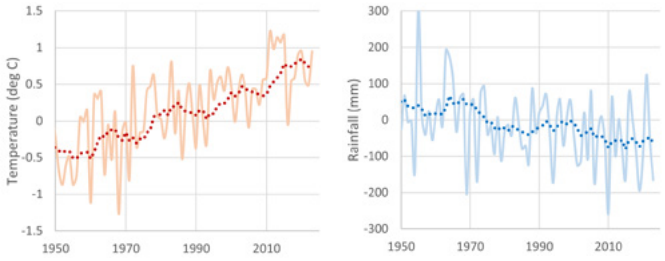
9 CLIMATE AND FORESTS

FACTS ABOUT PRESCRIBED BURNING AND WILDFIRE IN SOUTH-WEST FORESTS

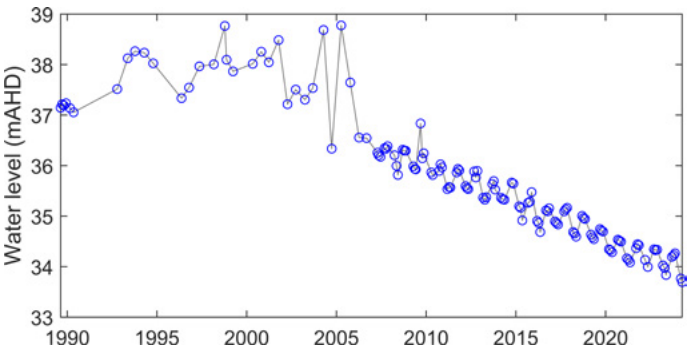
Past climate

South-western Australia's climate has changed. There was a major step down in Perth rainfall in 1974, and another in 2000. Further south the rainfall step downs occur later[1]. Bureau of Meteorology (BOM) mean temperature and rainfall anomalies for south-western Australia relative to the 1961–1990 baseline show these changes[2].



BOM temperature and rainfall anomalies for south-western Australia relative to the 1961–1990 baseline with 10-year moving average. Source: http://www.bom.gov.au/cgi-bin/climate/change/timeseries.cgi

The decreased rainfall and higher temperatures, which have caused the groundwater that the trees rely on to decline, have already taken a toll on south-west forests. The graph below shows a superficial bore located in forest on the Blackwood Plateau with a groundwater decline of 4 m since 2000.



Source: Department of Water and Environmental Regulation (DWER) bore 60918175[3]. Note: pre-2000 quality control was not rigorous.

Other forest regions with local groundwater systems, although not monitored, are also suffering.

Future climate

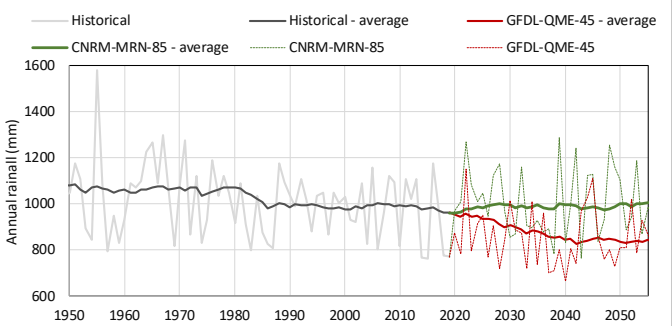
South-western Australia is one of the locations where global climate models have successfully predicted changing rainfall and temperature due to human-induced global warming. Climate models predict further warming and drying in south-western Australia:

- temperature increases
- rainfall decreases
- changed rainfall seasonality with more summer rainfall (relatively).

Rainfall will be less effective in generating stream flow and groundwater recharge due to

- increased evaporation
- greater interception losses.

For example, the Department of Water and Environmental Regulation (DWER)[4] estimated inflows to Nullaki (Wilson Inlet) using two global climate models that had increased temperatures and evapotranspiration (+ 5%); and 1) similar rainfall to (CRNM-MRNBC-85[5]) or 2) less rainfall (GFDL-QME-45[6];-14%) than the last 30 years. The predicted inflows for the next 30 years to Nullaki were 1) 10% less for the wet scenario and 2) 64% less for the dry scenario, compared with the flows for 1994–2023.



Historical and future potential wet (CRNM-MRNBC-85[5]) and dry (GFDL-QME-45[6]) annual rainfall for estimating Nullaki future inflows. Source: Hennig et al.[4].

