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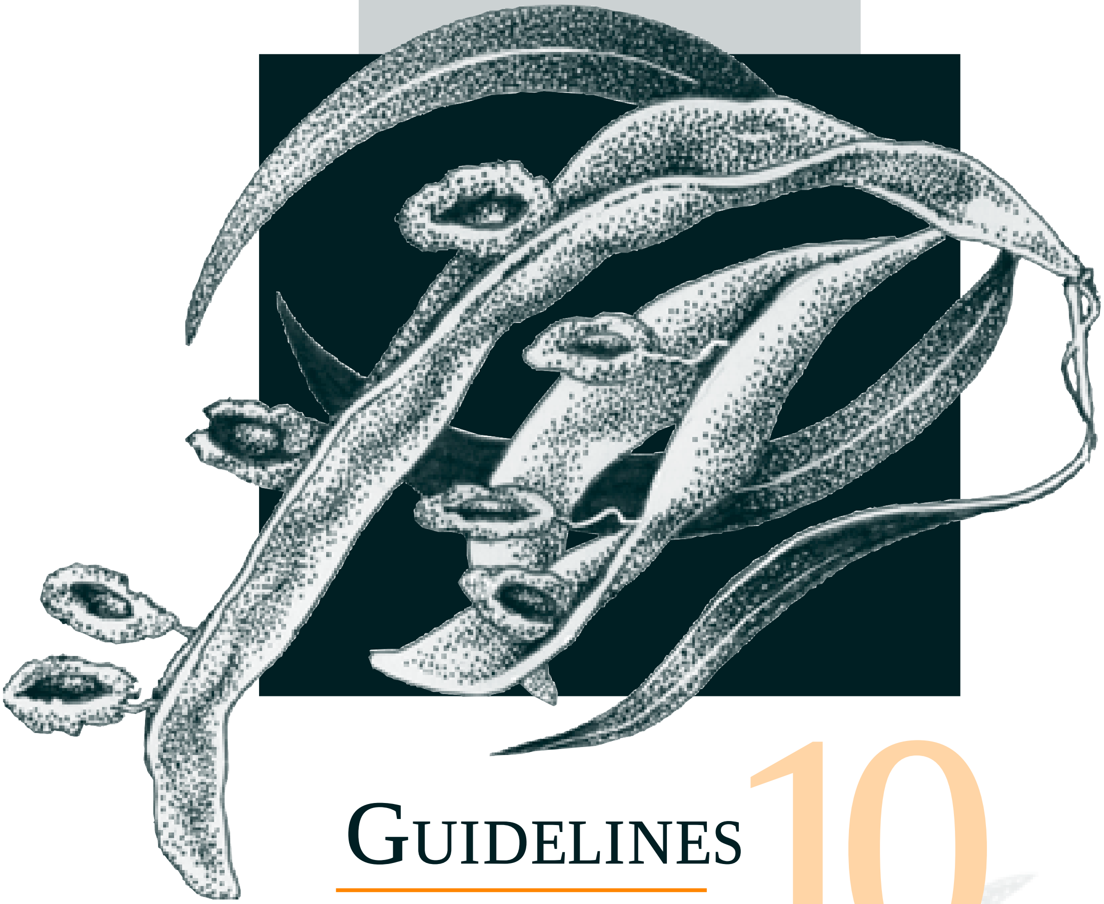

GUIDELINES 10

SEED COLLECTION RANGES FOR REVEGETATION

Australian National Botanic Gardens
Natural Heritage Trust
Helping Communities Helping Australia
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Bushcare
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FORESTRY AND FOREST PRODUCTS
Australian Tree Seed Centre

This guideline is about collecting local seed for revegetation and builds on our previous publication on the topic, Guideline 5: *Seed collections from woody plants for local revegetation.* It is primarily intended for people who have a regional role in carrying out revegetation, regeneration or the rehabilitation of degraded sites, perhaps advising others about these activities. The guideline provides a straightforward approach to answering the question often asked about collecting local native seed, 'How local should 'local' be?'

This is a rapid appraisal that establishes collection ranges for different groups of plants, based on what is known about important factors affecting plant provenance on a regional basis. The approach was developed for the Hawkesbury–Nepean catchment by the Hawkesbury–Nepean Catchment Management Trust in collaboration with Greening Australia, the Sydney Royal Botanic Gardens, Australian Association of Bush Regenerators, Australian Network for Plant Conservation, the National Trust, Bushcare and the National Parks and Wildlife Service. We think this group did an excellent job and developed something with much wider application than to just its own catchment.

