UNIVERSITY of OTAGO

Te Whare Wānanga o Otāgo

NEW ZEALAND

Ectomycorrhizal fungi on adventitious canopy roots of old-growth silver beech (*Nothofagus menziesii*)

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98 species of epiphytes on one *Nothofagus menziesii* tree

41 vascular plants
57 non-vascular plants and lichens

(Hofstede *et al*. 2001. *Journal of Biogeography* **28**, 1033.)

What about fungal diversity in canopy soil?

Nothofagus menziesii on the Cascade Road, south of Haast, South Is, NZ


Cascade Road, South of Haast, South Is, NZ

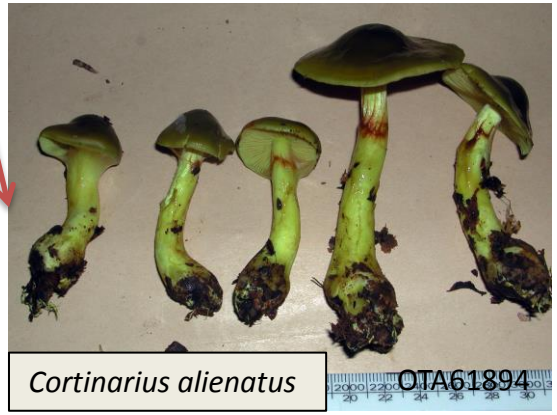
Canopy “soil” may be > 50 cm deep!

Discovered an extensive network of ectomycorrhizal adventitious roots!

