Lincoln University
Te Whare Wānaka o Aoraki

Bio-Protection
Bioprotection science for New Zealand

SCION
Next generation biomaterials

What the … did Katrin do for the last 4 years???

Ectomycorrhizal communities associated with a Pinus radiata *plantation in the North Island, New Zealand*

Project funding and supervisors

- Start in June 2004
- Joint project between Lincoln University and Scion (Former Forest Research Institute)
- Foundation for Research & Technology, contract C04X0302
- Lincoln University Supervisors
  - Dr. Eirian Jones, Dr. Hayley Ridgway
- Scion Supervisors
  - Dr. Tod Ramsfield, Margaret Dick


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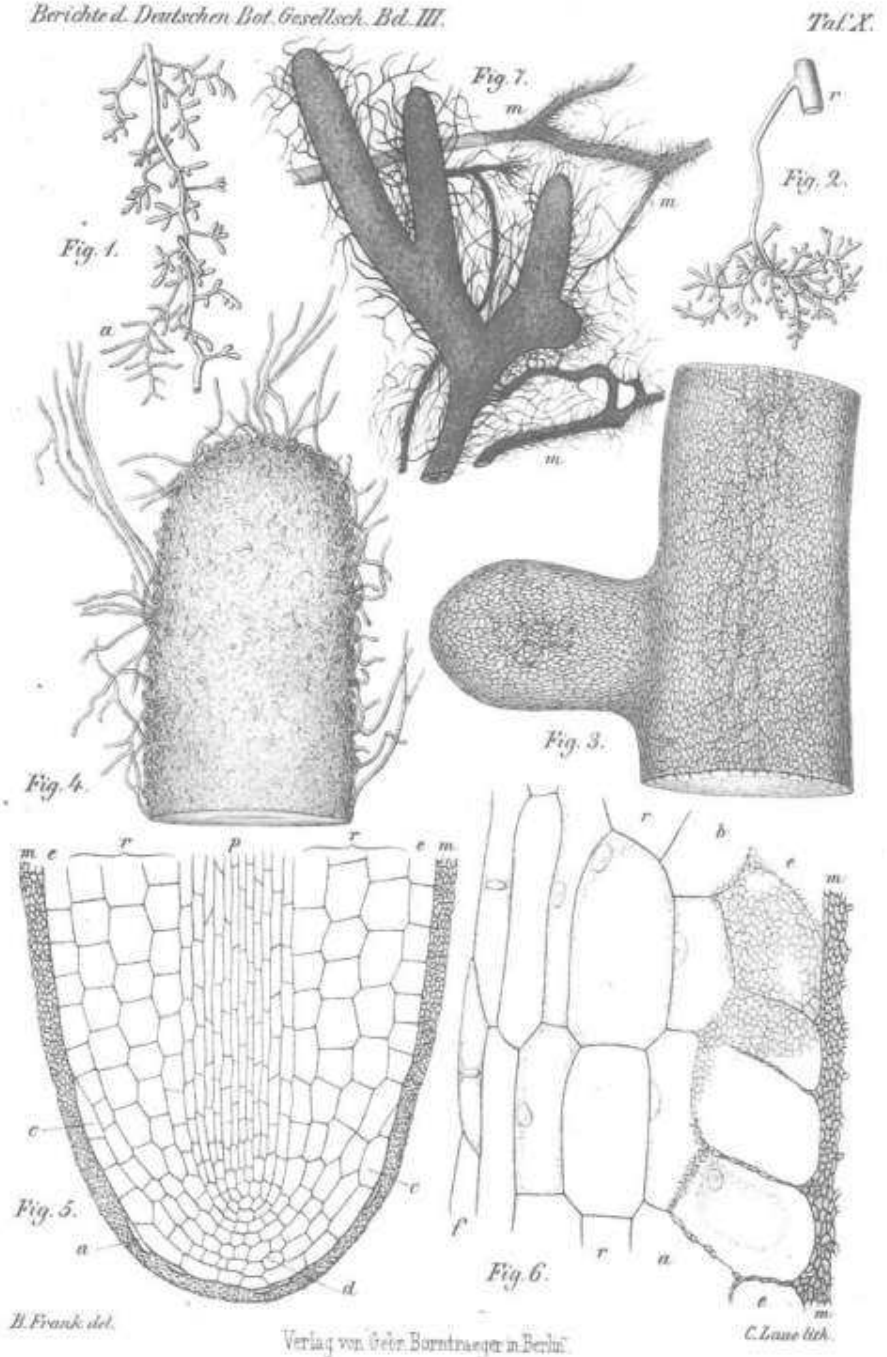
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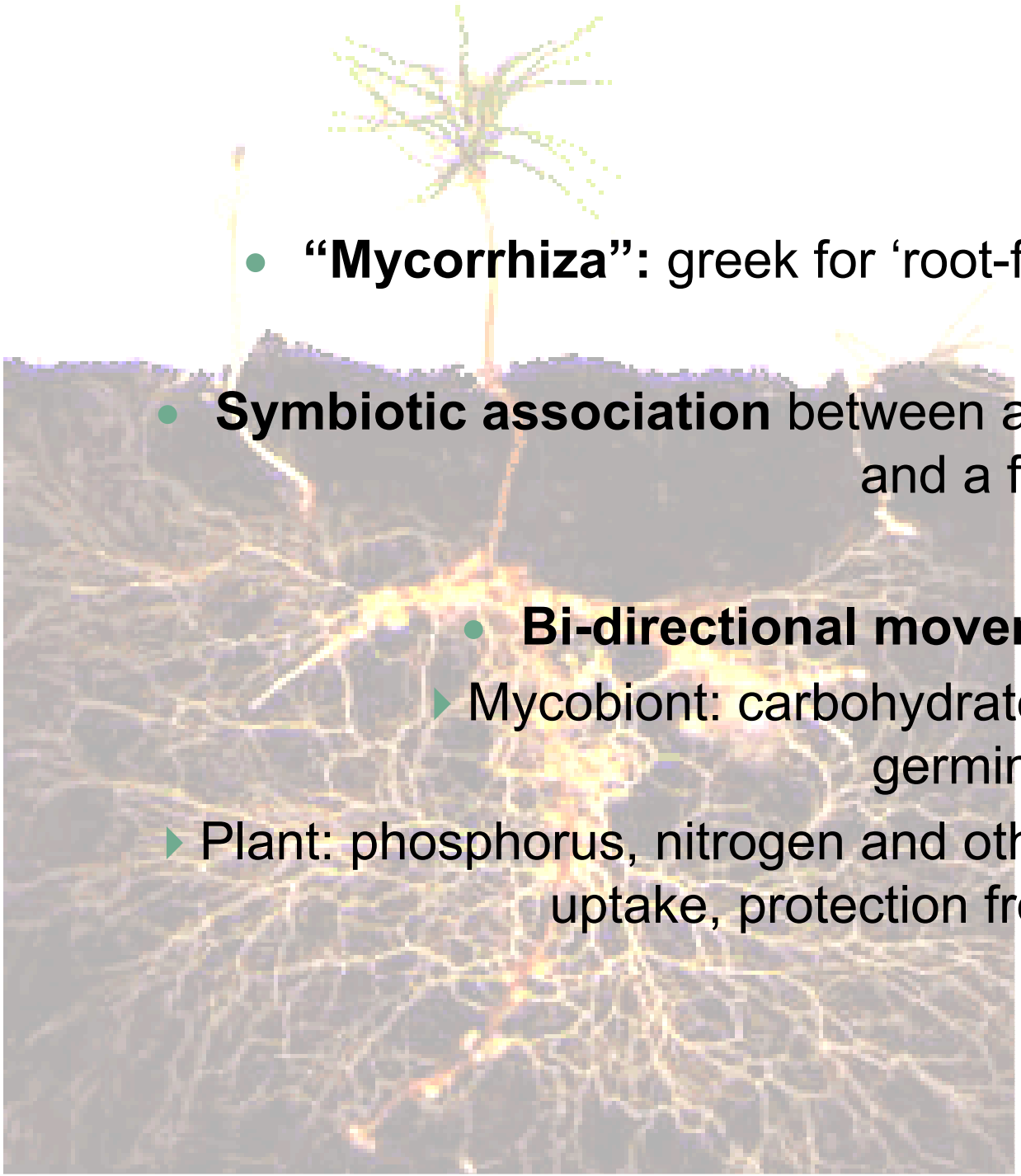
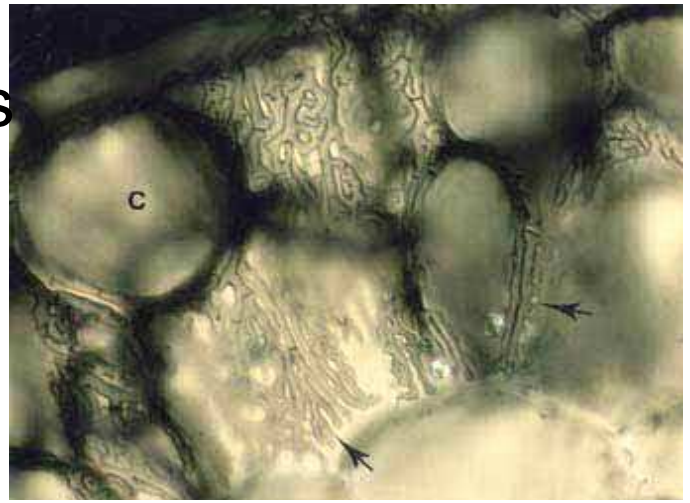


Mycorrhiza

- **“Mycorrhiza”:** greek for ‘root-fungus’, new organ
- **Symbiotic association** between a plant (photobiont) and a fungus (mycobiont)
- **Bi-directional movement of nutrients**:
  - Mycobiont: carbohydrates, vitamins, spore germination is stimulated
  - Plant: phosphorus, nitrogen and other minerals, water uptake, protection from root pathogens

