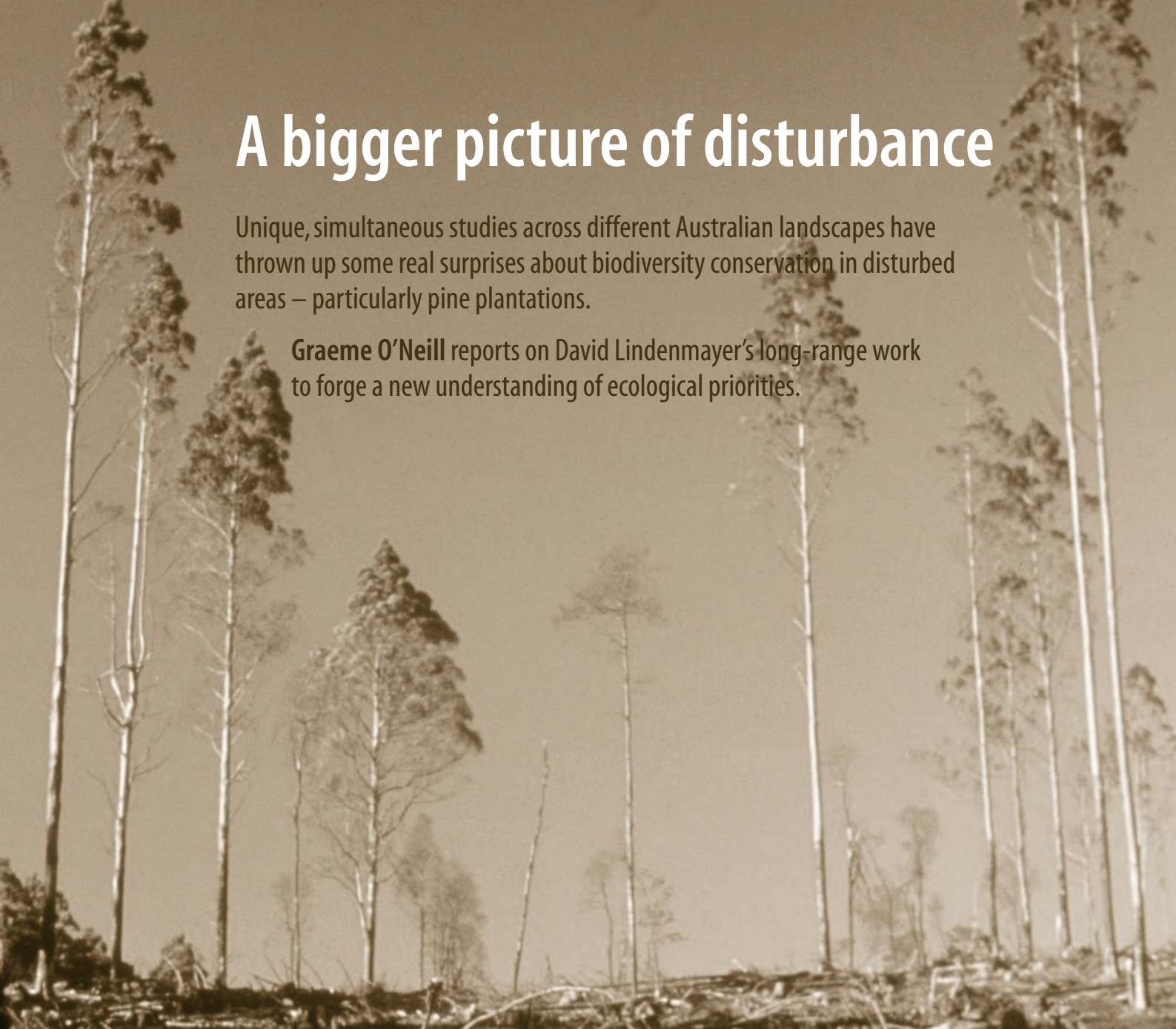


A bigger picture of disturbance

Unique, simultaneous studies across different Australian landscapes have thrown up some real surprises about biodiversity conservation in disturbed areas – particularly pine plantations.

Graeme O'Neill reports on David Lindenmayer's long-range work to forge a new understanding of ecological priorities.



David Lindenmayer

Left standing, slender mountain ash trees retained as part of a logging experiment.

Some native animals actually flourish in disturbed environments, whether the disturbance is natural or human-induced.

