



Centre for Sustainable Forest Management

National assessment of site quality: does species choice matter?

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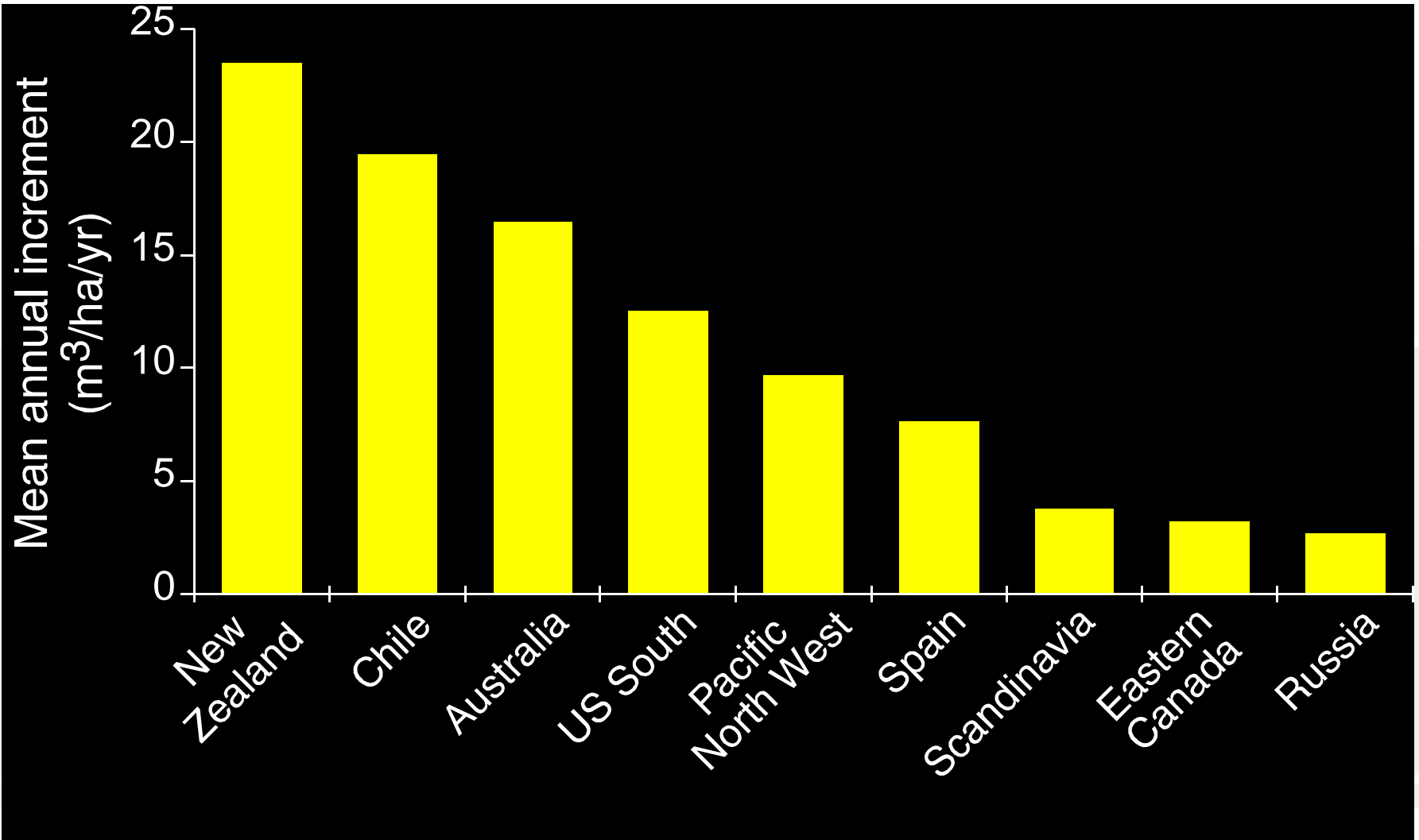
Outline

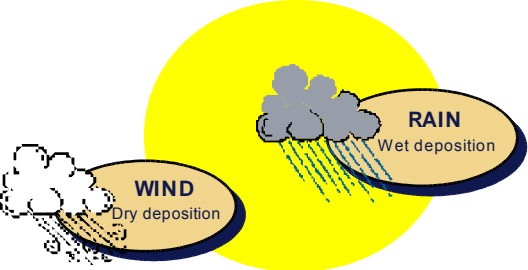
- **Introduction to New Zealand forestry**
- **Objectives**
- **National assessment of site quality for two species**
- **Other factors to consider**
- **Conclusions**
- **Future**

Forestry is important to the New Zealand economy

- 1.8 million ha of plantations
- 90% of plantations are *Pinus radiata*
- Wood products worth \$B3.5/yr in export earnings
- Industry has the potential to become New Zealand's biggest export earner within next 5-10yrs

International softwood growth rates





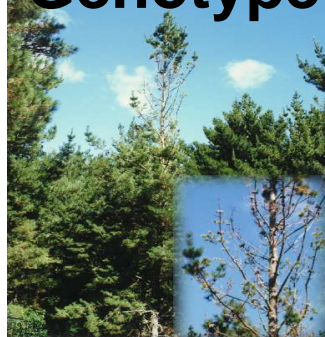
Productivity of New Zealand Forests
= f (site quality (soil, climate) +
management (genotype, stocking, weeds,
fertiliser, harvesting, site preparation))

