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A New Role for Weeds in Rainforest Restoration?

Issues in Tropical Forest Landscapes

An example of regenerating rainforest beneath camphor laurel regrowth.

Rainforest CRC

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Rainforest cover has been removed from many landscapes with adverse consequences for biodiversity, climate, land condition and water quality. Rapid, large-scale reforestation is required to restore biodiversity and ecosystem health in extensively and heavily cleared areas. While tree planting can re-establish a diverse rainforest on cleared land, the practice is expensive and only small areas of land have been reforested to date.

Sometimes, forest cover can return to cleared land through natural processes. Most rainforest plants have fleshy fruits that are attractive to fruit-eating birds. As the birds move between remnant rainforest and regrowth patches they disperse the seeds of rainforest plants. These processes have the potential to cost-effectively restore forest cover to large areas of cleared land.

In areas that have been cleared for long periods of time, regrowth may be dominated by introduced weedy plants. For example, regrowth dominated by camphor laurel trees covers extensive areas of cleared rainforest land in Australia. However, camphor laurel patches attract fruit-eating birds that disperse the seeds of rainforest plants. Many seedlings of rainforest plants have recruited to camphor laurel patches and, in the long-term, may come to dominate the regrowth. This process could be hastened by careful and strategic management interventions, but this requires a change in current attitudes towards the role of weeds in ecosystem restoration.

Succession is a process of progressive change in tree species composition following disturbance to a forested area. Later-successional rainforest species are characteristic of undisturbed forests. The process of rainforest restoration seeks to speed up succession towards a self-sustaining, rainforest-like ecosystem.

Camphor laurel dominated regrowth adjacent to extensive forests of the Nightcap Range in north eastern New South Wales.

Forest Clearing and Restoration

The clearing of rainforests over the past century has resulted in a substantial loss of habitat for species of native animals and plants. Forest areas that remain are often reduced to fragments surrounded by agriculture or urban development. By revegetating heavily cleared areas we can improve ecosystem health and reduce the threat of extinction to native species.

Changing patterns of land use such as the abandonment of marginal agricultural lands present an opportunity for the restoration of forest cover to degraded landscapes. In some cases, rainforest will naturally recolonise abandoned agricultural land but the potential for this to occur will be limited by the intensity of farming activities that have taken place and the length of time farming was conducted. Soil seed banks quickly become depleted following rainforest clearing. In most cases, reforestation will depend on the deliberate or natural dispersal of plants from remnant forests to cleared land.

Replanting an area to emulate the density and diversity typical of rainforest is one possible way of achieving reforestation, but is very expensive ($20,000 - $30,000 per hectare). Over large areas, strategies that make use of natural regenerative processes may be considerably more cost-effective. The establishment of any form of woody vegetation cover can help initiate the process of rainforest regeneration by shading out aggressive grasses and herbaceous vegetation and improving microclimatic conditions. Frugivorous (fruit-eating) animals can then greatly assist rainforest regeneration by dispersing the seeds of rainforest plants to areas of regenerating forest. Most rainforest plants bear fleshy fruits that are eaten by frugivorous birds or mammals. Birds in particular are important seed dispersers in Australian rainforests.

Exotic Species in Degraded Landscapes

Landscape modification by humans has been accompanied by the introduction of an increasing number of plant species, often originating from other continents (exotic species). In fact, the presence of exotic species is often used as an indicator of land degradation. In some areas, weedy

Camphor laurel grows in pasture when grazing pressure is reduced. When the trees form a closed canopy, rainforest seedlings may recruit to a patch.

exotic plants may come to dominate a site and prevent establishment of native species. On the other hand, exotic species might be useful in restoring function to highly degraded areas where native species have become extinct or where current environmental conditions prevent their growth.

These new, emerging issues in environmental management remain poorly understood. However recent research into the role of the exotic tree species, camphor laurel (*Cinnamomum camphora:* Lauraceae), is helping to fill this knowledge gap.

