Tāne's Tree Trust Guidelines to Species Selection, Ecosourcing and Seed Collection

These guidelines have been compiled by Jacqui Aimers, David Bergin, and Paul Quinlan, trustees of Tāne's Tree Trust, with input from other trustees. It is a working document that will be updated as new information arises.

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SPECIES SELECTION

- Species selection depends on the objectives for the tree planting or forest establishment, e.g., ecological restoration, amenity, farm shelter, erosion control, timber production, etc.
- For ecological restoration projects, the mix of species propagated needs to match, as close as possible, the species originally present before human settlement.
- Understand the limitations of soil type and match species selection to suit.
- Prioritise resilient species for drought-prone or exposed sites, but also consider less hardy species for the more sheltered, moister areas of planting sites.
- Priority should also be given to plant species important to the survival of native birds, with consideration of the seasonal food cycle. This will increase habitat values for native fauna and will, in turn, aid natural plant regeneration processes through dispersal of seed by birds.

Forest succession processes

- Consideration should also be given to forest successional processes. Planting programmes that include locally appropriate short-lived, pioneer native species, comprising a range of hardy shrubs and monocots, are recommended on most sites as a nurse cover to assist early development of later successional tree species. These nurse pioneers can out-compete weeds and quickly provide canopy cover, mimicking natural succession of native forest.

- A staged implementation may be useful. Not all species need to be planted at once. Later successional species can be planted in light wells after pioneer species have become established, or the stand can be managed to encourage natural regeneration of later successional species.

THE ECOSOURCING CONCEPT

- Ecosourcing is defined as the sourcing of seed (or vegetative material) from nearby natural populations to propagate native planting stock for planting in the same locality, i.e., collection of seed from wild populations that are as close as possible to the area being planted.
- Ecosourcing should be included in the planning stages of all native plantings.
- The fundamental unit for ecosourcing is the local population or provenance; i.e., a group of individuals of the same species that live in a particular geographic area.
- Ecosourcing is particularly important for ecological restoration projects but may be less relevant for other types of plantings, as discussed below.
- The ecosourcing concept also includes collecting seed across a large range of individuals within the source population. This results in a broader and more representative genetic base, which increases adaptive fitness and decreases the risk of inbreeding depression in forest plantings.

GENETIC POLLUTION

- Natural wild populations will occasionally have new genetic material introduced via pollen or seed dispersal. This adds to the within-population genetic diversity.
- However, if a large amount of new genetic material is artificially introduced into an area, then this could change the genetic character of the local population over time, i.e., genetic pollution could undermine the unique inherited characteristics of the local populations.
- Care needs to be taken to avoid planting either different provenances or commercially-bred strains near natural forest of high conservation value that contains the same species - due to the risk of genetic introgression or 'genetic pollution' undermining the unique inherited characteristics of the natural population

WHY IS ECOSOURCING IMPORTANT?

- The concept of ecosourcing recognises the unique genetic variation that occurs within species at the local level, which has evolved over very long periods of time and confers an adaptive advantage to local conditions.
- Provenances often show distinct differences in growth and form, foliage or flowering characteristics.

- Provenance studies undertaken for some native species show that these differences are persistent when grown in a different environment. They are distinct ecotypes, i.e., genetically distinct populations that have evolved to be adapted to local environmental conditions.

- Ecosourcing can help maintain distinctive local and regional landscape characteristics and identity. This, in turn, supports the perception of tūrangawaewae (sense of place), and connection to a local landscape area with its own unique, natural identity.
- Sometimes the genetic differences are not visibly evident but there are critical physiological differences that confer an adaptive advantage in the environment in which the plants evolved, e.g., frost hardiness or drought tolerance.
- Ecosourcing maximises survival by ensuring the best fit for the local environment. This is particularly important in an era of climate change where there are greater environmental pressures. There is some argument over whether we need to intervene and manipulate species distribution and take the effects of climate change into account. Regardless, applying ecosourcing principles will increase adaptive advantage.
- Adhering to ecosourcing principles is particularly important for ecological restoration projects, especially if they are close to areas of high conservation value, or where taonga species are being planted on or near iwi land. This prevents genetic pollution.

