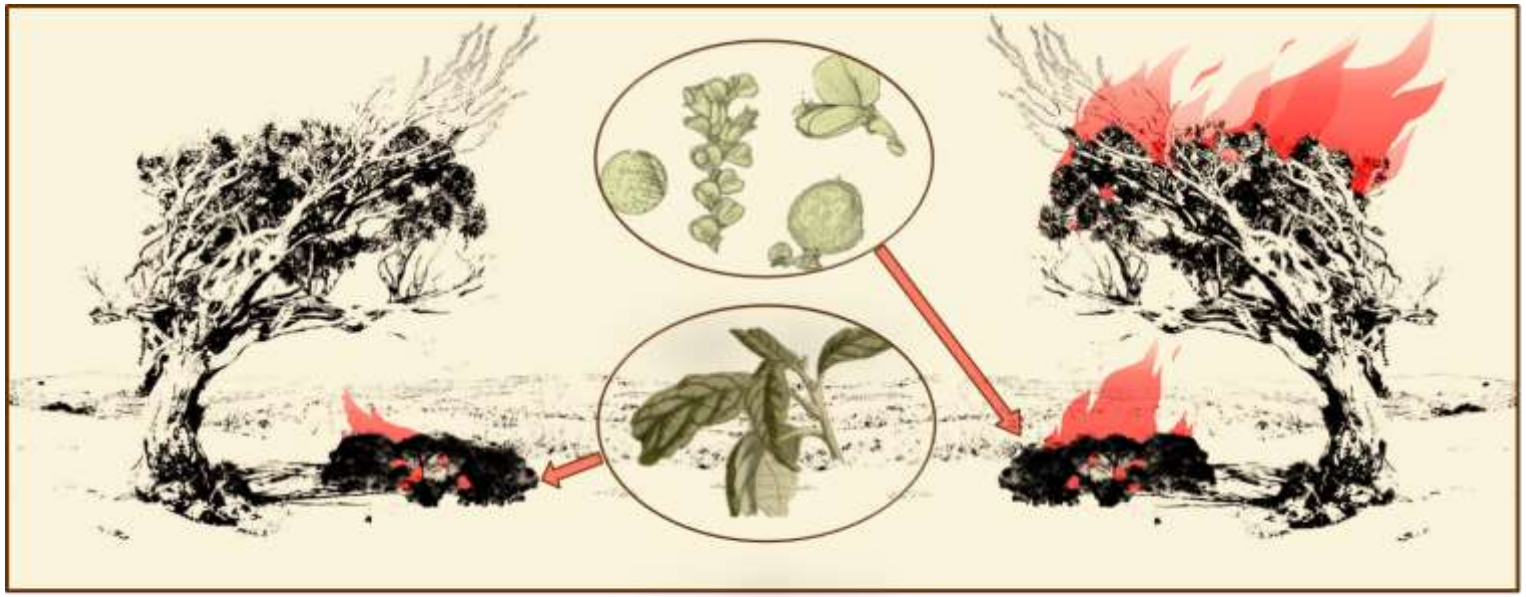
Biophysical modelling of risks and feedbacks from forest fires

The role of plant traits



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UNIVERSITY OF WOLLONGONG AUSTRALIA

