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Tuart canopy die-off during severe drought and heatwave

A severe and sudden die-off event, occurring in the regionally significant tuart (*Eucalyptus gomphocephala*) woodland in Rockingham Regional Park, coincided with extreme drought and heat conditions in early 2011.

Tuart is an endemic tree with a highly restricted distribution on the Swan Coastal Plain in southwestern Australia. Most tuart-dominated woodlands have been cleared for urban and agricultural development (DEC 2010); today, only 33% of these woodlands remain.

The Mediterranean climate of southwestern Australia is experiencing a sustained and substantial shift to drier and warmer conditions (Figure 1). Specifically, the region has had a pronounced, long-term decline in rainfall since the mid 1970s (Bates *et al*. 2008). Concurrently, the average temperatures have risen at a rate of 0.15°C per decade (Bates *et al*. 2008).

Drier conditions in southwestern Australia have corresponded with decreases in streamflow (Petrone *et al*. 2010) and groundwater levels as a result of reduced precipitation (Croton & Reed 2007) and increased exploitation for human use (Sommer & Froend 2011).

Corresponding with the hottest period of 2011 and in the midst of a record dry summer (BOM 2011), tuart crowns experienced a significant die-off in a regionally significant population (Figure 2).

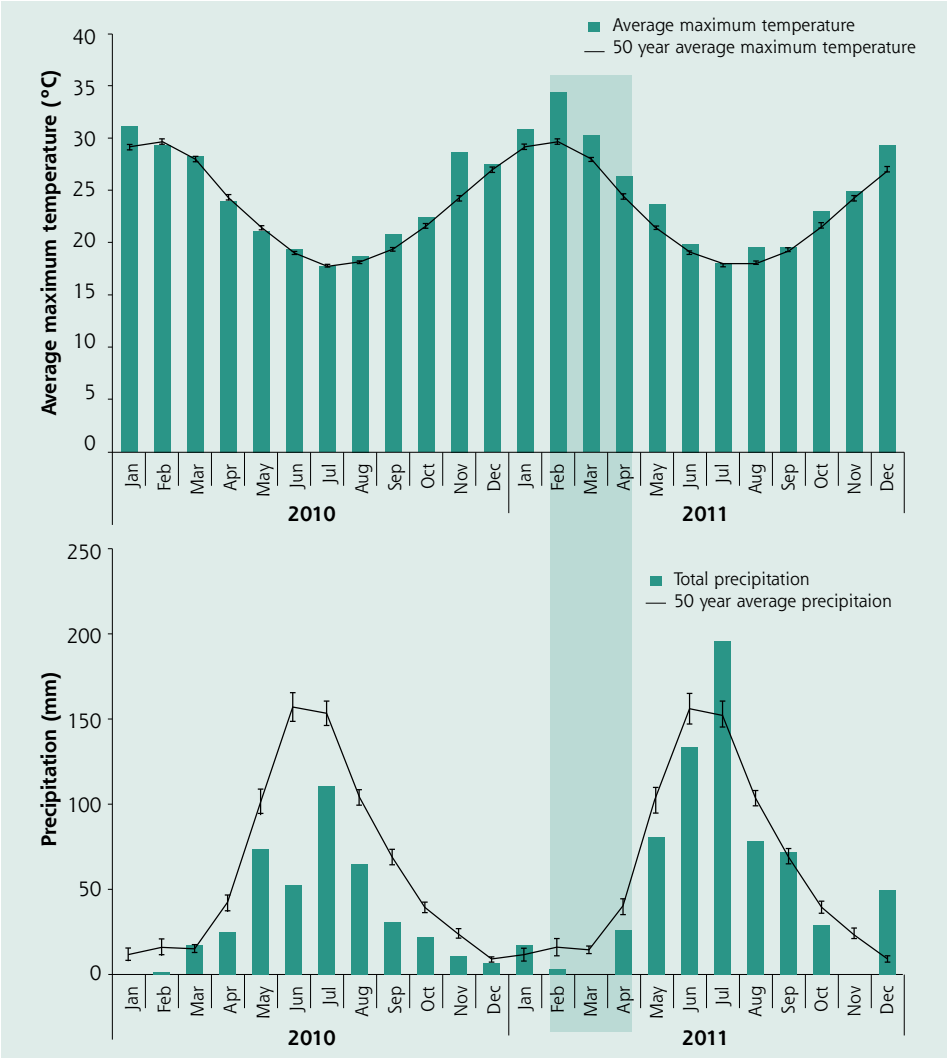

FIGURE 1 Fifty-year average maximum temperature and average precipitation (mm) for January to December and average maximum and total precipitation for January 2010–December 2011. Highlight represents period of tuart canopy die-off in the study area

