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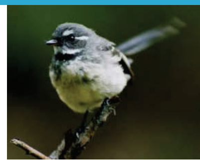


INFORMATION SHEET THREE

# Genetic Translocation as a Management Option for Species Threatened by Climate Change

As climatic zones shift, some species will be unable to disperse or adapt fast enough to cope with rapid climate changes. Apart from assisted migration, a second option to aid high risk species is genetic translocation.

This process focuses on moving individuals or gametes from one population to another *within* a species' current/historical range as a way of enabling gene flow and conserving/enhancing adaptive potential.

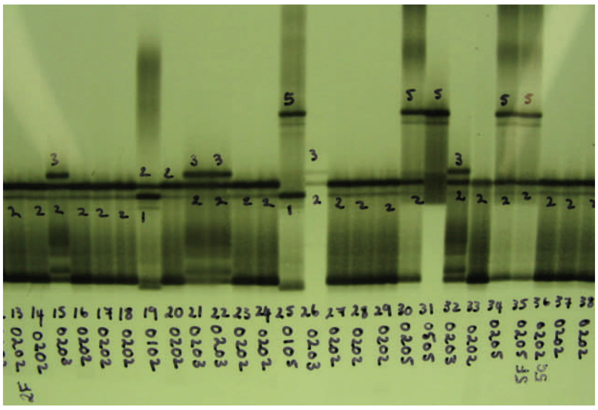
This information sheet explains the concept of genetic translocation as a management strategy for terrestrial plants and animals affected by climate change, including implications for managers and policy-makers.

## What is Genetic Translocation?

Genetic translocation differs from assisted migration in that individuals/genes are moved from one population into another existing population in order to increase genetic diversity and increase resilience to environmental change.

For example, a widespread plant species may occur across different altitudes, and introducing seeds from a low altitude population may allow high altitude populations to evolve traits to cope with a warmer, drier climate.

Genetic translocation is generally considered a safer and less controversial option compared to assisted migration, but there are still a number of potential problems and factors to consider.



**Microsatellite gel identifying genetic variation among individuals, reflected by banding patterns. Genetic translocations could increase variation among individuals within populations (© N. Endersby)**

**The critically endangered mountain pygmy possum is a good candidate for genetic translocation, with the aim of increasing genetic diversity in isolated, inbred populations. (© D. Heinze).**

## When to Implement Genetic Translocation?

The aim of genetic translocation is to establish viable populations capable of persisting in the face of environmental change. Scientists agree that there are a number of circumstances where genetic translocation might be considered as a response to climate change.

The first concerns threatened species that have suffered severe reductions in genetic diversity and where dispersal processes have been disrupted by habitat fragmentation.

For example, the mountain pygmy possum, *Burramys parvus*, is currently located in three genetically distinct, isolated populations and is threatened by climate change in the Australian Alps. Individuals from more genetically diverse populations could be moved to augment inbred populations.

Secondly, moving individuals from warm-adapted populations to colder locations could increase the probability of adaptation. For instance, populations of the same species of Eucalypts can differ in characteristics that make them more prone to drought or heat waves. Mixing genotypes from these populations can help provide an insurance policy that at least some trees will survive.

Finally, species threatened in their current range could be translocated to new sites within their historical range. For example, *Acacia attenuate* is threatened by fire and urban development in Queensland, and plants could be translocated to a nearby safer site, capturing the genetic diversity of the original population.

## Potential Problems of Genetic Translocation

There are potentially two situations where risks might be associated with genetic translocation. These include:

1. The likelihood of outbreeding depression—whereby offspring arising from crosses from the two populations have reduced fitness and are less viable.
2. Loss of local adaptation— where two populations are adapted to different local conditions, and the F1 (first crossed generation) from crosses between them is adapted to neither environmental condition and therefore has lowered fitness.

Research suggests that the risks involved with (1) are low, and arise when populations have significant local adaptation and/or have been isolated for a long time. Outbreeding depression typically involves the F2 or later generations, as the F1 generation often shows heterosis (outbreeding vigour), which can increase fitness.

**Experiments demonstrate low levels of local adaptation along elevational gradients in the alpine forb *Craspedia lamicola* (© S. Byars)**

## Which Species and When?

A number of factors should be considered before deciding if and when a species is a candidate for genetic translocation.

For all species, levels of genetic diversity within populations needs to be considered. The benefits of introducing genes into target populations and decreasing levels of inbreeding depression should also be assessed, along with potential for aiding in future climate change adaptation measures.

Conservation funds will be more readily available for threatened, high profile species. However, these species may already be genetically depauperate and found in isolated populations, meaning fewer potential source populations with fewer genetic options available.

For currently non-threatened species which may become affected by climate change, there is more time available to assess populations and genetic traits. Locally adapted genotypes are also more likely to occur across multiple populations and potential source populations can be more easily selected for desired levels of genetic diversity and differentiation.

## Implications for Managers and Decision-makers

Genetic translocation could benefit both threatened organisms and also widespread species which might be threatened by climate change in the future. Costs and risks are likely to be considerably lower than those associated with assisted migration.

However, there are risks involved, and these should be assessed on a case-by-case basis through risk assessment, including factors such as levels of suspected inbreeding depression and heterosis, population size, and rates of gene flow. Decision tree analysis and modelling are likely to be useful tools to assess outcomes.

Initially, small numbers of individuals could be introduced and monitored over generations to test for fitness changes over time. New populations might be successfully created by mixing genotypes from several populations, which could then evolve by selection and provide a level of pre-adaptation to future environmental changes.

Further, a classification of translocations based on specific genetic goals should be developed, for both threatened species and ecological restoration, separating targets based on 'genetic rescue' of current population fitness from those focused on maintaining adaptive potential.

**About the Adaptation Research Network for Terrestrial Biodiversity**

The Adaptation Research Network for Terrestrial Biodiversity is one of eight research networks administered by the National Climate Change Adaptation Research Facility. It is hosted by James Cook University in Townsville, north Queensland.

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For more information on the Climate Change Adaptation Research Facility and other Research Networks, please visit www.nccarf.edu.au

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