Threatened plant translocation case study:

Banksia brownii (Feather Leaved Banksia), Proteaceae

DAVE COATES*, REBECCA DILLON AND SARAH BARRETT

Department of Biodiversity, Conservation and Attractions, Western Australia.
*Email: Dave.Coates@dbca.wa.gov.au

The Species

- Long-lived non-lignotuberous shrub or small tree.
- Endemic to Western Australia.
- 18 extant (surviving; in existence) natural populations, 10 with less than 100 plants, which occur over a 90 km range around Albany (to the north and east).
- Three biogeographically and genetically distinct population groups have been identified and are considered to be separate conservation units for management and recovery.

Threatening Processes

- *Phytophthora* dieback.
- Inappropriate fire regimes (i.e., too frequent fire and lack of fire).

Deciding to translocate

Banksia brownii is highly susceptible to the introduced soil-borne pathogen *Phytophthora cinnamomi,* which is considered to be the greatest threat to this species' ongoing persistence (Shearer *et al.* 2013). Of 30 known populations, 12 are now presumed extinct due to *Phytophthora* dieback, 10 have less than 100 plants; of these, eight have less than 10 mature plants remaining with the decline in numbers largely due to *Phytophthora* dieback. Genetic diversity studies based on material from extinct (*ex situ* seed collections) and extant populations indicate that some 38% of total genetic diversity, based on contributions of within population variation and differentiation, has been lost from *B. brownii* due to *Phytophthora* dieback (Coates *et al.* 2015).

Population genetic studies (using microsatellite genotyping) have demonstrated significant levels of differentiation among populations of *B. brownii* corresponding to the three geographically and historically isolated disjunct population groups; Stirling Range National Park (SRNP), Milbrook-Waychinicup and Vancouver Peninsula. These isolated population groups also display ecological differences, and they occupy contrasting habitats in terms of substrate, associated vegetation and climate. The three population groups are therefore considered to be discrete conservation units important for the management and recovery of *B. brownii* (Coates *et al.* 2015).

Banksia brownii has a long juvenile period, requiring a fire-free period of at least 15 years to reach maturity and accumulate an adequate seed bank, making it vulnerable to short fire intervals. Two fires in close succession, in 1991 and 2000, in the eastern Stirling Range had a significant impact with no or minimal regeneration of several populations (Gilfillan and Barrett 2008; Barrett and Yates 2015).

The species was declared as Rare Flora under the Western Australian *Wildlife Conservation Act* in November 1980 and is currently ranked as Critically Endangered. It is also listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

The establishment of three translocated populations in new secure and disease-free locations was considered to be one of the most effective actions to initiate successful recovery of the species

Aim of the translocation

The aim of the translocation was to successfully establish three viable populations covering the three genetically and biogeographically distinct conservation units recognised in *B. brownii* (Figure 1). For each population the objective was to establish at least 200 mature adult plants in secure sites where threats, in particular *Phytophthora* dieback, were absent. An initial assessment of viability would be based on the production of viable seed and recruitment over subsequent generations.

Translocation working group and key stakeholders

- Department of Biodiversity, Conservation and Attractions (DBCA), Western Australia – to oversee development and implementation of translocation and ongoing monitoring and maintenance of translocation sites.

- Department of Biodiversity, Conservation and Attractions, Western Australia (Botanic Gardens and Parks Authority) – propagation of seedlings.
- Albany District Threatened Flora Recovery Team – to oversee implementation of Interim Recovery Plan for the species, including the translocations.

Biology and Ecology

- Primarily bird- and mammal-pollinated but insect pollination is also likely.
- Seeds are usually retained in the infructescences and remain viable for at least 30 years. They are released after fire.
- Recruitment is primarily confined to post-fire period.
- Population genetic studies have demonstrated significant genetic structure within *B. brownii* corresponding to the three geographically disjunct population groups. Higher levels of genetic diversity in the Stirling Range populations indicate larger and more stable population sizes over longer timeframes.
- The historically isolated population groups display ecological differences occupying contrasting habitats in terms of substrate, associated vegetation and climate.
- Climate is Mediterranean with hot dry summers and cool wet winters.

Site selection

Given the recognition of three genetically and biogeographically distinct conservation units within *B. brownii* (Figure 1), three separate translocations representing each conservation unit were considered optimal, to maximise the conservation of genetic diversity within the species. The three translocated populations would therefore represent the Stirling Range populations (Site 1), the Milbrook- Waychnincup populations (Site 2) and the Vancouver Peninsula population (Site 3).

A desktop GIS-based search was made of conservation reserves in the vicinity of the known *B. brownii* populations in each of the three regions to locate suitable sites. Search criteria included similar soil and vegetation to the natural populations, secure tenure, absence of threats and proximity to the known populations. Infestation with *Phytophthora* dieback was the most significant challenge as many otherwise suitable sites were infested. An additional factor in site selection was the risk of a major disturbance event (such as fire) and whether measures could be put in place to ensure the risk of an event affecting the translocated populations was low.

