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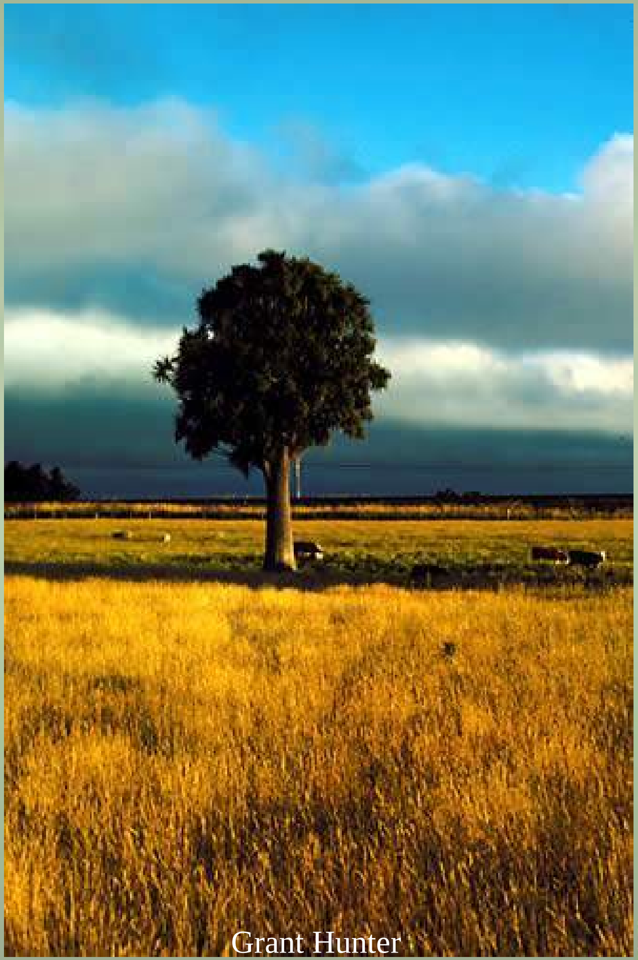
Erosion & sediment control using New Zealand native plants

Chris Phillips

Outline

- Setting the scene
- The problem
- What we've been doing
- What we know
- What does it all mean?
- Summary



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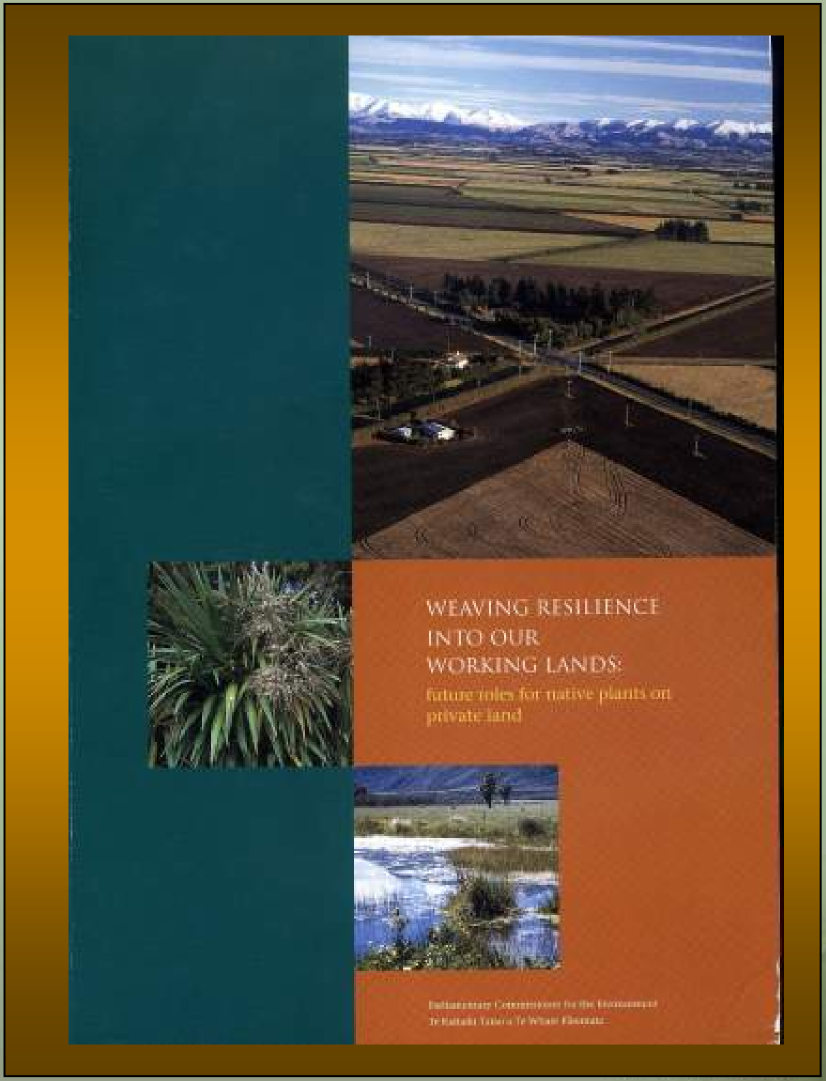
Context

- Improving biodiversity
- Carbon – natives, Kyoto
- Natives on farmland
- Greening “our” place
- Flooding risk
- Root information poor worldwide
- Willow sawfly



Willow sawfly

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The Big Question?

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

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

Why plants? - riparian functions

- Filtering of contaminants – bugs, sed., nutr.
- Bank stabilization
- Nutrient uptake by plants
- Denitrification
- Shading for temperature
- Shading for instream plant control
- Input of wood & leaf litter
- Enhancing fish habitat
- Controlling downstream flooding
- Recreation
- Aesthetics

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What do we want from our plants?

- Root depth - anchor plant
- Root spread – overlap with adjacent plants
- Strong surface root mat – hydraulic protection
- High root biomass – more the better
- Root occupancy – biggest volume
- Root strength – stronger roots more resistant to external forces

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After Good Friday flood 2005

Motupiko River near Kikiwa

Hunters Stm near Kikiwa

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What we do know about reveg.?

- Native reveg. not new – new & growing interest
- NZ R&D not kept pace with demand for knowledge
- International activity **>>>** NZ
- Emerging preference natives over exotics
- Recent focus on biodiversity not other functions
- Biod vs Landscaping vs functional bio-engineering
- Some empirical data on function – limited
- Some observations – valuable e.g. NZERN
- Information is not connected well
- Little on cost/benefit or performance

2 recent strands of work

Riparian plant trial

Common name	Botanical name
Karamu	*Coprosma robusta*
Ribbonwood	*Plagianthus regius*
Kowhai	*Sophora tetraptera*
Lemonwood	*Pittosporum eugenoides*
Kohuhu	*Pittosporum tenuifolium*
Lacebark	*Hoheria populnea*
Mapou	*Myrsine australis*
Fivefinger	*Pseudopanax arboreus*
Cabbage tree	*Cordyline australis*
Rewarewa	*Knightia excelsa*
Manuka	*Leptospermum scoparium*
Tutu	*Coriaria arborea*

Marden, Rowan, Phillips (in press)

Cabbage trees

Czernin (2002)