Australia's pine plantations are supposedly biological deserts, inhospitable to native mammals and birds. But it seems species like the common ringtail possum and the rufous whistler don't know it.

Australian National University ecologist Professor David Lindenmayer says while it is true that pure, large-scale stands of pines are ecological deserts, around Tumut, in southern NSW, both possum and whistler species are flourishing in a landscape of 10-year old pines interspersed with strips and islands of remnant eucalypt woodland. They are actually more abundant in this radically modified landscape than in the natural eucalypt woodlands outside the plantations.

In fact, Lindenmayer and his small team of co-workers from of the ANU's Centre for Resource and Environment Studies (CRES) have recorded more than 100 native bird species, along with numerous frogs and reptiles inhabiting the pine-eucalypt mosaic landscapes.

A friend and mentor, former CRES director Professor Henry Nix, once told Lindenmayer the only certain thing about the Australian environment was its uncertainty.

Lindenmayer has established the truth of Nix's observation during two decades of field research into

the habits and habitats of native animals – mammals, birds, reptiles and frogs – in human-altered and natural environments in south-eastern Australia.

Popular conservation in Australia is centred on preserving pristine environments like rainforest and old-growth forest, as much for their aesthetic appeal as their biodiversity. Almost by default, human activity is regarded as incompatible with wildlife conservation. Lindenmayer's surprising findings challenge these beliefs – he has found that some native animals actually flourish in disturbed environments, whether the disturbance is natural or human-induced.

He says the problem with current conservation philosophy and practice is that the ecosystems that have suffered most from human disturbance – woodlands, heathlands and grasslands – still harbour much of Australia's biodiversity, including many rare or endangered species. But, they're not accorded high conservation priority because they're not pristine, or lack the high aesthetic appeal of forested landscapes.

Lindenmayer believes such attitudes must change. 'To my mind, some of Australia's rusted-on conservationists need to mature their thinking and philosophy,

to incorporate conservation in areas that are neither wilderness or reserves.'

He believes it is essential to conserve endangered species wherever they are found, in pristine or degraded environments, even if humans must intervene to create favourable habitat. His own research has shown that human preconceptions of what constitutes 'favourable habitat' do not always coincide with animals' habitat preferences in the real world.

'You always get ecological surprises when you alter the landscape, he said.

'While you need pristine environments for some species, there are many elements to biodiversity, and some species don't do well in large, undisturbed wilderness areas.'

In pre-European times, fires sparked by lightning, or set by Indigenous hunters, created a complex mosaic of multi-aged woodland and forest that sustained complex communities of plants and animals. Since European settlement, fire suppression and the mass-clearing of woodland and forest landscapes has led to the decline of species that thrive in 'patchy', naturally disturbed environments, because few large, continuous areas of suitable habitat remain.

Lindenmayer says some ecosystems have been decimated to the point where the future of their resident species now depends on active, enlightened human intervention. But such remedies are shunned by sections of the conservation movement that believe in conserving pristine environments, and minimising human intrusion into nature's affairs.

His vision goes beyond merely managing the natural environment – he hopes his research will yield formulae for *designing* landscapes to create favourable habitat for declining or endangered species.

'The reality is that we have to manage natural resources,' he said. 'The question is: How can we do it in smart ways, so we can conserve species, while pursuing some components of commercial production.'

As a PhD student in the early 1980s, Lindenmayer conducted a ground-breaking study of the habitat requirements of Leadbeater's possum (*Gymnobelideus leadbeateri*) in the lofty mountain ash (*Eucalyptus regnans*) forests of Victoria's Central Highlands.

Missing, believed extinct for six decades, Leadbeater's possum was rediscovered in 1961 near Marysville, in young mountain ash forest regenerating after the Black Friday bushfires of 1939. The fires razed huge areas of old-growth forest, leaving many old, unburnt trunk stags with nesting hollows standing amid vigorously regenerating young trees with an acacia understorey – prime habitat for Leadbeater's possum.

When Lindenmayer began his survey in 1983, the possum was under threat on two fronts: the rotting stags were collapsing, and loggers were moving in to harvest the Class of '39. His original brief was to assess the impact of logging on the possum's habitat, and determine if it could be mitigated to achieve a better blend of conservation and timber production.

It evolved into much more than just a habitat study. 'I began looking at conservation reserves, wildlife corridors, logging experiments and wilderness.

