Landcare Research
Manaaki Whenua

Site occupancy of native plants in New Zealand

Chris Phillips
Jagath Ekanayake, Michael Marden

in this talk……

- Setting the scene
- Our approach
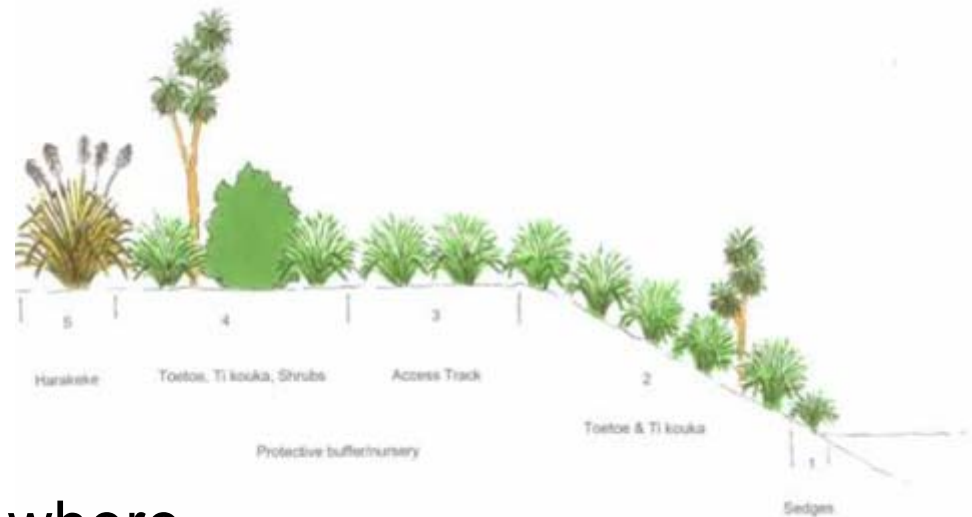 - root site occupancy
- How we do it
- Some results
- Wrap up

Context – 1

Why the focus on natives?

- Loss of riparian vegetation
- Loss of ecosystem services
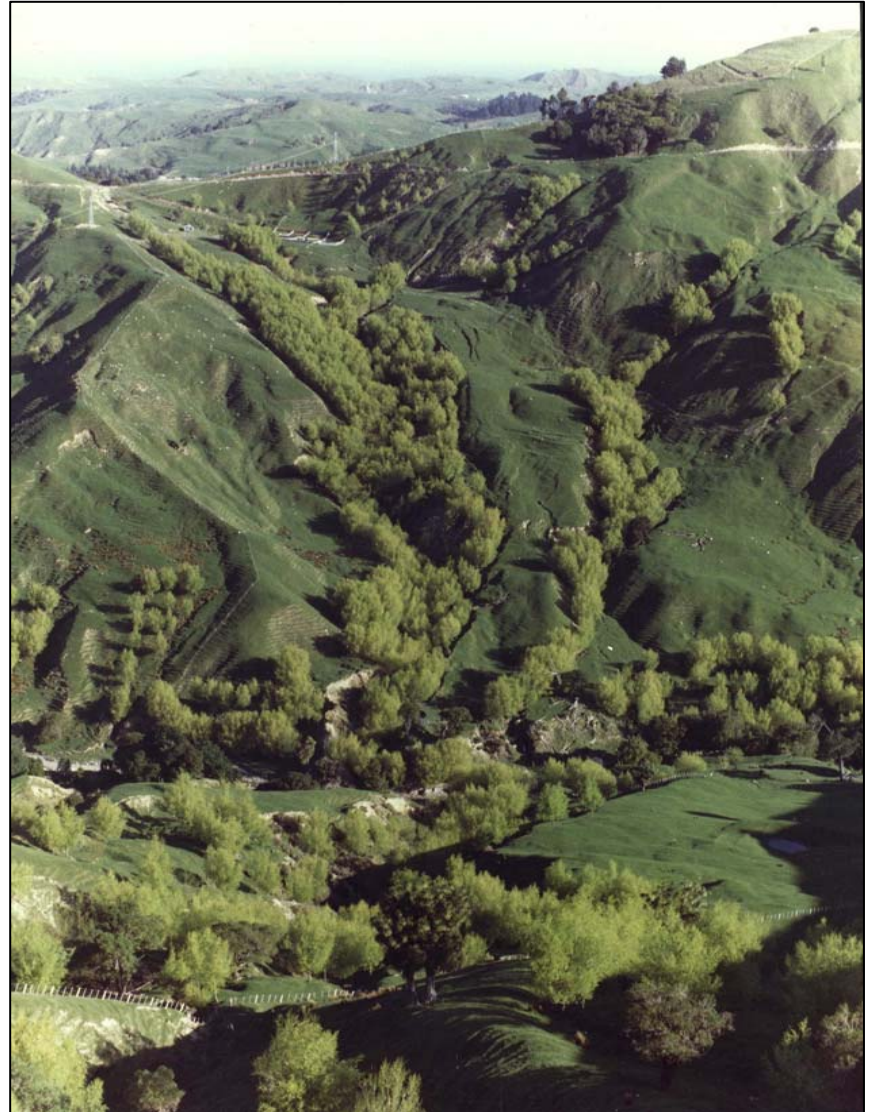- Degraded water quality & habitat

- Public desire to redress
- Community action
- Natives over exotics
- What to use, how many & where

Figure 4: Riverbank Restoration Plantings – Cross Section

Harakeke   Toetoe, Ti kouka, Shrubs   Access Track   Toetoe & Ti kouka   Sedges

Protective buffer/nursery

5   4   3   2   1

Wildland

INTEGRATED CATCHMENT MANAGEMENT
for the *Motueka River*

http://icm.LandcareResearch.co.nz/

Context – 2

Effectiveness of wide-spaced trees

Context – 2

Effectiveness of wide-spaced trees

How many? How far apart? Where to plant? When effective? How to gauge effectiveness?
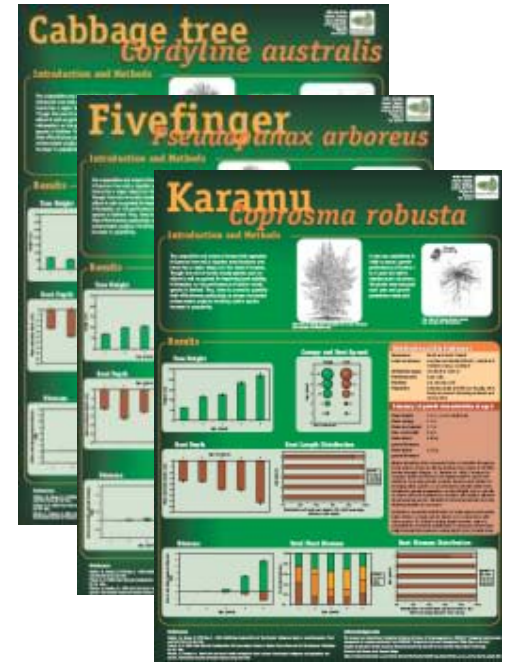
The Big Question?

