $500/ha, $2000 for high ecological values
- $1000 per ha for managing natural regeneration
- Refer to Te Uru Rakau office and website for details
  - www.teururakau.govt.nz/funding-and-programmes/forestry/planting-one-billion-trees

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Monitoring

Early performance of plantings

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What is monitoring?

- Defined as assessing the progress or state of something over a period of time
- Requires establishing a 'baseline' against which to measure change over time using standardised methods repeated at defined intervals
- Provides a record of trends as well as indicates any significant changes
- Provides opportunities to identify causes of any change
- Includes field reconnaissance and survey, collection of data, and analysing the results to compare changes over time

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Why monitor your plantings?

- Monitoring provides the means to determine success or otherwise of your restoration
- Success of planting programmes should be measured on the basis of what has survived and established at least two years after planting, rather than on how many seedlings were planted during the working bee!
- Regular and early monitoring highlights management requirements, e.g. need for timely weed or pest animal control
- Provides insights into what is working or not to guide future restoration planning

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Essentials of monitoring for community groups

Monitoring design

- Easy to understand and implement
- Based on a minimum sample size
- Scientifically robust – systematic, repeatable, representative
- Linked to mapping of planting sites

In the field

- Easy and quick to implement
- Meaningful
- Measures key parameters only
- Accessible and relocatable

Data management

- Easy data entry for planters
- Automatic data analysis

Results

- Automatic summary tables and graphs
- Enable comparisons – earlier measurements, other sites…

Important as monitoring is, if the procedure becomes too complex and too demanding of time, it will not be done
(Dr Ian Atkinson, Ecologist, 1994)

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Monitoring options for planted natives and beyond

Short term monitoring of plantings

1. Recording what was planted when and where
2. Early inspections after planting
3. Photographs
4. Subjective **BASIC** walk-through assessment for small plantings
5. Quantitative **ADVANCED** assessment for larger plantings

Long term monitoring of planted stands

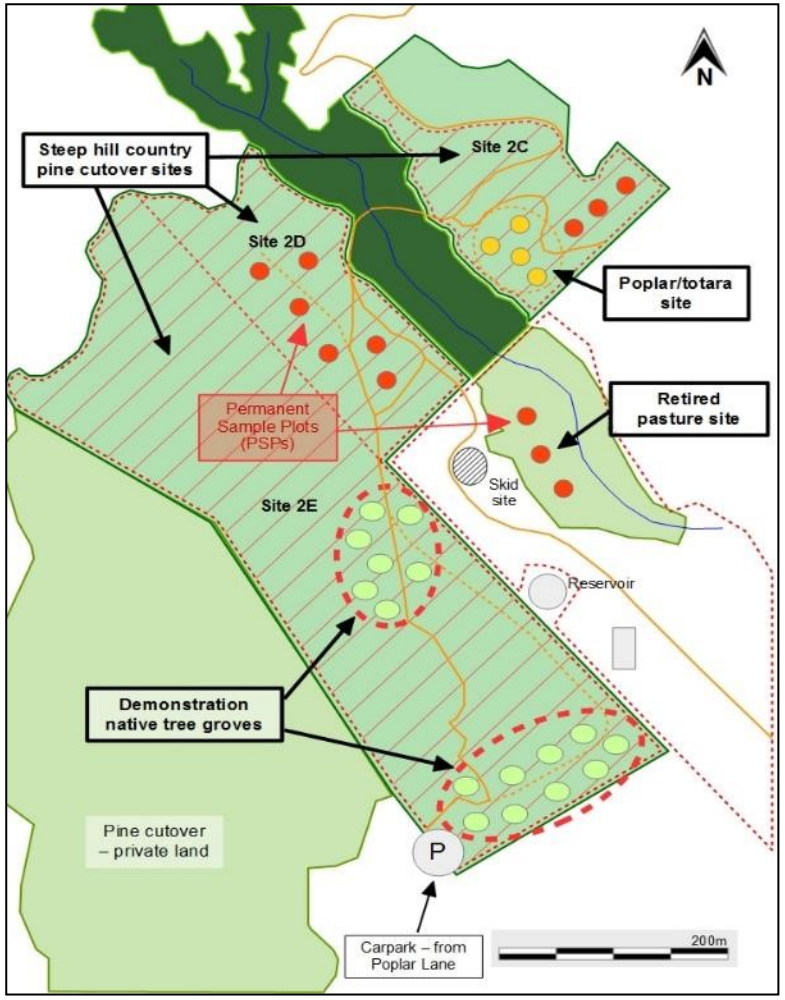
- Permanent Sample Plots

Native forest monitoring

- RECCE plots
- Carbon monitoring
- Biodiversity monitoring
- Regeneration surveys

Coastal and wetland monitoring

- Wetland monitoring handbook, WETMAK…
- Coastal Restoration Trust of NZ Coastal Monitoring Database (CMD)



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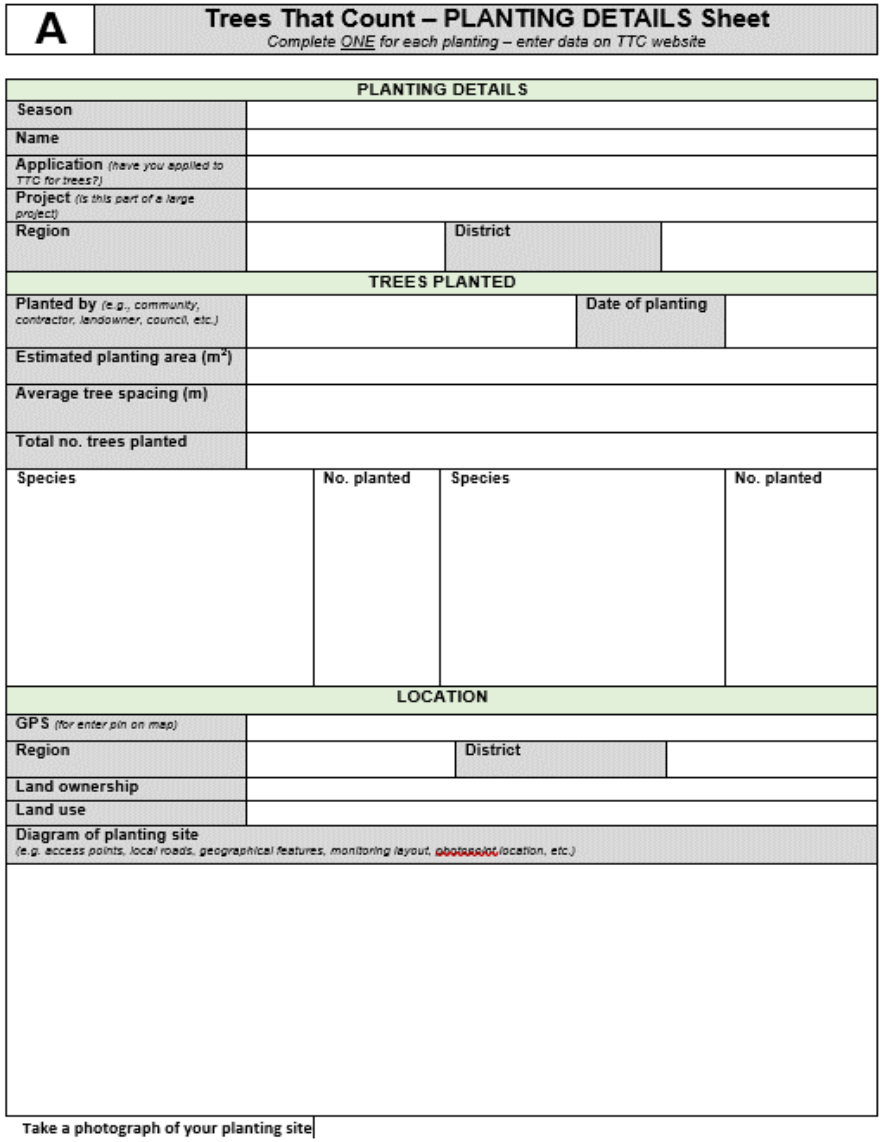
1. Monitoring your planted natives

Keep a record

- Note what was planted where and when you planted your natives
- A record for future reference
- Can also include appending the number of natives planted by species such as the nursery species list
- You can refer to this information during later inspections of the site and to plan the next stages of your planting project.
- Use **PLANTING DETAILS Sheet A**



A	Trees That Count – PLANTING DETAILS Sheet *Complete ONE for each planting – enter data on TTC website*			
PLANTING DETAILS				
Season				
Name				
Application *(have you applied to TTC for trees?)*				
Project *(is this part of a large project)*				
Region		District		
TREES PLANTED				
Planted by *(e.g., community, contractor, landowner, council, etc.)*		Date of planting		
Estimated planting area (m^2)				
Average tree spacing (m)				
Total no. trees planted				
Species	No. planted	Species	No. planted	
LOCATION				
GPS *(for enter pin on map)*				
Region		District		
Land ownership				
Land use				
Diagram of planting site *(e.g. access points, local roads, geographical features, monitoring layout, ~~photopoint~~ location, etc.)*				
Take a photograph of your planting site				

2. Monitoring your planted natives

Undertake early inspections

- After planting is completed inspect your project within the first few days after planting

- Check planted natives are still there and there is nothing likely to affect their performance
  - Fences are keeping out grazing stock and public
  - Pest animals such as rabbits are not browsing the natives
  - Identifying any other factors reducing success of your planting

- Early inspection and action to address any issues affecting your planted natives could mean the difference between success and failure

- It will provide insights into what is required for future planting plans

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3. Monitoring your planted natives

Photographs

- Before and after photographs easy way to demonstrate site has been planted
- Over time will provide a visual record of the establishment of your planted natives
- Photographs demonstrate project progress to other group members, funders and agencies, and for media releases
- Ideally, take a photograph of your planting from a fixed point (photopoint) that can be repeated to systematically
- Check out tips for effective photopoints, e.g. WETMAK module
- Avoid taking too many photographs as storage and captioning can be onerous

