Gondwanan Rainforest Burning

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Refugia burning

Intact World Heritage Gondwanan rainforest canopy Mt. Nardi, Nightcap NP

Defoliated World Heritage Gondwanan Rainforest canopy Mt. Nardi, Nightcap NP
Following aerial application of Chemical Fire Retardant – November 2019

Lophostemon confertus – Brush Box, Terania Creek Nightcap NP

Burned Rainforest, Terania Creek Nightcap NP

Burned rainforest trees,
Terania Creek, Nightcap NP.

Thin-barked and destined to die.

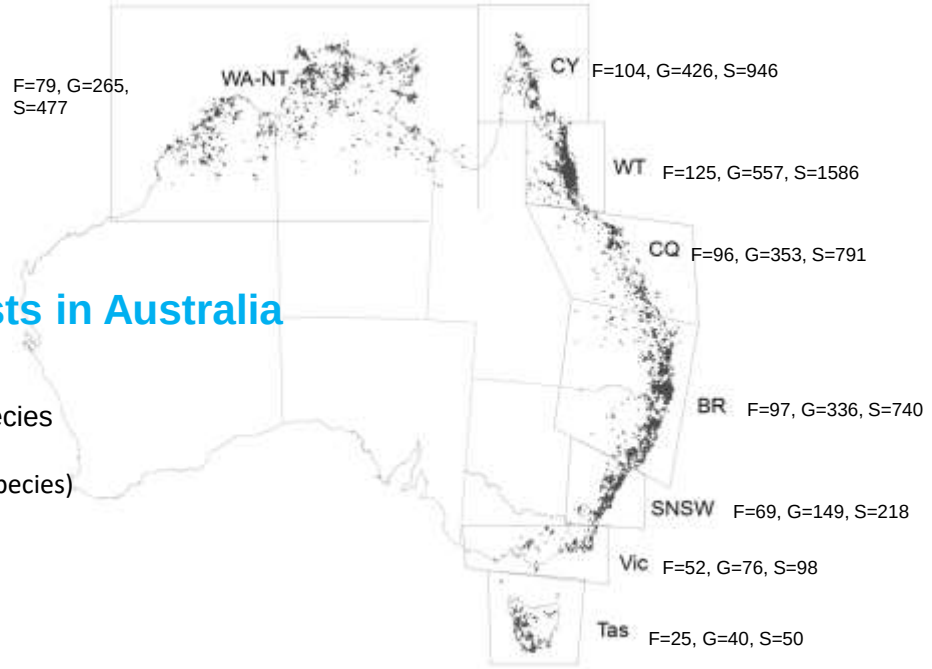
Full Pool
136 families (F)
668 genera (G)
2306 species (S)
1872 free-standing
434 climbing
180 000 distribution records (AVH)

Where are the Rainforests in Australia now?

Continental distribution of rainforest species

Woody taxa only in 10x10km cells (≥5 species)

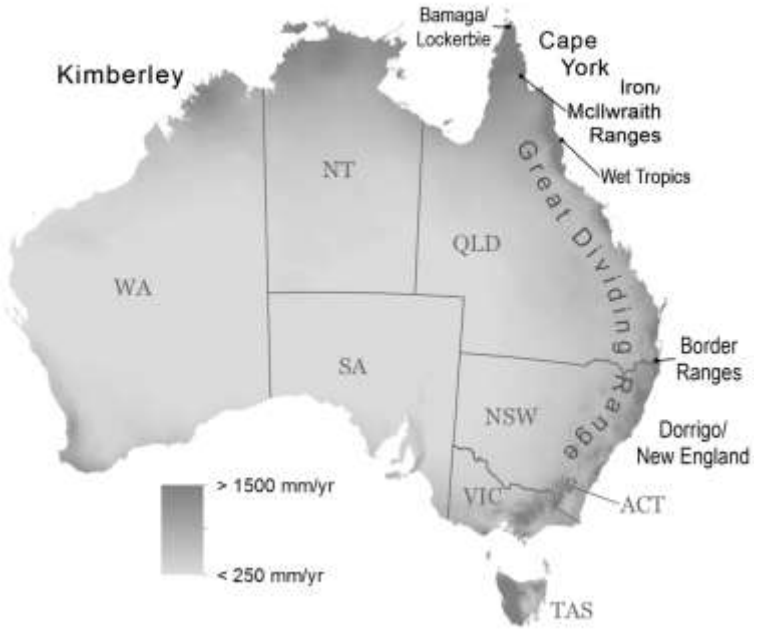
Continental and Regional species pools



Latitude

Tropical to Subtropical rainforests have the highest tree and vine diversity

Kooyman RM, Rossetto M, Sauquet H, Laffan SW (2013) Landscape Patterns in Rainforest Phylogenetic Signal: Isolated Islands of Refugia or Structured Continental Distributions?. PLoS ONE 8(12)



Continental rainfall

Rainforests occur in the wettest places

PLOS ONE


Fire intensity and impact
Erosion

Ancient Rainforests in a Changing World

Nothofagus - Antarctic Beech

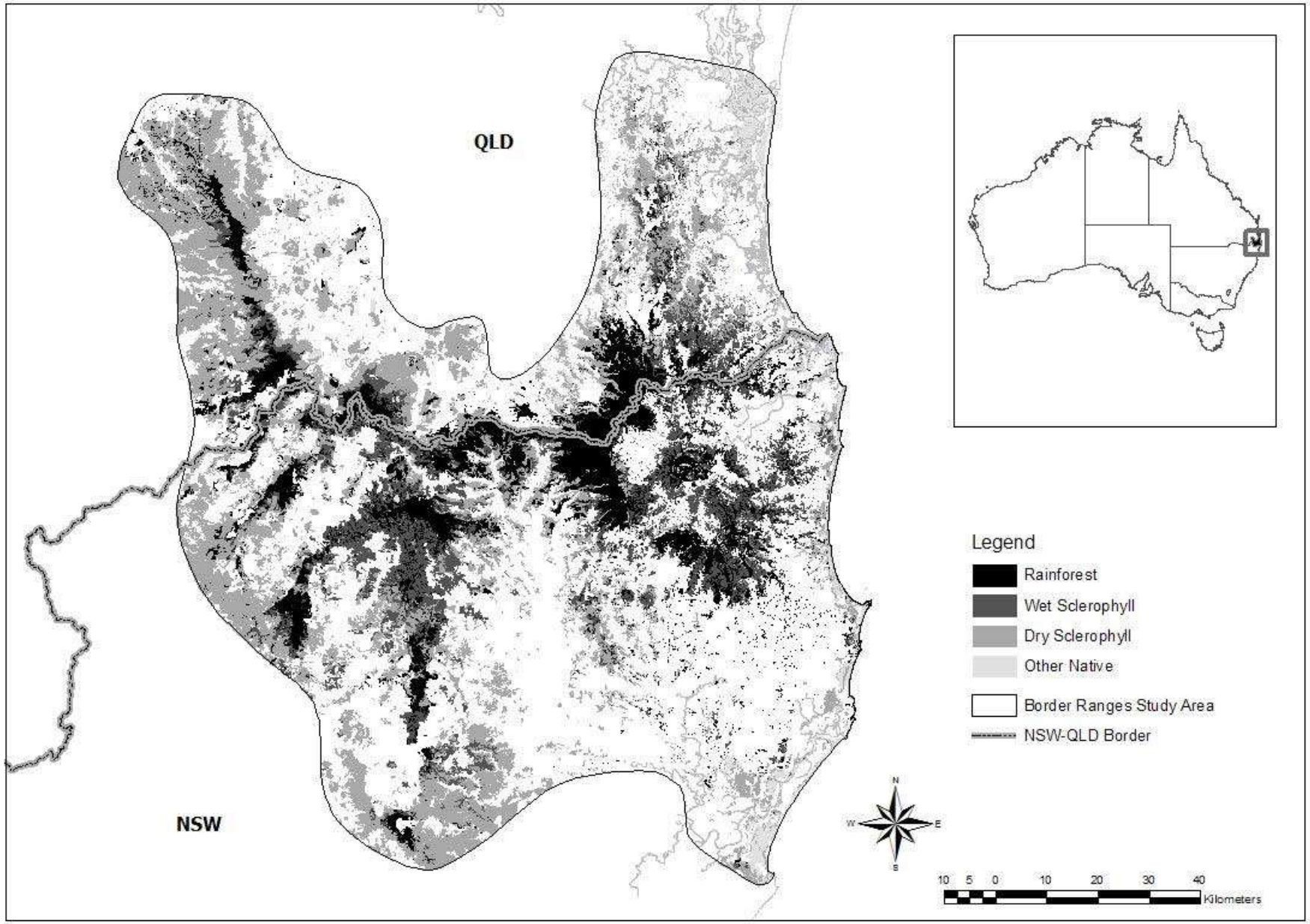
Rainforest with Gondwanan and Malesian elements