As it was not possible to locate a translocation site within areas of suitable habitat in the SRNP which was not affected by *Phytophthora* dieback, Site 1 was located north of the Porongurup Range in revegetated woodland on private property within 26 km of *B. brownii* populations in the SRNP. Translocations of several other Critically Endangered species susceptible to *P. cinnamomi* and endemic to the SRNP are also located on this site

Site 2 was located within remnant vegetation similar to the species' natural habitat on a *Eucalyptus globulus* (bluegum) plantation managed by the then Integrated Tree Cropping Pty Ltd (ITC), now Australian Bluegum Plantations (ABP). Significant areas of native vegetation within the plantation remain undisturbed and in good condition. The selected site was located within remnant vegetation on a high-point of a lateritic ridge and is *Phytophthora*-free.

Site 3 was located on Snake Hill in Torndirrup National Park, within 4.3 km of the natural population of the Vancouver Peninsular population of *B. brownii* in *Phytophthora*-free habitat similar to that of the natural population.

Translocation proposal

Two Translocation Proposals were developed; one for the Stirling Range and Milbrook – Waychinincup populations (Barrett and Jackson 2006) and one for the Vancouver Peninsula populations (Barrett *et al.* 2008). These were developed using a template provided by the then Department of Environment and Conservation (DEC), now DBCA, to guide and provide justification for the translocation. The Proposals were submitted to DEC where they were assessed by two independent reviewers as to whether they met DEC's policy on plant translocations, before being given approval for the translocation process to commence.

Pre-translocation preparation, design, implementation and ongoing maintenance

Each translocation was established with seedlings grown from seed collected from natural populations which has been stored in the DBCA Threatened Flora Seed Centre covering the three genetically and biogeographically distinct regions. Two translocation sites (Sites 1 and 2) were established with a proportion of seed collected from now extinct populations.

At each site, seedlings were established during winter and planted roughly in rows, amongst the existing vegetation, with progeny from the same maternal plant kept separate. Each plant was permanently tagged for monitoring purposes and caged to prevent grazing by rabbits and kangaroos. An automatic solar-powered irrigation system was established in spring to water plants during the first and second summer. As a precautionary measure to protect the translocation sites from disease, all equipment used during planting and monitoring was maintained under strict disease hygiene, with access restricted to dry soil conditions. Vehicles and footwear were cleaned of soil before entering the natural populations and translocation sites.