Ectomycorrhizal fungi

Taxonomic diversity

Cortinarius saturniorum



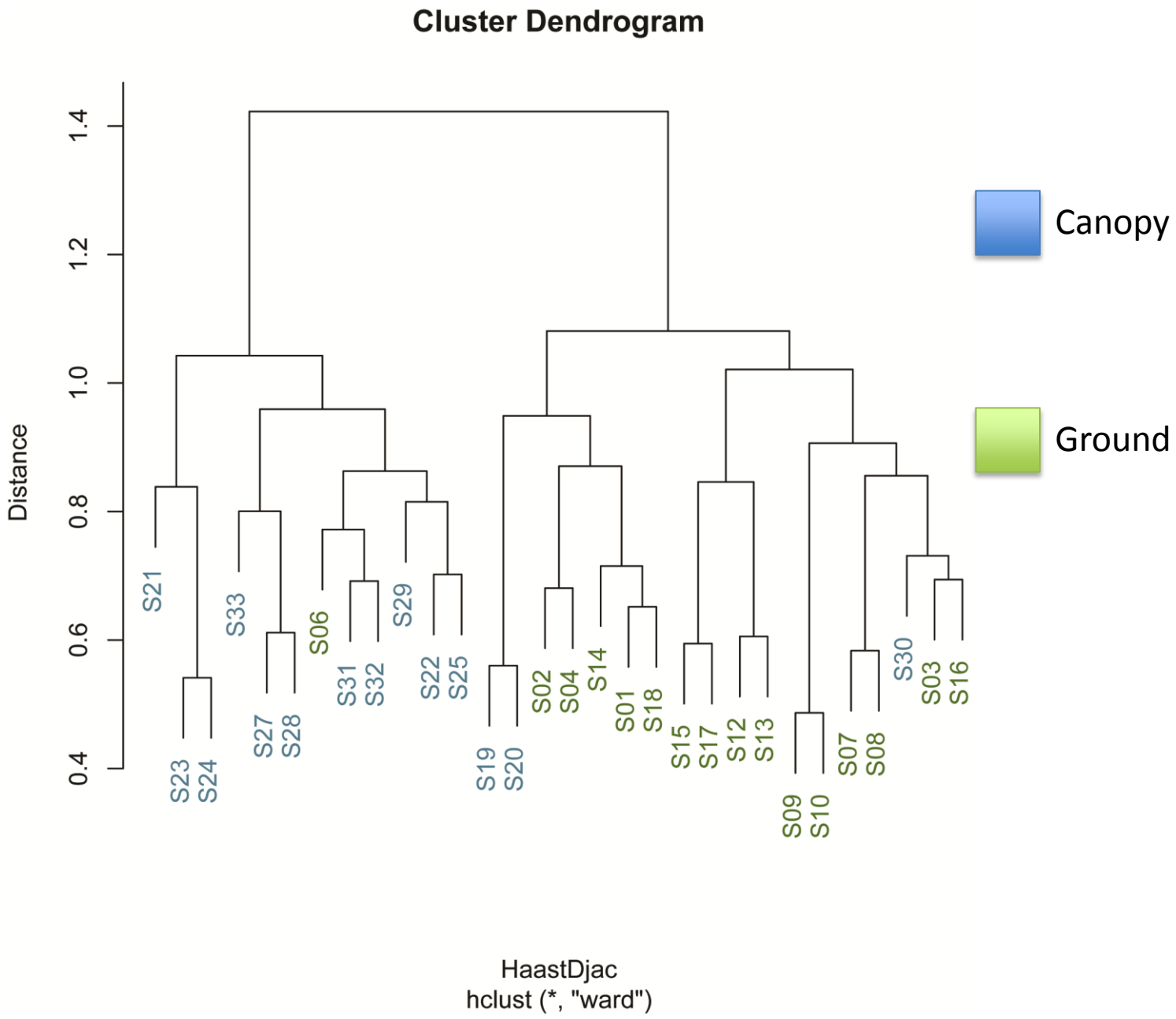