Rossetto, M., McPherson, H., Siow, J., Kooyman, R., van der Merwe, M. and Wilson, P.D. 2015. Where did all the trees come from? A novel multispecies approach reveals the impacts of biogeographical history and functional diversity on rain forest assembly. *Journal of Biogeography* 42: 2172-2186

Old-Growth Flooded Gum with Rainforest, Nightcap NP.

Many large trees with hollows lost.

> 90% lost previously to logging



Map provided by NSW OEH

Eidothea hardeniana – Proteaceae – Sch. 1

Uromyrtus australis – Myrtaceae – Sch. 1

Corokia whiteana – Argophyllaceae - Sch. 2

Hicksbeachia pinnatifolia – Proteaceae - Sch. 2

FREQUENTLY ASKED QUESTIONS

How badly has the Nightcap Oak been hit? Have the trees all been killed?

The impact on *Eidothea hardeniana* Weston & Kooyman Proteaceae (Nightcap Oak) is significant but as yet not fully evaluated. Monitoring of the whole population area is on-going and will take a few weeks yet

Perhaps as much as 30% of the habitat is affected, with perhaps 10% or more of the total population (of ca. 250 individuals) as mortalities, and this will likely increase with time.

Rainforest trees are mostly thin-barked and not tolerant of fire (with some exceptions), while seedlings and saplings quickly succumb.

What about other endemic trees and species like the Peach Myrtle?

With NPWS (SoS) we are currently undertaking surveys of the impact on Peach Myrtle (*Uromyrtus australis* A.J. Scott, Myrtaceae) and other threatened species.

Evaluations of the fire impacts in relation to both ecological and evolutionary function are being undertaken

Some sub-populations of Peach Myrtle have been destroyed, while others have been variously affected. In the main, the fire influence was mostly along the edges of the species habitat, but it has suffered badly in some locations.

A total of 16 threatened plant species and 27 threatened animal species were affected by fire in their rainforest and closely associated habitats in the Nightcap and adjacent NPs.

What will recovery look like/how long will it take in rainforests like this - will they recover or turn into other types of forest?

The data collected to date in the Nightcap suggests that historic logging played a major role in fire behaviour across the forest because of rainforest clearing, woody material left post-logging, and the spatial and size class rearrangement of tree and shrub species adjacent to rainforest refugia areas.

Rainforest recovery in some cases will be slow with the loss of large trees of sometimes enormous ages (>500 to 1000 years in some cases) making full recovery something well beyond human lifespans. However, seedling based regeneration and some resprouting (of some species) will occur. These are mostly natural forest areas with a strong natural regenerative capacity and a low incidence of weeds (at least on the lower nutrient soils).

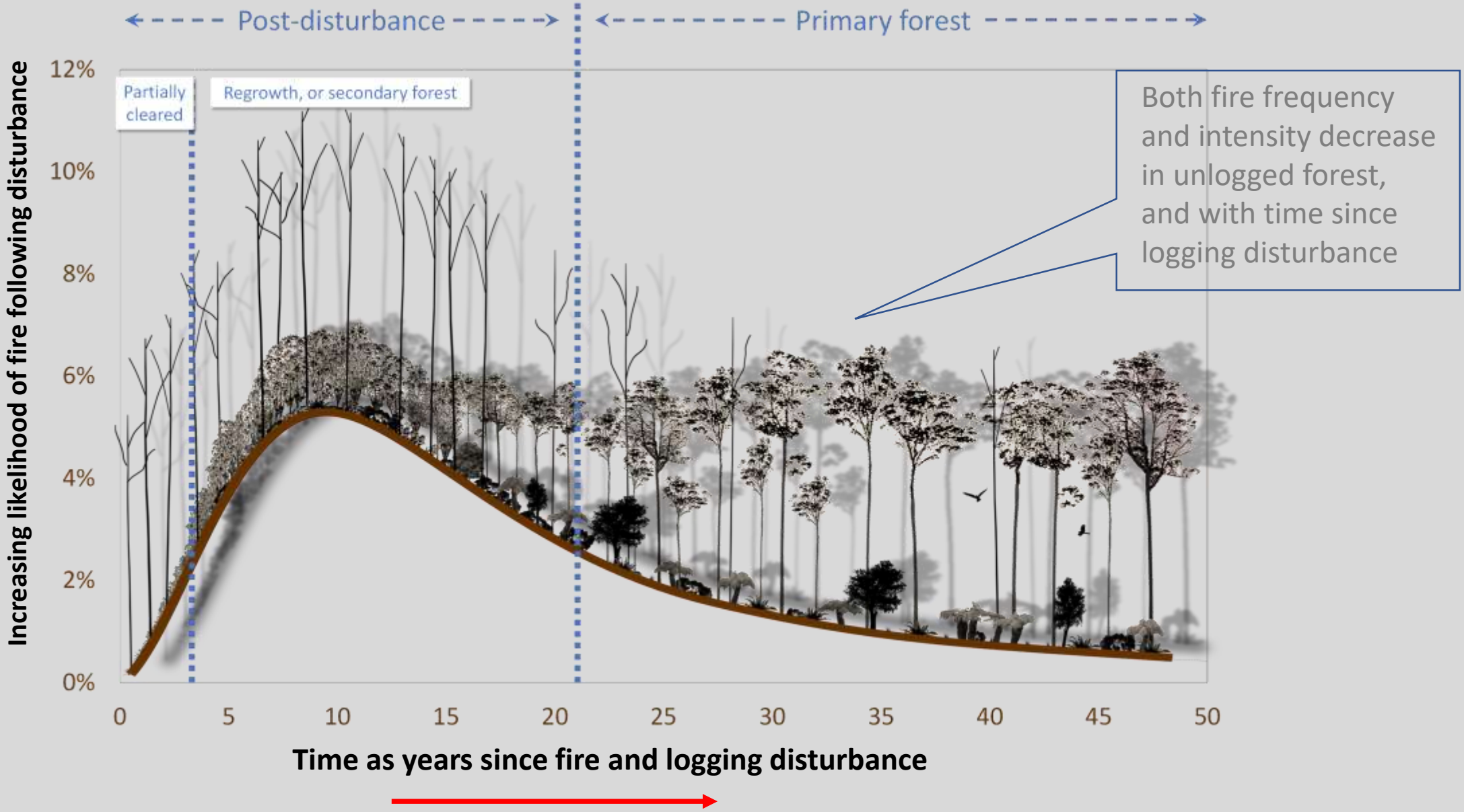
The issue is the assault on more than 40 My of evolutionary history and the loss of ecological function (e.g., large fruit producing habitat trees, canopy decline and loss of forest structure) that will impact on the forest for many decades and in some cases hundreds of years. For some threatened species, the fire has pushed them yet closer to extinction.

