Woody weeds and rainforest habitat restoration – benefits and risks

Carla P. Catterall

This Fact Sheet considers the roles of woody weeds in rainforest restoration.

It draws on recent developments in scientific knowledge to discuss how non-native trees can play a useful role in the process of large-scale forest restoration on retired farmland in the Australian subtropics and tropics.

Large-scale forest restoration is an important challenge for the 21st century.

In the 19th and 20th centuries, people worked hard to clear native forest cover, and replace it with cropland or pasture. But adverse consequences of over-clearing the world's rainforests are now accumulating.

Landscapes supporting native forest (upper) and cleared for cattle grazing pasture (lower), in the Dorrigo region.

Rainforest clearing has caused species' declines and extinctions, increased atmospheric CO_2, land degradation, and changes to riverbank stability and water quality. Time-lagged consequences mean that these problems will keep increasing even if all deforestation is immediately stopped.

Restoration of forest cover over large areas is needed simply to avert further environmental degradation. Even more would be needed to achieve environmental recovery.

Tree planting projects in recent decades have restored forest over small areas, but these are together nowhere near large enough to have sufficient beneficial ecological impact.

By contrast, **woody regrowth** can occur spontaneously over large areas of disused farmland. Worldwide, agricultural land is increasingly being abandoned, when soil degrades, if economic subsidies are withdrawn, or when people move to cities for other reasons.

The first trees and shrubs to establish are frequently non-native species; and often disliked by both farmers and conservation managers. But most agricultural lands are by nature non-native communities, and in this situation **any increase in forest cover could be ecologically beneficial.**

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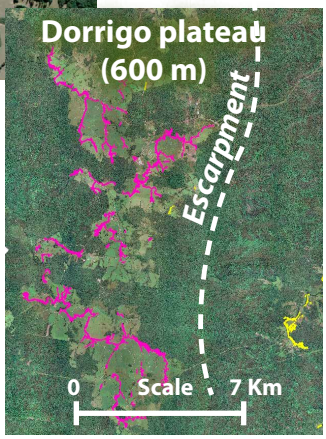
A case study in the Coffs - Dorrigo region

Privet regrowth

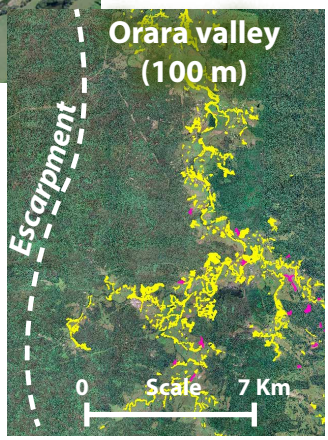


In the Coffs-Dorrigo region, most level land was cleared in the 1800s, and grazed by cattle for decades.

More recently, declines in the dairy industry have enabled non-native pioneer trees and shrubs to establish in areas of reduced grazing. Small-leaved privet dominates this regrowth at higher-elevations and camphor laurel at lower elevations.

In both cases, dense regrowth patches are formed, beneath which seedlings of native rainforest species (pictured top right) have established in the shaded ground beneath the non-native tree canopy.

Camphor regrowth



Pathways towards forests of the future

Farm production activities and grazing by livestock suppress tree regeneration. When farmland is retired and livestock removed, young forest trees may start to grow. However their establishment is often inhibited by persistent dense pasture grasses or other non-native ground cover plants.

Delays occur because tree establishment in retired farmland involves overcoming a series of different **ecological barriers to regeneration**. Two are especially important:

- **Competition from introduced pasture grasses** occurs when they grow as dense swards that suppress the seedlings of native rainforest trees. This competition occurs both above-ground (for light) and below-ground (for water and nutrients). Pasture grasses may also be fire-prone, which kills rainforest seedlings.
- **Dispersal limitation** occurs because most rainforest trees produce fleshy fruits which need to be transported by fruit-eating fauna (especially birds). Without this dispersal assistance the seeds only fall beneath the parent tree. Many of the dispersers rarely venture outside of intact forest, but fortunately a few also use open pasture, especially if scattered trees are present. This dispersal is especially important because the seeds of most rainforest trees are short-lived, so there is no "seed bank" reserve to assist forest regeneration in retired agricultural soils.

