Progress Report SP 2002-001

Genetic and ecological viability of plant populations in remnant vegetation

Plant Science and Herbarium

Project Core Team

Supervising Scientist	Dave Coates
Data Custodian	Dave Coates
Site Custodian	Dave Coates

Project status as of July 18, 2018, 10:19 p.m.

Update requested

Document endorsements and approvals as of July 18, 2018, 10:19 p.m.

Project Team	granted
Program Leader	granted
Directorate	granted

Genetic and ecological viability of plant populations in remnant vegetation

D Coates, M Byrne, C Yates, M Millar, T Llorens, S Mcarthur, N Gibson, J Sampson

Context

A priority for long-term conservation of remnant vegetation is the maintenance of viable plant populations. However, little is currently known about what biological factors actually affect population persistence. This project quantifies genetic and ecological factors that influence the viability of plant populations in fragmented Western Australian agricultural landscapes and explores how these are affected by remnant vegetation characteristics such as size, shape, isolation, disturbance and landscape position.

Aims

- Identify and quantify the genetic and demographic factors that affect the viability of plant populations in vegetation remnants. The focus will be on the effects of genetic erosion, inbreeding and pollinator limitation on seed production and seedling fitness.
- Examine and model the relationships between key genetic and demographic factors affecting viability and remnant vegetation characteristics, such as size, disturbance and landscape position.
- Develop specific genetic and demographic guidelines for management of remnant populations of the target taxa and general landscape design principles for major plant life-history types that will maximise the probability of population persistence.
- Develop an understanding of the population biology, mating systems and gene flow of flora with distributions centred on the seasonally wet Busselton ironstone communities to inform management for long-term conservation in relation to population viability (population size and degree of connection) and appropriate fire frequency.

Progress

- Analysis of the genetic diversity, mating system and reproductive biology of *Hakea oldfieldii* has been completed. A second paper has been published in *Ecology and Evolution.* The three population areas in Perth Hills, Busselton and south coast showed significant genetic divergence as expected but there was also significant population divergence within these areas indicating low historical connectivity. Low diversity is associated with historical processes rather than recent fragmentation. Populations were predominantly outcrossed even when severely reduced in size, indicating little effect of inbreeding in small populations, but reproductive parameters were higher in small populations with intact vegetation compared to disturbed sites, highlighting effects of understorey on pollinator abundance and behaviour.
- Analysis of reproductive output, mating system variation, progeny fitness and genetic diversity in relation to habitat fragmentation has been completed for *Eucalyptus wandoo.* A paper is in final preparation. Higher levels of soil electrical conductivity were strongly associated with greatly reduced fruit set, suggesting significant sub-lethal effects of secondary soil salinity on reproduction. Levels of pollination were surprisingly high in small populations but probably involve high levels of self-pollination, leading to low seed set in small populations. Increased seedling survival in certain populations was attributed to increased nutrient availability in the agricultural matrix.
- Analysis of reproductive output, mating system variation, progeny fitness and genetic diversity in fragmented populations of *Eremaea pauciflora* has been completed and a paper is in preparation.
- Papers on pollen dispersal, mating systems, reproductive biology and demography in *Banksia nivea* ssp. *uliginosa* have been prepared.

Management implications

- The ability to rapidly and accurately assess the conservation value of a vegetation remnant is a critical step in landscape management aimed at integrating the goals of conservation and agricultural production. Currently much of this assessment is based on best guesses using anecdotal species-specific evidence, on the general principle that bigger is better, and on simple presence and absence data that take little account of long-term remnant trajectories. Improved accuracy of assessment of long-term persistence of broad classes of plant species will facilitate improved prioritisation of remnants for conservation and therefore better allocation of limited management resources.
- Establishment of realistic empirically-based goals for remnant size, shape and landscape configuration that maximise regional persistence of plant species will allow more efficient conservation efforts at the landscape level by facilitating cost-benefit analyses for remnant management and restoration work.
- The *H. oldfieldii* study showed that conserving populations in intact habitat is a high priority to maintain the genetic and ecological processes in naturally fragmented and insular species. Management interventions, such as enrichment planting to increase the diversity of pollen donors, should also include habitat and understorey restoration to facilitate effective mating patterns. Seed collection should prioritise populations with intact habitat to maximise genetic diversity.
- Levels of secondary soil salinity should be assessed and monitored in high-value vegetation remnants in agricultural landscapes. The *E. wandoo* study revealed that low to moderate levels of soil salinity can have highly significant sub-lethal effects on reproductive output, which are likely to translate to reduced population viability.

Future directions

- Finalise a paper on mating system variation and reproductive output in *E. pauciflora*.
- Finalise papers on genetic diversity, pollen dispersal, mating systems, reproductive biology and demography in *B. nivea* ssp. *uliginosa*.
- Publish paper on reproductive output, mating system variation, progeny fitness and genetic diversity in *E. wandoo*.