Soon after planting

12 months after planting

TREES THAT COUNT TE RAHI O TĀNE

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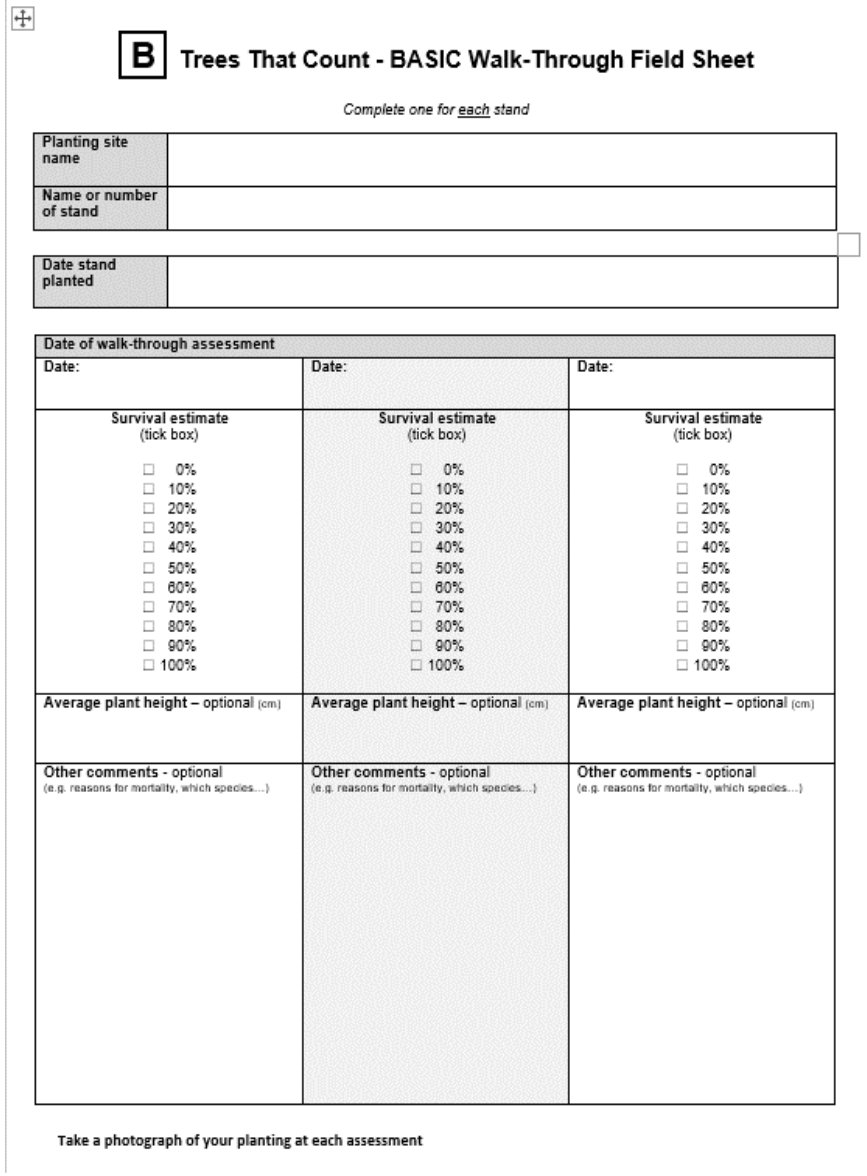
Native Trees for the Future

4. Monitoring your planted natives

BASIC Walk-through subjective monitoring (small plantings)

- For fewer than 1000 trees
- Undertake a walk-through assessment of planting site within a year of planting
- Best done by those who planted the site or where planting records and photographs taken at planting are available as baseline
- Undertake subjective estimate of survival in one of several bands
  - 0-20%, 21-40%, 41-60%, 61-80%, 81%+
- Optional further information useful including:
  - Estimate of average height
  - Reason for any mortality, e.g. animal browsing, or heavy frost
- Use the **BASIC Walk-Through Field Sheet B**



B Trees That Count - BASIC Walk-Through Field Sheet

Complete one for each stand

Planting site name	
Name or number of stand	
Date stand planted	

Date of walk-through assessment		
Date:	Date:	Date:
Survival estimate (tick box) ☐ 0% ☐ 10% ☐ 20% ☐ 30% ☐ 40% ☐ 50% ☐ 60% ☐ 70% ☐ 80% ☐ 90% ☐ 100%	Survival estimate (tick box) ☐ 0% ☐ 10% ☐ 20% ☐ 30% ☐ 40% ☐ 50% ☐ 60% ☐ 70% ☐ 80% ☐ 90% ☐ 100%	Survival estimate (tick box) ☐ 0% ☐ 10% ☐ 20% ☐ 30% ☐ 40% ☐ 50% ☐ 60% ☐ 70% ☐ 80% ☐ 90% ☐ 100%
Average plant height – optional (cm)	Average plant height – optional (cm)	Average plant height – optional (cm)
Other comments - optional (e.g. reasons for mortality, which species…)	Other comments - optional (e.g. reasons for mortality, which species…)	Other comments - optional (e.g. reasons for mortality, which species…)

Take a photograph of your planting at each assessment

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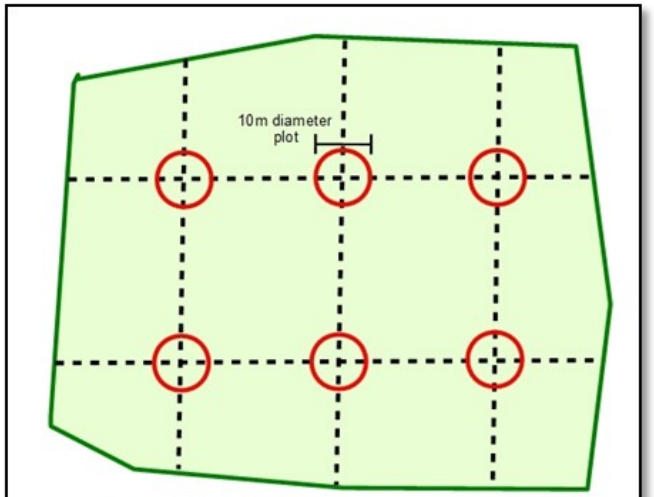
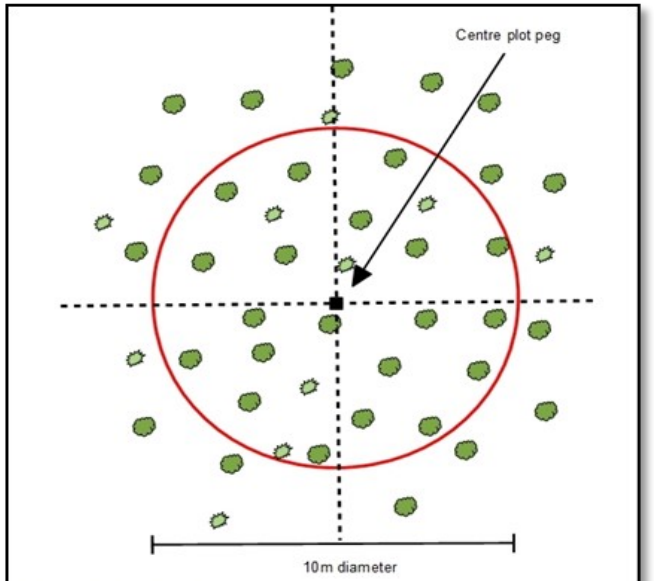
5. Monitoring your planted natives

ADVANCED Quantitative monitoring plots (large plantings)

- For larger projects with over 1000 natives planted
- Aim to establish several circular bounded plots across representative area along a transect or in a grid pattern
- 10m diameter plot will contain 15-30 trees; use smaller plots with higher plant density
- Minimum total sample of 200 planted natives measured and 6 plots
- Use a permanent peg placed in the centre of each plot
- Takes two persons approximately half a day to set up and complete baseline measurements; subsequent measurements less
- Establish plots as soon as possible after trees planted



Sampling large-scale TTC planted areas
- Establish grid across planted area with plot at each intersect of grid
- Require minimum of six 10m diameter plots per planting
- Aim to sample minimum of 200 planted natives

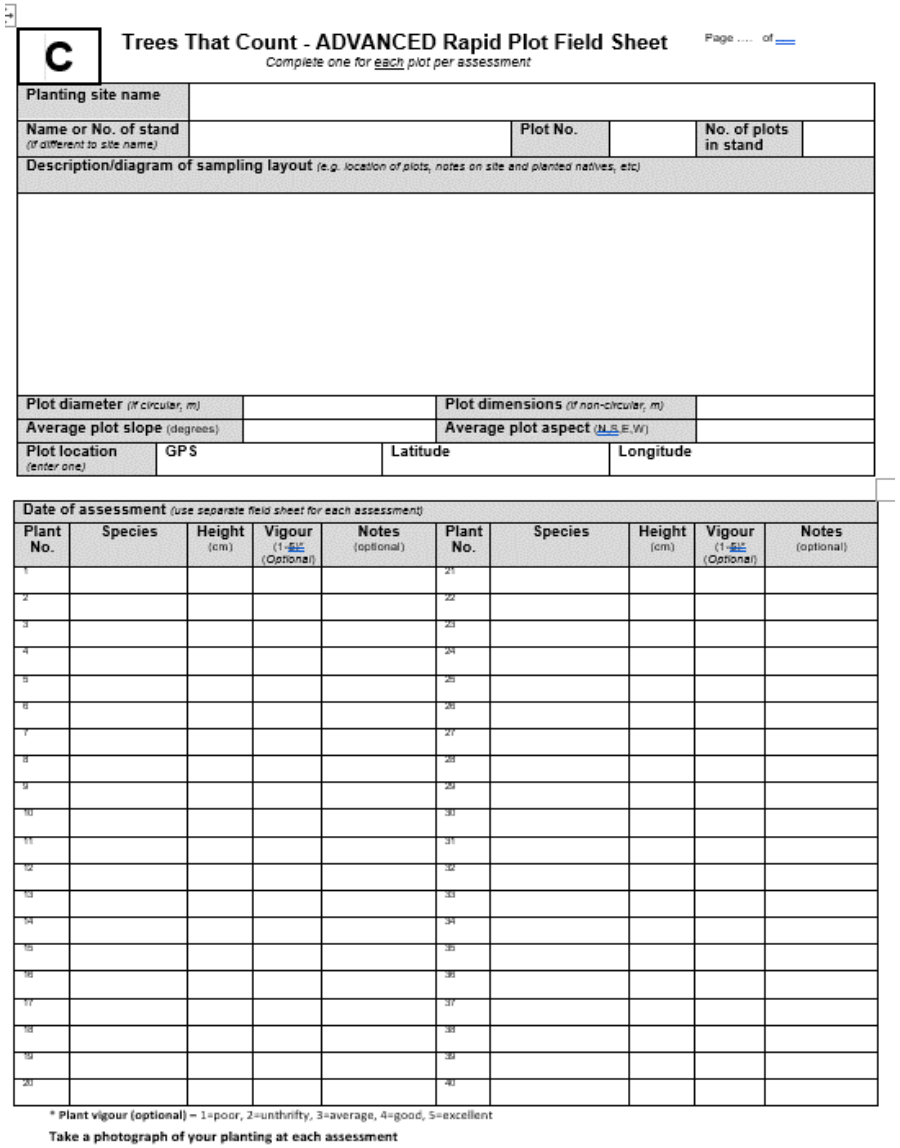


Sample plot layout
- Place permanent peg at centre of each plot
- Record survival and height by species for planted natives within 5m radius

5. Monitoring your planted natives

ADVANCED Quantitative monitoring plots (large plantings)

- Initial monitoring to be undertaken soon after planting
- Record for each planted seedling within plot:
  - Species
  - Height
  - Subjective assessment of plant vigour using 1-5 score
    - 1=poor, 2=unthrifty, 3=average, 4=good. 5=excellent
  - Additional information, e.g., frost damage, animal browsing, major weed species
- Repeat assessment annually for living trees only within each plot until a permanent cover established, 2-5 years after planting
- Use **ADVANCED Plot Field Sheet C**



C

Trees That Count - ADVANCED Rapid Plot Field Sheet

Complete one for each plot per assessment

Page .... of ....