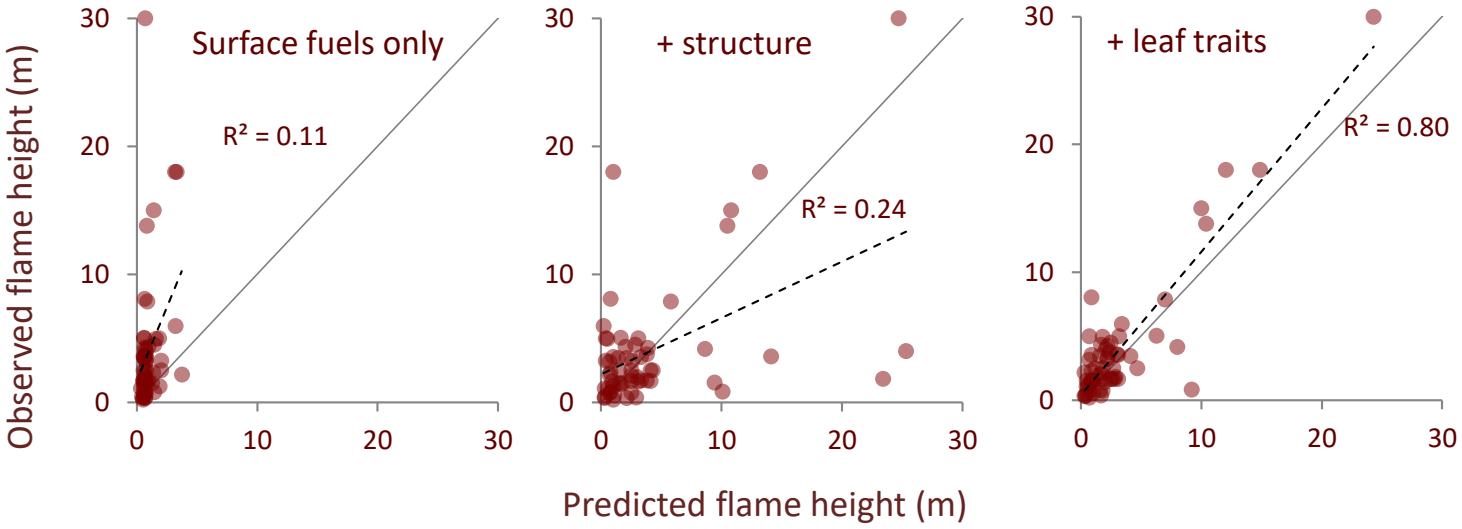
Plant traits

Ecosystems

CURRENT APPROACHES

1. Represent flammability with *fuel load*

2. Approximate plant trait effects



PLOS ONE

RESEARCH ARTICLE

Biophysical Mechanistic Modelling Quantifies the Effects of Plant Traits on Fire Severity: Species, Not Surface Fuel Loads, Determine Flame Dimensions in Eucalypt Forests

Philip Zylstra[1]*, Ross A. Bradstock[1], Michael Bedward[1,2], Trent D. Penman[2,3], Michael D. Doherty[2,3], Rodney O. Weber[4], A. Malcolm Gill[3], Geoffrey J. Cary[3]

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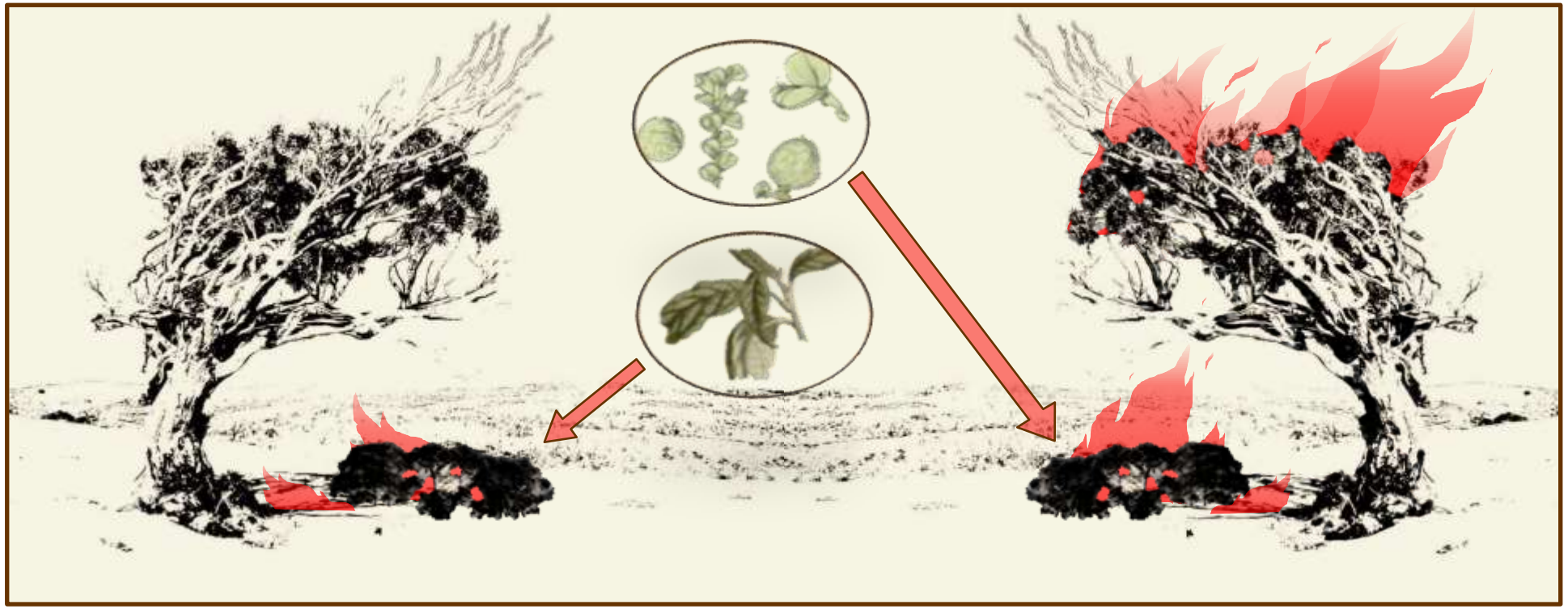