The approach relies on assembling a group of local experts – botanists, horticulturalists, beekeepers, bird enthusiasts, zoologists, ecologists, bushies and the like – to come up with a method for assessing the genetic provenance of native plants. There is just so much we do not know about the ecology and genetics of our native plants that this is very unlikely to be a perfect assessment. The original authors and FloraBank happily acknowledge that this approach is not based on hard science and has not been extensively tested. The main thrust of the work is to provide a practical method for people and groups to deal with local collection issues based on what they do know.

We hope that you find this approach useful in your region or catchment, and that it improves understanding and results in a better approach to local collection. As with any rapid appraisal, the assessment will improve over time as we learn more about our native plants.

Recapping

Guideline 5 provided a working approach to issues about provenance (seed origin), collecting local seed and using non-local seed. In the Guideline, we provided strategies that aim to maximise the genetic quality of the seed you collect for the purpose you have identified. We recommended that you collect seed *as locally as possible* from natural populations for use in revegetation and rehabilitation plantings, having regard to a range of plant and planting site characteristics and how they may change as we move further away from the local area to collect seed. It is usually the case that at some point you no longer feel comfortable that the characteristics of the plants you are collecting sufficiently match those of the local vegetation of your planting site, or that the collection and planting locations are similar. We advised that it is wise to recognise this point as the outer limit of a collection range. We advised that **the matching of environmental conditions at the planting site with those of the collection location** was the most important consideration in establishing the collection range.

This method

However, there are other, generally less obvious, factors that can also inform this decision making, and it was to these that the Hawkesbury–Nepean group turned their attention. They include:

Breeding system factors

• pollen and seed dispersal mechanisms

• seed crops over time

• longevity of species.

Distribution factors

• extent of distribution of the species

• population density

• fragmentation.

These factors are known to affect the flow of genes (genetic material) between plant populations, which in turn determines how genetically different one population will be from the next. The greater this difference, the narrower the recommended collection range. These are not the only factors that might be used, and you may extend the approach to include others. The Hawkesbury–Nepean group used an expert panel to assess each of these factors for a list of the important species for revegetation in its region.

Based on this assessment, the group placed species, genus or whole groups of plants that occur in its catchment into one of three collection ranges:

narrow collection range, within which it is crucial to collect from remnants located as near to planting site as possible

intermediate collection range, within which collection can be extended to remnants that were formerly contiguous

regional collection range, which includes remnants throughout a region.

The strength of the approach is in assessing a range of factors, which we know are keys to understanding variation in a species, and in assigning broad ratings. Looking across the ratings for a species informs our judgment about what should be the appropriate collection range.

Making this assessment in your area

Assemble a panel of local people who have the botanical and other skills to understand and identify the factors outlined above. Start by deciding the region you intend to cover and by making a list of the important species for revegetation in that region. Pick a species well known to the panel and consider each of the factors below in turn and record what is known. Then, continue down the list. Don't be disappointed if there is disagreement about a particular genus or species, or you discover at first that little is known about a plant. Ask your panel whether there are experts to whom you may refer, and seek their assistance to do this. If you are not confident about a certain species after due consideration, say so.

Assess breeding systems factors

Firstly, look at pollination

Pollen dispersal mechanisms have a significant bearing on plant variation. A narrower range may generally be associated with self-fertilisation (pollination of an individual plant with its own pollen) or plants pollinated by wind. A larger range is likely where there is a greater degree of outcrossing (pollen exchange among unrelated plants of the same species). Plants pollinated by insects such as bees and ants, birds (narrow versus wide territories) and bats potentially have wider breeding horizons. Species with profuse pollination over long flowering periods are expected to have broader breeding horizons than species with short flowering periods and poor pollen production.

Birds and mammals may be the main vectors of pollen and seed between remnants. The records of many bird observers provide information about the behaviour, diet and range of birds, from which pollination and seed dispersal horizons can be inferred. The same is true of amateur and professional zoologists in regard to the presence and influence of mammals such as possums and gliders.

