Threatened plant translocation case study:

Persoonia pauciflora (North Rothbury Persoonia), Proteaceae

NATHAN J. EMERY[1], PAUL HILLIER[2], CATHERINE A. OFFORD[1]

[1]The Australian PlantBank, the Royal Botanic Gardens and Domain Trust, the Australian Botanic Garden Mount Annan, New South Wales
[2]Office of Environment and Heritage, Hunter Central Coast Branch, Newcastle, New South Wales
Email: Nathan.Emery@rbgsyd.nsw.gov.au

The Species

- Spreading woody shrub growing up to 2 m high.
- Endemic to the Hunter Valley region of New South Wales.
- Around 1,000 individuals (including translocated plants) occur predominantly on private properties within an area of occupancy of 29 hectares and a linear range of 4.3 km.

Threatening Processes

- Habitat loss and fragmentation from urban development.
- Illegal clearing or harvesting.
- Accidental destruction from grazing or slashing.
- Fire.

Deciding to translocate

In 1999 *Persoonia pauciflora* (North Rothbury Persoonia) was formally described from a specimen collected from a floral survey in 1997. By 2012 the species' habitat was under threat from urban development and habitat fragmentation, and it was estimated that fewer than 350 mature individuals remained. Due to the ongoing threats and rarity of *P. pauciflora*, the species was listed as critically endangered under the NSW *Biodiversity Conservation Act 2016 (BC Act)* and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. In response, a National Recovery Plan was drafted to guide on-ground conservation efforts. Despite the recent increase in the number of mature individuals to around 800 following additional surveys on private properties, the combination of a highly restricted distribution, threats and poor knowledge of the species' ecology, meant that the species would most likely decline without management intervention. The supplementation of existing populations as well as the establishment of new populations in secure locations were included as main objectives in the species' recovery plan. However, a full-scale translocation was thought at the time to be a high-risk conservation outcome. Consequently, a small-scale experimental planting trial in 2015 was considered as the most appropriate 'first-step' target objective, before subsequent large-scale translocations, for the successful recovery of the species. Research on the species ecology was undertaken concurrently to further inform the translocation program (Emery *et al.* 2016).

Aim of the translocation

The aim of the initial planting was to understand the factors involved in successful *P. pauciflora* translocation, and obtain the necessary knowledge required to implement a full-scale translocation project. The main factors considered were: propagation material used (seedlings versus vegetatively propagated), and fencing to exclude macropods. Subsequent plantings were informed by the results of this initial planting. An important aim of the translocation process was to involve the local community; initially involving a local landowner with plantings on her property, and later involving community members in plantings on National Park land.

Translocation working group and key stakeholders

- The Office of Environment and Heritage (OEH), Hunter Central Coast Branch, New South Wales – to oversee the development and implementation of the experimental translocation trial, and site selection and preparation prior to planting.
- Royal Botanic Gardens and Domain Trust, New South Wales (The Australian Botanic Garden Mount Annan, ABGMA) – collection and propagation of plant material (Figure 1), development of translocation plan, and site selection.

Biology and Ecology

- Self-compatible breeding system.
- Insect pollinated – native *Leioproctus* bees are the main floral visitors.
- Fruits are occasionally dispersed by birds.
- Seeds have mechanical (encased in a woody endocarp) and physiological dormancy.
- Germination is most likely to occur in spring and autumn.

Figure 1. An example of *Persoonia pauciflora* plants propagated for translocation at the Australian Botanic Garden Mount Annan. Photo: Nathan Emery

Site selection

Site selection was restricted to within the current distribution of *P. pauciflora* and, more specifically, in areas recently set aside as conservation offset land. Visits were made to these areas to determine whether the local vegetation was suitable Broad-leaf Ironbark (*Eucalyptus fibrosa*) and Spotted Gum (*Corymbia maculata*) habitat similar to where extant *P. pauciflora* plants occur. The physical and chemical soil properties were described, no pathogens were detected (soil samples were tested for *Phytophthora* spp. at the Royal Botanic Garden's Plant Clinic), and potential future threats (e.g., herbivory) were documented.