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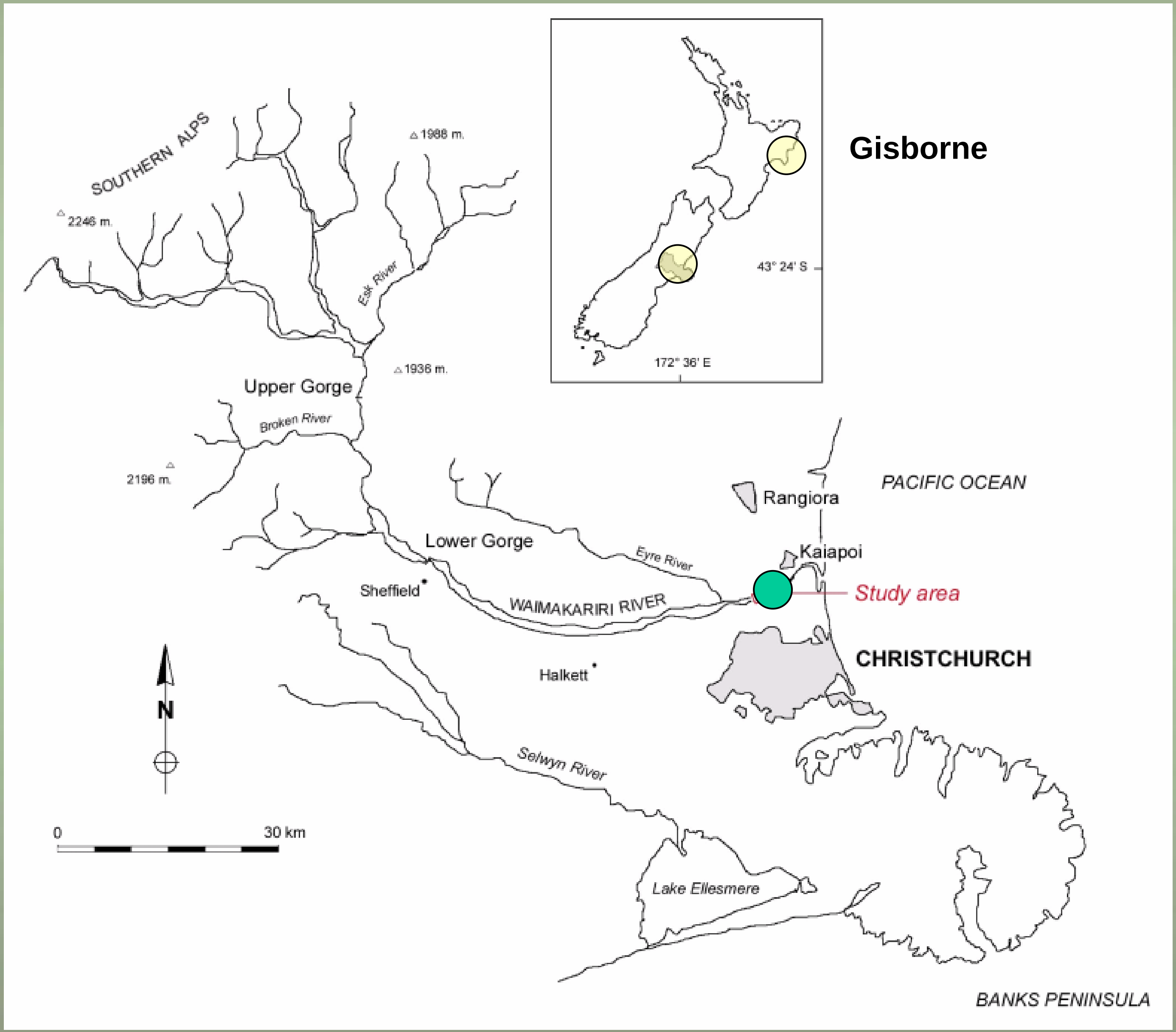
Study sites



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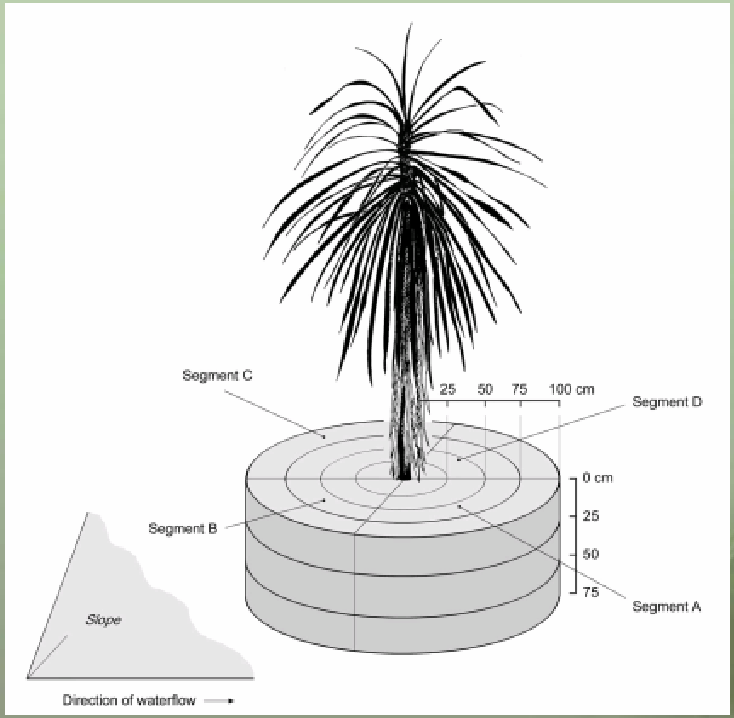
Methods - general

- Self-sown and planted
- Water or air excavation
- Morphology and biomass
- Partitioning of root system
- Root tensile strength
- Pullout tests
- Compare to willows & others



Results – above ground

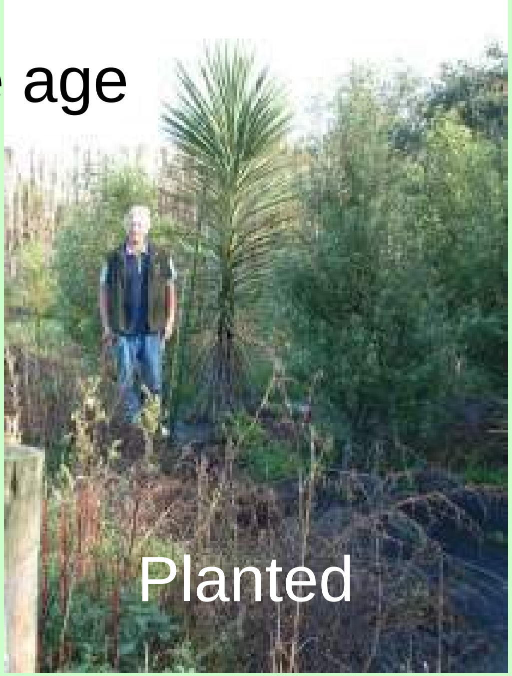
- Details not reported here
- Height 46-756 cm (big variation)
- Age 2-25 years
- <5 years most weight in foliage
- Most biomass in woody parts of older plants

25

13

Same age

Self-sown



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Root spread

Pittosporum tenuifolium (kohuhu)

Coprosma robusta (karamu)