Planting site name					
Name or No. of stand (if different to site name)		Plot No.		No. of plots in stand	
Description/diagram of sampling layout (e.g. location of plots, notes on site and planted natives, etc)					
Plot diameter (if circular, m)		Plot dimensions (if non-circular, m)			
Average plot slope (degrees)		Average plot aspect (N,S,E,W)			
Plot location (enter one)	GPS	Latitude	Longitude		

Date of assessment (use separate field sheet for each assessment)

Plant No.	Species	Height (cm)	Vigour (1-5)* (Optional)	Notes (optional)	Plant No.	Species	Height (cm)	Vigour (1-5)* (Optional)	Notes (optional)
1					21				
2					22				
3					23				
4					24				
5					25				
6					26				
7					27				
8					28				
9					29				
10					30				
11					31				
12					32				
13					33				
14					34				
15					35				
16					36				
17					37				
18					38				
19					39				
20					40				

* Plant vigour (optional) – 1=poor, 2=unthrifty, 3=average, 4=good, 5=excellent

Take a photograph of your planting at each assessment

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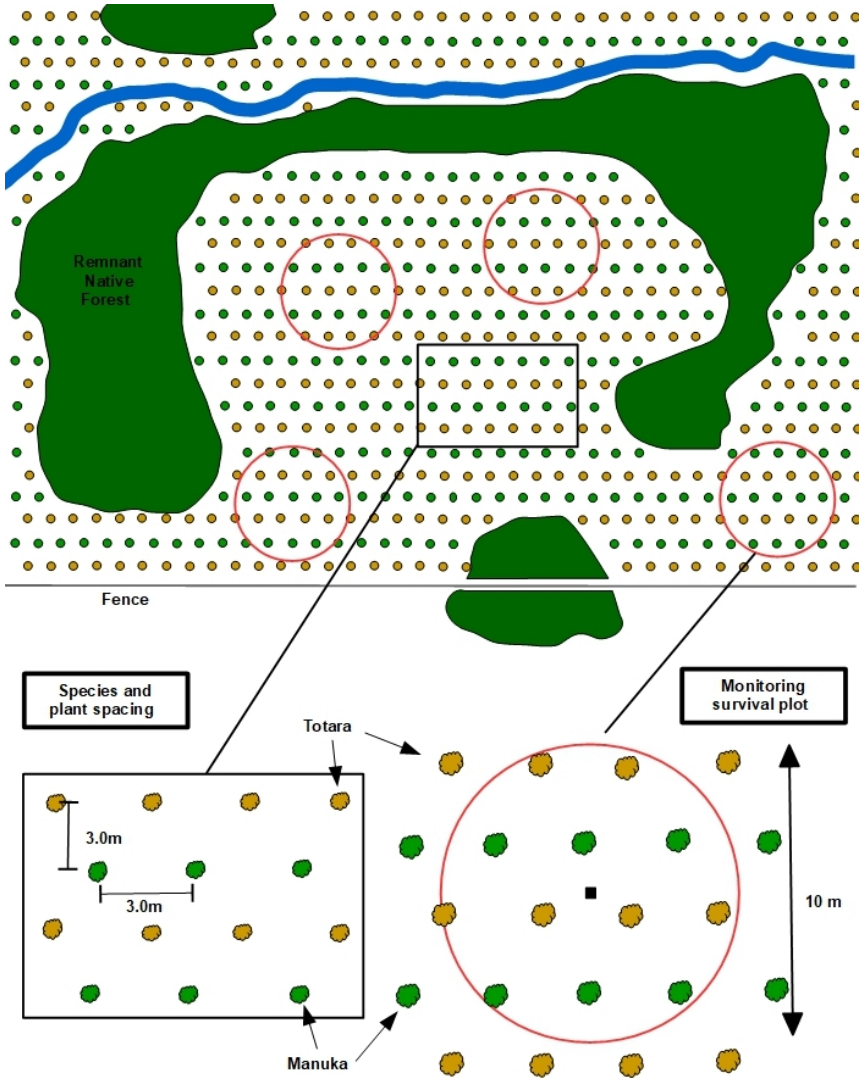
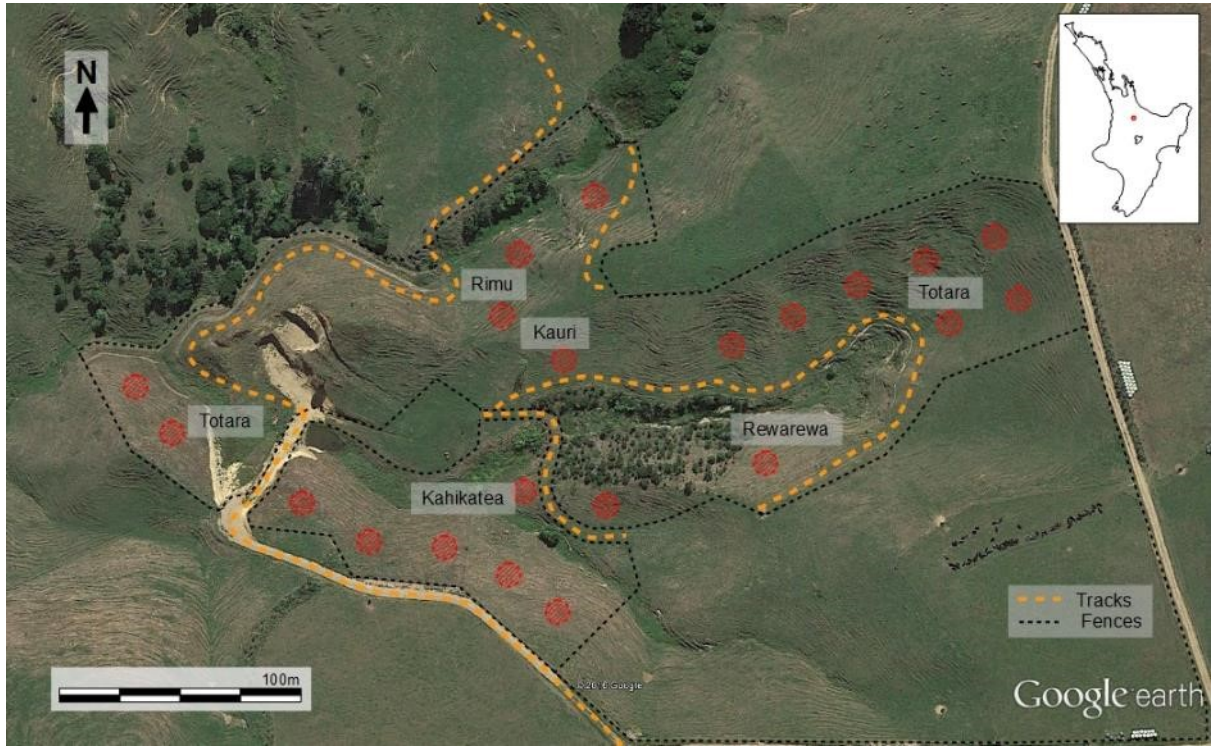
5. Monitoring your planted natives

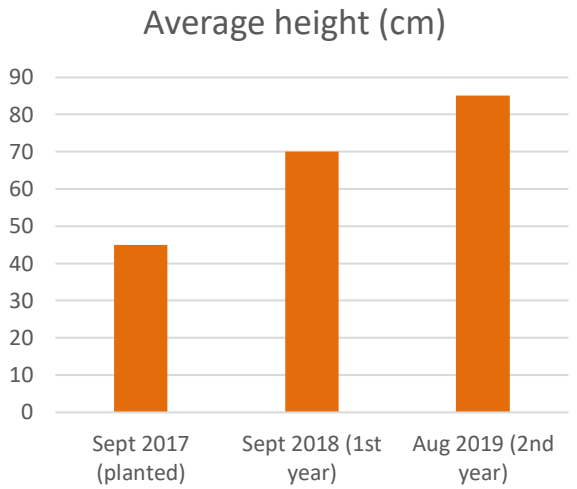


ADVANCED Quantitative monitoring plots (large plantings)



Online data management

- Trees That Count will have monitoring guidelines available on website
- Developing an online system to enter monitoring information including:
  - Site information – location, contacts, link to map, planting date, etc
  - Photographs
  - Subjective assessments from BASIC walk-through monitoring
  - Measurement data from ADVANCED plot monitoring into spreadsheets
- Aim to set up automatic data analysis and presentation of results using summary tables and graphs
- Results to include:
  - Mean overall survival across planting site from plots
  - Mean survival by species
  - Average plant height by species
- Launch expected soon



Date of assessment	Species	Average survival (%)	Average height (cm)	Plant vigour (1-5)
August 2019	Kauri	55	55	2.7
	Totara	90	95	4.6
	Karamu	90	103	4.9
	Puriri	40	89	4.5
	Manuka	80	110	4.8
	Kohuhu	75	75	3.7
Average		71.7	87.8	4.2