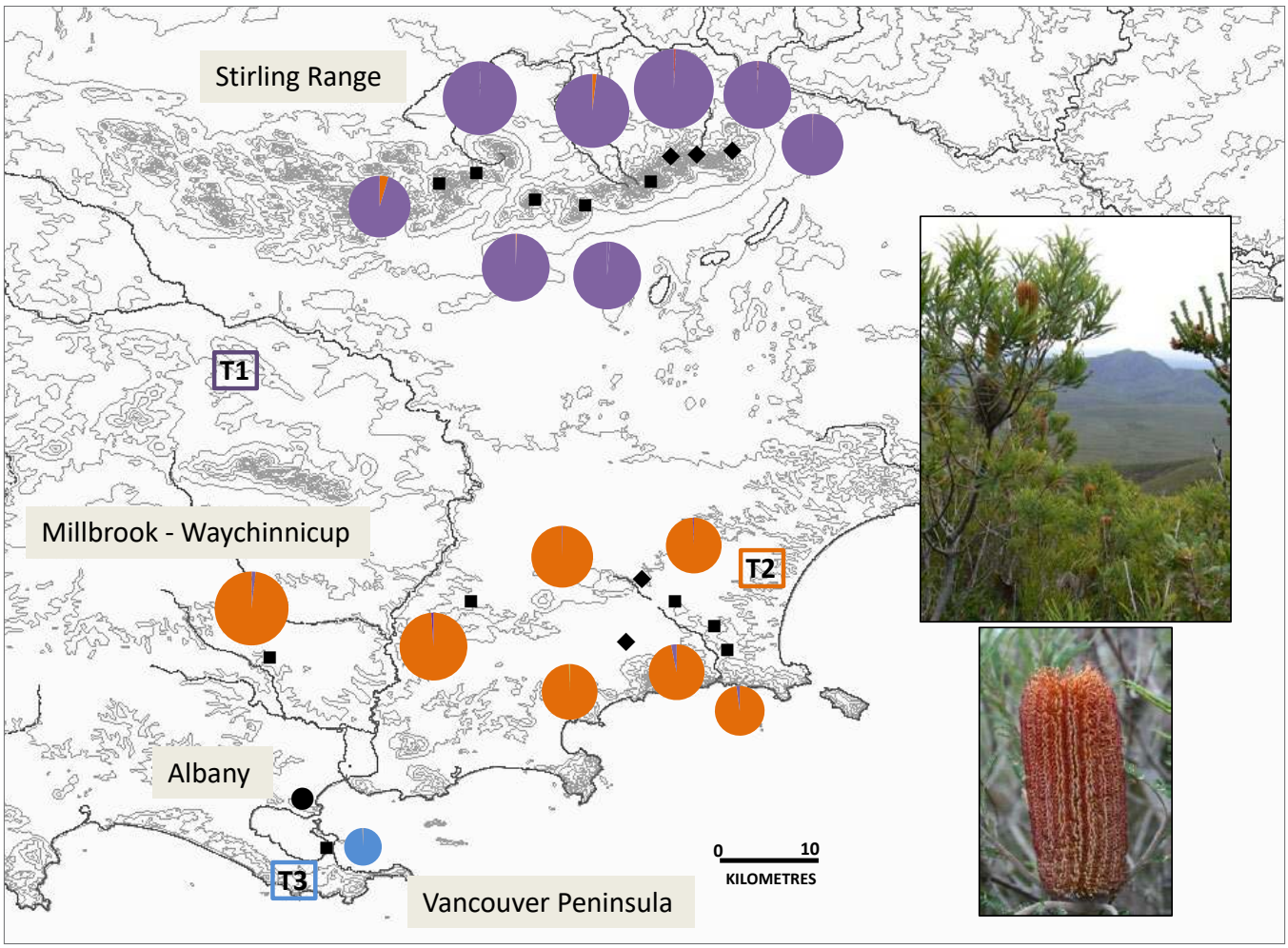

Figure 1. Mean q-matrix membership proportions of *Banksia brownii* populations (pie charts) when K=3 from a STRUCTURE analysis (see Coates *et al.* 2015). The size of pie charts is relative to the level of genetic diversity. Extant populations ■. Germinated seed from extinct populations ♦ was initially used to establish two separate translocated populations (T1 and T2) in disease free areas. Translocated population T3 was established with seed from the single Vancouver Peninsula population.

At Sites 1 and Site 2, the land managers, Mr Luscombe and ABP, currently implement *Phytophthora* hygiene procedures at the sites, maintain firebreaks and will aid in fire suppression activities if necessary. A management agreement has previously been entered into between Mr Luscombe and ABP with the Department, for translocations, which will ensure access for Departmental staff and the protection of translocated plants.

Site 3 within the Torndirrup National Park is managed by DBCA with strict *Phytophthora* hygiene procedures followed in the park. The site is situated within a fuel reduction zone that provides a protective buffer between Torndirrup National Park and the adjacent residential area.

Monitoring and evaluation

Detailed monitoring of the translocated population is undertaken every 12 months. More frequent informal monitoring is undertaken where possible. Detailed monitoring included counting the number of surviving plants and their height, width of the crown in two directions, reproductive state, number of inflorescences and fruits, whether second generation plants are present and the general health of the plants. To provide essential baseline data for assessing the performance of the translocated population, basic monitoring of selected original populations is also carried out every 12 – 24 months.

After 10 years, survival at site 1 is 20%, site 2 is 49% and site 3 is 50%. After an initial three years of good health and survival at site 1, extended dry periods resulted in a decline of plant numbers, indicating the site has become unsuitable for this species.

Subsequent actions

Banksia brownii is the sole host to the Critically Endangered herbivorous plant-louse *Trioza barrettae*. A coordinated approach to prevent co-extinction has recently involved the successful translocation of the plant louse from the Vancouver *B. brownii* population to the new translocated population (T3, Figure 1) (Moir *et al.* 2016).

Seed collection has been made from Site 2 for long term storage in the Departments' Threatened Flora Seed Store.

Outcomes

The aim to successfully establish three populations covering the three genetically and biogeographically distinct conservation units recognised in *B. brownii* has been met although long term viability has yet to be established. While all three translocated populations have flowered and produced seed from multiple plants, recruitment has only been observed at Site 2. The decline in plant numbers at site 1 has aided in more accurately defining the site characteristics required for this species, with further translocations at wetter sites required to conserve the Stirling Range population group. At Site 3, initial plantings in open granite habitat had poor survival, subsequent plantings targeted deeper, more vegetated soils.

What we learned

- It is possible to establish new populations of this species.
- Using an experimental framework when establishing translocations can provide critical information for long-term translocation success.
- This species may require higher moisture conditions than other Proteaceae from the region.
- Fencing and summer watering improves survival of planted seedlings.
- At site 3, optimal micro-habitat within the site was identified to ensure success.

References and further reading

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Threatened plant translocation case study:

Haloragis eyreana (Prickly Raspwort), Haloragaceae

MANFRED JUSAITIS*

South Australian Seed Conservation Centre, Botanic Gardens of South Australia, and School of Biological Sciences, University of Adelaide.
*Email: Manfred.Jusaitis@sa.gov.au

The Species

- Small, perennial herb with a deep stoloniferous rootstock.
- Endemic to southern Eyre Peninsula, South Australia.

Threatening Processes

- Habitat loss and fragmentation through agricultural development.
- Weed competition.
- Roadside management activities.
- Altered hydrological regimes.

Deciding to translocate

Extensive surveys between 1997-1999 counted approximately 16,000 individuals with an area of occupancy of 0.8 km^2 and an extent of occurrence of 711 km^2 (Jusaitis and Freebairn 2011). Since 1999, plant numbers at five population monitoring points have been steadily declining. The species is listed as Endangered under the Australian Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*), and assessed as Critically Endangered under IUCN criteria. *Haloragis eyreana* has rather specific habitat requirements, being found in low lying, disturbed areas subject to inundation or water runoff during winter.