Ectomycorrhiza ECM

- Most diverse type, ~ 6000 fungal species
- Only 3% of phanerogams are ECM
- ***BUT*** importance globally because most coniferous/plantation species are ECM
- Diagnostic features:
  - ***VISIBLE***
  - Mantle
  - Hartig net - intracellular



Mycorrhiza and Forestry

Mycorrhiza essential on plantation species

- Growth in the nursery – limits fertiliser substitution
- Facilitation of establishment
  - E.g. Douglas fir problems in New Zealand
- Pathogen protection – esp. nursery environment
- Nutrient deficiencies without mycorrhiza

The project – original research questions

- Aim: to observe serial changes in ECM on *P. radiata* in a plantation, characterisation of indicator species of successional stages
- Questions:
  - Is there a succession?
  - Is there a correlation between above- and belowground ECM species?
  - Can we find further species with the use of new methods?
  - Can we develop a fast identification protocol for ECM species?

The project as it panned out

3 Chapters:

- ECM species diversity in a *P. radiata* plantation in NZ
- ECM communities associated with different age classes of *P. radiata*
- Changes in ECM diversity from the nursery to outplanting

Material & Methods

- Nursery and 2, 8, 15, 26 yr old plantation sites plus 1yr old site in 2006 belowground survey
- Sporocarp surveys for aboveground ECM
  - Autumn 2005, 2006
  - Species ID with morphological and molecular methods
- Soil core surveys for belowground ECM
  - Autumn 2005, December 2005, Autumn 2006
  - Species ID with morphotyping and molecular methods
- Molecular: RFLP analysis, sequencing

ECM diversity, Chapter 3

ECM species diversity in a *P. radiata* plantation in NZ

- What ECM are associated with *P. radiata*?
  - Above- and belowground
  - Assess within site (α-) ECM diversity and characterisation of ECM communities:

    Richness, frequency, diversity indices, evenness
  - Use of molecular methods for species ID
- Comparison of above- and belowground ECM communities

ECM diversity - Results

- 18 ECM species above, 19 ECM species/types below
- Low richness/diversity compared to similar forests in Northern Hemisphere but similar to other exotic plantations in the Southern Hemisphere
- Species ID clarification for *Inocybe sindonia* and *Laccaria proxima* with sequence analysis

Inocybe sindonia

Laccaria proxima

ECM diversity - Results

New associates to *P. radiata* in New Zealand - aboveground

Inocybe sindonia

Lactarius rufus

Lycoperdon gunnii

Rhizopogon pseudoroseolus

Wilcoxina mikolae

ECM diversity - Results

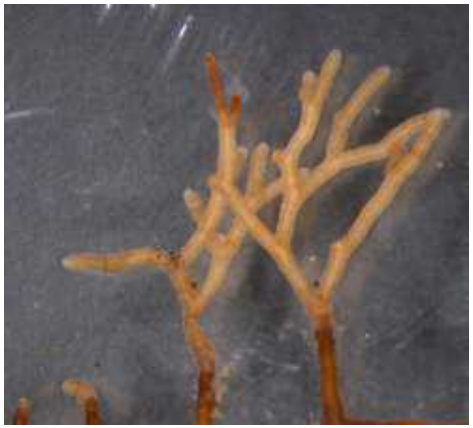
New associates to *P. radiata* in New Zealand - belowground

Pseudotomentella sp.

P. tristis

Rhizopogon luteorubescens

Tomentella sp.



Wilcoxina mikolae

? ? ? ?

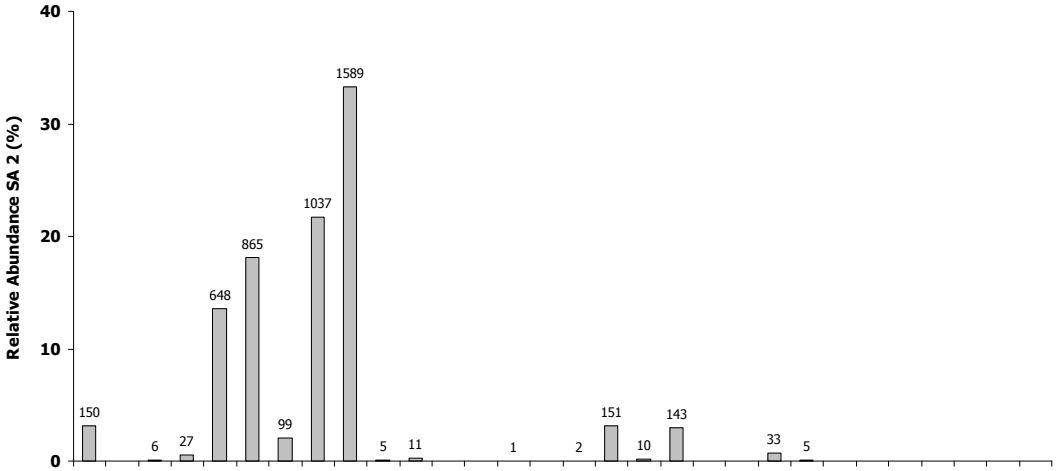
? ? ?