TREES THAT COUNT TE RAHI O TĀNE

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Native Trees for the Future

Monitoring

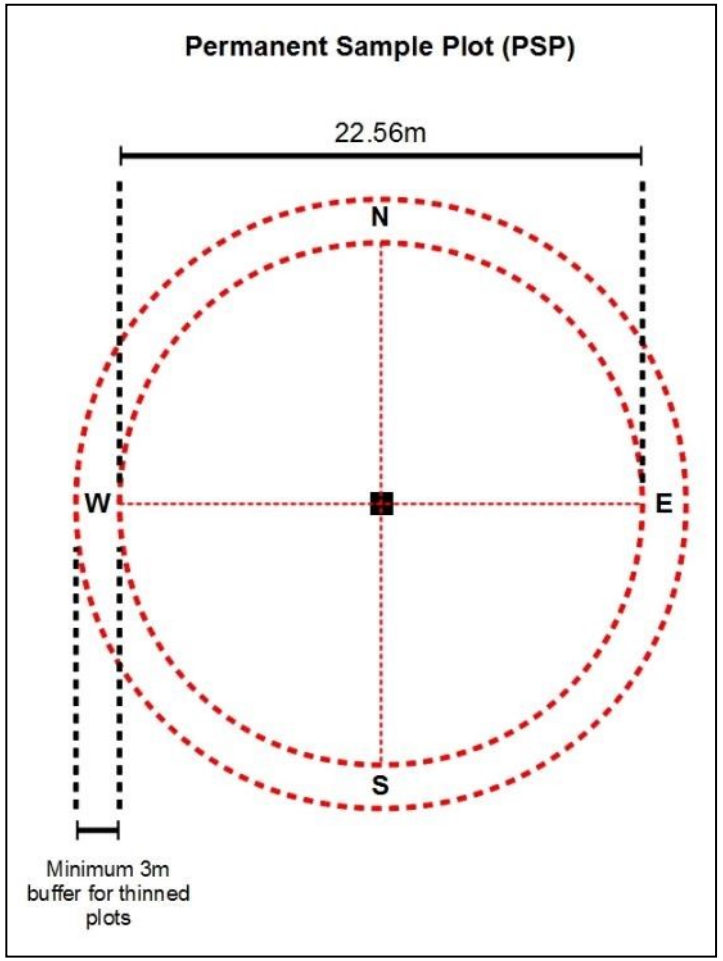
Long term performance of plantings

Long term monitoring of planted natives

Permanent Sample Plots

Establishment of plot

- For sampling planted forest long term Permanent Sample Plots (PSPs) can be established
- PSPs are bounded plots – a full standard PSP is 400 m^2
- Usually circular plot 22.8 m in diameter or square plot 20mx20m
- Treated wooden pegs or similar to mark plot corners or plot centre
- GPS coordinates recorded for relocation



TREES THAT COUNT TE RAHI O TĀNE

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Long term monitoring of planted natives

Permanent Sample Plots

Data recorded

- Site characteristics – e.g. slope, aspect, any disturbance
- All stems within each plot measured for diameter at breast height (DBH at 1.4 m above ground) by species including understorey
- Heights of a sub-sample of 12 canopy trees measured using a Vertex or inclinometer
- For shrubland plots measure root collar diameter of multi-leader shrubs (RCD at 10 cm above ground)
- Method based on Forest Research Institute PSP manual (Ellis and Hayes 1997)

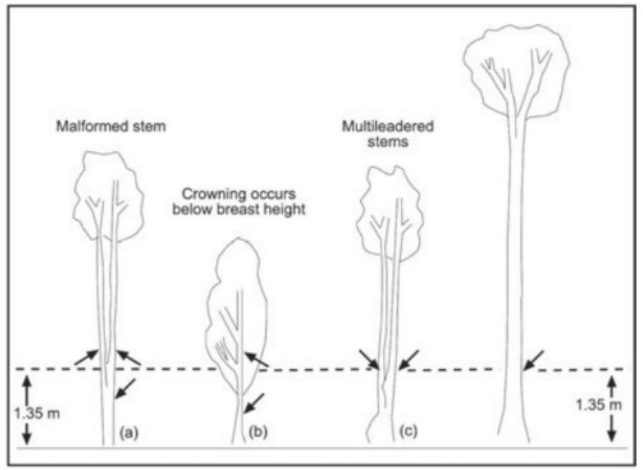
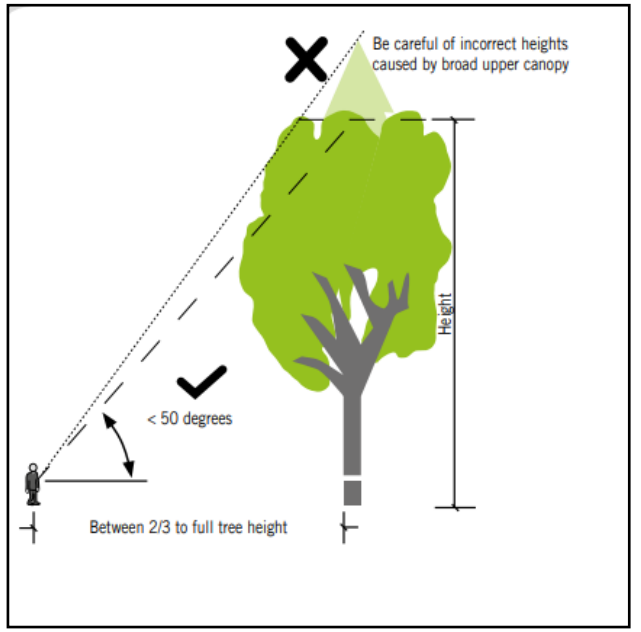


Figure 2. Diameter measurements: where to tag a tree (Modified from Allen 1993).



Establishing Permanent Sample Plots (PSPs)

TREES THAT COUNT TE RAHI O TĀNE

PSPs used for research trials

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APPENDIX 1 - Criteria and field sheet for measurement of planted natives for use with Permanent Sample Plots.

NATIVE FORESTRY PLANTING - ASSESSMENT CRITERIA
Environmental Restoration Ltd
(updated December 2016)

All site information and plant measurements to be entered on customised field sheets (as attached) using standardised alphanumeric codes for transcribing data into Excel spreadsheets for data analysis.

Trial/planting site identifiers – enter concise name of trial and location

Page No. – for each planting or trial, keep all sheets together and number each page

Planting date – enter date of planting or when trial was planted

Other – enter brief details of any other relevant information if required

Rep/Block No. – replicate or block number as per trial design

Plot No. – as per monitoring or trial design

Treatments – Depending on planting trial design, enter descriptor for each treatment in shaded area. Enter appropriate treatment code for each of the one or more treatments in separate column(s). For more than 2 treatments, further columns may need to be inserted into field sheet

Plant No. – each seedling to have a unique identifier – Rep/Block No./Plot No./Plant No.

Recorder and date – enter names of those undertaking assessment and date of assessment

Height (H) – total tree height to nearest cm using height pole. Measure natural height

Dead seedlings – enter as a dash (-) in the height column to allow calculation of survival by species

Crown spread – Length (L) by breadth (B) – maximum spread of live (green) crown to nearest cm using height pole in horizontal position

- first measure width of greatest crown spread, take second measure at right angles
- for analysis, plant spread calculated as square root of length x breadth

Vigour score (V) – subjective visual assessment of tree vigour or health based on a comparison within each species into one of 5 categories:

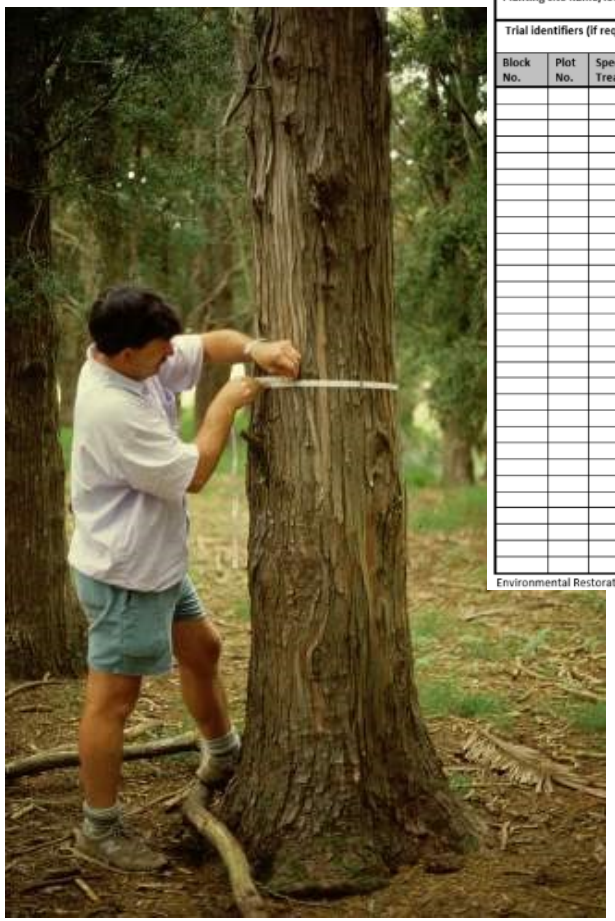
1. poor - few or no leaves, just alive
2. unthrifty - loss of leaves, severe frosting damage or browsing, poor foliage colour
3. average - moderate health and vigour
4. good - minor browsing, frosting damage, etc..., otherwise good growth
5. excellent - healthy plant with good foliage colour and growth

Comments – any addition information on plant condition such as:

Br – browsing by animals (possum, domestic stock etc...)
In – insect attack
Fr – frosting damage
Br – breakage of stems or branches

Comments can be in code form as above for common factors or more explicit to cover severity of plant condition and range of factors that appear to be influencing performance

Field sheets – can be customised to suit each trial design. Templates for 5 and 10 tree plots/lines and larger blocks are available.



