

Climbing plants are taking over the world's forests. What's going on, asks biologist William Laurance

Planet of the vines

GAZE out over a tropical rainforest and the scene looks idyllic – a kaleidoscope of trees festooned with colourful vines, orchids, ferns and lichens. Don't be fooled. Myriad ecological battles are being fought beneath this tranquil surface. None is more embittered than that between trees and their ancient enemies, the vines.

Biologists like myself who study these jungle ecosystems are now seeing a shift in this war. Whereas until a decade or so ago the two adversaries were evenly matched, vines now seem to be on the march. If that continues, the face of our forests – and of our planet – could be changed irrevocably. We are left scabbling to unearth the root cause.

If the forest were a financial system, trees would be its old money. Deeply rooted, they grow slowly, investing heavily over time in woody trunks and branches to support their leaves, and providing homes for a zoo of other species. Vines, on the other hand, would be the flashy junk-bond traders. Making up anything up to half of the plant species in a typical rainforest and producing up to 40 per cent of all leaves, they are down-and-dirty competitors. They invest almost nothing in supportive tissue, instead taking advantage of the trees' investments to scramble up to the top of the forest and produce great flushes of leaves that bask brazenly in the full sun.

Francis Putz, a biologist at the University of Florida in Gainesville, highlighted this fraught relationship in a 1980 paper entitled "Lianas vs trees". Lianas, or woody vines, can grow to over half a metre in diameter and hundreds of metres in length. Trees pay a high price for their presence. Lianas can strangle and deform a tree's branches, their dense foliage robs trees of life-giving sunlight, and their roots scarf up vital nutrients and water. Trees bearing lianas usually grow more slowly, reproduce less and die sooner than those without. Once lianas reach the canopy, they often climb laterally, effectively roping trees together so that, when

one falls, it can drag down others. This is why loggers hate them: if they don't cut every liana linked to a tree before felling it, another may be yanked down on top of them. "Loggers call them 'widow-makers,'" says Putz.

There are obvious reasons why some vines are becoming more prevalent. Humans have introduced invasive species such as the rubber vine to northern Australia and kudzu to the south-eastern US that smother native forests, grasslands and waterways. Most vines are light-loving, and increase rapidly in forests that have been fragmented by agriculture or selectively logged. Small, regenerating trees on the edge of disturbed forests provide ideal trellises for climbing quickly into the canopy. A decade ago, my colleagues and I revealed much higher liana abundances in fragmented than intact Amazonian forests. Trees in these areas are beleaguered, dying two to three times faster than normal.

Dynamic drivers

But vines are also proliferating in undisturbed forests. Oliver Phillips of the University of Leeds in the UK and his colleagues revealed in 2002 that lianas had increased sharply at the expense of trees at sites across western Amazonia. Something similar has been seen in nearly a dozen other intact forests in Central and South America. "It was controversial at first," says Phillips, "but few doubt it now."

What's happening? A likely cause is that tropical forests around the globe are becoming more dynamic, with trees dying and regenerating more rapidly – conditions that strongly favour vines. It is possible that global warming is intensifying windstorms that increase tree fall in the affected areas, yet there is little evidence for such an effect.

Instead, a more subtle driver seems to be at play: rapidly rising levels of atmospheric carbon dioxide. CO₂ fuels photosynthesis; as it increases, plants grow faster. Faster growth



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Vines stop at nothing in their scramble towards the forest canopy

brings more competition among plants for light, space and nutrients, which in turn drives higher rates of tree death and regeneration. Rising CO₂ could also favour vines directly. Several experiments over the past few years suggest that vines, with high photosynthetic rates, an abundance of energy-producing leaves and little costly supportive tissue, are primed to take advantage of rising CO₂.

This isn't to imply we know everything about the onslaught of vines. So far the trend has been spotted in undisturbed forests only in the Americas. Long-term studies are needed elsewhere to ensure this isn't a coincidence of geography. I wonder too about the fate of remote forests I have studied in the Congo basin. Vines there are naturally abundant because of disturbance by forest elephants. Yet elephant populations are collapsing from overhunting. Might vine numbers in these forests actually begin to decline?

Most evidence, however, suggests Earth is heading for a viney future. This worries ecologists like Stefan Schnitzer at the University of Wisconsin-Milwaukee. "Vines can change forests in a lot of ways," he says. "They hit big, slow-growing trees far harder

"Vines are down-and-dirty competitors, producing great flushes of leaves that bask brazenly in the sun"

than smaller, faster-growing species, meaning they can probably change the entire composition of the forest."

It's not just trees that are at risk. Ainhua Magrach, a postdoctoral researcher of mine at James Cook University in Cairns, Australia, has found that plants that live on trees, such as ferns, tend to be excluded in regions where vines are dense. These ferns are little islands of biodiversity, sustaining many animals in the rainforest canopy. A few species have mutualisms with aggressive ants that attack encroaching vines, but most are not so lucky.

The biggest worry is that proliferating vines could reduce carbon storage. Forests lock up billions of tonnes of carbon in woody tissue, and when vines kill or suppress trees some of that carbon is released into the atmosphere. Studies in Panama and Amazonia suggest rampaging vines replace just a small fraction of the carbon they cause trees to release. That could induce a positive feedback, with still more greenhouse gases and a warmer future for us all. If that goes too far, we really could be heading for a planet of the vines. ⁿ

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