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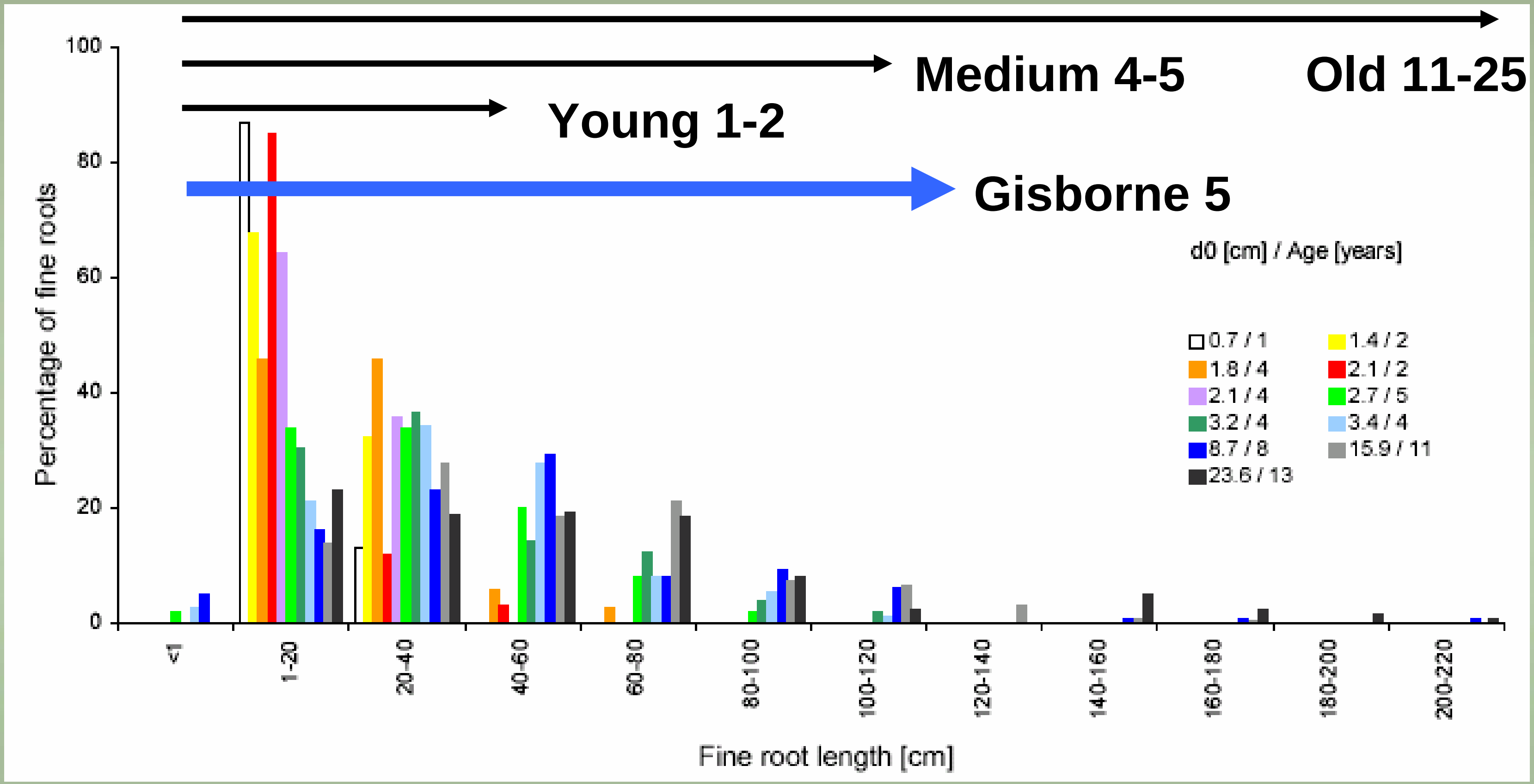
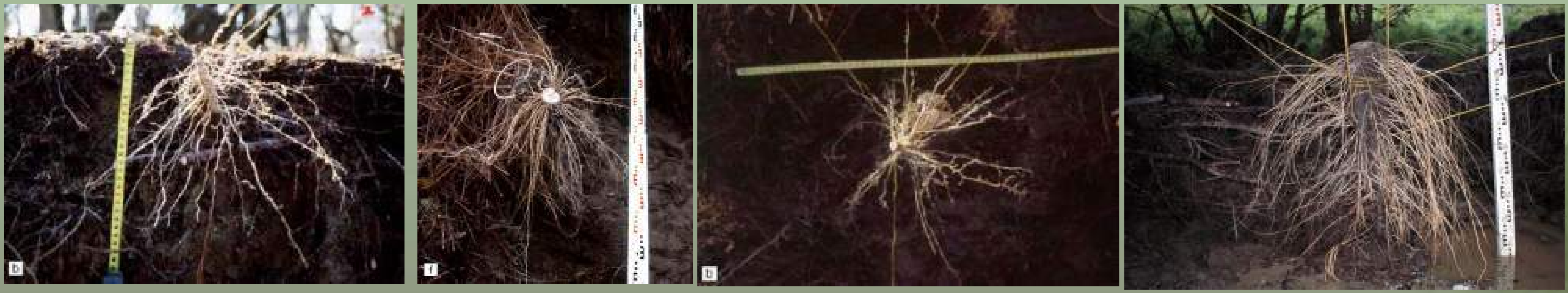
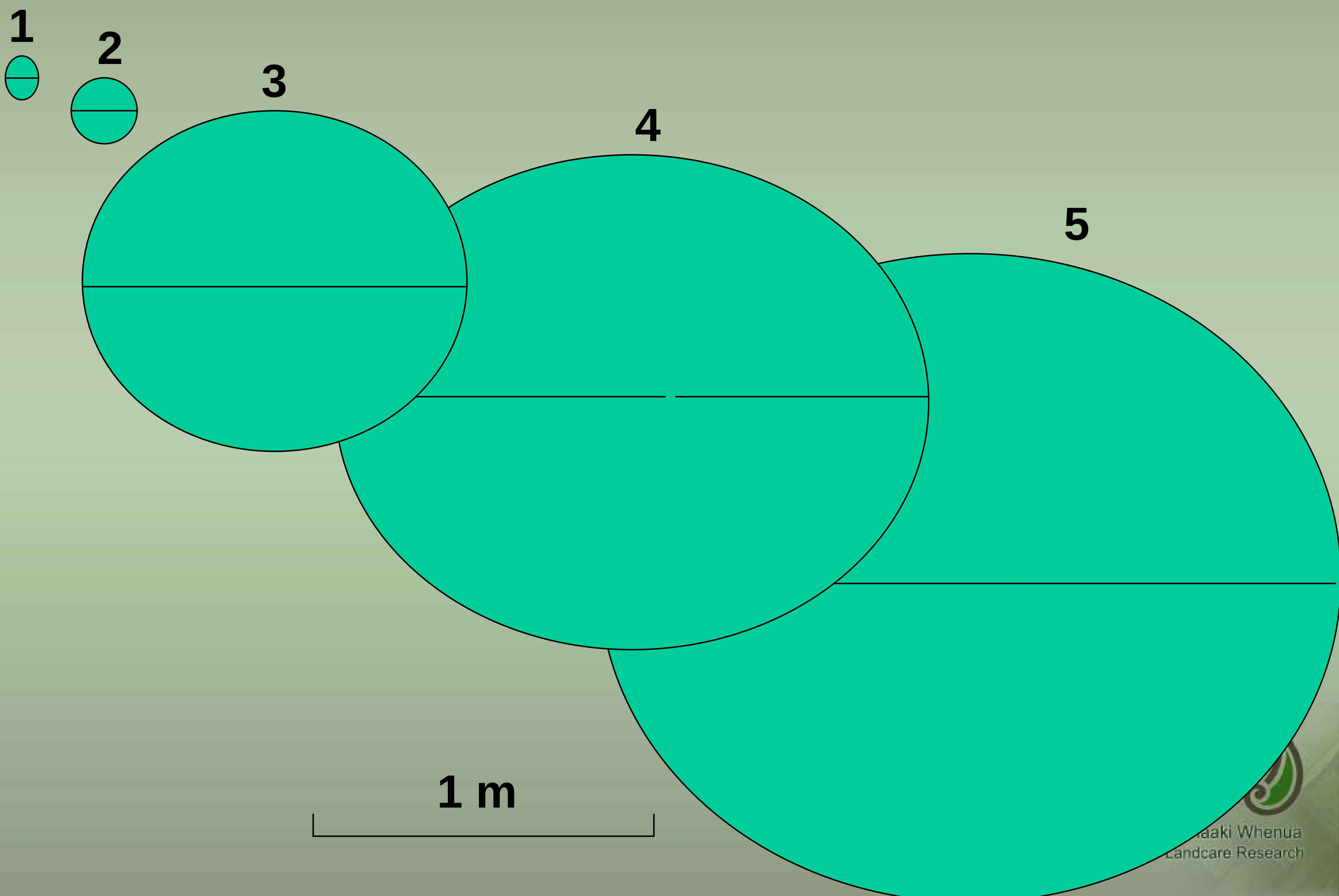
Root length