Site Quality

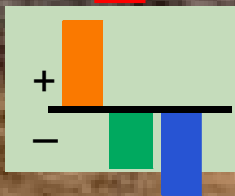
**Species/
Genotype**

Productivity

Management



**Change in soil
properties (site
quality?)**

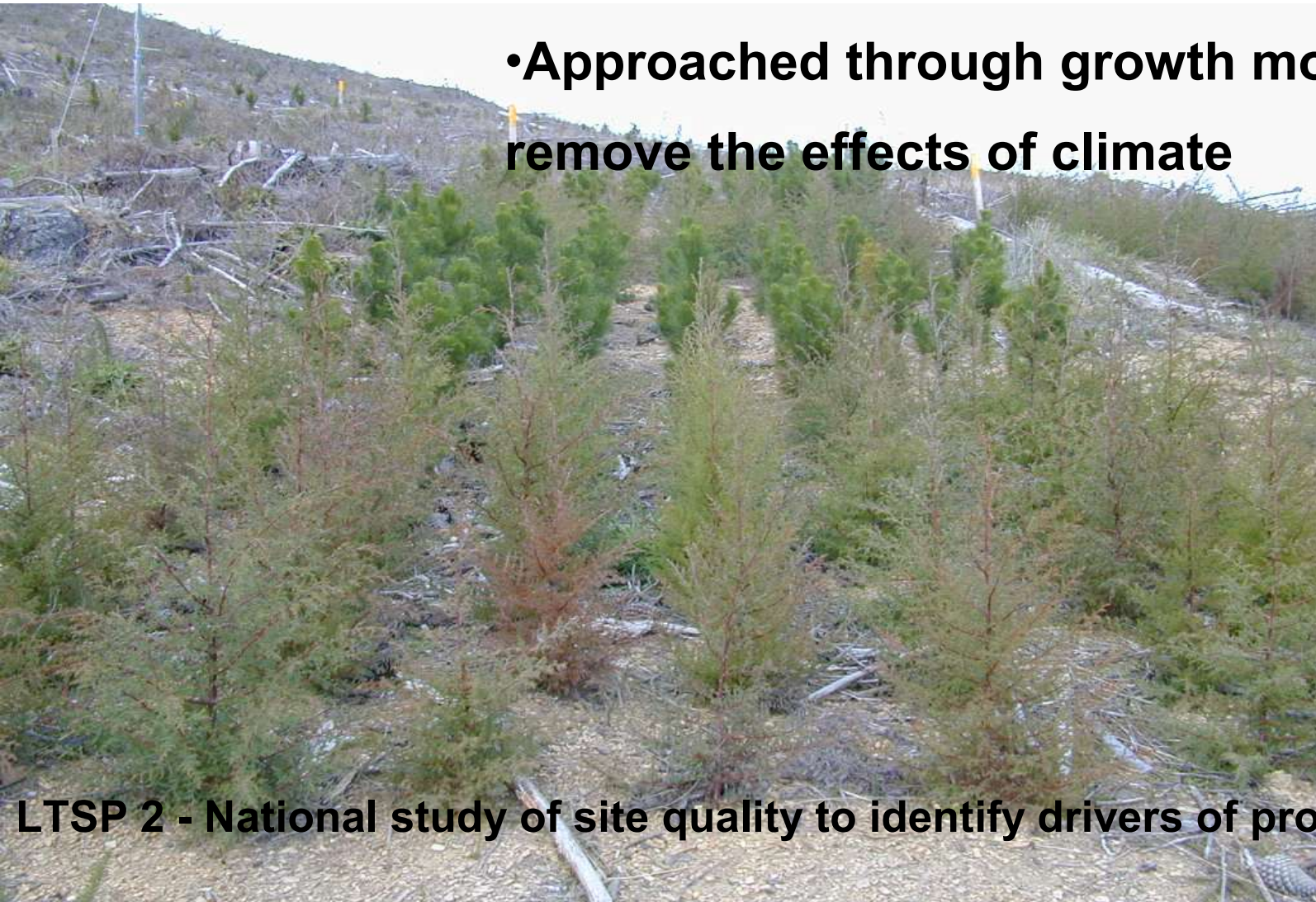


What do we know about sites and species productivity in New Zealand?

- **Productivity of species differs strongly across environments**
- **Species productivity differs across soil types**
- **But our knowledge of species productivity by site interaction is limited.**
- **Consequently, species choice may affect our perception of site quality.**

Objective

- Address question “does species choice affect our perception of site quality”?
- Approached through growth modeling to remove the effects of climate



LTSP 2 - National study of site quality to identify drivers of productivity

Species choice

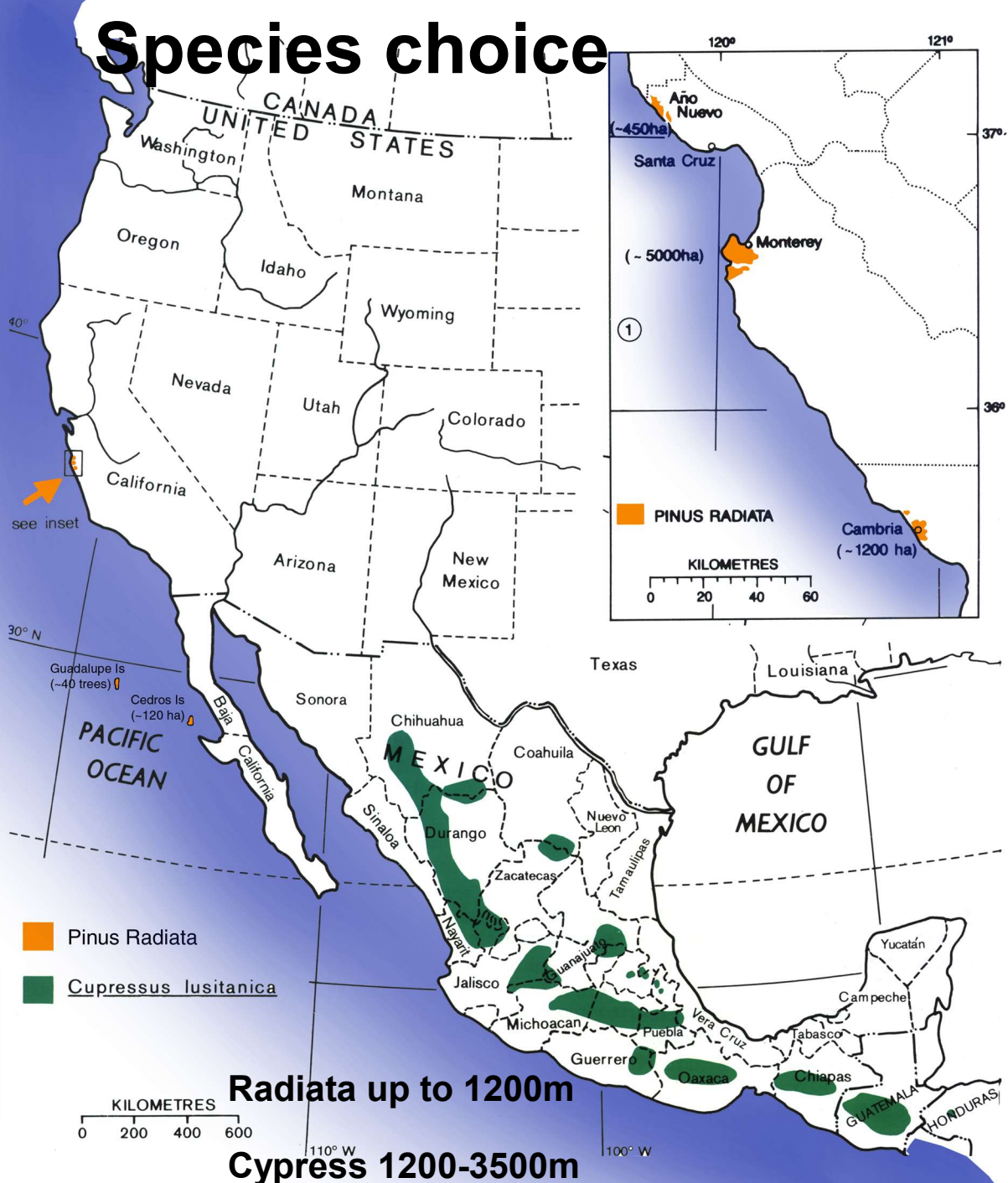
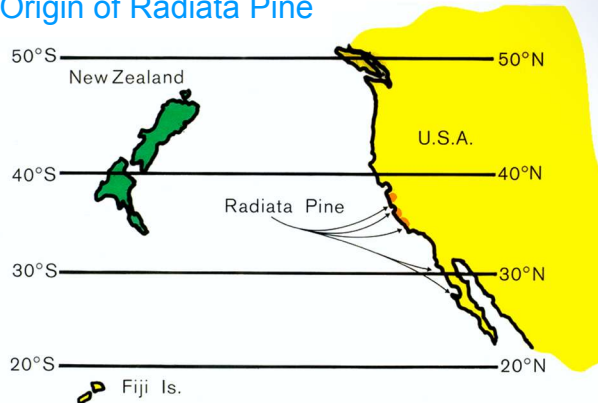


