Structural and functional connectivity in fragmented landscapes:

Insights into the conservation and restoration of New-Caledonian forests

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Introduction

New Caledonian rain forests growing on ultramafic substrate are affected by mining activities and recurrent bushfires for decades. It induces a dramatic fragmentation and reduction of the original forest cover to less than 20% of its initial extent (Jaffré, Munzinger et al. 2010).

The isolation of rain forest patches and the decrease of their size change their environment and alter their structural and functional connectivity which constitute critical threats for forest sustainability and resilience. Preserving and restoring structural and functional connectivity throughout the so called “ecological corridors” is a critical issue for managers. Nevertheless, the spatial patterns of such corridors are expected to differ from one plant species to another one according to their dispersal abilities and tolerance to abiotic parameters inherent to the fragmentation processes.

The main purpose of this study was to bring face to face the structural and the ecological connectivities to measure the impact of isolation and size reduction of habitats on the biological and ecological functionalities of populations.

Methods

Geometric features of patches and their structural connectivity was defined through spatial analysis initiated by remote sensing. Forest patches were delineated and structurally characterized by the sequential use of tree crown delineation (neural network) and image processing (such as textural analysis and classification) on very high resolution remote sensing data (Pleiades). On the other hand, taxonomic and functional diversity (dispersal syndrome, type and size of fruits) was measured in 67 forests fragments following a random inventory.

Results and conclusions

Preliminary results indicated that the automatic detection of forest patches through a classification forest/non-forests clearly separates the secondary vegetation from the rain forests through the detection of tree crowns. Furthermore the model was enabled to distinguish dense forest patches from isolated trees outside forests with an accuracy of well classified classes ranging from 73 to 83%. However the size and isolation of forest patches does not strictly predicted the species richness and biological contents. The secondary vegetation located in the surrounding of forests patches should enhance the connectivity of some population while other species are confined, unable to migrate from one patch to another. The fragmentation interferes with a general low dispersal ability of trees in New Caledonia leading to a low alpha-diversity and a very high beta-diversity. Such diversity patterns make very complex conservation strategies. Independently of the spatial fragmentation, it remains difficult to identify areas that could embody a high level of the total richness held in a mosaic of habitats.

References

Jaffré et al. (2010). "Threats to the conifer species found on New Caledonia's ultramafic massifs and proposals for urgently needed measures to improve their protection." Biodiversity and Conservation **19**(5): 1485-1502.