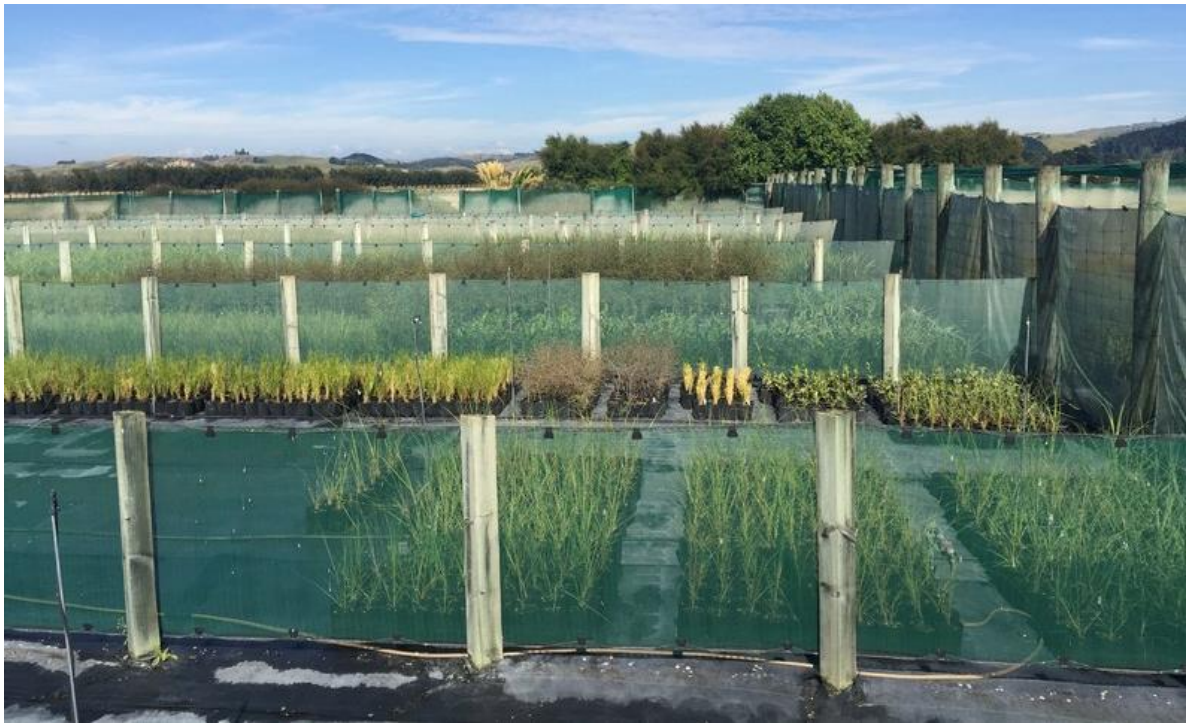
ECOSOURCING AND CULTURAL VALUES

- Cultural values need to be considered with ecosourcing but they are often overlooked.
- For many iwi groups, their particular provenances of native species with their unique local characteristics are a precious taonga (treasure).

- A Waitangi Tribunal report (Wai 262) has relevance here. Wai 262 documents the fundamental importance of treasured native flora and fauna to modern Māori in terms of their identity and kaitiakitanga (environmental guardianship). It recognises the importance of the whakapapa (lineage) of native species.
- It is important for tangata whenua that the unique characteristics of their local species are recognised and not compromised by genetic pollution from plants of the same species brought into their rohe that are different provenances or commercially-bred strains.