Can our New Zealand native plants perform a river bank stabilising function as well as introduced plants?

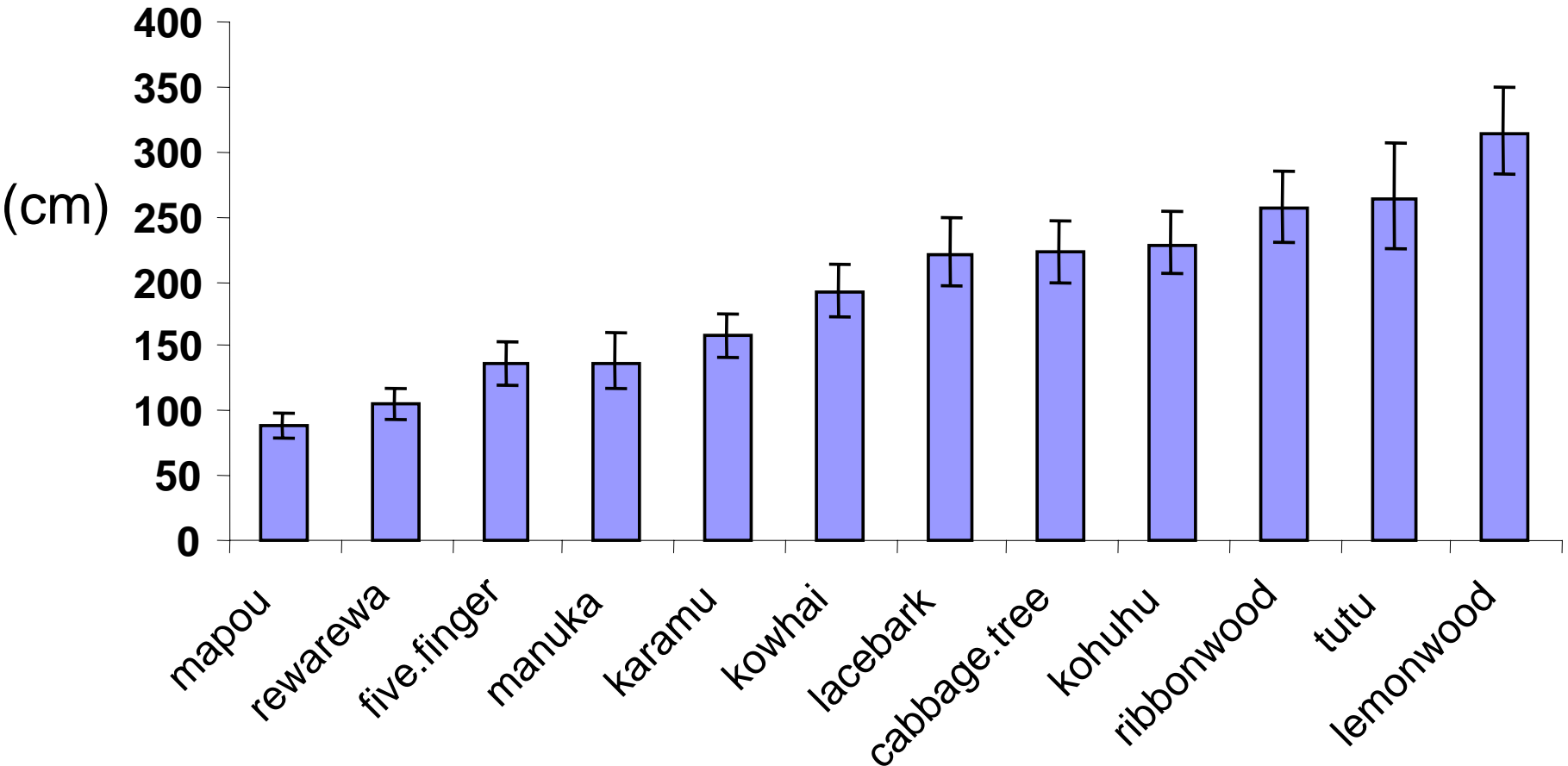**In geotechnical terms, how do we quantify the benefits of vegetation to soil stabilisation?**
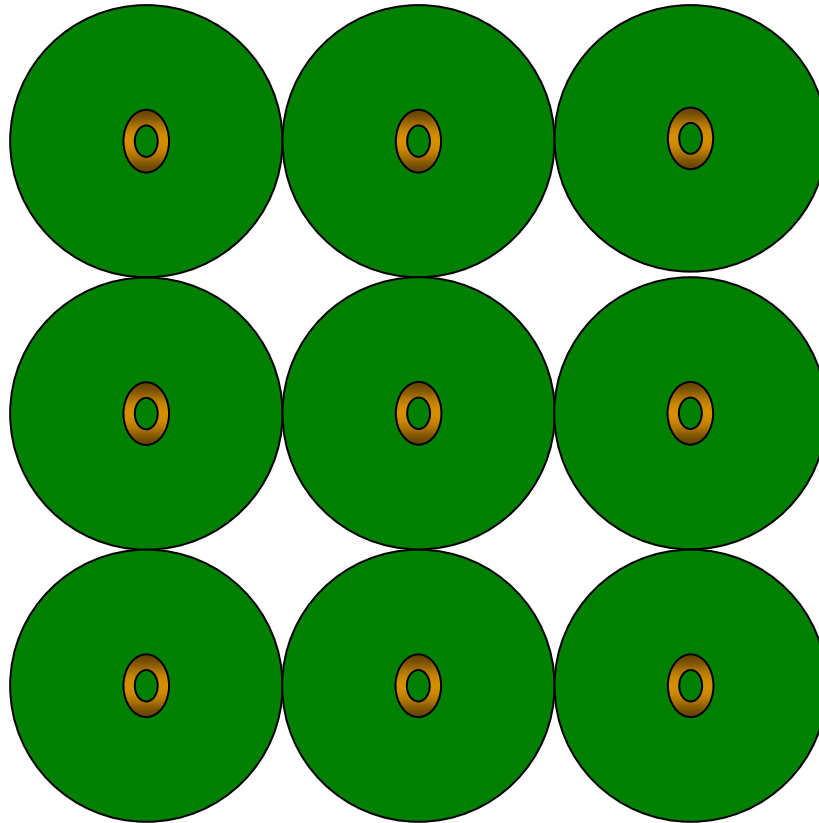
Native plant database