Plant traits

A physical model of heat transfer from a burning leaf, plant or stratum to its neighbours

+

Plant and community structure

+

Leaf trait effects on flammability

Fire behaviour

?

Fire impacts

Ecosystem influences

Alpine Ash *Eucalyptus delegatensis*

Yellow-bellied Glider

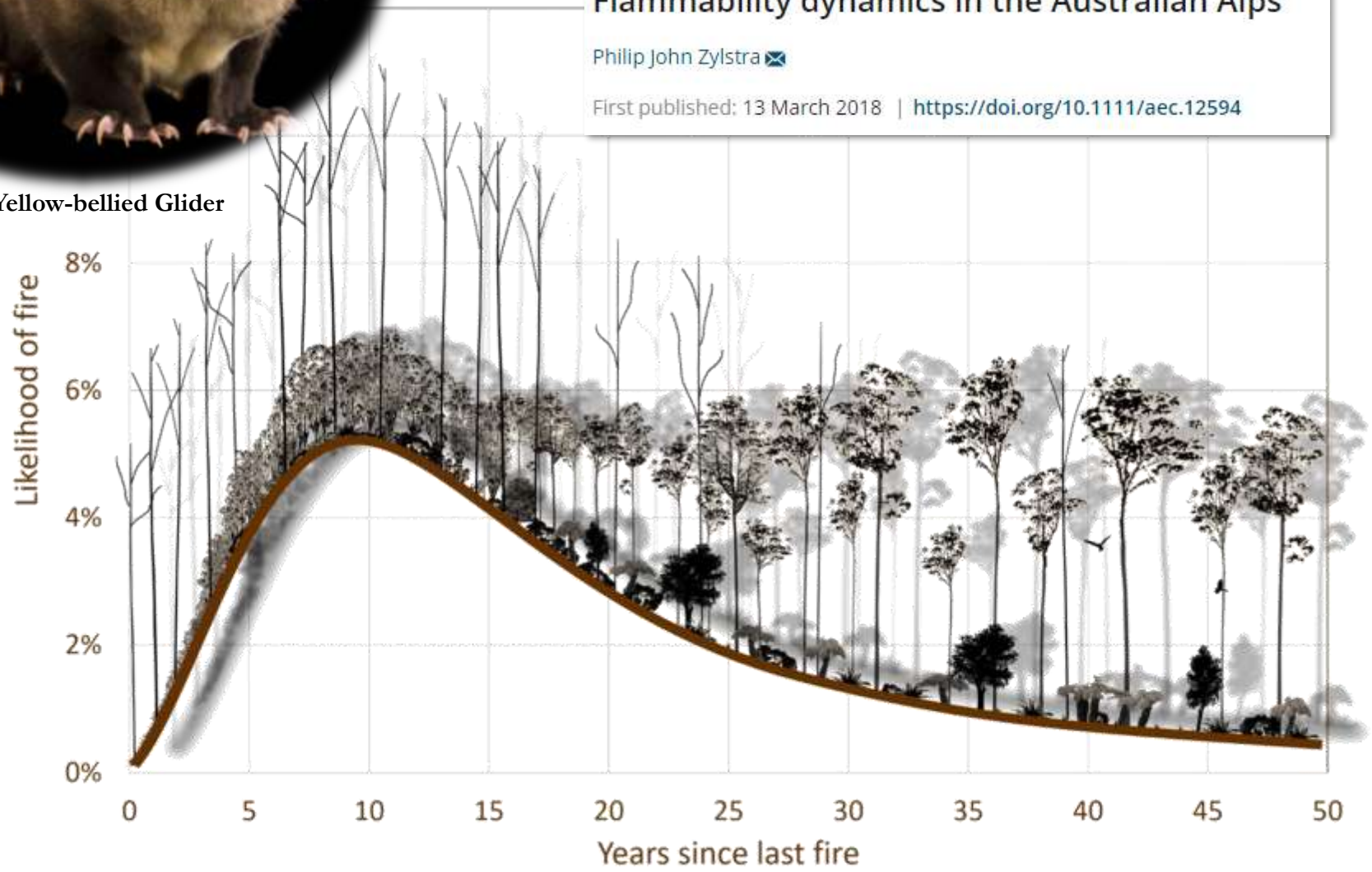
Austral ECOLOGY
A Journal of ecology in the Southern Hemisphere
Ecological Society of Australia

