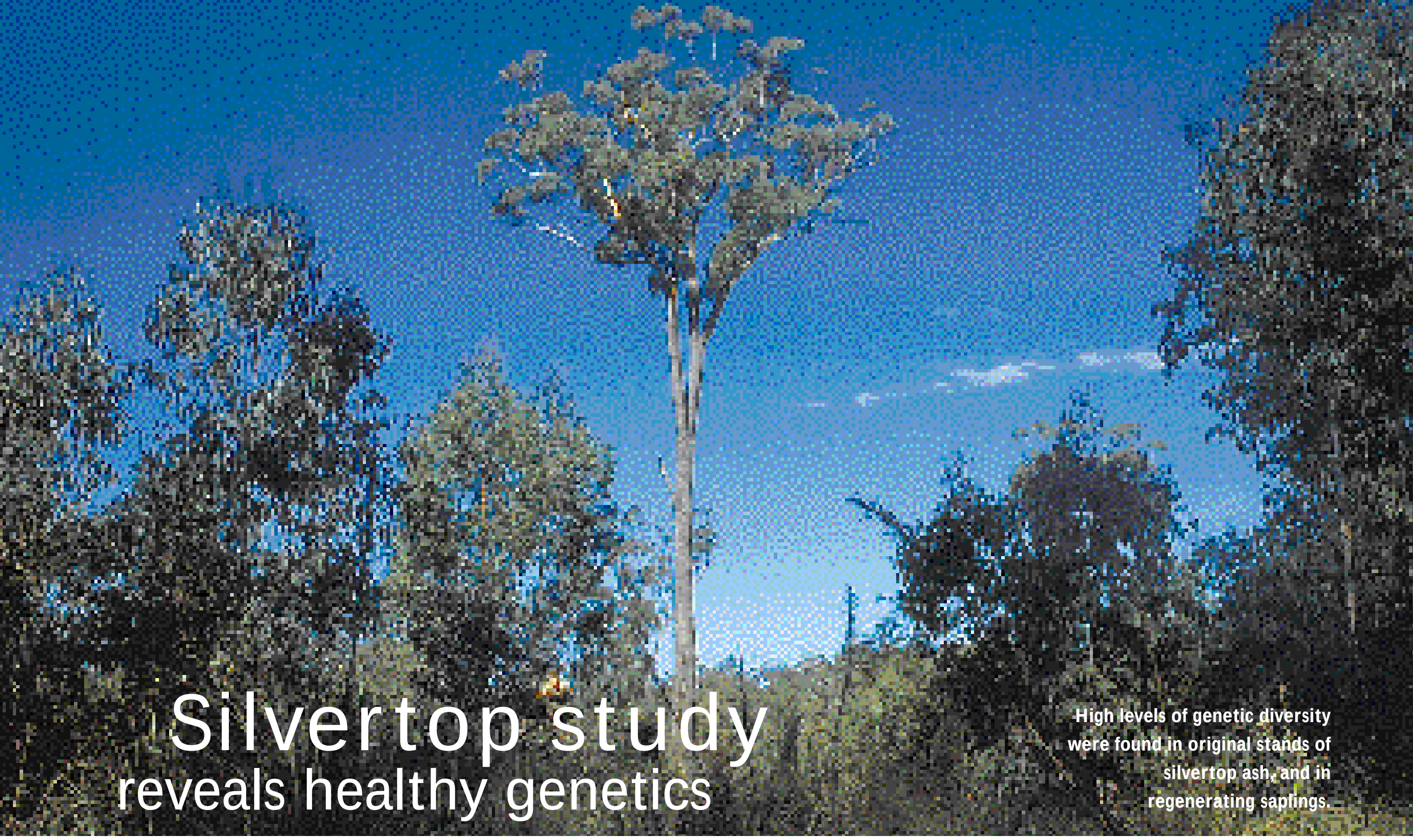

Silvertop study reveals healthy genetics

High levels of genetic diversity were found in original stands of silvertop ash, and in regenerating saplings.