Cortinarius alienatus OTA61894

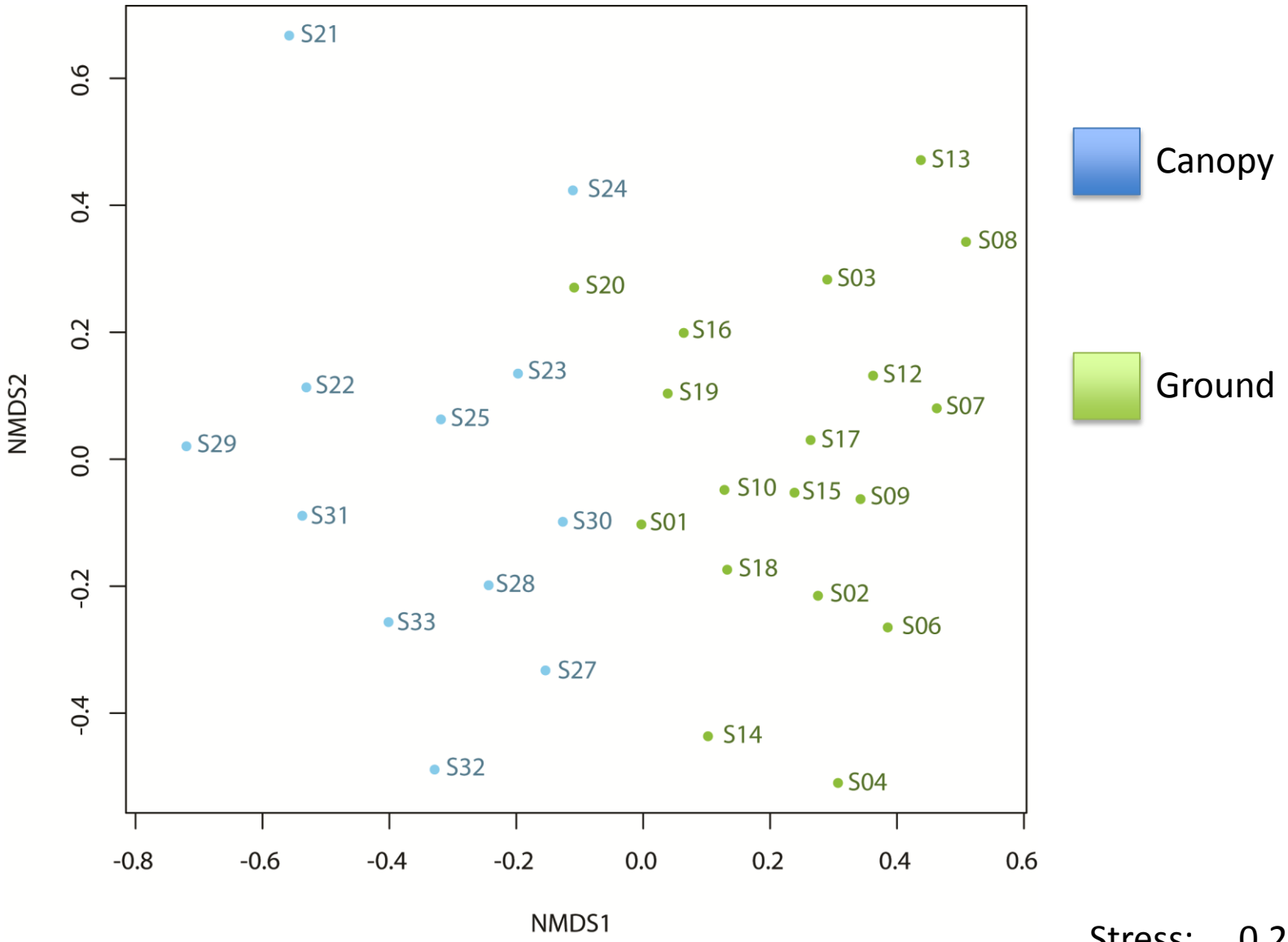
Cortinarius cucumeris

"Real" diversity