? ?

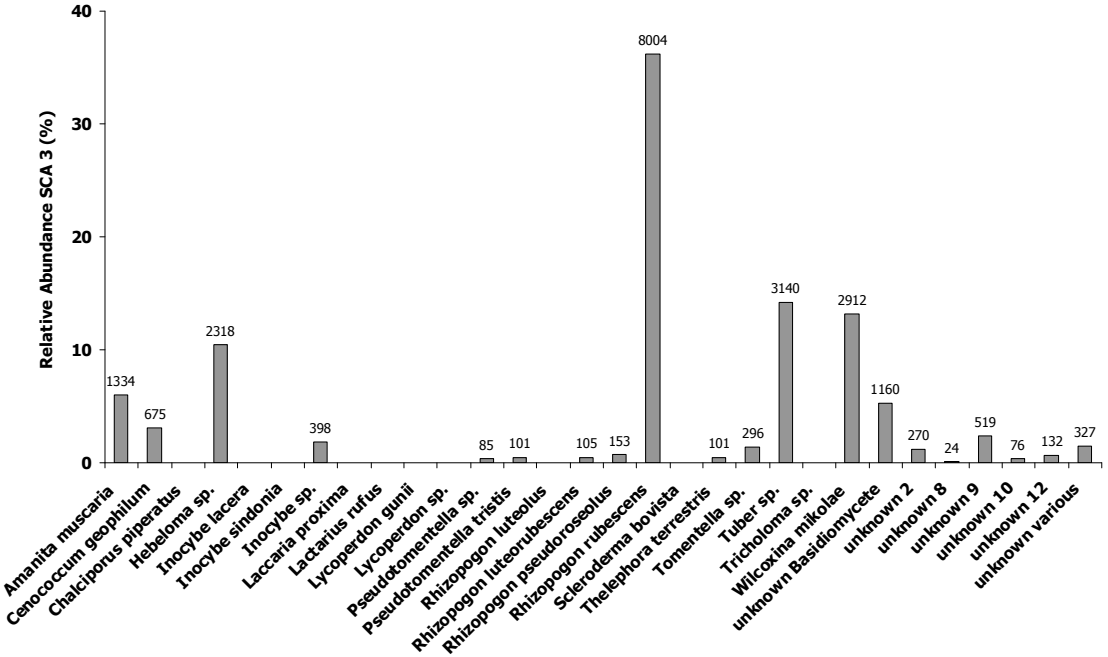
6 unknown types

ECM diversity - Results

Above



Below



- Little correlation
- 7 ECM species in common
- dominant species aboveground not observed below

ECM communities of different age classes, Chapter 4

ECM communities associated with different age classes of *P. radiata*

Aim: to assess and discuss effect of host age on the between-site diversity (β-diversity)

- Does ECM fungal species richness and diversity change with stand age?
- Do ECM communities change related to host age?
- Can we determine indicator species for identified stages?

