ARE RESTORATION PLANTINGS AN ECOLOGICAL SUCCESS?

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Abstract

Ecological restoration is a rapidly expanding practice that has developed in response to worldwide loss of habitat and ecosystem services. However, the success of this practice in restoring a functioning and representative ecological system remains poorly studied and uncertain. This is due to several factors predominantly, restricted funds, a knowledge gap between practitioners and the developing scientific field of restoration ecology, and the length of time it takes for some ecological systems to recover. In New Zealand restoration planting has occurred in large areas since the 1980s. These have now established canopies with unassisted seedling regeneration, making predictions of successional trajectory and ecological success assessments possible.

The ecological restoration of forests is most commonly carried out through dense planting of native seedlings. This study aims to measure the ecological success of this planting method within New Zealand lowland podocarp-broadleaved forests comparing it with a 'do-nothing' control site undergoing unassisted secondary succession and a reference site of the desired target community (mature lowland forest). Restoration success was determined by the Planted Site being closer than the Spontaneous Succession Site to the Reference Site in vegetation community composition within ordinational space (principal coordinates analysis).

It was found that the vegetation community within the Spontaneous sites was more comparable to the Reference sites than the Planted sites and thus, more successful. The compositional differences between the spontaneous and planted sites were further investigated by analysing environmental and structural variables of each site sampled to find explanatory variables that may be driving the success of forest restoration (in directing the successional process towards the desired target community within a reference site). A nested multivariate analysis of the plot data and generalised linear modelling of each site was carried out to find potential explanatory variables which highly correlated to restoration success (how close a site was to its reference).

Potential explanatory variables correlating to restoration success included; a lower diversity (Shannon Wiener Index) in the restoration plantings in both species richness and within the structural and function classifications of each species; a greater diversity of vegetation tiers; a fewer number of stems at breast height per individual tree; shorter canopy heights; smaller canopy diameters uncompacted soil; a greater diversity in microtopography; and a greater coverage of ground ferns.

These explanatory variables were then modelled using Akaike's Information Criterion to identify both descriptive and driving parameters. The Akaike models identified 16 different parameters as related

to the compositional differences when plotted in ordination space. High diversity within all three measured attributes (composition, structure and function) and presence of ferns are clearly descriptors of the success of Spontaneous succession here, while lessor soil compaction and diversity in microtopography at the site could be drivers. This success is demonstrated by soil compaction and a diversity in each of the species attribute classifications of structure, function and composition.

In conclusion spontaneous succession was found to be more successful. This is likely due to uncompacted soils, a greater microsite variation, a higher diversity of species, functional groups and structural characters. Further, the secondary successional dependence on functioning soils is confirmed here, as well as the presence of indicator species such as ground ferns. Management implications of these findings suggest passive restoration methods should firstly be considered in forest restoration. If in addition, planting is also considered necessary, accelerating and directing secondary succession requires more attention to pre-planting preparation of sites and of species selection.

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