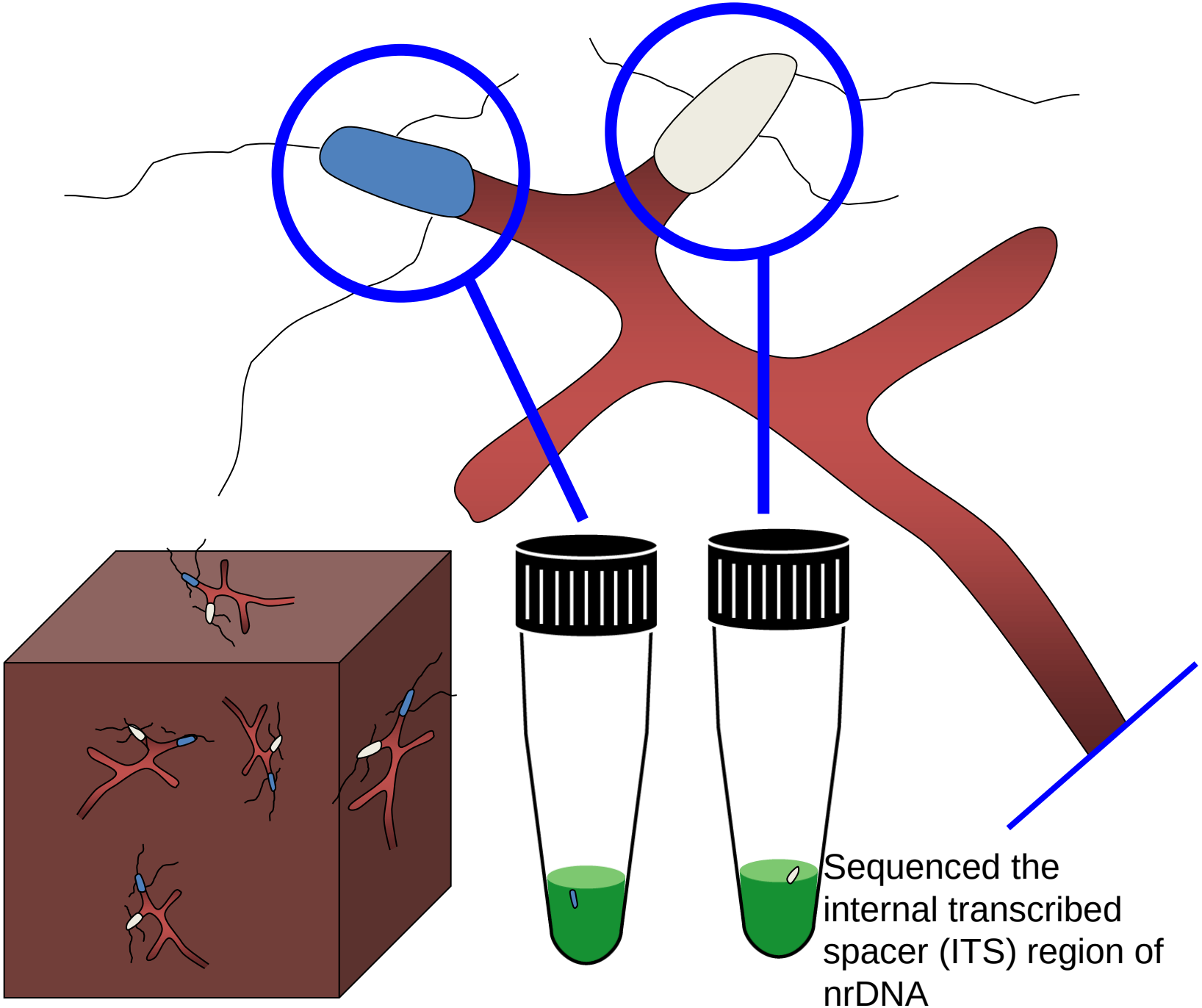
Are terrestrial and canopy ECM fungal communities different?