Original Article

Flammability dynamics in the Australian Alps

Philip John Zylstra

First published: 13 March 2018 | https://doi.org/10.1111/aec.12594

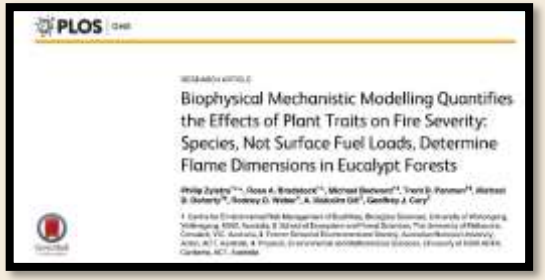


FRaME

Fire Research and Modelling Environment

Plant traits

Forest Flammability Model



Fire behaviour

Heat transfer physics
+
Thermal properties of soils, bark, wood etc
+
Ecology/physiology of flora and fauna

Fire impacts

Ecosystem influences

FRaME

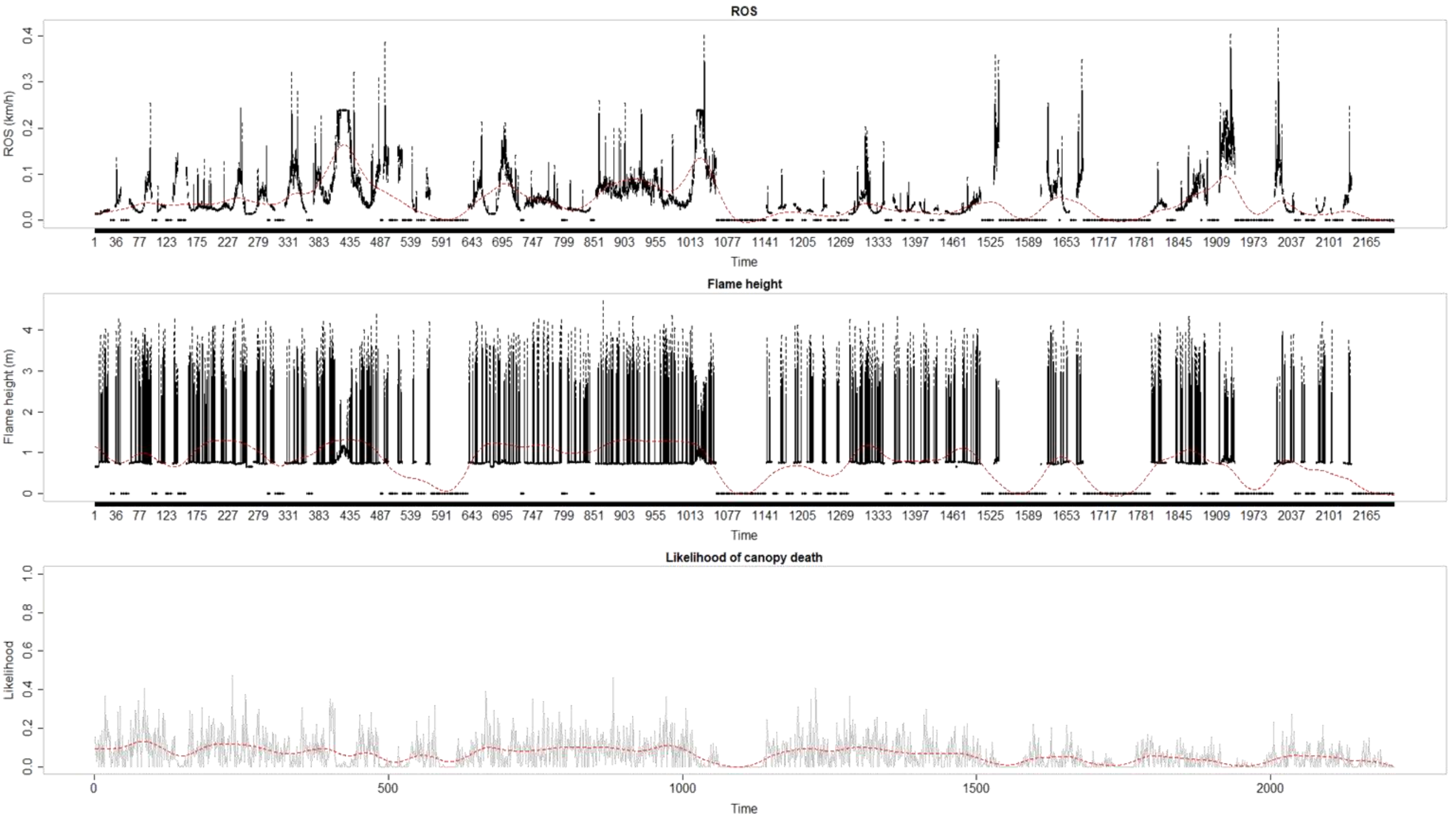
Fire Research and Modelling Environment

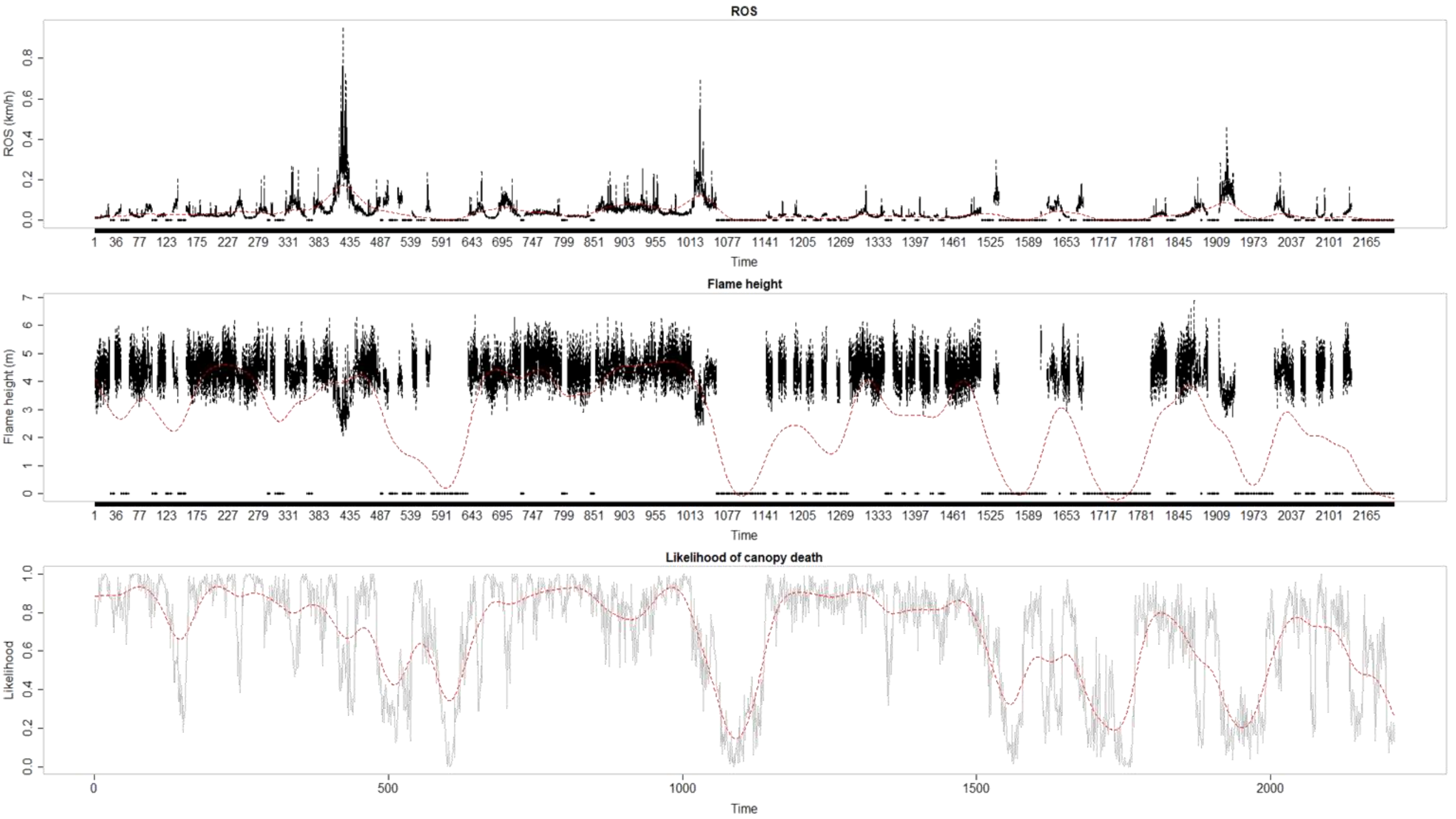
Fire behaviour

```
Average flame height = 1 m, (s.d.= 0.7 m)
Average flame length = 1 m, (s.d.= 0.6 m)
