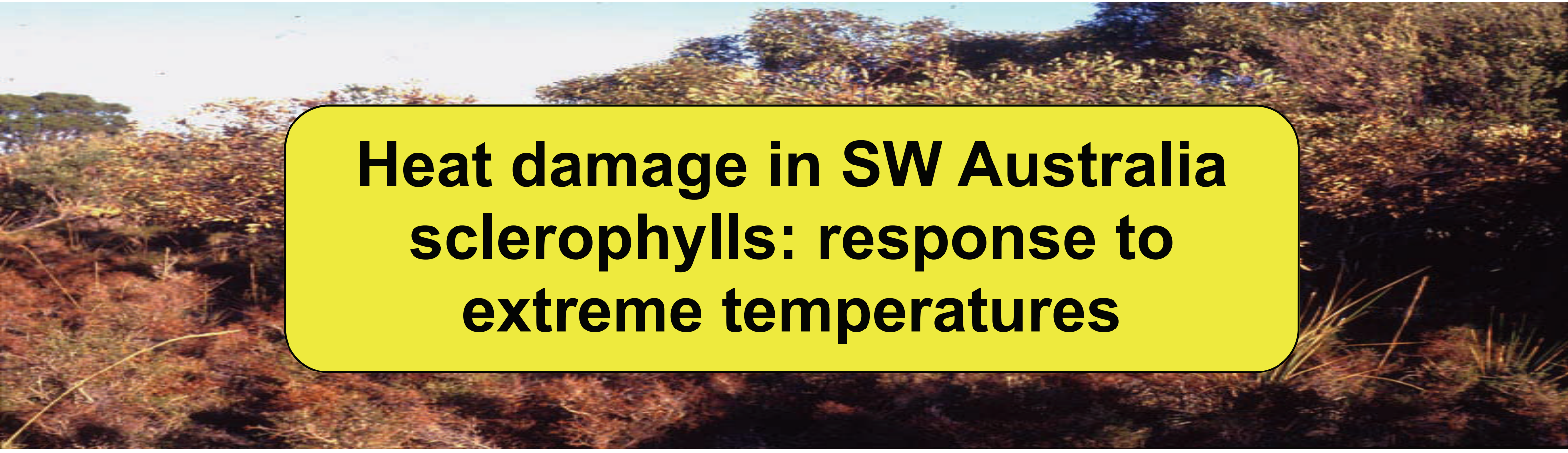
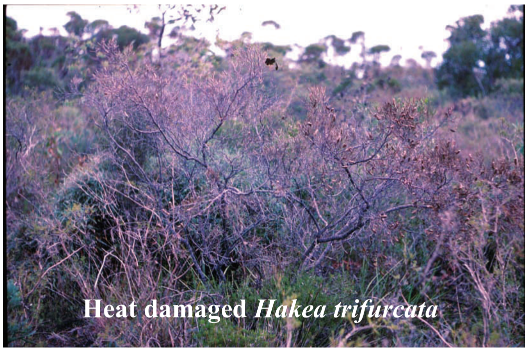


Heat damage in SW Australia sclerophylls: response to extreme temperatures

The ability to tolerate high temperatures is of considerable significance to plants exposed to hot climates, or climates that experience short periods of extreme heat. The onset of heat-induced tissue damage ranges between 40 and 55°C, with different plant parts displaying different levels of tolerance. The temperature optimum for photosynthesis is species specific, and can be quite variable for co-occurring species. Thus, not all species demonstrate the same degree of leaf damage when subjected to a given period of heat stress.

There is limited information on the heat tolerance of sclerophyllous shrublands and woodlands in Mediterranean-type ecosystems. This is partly because it is difficult to identify the effects of extreme heat in the field since a combination of factors may contribute to observed injury. The effects of extreme summer stress have been well documented for mediterranean ecosystems at the species and community level. For periods of prolonged water stress, drought tolerance is considered an extension of the normal summer response. In contrast, extreme temperature events (daily maximum temperature > 40°C) may last no more than a few days; temperatures capable of causing leaf damage will only occur for a few hours each day.



Heat damaged *Hakea trifurcata*

Mediterranean southwestern Australia experienced successive days of extreme temperatures and hot winds in January/February 1991, contributing to the death of native perennial shrub and tree species in a mallee-heathland. In the mallee-heathland, leaf damage and plant mortality was observed after two consecutive days of maximum temperatures > 45°C. The level of leaf damage and mortality varied between species, as did leaf morphology and degree of exposure to the elements.

Field study

A survey of the native flowering plant communities, including sedges and rushes (3 species), occurring at the three study sites showed that 59-73% of species present displayed signs of leaf damage 3 months after the heatwave. The 54 species examined were dominated by species in the Proteaceae (31 species, 25 displaying signs of leaf damage) and Myrtaceae (13 species, 10 displaying signs of leaf damage). Percentage leaf damage ranged from 0-89% (of crown) and was significantly correlated with adult mortality (0-44%) (r = 0.82, P < 0.001), although the two species with the highest level of damage (*Dasypogon bromeliifolius* and *Eucalyptus decurva*) had only 6.0% and 30.0% plant mortality respectively. The 14 undamaged species had thicker leaves, and were more exposed to wind, sunlight and bare soils. Undamaged leaves were more sclerophyllous (leaf mass per area = 516 ± 323 g m^{-2}) than damaged leaves (319 ± 153 g m^{-2}, P = 0.0106), although this was due to their greater thickness.

Conclusion

Species tend to be thick-leaved in hot, dry, more exposed environments, as thick leaves lose less water per unit volume than do thin leaves of the same stomatal resistance and effective leaf size. Differences between undamaged and damaged species reported in our paper may be a result of preconditioning, whereby species growing in more exposed habitats (e.g. growing in high light, exposed soil) are pre-adapted to tolerate periods of sustained heat stress.
The ability of a species to tolerate extreme temperature events will be determined by the interaction between leaf heat loads (a function of leaf size and transpiration), leaf heat-storing capacity (a function of leaf thickness) and exposure to environmental elements.

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