Case Study: Camphor Laurel in the Big Scrub – Scourge or Saviour?

From the nineteenth century, eastern Australian rainforests were targeted for clearing. Those that remain today are mostly restricted to steep slopes. The Big Scrub in northern New South Wales was once Australia's largest tract of lowland subtropical rainforest but by the early 1900s it had been reduced to a few small, scattered remnants, accounting for less than one percent of the original 75,000 hectares. As the dairy and banana industries in this area have declined over the last forty years, woody vegetation has returned to the landscape, mainly in the form of regrowth dominated by camphor laurel.

Camphor laurel is a native of Asia and was first introduced as an ornamental and shade tree in the 1800s. Camphor laurel trees bear abundant crops of round, bluish-black fruits approximately ten millimetres in diameter. Each fruit contains a single seed. In Australia, a mature camphor laurel tree can produce one hundred thousand fruits in a year. These fruits are eaten and the seeds dispersed by many birds and bats, helping to spread the species into new areas.

Camphor laurel seedlings on farmland.

The Big Scrub landscape today – macadamias in the foreground, camphor laurel dominated regrowth towards the centre, and young plantations on the hills in the background.

Concentrations of camphor laurel occur in areas where rainforests have been cleared from basalt soils and pastures have been established. When farmland is withdrawn from production or grazing reduced, camphor laurel trees can rapidly recruit and grow. A shrubland of abundant small individuals first forms, then a developing forest patch emerges as the trees grow and their canopies merge. Due to concern over its spread, camphor laurel has been declared a 'Class 3 pest plant' in Queensland and a noxious weed by a number of local governments in New South Wales.

Some people have campaigned strongly for government-assisted removal of camphor laurel as a matter of urgency, arguing that its aromatic compounds, such as cineole and camphor, may be poisonous to other plants and animals. It is known that camphor laurel can suppress pasture growth and it was feared that native plants may be unable to establish beneath these long lived trees, effectively 'locking up' the land, reducing productivity and biodiversity.

The first camphor laurel trees to colonise a cleared area are often situated along fencelines.

However, some observers have found that patches of camphor laurel regrowth can support a variety of native rainforest plants and animals. It has been suggested that camphor laurel patches can provide important habitat for species such as some types of fruit-pigeon, whose populations have declined following the clearing of rainforests. Camphor laurel may also act as a catalyst for further rainforest regeneration.

These divergent viewpoints have fuelled a heated public debate over the value of camphor laurel and the best strategies for management of its spread. To resolve such different and conflicting viewpoints, independent and factual information is needed.

Griffith University researchers Dr John Kanowski (left) and Stephen McKenna survey plants in camphor laurel regrowth in the Big Scrub.

Solving the Puzzle: Birds, Plants and Camphor Laurel Regrowth

Rainforest CRC researchers set out to objectively assess the potential for rainforest regeneration to occur in areas of camphor laurel regrowth in the Big Scrub region. They investigated which bird species in the region consume the fruits of rainforest plants and disperse their seeds; how common these birds are in camphor laurel regrowth patches; which rainforest plants are recruiting in these patches; and how many recruiting plants are present as seedlings.

Researchers measured the diversity and abundance of birds and plants in 24 patches of well developed camphor laurel regrowth using repeatable and quantitative survey methods. Each of the patches formed an area of at least three hectares and occurred on land that once supported rainforest vegetation but had been used for agriculture for many years. In each patch, the birds and plants were assessed within a 0.6 ha survey plot.

Birds in Camphor

Many species of frugivorous birds were recorded in camphor laurel regrowth (see Table 1) – ten species with high potential to disperse rainforest seeds, six with medium potential and eighteen with low potential. Birds that often eat fruit and also have a large gape (the width of the base of the beak) have the highest potential to disperse seeds of a wide range of rainforest plant species, while birds that rarely eat fruit have the lowest. A number of the high dispersal potential species were found to be common and widespread in the regrowth, including the figbird, pied currawong, rose-crowned fruit-dove and topknot pigeon.