'Wilderness is irrelevant to Leadbeater's possum – it thrives in forest that have been disturbed in specific ways.'

His research revealed the possum flourishes in these



David Lindenmayer

fire-disturbed landscapes, commuting from nesting hollows high in the trunks of mature mountain ash trees to feed on sap and insects in surrounding young regrowth forest with a dense understorey of acacias.

He became convinced that commercial logging and conservation could not only co-exist in the mountain ash forest, but that loggers could actually help recreate the 'edgy-patchy' habitat the endangered marsupial prefers by retaining strategic patches of mature trees with hollows, close to young forest regenerating on clear-felled coupes.

The mountain ash forest study in the Victorian highlands, which continues today, was the prototype for his trademark, large-scale, long-duration, multi-site ecological studies – he has five such experiments running concurrently in Victoria, NSW and the ACT.

The ecological research literature contains many references to small, scale studies describing how particular species respond to changes within individual habitat patches. Lindenmayer is concerned with the bigger picture: how do animal communities respond to landscape-scale disturbance and change?

He has two studies running in the pine plantations near Tumut, in southern NSW, another in the farmlands of the Riverina, and a fifth in the coastal heathlands of Jervis Bay, ACT. He works with just three full-time field staff and a statistician, shuttling between

Leadbeater's possum, once believed extinct after the devastating fires of 1939, seems to need disturbed, 'patchy' areas on the fringes of mountain ash forest.

The mosaics of native bush remnants surrounded by pine plantation forest at Tumut are surprisingly biodiverse.



David Lindenmayer



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Mountain ash coupes such as this one in Victoria's Central Highlands, may provide the sort of necessary disturbance that is key to the distributions of some native species.

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the five sites, with occasional help from volunteers from the Earthwatch Institute and the Canberra Ornithologists Group.

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Each project involves multiple, replicated sites, representative of the diversity of local environments. Some of the animals the ANU researchers are monitoring are common to multiple study locations.

Near Tumut, a major plantation forestry project on former grazing land left islands of eucalypt forest and woodland scattered through 10 000 hectares of young radiata pines. The ANU team established 166 sites to monitor changes in the abundance and diversity of mammals, birds, reptiles and frogs in the woodland patches and surrounding pine forests.

Graziers began clearing the Tumut woodlands in the mid-1800s, and the first pine plantations were established in the 1930s, so the original eucalypt-to-pine transition occurred long before the current study began.

But Lindenmayer learned that NSW Forests planned to establish a 10 000 hectare pine plantation on Nanangroe, a former grazing property with large native woodland remnants in a valley 15 km south-west of Tumut. His team set up a 132-site study in 1997, three years before planting began, and has been monitoring changes in the diversity and abundance of native vertebrates as exotic conifers begin growing where cleared and grazed paddocks once occurred.

He says while broad-scale, pure pine plantations are the biological deserts of repute, many native animals are flourishing in the Tumut landscape's mixture of young pine forests and woodland patches. Lindenmayer's team has recorded 100 native bird species. To their surprise, they found the remnant eucalypt woodland 'islands' retained most of their original animal species – albeit in

lower numbers – where ecological theory predicted a drastic loss of biodiversity.

In a parallel to the Leadbeater's possum story, the common ringtail possum (*Pseudocheirus peregrinus*) is prospering in the radically altered environment around Tumut. The possum, which occurs in all five of Lindenmayer's study landscapes, is uncommon in Victoria's wet montane forests, but thrives in the pine forests because the remnant eucalypt patches create the fragmented, 'edgy' environment it prefers.

Around Tumut, the possums nest in both the eucalypt patches and surrounding pine plantations, using pine needles to construct dreys – breeding nests – among the branches. But in the remnant eucalypt woodlands of Nanangroe, they nest in tree hollows. The warmer, drier climate at lower elevation makes it too hot to nest in the open. The possum's physiology leads it to adopt different nesting behaviours in different environments – an unexpected and exciting discovery.

Several once-abundant woodland birds including the rufous whistler (*Pachycephala rufiventris*), red-capped robin (*Petroica goodenovii*), and hooded robin (*Melanodryas cucullata*), are also flourishing in the Tumut plantations.

These species have declined markedly since farmers and graziers cleared much of south-eastern Australia's extensive box-ironbark woodlands in the late 19th and 20th centuries.

