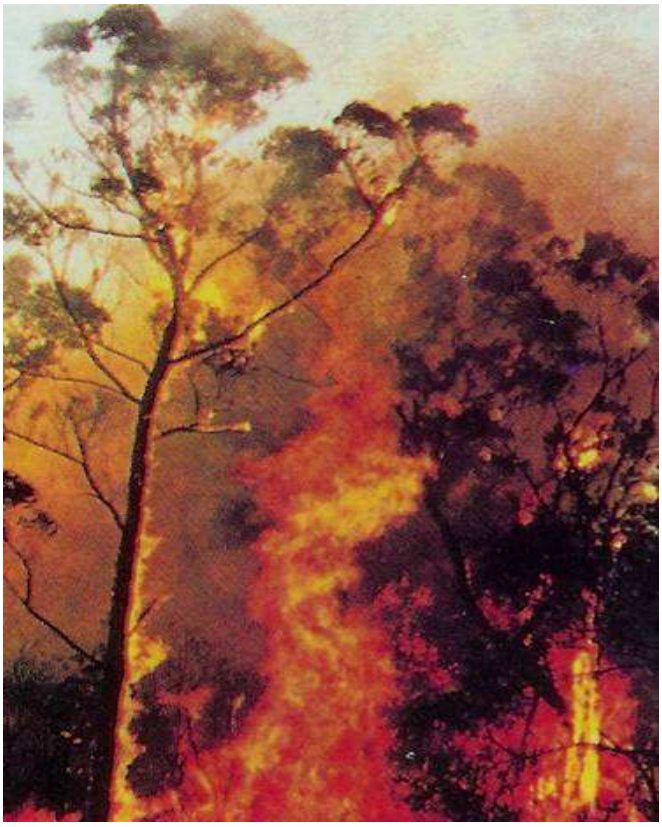
Tasmania's Ancient Bushfire Heritage



Bushfires are usually seen purely as a disaster or a tragedy. However, they have also had a vital role to play in the regeneration, growth and health of Tasmania's natural environment for millions of years.

Part I. FUELS AND FIRE BEHAVIOUR

1. Flammable World Forests

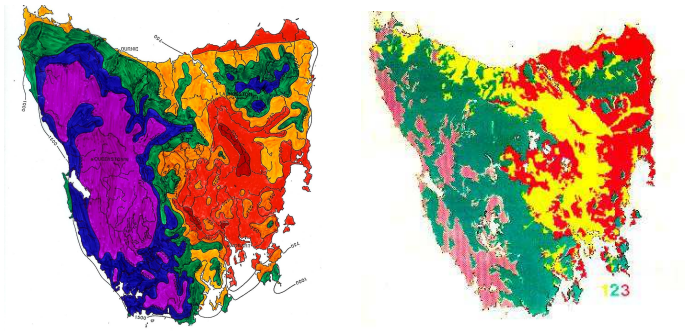
80% of world forests have summer or year-round rainfalls (warm and wet) and decay is rapid so enough fuel to carry a bushfire seldom builds up. The other 20% of world forests have cold/wet winters and hot/dry summers. Both slow down decay - so dead plant parts build up and dry below 16% moisture content each summer to become bushfire fuels. This 20% includes the world's tallest hardwoods in Tasmania and Victoria; and the tallest softwoods in western USA & Canada.

2. How Bushfires Start and Spread

Only fire makes charcoal - specks of which can be found in sandstones 300 million years old. For these fires to have started and spread requires lightning and enough time for dry fallen leaves and bark to have built up. When rain also occurs lightning fires can still start in hollow or rotten trees, or in deep peat layers. Humans began using fire about 500,000 years ago in Africa and some 40,000 years ago in Tasmania

3. Tasmanian Rainfalls and Vegetation Types

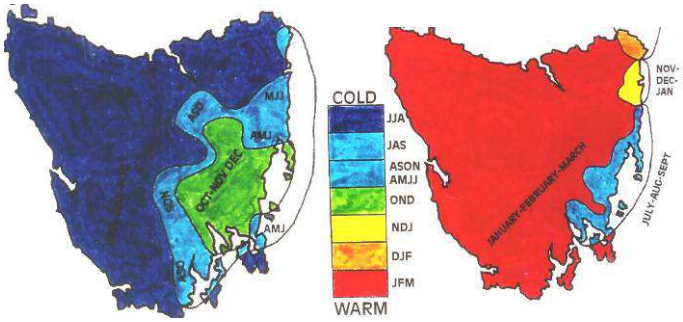
West & NE are wet and East & SE are dry. **Green, blue and violet** areas get over 1000 mm rain per year.



Pink and green = moorlands, rainforest, mixed forest and wet eucalypt forest that need more than 1000 mm per year. **Yellow =** grassy woodland or cleared. **Red** = dry forest.

4. Why Tasmanian Bushfire Fuels Build Up

Autumns, winters and springs are wet, ensuring good growth, but cool so decay is slow. Summers are warm and dry which means good drying but poor decay - so fuels build up all year.