Average rate of spread = 0.03 km/h, (s.d.= 0.02 km/h)
Direct attack was possible 88 % of the time
Parallel attack was possible 95 % of the time
```

Percentiles of fire behaviour (m, km/h)

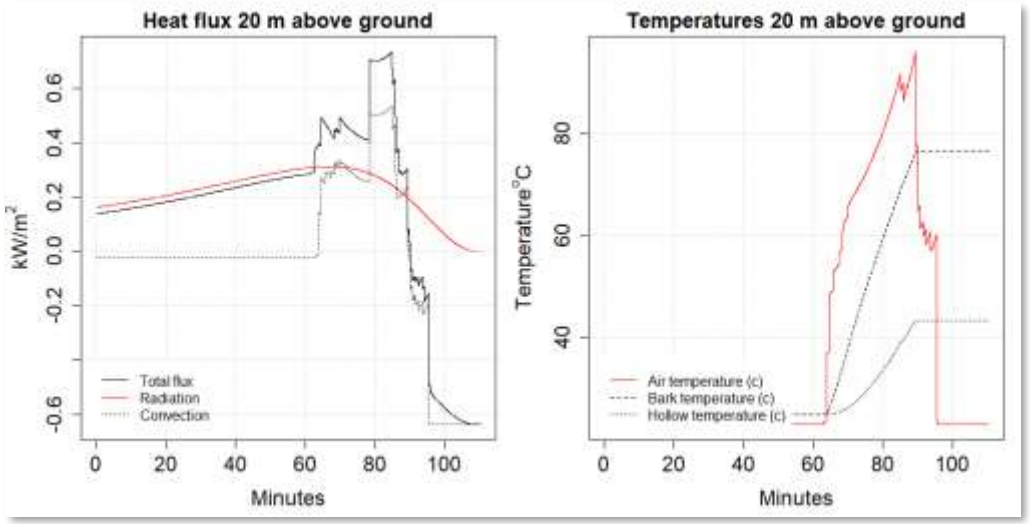
	Height	Length	ROS
0%	0.7	0.8	0.02
5%	0.7	0.8	0.02
25%	0.8	0.8	0.02
50%	0.8	0.8	0.03
75%	0.8	0.8	0.03
95%	2.9	2.7	0.08
100%	3.8	3.5	0.11