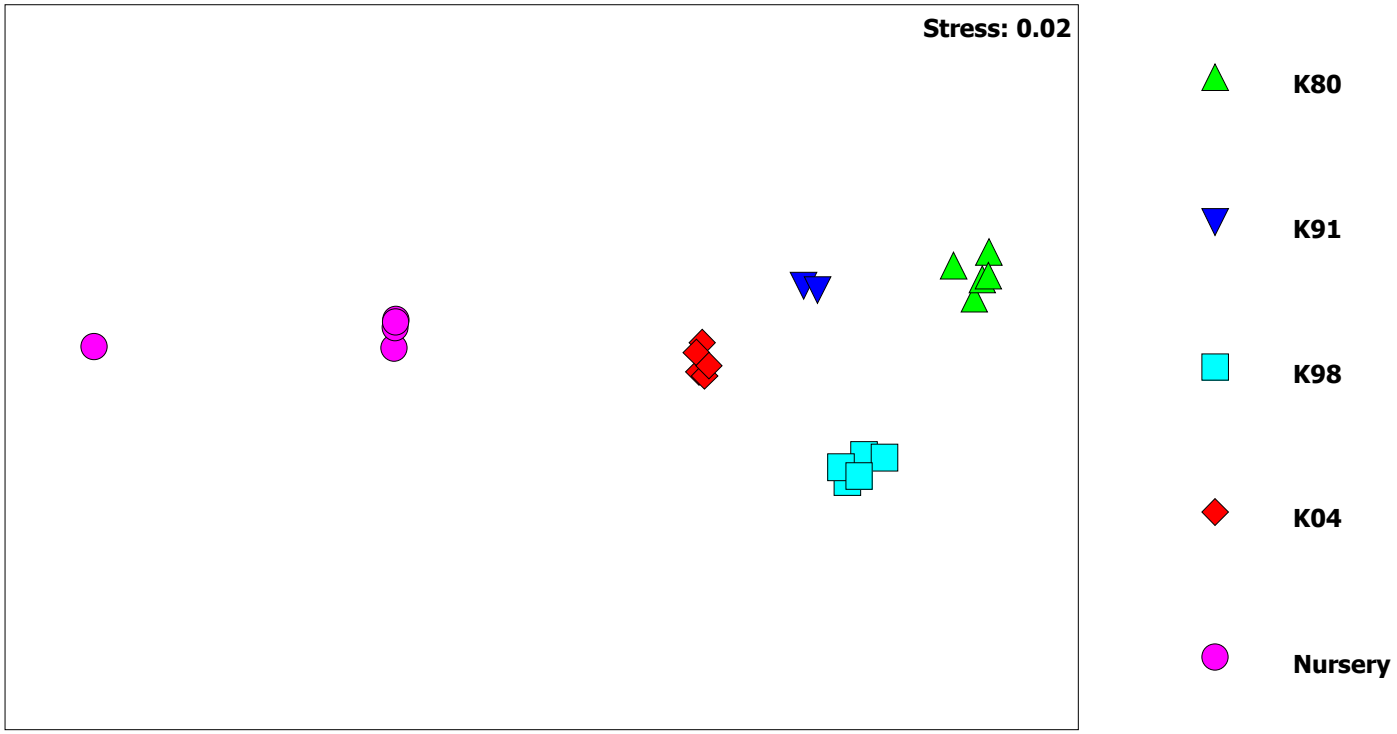
Chapter 4 - main results

- above richness increased over time, below it decreased from nursery → 2yr, then increased again

- above diversity increased until 15 yrs then declined, below it decreased from nursery → 2yr, then increased thereafter

Chapter 4 - main results

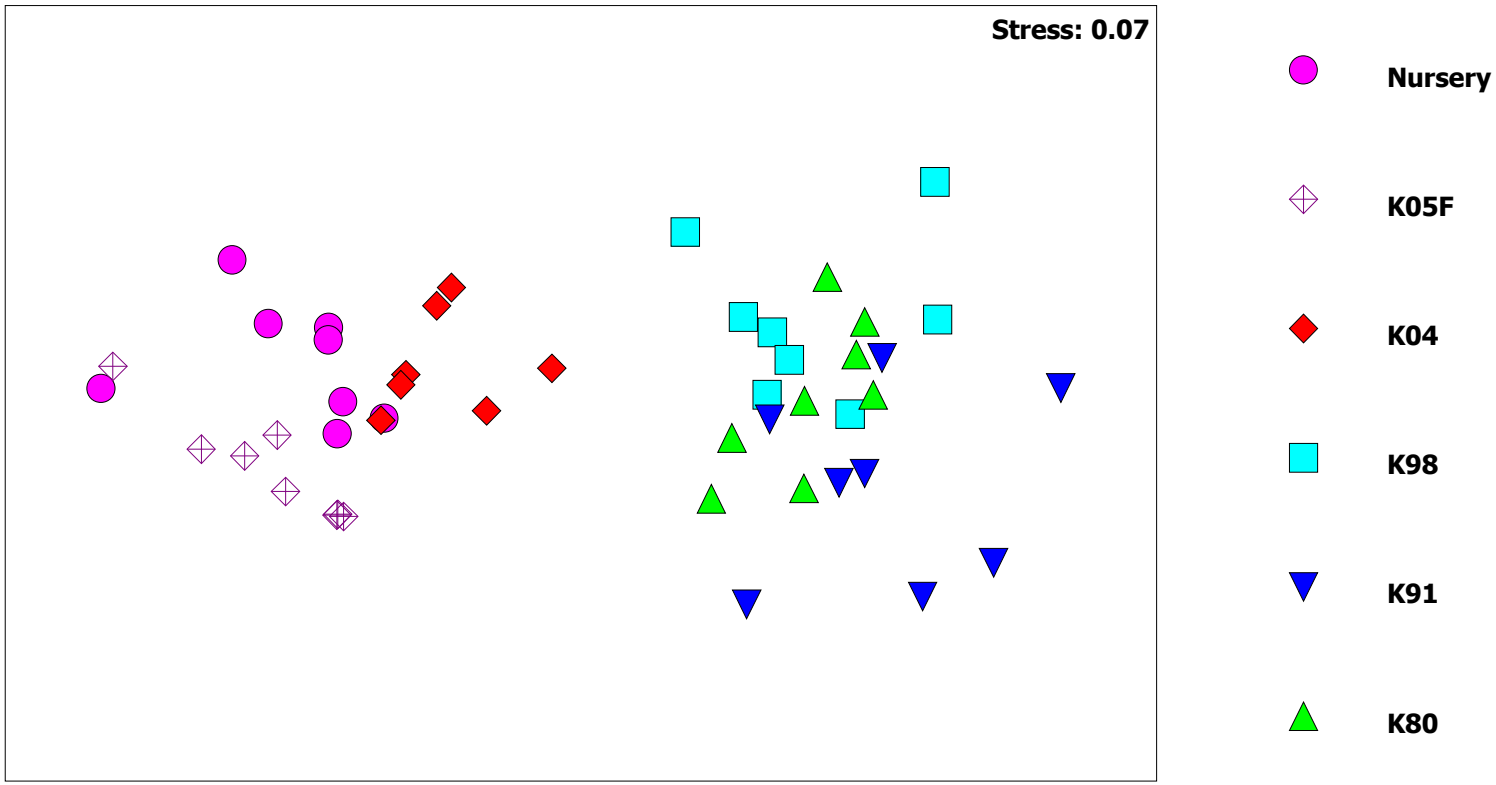
ECM communities in relation to stand age - above