Pinus radiata



Cupressus lusitanica

Origin of Radiata Pine



Diversity of Soils under New Zealand Forests

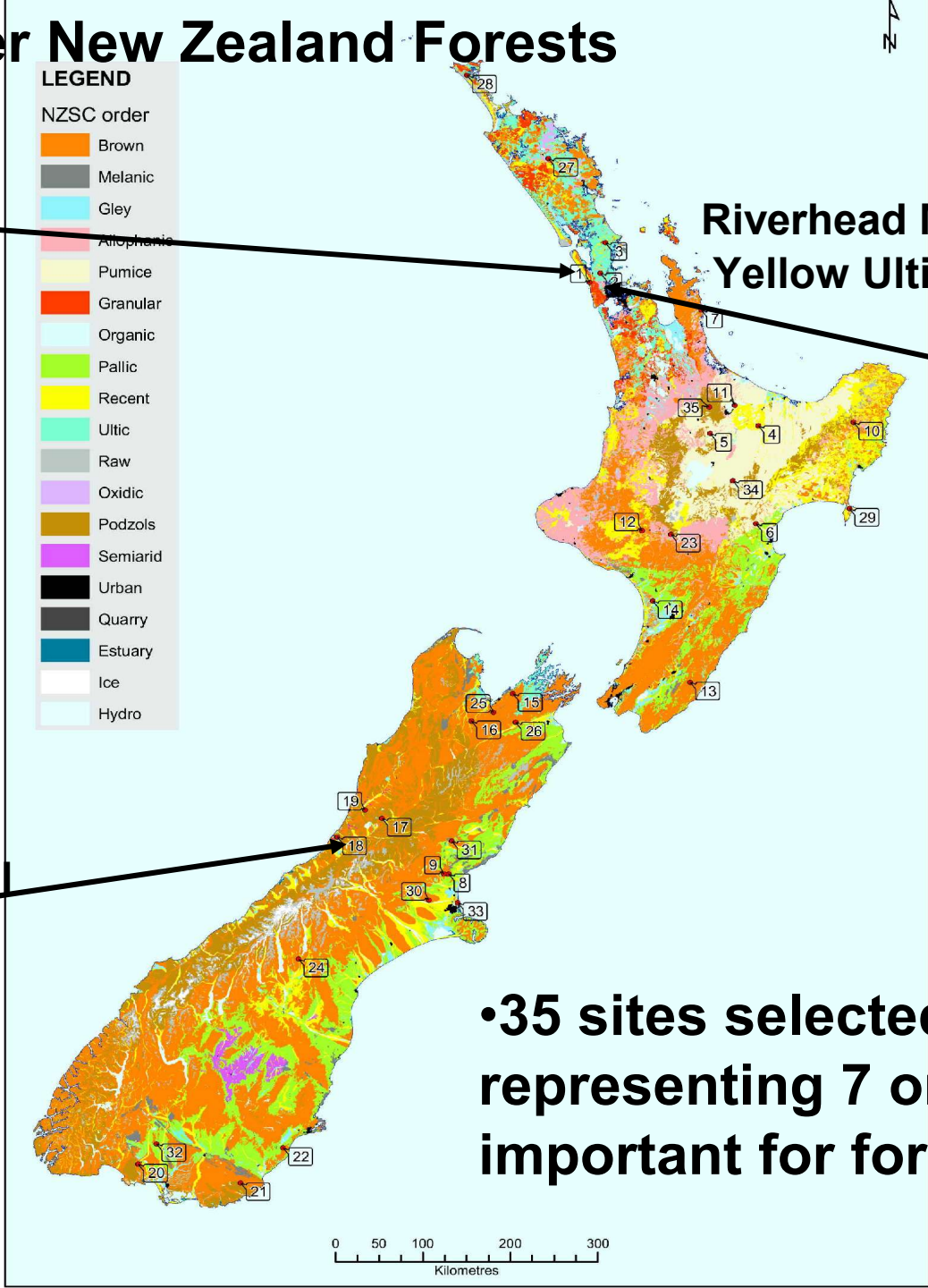
Woodhill Typic Sandy Recent



Hochstetter Perch-gley Podzol



- LEGEND**
- NZSC order
- Brown
 - Melanic
 - Gley
 - Allophanis
 - Pumice
 - Granular
 - Organic
 - Pallic
 - Recent
 - Ultic
 - Raw
 - Oxidic
 - Podzols
 - Semiarid
 - Urban
 - Quarry
 - Estuary
 - Ice
 - Hydro