Wompoo fruit-doves are important seed dispersers in old growth rainforest. But they are very reluctant to fly into cleared land, and are rarely seen in regrowth forest.

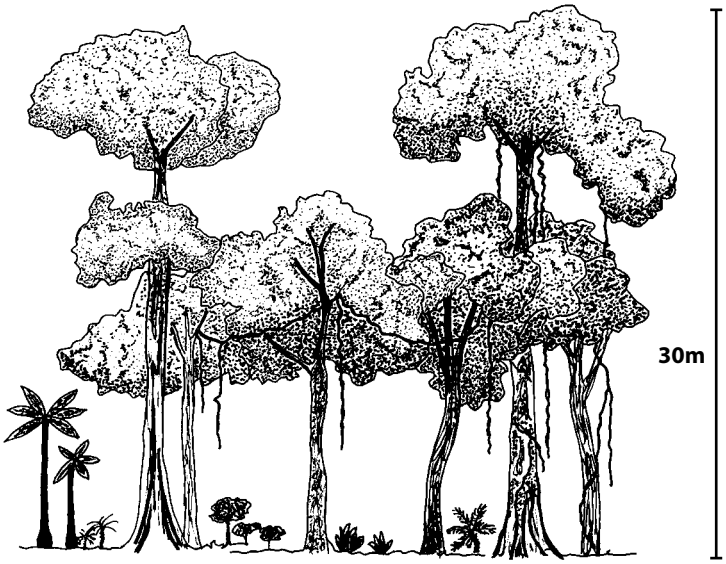
In spite of these barriers to regeneration, some scattered tree seedlings gain a foothold, and there are particular **pioneer species** which are typically most successful in doing so. **Native** rainforest pioneers in retired Australian farmland often include species of certain genera such as *Acacia*, *Alphitonia*, *Guioa*, *Homalanthus*, *Macaranga* and *Polyscias*.

Once the seedlings of pioneers establish and grow to sapling size, they in turn become capable of out-competing the grass. Their presence as scattered trees can greatly increase the recruitment of further tree seedlings, because they attract fruit-eating birds which bring in seeds from remnant forest areas, and also create shade which both suppresses the growth of pasture grasses and provides a microclimate that favours seedling establishment.

As the emerging pioneer tree seedlings increase in numbers and grow, their crowns coalesce to form the closed canopy of a new forest patch, which then attracts more seed-dispersing birds and provides more rainforest-like physical conditions.

Other, less hardy, rainforest species can now grow beneath this canopy. These forest patches also attract a greater diversity of rainforest fauna.

The pioneer trees grow rapidly in sunny areas, but they grow poorly when shaded by other trees and they are not very tall at maturity. Many pioneers also have short lifespans. Over time they die, making room for an emerging second generation of other native rainforest tree species, whose seedlings are more tolerant of shady conditions.



So, over decades, this **succession** progresses towards recovering the diversity and characteristics of mature rainforest.

Both native and non-native species can act as pioneer trees with this same ecological function in promoting further forest regrowth.

However the most abundant early tree and shrub colonisers are often **non-native** species such as wild tobacco, lantana, camphor laurel and privets (see p7). Just why these particular species are so successful in overcoming early regeneration barriers is poorly understood.

Bush regenerators and ecological researchers in many rainforest regions of eastern Australia are increasingly remarking on native tree seedlings seen growing beneath non-native pioneer species such as these.