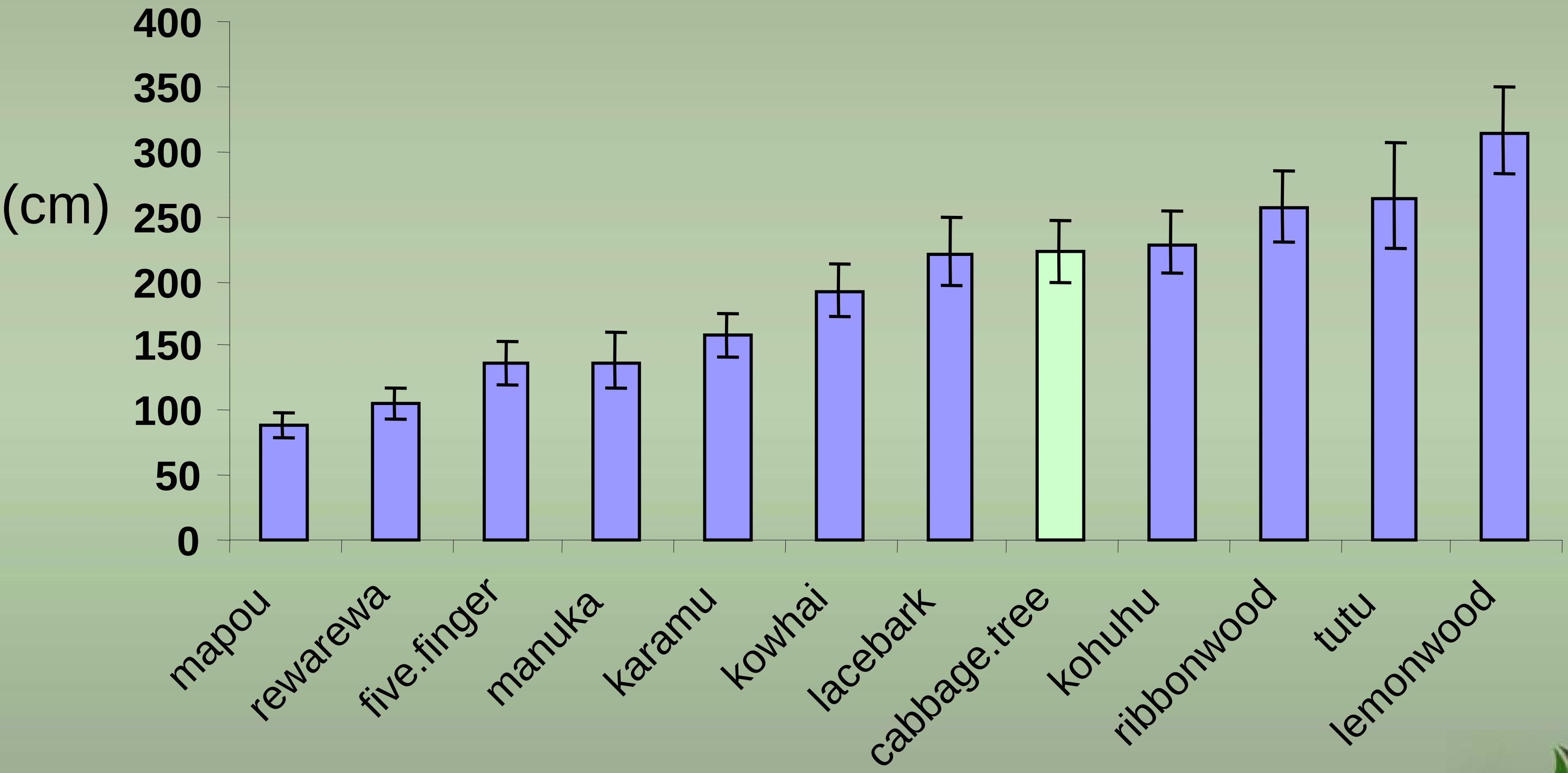

Medium 4-5
Old 11-25
Young 1-2
Gisborne 5
d0 [cm] / Age [years]
0.7 / 1
1.4 / 2
1.8 / 4
2.1 / 2
2.1 / 4
2.7 / 5
3.2 / 4
3.4 / 4
8.7 / 8
15.9 / 11
23.6 / 13
Percentage of fine roots
100
80
60
40
20
0
<1
1-20
20-40
40-60
60-80
80-100
100-120
120-140
140-160
160-180
180-200
200-220
Fine root length [cm]