Three sites were chosen in conservation offset land situated near the centre of the distribution of *P. pauciflora* where several isolated extant plants were present. A fourth site was chosen in a second conservation offset block within the distribution a year later in 2016, and a fifth site in a third conservation offset block outside of the distribution was selected in 2017.

Translocation proposal

A translocation proposal was prepared using a template developed by ABGMA. The template was designed to provide background information, address licensing questions and direct the translocation design and implementation following the Australian Translocation Guidelines (Vallee *et al.* 2004). The proposal was then forwarded to the Office of Environment and Heritage (OEH) for assessment and feedback prior to the commencement of planting.

Pre-translocation preparation, design, implementation and ongoing maintenance

A schematic of the initial planting design is illustrated in Figure 2. At each of the three sites, twenty-four plants (evenly split by propagation type: seedlings and cuttings) were randomly planted in six blocks over an area of 10 × 16 m (a total of 72 plants). Each block contained two cutting-propagated plants and two seed-propagated, and three randomly assigned blocks were fenced off to exclude macropod predation. Cuttings were originally sourced from two populations of 3 and 17 adult plants, respectively, and propagated at the Australian Botanic Garden Mount Annan. Each block was 4 m^2 with plants placed 1 m from the edges to avoid contact with the fence and/or adjacent conspecifics. Several juvenile plant deaths from frost damage prompted us to protect younger plants with tree guards.

Refinements to the experimental design were subsequently made for the 2016 and 2017 plantings. In 2016, the recipient site was approximately 30 x 40 m, and divided into twelve 10 m^2 plots. Ten different vegetatively propagated *P. pauciflora* plant accessions were placed randomly within each plot (120 plants in total). Tree guards were placed around each plant to protect from frost damage for two years post-planting. The site was left unfenced as grazing pressures were thought to be low. The recipient site for the 2017 planting was approximately 50 × 40 m comprising twenty 10 m^2 plots. Ten different plant accessions were randomly spaced apart and then planted (200 plants in total). Each plant was protected for the first two years by a tree guard, and the site was fenced to protect from macropod grazing.

Monitoring and evaluation

We monitored plant health (including signs of physical damage, foliage loss and changes in foliage colour), survival, growth (plant height and width), flowering and fruiting. The monitoring schedule was initially intensive, weekly for the first month (to detect signs of translocation shock), fortnightly, monthly, quarterly and eventually half-yearly. By 2018 (30 months post-planting), survivorship among the initial three planting sites was 67–71%. Plant mortality predominantly occurred in the first five months post-planting due to either frost

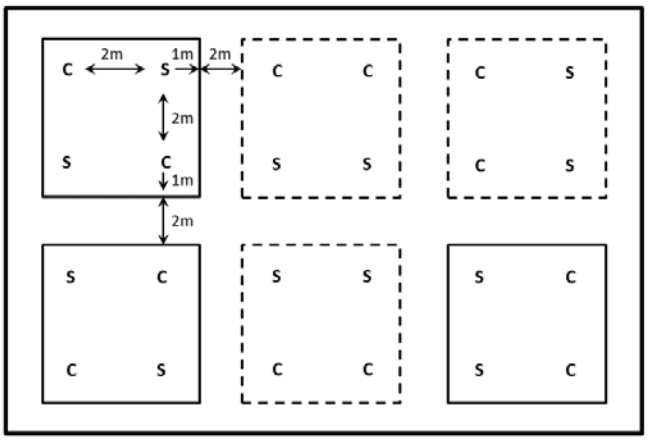

Figure 2. Site design of the initial translocation (plant and block positions were randomised at each site). Dotted line indicates an unfenced block, solid line represents fenced. C: plant cultivated from vegetative cutting; and, S: plant cultivated from seed.

or macropod damage and subsequent defoliation. All reproductively mature plants had flowered and set fruit for at least one season.

Monitoring plants in the initial translocation enabled the evaluation of fencing with propagation method. Survival was slightly higher for fenced plants (72%) compared to unfenced plants (63%), and plants propagated from cuttings (81%) compared to seedlings (58%). By 2018, unfenced plants had a higher growth index (measured as plant height and width) than fenced plants. Fenced *P. pauciflora* plants were often out-competed by other plant species that benefitted from the lack of grazing pressures within the plots.