Future evapotranspiration increases and decreased rainfall will cause the groundwater decline in forests to continue, causing tree deaths until a new equilibrium is reached.

The forests are stressed, prescribed burning adds to these stresses.

In our forests the higher temperatures and reduced rainfall will:

- cause lower groundwater tables which will lead to more vegetation deaths
- cause streams to have less flow and a shorter flow duration
- reduce the number of days with weather conditions allowing prescribed burning
- make prescribed burning more dangerous and escapes more likely
- make arson very dangerous with greater probability of causing harm.

Deforestation also causes decreased rainfall.

Andrich et Imberger[1] claim that 55% of the decrease in winter rainfall on the Darling Scarp, and 62% of the decrease in winter rainfall in the wheat belt, from 1960 onwards, can be attributed to land clearing. The remaining 45% and 38% of the rainfall decline is therefore attributed to some combination of long-term natural variation and human-caused climate changes.

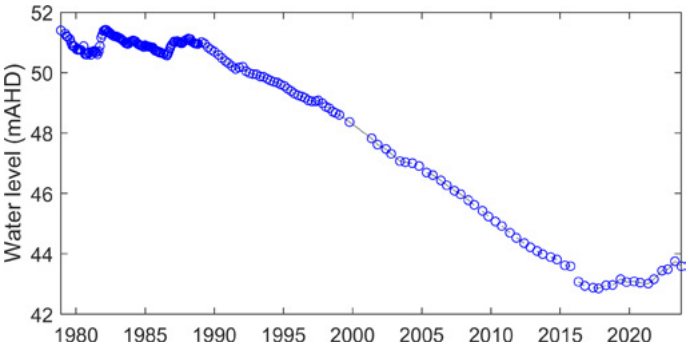
It was estimated that by 1970, 30% of the coastal strip had been cleared, and during 1970–1980 a further 50% was cleared (12 500 km^2). Similarly, during the 1950–1970 period, 48 000 km^2 or 28% of the wheatbelt area was cleared reducing native vegetation from around 60% to 30%. By 1980 only 20% of native vegetation remained. The periods of rapid vegetation clearing align with the inland rainfall declines relative to those observed at coastal stations.

Loss of canopy from prescribed burning reduces soil moisture.

Burning forests eliminates foliage, dead woody material and other litter on the ground. These changes result in more solar radiation reaching the forest floor causing it to dry out. This not only makes the remaining litter more flammable, but also kills the fungi and animals that decompose it naturally.

Abstraction for water supply can also causes groundwater decline.

Abstraction, decreased rainfall and increased temperatures work together to decrease groundwater levels. There was a steady decline in Gnangara mound groundwater levels following increased abstraction for Perth's water supply in the 1990s. This led to the drying of some local wetlands. Below shows the water level decline in a bore on the mound and photos of Loch McNess in 2007 and 2015[7].



Source: DWER bore 61610676[3].

Loch McNess in August 2007 (top) and in September 2015 (bottom)[7].

References

1 Andrich, MA & Imberger, J (2013) The effect of land clearing on rainfall and fresh water resources in Western Australia: a multi-functional sustainability analysis, *International Journal of Sustainable Development & World Ecology*, https://doi.org/10.1080/13504509.2013.850752

2 *Bureau of Meteorology climate anomalies for south-west Australia*: http://www.bom.gov.au/cgi-bin/climate/change/timeseries.cgi, downloaded May 2024.

3 Department of Water and Environmental Regulation bore data. https://wir.water.wa.gov.au/Pages/Water-Information-Reporting.aspx downloaded May 2024.

4 Hennig, K, Kelsey, P, Hall, J & Robb, M (in press), *Hydrological and nutrient modelling of the Wilson Inlet catchment, Water Science Technical Series, Report no. 88*, Aquatic Science Branch, Department of Water and Environmental Regulation, Perth, Western Australia.

5 Centre National de Recherches Météorologiques Coupled Global Climate Model - Multivariate Recursive Nesting Bias Correction - Representative Concentration Pathway 8.5 (high emissions).

6 Geophysical Fluid Dynamics Laboratory - Quantile Matching Extremes - Representative Concentration Pathway 4.5 (intermediate emissions).

7 Kretschmer, P & Kelsey, P (2016) *Loch McNess hydrogeology and causes of water level decline (1975–2011), Hydrogeological record series, HG60*, Department of Water, Western Australia.