Mean max root spread - Gisborne



Mean max. root spread – 5 year old



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Results - root depth

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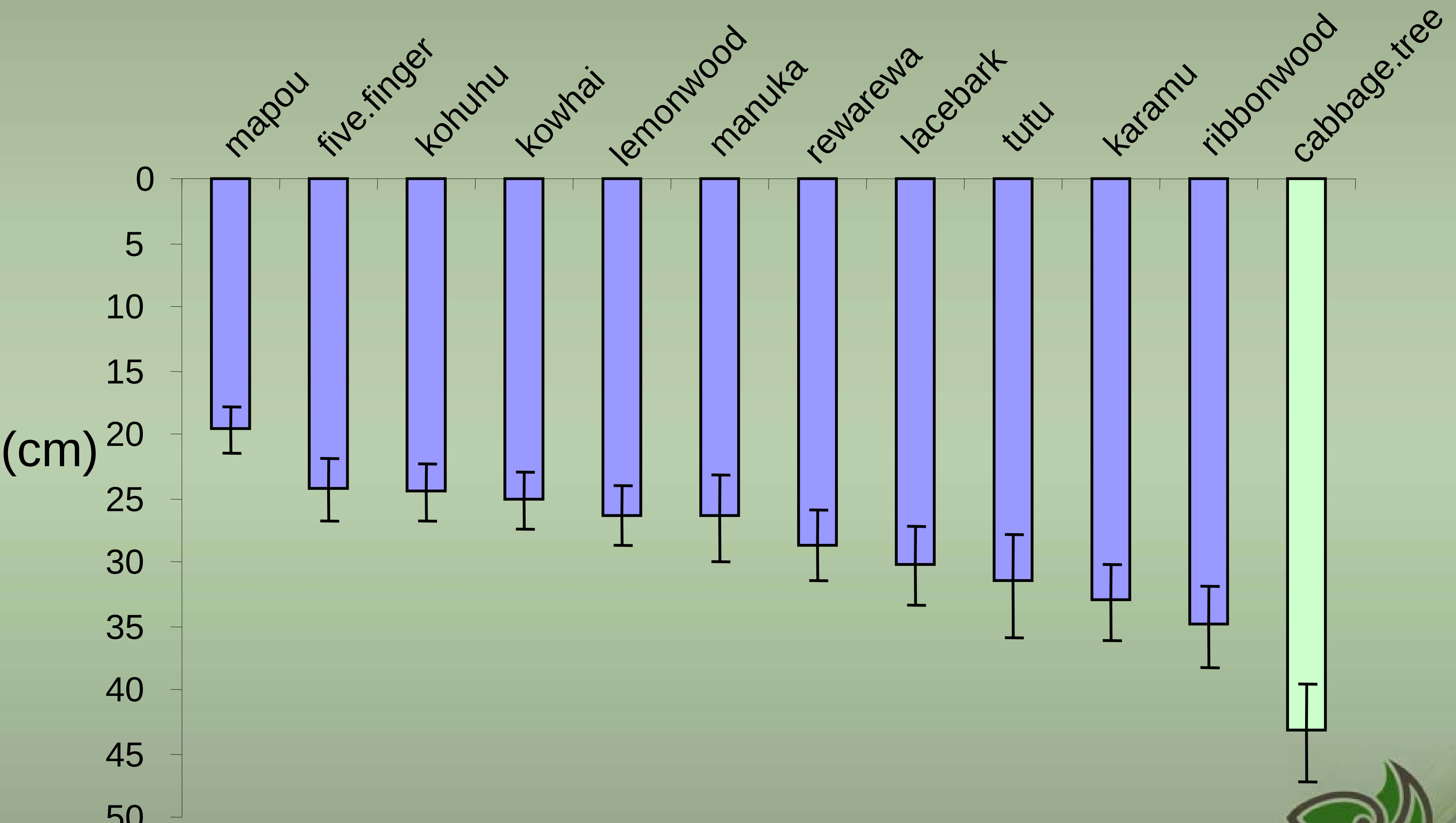
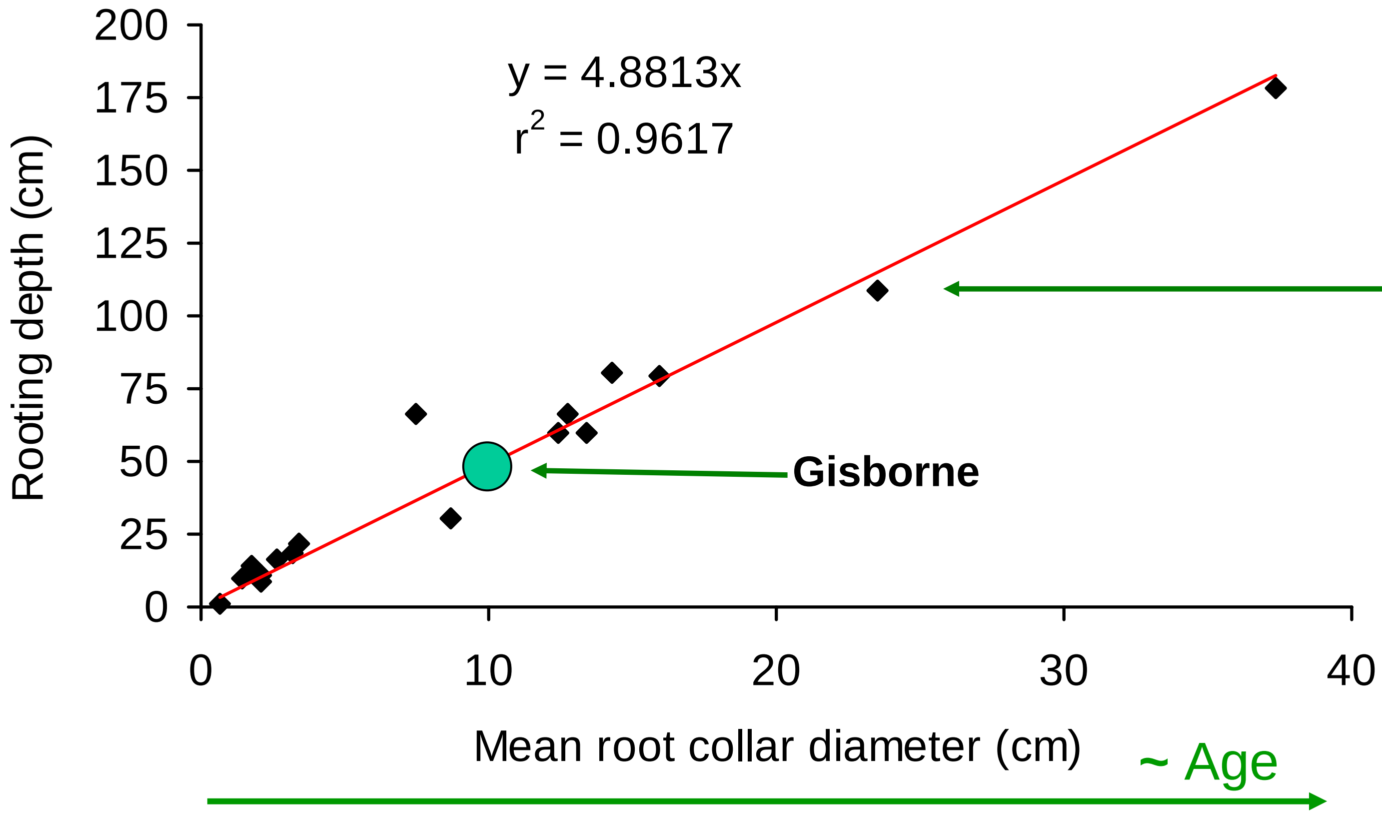
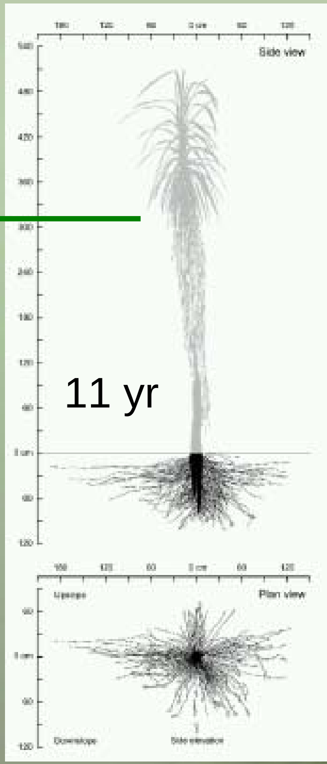
Root depth – 5 year old