Will we need to intervene to help these natural areas recover?
How? - by planting trees or seeds..?

Seeding and tree planting in such scenarios is not necessary and may actually be a threatening process in itself unless guided by approved Recovery Plans and informed by both genetic and demographic work to develop the best strategy.

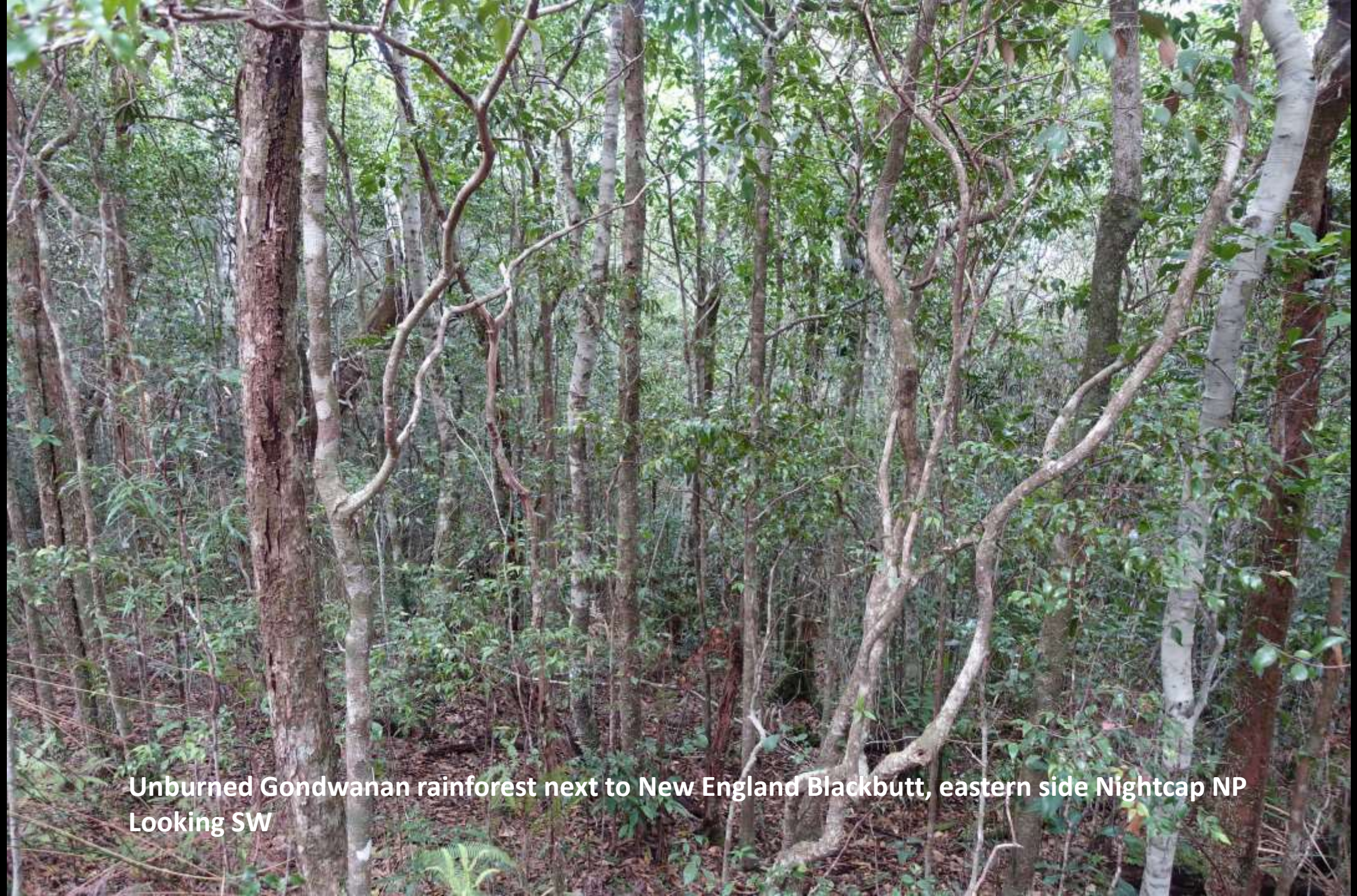
In general the best contribution we can make is to protect the natural systems and the natural ecological processes and intervene only after careful evaluation, and then only to assist the natural processes by (as an example) removing competing weed (or aggressive post-fire) species that might displace the rainforest or particular species.


Above Huonbrook, eastern side Nightcap NP



Flammability dynamics in eucalypt forest. The brown curved line shows the empirically measured annual likelihood of fire per ha, and the changes in regenerating forest are shown with years since fire. Zylstra 2014

Unburned Gondwanan rainforest next to New England Blackbutt, eastern side Nightcap NP



Unburned Gondwanan rainforest next to New England Blackbutt, eastern side Nightcap NP
Looking SW

Unburned Gondwanan rainforest next to New England Blackbutt, eastern side Nightcap NP
Looking NE from same location

Were the lowland sub-tropical rainforests affected by these fires?

Mostly not, and certainly not to the same extent as the upland rainforests. However, in parts of SE Qld (Lamington NP foothills) they were affected.

Should we plant more rainforest in the landscape to buffer against fire?

