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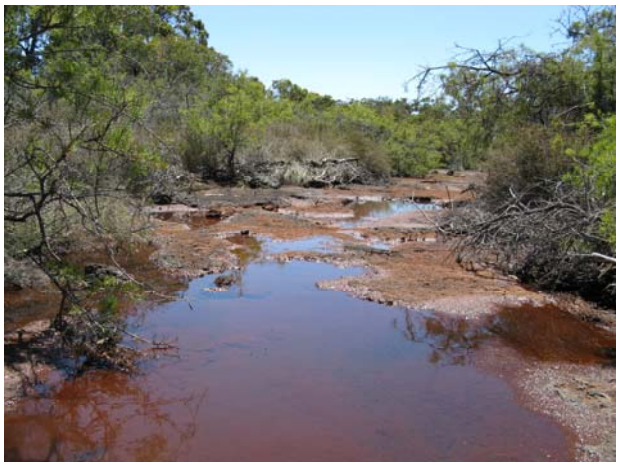
Long-term viability of locally restricted species in a threatened ecological community on the Busselton ironstones

By Colin Yates, Margaret Byrne, Neil Gibson

DEC Science Division colin.yates@dec.wa.gov.au; margaret.byrne@dec.wa.gov.au; neil.gibson@dec.wa.gov.au

Background

The seasonally wet ironstone plant communities of the Swan and Scott coastal plains are amongst the most endangered in south-west Australia and are of national and international significance. These plant communities, although historically restricted and rare, have been extensively cleared, occur in small isolated remnants and are now under considerable threat. For plant species in these fragments, populations are typically smaller and more isolated than they were historically, the abundances of their interacting species have changed, new species have been added, and the abiotic conditions and resources necessary for growth and reproduction have been altered.



For sexually reproducing plant species, changes to the pollinator community and declines in mate availability may have a number of important consequences for pollen flow, the mating system, seed production, and offspring fitness. These factors all influence population vital rates and viability. It is generally expected from studies of common species that smaller populations will produce fewer seeds because of increased inbreeding, and that offspring fitness will decline thereby reducing the probability of population persistence.

Over a three year period we investigated seed production, seedling fitness, mating system, landscape level gene flow, and demography for two plant species, *Calothamnus quadrifidus* subsp. *teretifolius* ms and *Hakea oldfieldii*, in the Busselton ironstone community to determine how population size and connectivity influences the viability of plant population fragments in this landscape.

Key findings

***Calothamnus quadrifidus* subsp. *teretifolius* ms**

- Fruit set and the number of seeds per fruit varied between populations, but there was no relationship with population size.
- Seeds are produced from a mixture of inbreeding and outbreeding. Levels of inbreeding were unusually high for a bird-pollinated shrub and are most likely a consequence of self-pollination rather than crossing between genetically similar plants. Seed fitness measured by rates of germination was variable but showed no relationship with population size.

- Seedlings and juveniles were only observed in the medium- and large-sized population fragments. Seedlings were observed in each year of the study.
- Seedlings emerged in greatest numbers in areas of bare ground where vegetation cover was lowest. These conditions were not present in the smallest populations where annual weeds were abundant. Seedling mortality was high, but seedlings which survived were recruited into the juvenile population of plants creating populations with mixed-age structure.
- Genetic diversity in medium and large populations was higher than in small populations. Genetic distances among populations were very high.

Hakea oldfieldii

- Fruit set and the number of viable seeds produced per weight of plant canopy varied between populations, but the relationship with population size was equivocal.
- Seeds arise predominantly from outbreeding due to a self-incompatibility system preventing self-pollination.
- Seedling emergence was only observed in one population in the wettest year when rainfall was above average. The low rates of seedling emergence and predominance of plants in adult size classes indicate recruitment may be more intermittent in *H. oldfieldii* than in *C. quadrifidus* subsp. *teretifolius* ms.
- Genetic diversity in *H. oldfieldii* was moderate and similar among populations. Like *C. quadrifidus* subsp. *teretifolius* ms, genetic distances among populations of *H. oldfieldii* were very high.

Management implications

- Seed production in *C. quadrifidus* subsp. *teretifolius* ms is apparently robust to the effects of population fragmentation. Plants in small populations are able to produce substantial numbers of viable seeds despite the availability of mates declining. Medium and large-sized populations of *C. quadrifidus* subsp. *teretifolius* ms are currently stable or increasing in size. Small populations, because of a lack of recruitment, will decline and eventually be lost from the landscape.
- Seed production in *H. oldfieldii* may not be as robust to fragmentation and decline in population size because of a self-incompatibility system. As a consequence small populations will be susceptible to mate limitation and subsequent reduction in seed production. Medium and large-sized populations of *H. oldfieldii* may be relatively stable in the short term but patterns of recruitment suggest that populations will decline in the longer term. Seasonal variation in seed production may make populations susceptible to local extinction following fire.
- For both species, management should continue to protect all populations from major disturbances such as roadworks and grazing that might affect persistence. Reducing the abundance of weeds in populations of both species will increase the potential for recruitment.
- High genetic differentiation between populations in both *C. quadrifidus* subsp. *teretifolius* ms and *H. oldfieldii* means that all remaining population fragments of both species contain irreplaceable genetic diversity. The loss of small populations will result in the significant loss of genetic diversity. Conserving the genetic resources of all populations through *ex situ* seed collections and using seeds from all populations to rehabilitate suitable areas in, or adjacent to, medium or large populations or restore new populations is a high priority.

The results of the study will guide management of species endemic to the Busselton Ironstone community.

For more information see:
Yates C., Byrne M., Gibson N., Langley M., Newman B., Sampson J., Stankowski S., Thavornkanlapachai R. (2009) Assessing the Long-Term Viability of the Locally Restricted Species *Calothamnus* sp. Whicher and *Hakea oldfieldii* in a Threatened Ecological Community near Busselton. DEC Science Division Report.

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