Then, look at seed dispersal

Similarly, the seed shape, size and weight, fruit and seed dispersal mechanisms and the viable life of seeds may all result in plant variation. How is seed of the species dispersed and what are its requirements for viability and germination?

A narrower range may generally be associated with large, heavy fruits and seeds dispersed by gravity. Bats and birds increase dispersal for seeds they eat (or carry) that might otherwise have a narrow range. A wider range may generally be associated with light, fluffy seeds with structures that assist in dispersal by wind and water. How easily is the seed dispersed in wind and water? How do the prevailing wind directions, topography, runoff and streamflow characteristics in your catchment affect dispersal?

Catchment boundaries may form 'divides' for species that disperse their fruit or seed in water, whereas this may not be the case for those that are dispersed by fauna, birds, or insects. Species found along streams that use water as a dispersal mechanism are likely to have a breeding horizon extending along, and adjacent to, the stream. In steep incised catchments, wind and water dispersal may not be as significant in extending breeding horizons as they are in broad flat catchments subject to regular flooding and winds over extensive areas.

Look at seed crops over time

Some species regularly set heavy crops of mostly viable seed every year. Some rarely do, or they do so once every so many years. Some species release their seed quickly; some retain viable seed on the plant for several years. The seed of some species remains viable for only a matter of days; for others, it can remain viable for many years in the soil. All other considerations being equal, species with regular and heavy crops of highly viable seed are generally expected to have wider breeding horizons than those with light, irregular crops of poorly viable seed.

Look at longevity

In general, the longer-lived a species is, the wider its breeding horizons. Annual species and those that live for a few years are regarded as having the shortest life spans and equate to the narrowest breeding range. Those that live for centuries are considered to have long life spans and wider breeding ranges. Those that live for decades fall somewhere in between.

Assess distribution factors

Firstly, look at extent of distribution

A species now represented over a large area is expected to have a wider breeding range than one represented over a small area.

Then, look at density

A species represented by more than 50 plants per hectare (high density) is expected to have a wider breeding range than one represented by less than 10 plants per hectare (low density). Where density is between 10 and 50 plants per hectare (medium density), the breeding range may also be considered moderate. *Note:* These figures apply to woody plants and were developed for the Hawkesbury–Nepean catchment. What density estimates might be more appropriate in your catchment?

Look at fragmentation over time

If a species occurs continuously over an extensive area of fairly uniform environmental conditions, there is likely to be minimal variation and a geographically large breeding range. By contrast, where a species has a similarly extensive range but is fragmented and environmental conditions vary greatly, there is likely to be considerable variation and geographically narrow breeding boundaries. So, it is generally less likely that plants from further afield will be similar. Use local knowledge of land use and the history of clearing to help establish whether gene flow would have occurred between what are now remnant patches of vegetation.

Firstly, are you sure that it is a wild and not planted remnant? If planted, what was the seed origin? Were remnants previously contiguous? How widespread was a vegetation type or species in the past? Local historical societies and local councils are good starting points to look for past aerial photos, old maps and literature.

Species confined to drainage lines or river systems may have less genetic variation within a catchment than between catchments. Hilly or mountainous catchment boundaries can greatly restrict gene flow. In contrast, some catchments have almost imperceptible boundaries and no landscape scale restrictions on gene flow. Steep, rugged and heavily forested areas present greater natural barriers to gene flow than flat featureless plains.

In natural vegetation not subjected to extensive clearing and change in land use, with no great landform restrictions on gene flow (fragmentation rated LOW, see Table 1), it is important to maintain a narrow collection range. Where recent clearing and land use has caused some fragmentation and isolation of remnants (fragmentation rated MEDIUM), a wider collection range is appropriate so that seed is collected from what were formerly contiguous populations. The widest collection range is appropriate for species occurring in remnants that have been greatly isolated and heavily fragmented for a long time, perhaps decades (fragmentation rated HIGH).

About differences in form

If the form, structure or function of a species (its morphology) shows marked variation from those of the local area, it cannot be considered local. Variations in plant form, structure and function are sometimes obvious to the naked eye, such as dramatic variations in flower, fruit or seed size, and plant structure or growth habit. Botanical classifications (taxonomy) sometimes recognise such variations in plant form or function within species. Classifications of genus and species are always changing, and even in common genus, such as *Acacia*, new species are recognised. An example of this is *Hardenbergia violacea*, where over a range of a few kilometres the plant has two distinct forms – one prostrate, one upright.

