Using Rainforest Research

Tree plantations can enhance Rainforest regeneration

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Tropical deforestation and reforestation

Natural rainforests in the tropics are being degraded or fragmented at an alarming rate. Over the past decade, more than 90% of the total global deforestation has taken place in moist tropical forests. This rate continues to increase, placing remaining natural rainforests under significant threat. The reduction of original forest cover due to logging or forest conversion to other simplified land uses has been at least 42% in tropical America, 21% throughout Asia and Australia, and 52% in Africa.

Such extensive deforestation has caused disruptions to major ecosystem functions such as biodiversity, nutrient cycles, and water balances, with the degree of disruption dictated by the severity of the disturbance. In reversing this destructive process, various forms of reforestation are being undertaken in different parts of the world to restore some of the functions of degraded ecosystems. In tropical north Queensland, reforestation initiatives include the establishment of native timber plantations and the protection of previously logged, or secondary rainforests.

In her PhD studies, Rainforest CRC student Martina Langi investigated the differences between these two systems of forest restoration by comparing production and nutrient turnover in plantations of different native species and in previously logged natural rainforests.

The nature of the study

The study area in tropical north Queensland includes several forest plantations and secondary natural rainforests within close geographical proximity and between the ages of fifty-five and sixty-four years.

Above: *Flindersia* plantation with rich understorey and other tree species comparable to its adjacent rainforest
Left: *Auracaria* plantation invaded by other species from adjacent rainforest

Providing science for the conservation and management of Australia's World Heritage tropical rainforests.

The Rainforest CRC is a research partnership involving the Commonwealth and Queensland State governments, the Wet Tropics Management Authority, the tourism industry, Aboriginal groups, CSIRO, James Cook University, Griffith University and The University of Queensland

Sites were selected in the Wongabel, Gadgarra, and Danbulla State Forests where three adjacent but distinct forest types were investigated:

- Hoop pine (*Araucaria cunninghamii*) plantation
- Queensland Maple (*Flindersia brayleyana*) plantation, and
- Secondary natural rainforest that had been logged several decades earlier.

A number of significant results emerged.

Plant density and species richness

The two plantation species were established as monocultures but the close proximity of the plantations and rainforest at each site facilitated the recruitment of native rainforest species into the plantation stands. Many of these trees subsequently grew up to join the upper canopy layers.

The highest density of colonizing rainforest tree species was found in the *Flindersia* plantations at each site. Similarly, the highest overall species richness was also found in the *Flindersia* plantations at each site. Thus a 0.25 ha quadrat in the *Flindersia* plantations at Gadgarra contained 94 species of trees and understorey species while the *Araucaria* plantation contained 73 species. The rainforest plot at the same site had 100 species. Similar patterns were found at the other sites.

Forest production and nutrient turnover

The highest basal area was invariably measured in *Araucaria* plantations with lowest values usually measured in *Flindersia* plantations and intermediate values in the secondary forest. Among sites, basal area was found to be highest on basaltic soils at Gadgarra and lowest at Danbulla where soils are derived from metamorphic parent material. Gadgarra also experiences the highest rainfall of all three sites.

Large differences occurred in the standing biomass of the three forest types. The *Araucaria* plantations tended to have the highest biomass while the *Flindersia* plantations tended to have the least. Productivity, which was measured by litterfall or stem growth, tended to follow a similar pattern. Litter decomposition was generally similar among the forest types but the rate of fine root turnover was higher in the rainforest and *Flindersia* plantations in comparison with the *Araucaria* plantations.

The three forest types differed in terms of the nutrient capital they contained although the greatest nutrient store tended to be present in the *Flindersia* plantations and natural rainforest stands while smaller nutrient stores were present in the *Araucaria* plantations at each site. Turnover, measured as nutrient return via litterfall and litter decomposition, was invariably greater in rainforest stands than in either plantation type.

Conclusions and Further Research

The three forest types differ in terms of biomass and productivity. They also differ in nutrient content and nutrient turnover. Current work is examining the relationship between the biomass, productivity, nutrient turnover and tree species richness in the various stands. Future studies will explore the efficiency of nutrient use in plantations and natural forest and the influence of differing levels of tree species richness on these attributes.

Typical north Queensland rainforest opening showing patches of remaining rainforest with plantation plantings on the left - both systems benefit from their close proximity

For Further Information

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