Clear sequence of ECM species changes related to stand age with growing complexity and clear indicator species

Chapter 4 - main results

ECM communities in relation to stand age - below



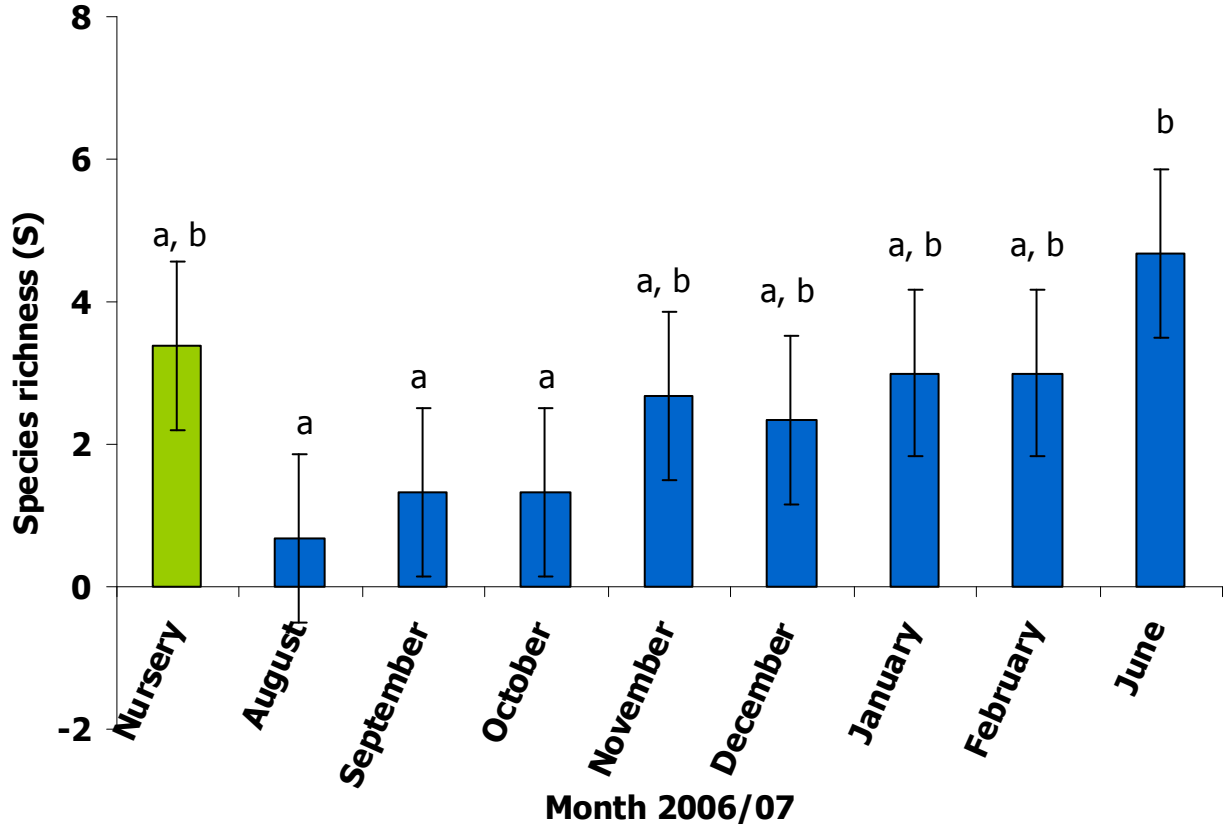
No change in ECM composition that was directly related to stand age, two distinct groups of ECM however – ‘young’ and ‘plantation forest’ group, indicator species for each group