ROS
ROS (km/h)
0.0
0.1
0.2
0.3
0.4
1 36 77 123 175 227 279 331 383 435 487 539 591 643 695 747 799 851 903 955 1013 1077 1141 1205 1269 1333 1397 1461 1525 1589 1653 1717 1781 1845 1909 1973 2037 2101 2165
Time
Flame height
Flame height (m)
0
1
2
3
4
1 36 77 123 175 227 279 331 383 435 487 539 591 643 695 747 799 851 903 955 1013 1077 1141 1205 1269 1333 1397 1461 1525 1589 1653 1717 1781 1845 1909 1973 2037 2101 2165
Time
Likelihood of canopy death
Likelihood
0.0
0.2
0.4
0.6
0.8
1.0
0
500
1000
1500
2000
Time


ROS
ROS (km/h)
0.0
0.2
0.4
0.6
0.8
1 36 77 123 175 227 279 331 383 435 487 539 591 643 695 747 799 851 903 955 1013 1077 1141 1205 1269 1333 1397 1461 1525 1589 1653 1717 1781 1845 1909 1973 2037 2101 2165
Time
Flame height
Flame height (m)
0 1 2 3 4 5 6 7
1 36 77 123 175 227 279 331 383 435 487 539 591 643 695 747 799 851 903 955 1013 1077 1141 1205 1269 1333 1397 1461 1525 1589 1653 1717 1781 1845 1909 1973 2037 2101 2165
Time
Likelihood of canopy death
Likelihood
0.0 0.2 0.4 0.6 0.8 1.0
0 500 1000 1500 2000
Time