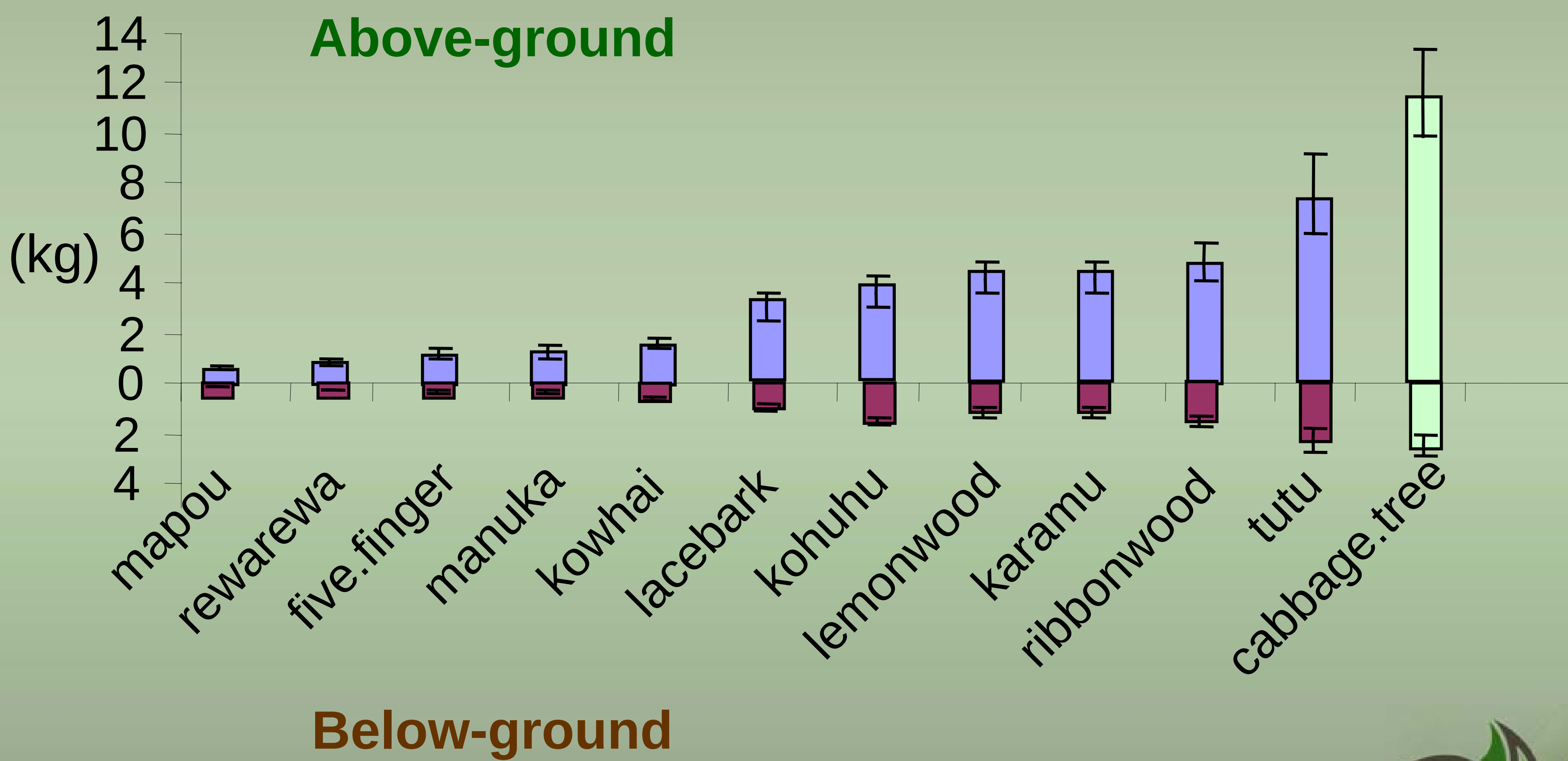


Root depth – cabbage tree





Biomass – 5 year old



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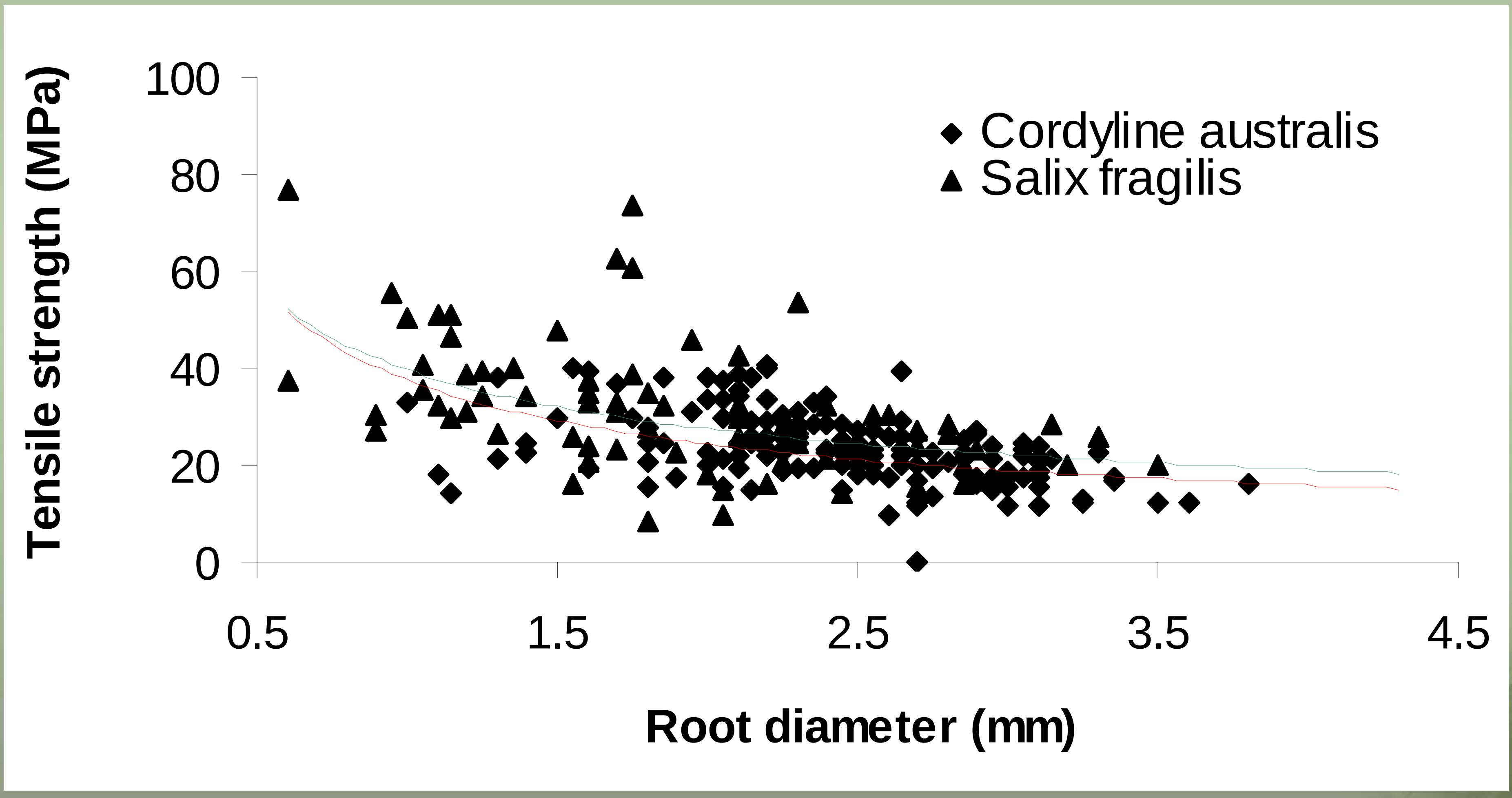
What about willows?

- Ubiquitous in the landscape
- Love ‘em or hate ‘em
- Problem or protector – weed or wonder
- How do we move from willows to something else?
- Should we change & why?