Survival of nursery ECM, Chapter 5

Changes in ECM diversity from the nursery to outplanting

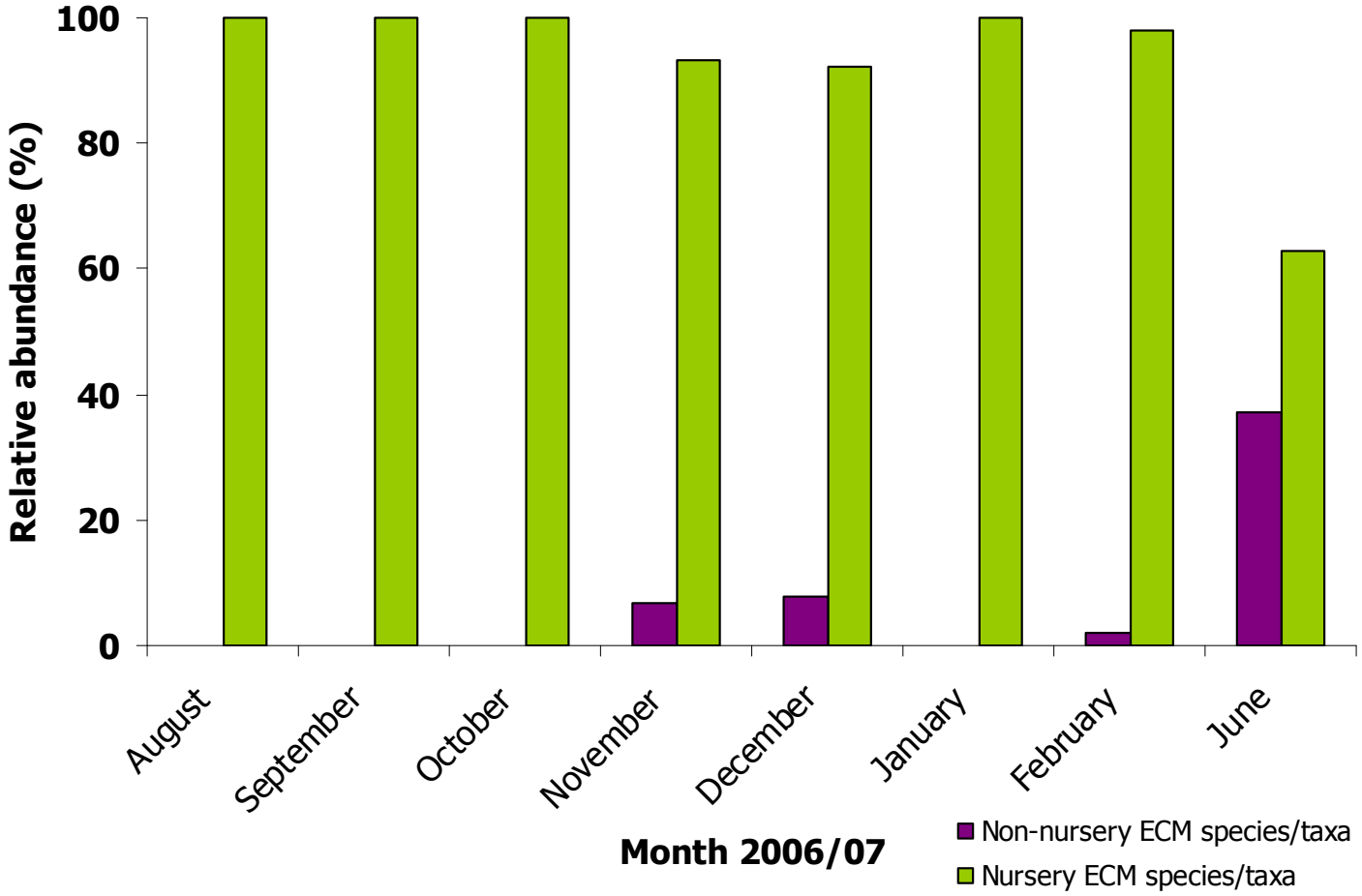
- Do ECM fungi from the nursery survive the outplanting into clearcut sites?
- How long can nursery fungi persist?
- When does a change from nursery to forest species occur?