For scientists studying population genetics, challenges lie not only in the laboratory, where they tangle with DNA, but also in the field, where the task of gathering genetic resources can be equally demanding.

Innovative techniques are often needed to collect DNA from native mammals. Northern hairy-nosed wombats in Queensland's Epping Forest National Park – which hate to be trapped – are cleverly monitored by collecting hairs on sticky tapes laid across burrow entrances. Enough genetic information is contained in the hair follicles to enable their individual identification.

Despite their relative immobility, members of the Plant Kingdom can also play hard to get. Just ask Dr Jeff Glaubitz, a molecular geneticist from British Columbia who is working at Canberra with Dr Gavin Moran at CSIRO Forestry and Forest Products. Glaubitz leads a project assessing whether forestry practices such as clear-felling are narrowing the genetic base of native tree species.

The three-year study is taking place near Orbost in eastern Victoria, where the Victorian Department of Natural Resources and Environment is assessing a range of forest management options in its Silvicultural Systems Project. It is part-funded by the Forest and Wood Products Research and Development Corporation.

So far the study has focussed on silvertop ash (*Eucalyptus sieberi*), the most important harvested species in low-elevation forests of East Gippsland. The silvertop ash differs from the trees Glaubitz is accustomed to. At home in British Columbia, his research centred on western red cedar (*Thuja plicata*). Although these trees soar to great heights (55 m), there are usually leafy branches not too distant from ground level.

When Glaubitz saw the forests of East Gippsland, he realised the need for a different sampling strategy. The branches of the silvertop ash, which grows as tall as 47 metres, begin way up in the crown, 20-30 m above ground.

How was he to gather leaf specimens from such a height? They couldn't be taken from the forest floor, because their tree of origin wouldn't be able to be determined.

Glaubitz could have adopted the technique of Dr Bernie Hyland, a legendary authority on tropical rainforest trees from CSIRO Plant Industry. Hyland never traipses Australia's northern jungles without a hard hat, a shanghai (slingshot) and a brush hook (long machete).

His method of procuring rare specimens of fruit and blossoms from high up in the canopy is to use his trusty slingshot to catapult a lead sinker and fishing line across a desirable branch, followed by some rope. Often two people are needed to haul down the 'captured' limb.

Instead, Glaubitz chose a method favoured by seed collectors from the Australian Tree Seed Centre: shooting them down with a rifle. Assisted by the crack skills of John Owen, Glaubitz was able to gather and catalogue samples from 225 trees in only one week (see story on page 9).

But the fun wasn't over yet. The next step for Glaubitz was to sample 600 saplings in areas of dense, forest regeneration (minus a machete). The task took three weeks, working from dawn until dusk. 'For me this was the hardest work of all,' Glaubitz says. 'It's a jungle out there. The site was logged in 1989-90 and the understorey was often incredibly thick. We had to use a compass to mark out the sampling grids.'

After a series of exhausting trips south, Glaubitz had amassed enough material to knuckle down to the next set of challenges: this time in the laboratory.

'We compared the genetic diversity of silvertop ash on unharvested control plots with that of new stands of saplings on three pairs of clear-felled sites,' he says. 'One pair was re-sown from a helicopter using seed from a small number of the original trees. The others relied on seed trees, with site preparation by either burning or mechanical disturbance.'

Leaves from 100 trees in each plot (mature trees in the controls and saplings from the harvested sites) provided the material for genetic analysis. The scientists analysed two types of DNA markers (known as RFLPs and microsatellites) to assess the trees' genetic material. Microsatellites are highly variable. One of their uses is in human 'DNA fingerprinting'.

The analysis revealed high levels of genetic diversity in both the original stands and the regenerating saplings, and no change in diversity. This led Glaubitz to the conclusion that clear-fell harvesting is not reducing genetic diversity in the silvertop ash of the south-east forests.

