Australia after rabbits

Peter Sandell, Parks Victoria

The crash in rabbit numbers across Australia is giving cause for cautious optimism as pastoralists and researchers work to keep the populations pinned down.

Steve Davidson reports on whether the land is bouncing back in the wake of rabbit haemorrhagic disease.

SINCE ITS ESCAPE from Wardang Island, South Australia, in 1995 and subsequent deliberate releases, rabbit haemorrhagic disease (RHD) has spread to every Australian state and territory.

The virus responsible, a calicivirus, has caused massive mortalities to the rabbit populations that have plagued the countryside and affected ecosystems since their introduction for sport by English pastoralists in 1859. With the crash in numbers then, what early impact has RHD had on native flora and fauna, and on our agriculture?

'The greatest benefits from RHD seem to have occurred in inland Australia where the disease has had the greatest effect on rabbit numbers,' says Dr Brian Cooke of CSIRO Sustainable Ecosystems.

A review of RHD impacts by Cooke and Professor Frank Fenner, of the John Curtin School of Medical Research, found that most RHD studies reported impressive initial declines of rabbit numbers, especially in arid and semi-arid regions.

For example, in the Flinders Ranges of South Australia, rabbit numbers recorded at Gum Creek station and the adjoining National Park have remained below 15% of pre-RHD levels. At the other extreme, introductions of the virus into Tasmania have produced little observable effect despite an occasional outbreak. The initial impact of RHD in Australia certainly decreased as it spread from the arid zone to wetter regions.

The present pattern of disease outbreaks is complex. Most older rabbits are now immune and each year the disease can only break out among young rabbits produced during the breeding season. However, these young rabbits have age-specific resistance for the first five to six weeks of life and they also gain protection from maternal antibodies, acquired across the placenta, until about 13 weeks of age.

This means that the virus usually begins to spread late in the breeding season, although it may be suppressed by hot summer weather and reappear in susceptible rabbits during autumn. Because of this, in cooler areas and in regions where summer rainfall is frequent, RHD outbreaks typically occur in late spring and summer. In hotter inland areas, however, outbreaks generally begin in autumn or winter when rabbits there start breeding.

High impact on feral predators

Across vast areas of semi-arid Australia, the rabbit is the primary prey of feral cats and foxes. There has been concern that declines in rabbit numbers, as RHD takes its toll, could lead to increased predation pressure on native fauna if foxes and cats turn to native animals for food.

Dr Chris Holden, of National Parks and Wildlife SA, and Greg Mutze looked at how RHD-induced rabbit decline in the Flinders Ranges region affected foxes and cats. They found that the advent of RHD reduced rabbit numbers there by 85%, and this led to substantial declines in abundance of the introduced predators within 6–10 months.

Both cats and foxes suffered as rabbits became scarcer, but in somewhat different ways.

The diet of foxes consisted of much less rabbit and more invertebrates and carrion after RHD. Before the

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As rabbits declined, feral cats in the Flinders Ranges changed their diet relatively little, but their physical condition deteriorated, and many either died or did not breed successfully.

Bill Gemmell

Far right: Fox numbers have fallen as rabbits become harder to find. These foxes were shot as part of an earlier, unsuccessful, project to eradicate feral pests from South Australia's Narrung Peninsula.

disease, rabbits were present in 63% of fox stomachs, while after RHD this fell to less than 16% at all times.

Although the fox is flexible in terms of prey and they maintained physical condition after RHD, low rabbit numbers, especially during the rabbit's breeding season, seem to have curbed fox recruitment and numbers have fallen.

Apart from consuming rabbits less often, the Flinders cats changed their diet relatively little as rabbits declined. In the face of rabbit scarcity, invertebrates such as grasshoppers, locusts and centipedes were taken more often, but cat predation on reptiles, birds and small mammals did not increase.

But the physical condition of cats did deteriorate. Three years after RHD, cats weighed 17% less for a given body length. Many cats either died or did not breed successfully due to poor nutrition.

Reassuringly, Holden and Mutze say that because of the negative impacts of rabbit decline on foxes and feral cats due to RHD, we do not need to be too concerned that these supremely efficient predators will decimate native animals as rabbits succumb to the disease. In fact, they conclude that, at least in the Flinders Ranges, total predation on native fauna by foxes and cats has decreased since RHD arrived.

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It seems that the worst fears of some – that RHD would be bad news for native fauna – have not been realised. Other authors have reached similar conclusions. One study showed that at Roxby Downs, where RHD reduced rabbits to 3% of their former numbers, cat sightings fell by 70% and previously abundant foxes were rarely seen.

Here cats did roughly double the number of native prey items (lizards, small marsupials and birds) they ate, but this was offset by the fact that less than half the original cats were present. Meanwhile, vegetation benefited from the reduction in rabbits.