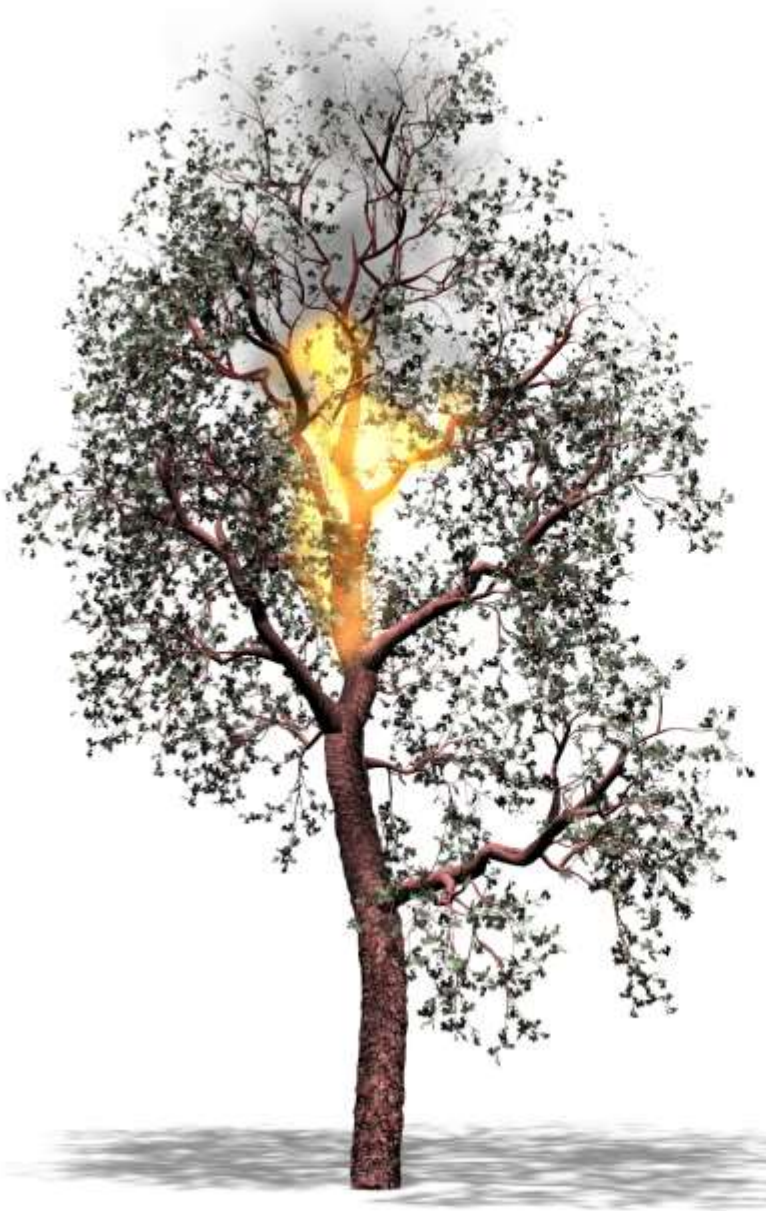
Expanding the area of rainforest on previously cleared privately owned lands to buffer against future fires in the landscape is a good strategy, and one that collectively we can, and should support. In some cases rainforest may be destroyed by fire but it is also resistant to fire, and modifies fire behaviour.

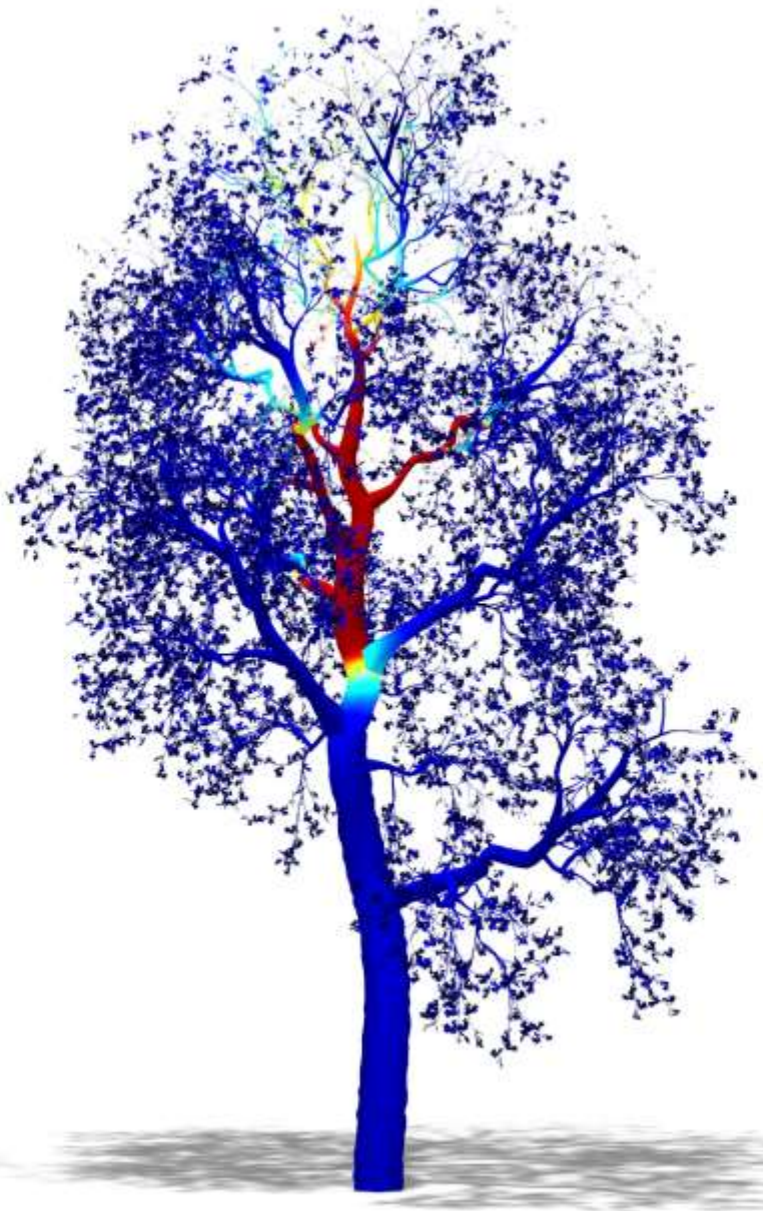
Groups like ENVITE and Big Scrub Landcare have been doing that for many years and understand the role of rainforest in the landscape. Talk to them and people like Mark Dunphy about how to do that.