Mean max. root spread
5 year old natives

growth – above and below, canopy occupancy, root architecture, root biomass, root occupancy, root depth, root strength, root X-sectional area/shear area
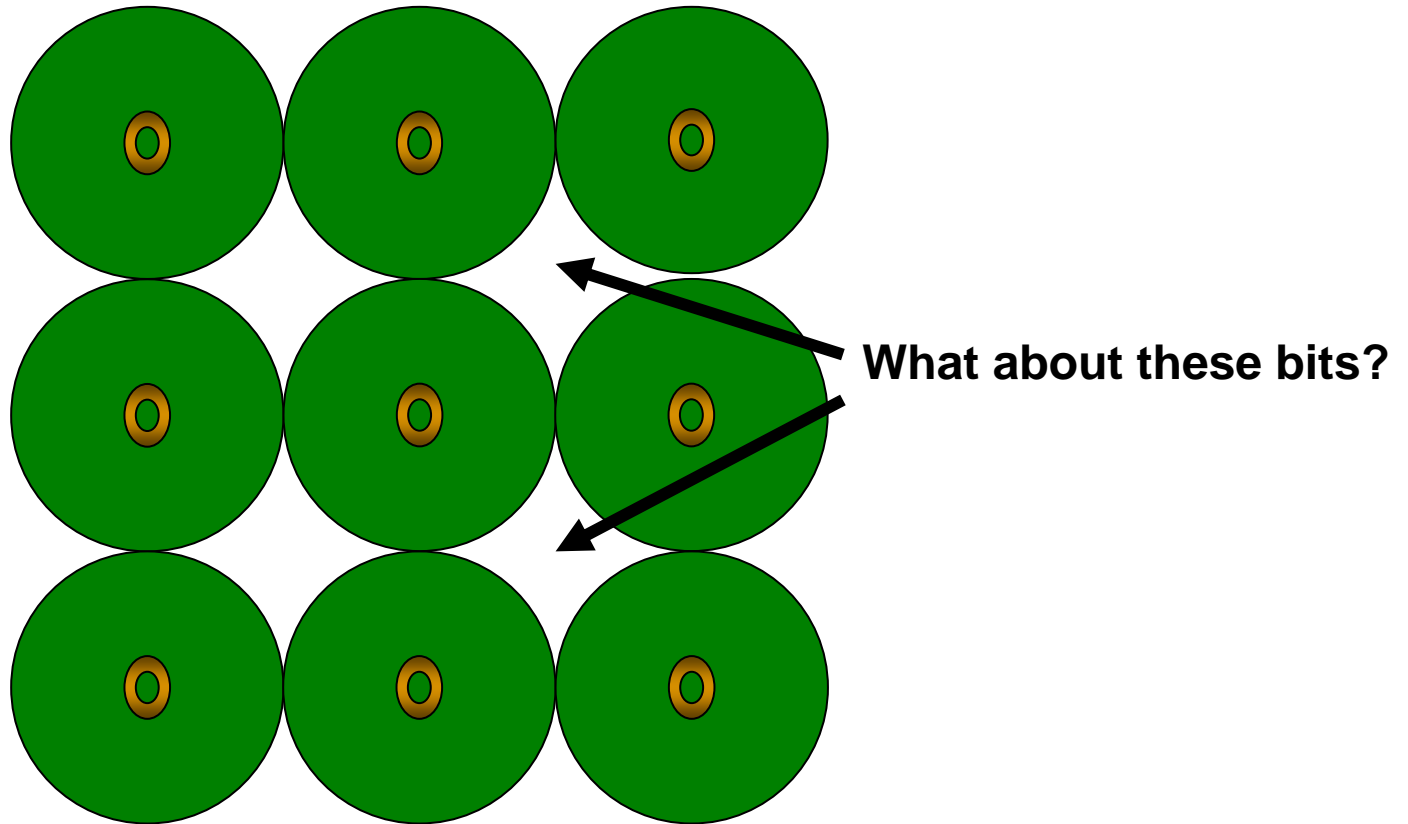
Root site occupancy
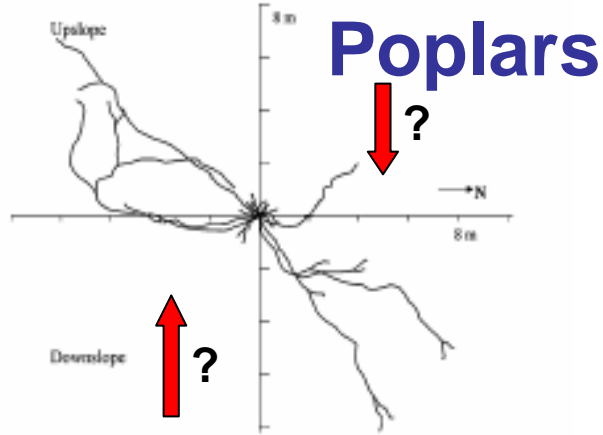

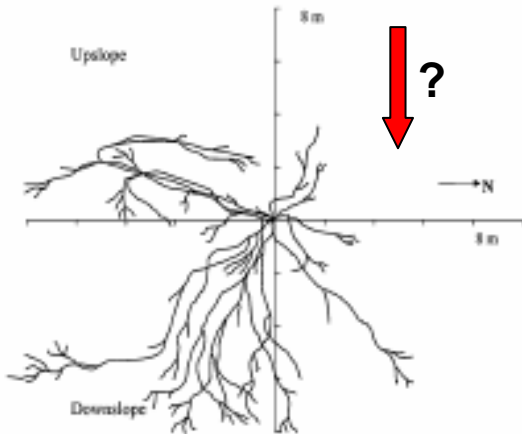**100% root site occupancy**

Root site occupancy

What about these bits?

