Gene loss and climate change

A recipe for extinction?

Many uncertainties surround the timing, magnitude and patterns of climate change. Because these factors influence pressures such as habitat loss and fragmentation, the impact of climate change on Australia's wildlife is difficult to predict. It is safe to assume, however, that as global temperatures rise, the climatic conditions favoured by a species will shift to higher altitudes and latitudes.

Such changes are likely to contract the habitats of many of Australia's endangered vertebrates. When habitats shrink, populations decline and lose genetic diversity. Species most at risk will be those with small populations, slow growth rates and poor dispersal abilities. In some instances, the presence of cities and cleared land will put potential new habitats out of reach.

Sharing the list of Australia's 10 vertebrates most threatened by climate change are two birds, a snake, a fish and six mammals (see table). Probably the best known of these is the northern hairy-nosed wombat, a species whose reproductive rate is slow, particularly in adverse conditions. The wombat exists as a single colony of about 65 individuals, occupying some 300 hectares of the 3000 ha Epping Forest National Park in central Queensland. The park was fenced off from cattle in the early 1980s.

Efforts to save the northern hairy-nosed wombat (*Lasiorhinus krefftii*) rely on finding out as much as possible about the species, as a basis for its conservation management. For biologists, this is a test of persistence and ingenuity, because the wombat is reluctant to share its secrets.

Much of what is known about the movements and demography of the wombat population is based on trapping, blood sampling and radio tracking studies by Queensland's Department of Environment (QDoE). But these techniques are not ideal, because the females in particular are trap shy. Thus trapping surveys are likely to record a disproportionately high number of males. The biologists also wanted to avoid sedating and handling the animals, which can weigh up to 40 kilograms.

Dr Andrea Taylor holds one of only 65 remaining northern hairy-nosed wombats. Studies by Taylor and her colleagues have found that the wombat has experienced a significant decline in of genetic diversity as a result of habitat loss and degradation.

What they needed was a way of monitoring the wombats without having to catch, sedate and handle them. And with a cunning yet simple surveillance technique, combined with the wombat equivalent of 'DNA fingerprinting', the solution appears to have been found. It involves collecting hair samples on raised tapes laid across the

The wombats must be sedated before being handled and blood sampled. The task is performed here by Dr Andrea Taylor and Cindy McLaughlin.

An innovative new monitoring system involves collecting wombat hairs on tapes laid across the burrow entrances. Individual wombats can then be identified from the genetic information contained in the hair follicles.

entrances to the wombats' burrows. The hair follicles contain sufficient genetic information to enable individual wombats to be identified.

Dr Andrea Taylor assessed the hair-sampling technique during her PhD research at the University of New South Wales into the loss of genetic variation among the northern hairy-nosed wombats. 'By continually hair sampling the population we can find out where individuals are moving to,' Taylor says. 'The effect is similar to that achieved by radio tracking, but also includes information about population numbers.'

Studies by Taylor and her colleagues have found that, unlike the more abundant southern hairy-nosed wombat (*L. latifrons*), the northern hairy-nosed wombat has experienced a significant decline in genetic diversity as a result of habitat loss and degradation. The wombat's plight is outlined in the recently-released Department of Environment, Sport and Territories report, *Australia: State of the Environment 1996*, as an example of genetic drift. This occurs in small populations when too few offspring are born in each generation to carry all of the genetic variability of the parent population.

This loss of genetic diversity is likely to reduce the wombat's capacity to resist pressures such as drought, disease and climate change. Another danger is the possibility of inbreeding, leading to fewer, less vigorous young. It is difficult to assess whether this is occurring at Epping Forest, because so little is known about the species' normal reproduction.

Learning more about the ages and relationships of the wombat population will depend on the long-term continuation of the hair-sampling program, which is coordinated by a 'recovery team' led by Dr Alan Horsup of QDoH. The hair samples are analysed in Bill Sherwin's laboratory at the University of NSW, and the animal's feeding ecology is being studied by PhD student Andrew Woolnough at James Cook University.

Taylor, who now works at Macquarie University, is studying the genetic diversity in New Zealand of three vulnerable Australian marsupials: the parma wallaby, tammar wallaby and brush-tailed rock wallaby. It is thought that the New Zealand populations may contain unique genetic diversity which has been lost from Australia through population extinction. It is possible that their genes could be reintroduced to boost the inevitably declining diversity of local populations.

For the wombats of Epping Forest, however, genetic variability can only be regained through the long-term process of random mutation. Careful management may overcome some of the problems associated with inbreeding and genetic drift, but the wombat's ability to survive a habitat shift is poor. Climate change may be the pressure that drives the northern hairy-nosed wombat, and other vertebrate species, to extinction.

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• A feature on *Australia: State of the Environment 1996* starts on page 11.

Feral cats represent one of many threats to the survival of the northern hairy-nosed wombat. This one is held by Alan Horsup from Queensland's Department of Environment, leader of the northern hairy-nosed wombat 'recovery team'. Behind him is a wombat trap, part of a traditional system used to study the wombat colony at Epping Forest National Park.

Ten vertebrate species most threatened by climate change

Species	Vertebrate order	Loss of core climate area (%)
Kowari *(Dasyuroides byrnei)*	Mammal	99.6–100
Red-tailed phascogale *(Phascogale calura)*	Mammal	99.4–100
Central rock-rat *(Zyzomys pedunculatus)*	Mammal	94.0–100
Forty-spotted pardalote *(Pardalotus quadragintus)*	Bird	86.0–100
Swan galaxias *(Galaxias fontanus)*	Fish	81.8–100
Dusky hopping-mouse *(Notomys fuscus)*	Mammal	78.9–100
Heath rat *(Pseudomys shortridgei)*	Mammal	71.7–100
Broad-headed snake *(Hoplocephalus bungaroides)*	Reptile	65.1–98.9
Northern hairy-nosed wombat *(Lasiorhinus krefftii)*	Mammal	59.4–100
Carpentaria grass wren *(Amytornis dorotheae)*	Bird	51.6–100

Climate change due to increasing greenhouse gases is a potential threatening process to Australia's biodiversity. Some vertebrate species may be driven to extinction due to loss of core habitat.

Source: *Australia: State of the Environment 1996*, after Dexter *et al.*, 1995