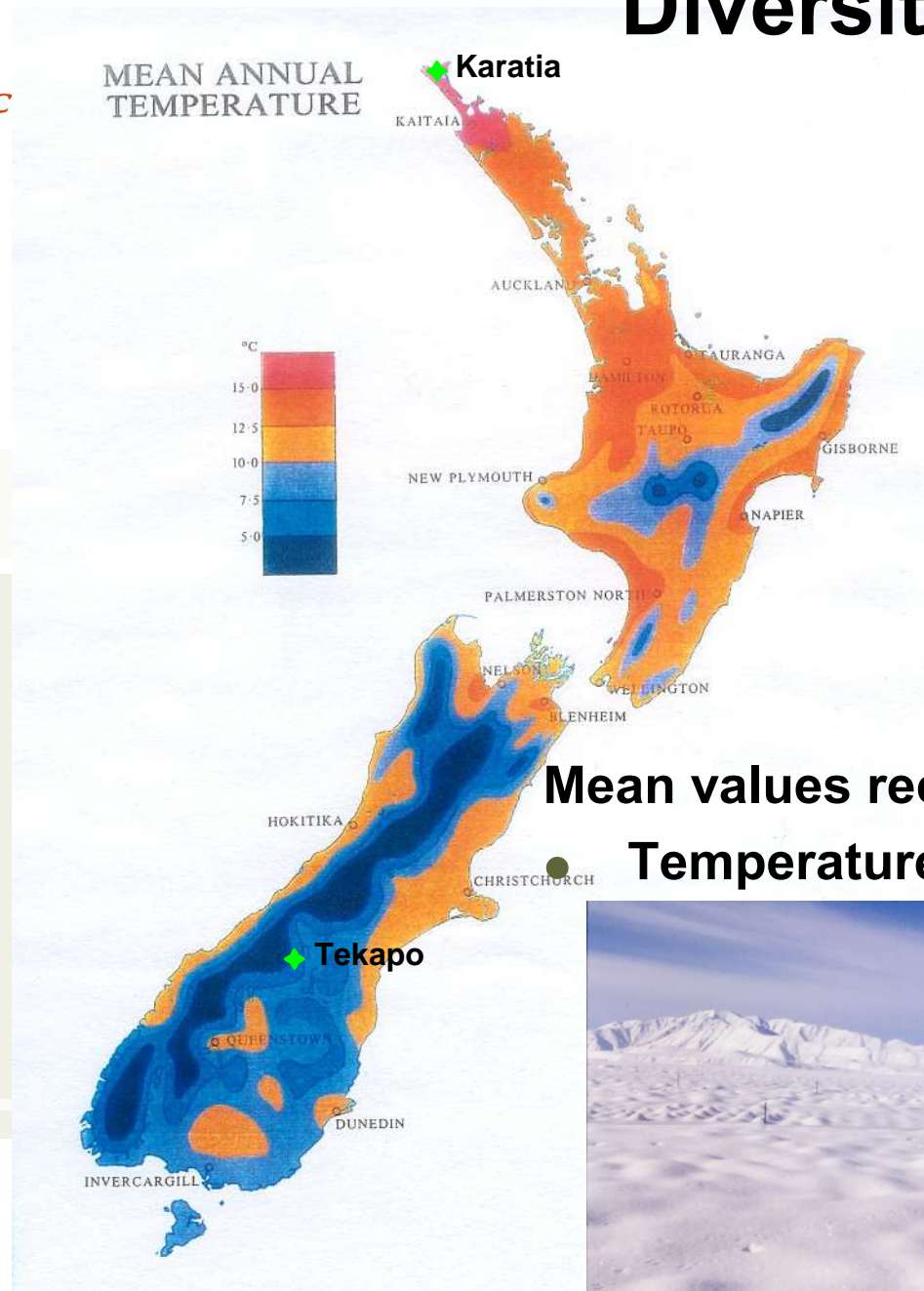


Riverhead Mottled Yellow Ultic



•35 sites selected
representing 7 orders
important for forestry

Diversity of climate

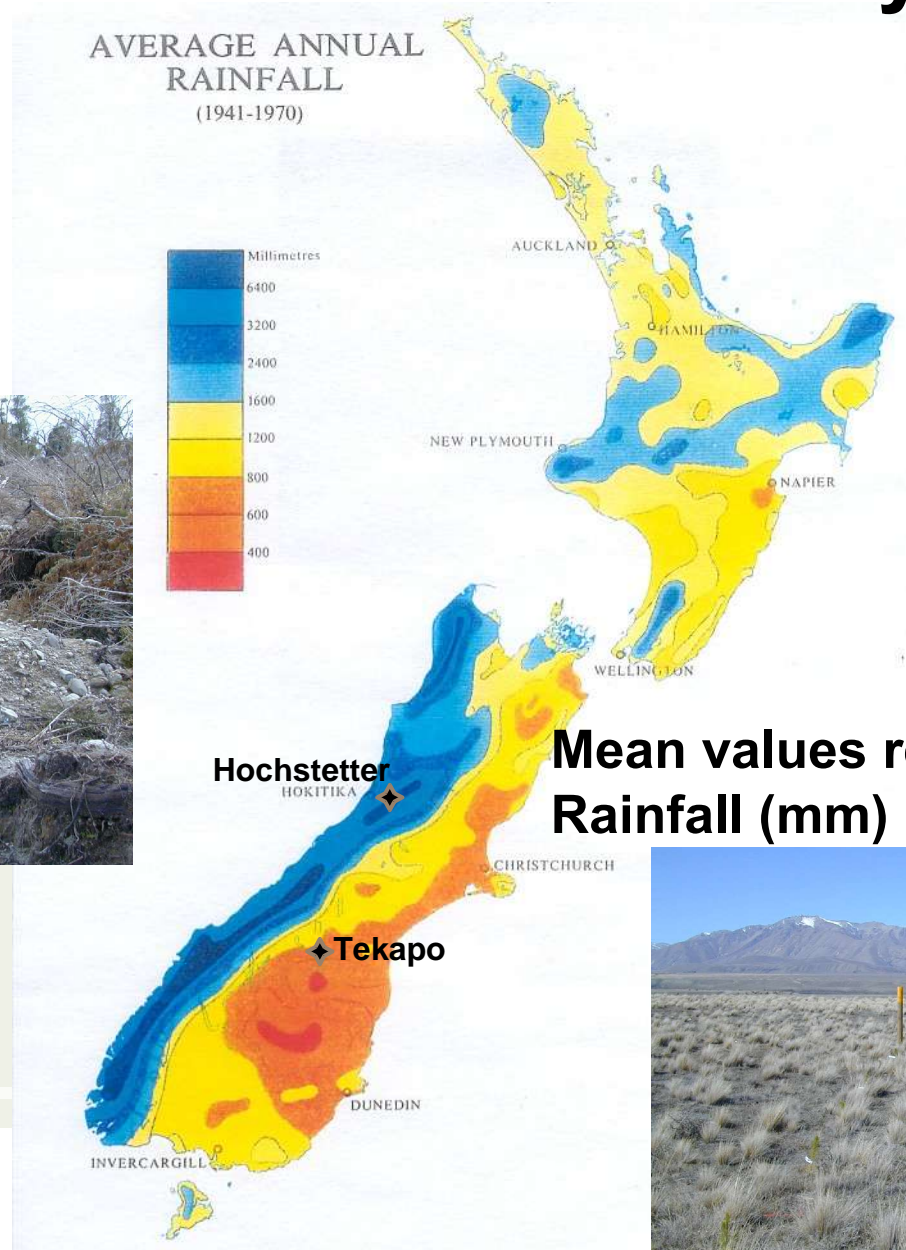


Mean values recorded for 35 sites

● Temperature (C°) 11.5 (8.8-15.5)