Targeted interventions: regrowth acceleration vs weed suppression

Without human intervention, initial regrowth in pasture can sometimes take decades to establish. And although weedy regrowth may establish more rapidly than native pioneers, the subsequent transition from dominance by non-native species to dominance by native species could take many further decades. This raises the question of how to devise targeted and cost-effective interventions to accelerate these processes, as alternatives to the most intensive option of tree planting to reinstate forest species. There are two stages at which such interventions could be useful.

1. Kickstarting early regrowth of trees in disused farmland

When persistent dense grass or herbs inhibit early seedling recruitment, intervention may kickstart the process of forest succession. Two main approaches have been tried: (1) increasing seed supply (e.g., by sowing seeds or installing perches to attract seed dispersers); and (2) suppressing grass and herbs (e.g., with herbicide, cutting, or pulling). Limited research so far indicates that each alone could be ineffective: actions to increase seed input need coupling with grass suppression.

Pied currawongs play a useful role in moving seeds of pioneer rainforest trees into pasture, enabling forest regeneration to begin.

Research in tropical Australia has found that grass suppression (with herbicide) caused a 50-fold increase in rainforest seedling density in open pasture adjacent to rainforest, 800-fold under bird perches, and 1500-fold under scattered pre-existing native trees and non-native shrubs (A).

This Polyscias seeding has germinated and established in 9 months, after herbicide treatment killed dense pasture grasses which would otherwise have prevented its emergence.

And the herbicide also triggered further succession, as wild tobacco germinated and grew into ground-shading and bird-attracting clumps within 1-2 years (B).

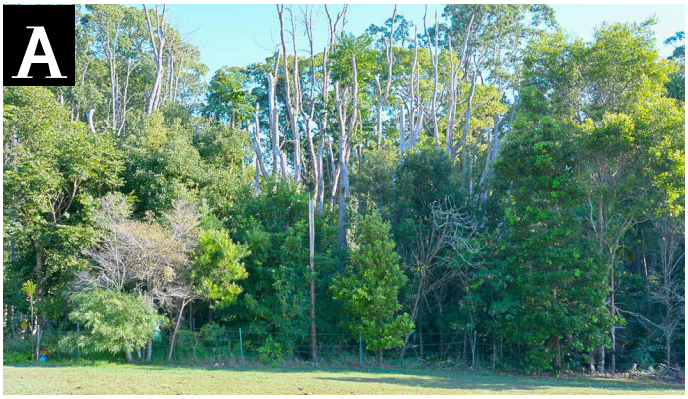
20 months after herbicide treatment to suppress the pasture grasses, wild tobacco has germinated and grown to about 3m tall, covering much of the ground in this 80x80m experimental plot.

2. Accelerating a shift towards native trees in established weedy regrowth

After a tree canopy of mainly non-native species has become established on disused farmland, rainforest seeds and seedlings can accumulate at ground level. Succession towards native rainforest may then be accelerated by removing all or part of the non-native canopy (e.g., by herbicide stem treatment or cutting).

However if the woody weed seedlings are removed before enough of them have grown to tree size, there will have been no opportunity for birds to bring in rainforest seeds.

Bush regeneration practitioners in subtropical Australia have found that targeted poisoning of trees in camphor laurel patches: (1) causes more rapid growth of the previously accumulated native seedlings (A); and (2) triggers germination of native rainforest pioneer trees (B) whose seeds were imported by disperser birds, and which had accumulated in the soil (many being longer-lived than those of other rainforest trees).



Here, several years after a patch of camphor laurel trees was poisoned with herbicide, dense pioneer rainforest trees have grown from seed previously brought in by birds while the camphor laurels were alive.

Ficus coronata (left) and *Cryptocarya glaucescens* (right).

Lewin's honeyeaters feed on rainforest fruits and spread their seeds by flying out to the scattered trees and shrubs growing in adjacent pasture.

Making decisions about interventions to harness the positive roles in of certain woody weeds in forest regeneration requires a consideration of several factors.