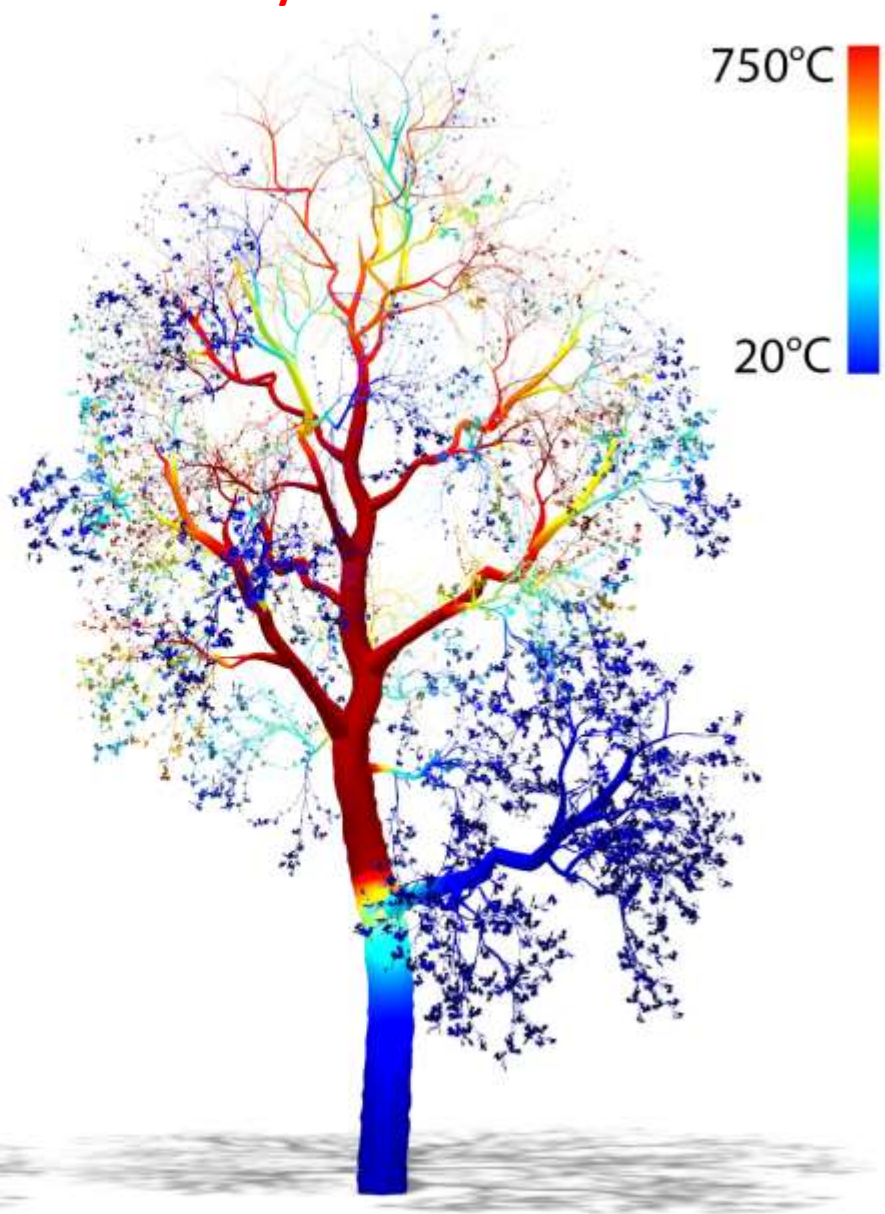
Vegetation structure, Flammability and Fire behaviour: What do we know?

Interactive Wood Combustion for Botanical Tree Models. 2017. SÖREN PIRK, Stanford University. MICHAŁ JARZĄBEK, TORSTEN HÄDRICH, DOMINIK L. MICHELS, WOJCIECH PALUBICKI

A: Way hotter than this model…







How hot is a forest fire?

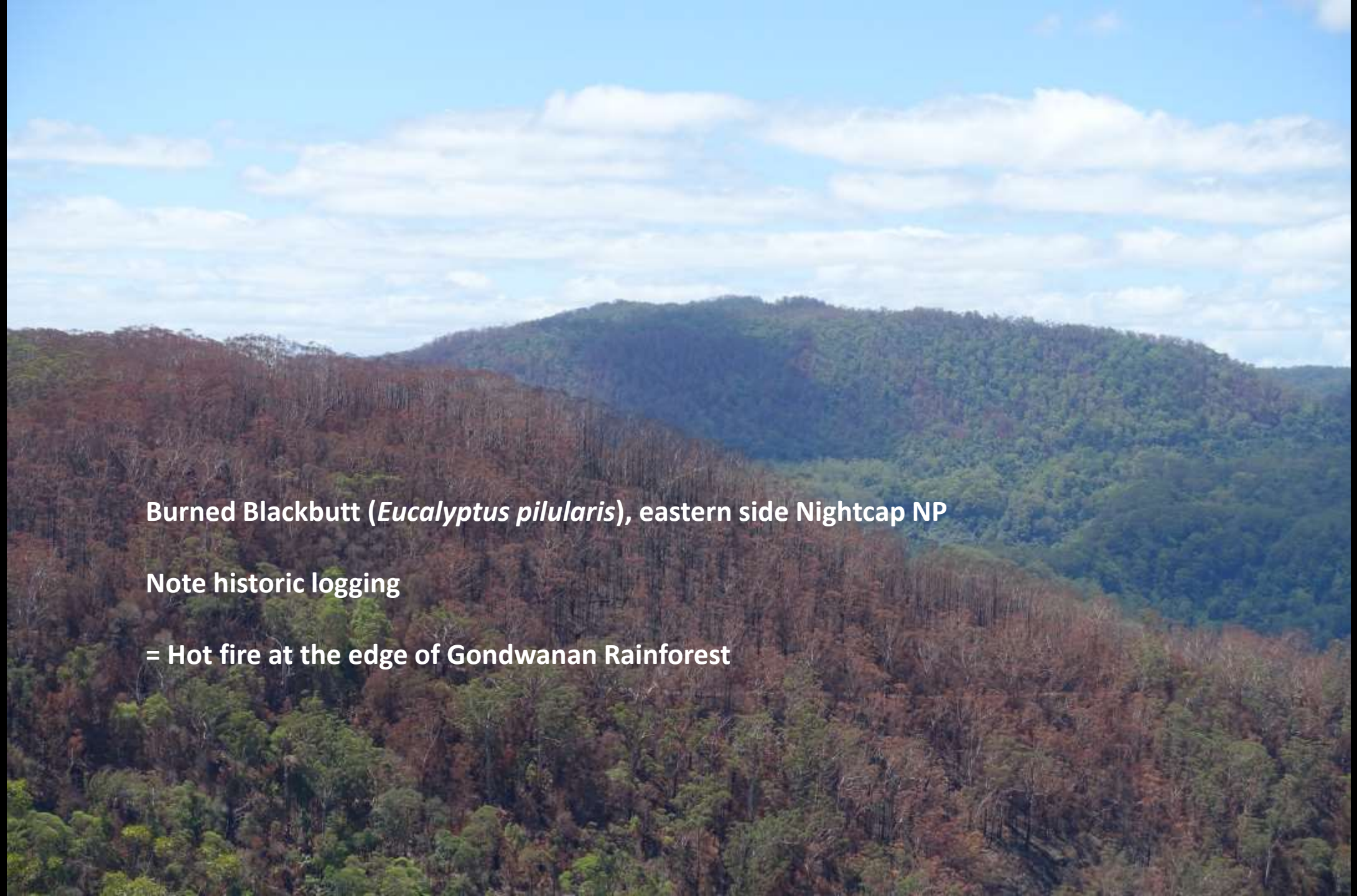
Burned New England Blackbutt, eastern side Nightcap NP

