Mosaic Fires not Wildfires? Logistic Lessons from Beetles in South-West Australia.

Paul Van Heurck [1, 2]

[1] *Department of Environment and Conservation, Perth, WA, Australia*
[2] *Curtin University of Technology, Department of Environmental and Agriculture, Perth, WA, Australia.*

Abstract

The south-west of Western Australia is one of the Earth's 20 most diverse centres of vascular plants. This globally renowned biodiversity of the south-west's flora and fauna is hypothesized to have resulted due to the long period of geologic stability following the last major glaciation in the Permian (c. 245 million years before present time) when the south-west landscapes were ground down by ice-sheets to their present low-relief. Since then landscape stability together with gradual climate change, plus the steep east-west geographic gradients of both the annual rainfall and highly eroded infertile soil complexes have favoured the evolution of a patchy landscape mosaic of highly diverse flora and fauna communities.

This mosaic of south-west communities has been burnt by lightning-ignited fires for a very long time. Around 30 million years ago the seasonal Mediterranean climate, with dry summers and lightning-storms, was well established in south-west Australia. Fire therefore imposed another mosaic gradient of temporal interactions between the fluctuating aridity of the climate, the mosaic of diverse plant communities and their vegetation age since fire. From around 50,000 years ago aboriginal "fire-stick farming" may have become another frequent source of fire spread across southern Australia.

Globally arthropod species are estimated to makeup at least 70% of all living species, of which one-in-five have been scientifically named. The highly diverse and endemic south-west arthropod fauna has evolved species with contrasting fire tolerances; including both ancient relict species and pyrophilic arthropod species which have long evolved to favour or tolerate either very old long unburnt patches containing moist habitats such as deep litter or old rotting logs, in contrast to very recently burnt habitat patches of still smoldering ashbeds and recently heat-killed trees. The co-evolution of these arthropods with contrasting fire tolerances supports the hypothesis of a per-historic fire and vegetation mosaic of relict and pyrophilic habitat patches long persisting in the south-west landscape.

However this past mosaic of relict and pyrophilic habitats is threatened by the increasing number and size of wildfires in southern Australia forests, as a result of both changed fire regimes since European settlement, and declining rainfall due to climate change causing dryer, hotter and longer summer fire seasons. On the 20th March 2003 an intense wildfire burnt approximately 20,000 ha of southern jarrah forest and heathland plains, near the south coast of Western Australia. The rapid southward spread of the fire was largely halted at the northern boundary of London forest block, patchily prescribed burnt in the previous spring of 2002. In 2004 the Walpole Fine-grain Mosaic study was established to compare the fire impacts of this wildfire and nearby mosaic burns on the biodiversity of invertebrate assemblages and also perfect the operational logistics of mosaic burning.

In the Walpole Mosaic project area, I found that beetle (Coleoptera) species represented roughly 10 - 20% of study invertebrate richness, and occurred in all trophic guilds. My PhD project tested a standardized set of metrics for monitoring changes in beetle biodiversity. Total study richness of 445 beetle species is partitioned amongst 225 more common species and 220 singleton or rare species, of which 97 only occurred in patchily, mosaic burnt sites, while 64 species were exclusive to wildfire burnt sites. This lesson of habitat complementarity within the rare beetle fauna teaches us the long-term logistics, for reducing wildfire impacts, by creating mosaic fire regimes at landscape scales, to establish heterogeneity of post-fire ages at a fine-grained scale within individual forest and vegetation patches in southern Western Australia. A fine grain mosaic of relict and pyrophilic habitats is the best insurance against the total loss of diverse refuge habitats of invertebrates, in future south-west wildfires.