Threatened plant translocation case study:

Hibbertia spanantha Toelken & A.F.Rob (Julian's Hibbertia), Dilleniaceae

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The species

- Perennial long lived erect to prostrate subshrub.
- Endemic to the Sydney basin.
- First located in 2007 in Turramurra, Sydney.
- A second population discovered in Spring 2013.
- Gazetted in 2015.
- Now known from only 3 disparate locations.

Threatening processes

- Habitat loss and fragmentation.
- Urbanisation.
- Altered fire regimes.
- Genetic depression.
- Lack of reproduction.
- Invasive species.

Deciding to translocate

Hibbertia spanantha was discovered in 2007 from one discrete location in the suburb of Turramurra, Sydney, and was originally known as *Hibbertia* sp. Turramurra (A.F.Robinson s.n. NSW981514). It was formally described as *Hibbertia spanantha* in 2015 (Toelken and Robinson 2015) and has been listed as Critically Endangered under the New South Wales *Biodiversity Conservation Act 2016* and the *Environmental Protection and Biodiversity Act 1999*. This listing was primarily based on the species' limited distribution and low number of mature individuals (NSW Scientific Committee 2015; Threatened Species Scientific Committee, 2016). At the time of implementing the translocation program, only two other populations had been located. One of these comprised of six individuals and was confined within a fragmented bushland reserve located in the Hornsby Local Government Area (LGA). A development within the vicinity of the reserve posed a potential risk, given the species' limited population size. Additionally, no occurrences of successful reproduction had been recorded (*i.e*., no seeds or juvenile plants had been observed). It was then decided to augment the population to provide insurance against the possibility of unintentional damage caused by the development.

Aim of the translocation

Although the nearby development posed no immediate threat to the population, the proximity of works and lack of signs of reproduction, meant the population may have been in danger of accidental damage leading to, at worst, local extinction. The translocation program aimed to provide short- to medium-term insurance for the local population, in the event of damage from the adjacent development. Initial plans to augment the existing population through direct seeding were quickly stymied when no viable seed could be located. Instead, the program sought to introduce additional plants propagated from cuttings. The cuttings were to be collected from the parents in the reserve and used to propagate individuals for planting in similar habitat near the parents.

Translocation working group and key stakeholders

- AMBS Ecology and Heritage Pty Ltd.
- Hornsby Shire Council.
- The Australian Botanic Garden Mount Annan.

Biology and ecology

- Insect pollination.
- Seeds probably gravity dispersed.
- Possibly fire dependent germination.
- Generally flowers October-November, although plants have been observed to produce flowers throughout the year (OEH 2017).
- Grows in tall open forest vegetation associated with sandy to light clays of Coastal Enriched Sandstone Dry Forest and or Coastal Shale Sandstone Forest (OEH 2013 in Toelken and Robinson 2015) and Sydney Turpentine Ironbark Forest (OEH 2013). These communities occur within the broader

vegetation classes of Sydney Coastal Dry Sclerophyll Forests and Northern Hinterland Wet Sclerophyll Forests (Keith 2004).

Site selection

Propagated plants were replanted near the parent plants, in areas determined by field surveys as Sydney Turpentine Ironbark forest. Site inspections further refined the planting locations based on aspect, sun exposure/shade and litter depth relative to the parent plants.

Translocation proposal

The proposal for propagation and population augmentation was embedded in the project development Environmental Management Plan and required as a project condition of consent. The proposal was also reviewed by Hornsby Shire Council.

Pre-translocation preparation, design, implementation and ongoing maintenance

The Australian Botanic Garden Mount Annan (ABGMA) was commissioned to collect and propagate cuttings from each parent *Hibbertia*. Cuttings were struck from a combination of 'soft-tip' and 'semi-hard wood' material, using a two-staged hormone treatment developed by ABGMA nursery. A total of 27 cuttings were collected from three individual specimens (clonal), of which a total of 18 cuttings successfully struck. Of the 11 cuttings that survived, eight were supplied for translocation and 3 were retained by ABGMA as part of *ex situ* conservation. The retained cuttings were used for a second iteration of propagation, however only one of the accessions produced surviving cuttings. The eight *Hibbertia spanantha* cuttings from the first propagation represented three accessions (individual specimens).

Planting occurred in pre-selected locations in autumn 2015, a period which corresponds with a slowing in the active growth of many native plant species. In addition, autumn planting reduces the risk of transplant shock by providing a period of establishment before summer heat stress. The cuttings were collected from the ABGMA nursery one day prior to planting and were visibly robust, with a higher leaf biomass than the parent plants. Two of the cuttings had developed a stunted appearance quite dissimilar to that of the parent plants. The propagated *Hibbertia* plants had also flowered the previous season in the nursery but did not produce fruit.