Note historic logging debris and residues

Burned New England Blackbutt, eastern side Nightcap NP

Note historic logging debris and residues

= Hot fire at the edge of Gondwanan Rainforest

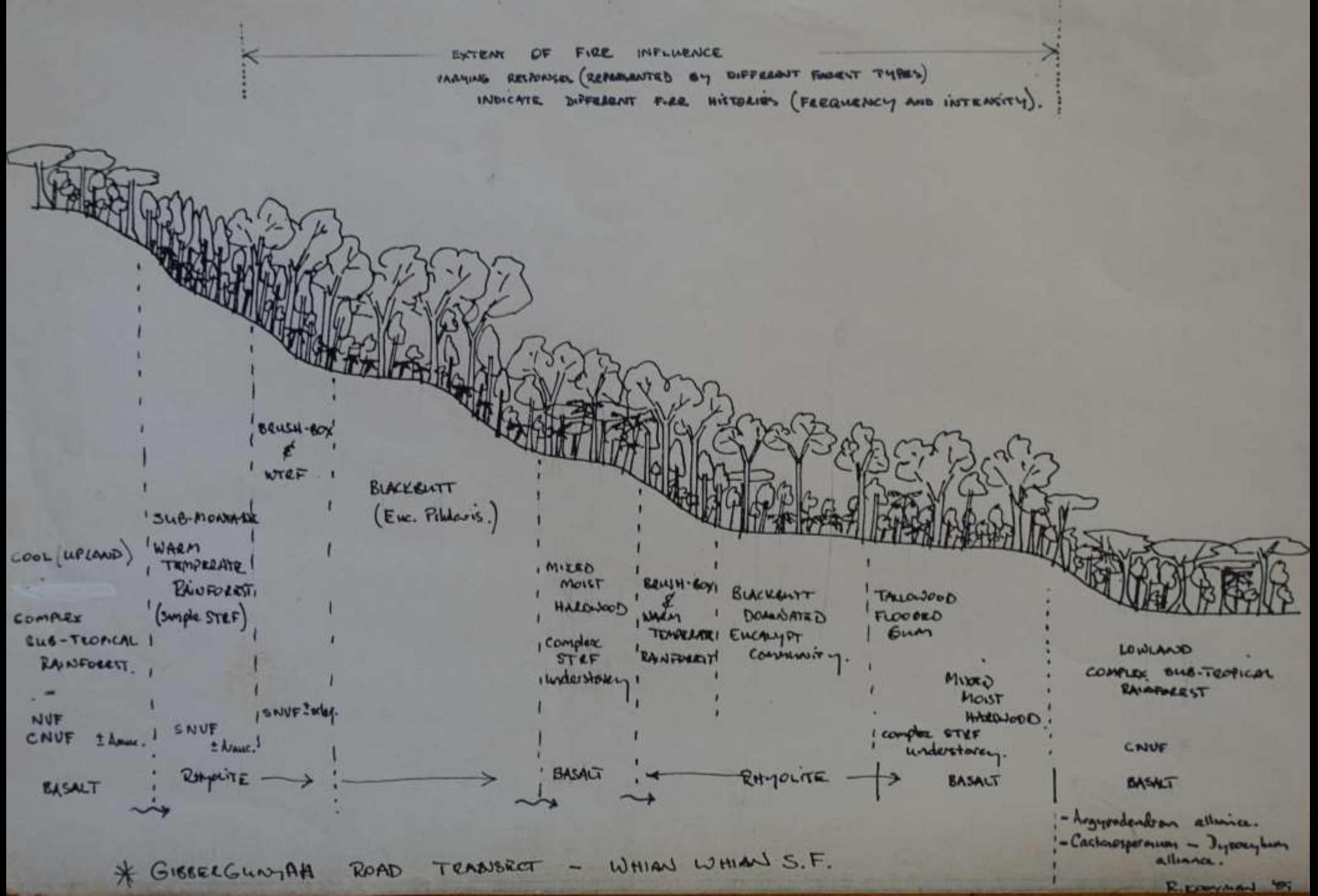


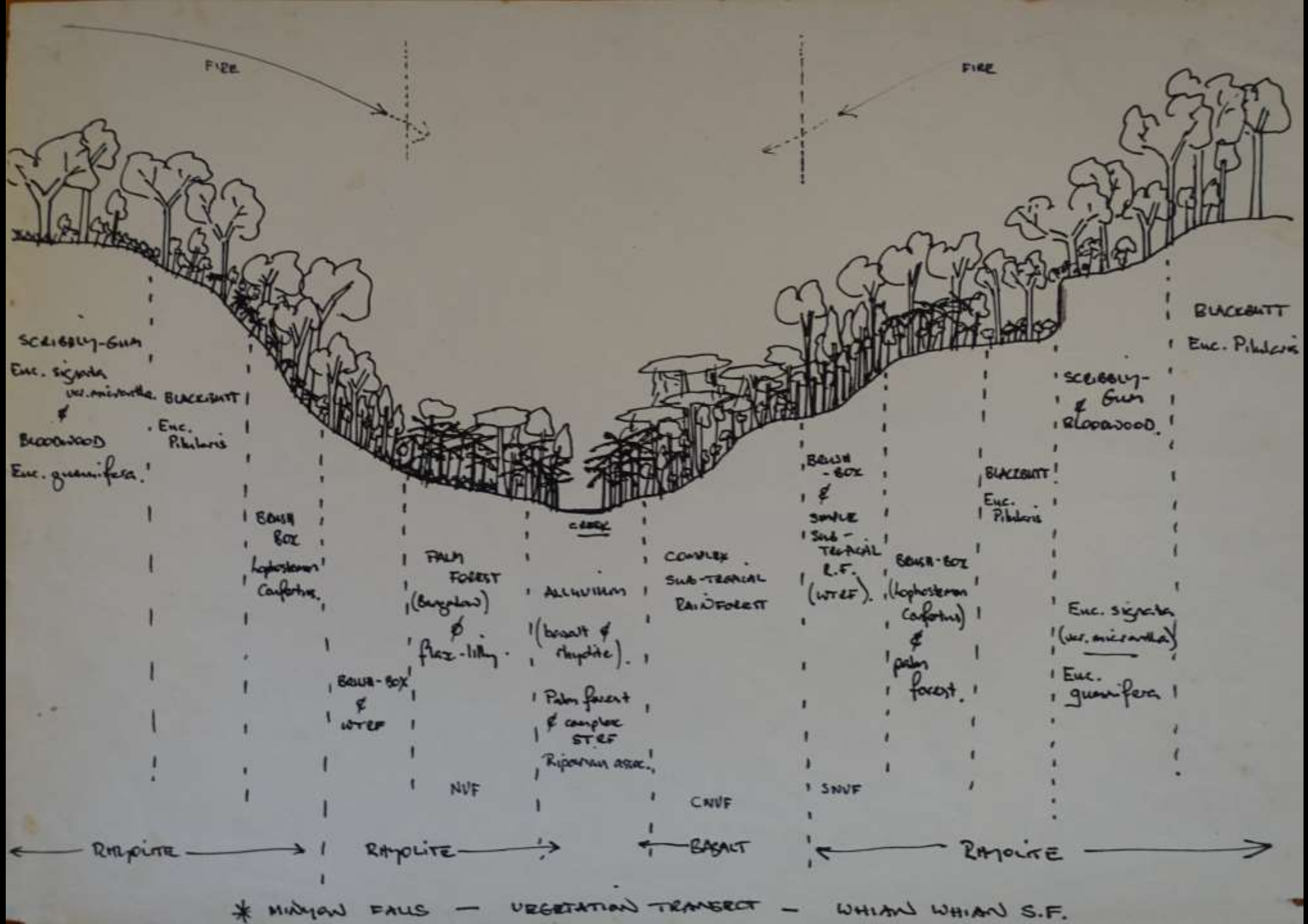
Burned Blackbutt (*Eucalyptus pilularis*), eastern side Nightcap NP