ISSUES WITH ECOSOURCING

- A major issue with ecosourcing is defining what the boundaries are for local provenances, i.e., the physical area that defines the population.
- In practice, there is a range of interpretations of boundaries used for ecosourcing, including:
    - distinct geographic features (particularly topography and climate) or soil types;
    - regional council boundaries that may be split into broad zones (e.g., coastal versus inland, or lowland versus upland);
    - ecological regions or ecological districts, as described by McEwan (1987); or
    - restricted areas based on limited species distributions or documented genetic differences within species, such as for rare ecosystems and species.
- Many practitioners select ecological regions or districts as a practical scale at which ecosourcing can be carried out because this represents natural subdivisions that invoke an objective approach. However, these boundaries have not been mapped based on plant genetics.
- Each native species has a different pattern of genetic variability across its natural range depending on its natural history. Some show little genetic variation over large areas, even over the whole country. In contrast, other native species have genetically distinct populations that are specifically adapted to habitat areas much smaller than those of the ecological district.
- There are many parts of New Zealand where remnants of natural forest are now scarce. For example, it may be difficult to ecosource seed in some lowland areas yet re-establishing native forest in these areas is highly desirable.
- Where seed is not readily available locally, and seed needs to be obtained from outside the local area, seed collection should preferentially come from within the 'seed distribution catchment', i.e., the area over which seed dispersal is likely to occur. This will depend on the seed dispersal mechanisms of the species, e.g., the flight distance of a kereru.



SITUATIONS WHERE ECOSOURCING MAY BE LESS RELEVANT

- Ecosourcing may have less relevance where native trees are planted primarily for reasons other than ecological restoration, such as for amenity values or educational purposes (e.g., in arboretums), or timber utilisation.
- Also, where species are part of an ex-situ threatened species programme, they will often need to be planted outside their natural range, particularly if they have a limited natural distribution. Regardless, it is important to conserve the different genetic provenances of threatened species.
- There is conjecture about the sourcing of native tree seedlings for establishing timber plantations; e.g., selecting faster-growing provenances for planting beyond their natural geographical region.
- The use of seed from the best-performing provenances may give improved growth, tree form, and wood quality – and may be a prudent option for landowners and investors in establishing native tree plantations.
- Further research is required to determine patterns of variation among provenances of the major native timber species, the benefits of using selected seed sources in plantations for wood production, and the implications for maintaining local (natural) gene pools.
- Avoiding the planting of non-ecosourced native plantings near natural forest will reduce the potential for genetic pollution of local natural populations.

SEED COLLECTION

Planning

- A carefully designed seed collection strategy will ensure optimum timing, desired species balance, and appropriate ecosourcing, which will subsequently result in better germination and healthier seedlings.
- Seed collectors must negotiate protocols for collection well ahead of time with land-owners and land managers. In regards to Department of Conservation land, a permit for seed collection is required and this must be applied for ahead of time.

Seed collection practices

- Collection of seed needs to be done systematically, with collection from a wide selection of the population, rather than just from one spot. It is critically important to collect seed from a sufficient number of parent trees (at least 10 per provenance but preferably a much greater number). This will maximise the capture of genetic variation and subsequently increase adaptive fitness and decrease the risk of inbreeding depression in the planted population.
- The more diversified a population is, the better the chance for its adaptability and survival in a changing environment.
- Collection from unhealthy or aberrant individuals should be avoided.
- Propagation via seed should always be the preferred option as there is a better sampling of the genetic diversity in the source population, resulting in greater genetic variability and, therefore, greater genetic resilience in the planted population.
- For species not easily propagated from seed, rooted cuttings or wildlings (naturally occurring seedlings) may be an acceptable option to bulk up planting stock in poor seed years (where permitted). However, the use of rooted cuttings carries the risk of lower genetic diversity and increased risk of inbreeding depression in the planted population.

- Preferably, collection of seed should occur within natural forest without a history of logging, particularly selective logging. This is to avoid the possible effects of high grading where a 'cut the best and leave the rest' strategy has resulted in a prevalence of inferior genotypes in the remaining population. (Fortunately, high-grading is less of an issue in New Zealand compared with some northern hemisphere countries where many generations of trees may have been selectively logged within a forest).

- Combine seed collected from parents within one population for sowing and propagation.
- Genetic diversity can be compromised by poor seed collection practice, e.g., stripping all the seed from a few close-by trees and collecting from the same plants every year because it is convenient. This results in a narrowing of the genetic base and increases the risk of inbreeding depression in the planted trees and compromises regeneration where seed was collected.
- The incorrect practice of collecting seed from plants that are acclimatised plantings of unknown origin, rather than wild populations, is another compromise of the ecosourcing concept.

