Genetic Translocation Stragies Explained

What are Translocations?

Translocation is defined by the International Union for Conservation of Nature (IUCN) as "the movement of living organisms from one area with free release in another". This movement can be between wild and captive populations, or between two or more wild populations.

The IUCN recognises three different types of translocations;

- *augmentation* (movement of individuals into a population of conspecifics),
- *introduction* (movement of an organism outside its historic range)
- *re-introduction* (movement of an organism into a part of its native/historical range from which it has disappeared)

Translocations for biodiversity conservation:

Translocations are increasingly being utilised as an important tool for conserving biodiversity, particularly threatened and keystone species. Under the combined pressures of habitat fragmentation, climate change and other forms of environmental degradation, translocations are absolutely essential if we want to maintain biodiversity and healthy, functioning ecosystems. Unfortunately, poor planning and a failure to understand the role of genetics often compromises the outcomes of translocations. Smarter strategies, based on the best of ecological and genetic science need to be developed if we are to achieve more successful translocations.

What are Genetic Translocations?

While translocations are well defined by the IUCN, the genetic implications of a translocation are less clear, yet integral to the short and long term success of a translocation. Dr Andrew Weeks, Director of **cesar**, has developed four different categories of Genetic Translocation;

- Genetic Capture
- Genetic Rescue
- Genetic Restoration
- Genetic Adaptation

While all four categories of Genetic Translocation aim to maximise genetic diversity and population resilience, the category and type of translocation utilised differs depending on the goals of the translocation. **cesar** are adept at

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identifying the genetic implications of translocations and developing strategies that lead to higher success rates and more effective translocations.

Genetic Capture

Genetic Capture is a translocation strategy that **cesar** recommends for the conservation of endangered and critically endangered species where source individuals or seed are scarce. The aim of this strategy is to 'capture the genetics' of a population for ongoing breeding and conservation. By translocating 20-50 individuals or seed, the goal is to capture greater than 95% of the standing genetic variation within the source population (assuming an equal contribution to the next generation by each of these individuals or seeds).

Genetic Capture is also a highly effective tool in the establishment of captive breeding programs or seed orchards. Often genetic factors are ignored in these situations, however, our research and experience indicates they are critical for success.

Ideally, a new population established through Genetic Capture will reach an effective population size of 1000 individuals within several generations of the translocation. This needs to happen either by rapid expansion through breeding or through continued introductions, as genetic variation is naturally lost each generation. In some situations (e.g. endangered mammals), we recommend continued introductions as the only way to negate or limit the effects of small population size, and to ensure conservation objectives are achieved over the long term.

Genetic Rescue

Genetic Rescue is a translocation strategy that **cesar** recommends in the conservation of populations and species in significant decline. Genetic problems often arise in populations that have experienced a large reduction in density over a short period, and subsequently undergone a large drop in effective population size that persists for a number of generations. Genetic Rescue involves the introduction of individuals and genes from a healthy population into a recipient population in genetic decline or at risk of extinction.

Using genetic science and principles **cesar** is able to track and predict the loss of genetic diversity in genetically compromised populations, which is critical to developing an effective recovery plan. For example, if the effective population size is 5 individuals for one generation, as much as 90% of genetic variation will be retained. However, if the effective population size remains at 5 for 10 generations, we can predict that there will be an overall reduction of 65% in genetic diversity (Figure 1). As a consequence, a number of genetic issues begin to emerge like random genetic drift, build up of genetic load and ultimately inbreeding depression. Understanding and measuring this loss of genetic diversity is crucial, as it can have drastic

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consequences for the fitness and adaptability of a population and can eventually lead to its extinction.