Diversity of climate



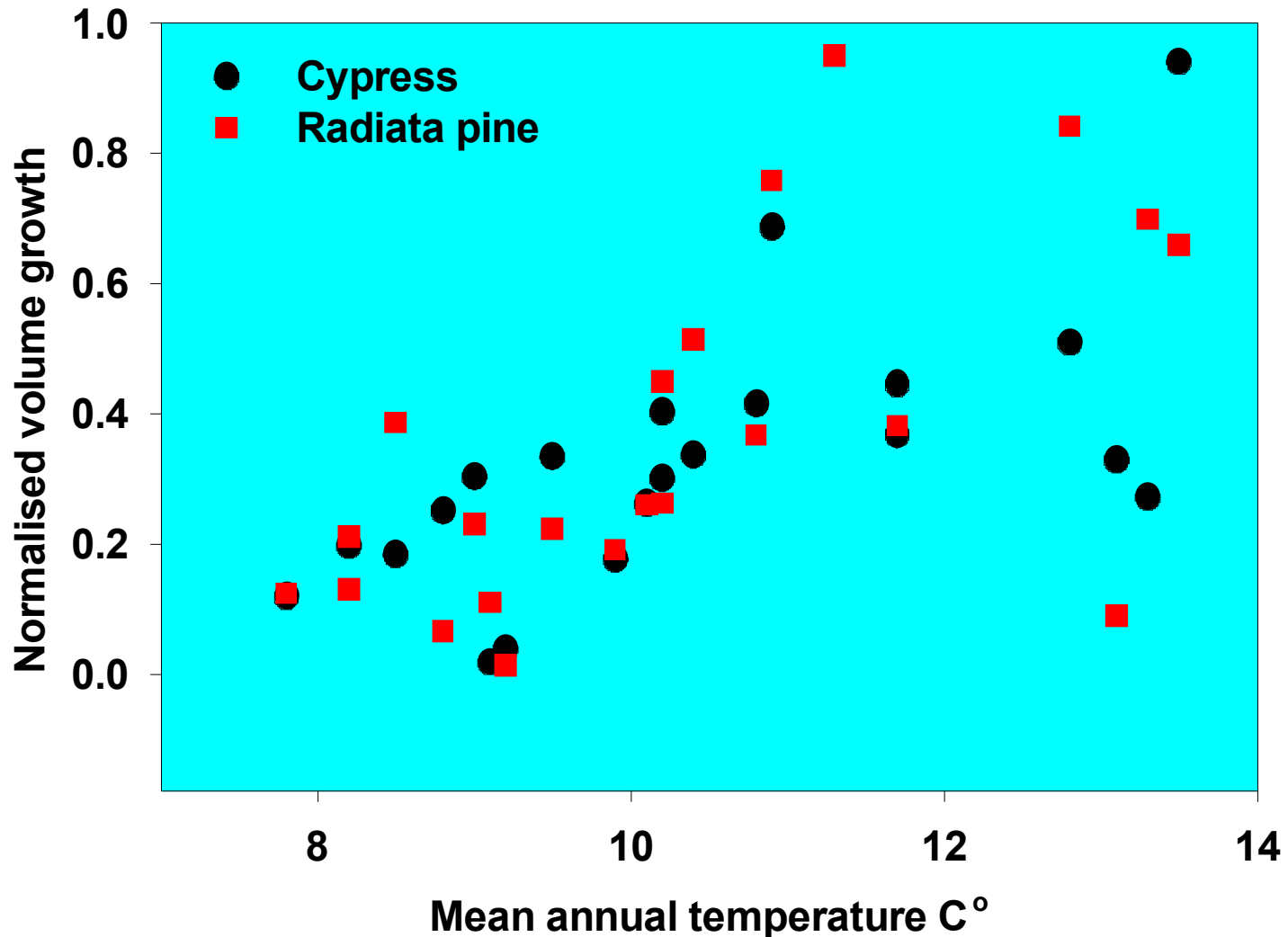
Site quality plot - layout



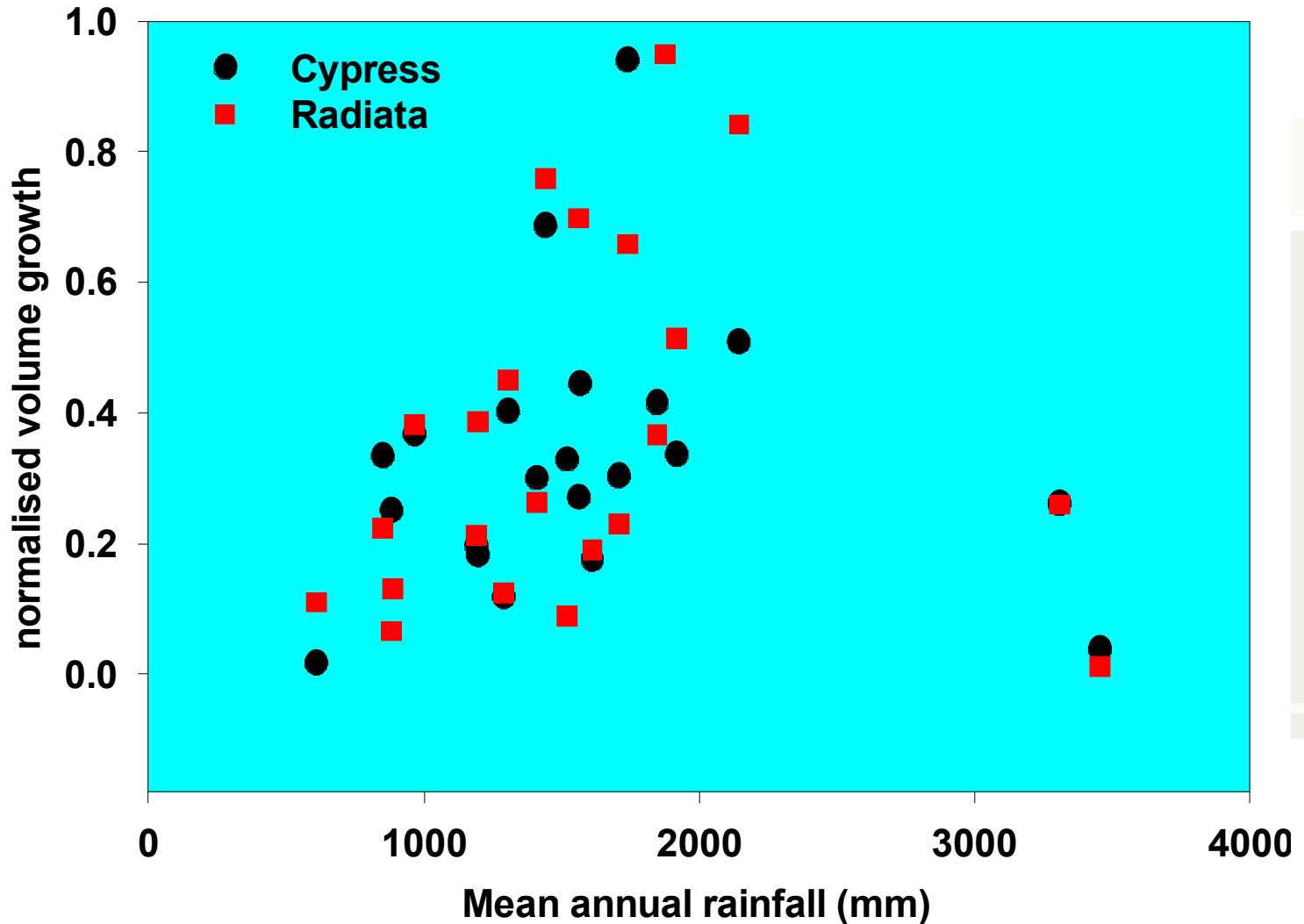
How good is this Site?