The rose-crowned fruit-dove disperses many rainforest plant seeds and was recorded frequently in camphor laurel regrowth. The species is listed as Vulnerable under the New South Wales Threatened Species Act 1995 (Image: © Tom Tarrant).

Most frugivorous birds used the surveyed patches in winter (see Figure 1) when camphor laurel is in fruit. Large flocks of topknot pigeons flew across the landscape between remnant forest and regrowth patches throughout the winter, however many frugivorous birds also used the patches in summer when camphor laurel was not in fruit but when most native rainforest trees were fruiting.

Plant Recruitment

Plant surveys identified 181 species of local rainforest plants in the 24 selected regrowth patches, including life forms typical of rainforest such as trees, palms, shrubs, vines, epiphytes and ferns at all stages of growth. There were also 23 species of exotic plants, mostly trees and shrubs, as well as four local non-rainforest species. The surveys clearly showed that the seedlings of native trees are able to survive and grow in camphor laurel patches. Fifty species of local rainforest trees were recorded as adults in the regrowth patches (in a total sampled area of 6 ha), while 75 species of local rainforest trees

Table 1: Frugivorous birds that potentially disperse rainforest seeds to 24 selected camphor laurel patches in the Big Scrub region, New South Wales. Seed dispersal potential was determined from the proportion of fruit in each individual's diet, its gape width and whether it disperses viable seeds

Birds with high potential to disperse seeds		Occurrence % of patches
Figbird	*Sphecotheres viridis*	96
Pied currawong	*Strepera graculina*	96
Rose-crowned fruit-dove	*Ptilinopus regina*	92
Topknot pigeon	*Lopholaimus antarcticus*	63
Green catbird	*Ailuroedus crassirostris*	42
Olive-backed oriole	*Oriolus sagittatus*	24
Satin bowerbird	*Ptilonorhynchus violaceus*	17
Wompoo fruit-dove	*Ptilinopus magnificus*	13
Channel-billed cuckoo	*Scythrops novaehollandiae*	4
Paradise riflebird	*Ptiloris paradiseus*	4
Birds with medium potential to disperse seeds		**Occurrence % of patches**
Lewin's honeyeater	*Meliphaga lewinii*	100
Silvereye	*Zosterops lateralis*	100
Mistletoebird	*Dicaeum hirundinaceum*	58
Varied triller	*Lalage leucomela*	54
Barred cuckoo-shrike	*Coracina lineata*	4
Regent bowerbird	*Sericulus chrysocephalus*	4