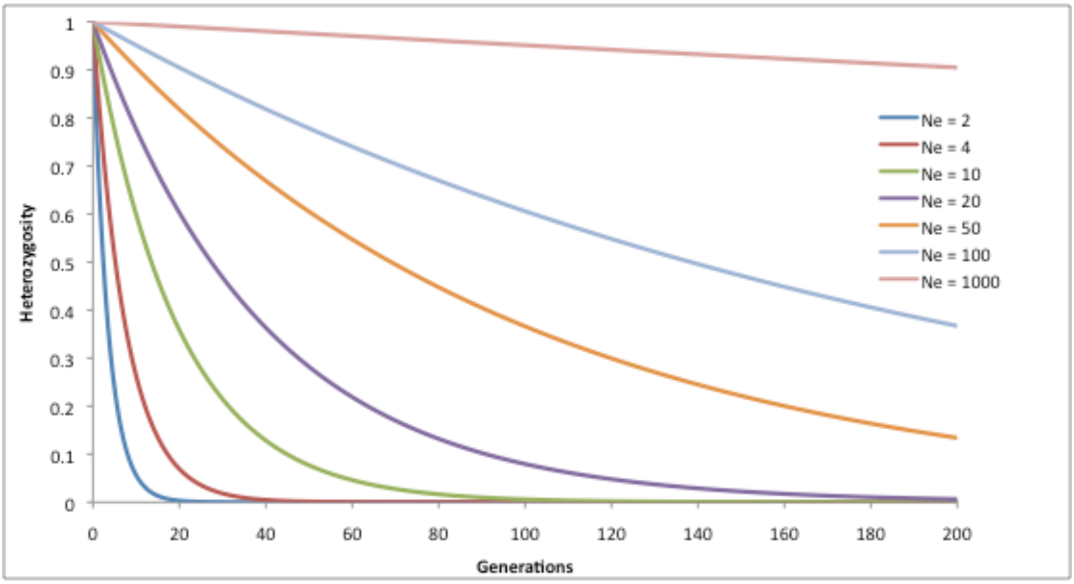

Figure 1. Loss of genetic variation with time (generations) for consecutive effective population sizes of 2, 5, 10, 15, 20 and 50. Please note – effective population size will always be less than census size.

In the past, translocations undertaken for Genetic Rescue were uncommon in Australia. The only known example being the Genetic Rescue of the mountain pygmy possum population at Mt Buller, conducted by **cesar** in conjunction with DSE (Victoria). If we are to slow the rate of species extinction in Australia, Genetic Rescue will need to become a common practice and strategy underpinning translocations. Right now many populations of threatened species in Australia are in urgent need of Genetic Rescue.

Genetic Restoration

Genetic Restoration is a translocation strategy **cesar** recommends for the primary purpose of restoring optimal genetic variation within a population or a species. Threatened populations that have lost genetic variation due to decreases in effective population size and inbreeding are more susceptible to extinction. The adaptive potential of these populations is also compromised, and accordingly they are less able to adequately respond to environmental change, and threats such as parasites and disease.

Genetic Restoration is a long term strategy that requires careful planning, monitoring and implementation. Our ultimate aim is to increase the effective population size to over 1000 individuals through translocation, but to reach this number potentially requires increasing the census population size to several thousand. While this might be unrealistic for many threatened species, we can reconnect isolated populations through assisted migration (gene flow). This approach effectively simulates the effects of having a single large population. It's currently accepted that only one effective migrant per generation is needed to reconnect populations and restore genetic diversity. We simply need to restrict the amount of gene flow to ensure the local adaptive potential of each individual population is not lost.

Genetic Adaptation

Genetic Adaptation is a translocation strategy that **cesar** recommends for many threatened, keystone and common species adversely impacted by environmental threats and changes, in particular, climate change. It's predicted that in coming decades climate change will push many species to the brink of extinction. Compounding the problem is the fact that many species have become fragmented into isolated populations by human development and activity. This fragmentation leads to restricted gene flow between populations and a significant decline in genetic diversity. The end result is a distinct inability of species to adapt to challenges like climate change.

cesar's approach to these challenges is to utilise translocation to maximise genetic diversity in populations and species at risk. We do this by increasing gene flow between isolated populations, giving species the greatest chance of survival through evolutionary adaptation. There is already clear evidence of rapid evolution in response to climate change in several short-lived species, suggesting that many organisms have the capacity to respond to climate change within a period of decades. Conversely, species that experience diminishing genetic variation in the years ahead are at the greatest risk of becoming extinct if we fail to act. In fact, the long term implications of ignoring Genetic Adaptation when planning translocations will extend well beyond the persistence of species, with potential impacts on biodiversity, and ecosystem function and resilience in response to climate extremes.

For a confidential discussion about your needs please contact the Genetic Insights team via our website www.cesaraustralia.com.