

Effects of drought on our south-west bushland

2010 was one of the driest and hottest years on record across the Perth Metropolitan Area. We asked five experts for their observations on current bushland health and the potential implications if below average rainfall continues this winter.



Widespread canopy decline of jarrah (*Eucalyptus marginata*) in the Ridges area of the Gnangara Mound on the Swan Coastal Plain in April 2011.
Photo – Ray Froend

Substantial deaths of jarrah (*Eucalyptus marginata*), marri (*Corymbia calophylla*) and some wandoo (*Eucalyptus wandoo*) have been observed along the Darling Scarp from Perth to Brunswick Junction. Professor Giles Hardy suggests as much as 60 per cent of the vegetation is affected. "Further east, these deaths are continuing and we are seeing around 10–15 per cent of forest dying, especially along ridges, where soils are shallow, and possibly on sites affected by *Phytophthora* dieback. Jarrah, *Banksia grandis* and sheoak (*Allocasurina* species) appear quite susceptible, although many other species in spots are also dying, including marri," he says.

Associate Professor Ray Froend has observed widespread mortality of vegetation on the Swan Coastal Plain. "The most affected have been the phreatophytic tree species (deep-rooted plants that obtain water from a permanent ground supply or from the watertable)

succumbing to a rapid depletion (within a season) of available water sources. Canopies of whole stands of trees have browned, shed and died (for example the Ridges area of the Gnangara Mound). However the more widespread response has been 'spot deaths' of individual or small clusters of trees," he says.

Insect attack

The degradation in plant and ecosystem health from drought is being exacerbated by secondary impacts. "Foliage discolouration in jarrah and marri is coupled with drying in the stem wood which is now being attacked by wood-boring insects," explains Dr George Matusick. "Although many of our prominent tree species can 'dieback' during periods of drought and re-grow their canopies when the rain returns, the amount and level of insect attack on the stressed trees suggest they are not coming back.

I would not be surprised to see high levels of tree mortality, including seedlings, resprouts and large mature trees, on the sites that have been affected."

Short-term response

"Many forests throughout the world will 'self-thin' during periods of drought, with weaker individual trees dying while the rest of the forest survives," explains Dr Matusick. "However in the south-west of WA, the trees are so tough at hanging on and staying alive that when they hit their breaking point, many or most trees die in a given area. This attribute of the forest is resulting in a step-down pattern of mortality. In other words, instead of the weakest individual tree, shrub and understorey species dying throughout the forest, large patches of forest are dying all at once," he said.

Professor Hardy believes many of the jarrah and tuart (*Eucalyptus gomphocephala*) trees that have collapsed will not resprout. "Many stressed trees are getting heavily infested by insect borers and there is significant evidence of frass at the base of many trees in the forest, particularly marri. Eucalypts are very resilient to drought and appear healthy for a long time after effectively being dead. So we can expect to see a substantial increase in tree deaths in the jarrah forest and on the Coastal Plain," he says.

Long-term outlook

"Mortality is likely to increase substantially and extend to many more sites if we have a dry 2011 winter as some models are predicting," says Professor Hardy.

Dr Matusick agrees we will see much more plant mortality next spring and summer if winter rainfall is low.

"It is possible that we will see spikes in insects and disease in the forest next year

that will be a by-product of the death that is occurring now. I would expect to see *Banksia grandis*, sheoak, jarrah, and marri continue to die well into next summer unless we receive substantial rain this winter," he says.

Professor Erik Veneklaas suggests that the mortality may help reduce the density of vegetation. "Denser vegetation requires more water, which the roots are not able to supply, causing species with high water requirements or low drought tolerances to suffer mortality. We may simply end up with a more open vegetation in which some species are less prominent than before (or disappear) while others may become more abundant (and new ones may appear). This is not a disaster as long as it doesn't mean that invasive species take over or rare species are decimated," he says.

Recent research completed by Ray Froend suggests that below average rainfall on the plain during the past 20 years has resulted in a significant shift in the composition and structure of the banksia woodlands and wetland vegetation of the region (Froend and Sommer 2010). This gradual, progressive change in the vegetation is characterised by a decrease in the density of plants and increased proportion of xerophytic (drought tolerant) and shallow rooted species over many years. Recovery of the vegetation from 'threshold' seasonal events has been recorded for banksia woodland (Sommer and Froend 2011); however, the density and composition of the vegetation has changed, and, with a continuation of below average rainfall conditions, is unlikely to return to a pre-impact state.

"Since European settlement, management of our forests and woodlands has changed their structure substantially," says Professor Hardy. "In the jarrah forest, the stand density and leaf area index is much higher than before

Europeans arrived. There are fewer old trees (which use less water) and more young trees using more water in an environment that is much drier than it was previously. The question becomes: should we consider trying to reduce stand density to (attempt to) maintain a forest by reducing tree water use in a stand, or do we walk away and just watch what happens and then let them 'stabilise' naturally? This will take many decades or more."

To Dr Pieter Poot, the worry is not just one year with exceptionally low rainfall and high temperatures, but that south-west Australia has become considerably drier since the mid 1970s and many of our plant communities are likely to be under chronic drought stress. "Predictions for the future are that it will only get worse; south-west WA is among the few areas where future climate modelling not only indicates warmer temperatures but also less rainfall," he says.

"It would be no surprise that if this trend continues tipping points may be reached where we would see much more large-scale plant death. Obviously, this is bad news for some of our rare plant and animal species and communities which we may lose. Also, some of the common ecosystems that we are all so familiar with are likely to change in species composition, some of the change being gradual but others much more abrupt. Some people would say that evolution will take care of it and our native plant and animal species will simply adapt to the changed conditions. However, many of our plant and animal species now live in fragmented, isolated populations in a matrix of agricultural or urban land that they simply cannot traverse. They are also greatly affected by a range of exotic weeds, pests and diseases that we have brought in."

More information

Froend, R and Sommer, B (2010) Phreatophytic vegetation response to climatic and abstraction-induced groundwater drawdown: Examples of long-term spatial and temporal variability in community response. *Ecological Engineering* 36: 1191–1200.

Sommer, B and Froend, R (2011) Resilience of phreatophytic vegetation to groundwater drawdown: is recovery possible under a drying climate? *Ecohydrology* 4: 67–82.

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Contributors

All contributors to this article are keen to get trans-disciplinary collaboration to conduct research on bushland health, monitor change and develop management tools.

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