Collecting and Storing Rare Seeds©

Andrew Crawford, Anne Monaghan, and Anne Cochrane
Department of the Environment and Conservation, Threatened Flora Seed Centre, Locked Bag 104, Bentley, Western Australia 6983
Email: Andrew.Crawford@dec.wa.gov.au

INTRODUCTION

Western Australia possesses a rich and diverse flora comprising over 12,000 native taxa (Western Australian Herbarium, 2010) with most species (60%) being endemic to the state. The south-west region of the state is the most diverse, containing over 7,000 plant species, of which half are endemic to the region (Hopper and Gioia, 2004).

Associated with this species richness is a high number of rare, threatened, and poorly known species; currently Western Australia has 3,100 taxa listed as rare, threatened, or poorly known, with a further 13 taxa presumed to be extinct (Smith, 2010). Of these conservation taxa, 406 are protected under the state legislation and are referred to as Declared Rare Flora (DRF). The remaining taxa are known as Priority Flora. These are taxa that are poorly known and in need of further survey to ascertain their conservation status. The high numbers of threatened species, more than for other Australian States and most countries (Hopper and Gioia, 2004), in combination with high species endemism, has resulted in the south-western botanical region being listed as one of the world's 34 biodiversity hotspots (Mittermeiser et al., 2004). A biodiversity hotspot is defined as an area containing at least 1,500 endemic plant species but also having lost at least 70% of its original habitat (Mittermeiser et al., 2004).

The Department of Environment and Conservation (DEC) is the authority responsible for managing Western Australia's flora, including its threatened flora. In order to reduce loss of genetic diversity a range of recovery actions are undertaken. These actions can range from fencing and weed control (Cochrane, 2004) through to species reintroductions (Monks and Coates, 2002), but importantly integrate in situ management with ex situ conservation. Whilst conservation of plants in situ is always the main priority, seed collection and the long term storage of this material ex situ is an important and complementary component of this strategy.

In 1992 DEC established an ex situ seed storage facility, The Threatened Flora Seed Centre (TFSC), with the primary purpose of conserving seeds of WA's conservation significant plants for use in species recovery. In 2001 DEC joined with the Royal Botanic Gardens, Kew (U.K.) in an international seed conservation partnership, The Millennium Seed Bank Project (MSBP). This project aimed to conserve 10% of the world's dryland flora, as seed, by 2010. Prior to this there were few long-term conservation seed banks in Australia, whilst now there is a facility in every State and mainland Territory.

The TFSC has always aimed to use "best practice" for the collection and storage of seeds and these practices are now reflected in the germplasm conservation guidelines for Australia (Offord and Meagher, 2009). A good quality seed collection is made up of a number of components. These include: a known plant identity; good collection data; a genetically representative sample; and viable seed that is stored

under conditions that aim to maximize longevity. In all cases the collection should be made in a way which doesn't adversely impact on the source population.

A good description of the target species is essential to ensure that the correct species is collected, hence avoiding a waste of time, effort, and resources. It is also important to ensure that a herbarium voucher specimen is taken and lodged at the relevant state herbarium. This not only verifies the identity of the collected species but also "future proofs" this identity. If taxonomic changes take place then these can be tracked via the specimen to the seed collection. Good collection data is crucial to a good seed collection. Plant descriptions aid in identification, whilst site descriptions and location details pinpoint the place of collection and can aid in the selection of future reintroduction sites. Details about the number of known plants and the number of plants sampled in the source population give an indication of the genetic quality of a collection with respect to the proportion of plants sampled from the population.

Genetic diversity within a seed collection forms the building blocks for the successful utilization of seeds for establishment of new populations in the wild. The current sampling strategy used by the TFSC aims to capture a large proportion of the genetic diversity found within a population. In order to achieve this goal at least 30 individuals of an outbreeding species or 59 individuals of an inbreeding species should be sampled (Brown and Marshall, 1995). Where the breeding system is unknown a target of at least 50 plants is used (Guerrant et al., 2004). The plants sampled should be chosen at random from across the population taking into account any variation in ecotypes that may occur. The diversity across populations is also sampled with the aim of sampling all populations of DRF.

In order to conserve the species from which we are collecting seeds, we need to make sure that our collecting activities don't have a negative impact on natural populations. To avoid over collection no more than 20% of available seed should be harvested. The harvest should be conducted in a way which minimises impact to plants. Care should be taken when accessing a site to ensure weeds or diseases are not introduced to the population (Cochrane et al., 2009).

If a seed collection is to be of conservation value it needs to be viable when required for use. The most reliable method of determining seed viability is by a germination test under controlled conditions. If seeds germinate they are clearly viable, however if they do not they may be nonviable or dormant. This can lead to underestimation of the true viability of a collection; however it is a good reflection of how many seedlings we can produce based on our knowledge at a point in time.

The two main factors that will affect the longevity of seeds are temperature and seed moisture content. Seeds are stored at the TFSC according to internationally accepted standards for seed conservation (FAO/IPGRI, 1994); seeds are dried to a low moisture content (ca. 3%–7%) then frozen at -20 °C. Under these conditions orthodox seeds, that is seeds that can be dried to low moisture content without loss of viability (Roberts, 1973), should hopefully remain viable for decades, if not hundreds of years. Germination re-tests are conducted periodically to check that the viability of collections is being maintained. A review of the retest data from 375 seed collections from the TFSC found that declines in germination were evident in only a small number of collections. Many of the declines appear to be collection-specific, as other collections of the same taxon did not decline (Crawford et al., 2007).

So how successful has DEC's seed conservation program been? One measure of success is a target adopted by countries around the world as part of the Convention on Biological Diversity's Global Strategy for Plant Conservation (2002). Target 8 of this strategy was to have seeds of 60% of threatened plant species in accessible ex situ collections, preferably in the country of origin and 10% of them included in recovery and restoration programmes by 2010. The Department of Environment and Conservation has successfully met this seed collection and reintroduction target for Western Australia. To date, seed samples from 75% (293 taxa) of WA's extant DRF and 26% (708 taxa) of the Priority taxa have been collected and stored. These collections are often referred to as insurance policies against extinction in the wild (Offord and Meagher, 2009) however in order to claim on this insurance policy we need to be able to successfully re-establish plants back into the wild from our stored collections, a sometimes difficult process (Cochrane et al., 2007).

The DEC has an extensive flora reintroduction program which aims to improve the conservation status of endangered species. These reintroductions are carried out to complement the conservation of existing populations, not to mitigate actions that may affect the populations. The Department currently has 46 species in seed-based reintroductions. There are many challenges associated with reintroducing species back into the wild, but these reintroductions have resulted in significant increases in the number of plants for many of these threatened species (Cochrane et al., 2007). For example, the critically endangered *Grevillea batrachioides* is known from only one natural population of 56 plants, but reintroduction of 94 plants has effectively trebled the known number of plants in the wild.

Ex situ seed conservation aims to conserve high quality, genetically representative samples of conservation-significant species for future use. By adhering to good collection and storage protocols the TFSC has underpinned one of Australia's most ambitious flora reintroduction programmes. This program has resulted in significant improvements in wild plant numbers, a true measure of the value of ex situ seed conservation.

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