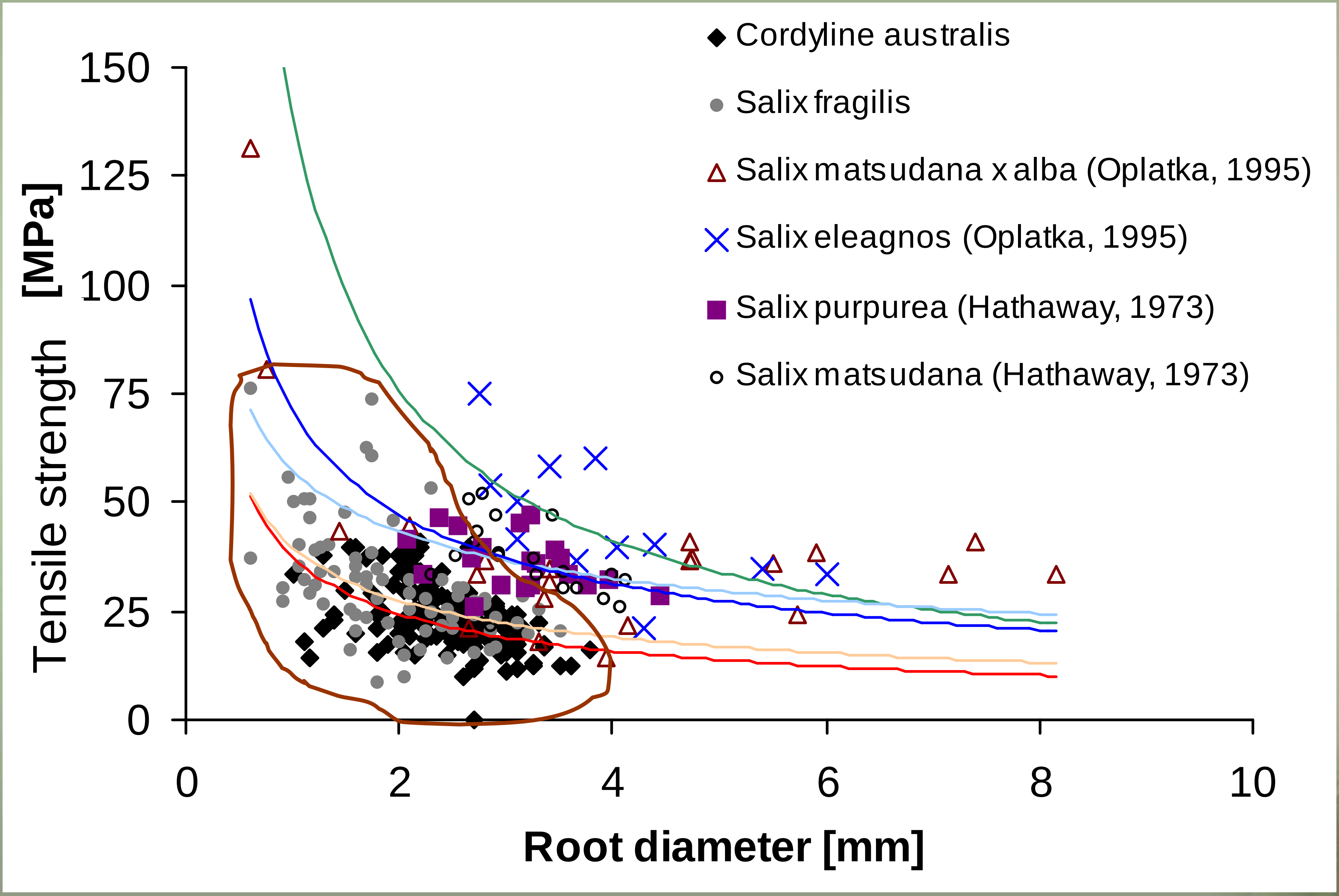
Let’s discuss more later……..

Tensile strength

Willow & cabage tree



Tensile strength – other willows

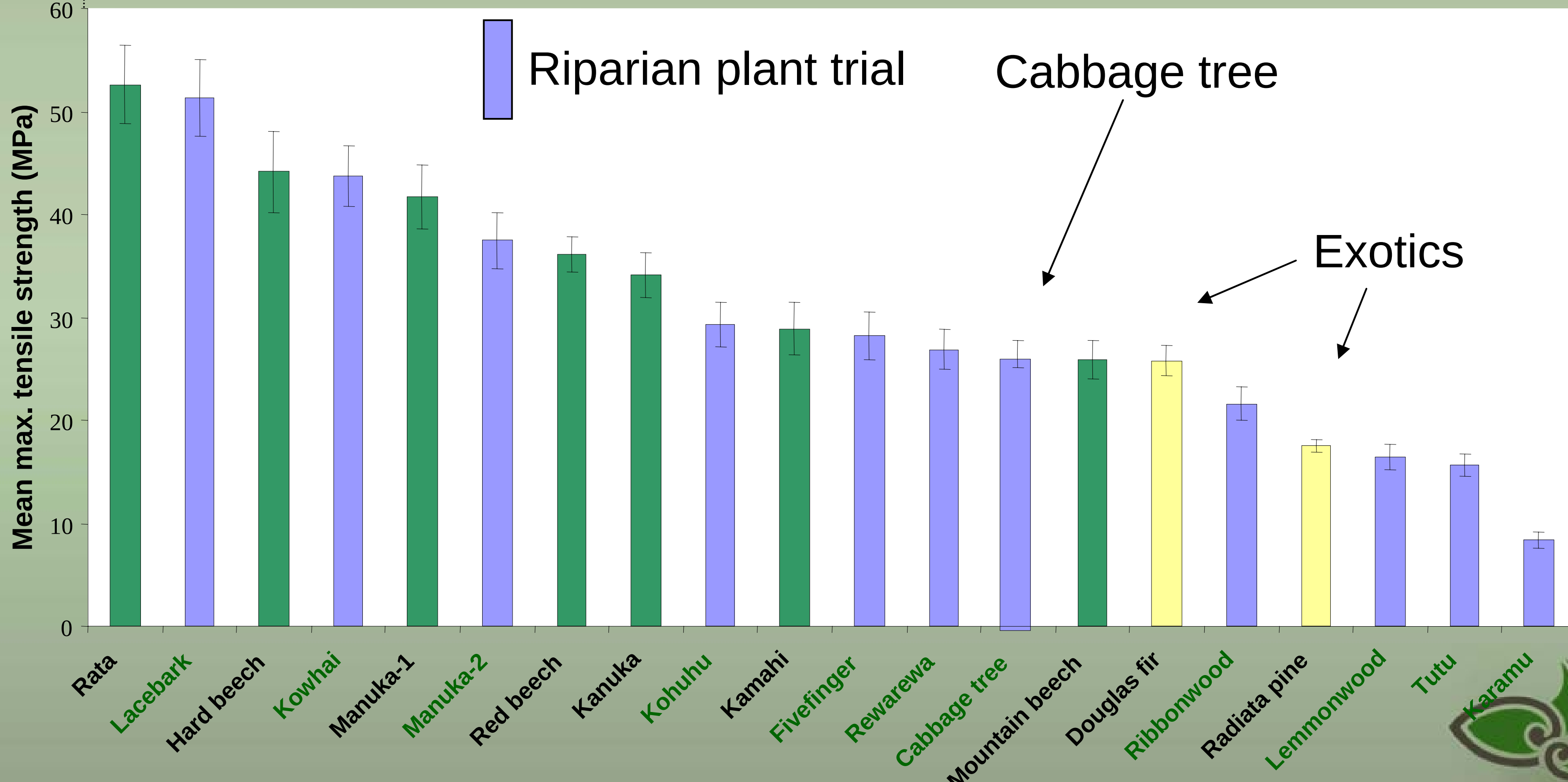


Root tensile strength – natives & others

(1 - 4 mm diameter)