- Hyphal ingrowth bags *New Phytol* **151**, 753–760
  - Nylon mesh (50 µm) bags + acid-washed sand
  - Buried in canopy and ground soil
  - 5 *Nothofagus menziesii* trees, 5 ground bags + 5 canopy bags per tree
  - DNA extracted after 12 months
- Terminal restriction fragment length polymorphism (TRFLP) analysis
  - Internal transcribed spacer (ITS) region
  - → a "DNA profile" of each sample
  - Graph with cluster analysis and ordination


Cluster Dendrogram
Distance
0.4
0.6
0.8
1.0
1.2
1.4
S21
S23
S24
S33
S27
S28
S06
S31
S32
S29
S22
S25
S19
S20
S02
S04
S14
S01
S18
S15
S17
S12
S13
S09
S10
S07
S08
S30
S03
S16
Canopy
Ground
HaastDjac
hclust (*, "ward")

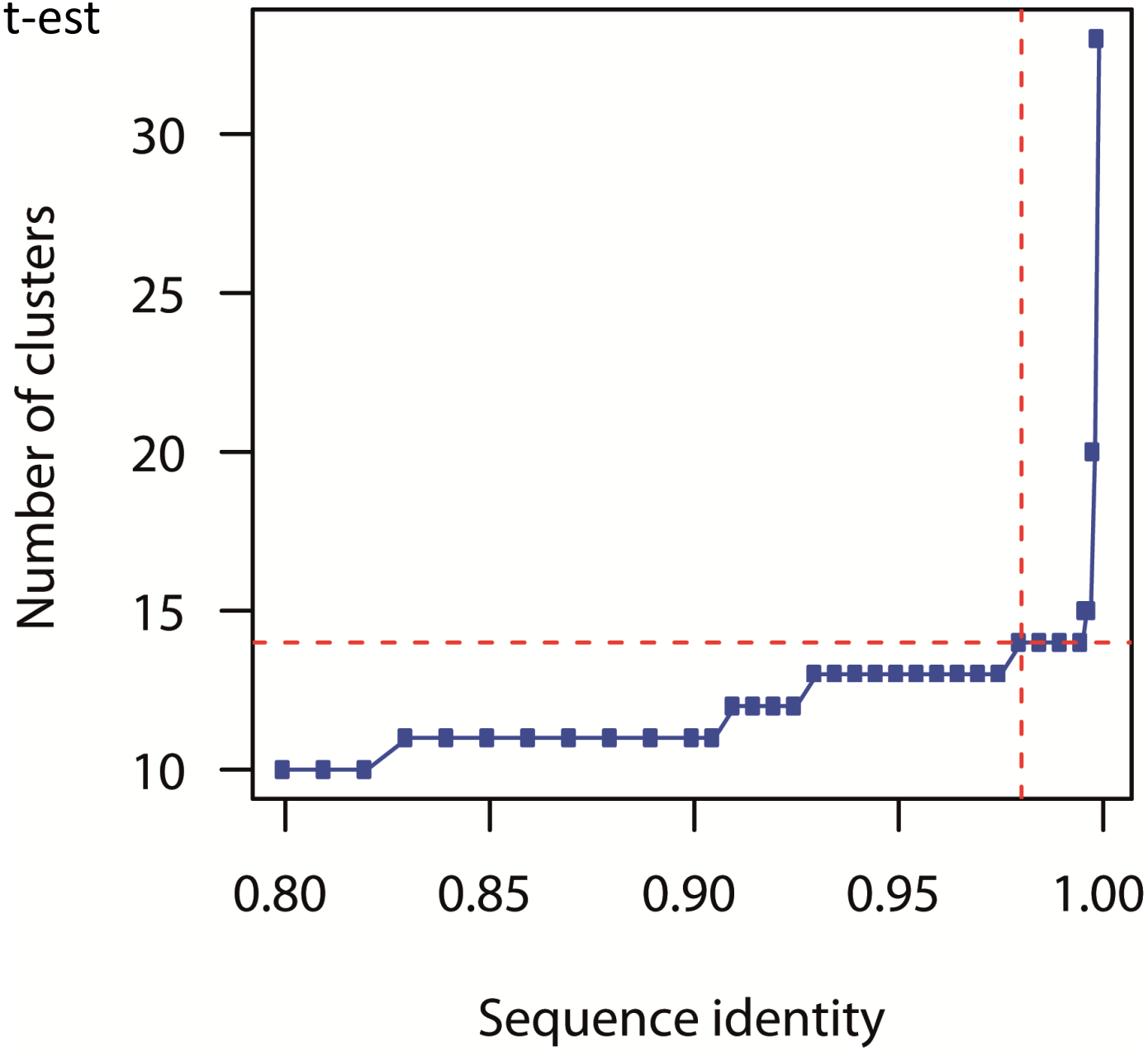


Stress: 0.2044846



