Threatened plant translocation case study:

Tetratheca erubescens, Elaeocarpaceae

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The species

- Long-lived, lithophytic small shrub with slender, largely aphyllous (leafless) stems arising from a stout woody base.
- Endemic to Western Australia (rank: Vulnerable, Western Australia *Wildlife Conservation Act 1950*).
- Single natural population (covering 3.5 ha) ~500 km north-east of Perth.

Threatening processes

- Mining and exploration (direct removal, indirect effects).
- Limited habitat (restricted to steep cliffs).
- Weed invasion.
- Potential predation (foliage and seed).
- Inappropriate fire regimes.

Deciding to translocate

To mine an iron ore body in the Koolyanobbing Range in Western Australia, Cliffs Asia Pacific Iron Ore (hereafter referred to as Cliffs) received a Ministerial Statement (1054) that agreed to the implementation of the proposal subject to a list of Conditions, including the conservation and protection of *Tetratheca erubescens*. One such condition stated 'establish a new self-sustaining population of at least 313 mature individuals of *Tetratheca erubescens* on a suitable landform that is suitable for the species'. Consequently, translocations would need to be carried out to achieve this Ministerial Condition.

As part of an offset package to mine and subsequently remove *T. erubescens* individuals from banded ironstone habitat, Cliffs were required to undertake translocation research with the aim of contributing to the scientific understanding of the long term recovery and protection of this threatened species. In 2016-2017, a comprehensive research program commenced and was undertaken in collaboration with Kings Park Science (formerly Botanic Garden and Parks Authority).

Aim of the translocation

The objectives of the proposed translocation were to:

- Reduce the overall impact to the species and assist in preserving the number of *in situ* individuals. This would ensure the long-term security of the population in the Koolyanobbing Range and prevent escalation of the species threat status.
- Improve the understanding of methods to successfully translocate *T. erubescens* and assist in the establishment of populations on natural and disturbed landforms, through a comprehensive research program.
- Achieve the Conditions outlined in Ministerial Statement 1054.

Translocation working group and key stakeholders

- Department of Biodiversity, Conservation and Attractions (Kings Park Science) – oversee the development and implementation of translocation (research program, translocation proposal, propagation of material – including engaging a commercial supplier (Natural Area Consulting Management Services), and installation); ongoing monitoring of translocation sites; and reporting to Cliffs.
- The University of Western Australia (School of Biological Sciences) – develop the experimental approach, analyse the data and report research findings.
- Cliffs Asia Pacific Iron Ore – develop translocation proposal; support implementation and ongoing monitoring of translocation; preparation and maintenance of translocation sites; and reporting to the Department of Biodiversity, Conservation and Attractions and relevant stakeholders.
- Department of Biodiversity, Conservation and Attractions (formerly Department of Parks and Wildlife) and Department of Water and Environmental Regulation (formerly Office of Environmental Protection Agency) – advice on development and approval of translocation proposal.

Biology and ecology

- Insect pollinated (most likely buzz-pollinated; Butcher *et al.* 2009).
- Myrmecochorous (ant) and gravity seed dispersal.
- Physiologically dormant seeds (Butcher *et al*. 2011; Elliott *et al.* 2017b).
- Application of warm stratification enhances germination (Elliott *et al.* 2017b).
- Occurs on ridges, cliffs and rocky outcrops associated with ironstone, in shallow red sandy loam.

Site selection

Recipient sites (natural and disturbed) for translocations were selected based on Elliott *et al.* (2017a):

- Habitat species modelling (*i.e*., the likelihood of occupancy; Miller 2015).
- Land tenure and risk of future mining activity.
- Safe and ongoing accessibility to sites.
- Physical and chemical assessment of soils.
- Geology (type and presence of cracks/fissures).
- Location (distance to natural population, elevation, aspect).
- Potential area for future occupancy.
- Resource availability.
- Capacity for site maintenance (*e.g*., irrigation).