Wettest three months are in Winter and Spring

Dryest three months are in Summer

5. Why Tasmanian Treeless Areas Burn

Buttongrass moorlands mostly grow on infertile, poorly drained soils. Their raised bases can hold coiled dead leaves above the soil and below a green and dead mat of leaves. These can be burnt over wet soils two fine days after heavy rains from age four onwards, (but many have not been burnt since 1934.)

Heathlands and *knee-high bracken* have enough fuel to burn from age four. But un-grazed *grasslands* can burn from age two.

6. Why Old Temperate Rainforests Burn

Charcoal layers make up to 25% of some Victorian brown coals formed up to 60 million years ago from temperate rainforests like those in Tasmania today. These layers show decay was never complete so dead plant parts slowly built up to become fuels that spread the lightning fires. They also show that these forests regenerated after every fire. Old trees die, leave gaps and let the sun in to dry mosses, lichens and other fuels. Fires are rare before age 80 but few temperate rainforests stay un-burnt for more than 400 years.

Dead and dying old temperate rainforest trees

Tea-Tree Bark carries fire up into rainforest crowns and is a major source of wind-blown sparks.

Mosses and Lichens on these sassafras trees and on logs and rocks can dry to become fuel without dying - so keep increasing in volume until the next fire.

Dry, Dead, Rotten Wood in an old rainforest is tinder for wind-blown sparks.

In Feb 1982 the Savage River Fire burnt 15,000 hectares of never-logged old rainforest, mostly as a crown fire, in one night – and all rainforest species have regenerated following the fire

7. Fires in Mixed Forest (Eucalypts over Rainforest)

These mixed forest eucalypts regenerated after a fire 300 to 400 years ago. Seed must have come from nearby parents. This logic goes back to the origin of these kinds of eucalypts. Like pure rainforest, these forests become flammable from age 80 and few escape fire for 400 years.

8. Wet Eucalypt Forest with Tall Shrubs

Wet eucalypt forests grow on moist sites over tall, dense shrubs that keep sun and wind off fuels on the ground. Decay is fairly good so annual fuels increase about *half a tonne per hectare***.** From age 20 to 80 wet eucalypts can burn in extended dry periods.

9. Wet Eucalypt Forest Regeneration needs Fire.

Eucalypt seeds are tiny with very thin coats. They fall in millions but decay or are eaten by insects. Rarely does one become a seedling **–** *except after a fire*.

10. Wet Eucalypt Forest Fuels

Dry, rotten dead wood in treetops is tinder for blown embers (and a probable lightning rod), and hollow trees can shelter lightning fires from rain.

Stringy barks of eucalypts and tea-trees carry *flames* up into the wind and make *wind-blown ember-storms*. They are also *tinder* for turning sparks into numerous spot-fires.

Candle bark dries to tubes up to thirty metres long that can feed *flames* inside the tubes while hot, dry winds can carry them more than 20km as in Vic fires in 1939 and 2009

Dry Periods are the main cause of dead plant parts becoming bushfire fuels, especially when tall shrub leaves wilt and let the sun in to dry the forest floor and make live mosses and lichens dry enough to burn.

11. Why Tasmanian Dry Forests Burn.
Tasmania's eucalypt woodlands and dry forests have grassy or knee-high, small-leafed, prickly, heath-like flammable undergrowth. Before shedding dying leaves, bark and wood, all eucalypts withdraw re-usable foods leaving tannins that make them rot-resistant so fuels increase about one tonne per hectare per year. Dry forests are hard to burn until age four but few stay unburnt over age twenty**.**

Dry Forest Litter 20+ tonnes per hectare

12. Conditions for Eucalypt Bushfires
>*Enough fuel* = many years without fire.
>*No recent rain, dry soil and dry air* **=** dry fuels.
>*Ignition* **-** by lightning, embers or humans.
>*High temperatures* - to speed burning.
>*Strong winds* **-** to drive the fire and spread sparks and flaming candle bark far and wide.

13. Spot Fires
This spot fire came from a storm of stringy bark embers but it only started in very dry, finely-divided, tinder-like fuel.

14. Bushfire!
Flames run up stringy barks and dead trees, heat tree crowns and some catch fire. General crown fire can occur in extreme fire weather. Bark embers and brands start spot-fires. (See front cover picture)

15. Fire Cycles
Eucalypts evolved into an existing fire environment with fuels that resist decay. Plant foods are taken from, and tannins left in, dying leaves, bark and wood. These speed fuel build ups and increase the frequency and the spread of lightning fires and so determine the long-term average return of the fires vital for 12 million years of eucalypt regeneration.

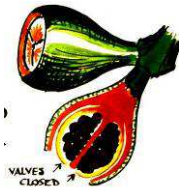
Part 2. FIRE EFFECTS

16. – on Fuels
Most fuels are consumed by fire but these remain: -
>*Litter layer* **-** charred bits left on top of the soil.
>*Shrub layer* - charred stems left and the sun let in.
>*Dead bark on trees* - charred bark on trunks.
>*Dead wood* **-** much charred wood left on.standing and fallen dead trees

17. – on the Forest Carbon Cycle
Forests take in carbon dioxide (CO_2) and water to make organic matter that later dies and either burns or decays. Carbon is stored in the trunks, branches and roots of growing forest trees, and in the soil. Growth slows after some 200 years and internal decay of trunks speeds up so the rate of carbon storage decreases. When trunks and branches have hollowed out, old growth forest may become carbon neutral until the next bushfire. After a bushfire CO_2 emissions are very much reduced because that which burns cannot also decay. Bushfires fix some carbon as charcoal so release *less* CO_2 overall than decay does.