Sequenced the internal transcribed spacer (ITS) region of nrDNA

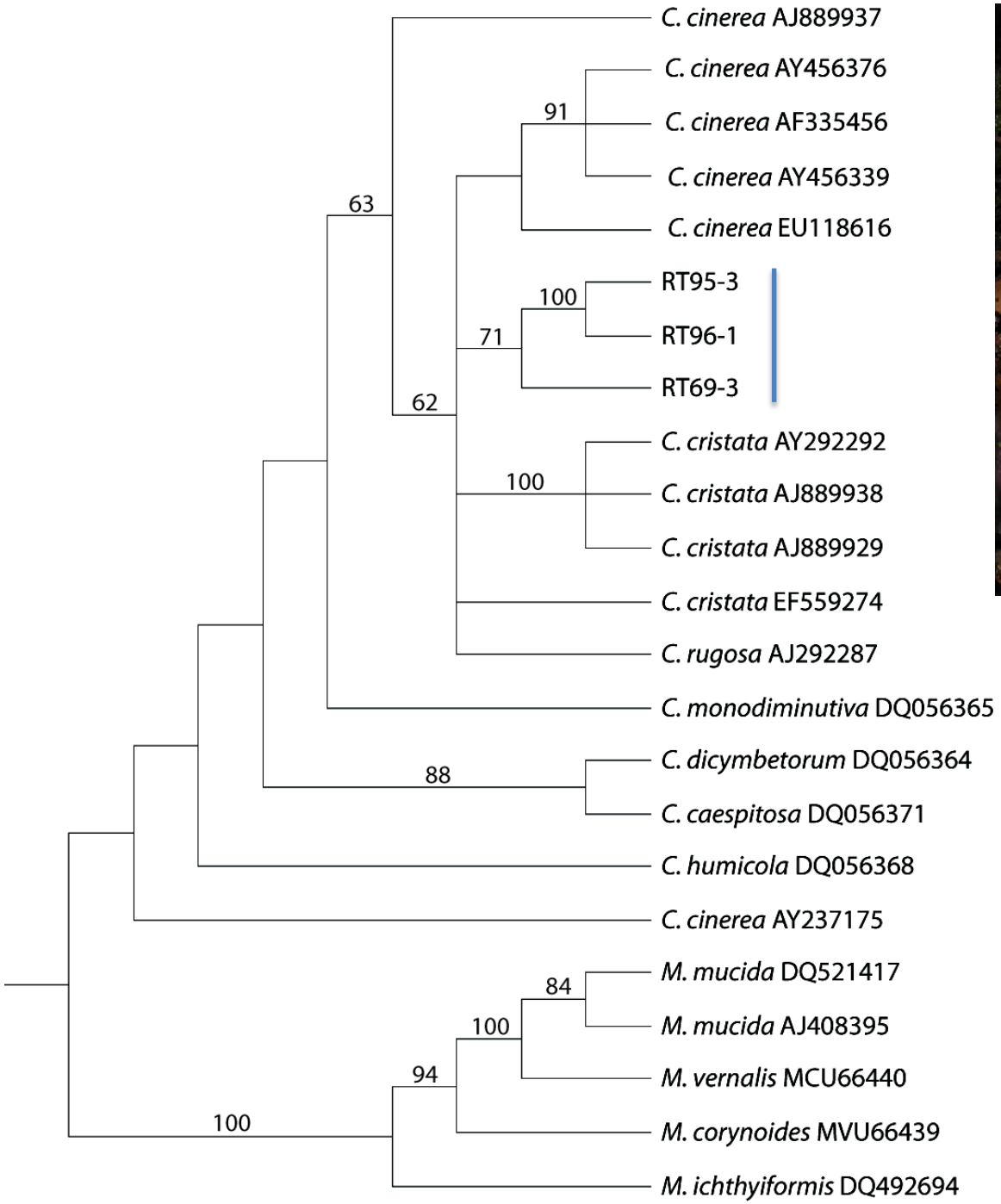
Cd-hit-est



http://weizhong-lab.ucsd.edu/cd-hit/

Fungal diversity on canopy root tips

Genus	No. of clusters	No. of sequences
Cortinarius	3	13
Russula	2	18
Lactarius	1	9
Laccaria	2	5
Inocybe	2	3
Thelephoraceae	1	14
Leotia (Asco)	1	5
Clavulina	1	3
Cenococcum (Asco)	1	2
Total	**14**	**72**



Clavulina

a “coral” fungus

Leotia lubrica
"jelly babies"

Not previously known to be ectomycorrhizal with *Nothofagus*

7 canopy root tips had two ECM fungi, including 4/5 *Leotia* roots.

The value of giving species names to DNA sequences:

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Sequences identified as *Lactarius umerensis*—previously known from soil and tree branches!