Watson & Marden (2005)

Willows 30 - 125 MPa



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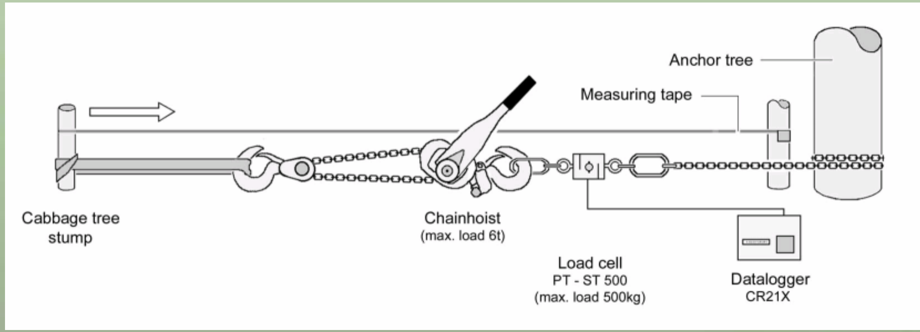
Pullout resistance



- Rhizome broke
- No second peak
- Most fine roots pulled out
- Only near surface fine roots broke in tension

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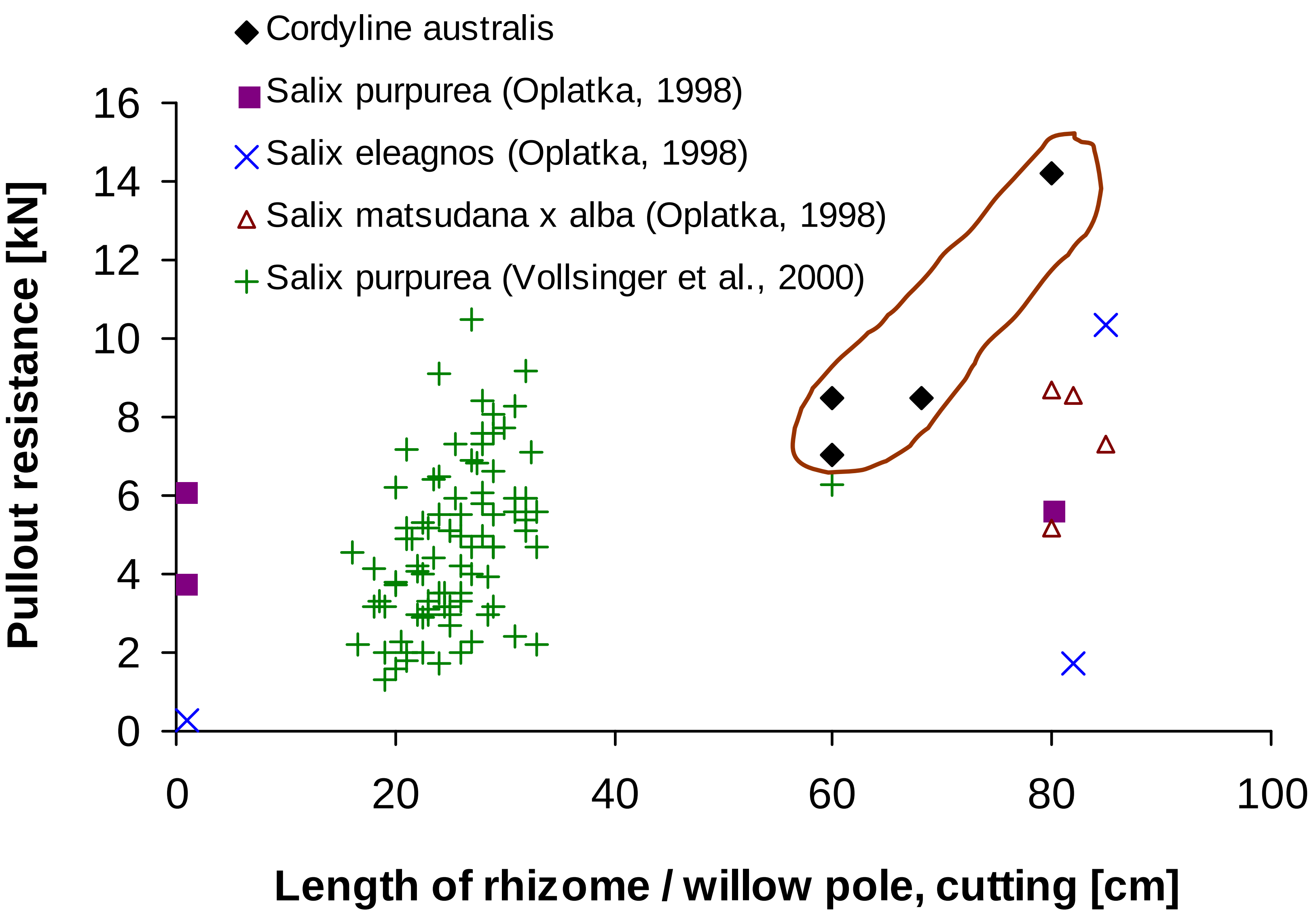
Pullout resistance



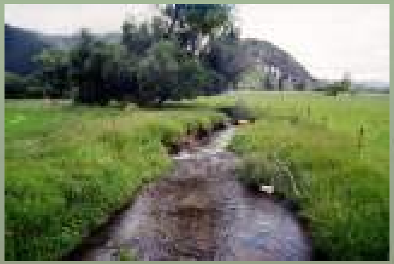
Decisions?

Ecologically designed vs functional performance?

- Depth – cabbage tree, ribbonwood
- Spread – lemonwood, ribbonwood
- Above gd biomass – cabbage tree, tutu
- Below gd biomass – cabbage tree, tutu
- Tree height – lacebark, ribbonwood, cab. tree
- Canopy spread – tutu, karamu
- Root strength – lacebark, kanuka, kohuhu

Implications for bank stabilization - small streams

- no limitations, provided that bank height is not more than ~2 m and channel bed is stable
- success depends on density - formation of dense canopy & full root occupancy of the soil
- shallow soil stabilisation after 3-5 years
- improvement in deeper slope stabilisation expected within 7-10 years of establishment
- species can withstand breakage and over-topple



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Implications for bank stabilization - large streams

- lack of roots in deeper soil layers limits usefulness in streams where bank undercutting occurs
- ineffective if bank height exceeds effective rooting depth ~ 2 m.
- banks would need to be graded and unstable channel beds artificially regraded prior to planting

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Future – needs mostly applied science!

- Faster growing – seed/cutting/???
- The answer lies in the soil ‘me lad’
- Roots & soil strength – how does it work
- Delivery applications
- Performance – functional and C/B
- Performance – natives vs exotics
- Performance – weeds and maintenance
- Performance – plants and “hard controls”
- Info & Knowledge connecting & marketing

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Summary

- NZ natives take longer to grow than exotics – but not slow
- Some natives can regenerate, eg cabbage trees - good
- On own, natives not as good as willows for stabilising soils
- Effective after about 5 years
- Change the ecological mix to suit site
- Mixed plantings of natives and exotics?
- More work needed
  - non-woody spp
  - Mixed exotic/native
  - Modelling
  - Willows & natives

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The end- yay!

INTEGRATED CATCHMENT MANAGEMENT
for the Motueka River

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

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