Subsequent actions

The staged translocation approach for *P. pauciflora*, has resulted in increasingly successful plantings. The short-term success in the initial translocation gave us confidence to proceed with additional, larger translocations. The second translocation in 2016 was in a nearby conservation offset within the species distribution, and used 120 vegetatively propagated plants, which were protected with tree guards and left unfenced. By 2018, plant survival was 71% (86 plants) with 57% of plants having flowered. However, in this planting, mortality was associated with significant macropod grazing pressure.

Informed by the first two plantings, a new site was selected in 2017 in a conservation offset around 1.5 km linear distance from the nearest extant population. The site was fenced and had very little understorey, to lessen the effect of initial plant competition. After six months, 200 of the 203 translocants survived and 98% had flowered.

A new site will be chosen in 2018 for an additional translocation of 400–500 plants. Genetic testing on a representative sample of plants from the distribution will guide the design of this proposed translocation. Monitoring is ongoing across all sites to determine success and includes pollinator observations and recruitment events. The results of this research will be used to assist future translocation projects, such as those under the OEH New South Wales 'Saving our Species' program.

Outcomes

The long-term outcome of successful translocations is to establish self-sustaining populations. Although the monitoring data showed good short-term survival, growth, flowering and fruiting, no recruitment has yet been recorded. This was expected as previous literature suggest between 1–2 years for *Persoonia* endocarps to sufficiently breakdown for germination to occur (Norman and Koch 2008; Chia *et al.* 2016). A seed burial experiment of *P. pauciflora* showed no germination following 18 months burial (unpublished).

It was demonstrated that experimental trials are important for identifying several factors that might affect the establishment of *P. pauciflora*, thereby minimising any possible negative impacts of these for subsequent large-scale plantings. The original aim to establish an

Figure 3. Volunteers from the North Rothbury community being briefed by the translocation team as part of the *Persoonia pauciflora* planting day in 2016. Photo: Catherine Offord

experimental translocation trial demonstrated that plants propagated from cuttings had the highest survival. Furthermore, protecting plants from frost and macropod grazing increased survival in the short-term.

Over 100 volunteers from the local community assisted in the translocation plantings of *P. pauciflora* in 2016 and 2017 (Figure 3). Feedback gathered across three community planting days was resoundingly positive, and a translocation team member continues to provide information on *P. pauciflora* for the community.

What we learned

- A small translocation trial using an experimental framework was important in understanding factors important for establishment and survival.
- Attention to appropriate planting material is required.
- Fencing provides protection from macropod grazing, but can inhibit growth due to an increase in plant competition.
- Involving the local community in plantings encourages stewardship and respect for the plight of threatened species.

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Threatened plant translocation case study:

Cassinia rugata (Wrinkled Dollybush), Asteraceae

PHIL COLLIER AND ROBIN GARNETT

Rubicon, Tasmania
Email: phil@rubicon.org.au

The Species

Cassinia rugata (Wrinkled Dollybush) was rediscovered in Tasmania in 2010, and is known from two private properties in the central north: (1) Rubicon that is covenanted with about 6 to 9 ha of suitable habitat, and (2) on Squeaking Point Road that has an informal area set aside of approximately 0.6 ha. A few plants were mapped on roadsides in 2010 in the neighbourhood of these properties. The total population in Tasmania in 2014 was approximately 500 mature plants. It is listed as Endangered in Tasmania and Vulnerable nationally, with only a few small populations known in Victoria (Carter and Walsh 2006).

Biology and Ecology

In central north Tasmania, *C. rugata* is a multi-branched shrub that grows to about 1.5 m in wet (sedgy) heathland. Plants decline rapidly when shaded by shrubs or trees, and plants in long-undisturbed open situations tend to become straggly and die back. Experiments at Rubicon showed that after fire, caged plants survived and grew faster than uncaged plants. However, response to fire is not predictable or well-understood.

Threatening Processes

All known roadside plants neighbouring the two extant Tasmanian populations have disappeared for reasons unknown within the last five years. The Squeaking Point Road population was threatened recently by conversion of its wet heathland habitat to a horse paddock; only a last-minute intervention with a willing land-owner prevented the extirpation of this population. Any other currently unknown populations are subject to similar risks, especially if not within view of a public road and a knowledgeable public.