These include:

- the **timing of intervention**, which influences how many seeds or seedlings have accumulated;
- the **amount of nearby rainforest** or rainforest trees (the seed sources);
- the **time since the land was retired** from production, the **type of former land use** and the observed quantity of **native seedlings that are already regenerating**; and
- the **current environmental functions of woody weed cover** (such as its contributions to land stability or wildlife habitat).

Ecological management dilemmas: pros and cons of woody weeds

Clearly, some common woody weeds have the capacity to facilitate rainforest regeneration in retired farmland. Tolerating or even encouraging their early growth could therefore be a useful part of a manager's restoration toolkit.

However, this idea runs contrary to a widely accepted priority in restoration activities within Australia: that of suppressing or eradicating non-native species.

The dilemma for management involves weighing the potential benefits of woody weeds in reforestation against any undesirable ecological consequences of their dominance in early successional plant communities.

The best course of action will differ in different situations, but the following issues will frequently be relevant.

Undesirable environmental effects of hasty control in retired pasture

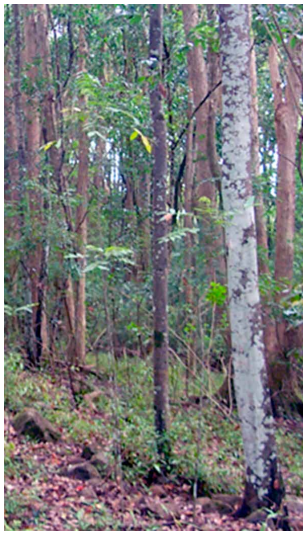
- Removal of the non-native pioneers when they first appear will not only prevent the regeneration cycle from beginning, it will maintain another non-native plant community – of imported pasture species such as paspalum, setaria, kikuyu, signal and guinea grasses, and associated weeds. The diversity of native plants and animals in pastures, especially non-native pastures, is typically very low.

The pressure of a dense grass cover limits forest regeneration in ungrazed paster

- Areas reforested with mixtures of native and non-native trees have useful environmental functions. These include land and streambank stabilisation, water regulation and filtration, carbon storage, improved soil condition, and provision of fauna habitat.

  Indeed, tree planting on farmland often consists of timber or carbon plantations, dominated by species that are not native to the region's forests, and chosen for fast growth or wood characteristics. Biodiversity in such plantations is no greater than in weedy regrowth forests, and the latter often have greater habitat value for wildlife.

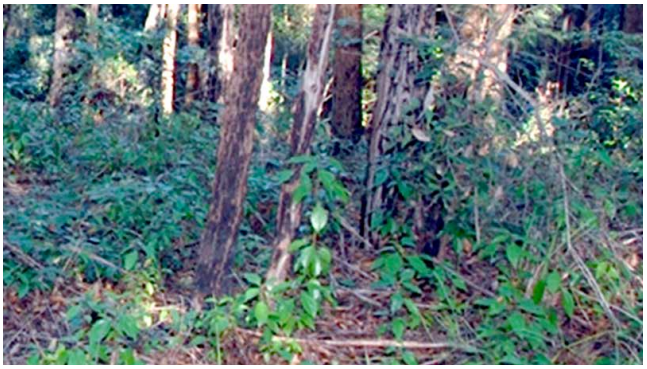
Cabinet timber plantation



Camphor laurel regrowth

Situations where there are potential negative effects of inaction

- In some situations other than retired farmland, these same non-native woody species are less ecologically desirable. For example, camphor laurel can invade the understorey of infrequently-burned eucalypt forest, potentially causing undesirable ecosystem change. In dry rainforest, lantana can promote increased fire frequency, killing rainforest seedlings.



Camphor laurel seedlings invading the understory of eucalypt forest (Bellingen valley).

- In regrowth on retired farmland, these species sometimes occur in dense stands above areas of bare or litter-covered ground, with little regeneration of native trees. Complex reasons for this potentially include shading, below-ground competition, chemical interactions and remoteness from native seed sources.