ERL Field Data Sheet – Permanent Sample Plot (PSP)/growth plot for trials and block planting

Planting site name/location:				Planting date:					Transect/plot No.:				Page of					Other notes:				
Trial identifiers (if required)				Recorder:					Recorder:					Recorder:								
Block No.	Plot No.	Species & Treatment	Plant No.	Date: H	L	B	V	Comments	Date: H	L	B	V	Comments	Date: H	L	B	V	Comments				

Environmental Restoration Ltd, Rotorua, last updated December 2016

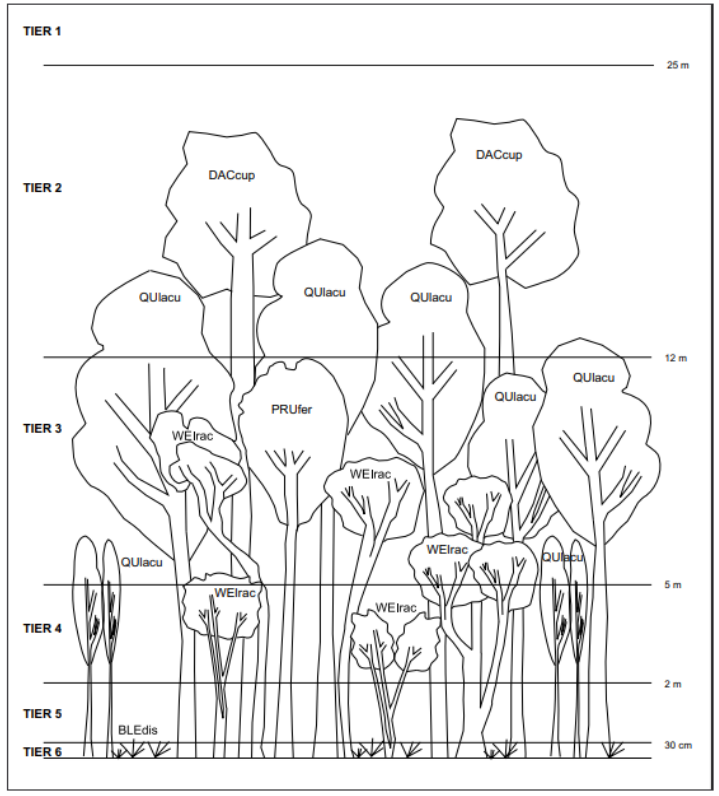
TREES THAT COUNT TE RAHI O TĀNE

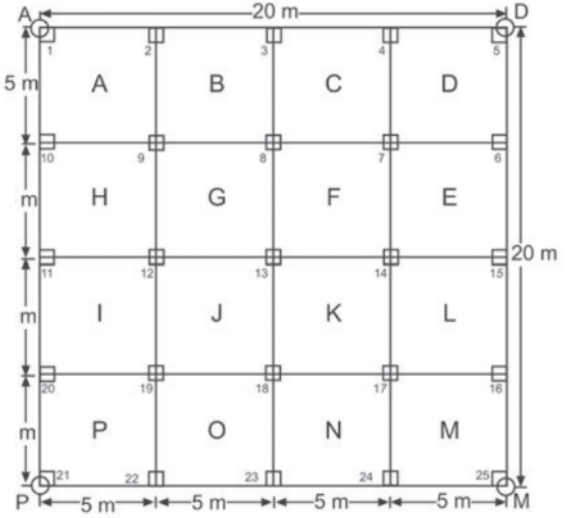
Tāne's Tree Trust
Native Trees for the Future

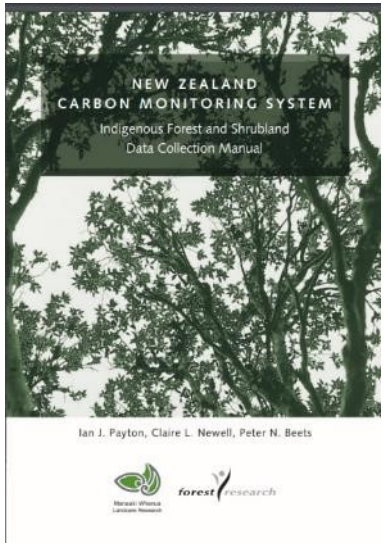
Long term monitoring of native forestry and biodiversity

Reconnaissance Plot (RECCE)

- For monitoring long term changes in biodiversity
- 20mx20m plots with permanent pegs
- Assessment of vegetation cover by tiers using percentage cover by species within defined height tiers
  - 0-30 cm, 30 cm – 2 m; 2-5 m, 5-12 m, >12 m
- Photopoints located in each plot with location and bearing noted
- Based on guidelines by Hurst and Allan (2007), Payton et al. (2004)







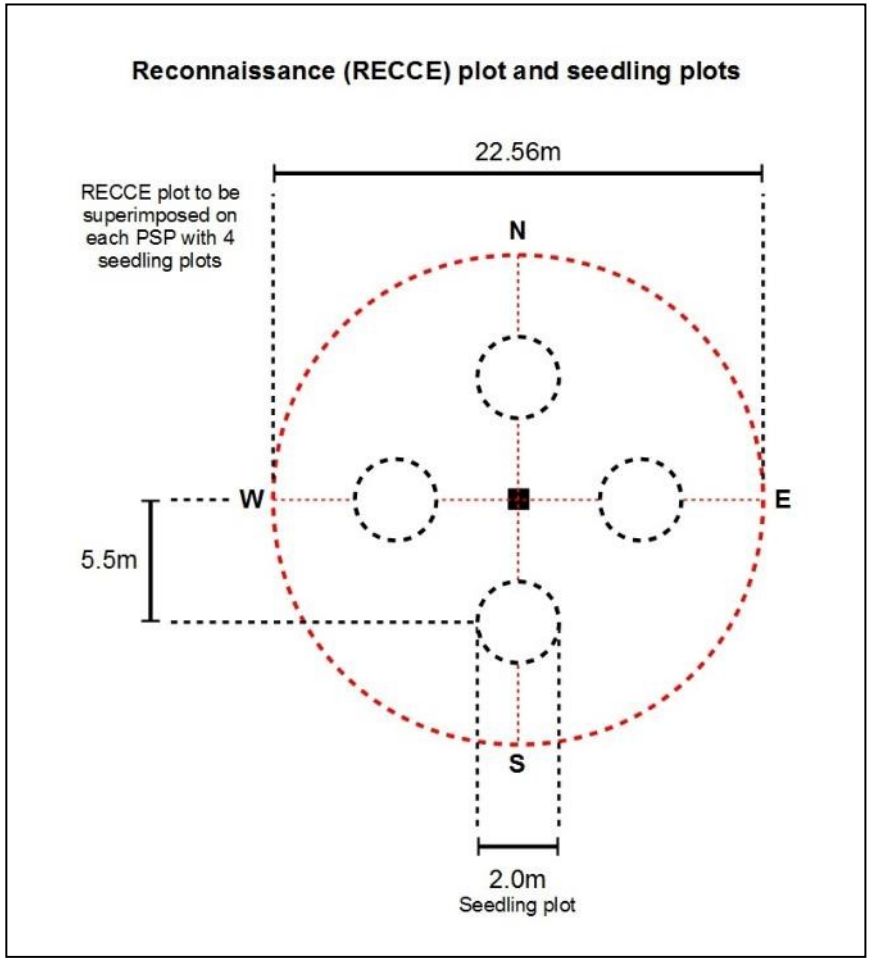
Long term monitoring – regeneration

Seedling plots

- Plots can be established within PSPs to assess regeneration of trees and shrubs
- Size variable depending on sampling density and number of seedlings
- Usually small 1 or 2 m diameter or square plots
- Pegs and GPS used to relocate for remeasurement

Ground cover plots

- Similar small bounded plots established in PSPs to quantify changes in ground cover vegetation over time
- Aim is to provide a quick assessment of any changes in ground cover vegetation



TREES THAT COUNT TE RAHI O TĀNE

Tāne's Tree Trust
Native Trees for the Future

Monitoring

Coastal sand dunes

Monitoring of coastal sand dunes

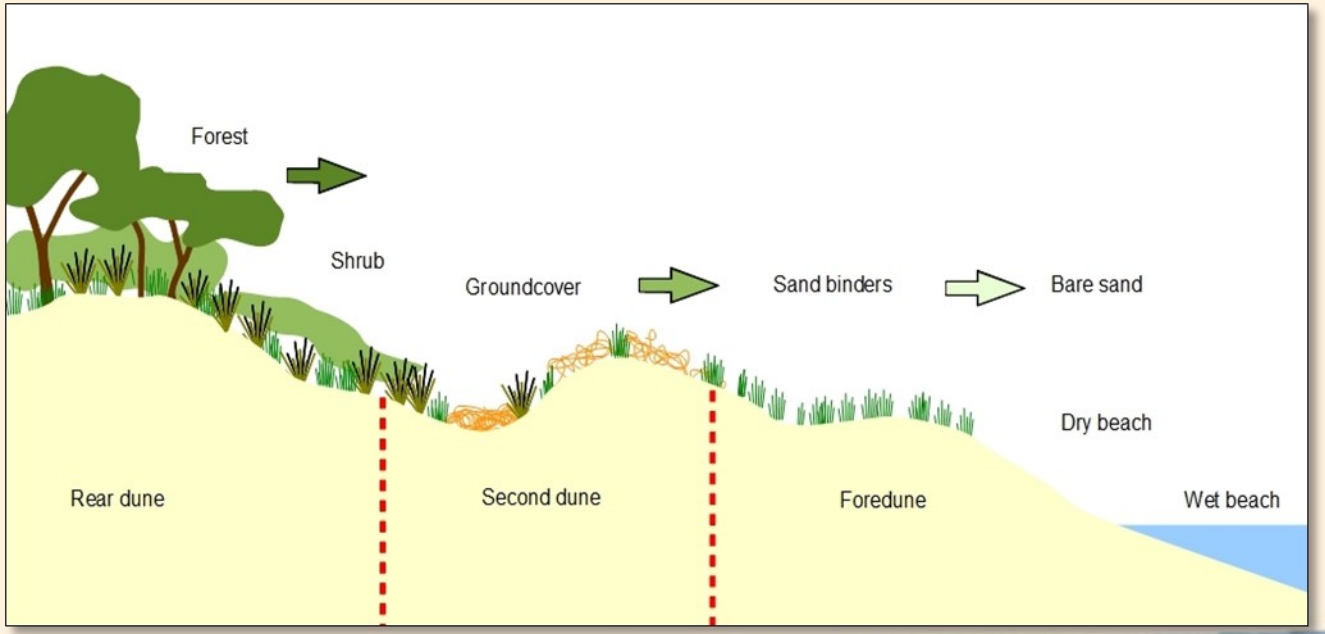
- The Coastal Restoration Trust has developed easy-to-use methods for monitoring changes in vegetation cover on coastal sand dunes

- A scientifically robust monitoring programme enables Coastcare communities to:
  - measure and illustrate the success of their work
  - gain an understanding of their dune systems and the importance of appropriate plant species communities
  - provide the basis upon which to continually improve best practices