Effect of temperature on species productivity age 2 years (24 sites)



Effect of rainfall on species productivity age 2 years (24 sites)



Initial analysis of residuals from growth model

When Corrected for the effects of: (a) temperature
(b) rainfall

- normalised growth patterns for both species differ between soil orders

Mean Residuals for each soil order

	Pumice	Allophanic	Brown	Pallic	Podzol	Recent	Ultic
n=24	2	5	8	3	1	3	2
Radiata	0.328	0.098	0.001	-0.025	-0.071	-0.132	-0.317
Cypress	0.385	-0.056	-0.021	0.115	-0.061	-0.192	0.033

- Soil order is a useful tool for looking at variations between sites once environmental effects removed

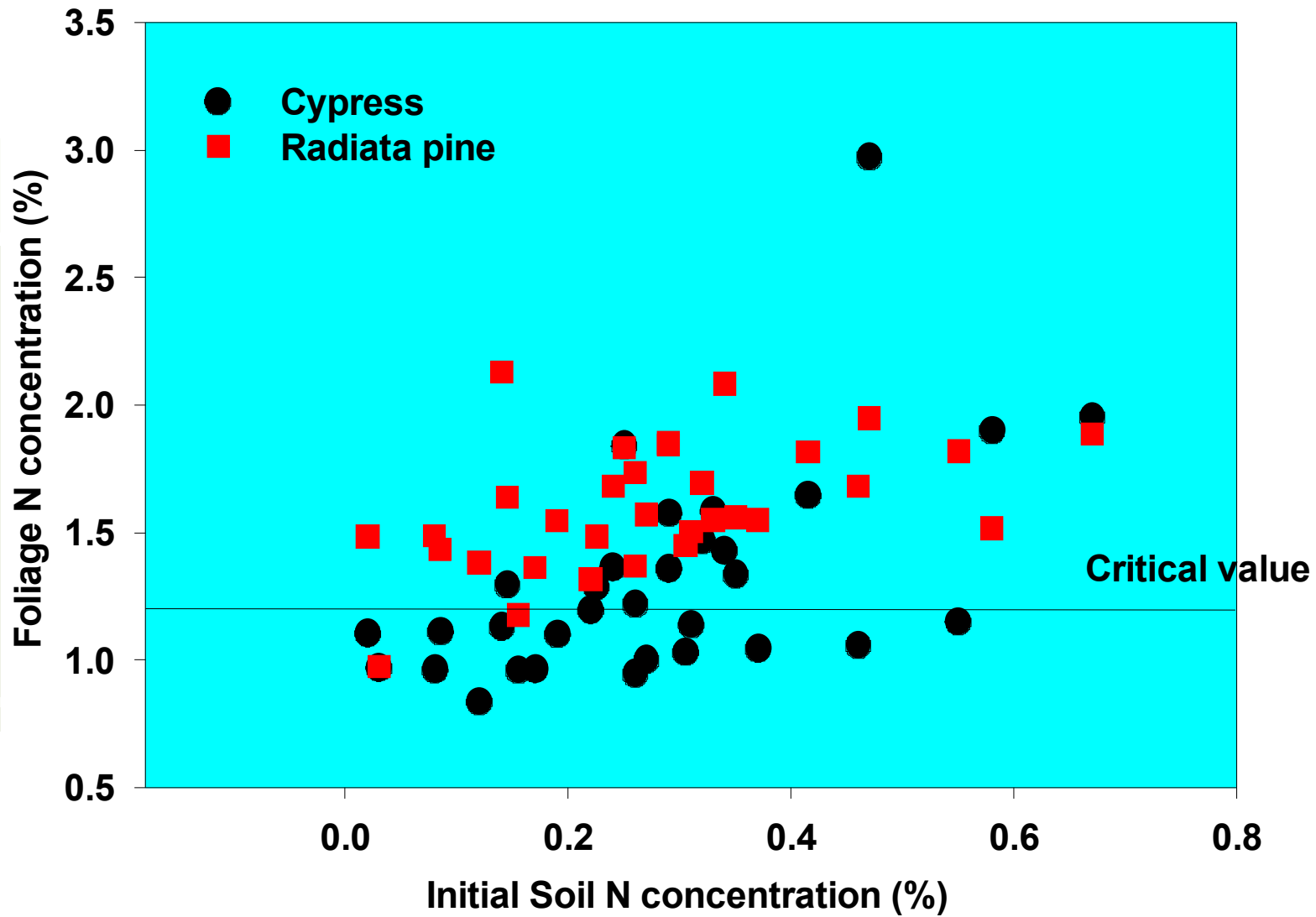
Effects of key soil properties

	Gain/loss relative to radiata	pH	N	CEC	Ca ex	Mg ex	K ex
Pumice	-6 (cypress)						
Allophanic	15 (radiata)	5.5	0.46	38.6	5.7	2.4	0.76
Brown	2 (radiata)						
Pallic	-14 (cypress)	5.4	0.20	18.8	9.9	1.7	0.26
Podzol	-1 (cypress)						
Recent	6 (radiata)						
Ultic	-35 (cypress)	5.1	0.2	18.4	3.7	1.3	0.30