Prior to planting, each cutting was assigned a recording number and baseline data was collected at each location. This included descriptive information (date, coordinates, tag number, accession number and location description); abiotic factors (soil texture and colour, percent bare ground, leaf litter depth (mm), depth to parent material (mm) and plant health (total height (mm), evidence of disease/stress, evidence of flowering/fruiting, growth form). In addition, soil cores were collected from each hole prior to planting using a single cylinder, hammer driver and 4.86 cm diameter coring tube. Samples were collected to 10 cm depth. Samples were stored in a sealed plastic zip lock bag, with relevant site codes, and refrigerated until analysis.

At the time of planting the soil moisture levels were high and the soil was wet to the touch; but no soil moisture readings were collected. Planting sites were physically tagged and coordinates were recorded. Planting holes were deep enough to only cover the root ball and no deep stem planting was conducted. Approximately 300–500 ml of water was placed in the bottom of each hole prior to planting, with an additional 500 ml used to water each individual immediately after planting. At the time of planting the root structure of the *Hibbertia* was noted as a fine network of delicate roots and no discernible vertical tap root. Plants were watered the day after planting with 300-500 ml of water, and then every 2 days for one-week post planting.

Figure 1. Parent *Hibbertia spanantha* (left) has a much lower leaf biomass that the majority of planted individuals (right) (April 2015). Photo: Chantelle Doyle

After this time, watering occurred weekly for one month in accompaniment to monitoring of the plant health. Regular watering ceased in July 2015. However, after a long dry spell over November and December, translocated *Hibbertia* plants were watered. At the time of watering the soil was still damp to the touch but drier than at the time of planting.

Monitoring of plants occurred for one-year post planting (concluding June 2016). Throughout autumn and winter 2015, all plants were healthy and the natural soil condition moist due to regular rainfall.

Translocated *Hibbertia* plants began to produce buds in September and October, but four of the planted individuals died whilst in bud or with partially opened flowers. The three surviving *Hibbertia* were much smaller in stature (Figure 2), two being of a morphologically 'stunted' accession and the third dropping most of its leaves. One of the plants from the 'stunted' accession was reported as dead in April 2016 and a second plant was reported as dead in June 2016. At the time of the final monitoring, only one *Hibbertia* remained alive, albeit with only very sparse basal leaves remaining. This plant has since died.

Analysis of soils collected from both pots and planting sites showed the planting site soils had lower moisture content (%), pH, electrical conductivity and nitrogen and phosphorous levels (recorded as available P, ammonia, nitrate/nitrite) than pot soils. Percentage carbon was also recorded but varied considerably between samples.

Subsequent actions

Anecdotal observations suggested that soil nutrients and period of 'hardening off' may have a role in the survival of cuttings when planted back into their natural habitat. A second propagation and population augmentation trial is being conducted by AMBS and Hornsby Shire Council, with support of the NSW Office of Environment and Heritage (OEH) to test this possibility. Cuttings for this trial have been acquired from accessions retained by ABGMA after the original trial.

The second trial began in August 2017 with the aim to propagate 25 *Hibbertia spanantha* under five nutrient treatments (including using provenance soil), and the intent being to plant cuttings near the parent population after a standardised period of hardening off. Each of the planted individuals will be monitored for a minimum of two years post planting.

The trial is already yielding interesting results about propagation techniques and plant performance in a nursery environment

Outcomes

The original aim to augment the existing population of *Hibbertia spanantha* was not achieved, as all planted individuals have died. Observations during the first

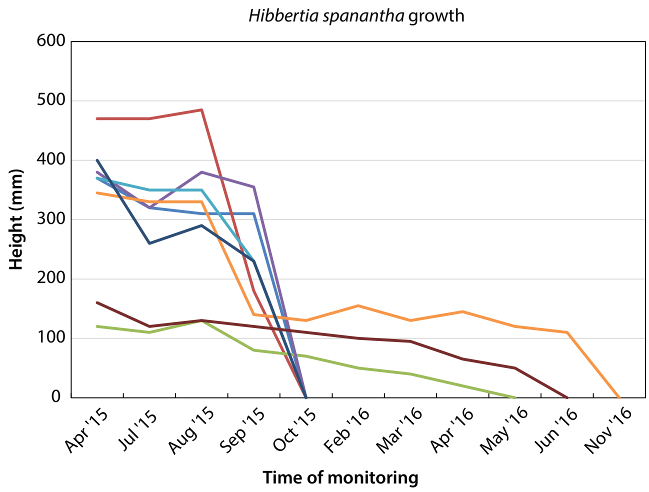

Figure 2. *Hibbertia spanantha* height (mm) of different individuals from planting to termination of monitoring in November 2016.