Dune monitoring transects

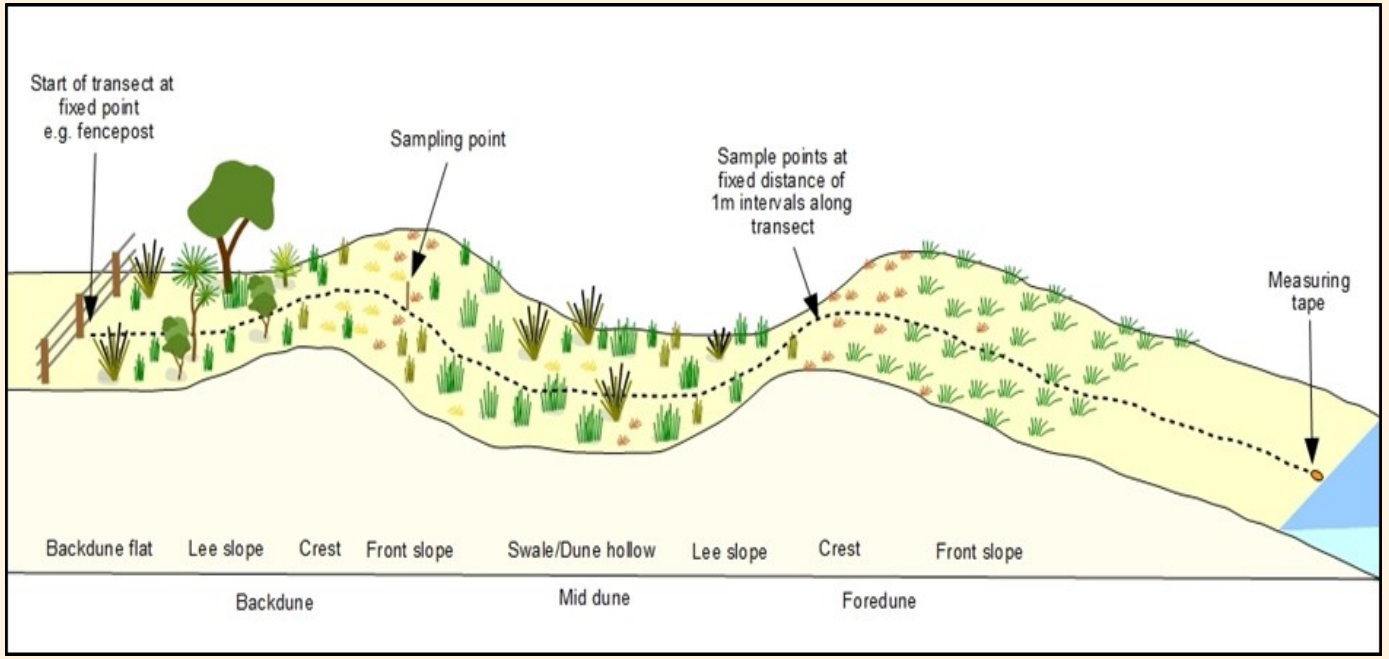
- Sampling change in vegetation and dune form along transects perpendicular to the coast will provide an indication of the vegetation types and species in each zone.

- Re-measurement of these characteristics using consistent methods will show any changes that are occurring over time.



Setting up a dune transect

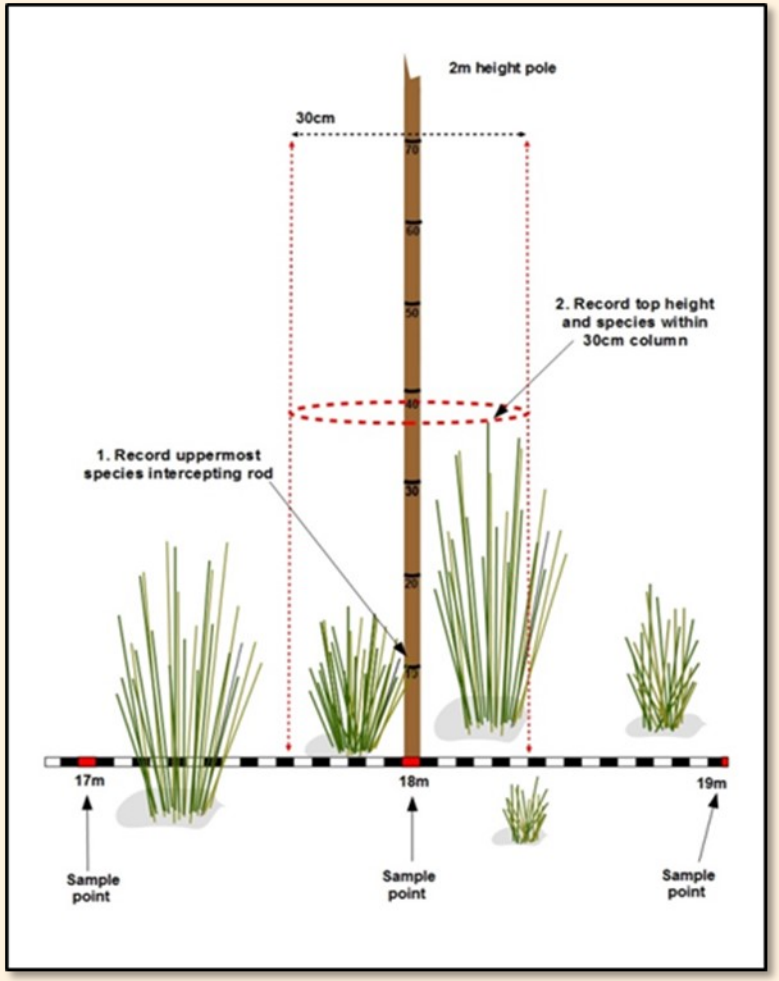
- Set up a transect by running a tape across the dune along a bearing perpendicular to the coast from a fixed landward marker (e.g. peg, fencepost) to high water mark.



Rapid point sampling

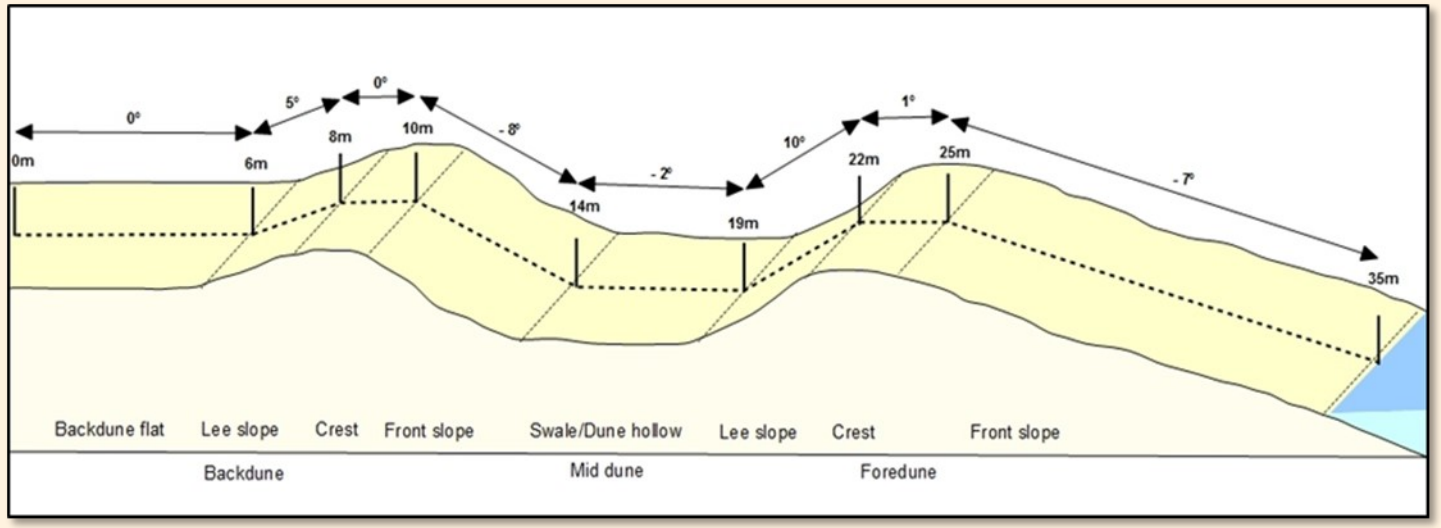
- At 1m intervals along the tape, drop the 2m long sampling rod as close as possible to the tape, avoiding excessive disturbance

- At each sampling point:
  - Record the uppermost species touching the sampling rod (1)
  - Then record the species and height of the upper most plant within the 30 cm diameter of the sampling rod (2)



Mapping dune profile

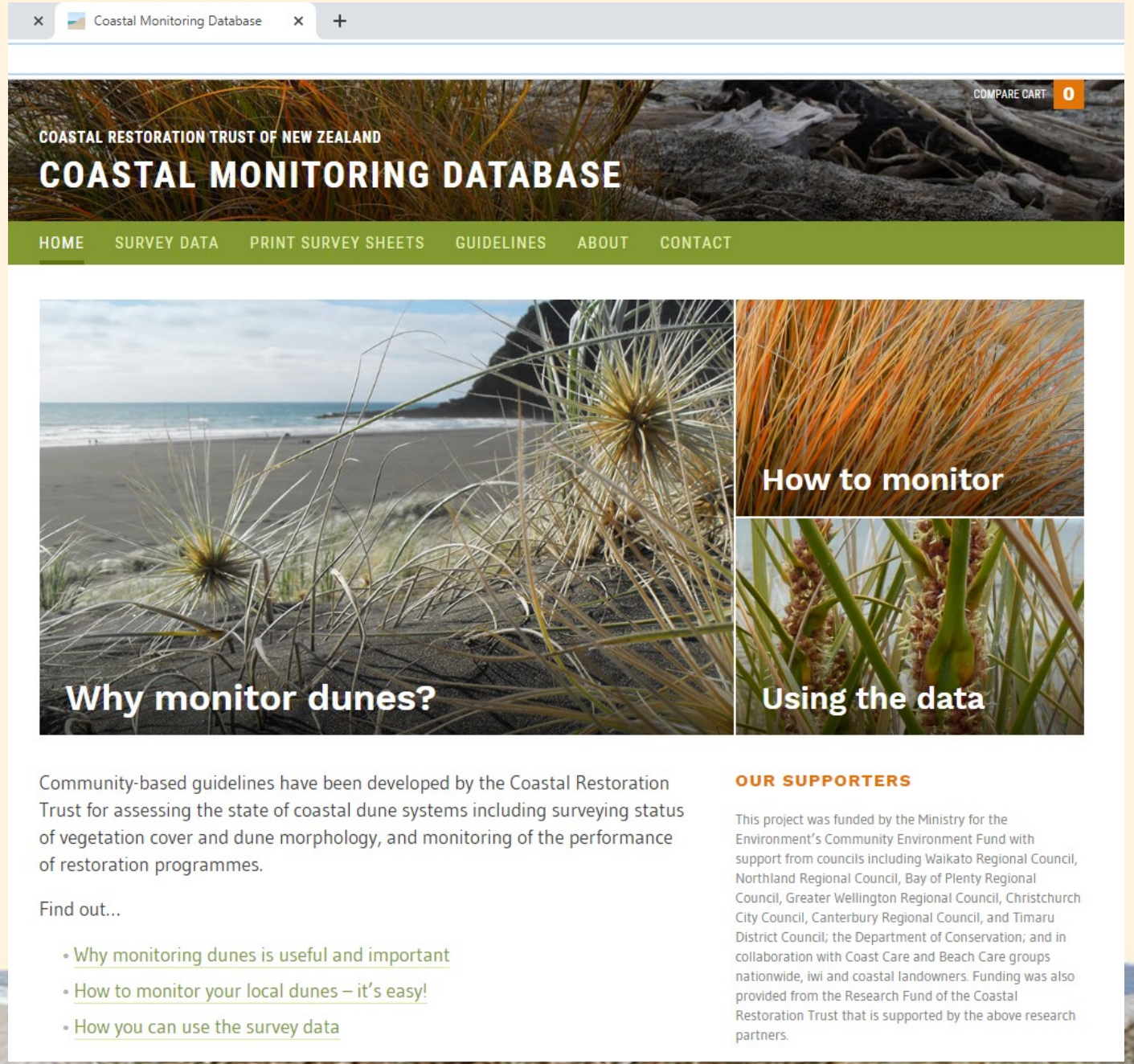
- A practical method for mapping the dune profile involves recording angles between changes in contour along each transect
- Download the free compass and inclinometer app onto phone or ipad, or use a manual inclinometer
- Identify the nearest sampling point to each major change in angle of the dune profile
- Record angle of the slope by holding the phone or inclinometer at same angle of dune