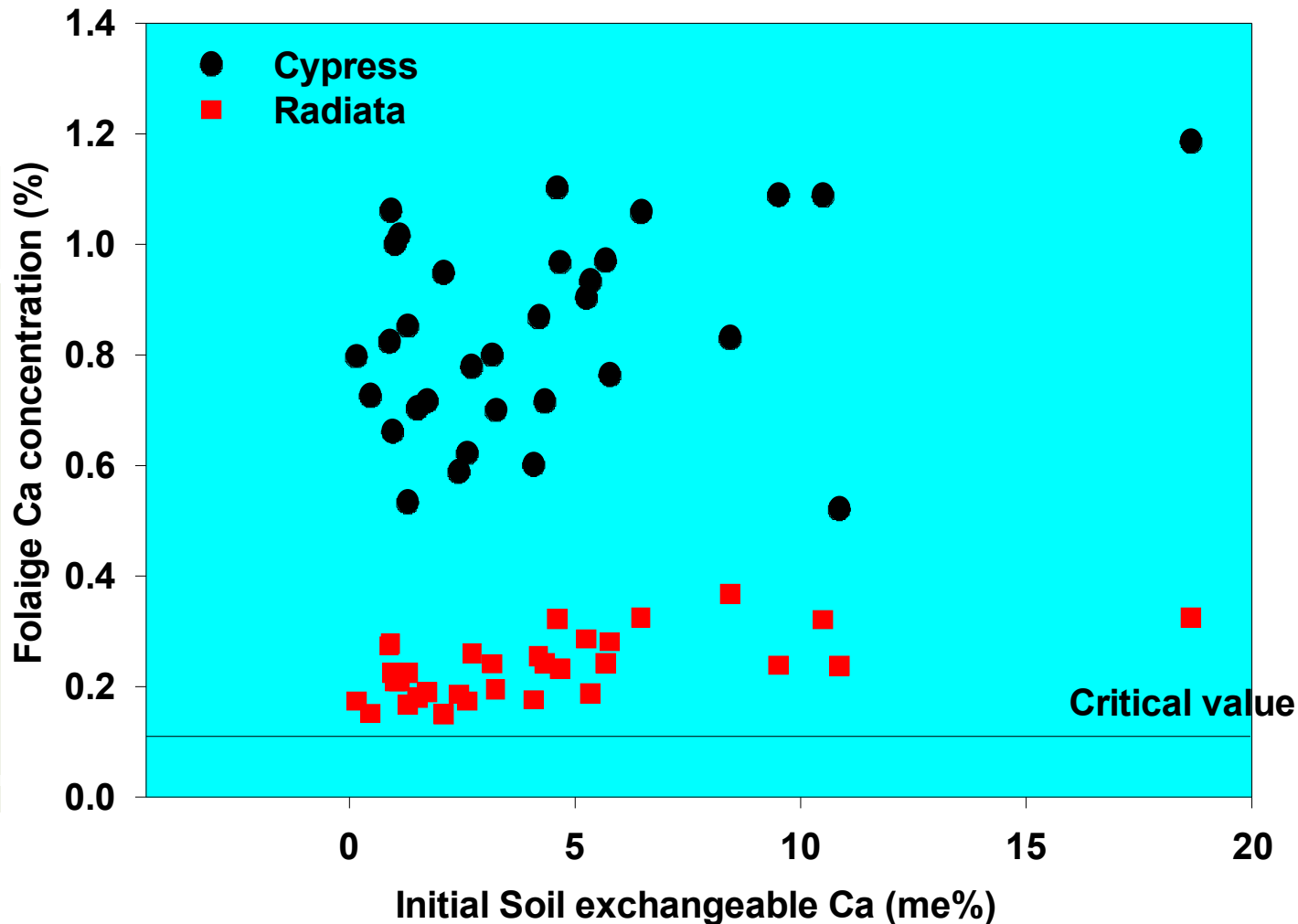
New Zealand soil classification

- Allophanic dominated by allophane
- Pallic high density, often with fragipan
- Ultic strongly weathered with clay enriched subsoils

Initial soil N status (0-10cm) vs foliage N status age 18 months (35 sites)

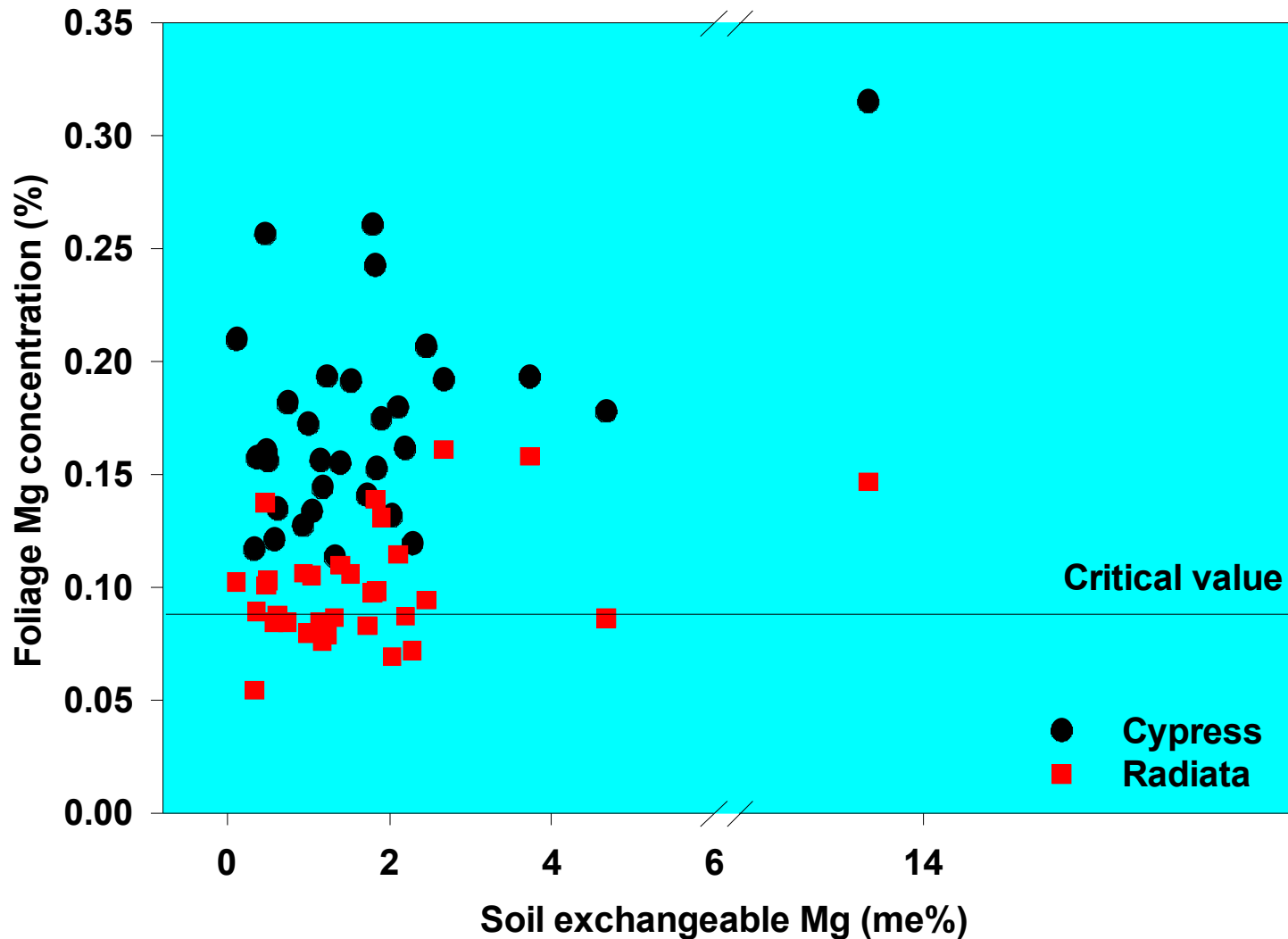


Initial soil Ca status (0-10cm) vs foliage Ca status age 18 months (35 sites)