100% root site occupancy

Poplars

5 yr

?

?

7 yr

?

9.5 yr

?

?
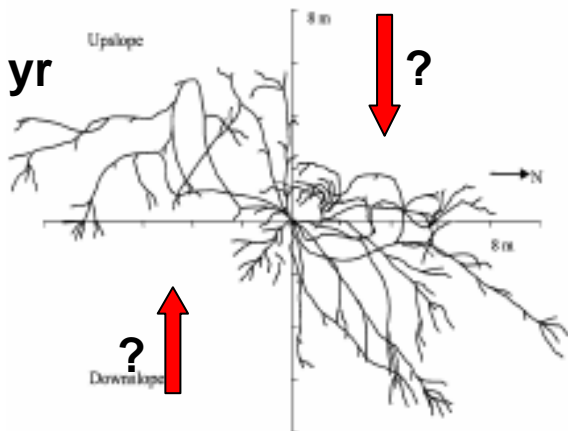
McIvor et al (2007)

Cabbage tree

4 yr   8 yr   25 yr
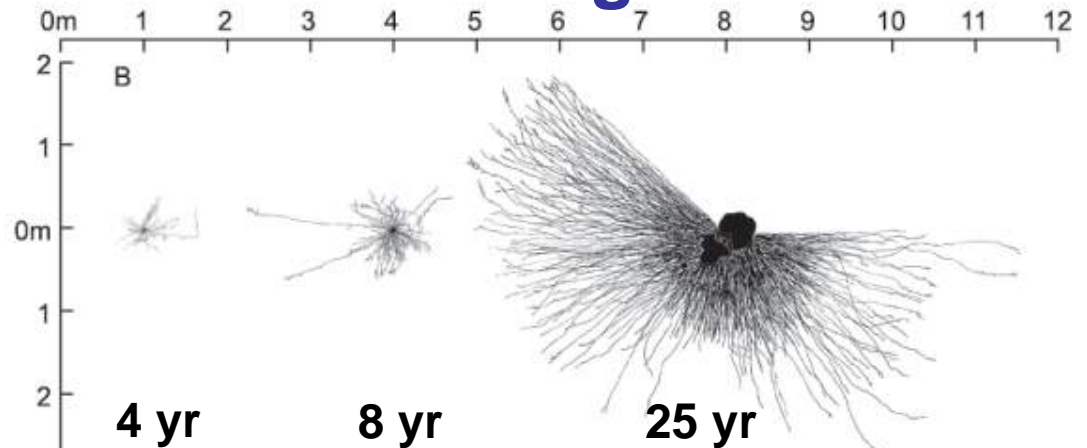
Czernin & Phillips (2005)

Totara

4 yr

Marden & Phillips (unpub.)

Root site occupancy

Root biomass
Total root length
Root surface area
Root reinforcement
Etc.

100%

0%

Radial distance from stem/stump

Root site occupancy

"Effective" root spread radius

100%

? ⟵―――⟶ **?**

Site occupancy

0%

Mean maximum
root length radius
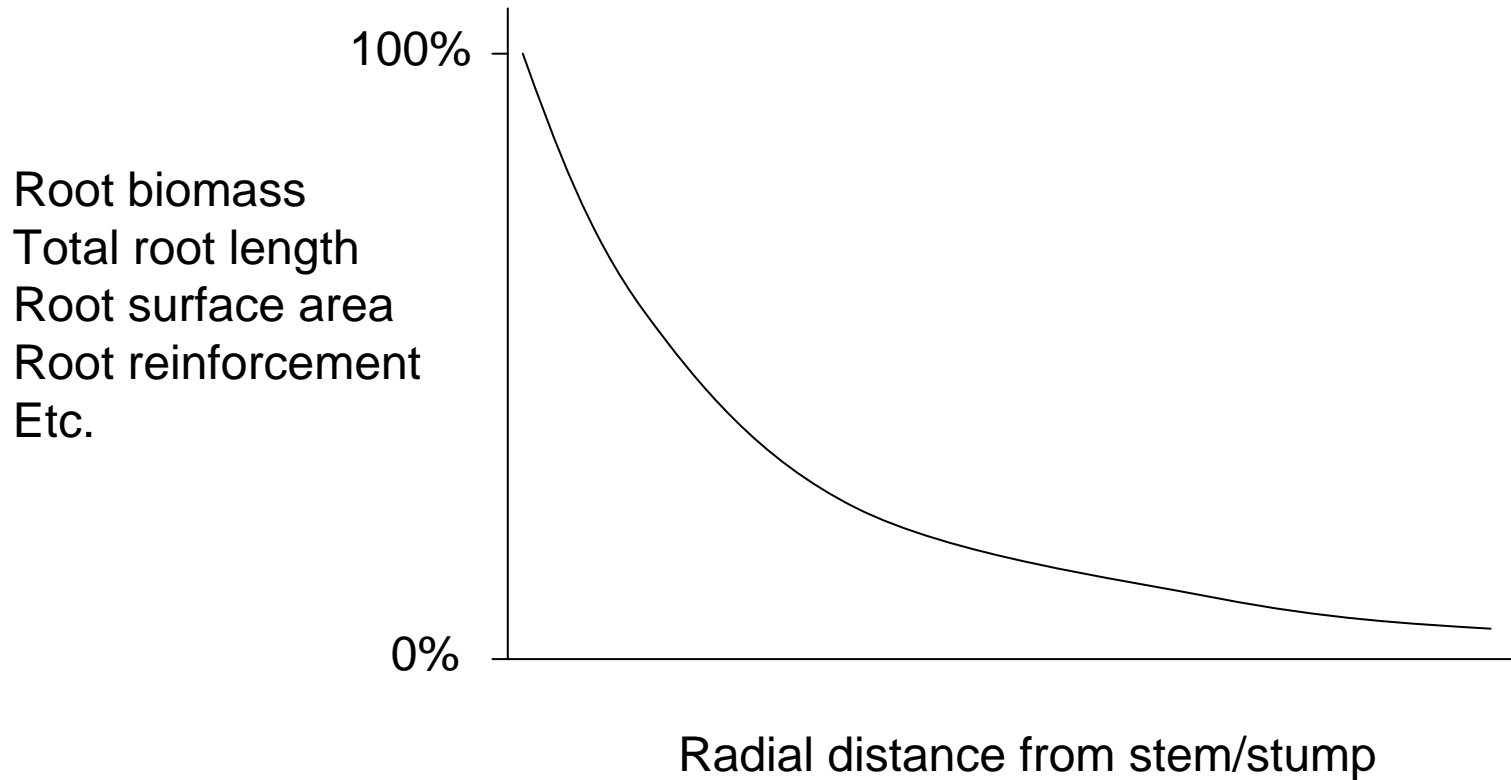
Root reinforcement index (RFI) = Root surface area
―――――――――――――――
Root spread area

