Climate Change in Southwest Australian Shrublands: Response to Altered Rainfall and Temperature

Amity Williams

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I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary education institution.

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Amity Louise Williams

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ABSTRACT

On-going climate change through the 21st century projects increasingly warmer and drier conditions for Mediterranean-type ecosystems (MTEs), creating threats to species persistence in these biodiversity hotspots. For the highly biodiverse kwongan of southwest Australia, this means a climate shifting towards semi-arid conditions, yet how this unique vegetation type will respond to a novel hotter and drier climate is largely unknown. Therefore, this study examined the effects of altered rainfall and temperature on demographic processes of woody kwongan in post-fire (0 - 3 years since last fire) and mature (12 - 15 years since last fire) stands across a soil depth gradient in the northern sandplains of southwestern Australia, seeking to identify the consequences for plant species and functional trait composition. To achieve this, a selection of commonly occurring species (*Banksia attenuata*, *Banksia hookeriana*, *Melaleuca leuropoma* and *Beaufortia elegans* as primary focal species) were used to form a plant functional trait scheme, with fire-response strategy (resprouter, non-resprouter) as a trait of key interest due to the fire prone nature of MTEs, and leaf type (broad, needle, small), growth form (shrub, subshrub) and seed size (large, medium, small) as traits of interest due to their potential roles in drought and temperature responses. Passive rainout shelters were used to reduce rainfall, and drip irrigation to increase rainfall, by ~ 30 %. Open top chambers were used to increase temperature, with daytime temperature increased by an average of 2.9˚C.

Seedling germination, survival and growth, and adult survival, health, flowering and fruiting were reduced by drought and warming, with increased rainfall producing little change. Greater magnitude of reduction was observed under experimental warming, however experimental drought resulted in greater level of change in functional trait composition. Despite the general higher resistance of adult resprouters, it was non-resprouters that showed potential to become the dominant fire-response strategy in a drier environment, through higher seedling resilience and similar resistance as adults to resprouters. With a decline in survival for both post-fire resprouts and seedlings, resprouters could be at risk of population decline in the long term. Subshrub and small leaf traits were the most successful in drought conditions due to their drought tolerant nature, while broad leaf and shrub traits will likely suffer population decline. In warmer conditions, significant decline in resprouter seedling survival was matched by equally large decline in non-resprouter adult survival, indicating little change in dominance of non-resprouters at the seedling stage and resprouters at the adult stage, and thus little

change in their relative abundances. The needle leaf trait was most competitive in warmed conditions performing well relative to other traits both in seedlings and adults. Shallow soil profiles, reflecting lower water availability, negatively affected demographic rates, suggesting decreases in diversity and density on shallow soils as less drought tolerant species retreat to deeper soil profiles with greater water stores.

Results here show potential for large scale change in MTEs in projected warmer and drier climates, through decline in vulnerable functional traits, and thus reduced density of woody species and losses to biodiversity. Further investigation is needed into the combined effect of warming and drought, in addition to impact of altered fire regime, with changes in fire behaviour projected for MTEs as a result of warmer and drier conditions. Investigation that encompasses a broader range of Mediterranean species is also necessary to provide greater accuracy to conclusions drawn here on functional trait responses.

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conditions due to higher persistence in resprouters balanced by their lower recruitment, although a shift to further dominance of resprouters could occur through resources becoming available from declines in non-resprouter persistence.

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