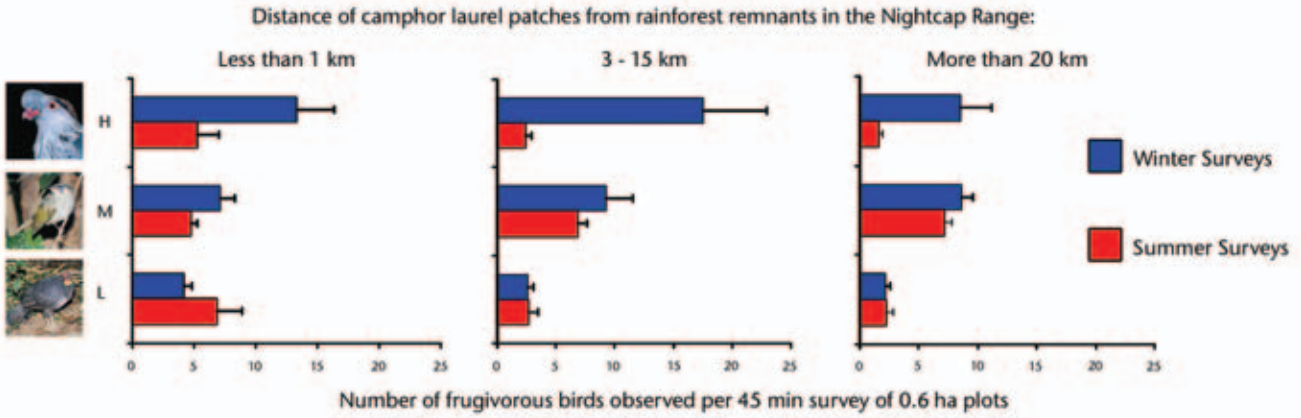

Figure 1: Number of frugivorous birds recorded in camphor laurel regrowth patches in winter and summer at three distances from the largest areas of remnant rainforest. H = bird species which have a high seed dispersal potential; M = medium; L = low. Numbers are averaged across seven to nine sites in each distance class, with three to four repeat visits per patch (Images: Terry Reis).

were found to be recruiting as young trees within a 1.2 ha subset of this area.

The individual adult trees counted were mostly mature camphor laurels (66%), with 9% privet (*Ligustrum lucidum*) and 25% native species. However, the emerging generation of young tree recruits displayed a different population structure with only 22% of the individuals being camphor laurel, 31% privet and 47% natives. Many native tree species typical of mature rainforest were appearing as young plants even though they were uncommon as adults. Most of these species are dispersed by birds (see Figure 2).

Statistical analyses showed that bird-dispersed native tree species, especially those of later successional stages, were becoming increasingly prevalent among the recruits.

Can Camphor Laurel Facilitate Rainforest Regrowth?

Camphor laurel is readily establishing in the former Big Scrub landscape. It can colonise pasture and rocky sites and grows rapidly to maturity, enabling it to play a pioneer-like role in regrowth on pasture sites.

Three ecological features of camphor laurel patches facilitate rainforest regrowth:

1. Camphor laurel attracts frugivorous birds that disperse the seeds of rainforest plants;
2. A well-developed camphor laurel patch usually has a dense canopy that shades out grasses and herbaceous plants which are otherwise likely to inhibit seedlings of rainforest trees; and
3. The tree canopy and leaf litter layer may further contribute to regrowth by creating a microclimate suitable for the germination and establishment of rainforest plants.

This suggests that there is potential to manage camphor laurel regrowth to facilitate rainforest regeneration over large areas, especially where strategic reforestation will be beneficial, for example, increasing total forest cover or providing linkages between areas of remnant forest.