Translocation proposal

A translocation proposal was developed by Cliffs in consultation with Kings Park Science, using a template provided by the (then) Department of Parks and Wildlife (DPaW) to guide and provide justification for the translocation. The proposal was submitted to DPaW where it was assessed by several independent reviewers. The proposal met the policy requirements on plant translocations and was granted approval for the translocation process to commence (2017). Translocation approval conditions included submission of an annual report that outlined the following year's translocation plan.

Pre-translocation preparation, design, implementation and ongoing maintenance

Initial sites were selected based on a ranking system and approved by DPaW. For example, sites that had a modelled likelihood of occupancy that was high, a geology consistent with the natural population, habitat potential of establishing a large number of plants, and no risk of future mining activities were ranked as most

Figure 1. Images of *Tetratheca erubescens* in the natural population and translocations. Top left – Mature plant in natural population at Koolyanobbing Range; Top right – Flower of *Tetratheca erubescens*; Bottom left – Cuttings planted at a translocation located on Koolyanobbing Range (2017 translocation); Bottom right – Two month old translocated plant (cutting derived; 2017 translocation). Photo: Carole Elliott

suitable for translocation. Site preparation involved choosing microsite locations for different translocation material (tubestock, seed) and the drilling of holes (5 cm diameter and 9 cm deep) into translocation site substrate.

Source material (wild collected cuttings and seed) for sites was collected under strict provenancing guidelines, databasing curation (collection, propagation, transportation, labelling, translocation) and licensing conditions. Provenance of material was determined by the species population genetic structure (Krauss and Anthony, 2014) and currently accepted protocol (conservative – protecting existing genetic structure by sourcing material closest to the translocation site) for translocating material of a genetically structured species (DPaW approved). Tubestock and seeding locations were mapped with meticulous continuity of records to ensure source and destination of material was known.

Translocations were designed around comparing the success of planting tubestock and direct seeding. For the translocation of tubestock, we used plants propagated from cuttings that were nine months old. Tubestock treatments that were investigated included planting substrate (cliff or scree slope), potting mix with field soil inoculation, and use of iron-rich fertiliser, irrigation and biodegradable pots. For direct seeding, we investigated the effects of irrigation and seed priming on the emergence and survival of *in situ* seedlings.

The first translocations were implemented in 2017 on natural and disturbed landforms in close proximity to natural populations. Regular irrigation (hand watering) was maintained for one year for each year's translocation program to ensure one summer of augmented soil moisture for a subgroup of treatments. Cliffs maintained the irrigation schedule, and controlled weeds and pests on all sites to ensure the best possible outcome of the experimental translocations.

Monitoring and evaluation

Intensive monitoring of tubestock and direct seeding will be conducted at 3/6 months for the first year of the translocation and then annually thereafter. Monitoring will involve quantification of seedling establishment, survival (sown seed, planted tubestock), growth (seedling and tubestock height, number of stems), health (viable foliage cover) and reproduction.

Early evaluation showed that planting tubestock into natural habitat resulted in ~30% survival two months post-planting (October 2017), which was before the onset of extreme summer heat (December 2017). For direct seeding trials, no seedlings were detected in the following months after sowing, but seeds remain viable allowing for future recruitment. Rainfall was 52% below average for 2017 (BOM 2018).

Subsequent actions

Regular monitoring will be undertaken for the next few years with additional trials planned for installation during the next three winter seasons. Results from earlier trials will be assessed and used as the basis for the development of new hypotheses and treatments for future evaluation.

Outcomes

It appears that *Tetratheca erubescens* can be physically placed into its natural cliff habitat via cuttings with some level of short-term success. Early results suggest that microhabitat placement, seasonal rainfall and access to supplementary water (irrigation) are essential for translocation success.

What we learned

- Spatial habitat modelling is essential for identifying and selecting potentially successful translocation sites.
- Knowledge of population genetic structure is critical to make informed decisions on sourcing and translocating plant material in the wider landscape.
- Fresh seeds are difficult to germinate under controlled laboratory conditions, unless dormancy is broken and a germination stimulant is applied.
- It is possible to have survival of tubestock (after two months) on natural cliff habitat in a semi-arid environment.
- Site amendments play a pivotal role in plant establishment.

References and further reading

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