Where distinct morphological differences occur between plants of the same species, we recommend that the collection range is restricted to the area in which a distinct form is distributed.

Pulling the assessment together

Table 1 summarises the process of allocating each species to a collection range. If you are not confident about a certain species after due consideration, say so. If, after consideration, the allocation of factors to collection range in Table 1 appears not to suit your catchment, then you should change the allocation. The allocation in Table 1 is a guide only.

By way of example, Table 2 shows how the Hawkesbury–Nepean group placed plants into collection ranges for their catchment – it may be different in yours!

Table 1: Collection ranges in the Hawkesbury–Nepean catchment

Collection Range

Factors	Narrow		Intermediate		Regional
Pollination	self-pollinated	wind-pollinated	insect-pollinated	bird-pollinated	bat-pollinated
Seed dispersal	gravity			wind or water	bats and birds
Longevity	short-lived				long-lived
Extent	small number and small area				large number and large area
Density	low		medium		high
Fragmentation	low		medium		high

About collection ranges

We found it difficult to give more detailed guidance on how large the collection ranges may be. Every region is different and you must fall back on your own judgment.

A note about narrow collection range

When collecting from within or very close to a remnant, greater attention should be paid to maximising the genetic quality of the seed you collect. Strategies for doing so are provided in FloraBank Guideline 5. In particular, you should avoid collection from what may be related plants. Knowing when remnants became reproductively isolated helps establish whether inbreeding may be occurring within the remnant. It is more likely that plants are all closely related and thus genetically similar when there are only a few plants left in an area and they have been isolated for a number of generations of that species. In extreme cases, plants descended from a single individual could be virtual clones. Use commonsense and collect more widely if there are only a few plants of a species left from which to collect seed to re-establish a large population. Otherwise, you may be limiting the genetic diversity of the population you establish and greatly reducing the seed resources available for use. If you suspect inbreeding has occurred, collect seed from old individuals, encouraging germination from the soil seed bank or use vegetative propagation (cuttings and division) to help re-establish 'old' genes in your new population.

A note about regional collection range

By 'region' we mean the biogeographical or major botanical divisions of your State (available from your State herbarium) and suggest that you do not collect beyond these.

Table 2: Collection ranges in the Hawkesbury–Nepean catchment

Collection range	Plant categories	Pollination	Seed dispersal	Life span	Extent and density
Narrow	forbs & herbs	wind, insect	insect, gravity, mammal, bird	short	small high density
	wattles	wind, insect, bird	insect, gravity	short–medium	small high density
	peas	self, bird, insect	insect, gravity	short–medium	small high density
	orchids & lilies	insect	wind	short–medium	small medium density
	ferns & allies[1]	none	wind spores	short–long	small medium density
Intermediate	heaths & understorey shrubs	wind, insect, bird, (maybe self)	insect, gravity, mammal	short	small high density
	daisies	insect	wind	short–medium	small high density
	grasses	wind	wind, mammal, bird	short	high density
	fleshy fruit plants (not trees)[2]	insect, bat, mammal, bird	bat, mammal, bird	medium	small high density
	banksias	insect, mammal, bird	wind, gravity	medium–long	small medium density
	casuarinas & conifers	wind	wind, gravity, bird	long	small high density
	eucalypts, angophoras, syncarpias, callistemons	insect, bat, mammal, bird	wind, gravity	medium–long	small high density
Regional	trees with fleshy fruits	insect, bat, mammal, bird	bat, mammal, bird	long	small medium density

1. Ferns & allies are a special case because of their reproductive physiology.
2. Such as Billardiera, Dianella, Exocarpus.

Your Comment

The FloraBank guidelines are a consolidation of existing information and draw on the practices observed at seedbanks across Australia, as well as the expertise and technical understanding of the Australian Tree Seed Centre at CSIRO Forestry and Forest Products, Greening Australia's Seedbanks and the Australian National Botanic Gardens Seedbank. The guidelines present, as far as is known by the authors, best practices. However, they are drafts because we recognise that other people may have better approaches, and that best practices change with time. Also, our climate and vegetation is diverse and not all practices are equally applicable across Australia. If you would like to comment on any of the guidelines, please contact the FloraBank Coordinator. If you have practices or knowledge you would like to share with others, you can do this through the forum pages of the FloraBank web site.

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