18. - on Soils
Fire may heat dry soils to five centimetres depth and char the top two centimetres of organic matter *in* the mineral soil. Its ash recharges soil fertility and reduces soil acidity. The heat kills the old soil fungi and lets in bacteria and new fungi - for one year only. In dry years organic matter *above* the mineral soil can become fuel in our fire environment.

19. - on Eucalypt Seed Fall
Eucalypt seed originates in a thick-walled gum nut covered with moist live bark. Seeds and gum nuts on the ground are killed but some seed on the trees is protected even when its gum nut is killed. As it dies its valves dry, shrink back and let its seeds fall out. Up to four years of seed is shed in two weeks into fire-softened soil and buried by the next rain. This beats seed-eaters and fungi.



20. - on Seeds Sprouting
Soil heating and smoke are vital for the sprouting of many forest species that have seeds stored in the soil.

Vigorous Seedlings under Fire-killed Trees

21. - on Seedling Growth
New bacteria thrive on outputs from seedling which in turn thrive on bacterial outputs. This partnership can last fifteen years. But the old soil fungi take over one year after the fire so no new seedlings succeed.

22. - on Lignotuber, Trunk and Branch Shoots
In dry forests stunted shoots grow from underground woody masses called lignotubers. Fire kills these but stimulates vigourous new shoots capable of growing into a tree. When any eucalypt crowns are scorched new shoots can sprout wherever the bark has protected the underlying branch and trunk buds.

23. – on Browsing Animals
After long dry periods wet forest fires stay alight overnight and drive browsing animals off large burnt areas and their reinvasion from the edges can't beat seedling growth.

24. - on Eucalypt Age Classes
Dry eucalypt forests can contain trees of many ages - each from a different fire some four to 20 years apart. Each age can have many rates of growth - so dry forest may *appear* to be continuously regenerating. Wet eucalypt forests can have up to five ages from five fires some 20 to 80 years apart. Mixed forests usually have one or two ages from fires about 80 to 400 years apart. Fire-sensitive pure rainforests usually have a fire age in the 400-year range - plus some slower-growing younger seedlings as gaps form.

25. Bushfires and Ice Ages
Ice age temperatures were some 5° C lower and sea levels about a hundred metres lower than today. Forests were mostly below today's sea level while moorlands and grasslands covered most of today's Tasmania. Wherever today's fire-dependent species were growing bushfires must have burnt often enough to regenerate them. After each ice age the climate warmed, seas rose and forests returned to the good sites in spite of fires, but poorly drained infertile sites stayed open as buttongrass moorlands.

26. Long Term Effects of Tasmanian Bushfires
If fires in rainforests averaged 300-year intervals from 60 million years ago, today's flora and fauna have re-grown or returned after each of some 200,000 fires. If fires in wet eucalypts averaged 50 years from 12 million years ago there have already been up to 240,000 fires. If fires in dry eucalypts averaged ten years from 12 million years ago there have been up to 1,200,000 fires. Millions of years of eucalypt fuels have ensured their forests burned often enough to regenerate all of today's flora and fauna.

27. Summary
Lightning has ignited world forests for at least 300 million years. Tasmania's temperate rainforests have fuelled and been regenerated by bushfires for more than 60 million years. About 12 million years ago the eucalypts evolved into that fire environment. Their rot-resistant fuels increased fire frequency and their stringy and candle barks increased fire spread.

Wet and mixed forest eucalypts depend on fire at 20 to 400 year intervals for their regeneration. Bushfires in these forests gave Tasmania the World's Tallest Hardwoods like this Andromeda Stand in the Styx Valley.

Tony Mount Oct 2009

Author's Experience and *Publications (abbreviated titles)*
1957 Found and measured first Tall Trees in Andromeda stand
1961 *Regeneration Surveys for Cutover Eucalypt Forests*
1964 *The Interdependence of Eucalypts and Forest Fires*
1966 *MSc (Tas) -Three Studies in Forest Ecology.*
1967 Invited to lecture at all four UK Forestry Schools
Visited winter rainfall forests in Spain and California,
1969 *Eucalypt Ecology as Related to Fire* (at Tallahassee, USA)
Impression of North American Attitudes to Fire
1972 *The Derivation and Testing of a Soil Dryness Index*
1972,3,4 Melbourne Uni -taught Forest Ecology & Conservation
Found charcoal layers in Victorian brown coals.
1979 *Natural Regeneration Processes in Tasmanian Forests.*
1984 *Guidelines for Fuel Reduction Burning under Dry Forests*
1987 *Australian Bushfire Research* (for Forestry Council)
2009 *Tasmania's Ancient Bushfire Heritage*
Managing Tasmania's Fire Environment

Available at publications at www.bushfirefront.com.au