Example - 5 Year old Cabbage tree
Estimating the Reinforcement Index (RFI)

Root surface Area (cm^2)

6301

3263

514

A

B

D
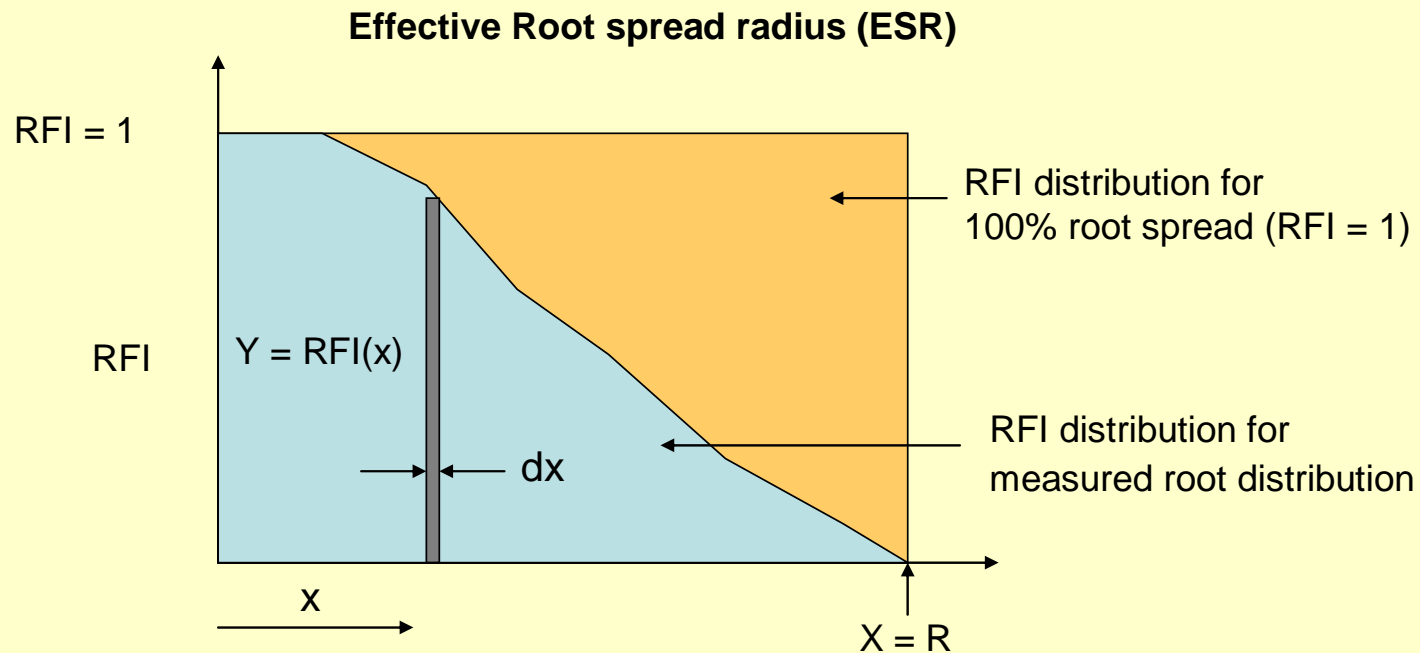
50cm   100cm   150cm

L

R1   R   R2

RSA = 2Pi*R*L
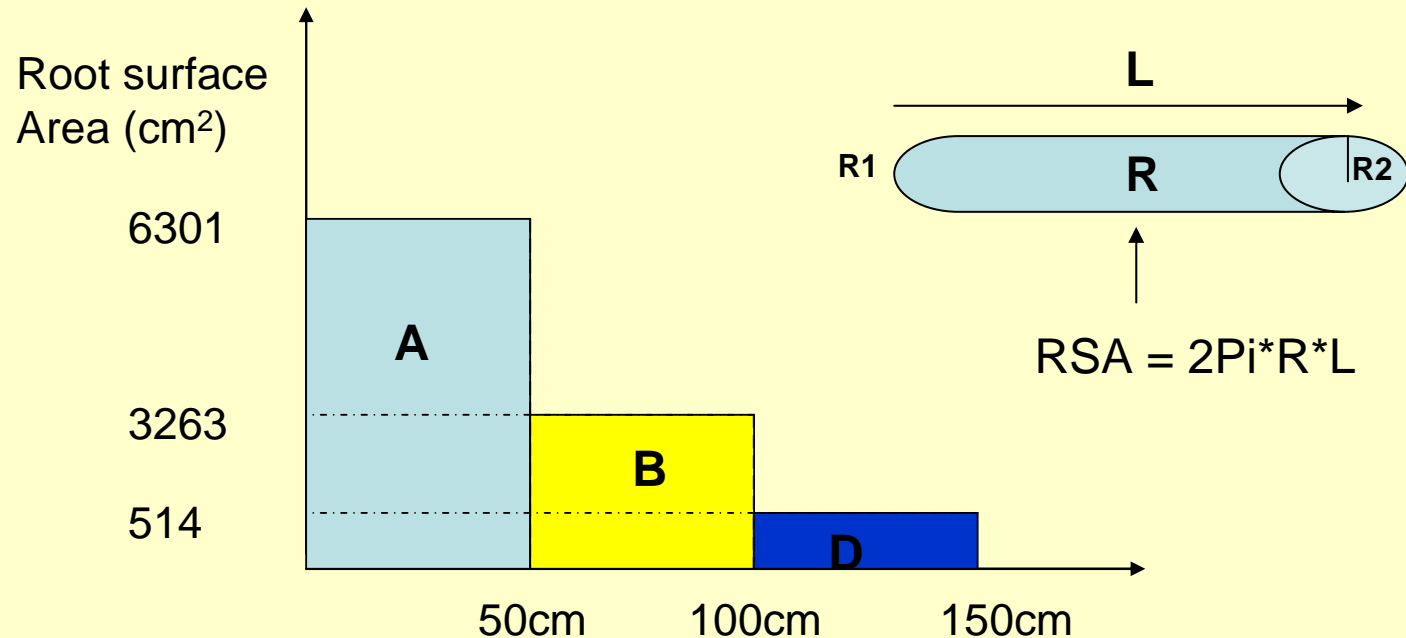
$$RFI(0-50cm) = \left(\frac{6301}{PI(50)^2} \right) = 0.8022$$