'If there had been a reduction in genetic diversity this might have increased the risk of losses from pest or disease outbreaks, or reduced the species' capacity to adapt to environmental changes such as global warming,' he says.

Genetic diversity can be lost when 'bottlenecks' are allowed to occur in the forest regeneration system: for example, if not enough seed trees are left when a forest coupe is harvested. Loss of genetic diversity under such circumstances will depend on the flow of pollen from trees surrounding the seed trees, and the contribution of seeds from logging slash.

Glaubitz says the high level of genetic diversity in the regenerating stands – despite the small number of seed trees and of tree sources of the seed spread from the air – is due to a range of factors.

'Pollinating bees move freely among the trees, and the trees can store a seed crop for three years after fertilisation,' he says. 'The seed shed by individual trees is therefore likely to be genetically diverse.

'In addition, the source of some saplings could be seed from logging slash and from trees bordering the felled area. This storage of seed on the tree could be an adaptation to the frequent hot bushfires which characterise this part of Australia.'

In other research still in progress, Glaubitz is seeking answers to basic questions of population genetics such as relatedness and spatial structure. In an effort to understand the tree's mating system, seeds from trees of known location are being germinated, enabling outcrossing rates to be measured. 'Using DNA markers we can track where the pollen flows and how far,' Glaubitz says. 'This has important implications for forest management.'

Further research is needed to see whether the high level of genetic diversity revealed in silvertop ash is shared with other eucalypt species – particularly locally rare species such as *E. botryoides* – and other organisms in the ecosystem. In August, Glaubitz presented his research findings to a Beijing conference on the contribution of genetics to sustained global forest resources.

Contact: Dr Jeff Glaubitz, CSIRO Forestry and Forest Products, (02) 6281 8327 fax (02) 6281 8211, email: Jeff.Glaubitz@ffp.csiro.au.

Australia advances, on video

Papua New Guinea depends heavily on its waterways – for drinking, fishing, farming and transport. But waterways in many provinces have become clogged by the South American water hyacinth, a vigorous species whose seeds can remain viable in sediments for up to 17 years.

When CSIRO scientists were asked to help, they began looking for a natural biological enemy. Surveys in South America had found several species of weevil that would eat water hyacinth, yet not harm other plant species. In fact, these weevils were so choosy, they would rather die than eat anything else.

Water hyacinth weevils lay their eggs on the stems and leaves of the weed. They hatch into grubs that munch on the inside of the stems. Then, after resting in a cocoon for several weeks, they appear as fully grown weevils to feast some more on the leaves. Over a number of seasons the plant becomes waterlogged and dies.

The story of the water hyacinth weevil, which is now munching its way across the waterways of Papua New Guinea, is featured in series one of *Australia Advances*, a collection of videos produced by CSIRO Publishing. Each video series contains eight, two-minute stories outlining a particular research achievement.

Another entomological success story is the invention of the phalloblaster, a device for inflating a moth's penis to enable its identification. This research is described on page 36, but only the video features the phalloblaster in action!

A number of advances in health-related research are featured in the videos. They include the manufacture of isolutrol, a compound found in the gall bladder of sharks that helps to prevent acne, a skin polar probe for melanoma detection, investigations into the bat lyssavirus, and the use of whey as a high-protein fat substitute in cold meat products.

Other stories cover the development of a personal air pollution meter, immuno-contraception for foxes and other feral pests, recycling phone books into a waterproof timber substitute and the use of carbon dioxide by blue-green algae.

The *Australia Advances* video series, and transcripts, can be viewed on the World Wide Web at www.ozadvances.csiro.au. They are also being shown on television networks throughout Australia.

Executive producer, Nick Pitsas, says the videos are useful for showing examples of science at work to late primary and secondary students. He says a new series will be added to the collection every couple of months, with series three and four available in November.

Series one and two are available together on VHS videos from CSIRO Publishing for $39.95 plus $8 postage, free call 1800 645 051, email: sales@publish.csiro.au.

The water hyacinth, a voracious invader foiled by biological control.