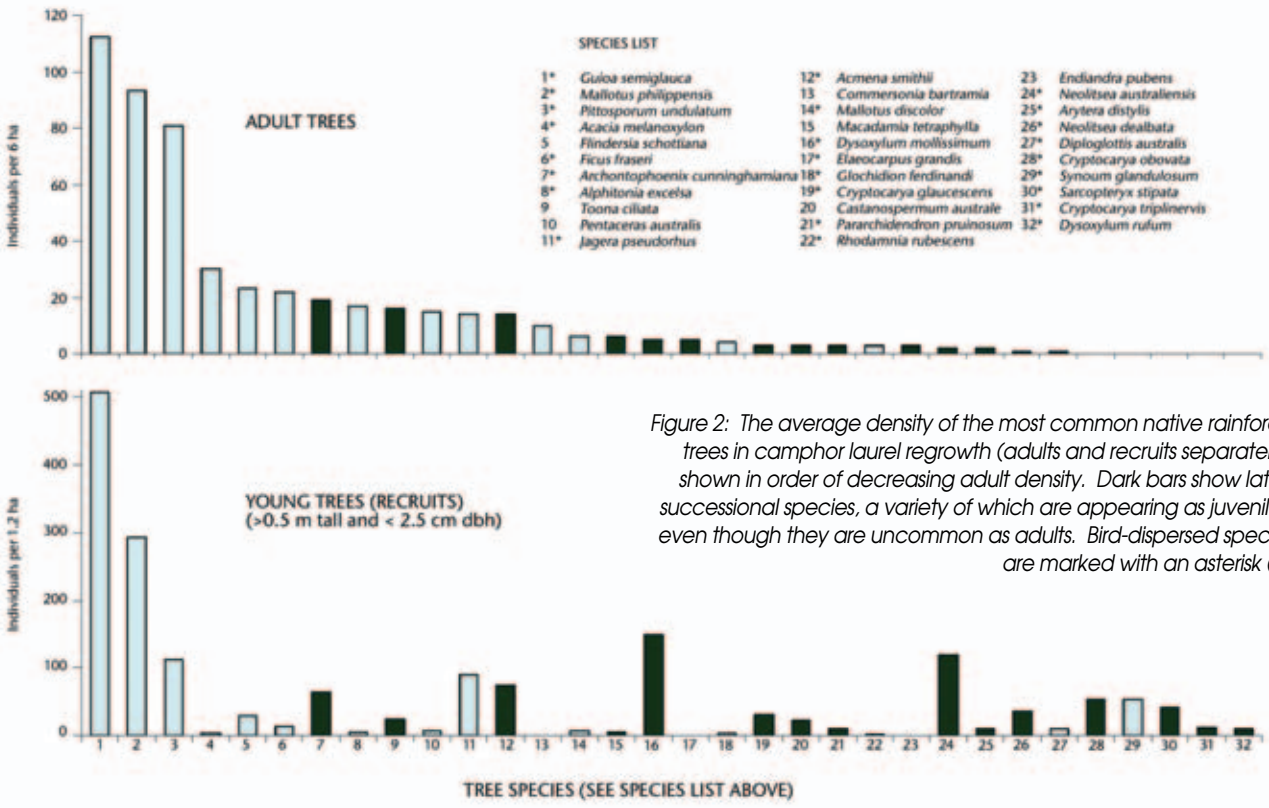

Figure 2: The average density of the most common native rainforest trees in camphor laurel regrowth (adults and recruits separately), shown in order of decreasing adult density. Dark bars show later-successional species, a variety of which are appearing as juveniles, even though they are uncommon as adults. Bird-dispersed species are marked with an asterisk (*).

Without the forest-like structure that camphor laurel brings to the landscape, regrowth may not have progressed as rapidly past a combination of exotic pasture grasses and herbaceous plants.

Camphor laurel management could involve two phases:

1. Tolerating the development of camphor laurel regrowth until the canopy has closed and a sufficiently large pool of native recruits has established; and
2. Progressively removing camphor laurel trees and seedlings to assist the rainforest recruits to grow more rapidly to full size.

These actions may need to be combined with an enrichment planting program of native rainforest trees, along with continued strategic control of exotic seedlings that may appear. Field trials and further research are needed to test whether such an approach is feasible and is cost effective.

Members of the community discuss the issue of camphor laurel regrowth at a Big Scrub field day.

Exotic Plants and Rainforest Restoration

This study shows how some exotic species may have a positive role in facilitating forest recovery in cleared landscapes, however this will need to be assessed on a case-by-case basis. Some invasive exotic species can seriously degrade ecosystem function without any positive effects on biodiversity. On the other hand, in highly modified landscapes, certain exotic plant species have come to play an important role in ecosystem function and native species now depend on them for survival.

Given the large changes in the environment that have occurred since clearing of rainforest in most landscapes, it is highly unlikely that regenerating forests can ever be identical to those that previously existed. The conservation of remnants of original forest remains a priority for management, as they are critical reference points, heritage sites and genetic resources. But in many areas, preservation of remnants alone will be insufficient to maintain even the present biodiversity. Achieving long-term conservation and restoration may require a shift in the current thinking about best management practices for reforesting landscapes and the role of weeds in the functioning of ecosystems.

Camphor laurel regrowth at the end of a rainbow (Image A Rohlfe).

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