program have however provided insights into the behaviour of the plants which has posed further questions on potential for the propagation and translocation of this species. This has led to a second propagation and planting trial with cuttings planted in autumn 2018. This new trial aims to monitor the impact of growing medium, nutrient levels and hardening off on the survival of planted individuals. Lessons from the failed translocation and the new trial will be used to inform future propagation practice and hopefully improve long term survival success.

What we learned

- Propagation of cuttings using rooting hormone and standard potting media had high initial success. The species can produce struck cuttings from a variety of plant ages, *i.e.*, both tip material and woodier sections of plant tissue.
- *Hibbertia spanatha* propagation success can depend on the parent plant, collecting from a variety of individuals may be important for propagation success.
- Flowering occurs from September to November, but may also respond to positive environmental cues at other times of year (as indicated in the Threatened Species Profile (OEH 2017) and flowering in nursery environment).
- Plants with lower leaf biomass survived longer post planting. This may also reflect potting mix nutrient levels.
- The bulk of plant deaths coincided with flower production. It is uncertain if flower production was a factor contributing to plant senescence or occurred as a response to plant stress. Strategies to manage flowering the first year post-planting may increase survival (*e.g.* pruning, additional water).

References and further reading

Keith, D.A. (2004). *Ocean shores to desert dunes: the native vegetation of New South Wales and the A.C.T*. Department of Environment and Conservation, Hurstville.

OEH (2013). *The Native Vegetation of the Sydney Metropolitan Area (Version 2.0)*. Office of Environment and Heritage, Department of Premier and Cabinet, Sydney.

OEH (2017). *Julian's Hibbertia-profile.* Office of Environment and Heritage NSW Government, Sydney. Accessed 6th February 2018 Available from www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20279

Scientific Committee (2015). Hibbertia sp. *Turramurra Final Determination NSW Threatened Species Scientific Committe*e. Available from www.environment.nsw.gov.au/resources/threatenedspecies/determinations/FDHibbTurraCR.pdf

Threatened Species Scientific Committee (2016). *Conservation Advice* Hibbertia spanantha *Julian's hibbertia*. Department of the Environment and Energy, Canberrra.

Toelken, H.R. and Robinson, A.F. (2015). Notes on *Hibbertia* (Dilleniaceae) 11. *Hibbertia spanantha*, a new species from the central coast of New South Wales. *Journal of the Adelaide Botanic Gardens* 29: 11–14

Threatened plant translocation case study:

Wollemia nobilis (Wollemi Pine), Araucariaceae

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The species

The Wollemi Pine is a Critically Endangered conifer that is endemic to a single catchment in Wollemi National Park, NSW. Fewer than 100 mature Wollemi Pines remain in the wild. The Wollemi Pine is a high profile species since its discovery in 1994 by David Noble. It has attracted international media interest, and was dubbed a 'living fossil' because of its similarity to previously described fossil records (Chambers *et al.* 1998). The Wollemi Pine was the subject of the State of New South Wales' first Recovery Plan for a threatened species, which included *in situ* management and *ex situ* conservation actions. Another action was a campaign of 'cultivation for conservation' by the Royal Botanic Gardens and Domain Trust, with the first plants available for sale in 2005.

Biology and ecology

The trees occur in deep gullies within warm temperate rainforest. The tallest recorded Wollemi Pine is 42 m. Wollemi Pines are multi-stemmed and show little genetic variation among individuals (Greenfield *et al.* 2017), and recruitment from seed appears to be rare. Seed viability is typically around 10% (Offord *et al.* 1999) and the survival of germinants in the wild is around 35% (Zimmer *et al.* 2014a). Once seedlings establish, survival rates are higher, but growth rates remain low (Zimmer *et al.* 2014a).

There are around 200 seedlings and juvenile Wollemi Pines in the wild. It is likely that the creation of canopy gaps would increase Wollemi Pine recruitment, as many rainforest trees.

Threatening processes

The most significant threat to the Wollemi Pine is its limited geographic distribution. The risk of a single catastrophic event affecting all individuals is very likely.

Photo 1. Wollemi Pines in the wild. Photo: Heidi Zimmer