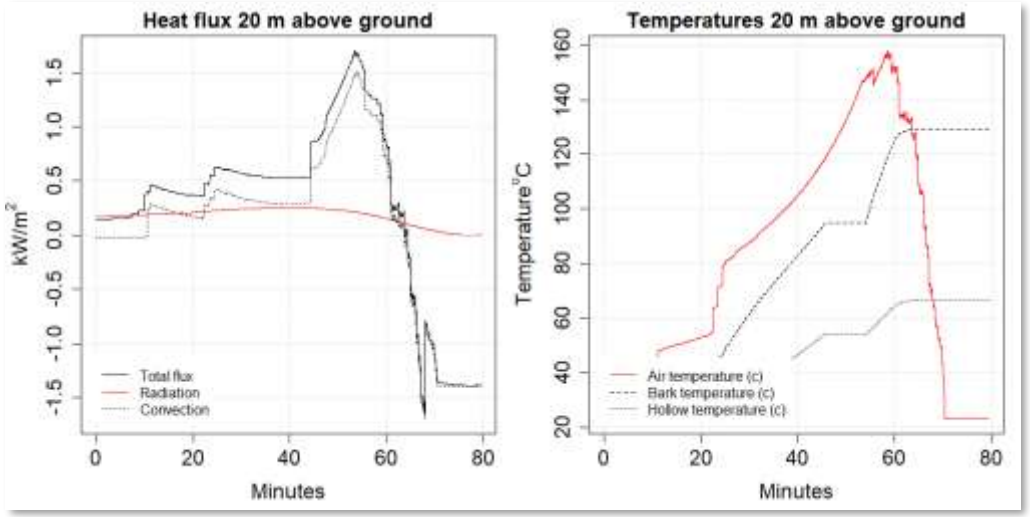
Fauna risk statistics

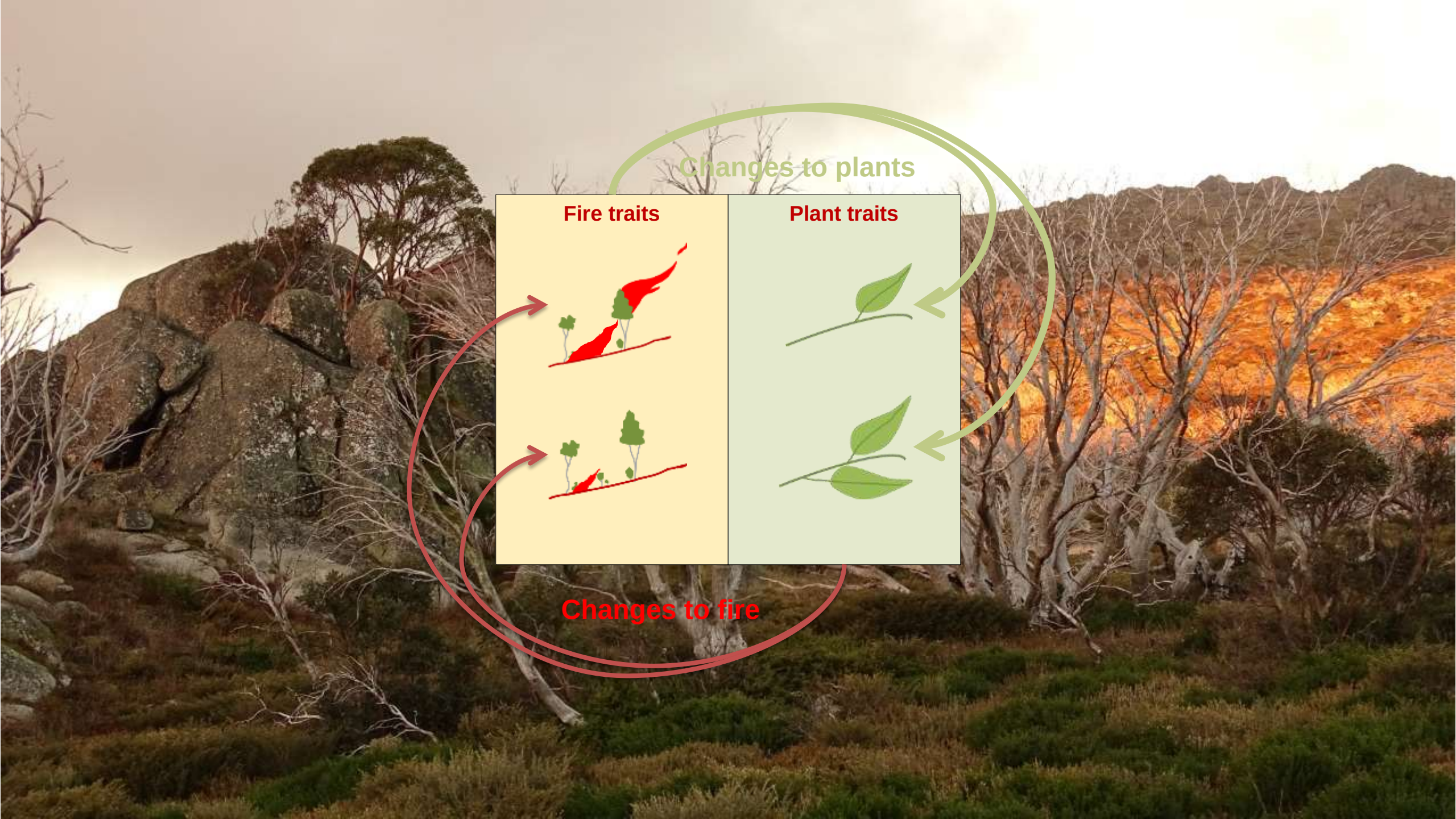
The hollow was heated to 43 degrees Celsius
Mortality was 0 % likely



Fauna risk statistics

The hollow was heated to 66 degrees Celsius
Mortality was 100 % likely




Changes to plants
Fire traits
Plant traits
Changes to fire

Thanks to:

- NSW Environmental Trust
- Australian Alps Liaison Committee
- ACT National Parks Association