$$RFI(0-100cm) = \left(\frac{3263}{PI(100^2-50^2)} \right) = 0.1385$$

$$RFI(0-150cm) = \left(\frac{514}{PI(150^2-100^2)} \right) = 0.0131$$

RFI = 0.9538

Effective Root spread radius (ESR)

$$Effective \ \ Root \ \ Spread \ \ Radius \ \ (ESR) = \left(\frac{x\int\limits_{0}^{R} RFI(x)dx}{x\int\limits_{0}^{R} 1dx} \right) R$$

Note: For an ideal tree which has (100% root surface area / spread area, RFI = 1), ESR = R

$$(ESR)(cm) = \left[\frac{\text{Moment of RFI distribution of measured root spread on Y axis}}{\text{Moment of RFI distribution for 100\% root spread on Y axis}} \right] R$$
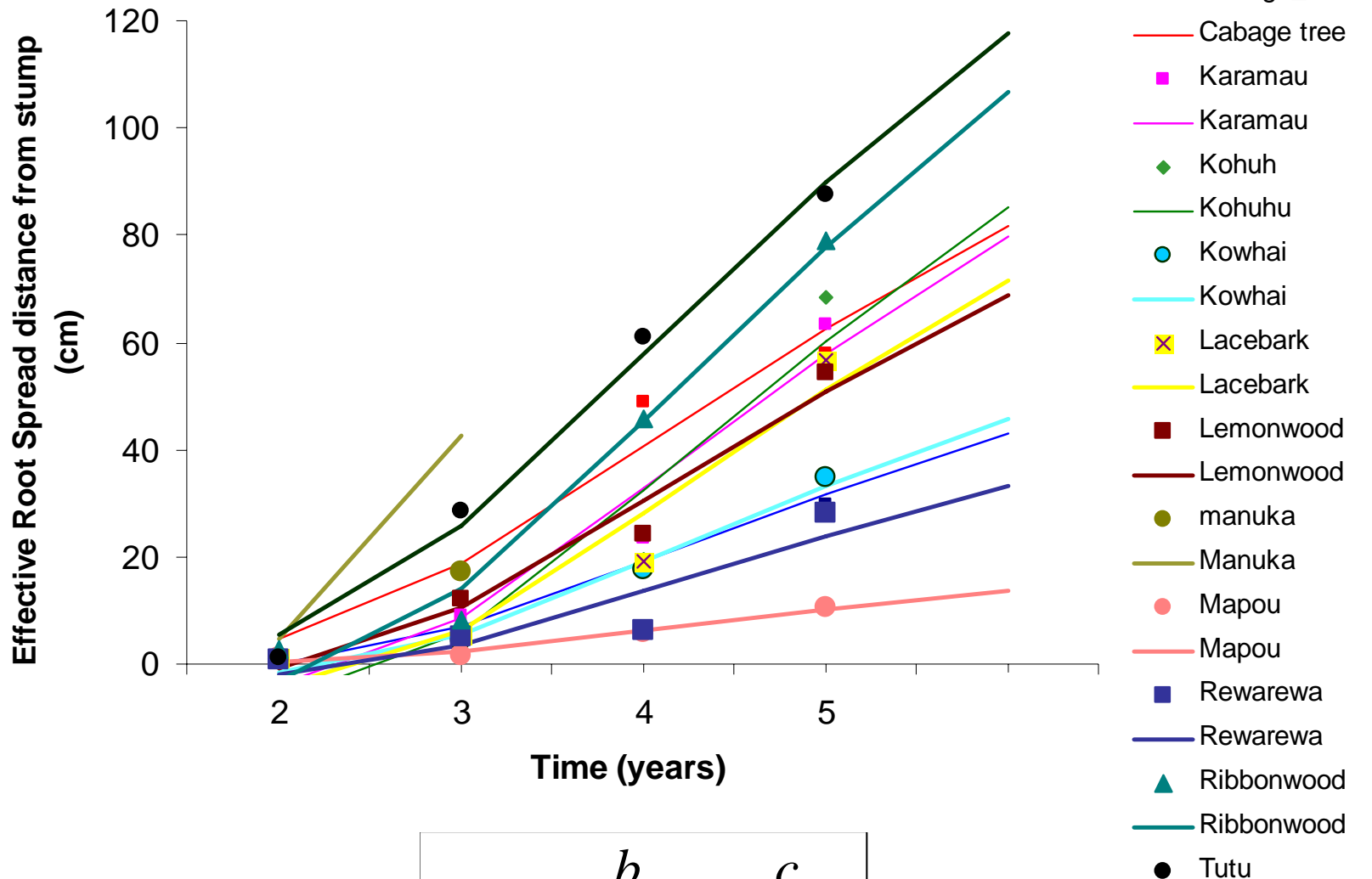
Fig-5 Estimating ESR – 5 Year Cabbage tree
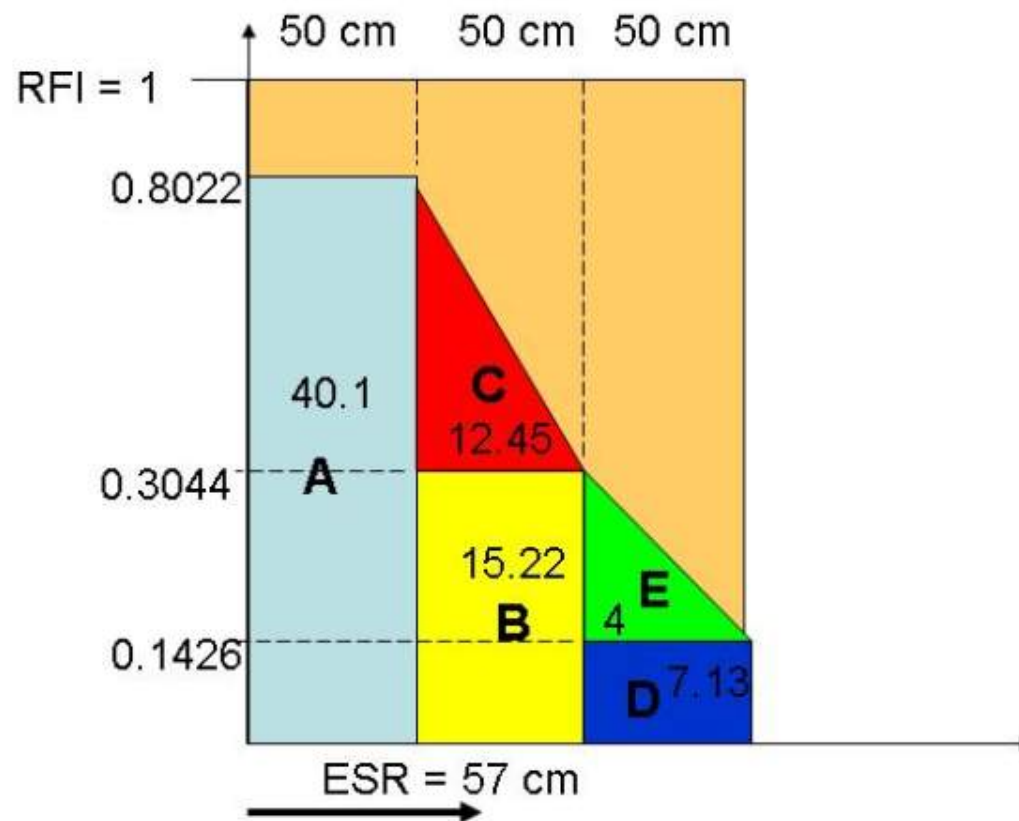
$$ESR\ (cm) = \frac{[40.1*25 + 15.22 * 75 + 12.45* 66.6 + 7.1* 125 + 4*91.6] * 150}{[150 * 75]} = 57\ cm$$