ECM species richness after outplanting



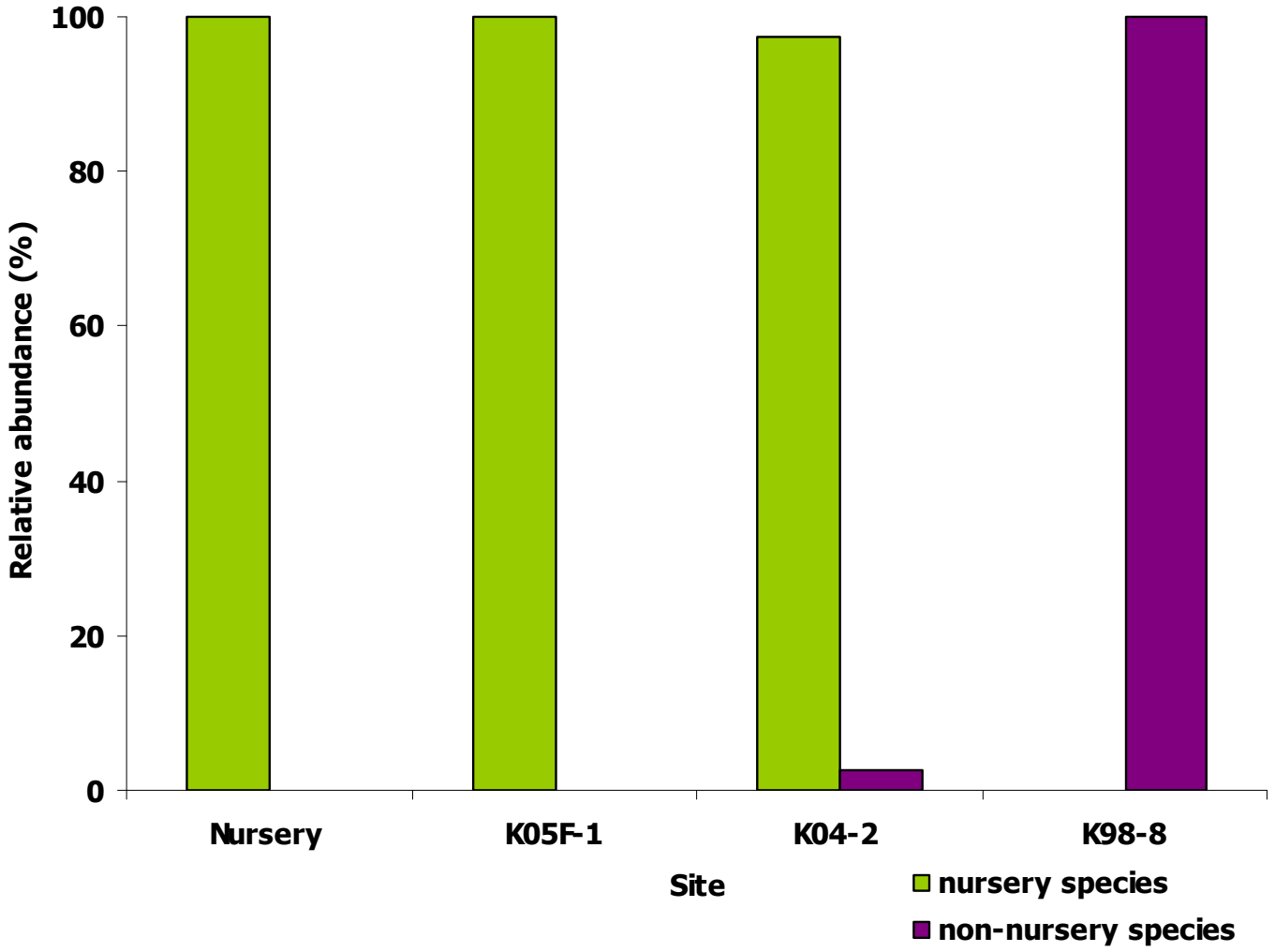
ECM richness declines but recovers within one year to a higher level than previously

Dominance of nursery ECM in 1st year



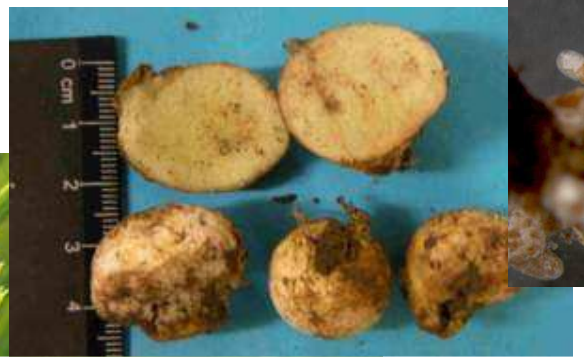
- All nursery ECM present in 1st year, dominant
- First non-nursery ECM 6mths after outplanting

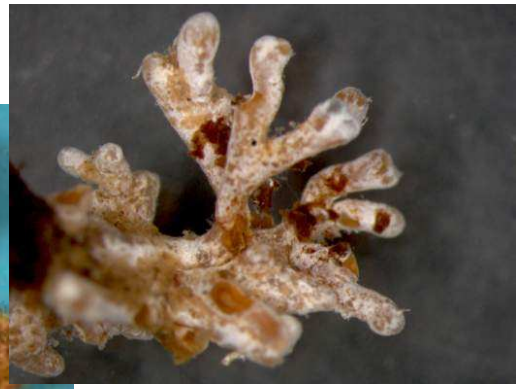
Change from nursery to forest ECM



Survival of nursery ECM - Results

- Nursery ECM survive first year of outplanting, dominant in first year of plantation
- First non-nursery ECM 6 months after planting, minor abundance
- Nursery ECM dominant for two years, completely replaced after seven years
- *Rhizopogon rubescens* most persistent and abundant ECM in outplanting





Acknowledgments

- My supervisors
- FRST Funding
- Dr. Geoff Ridley, Ian Hood, Dr. Ian Dickie
- FUNNZ – Fungal Network of New Zealand
- Kaingaroa Timberlands, Nigel Heron
- Alison Lister, James Ross
- Everyone here at Scion formerly known as Ensis, formerly known as Forest Research, formerly known as New Zealand Forest Research Institute from the Forest Protection group, formerly known as the Forest Biosecurity and Protection group, formerly known as the Forest Health Group formerly known as…..