Role of epiphytes not neutral

‘Short-circuit’ the tree-to-ground flow of nutrients

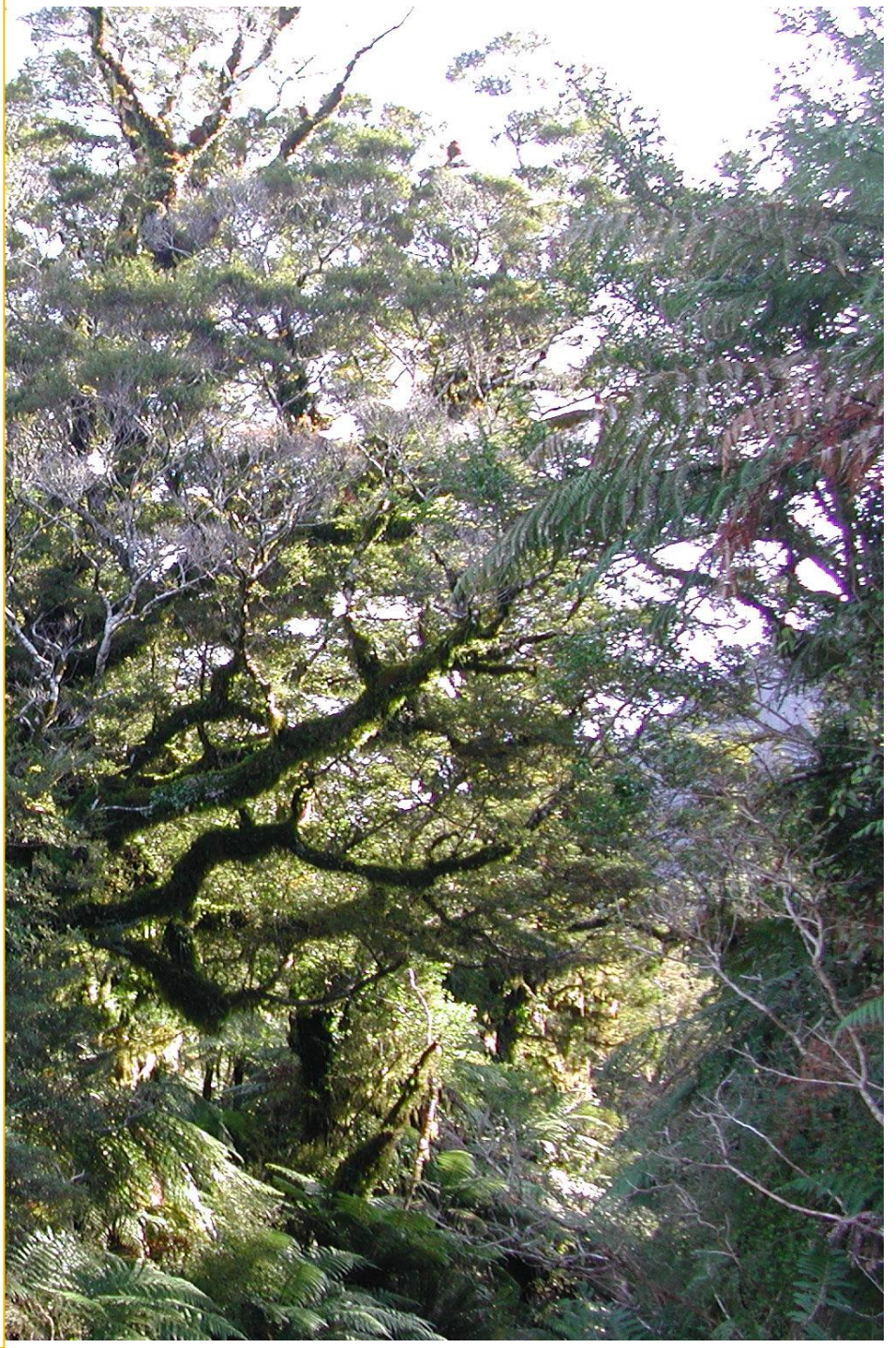
Canopy nutrients not necessarily static

Canopy ectomycorrhizas intercept organic nutrients—less requirement for microbial mineralization

Fungal accumulation of organic N and C in canopy soil contributes to organic matter buildup

Recent study of canopy roots in *Quercus copeyensis* in Costa Rica found no ECM, despite ground roots being ECM (*Biotropica* **43**, 401–404)

Reports that European beech (*Fagus sylvatica)* have ECM canopy roots. (*Pedobiologia* **54**, 119–125)



Are canopy ECM dominated by fungi with wind-dispersed spores?

What about mycelial dispersal of ECM? Is there higher genetic diversity in canopy ECM?

Can sequestrate (truffle-like) fungi get up into the canopy?

Obvious need to compare canopy and ground fungal diversity.

Other NZ canopy soil microbes

Cyanobacteria: Lake Marion trailhead along the road to Milford Sound (unpublished, Steve Stephenson *et al.*)

NEW ZEALAND	**Sample**	**Sample**	**Sample**	
	1	2	3	
Aphanocapsa fusco-lutea	X	x		
Aphanocapsa muscicola	X			
Aphanothece bullosa		x	x	Very dominant in Sample #3
Aphanothece pallida	X			
Aphanothece saxicola	x			
Chroococcum minutus	x			
Hapalosiphon intricatus	X	x		Very dominant in Sample #2
Oscillatoria minutissima			x	
Phormidum kuetzingianum	x	x		
Phormidum numidicum	x	x		
Rhabdogloea smithii	X	x		

Chytrid fungi:

Longcore JE 2005. Zoosporic fungi from Australian and New Zealand tree-canopy detritus. *Australian Journal of Botany* **53**, 259–272.

Acknowledgements

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