- Not all non-native woody plants have the ecological properties which make them useful as pioneer forest trees. For example, tree species that are shade-tolerant may pose much greater risks, species that are not frugivore-attracting have fewer benefits, and vines which can smother trees may reduce or reverse the development of regrowth.

Questions about the ecological roles of weedy regrowth can create vigorous discussion amongst both restoration practitioners and environmental scientists.

Common non-native pioneers in Australian rainforest landscapes

These non-native species are especially effective at initiating woody regrowth within disused pasture.

They all produce fleshy fruits eaten by birds that widely disperse their seeds. Their seedlings are fast growing in the open and able to establish among dense pasture grasses, but since they grow much more slowly in shade, the more shade-tolerant rainforest seedlings can emerge beneath them. However this may be a slow process.

Wild tobacco (*Solanum mauritianum*)
Origin south America; shrub/tree; height 4 m+; lifespan 2-3 decades; shade-intolerant.

Camphor laurel (*Cinnamomum camphora*)
Origin southern Asia; tree; height 20 m+; lifespan exceeds 100 years; shade-intolerant.

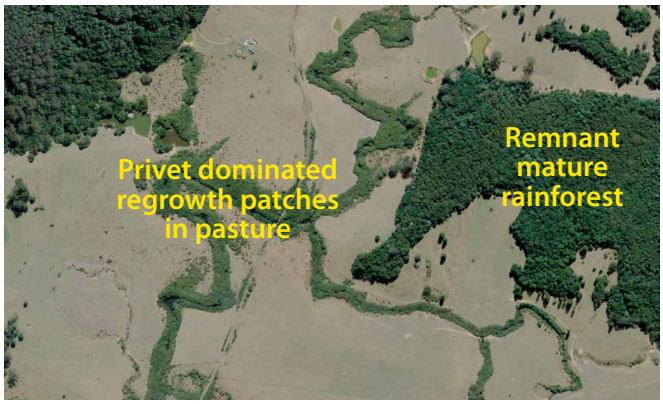
Lantana (*Lantana camara*)
Origin tropical Americas; scrambling shrub; height 3 m+; lifespan may exceed 2 decades; shade-intolerant.

Privets (*Ligustrum sinense* illustrated; *L. lucidum*)
Origin southern Asia; height 7 m+; lifespan likely several to many decades; partly shade-tolerant.

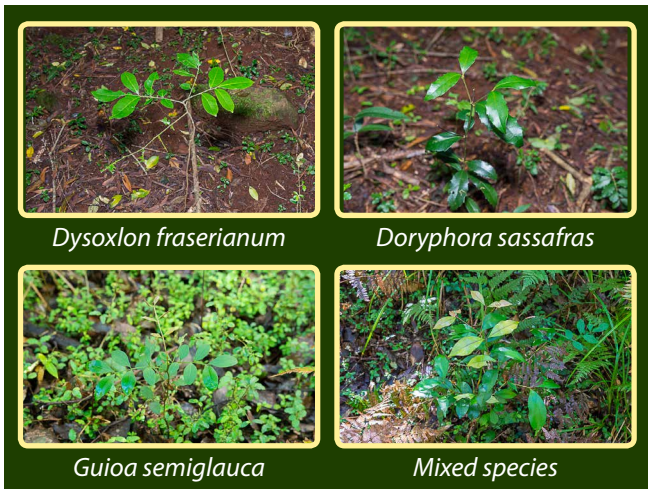
Towards informed management

Further evidence is needed about the multidimensional roles played by non-native woody plants in reforestation, and how these roles may vary among species and situations.

To give just one example, closeness to existing remnant forest (a source of seed and dispersers) seems likely to be important. But there is insufficient information about how important, how close, how much forest, to provide a sound basis for management decisions. Only future research can deliver the answers.



Rainforest seeds from the remnant forest on the right are more likely to reach nearby regrowth patches than those located further away (Dorrigo Plateau).



Native rainforest tree seedlings emerging within patches of privet-dominated regrowth.

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