Note historic logging

= Hot fire at the edge of Gondwanan Rainforest


Flooded Gum
+ rainforest
Brush Box
+ rainforest
Tea-tree Rocky Heath
Brush
Box
Brush Box
+ rainforest
Rainforest – Coachwood type
with Hoop Pine
New England Blackbutt


EXTENT OF FIRE INFLUENCE
VARYING RESPONSES (REPRESENTED BY DIFFERENT FOREST TYPES)
INDICATE DIFFERENT FIRE HISTORIES (FREQUENCY AND INTENSITY).
BRUSH-BOX & WTRF
BLACKBUTT (Euc. Pilularis.)
SUB-MONTANE WARM TEMPERATE RAINFOREST (simple STRF)
COOL (UPLAND) COMPLEX SUB-TROPICAL RAINFOREST.
NVF
CNUF ± Acmc.
SNUF ± Acmc.
SNUF ± Acmc.
BASALT
RHYOLITE
MIXED MOIST HARDWOOD
Complex STRF understorey
BASALT
BRUSH-BOX & WARM TEMPERATE RAINFOREST
BLACKBUTT DOMINATED EUCALYPT COMMUNITY.
RHYOLITE
TALLOWOOD FLOODED GUM
MIXED MOIST HARDWOOD
complex STRF understorey.
BASALT
LOWLAND COMPLEX SUB-TROPICAL RAINFOREST
CNUF
BASALT
- Argyrodendron alliance.
- Cactaceae-Proteaceae - Dysoxylum alliance.
* GIBBERGUNYAH ROAD TRANSECT - WHIAN WHIAN S.F.
R. FOREMAN '85


FIRE
FIRE
SCRIBBLY-GUM
Euc. signata
var. miniata
&
BLOODWOOD
Euc. gummifera
BLACKBUTT
Euc. Pilularis
BOXA BOX
Lophostemon Confertus
FALSE FOREST (Bungalow) & flax-lilly
BOXA-BOX & WTEF
CREEK
ALLUVIUM (basalt & rhyolite)
Palm forest & complex STEF
Riparian assc.
COMPLEX SUB-TROPICAL RAINFOREST
NVF
CNVF
BOXA-BOX & SNVF SUB-TROPICAL R.F. (WTEF)
BOXA-BOX (Lophostemon Confertus) & palm forest
BLACKBUTT
Euc. Pilularis
SCRIBBLY-GUM & BLOODWOOD
BLACKBUTT
Euc. Pilularis
Euc. signata (var. miniata)
Euc. gummifera
RHYOLITE
RHYOLITE
BASALT
RHYOLITE
* MINYON FALLS — VEGETATION TRANSECT — WHIAN WHIAN S.F.

Paleo-Antarctic Rainforest Lineages
The Gondwanan ‘Survivors’

Riding on Australia (Sahul), the survival and movement of ‘woody’ Gondwanan lineages from Patagonia-Antarctica to S.E. Asia (70 Mya to Present) is one of the great biological survival stories.

This natural-history adventure features an incredible slow-motion escape from ice-age impacts, massive climate change and extinction, and for some ancient lineages ends in a breathtaking last minute leap onto the recently uplifted mountains of Papua and S.E. Asia.

Can they survive the combination of human impacts and climate change?

Kooyman, R.M., Wilf, P., Barreda, V.D., Carpenter, R.J., Jordan, G.J., Sniderman, J.M.K., Allen, A., Brodribb, T.J., Crayn, D., Feild, T.S., Laffan, S.W., Lusk, C.H., Rossetto, M., Weston, P.H. (2014**) Paleo-Antarctic Rainforest into the Modern Old World Tropics: the Rich Past and Threatened Future of the ‘Southern Wet Forest Survivors’** *American Journal of Botany* 101:2121-2135.

K – Late Cretaceous = ca. 70 Mya
P-E – Paleocene to Eocene = 60 - 34 Mya
Ne+O – Neogene + Oligocene = 34 – 2.6 Mya
Current day floras by location.

Kooyman, R.M., Wilf, P., Barreda, V.D., Carpenter, R.J., Jordan, G.J., Sniderman, J.M.K., Allen, A., Brodribb, T.J., Crayn, D., Feild, T.S., Laffan, S.W., Lusk, C.H., Rossetto, M., Weston, P.H. (2014) **Paleo-Antarctic Rainforest into the Modern Old World Tropics: the Rich Past and Threatened Future of the 'Southern Wet Forest Survivors'.** *American Journal of Botany* 101:2121-2135.