Effective root spread measured & predicted using model equation

$$y = a + \frac{b}{x^{0.5}} + \frac{c}{\exp(x)}$$

Model parameters

Parameters for Effective Root Spread Radius				
	a	b	c	r2
5-Finger	175.89	-328.5	416.75	94
Cabbage tree	311.82	-567.9	698.45	96
Karamu	347.6	-661.2	857.97	94
Kohuhu	384.5	-739.4	972.26	90
Kowhai	195.7	-370.5	477.9	98
Lacebark	318.04	-608.6	796.7	93
Lemonwood	286.1	-536.3	683.5	97
Mapou	56.52	-105.8	137.3	97
Rewarewa	145.7	-277.58	360.6	84
Ribbonwood	453.2	-855.8	1100.4	98
Tutu	452.8	-826.7	1013.59	99

Site occupancy (%) for planting density 1m x 1m
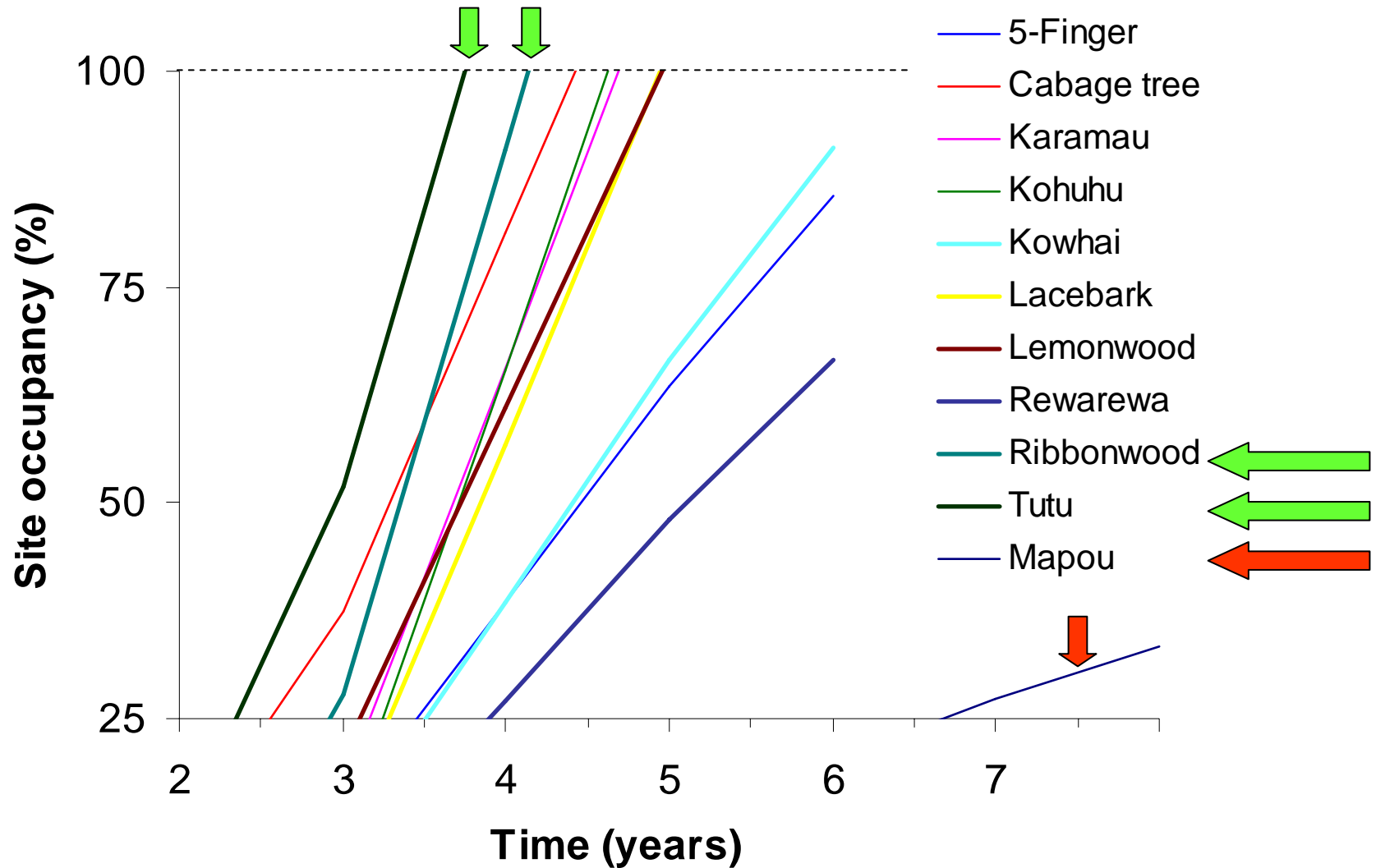
Site occupancy (%) for planting density 2m x 2m
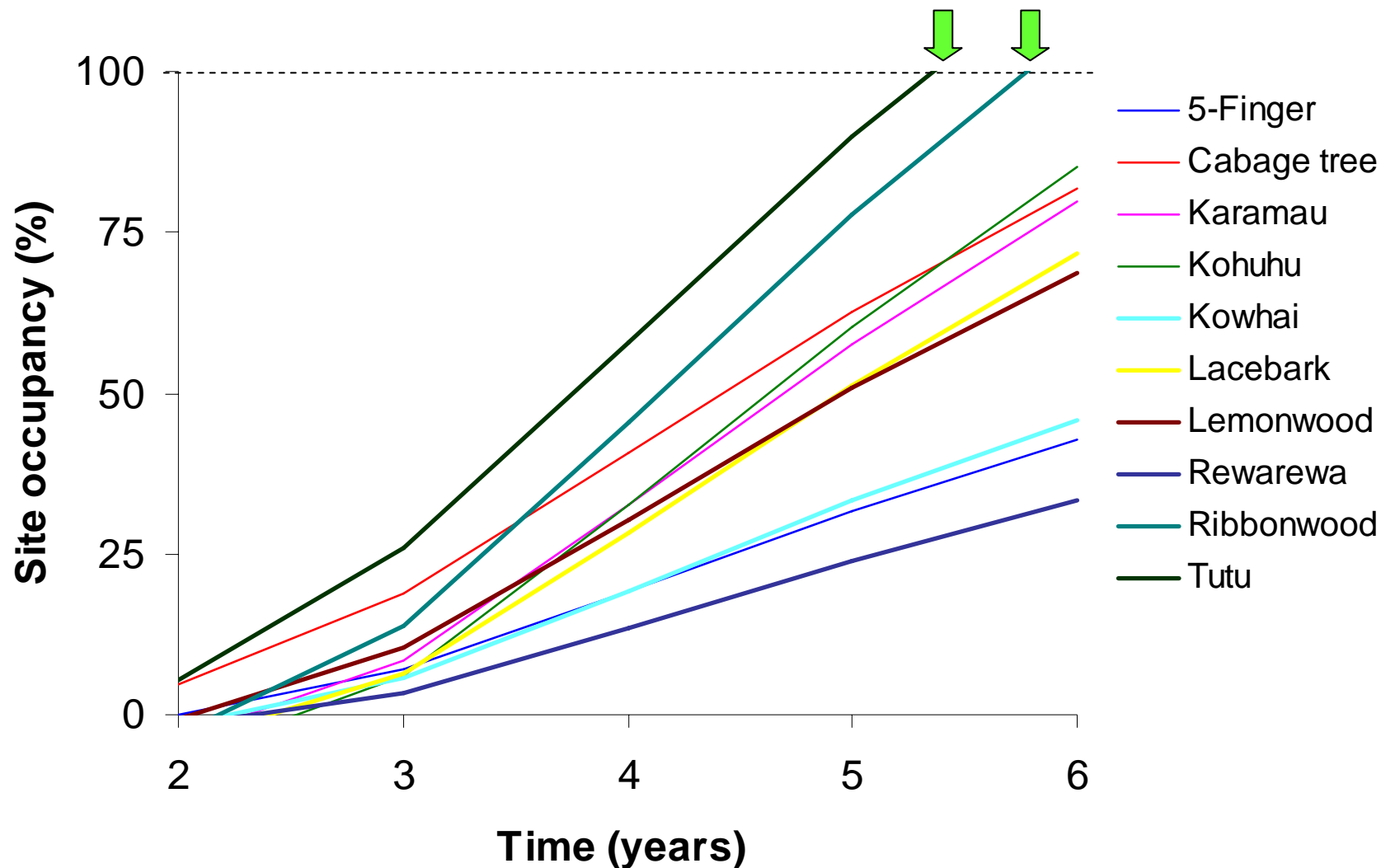
Next steps?

- Aim to develop a simple tool
- Choose a mix of species
- Optimisation for site reinforcement
- Scenario testing
- Carbon modelling
- Other parameters such as canopy spread – shade etc

Takeaways

- Not all native plants perform the same
- Root surface area reflects root-soil interaction
- Root site occupancy good measure
- Effective root spread better estimator than mean max root spread
- Develop models for use in planting plans
- Use natives for different functions?

Thanks for listening

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"The unhealthiness in our world today is in direct proportion to our inability to see it as a whole."

Peter Senge