FIGURE 2 Aerial photograph looking north from Lake Cooloongup, showing tuart crown symptoms in the affected study area (on the left) and healthy crowns in the unaffected study area (on the right) (Photo: Brett Glossop)

We estimated the incidence of damage, described the symptoms and severity of the die-off, and identified potential differences between affected and unaffected woodland sites.

Methods and results

The study area represents the rainfall catchment for Lake Cooloongup (Figure 3).

Using a combination of remote sensing and field-based approaches, we investigated the extent and severity of canopy die-off, and highlighted potential predisposing site factors.

A field survey of affected and adjacent unaffected tuart woodland was conducted in Rockingham Regional Park. Total percent of canopy die-off, the percentage of total foliage composed of epicormic resprouts formed following the disturbance, and the percentage of total crown with recent flagging (yellow and dead foliage) were estimated.

An estimated 500ha of tuart woodland was severely affected between February and March 2011. Tree foliage rapidly discolored and died over this period.

Tree health was substantially different between the affected and unaffected woodland. Approximately 90 ± 5 % of trees larger than 20cm diameter were impacted in the affected woodlands, compared with only 6 ± 6% in unaffected areas. Although affected trees lost most of their original foliage, mortality was low (3%) due to prolific epicormic re-sprouting from the stem and lower branches.

Tree density in the unaffected area had approximately 4.5 times greater than in the affected woodland.

The primary difference between affected and unaffected sites was their drainage patterns. The affected woodland occurred in a slightly raised, water shedding flat plain. Unaffected areas occupy water-gaining sites with notable past erosion, and consequently averaged approximately 2m lower in elevation. Unaffected woodland is situated at the base of a cemented dune that has historically facilitated drainage into the nearby Lake Cooloongup.

Conclusions

Precipitation drainage patterns are thought to explain the difference between affected and unaffected woodland. Dropping groundwater levels, a relatively shallow soil profile, and extreme drought and heat in 2010–11 are thought to predispose water-shedding sites to drought-and-heat-triggered canopy die-off during extended periods of dryness. ■

More information

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*Full paper can be found: Matusick, G., Ruthrof, K.X. and Hardy, G. (2012) Drought and heat triggers sudden and severe dieback in a dominant mediterranean-type woodland species. *Open Journal of Forestry* 2, (4) 183–186.

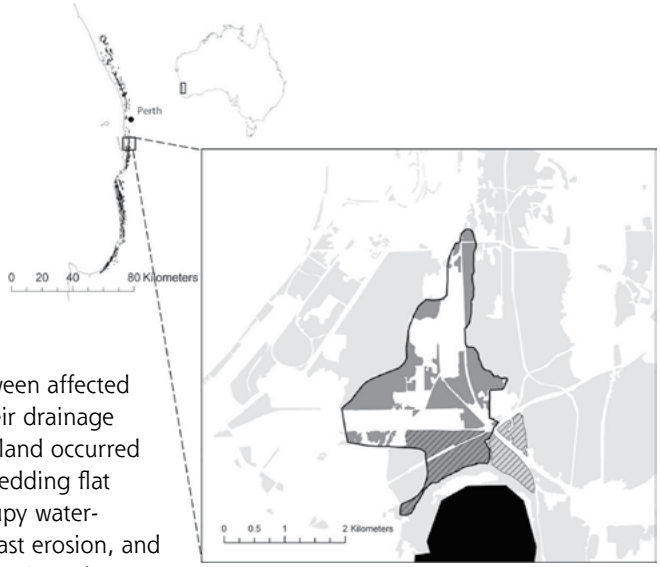

FIGURE 3 The location of the study site in the south west of Western Australia within the range of Tuart (shaded). Inset: the native vegetation (light and dark grey shading), surrounding Lake Cooloongup (black), affected by crown die-off (dark grey shading). Sampled unaffected (light grey hatched) and affected woodland (dark grey hatched)

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