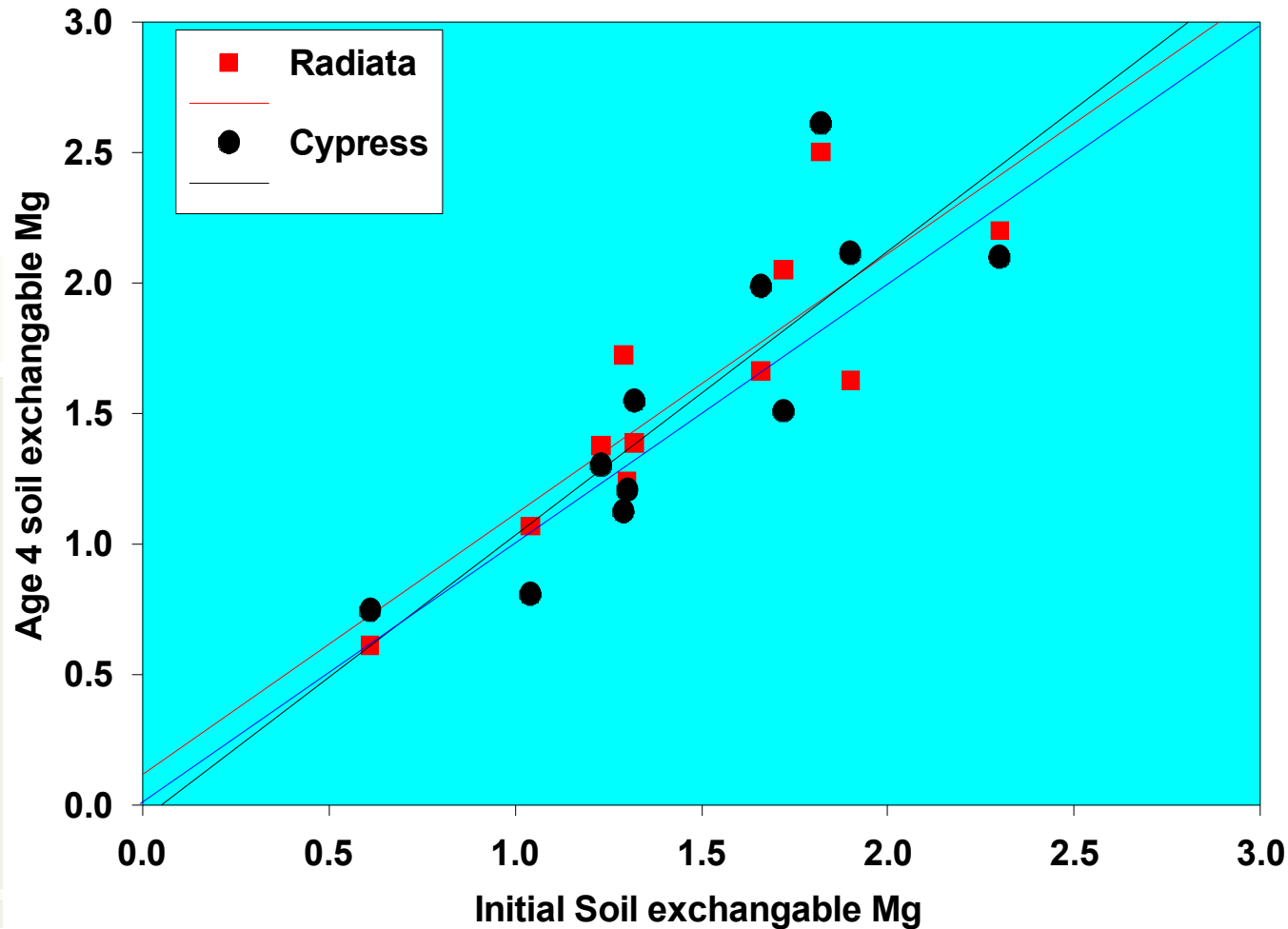


Initial soil Mg status (0-10cm) vs foliar Mg status age 18 months (35 sites)



•Is nutrient uptake from soil different between the species?

Species effects on soil properties (0-10cm) four years after planting (11 harvested sites)



- Species are allocating nutrients differently

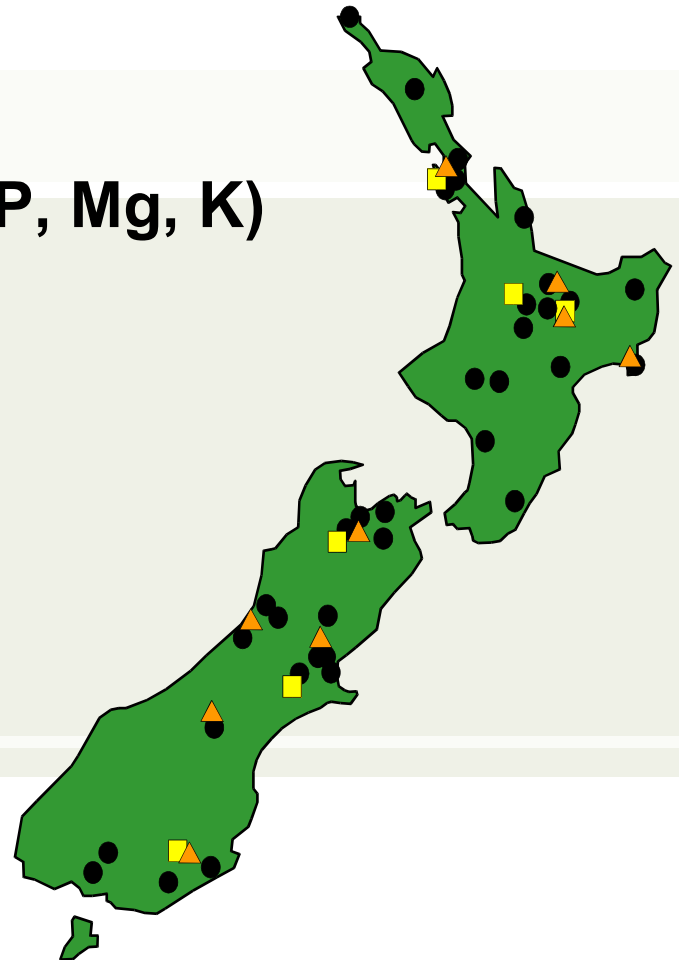
- Difference in nutrient use efficiency are important
- Radiata pine clones show large range of response to nutrient supply



Plants as indicators of site quality

LTSP series 3: Genotype x Environment

- Multiple sites
- Range of nutritional issues (N, P, Mg, K)
- 3 species
 - 40 clones Radiata pine
 - 30 clones Cypress
 - 20 families Douglas fir



Conclusions

- An interaction at the soil order level with species productivity has been observed
- As a consequence, our understanding of “site quality” may depend on species choice
- Further data from our remaining sites is required to confirm this observation
- Assessment of site quality may well be dependant on more than just plant species and soil fertility (LTSP 4)

The future

- **A world wide network of site quality plots**