Eidothea hardeniana – Proteaceae – Sch. 1

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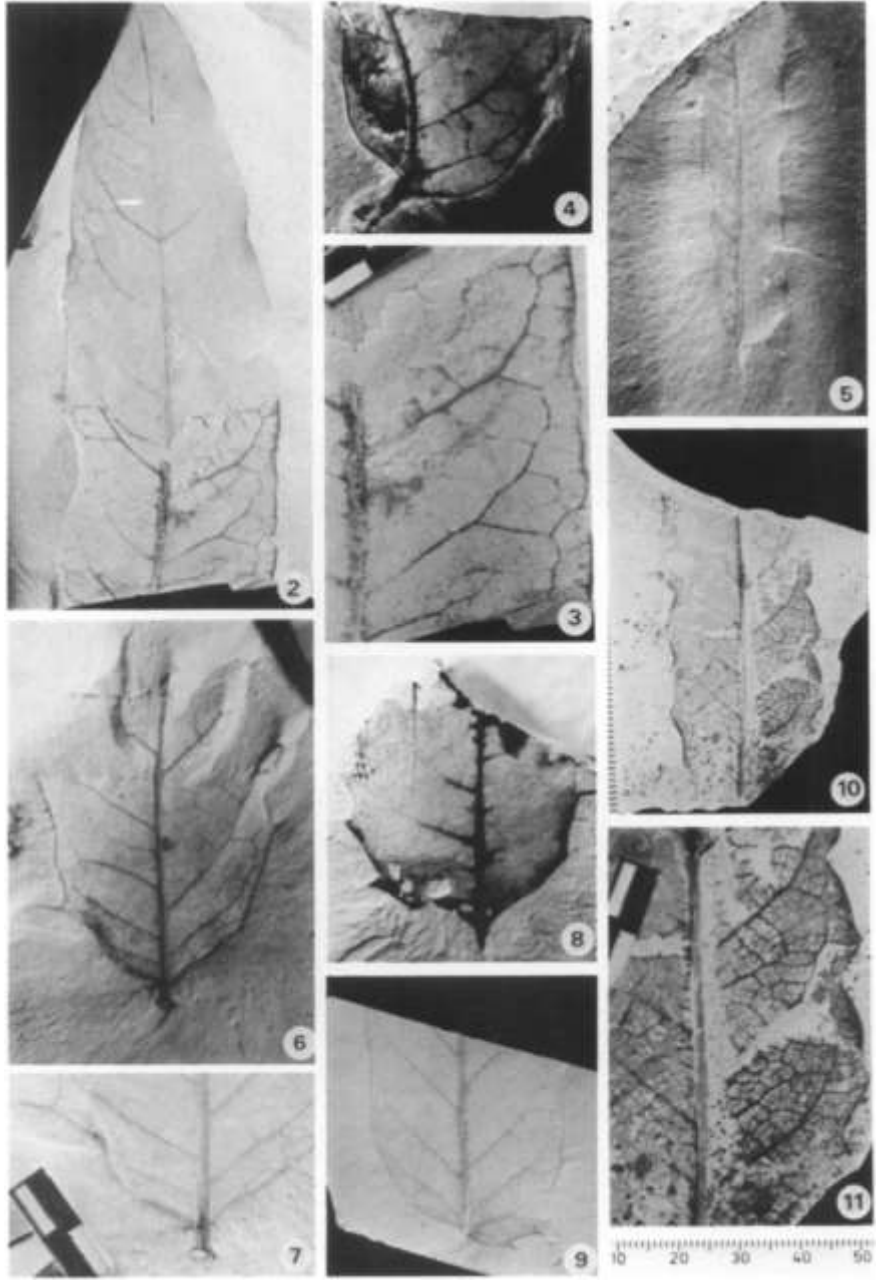
Hicksbeachia pinnatifolia – Proteaceae - Sch. 2

Paleo-Antarctic Rainforest Lineages

Community Assembly through time:

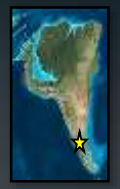
Ceratopetalum, Ackama / Caldcluvia, Austrobuxus, Araucaria, Akania, Ripogonum, diverse Laurales, Orites, Wilkiea, Todea, Dicksonia, Sticherus … and many more…

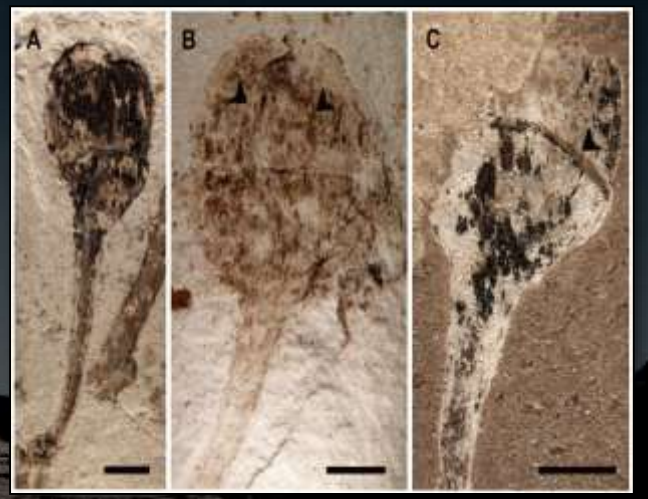
Ancient Forests in the Modern World

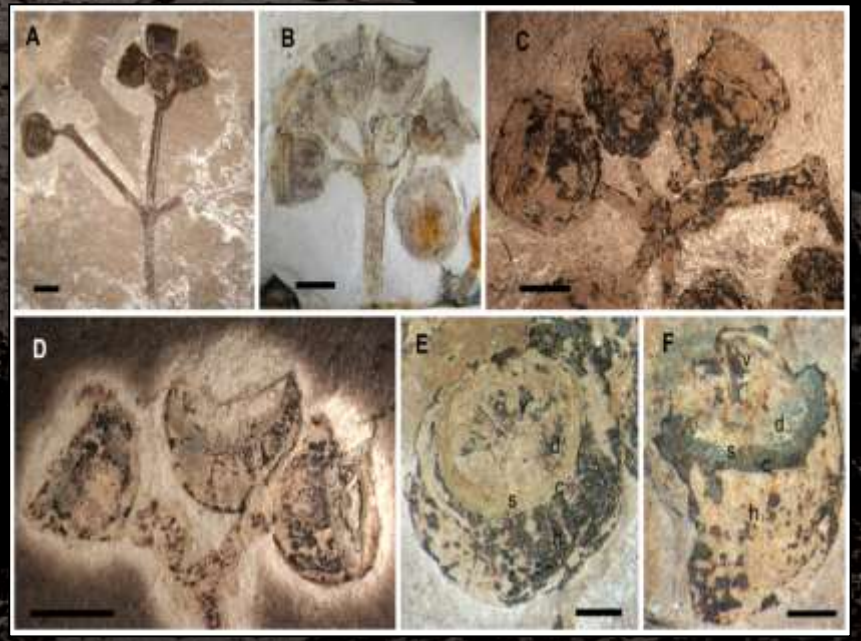


M. A. Gandolfo, M. C. Dibbern and E. J. Romero. 1988*. Akania patagonica* n. sp. and Additional Material on *Akania americana* Romero & Hickey (Akaniaceae), from Paleocene Sediments of Patagonia. *Bulletin of the Torrey Botanical Club* 115: 83-88.

Patagonia's fossil Eucalyptus: *Eucalyptus* leaves, flowers, fruits.
Gandolfo et al. 2011; Hermsen et al. 2012







Upland heaths (*Leptospermum*; wet and dry types)


Flooded Gum
+ rainforest
Brush Box
+ rainforest
Tea-tree Rocky Heath
Brush
Box
Brush Box
+ rainforest
Rainforest – Coachwood type
with Hoop Pine
New England Blackbutt


Post-fire research and monitoring


Post-fire research and monitoring

Post-fire research and monitoring

Acacia orites will add more fire influence to the forest

Eidothea hardeniana – Nightcap Oak

Eidothea hardeniana – Nightcap Oak. Ancient basal lineage in Proteaceae

LEST WE EVER FORGET >40 My of Australian evolutionary history