CRT Coastal Monitoring Database (CMD)

On the Coastal Restoration Trust website

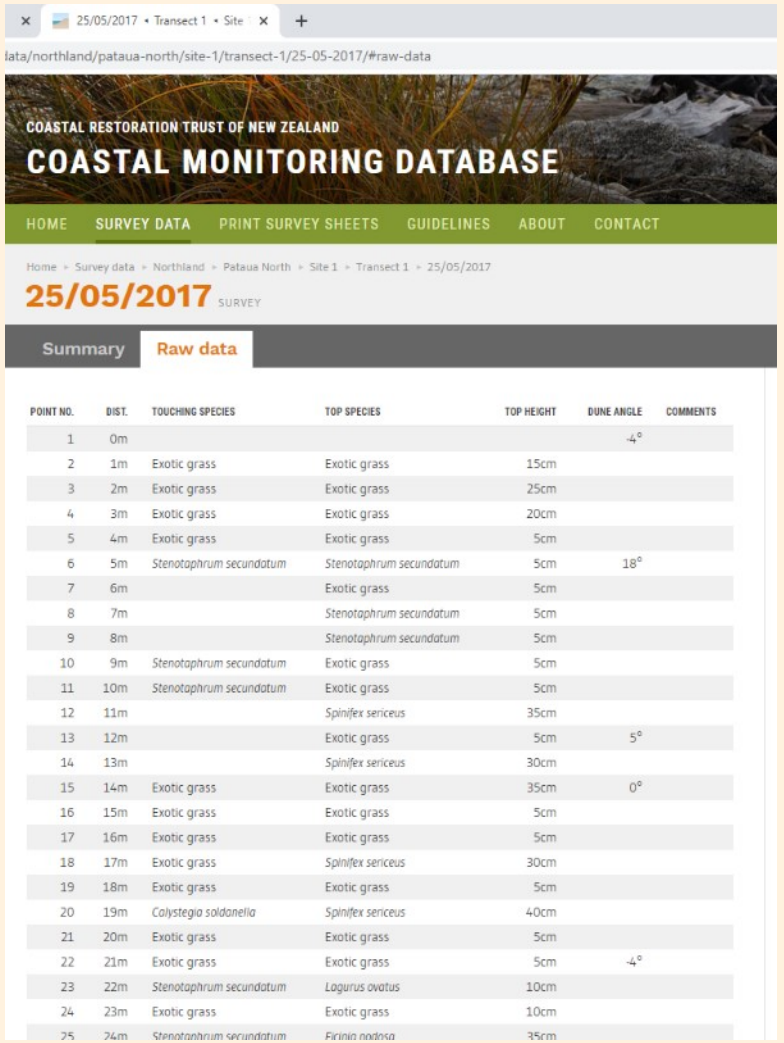
https://monitoring.coastalrestorationtrust.org.nz/



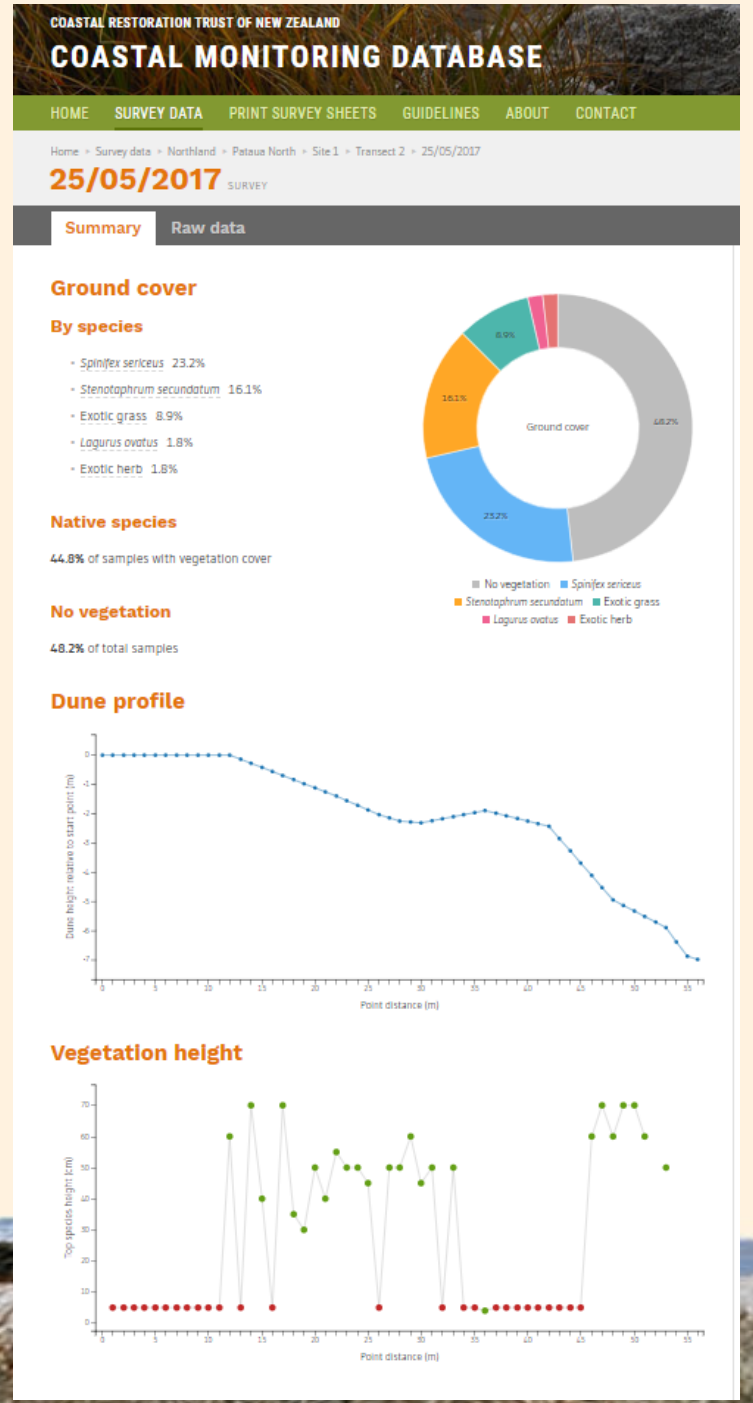
COASTAL RESTORATION TRUST OF NEW ZEALAND
Tāhuna Ora

Data management

- Guide, maps and field sheets online
- Data can be entered by those monitoring directly to website spreadsheet
- Data is automatically analysed
- Results immediately available as summary tables, graphs and dune profile diagrams



POINT NO.	DIST.	TOUCHING SPECIES	TOP SPECIES	TOP HEIGHT	DUNE ANGLE	COMMENTS
1	0m				-4°	
2	1m	Exotic grass	Exotic grass	15cm		
3	2m	Exotic grass	Exotic grass	25cm		
4	3m	Exotic grass	Exotic grass	20cm		
5	4m	Exotic grass	Exotic grass	5cm		
6	5m	*Stenotaphrum secundatum*	*Stenotaphrum secundatum*	5cm	18°	
7	6m		Exotic grass	5cm		
8	7m		*Stenotaphrum secundatum*	5cm		
9	8m		*Stenotaphrum secundatum*	5cm		
10	9m	*Stenotaphrum secundatum*	Exotic grass	5cm		
11	10m	*Stenotaphrum secundatum*	Exotic grass	5cm		
12	11m		*Spinifex sericeus*	35cm		
13	12m		Exotic grass	5cm	5°	
14	13m		*Spinifex sericeus*	30cm		
15	14m	Exotic grass	Exotic grass	35cm	0°	
16	15m	Exotic grass	Exotic grass	5cm		
17	16m	Exotic grass	Exotic grass	5cm		
18	17m	Exotic grass	*Spinifex sericeus*	30cm		
19	18m	Exotic grass	Exotic grass	5cm		
20	19m	*Calystegia soldanella*	*Spinifex sericeus*	40cm		
21	20m	Exotic grass	Exotic grass	5cm		
22	21m	Exotic grass	Exotic grass	5cm	-4°	
23	22m	*Stenotaphrum secundatum*	*Lagurus ovatus*	10cm		
24	23m	Exotic grass	Exotic grass	10cm		
25	24m	*Stenotaphrum secundatum*	*Pinnia nodosa*	35cm		



