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### Standard Paper

# Nurse-based restoration of degraded tropical forests with tussock grasses: experimental support from the Andean cloud forest

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## Summary

1. The degradation of the Andean cloud forest raises strong biological conservation issues and threatens the sustainability of a crucial water resource. The idea that nurse-based restoration can accelerate the recovery of these forests is underexplored, despite its promise as a restoration technique. Recent conceptual models predict that facilitation among plants may be an important mechanism, but there is a lack of strong empirical support. We gathered experimental data to test this prediction and explore the relevance of using nurse-based forest restoration in these environments.
2. A 20-month factorial experimental design in the Andean tropical cloud forest was established. We measured the survival and estimated the biomass production of transplanted seedlings of a keystone canopy forest species, *Ceroxylon echinulatum* (Arecaceae), in a deforested area in the presence/absence of herbivory, a potential nurse plant (the tussock grass *Setaria sphacelata*, Poaceae) and artificial shade.
3. The joint effects of deforestation and herbivory led to the death of all seedlings, whereas most seedlings survived in the adjacent forest, which was used as the control. The presence of nurse plants led to significantly higher survival and growth of *Ceroxylon* seedlings throughout the experiment, regardless of herbivore presence.
4. The nurse effects were explained by a reduction of the relative abiotic stress experienced by the seedlings outside the forest, that is, the consistently decreasing maximum vapour pressure deficit. Furthermore, nurse tussocks delayed and reduced the effects of herbivory

by offering physical protection and a refuge for seedlings against detection by herbivores. However, the effects of herbivory and abiotic stress on facilitation were not additive.

5. *Synthesis and applications.* Facilitation in degraded cloud forest can be intense as soon as the beneficiary plants are driven away from their physiological optimum (relative abiotic stress) and/or are confronted by herbivory. Using pre-established exotic tussock grasses as a nurse-based restoration technique in degraded cloud forest is a low-cost, non-detrimental (to biodiversity) option, especially in the absence of nurse trees and shrubs. The success of this method requires transplanting seedlings at the base of tussocks.

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### Keywords

*Ceroxylon echinulatum* ; competition; deforestation; facilitation; herbivory; plant–plant interactions; rehabilitation; *Setaria sphacelata* ; stress-gradient hypothesis; tussock grass

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