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Climate change risks for biodiversity and ecosystem function in species-rich shrublands

Plant Science and Herbarium

Project Core Team

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Project Team	granted
Program Leader	granted
Directorate	granted

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Context

Correlative bioclimatic models are the primary tool for predicting the impacts of projected climate change on south-west Western Australia's globally renowned, species-rich shrublands (kwongan). These models have many untested and limiting assumptions. Empirical and experimental studies investigating the relationship between climate, ecohydrology and population dynamics are needed to develop better and more realistic mechanistic models for predicting the impacts of climate change on kwongan.

Aims

- Quantify seasonal patterns of water input, storage and distribution in the soil profile for shrubland sites of contrasting soil depth in relation to rainfall and plant water use.
- Quantify diurnal and seasonal patterns of plant water use among selected species from two major woody plant guilds (surface-water dependent sub-shrubs; groundwater-dependent shrubs and small trees) for shrubland sites of contrasting soil depth.
- Quantify the effects of decreased rainfall and increased air temperature on plant species ecophysiology and demography, identifying potentially lethal thresholds.
- Quantify plant demographic behaviour (survivorship, growth, fecundity) among selected species from two woody plant guilds for shrubland sites of contrasting soil depth.
- Apply a simulation modelling framework that links climate, soil water dynamics, plant water use and demographic response to investigate potential impacts of climate change on plant species and communities.

Progress

- Two scientific manuscripts describing the results of climate manipulation experiments prepared for publication.

Management implications

The project will provide projections of the likely risks of adverse effects of unavoidable climate change on plant species and communities in the Midwest Region and more generally for south-west Western Australia. The results of the study show that:

- decreased rainfall reduces woody species germination, seedling survival, growth and plant survival along with flower and fruit production in mature vegetation;
- increased temperature reduces woody species germination, seedling survival and plant survival in conjunction with canopy health and fruit production in mature vegetation; and
- the magnitude of these changes varied among species from different plant functional types and was greatest in parts of the landscape where soil water is most limiting.

Under projected warmer and drier climates for the region there are likely to be declines in species richness and changes in composition of kwongan toward lower stature more drought tolerant species. Management should continue to focus on mitigating the risks and effects of interacting threatening processes, maintaining the genetic diversity of species to maximize potential for evolutionary adaptation, maintaining or enhancing ecological connectivity to maximize potential for species migration and identify the location of potential refugia where conditions remain suitable for the most vulnerable species to persist.

Future directions

- Publish results from climate manipulation experiments in scientific journals.