The young pines form a dense canopy, and their untrimmed lower branches provide a vital structural element – an understory – that has almost disappeared from Australia's remnant box-ironbark communities because of grazing and changed fire regimes.

The woodland islands that are surrounded by young pines are experiencing major changes in their avifauna: woodland birds are being displaced by forest-dwelling relatives like the olive whistler, golden whistler and yellow-faced honeyeater.

Meanwhile, eucalypt woodland remnants on farm-

land outside the Tumut plantations, and on properties neighbouring Nanangroe, retain a classical assemblage of woodland birds, including crested shrike tits, eastern rosellas and brown treecreepers.

‘The structure of the woodland hasn’t changed; the context has,’ Lindenmayer said. ‘The context of the woodland influences what lives there. Forest birds are moving into the eucalypt woodland islands because they perceive the landscape as a forest.’

Overseas researchers have identified similar contextual effects, but Lindenmayer believes his team is the first to observe the transformation of a woodland into a ‘virtual forest’.

Reptile diversity and numbers are changing much more slowly, and the frog assemblage is essentially unchanged. ‘Some species of frogs are very dependent on riparian areas – they don’t recognise native vegetation as habitat, and are only affected by hydrological changes,’ he said.

The recently established Riverina Restoration Study has underscored the importance of understorey vegetation as habitat for woodland birds. Without this structural refuge, noisy miners (*Manorina melanocephala*) invade and dominate remnant patches of vegetation, driving out other bird species.

The Riverina study, covering 168 sites, is investigating the ecological effects of revegetation projects on farms and grazing properties in two areas around the Murrumbidgee and Murray rivers.

The ANU researchers have established sites on ‘pigeon-paired’ farms, some with large patches of remnant vegetation, others with virtually none. Some farmers are undertaking high-intensity revegetation with eucalypts and casuarinas, with an understorey of acacias and grevilleas, while others are revegetating on a smaller scale, or not at all.

The complex experimental design, conceived by Lindenmayer’s long-time colleague, CRES biostatistician Professor Ross Cunningham, allows the ANU researchers to study the ecological effects of different combinations of remnant vegetation and revegetation.

Lindenmayer credits Cunningham with investing their field experiments with a flexibility that makes it possible to ask *post hoc* questions not envisaged when they began.

While it’s early days, Lindenmayer says it is already clear that the combination of high-intensity revegetation and woodland remnants attracts a greater number and diversity of birds than remnant vegetation alone. With the benefit of an understorey, declining woodland species like redcapped and hooded robins are on the increase.



David Lindenmayer

Woodland patches in an emerging pine system near Nanangroe, NSW.

Where mammals are concerned, common ringtail possums already seem to be responding to changes at the level of the individual farm, whereas brushtail possums (*Trichosurus vulpecula*) are more responsive to landscape-level changes.

Environment Australia recently commissioned Lindenmayer’s team to study the ecological effects of prescribed patch-burning on coastal vegetation at Jervis Bay with the aim of maintaining its rich biodiversity. They have established a complex of 112 sites in coastal heathland, woodland and remnant rainforest communities.

Each of the five large-scale studies differs in design because they address different ecological questions. ‘I’d love to say I had a grand vision 10 years ago, but the statistical tools drawing out common themes, have only recently become available,’ Lindenmayer said.

‘The really big insights will come from stitching together large-scale studies.’

‘In conservation, everyone is looking for easy, quick answers, or magic-bullet solutions. Unfortunately, there are few short-cuts. The big problem in natural resource management has always been a lack of informed scientific data to take us forward.’

‘Nature is complex, and the devil is in the detail. It makes ecological research very exciting, but also very difficult.’

‘Sometimes you get criticism from both sides. The Greens have criticised our central highlands experiment because it involves traditional logging practices like clearfelling and burning.’

‘They shouldn’t be concerned about how it looks today, because we’re trying to create a complex- multi-aged forest that will provide optimum habitat for Leadbeater’s possum and other wildlife in 20 years time. We’re trying to do something similar at Nanangroe.’

Last November a panel of Lindenmayer’s peers recognised him as Australia’s leading thinker in environmental science, in the ‘Smart 100’ awards scheme sponsored by the national news magazine *The Bulletin*.

More Information:

Lindenmayer, D.B., and Franklin, J.F. (2002) Conserving forest biodiversity: A comprehensive multiscaled approach. Island Press, Washington.

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Left: Burning off a discarded wood pile in a pine plantation.