Labelling and record keeping

- Carefully labelling is needed throughout seed collection, storage, sowing and propagation.
- Record keeping in seed collection is paramount. Location of seed collection (preferably with GPS), date, name of collector(s), number of trees/shrubs collected from, and a habitat description needs to be recorded and entered into a database.
- Seed packets and propagated plants need to be well labelled.
- It is in the interest of seed collectors, seed merchants and nurseries to provide accurate detailed records of seed collection as proof that ecosourcing is being practised.
- Purchasers should ask questions about planting stock and seek assurance that the plants are in fact ecosourced.

RECOMMENDATIONS

Tāne's Tree Trust advocates for best practice ecosourcing as outlined above, but it should not be so rigidly enforced that it becomes a deterrent to planting native forest. Strict adherence to the use of local seed raises difficulties where the definition of boundaries for seed-collecting zones is not clear, or the supply of local seed is inadequate. We believe a pragmatic approach is required to incentivise the adoption of ecosourcing principles in raising and planting natives for multiple purposes. In summary, we recommend the following principles:

Selecting boundaries

1. Determine whether your species and ecosystems are naturally rare or are part of once well-represented ecosystems regionally and nationally.
2. Select geographic boundaries that are practical to meet requirements of seed collection, based on the abundance and distribution of the species, and the degree of genetic differentiation over its natural range.
3. Ecosourcing boundaries can be defined by a distinct geographic locality, a distinct soil type, zones within a regional council boundary, or an ecological region or district. Native species show widely varying degrees of intraspecific genetic differentiation – so there is no single scale that is appropriate for all circumstances. Decisions on boundaries for ecosourcing should be based on all the available information about the species.

Seed collection

4. Some species, such as mānuka, can grow across a wide range of habitats and have distinct ecotypes, so in this case, it is important to match the seed collection with similar habitats to the one being planted.
5. If seed sources are non-existent or rare in the locality of the planting site, seed can be sourced from similar habitats in neighbouring regions, but preferentially from within the 'seed distribution catchment'.
6. Collect seed from a minimum of 10 parent plants (and preferably a much greater number) from throughout the source population wherever practical to ensure an adequate sample of local genetic variation.

7. Propagation via seed should always be the preferred option as vegetative propagation can limit the capture of genetic variation and lead to inbreeding depression. For poor seeders, rooted

cuttings (or possibly wildlings) can be used to bulk up planting stock but this must be done judiciously. If necessary, collect cuttings from a minimum of 10 parent plants.

8. Depending on the scale of the source population, collect from a wide sample of parent plants, e.g., for tree species, collect from parent trees located over several hundred metres.

Plan ahead and ask questions

9. Plan reforestation programmes well in advance, allowing time for appropriate seed collection to meet ecosourcing requirements of planters, and time for propagation and growing on - this gives the nursery sufficient time to allow for collection and propagation of ecosourced seed. Few nurseries sell ecosourced stock 'on spec' - most require a contract.
10. The seed of the faster-growing shrub species must be collected at least 15 months before planting is scheduled, to allow for up to 1 year of propagation in the nursery. For many native tree species, seedlings will take a minimum of 2 years to grow in the nursery, so plan seed collection up to 2.5 years before planting. Native shrub hardwoods, harakeke, ti kouka, toetoe, sedges, rushes, etc., take at least 1 year to raise in the nursery; whereas tree species such as totara, kauri, kahikatea and rimu, and hardwood trees such as kohekohe, beech, rewarewa, hinau, etc., take a minimum of 2 years to raise in the nursery.
11. Request proof of ecosourcing from your nursery supplier before purchase. Be prepared to ask for locations of collection and how many parent trees seed was collected from. Ask to see documentation if in any doubt. Good nursery operations will have accurate databases.
12. Be prepared to pay more for appropriately ecosourced planting stock. Better field performance will ultimately offset the greater initial up-front cost.

13. Do not plant non-ecosourced material near natural forest of high conservation value that contains the same species as this can cause genetic pollution of the natural population. Similarly, avoid planting commercially-bred strains near wild populations (e.g., mānuka strains grown for high-UMF honey production).

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