TREES THAT COUNT TE RAHI O TĀNE

Tāne's Tree Trust
Native Trees for the Future

Monitoring

Wetlands, estuaries, riparian

TREES THAT COUNT TE RAHI O TĀNE

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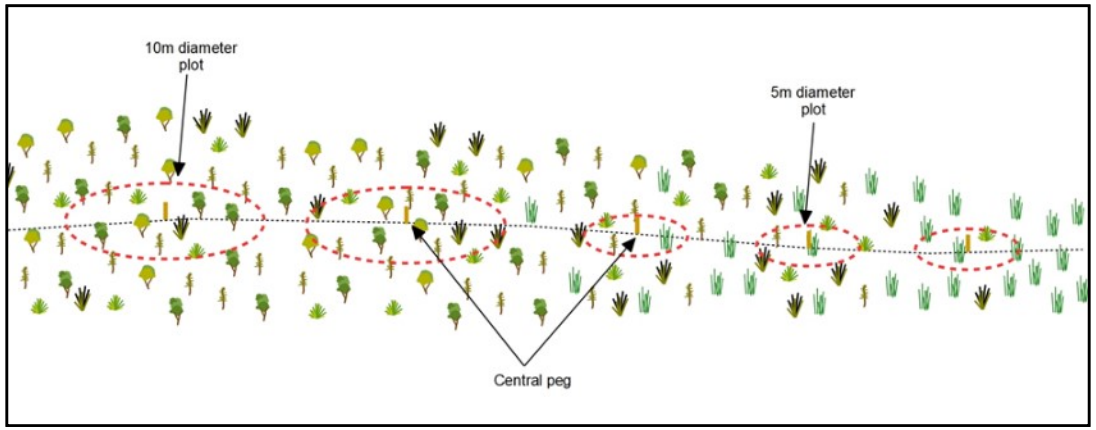
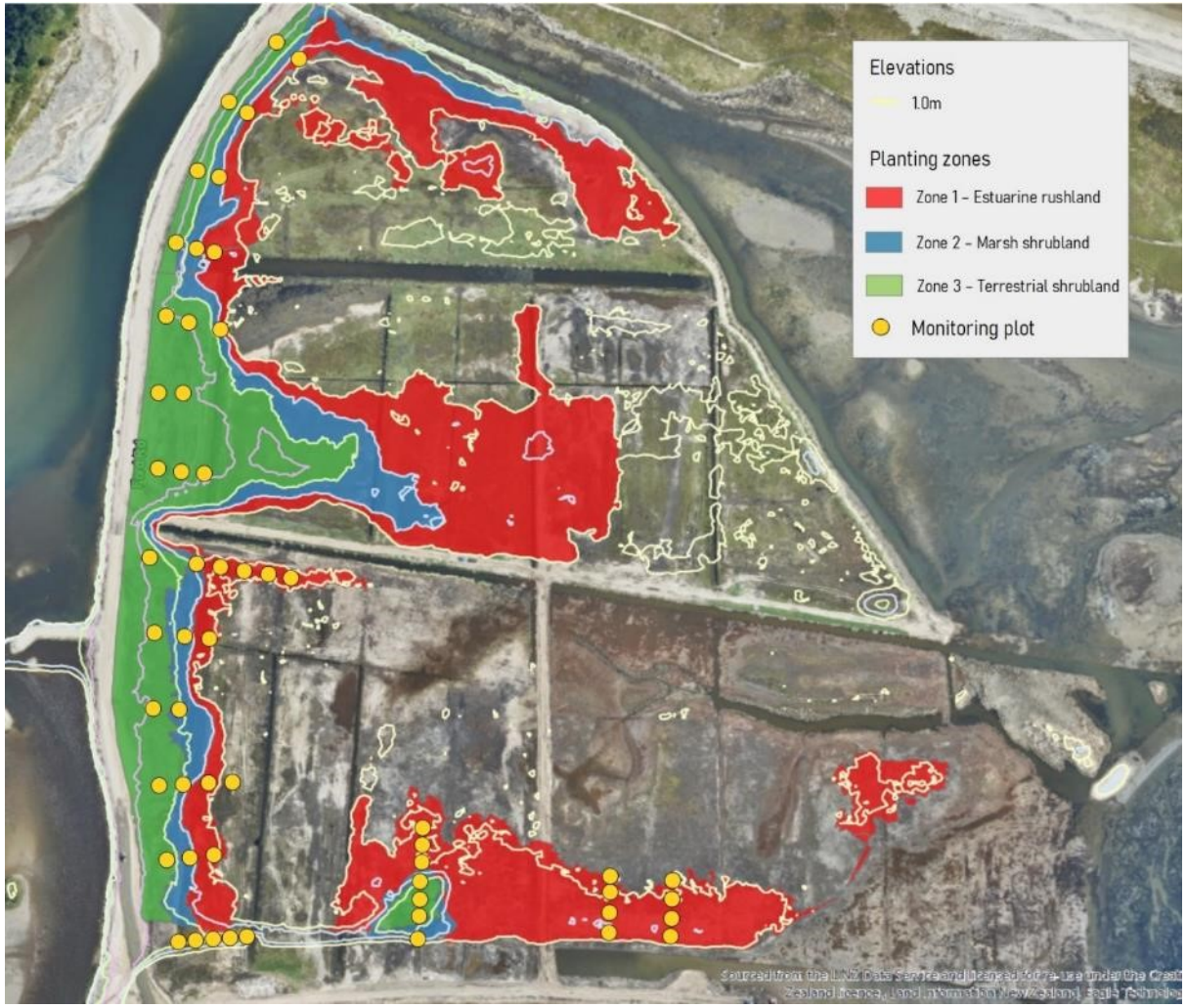
Native Trees for the Future

Wetland/estuary planting - monitoring

- Transects established to sample gradient from terrestrial zone to estuarine zone
- Series of plots along each transect to measure planted natives
- Use larger plots where native shrubs planted at wide spacing, and small plots with dense planting of sea rush, etc





TREES THAT COUNT TE RAHI O TĀNE

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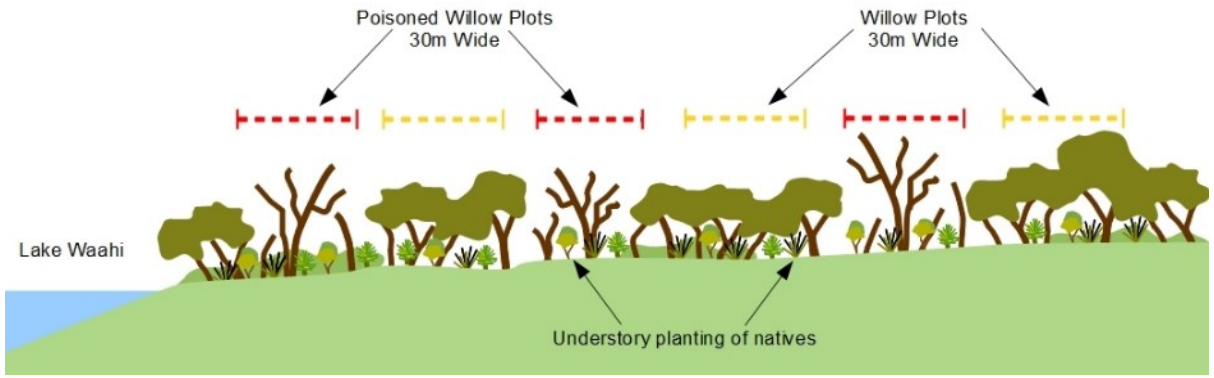
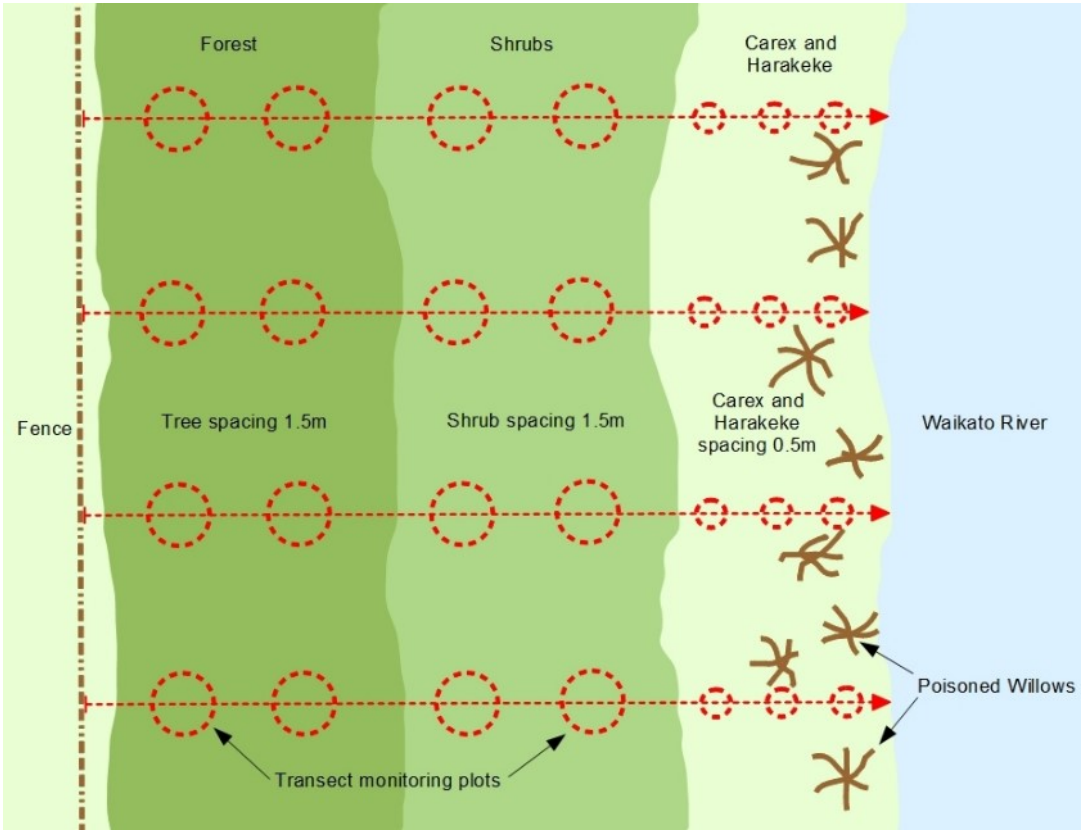
Maketu estuary planting - monitoring

Riparian planting - monitoring

- Transects set perpendicular to river and lake across gradient of planting from water edge inland
- Circular plots located along transects – plot size dictated by plant density
- Survival, height, canopy spread and plant vigour assessed annually within each plot



Lake Waahi, Huntly, lake riparian trials



Waikato River riparian planting trials