Nevertheless, the spread of RHD has not inevitably led to reduced numbers of cats and foxes and an increase in native fauna. One study reported no significant change in small mammal populations in central Australia following the spread of RHD.

Native vegetation struggles back

Cooke and Fenner's overview of RHD studies indicates significant early regeneration of native shrubs in the Flinders Ranges of South Australia, in areas where regular outbreaks of the disease had occurred.

As part of the National RHD Monitoring and Surveillance Program, Peter Sandell of Parks Victoria has also been investigating the effects of RHD on semi-arid woodland communities in the Mallee region of north-west Victoria.

This region has been grazed by livestock since the 1860s, and by rabbits since the 1870s. Major rabbit-control works began on the declaration of two national parks there in 1980 and 1991, reducing rabbit spotlight counts from up to 50 rabbits a kilometre to 2–8 a kilometre.

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The spinifex hopping mouse, (*Notomys alexis*). It seems that the worst fears of some – that RHD would be bad news for native fauna – have not been realised.

After the arrival of RHD in 1996, spotlight counts again dropped dramatically and have remained below 0.5 rabbits per spotlighting kilometre.

Unfortunately, initial recovery of the woodlands has not been so dramatic, but there are some positive signs.

Sandell and his colleagues recorded increased persistence of vegetative regrowth of some tree species, notably cattle bush or rosewood (*Alectryon oleifolius*). But the long-standing lack of widespread regeneration of woody perennials through germination of seedlings continues.

This is not really surprising as such regeneration is a rare or episodic event, and low rainfall during the first few years of RHD was probably not conducive to mass germination.

Reduced rabbit numbers allowed general recovery of native flora in the pasture layer, with palatable species coming back more strongly than weedy species in circumstances where kangaroo grazing wasn't too severe and cattle were excluded.

A change in the seasonality of peak rabbit numbers, especially in arid areas, is a big part of the RHD story.

Greg Mutze, Peter Bird and colleagues at the Animal and Plant Control Commission say that – because RHD has reduced rabbit numbers mostly in spring – prospects of recovery appear to be best for short-lived annual plants that flower and set at this time of year. For example, in coastal South Australia at Coorong National Park, native orchids have increased eight-fold in the last three years.

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The quandong, a hardy native species that has long been suppressed by rabbits.

The long-standing suppression of woody perennials such as sandalwood, (pictured), by rabbits and other introduced animals, affects landscape stability.

Far right: annual plants that flower and set seed in the spring have benefited from the reduced rabbit numbers. The pink fairy orchid (pictured) is a native that has responded strongly.

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The impact of RHD on rabbit numbers at the end of summer, however, has been much less, so the news is not good for many woody perennials, such as sheoak, that take several years to grow beyond the reach of hungry rabbits.

Another obstacle to the recovery of arid and semi-arid woodlands is the ability of rabbits to prevent regeneration, even at extremely low densities.

Earlier research showed that just one or two rabbits per hectare could seek and destroy all acacia seedlings in arid-zone woodlands. Elsewhere, in coastal South Australia, just three rabbits per hectare prevented sheoak regeneration.

Worse still, recent evidence collected in the state's arid Gammon Ranges National Park, in the wake of RHD, by Dr Bob Henzell, also of the Commission, shows that half the seedlings of mulga (*Acacia aneura*) can be removed by just one or two rabbits per square kilometre.

He says the 25-year study indicates that meaningful mulga regeneration will probably only occur if we can reduce rabbit densities to just one (or less) per square kilometre: a 'big ask'. At this level of abundance, rabbits were so scarce they were never seen, and were only detectable by an occasional dung pellet.

Newly germinated mulga seedlings. Just a few rabbits per square kilometre can seek and destroy half the seedlings present.

Henzell says the long-standing suppression of mulga and other trees and shrubs – such as bullock bush, sandalwood, quandong, native honeysuckle and native apricot – by rabbits and other introduced animals, is a serious state of affairs because these woody perennials contribute more to landscape stability than short-lived, less drought-tolerant plants. They are still there during dry spells to help stabilise the soil and to provide forage for native fauna and livestock.

While some people talk of prolific shrub regeneration in the arid zone following RHD, Henzell reckons much of this regeneration is regrowth of already-established seedlings that had been browsed back to ground level by rabbits. Some may date back to the early 1970s.

Although this recovery is welcome, Henzell warns that the number of seedlings actually germinating and surviving since the arrival of RHD is relatively small, at least for highly palatable trees and shrubs. New seedlings may not do as well as older plants re-shooting with the benefit of established roots. Time will tell.

Taken together, the research findings emphasise the need for a high level of rabbit control in conservation areas and this will only prove possible through a combination of several biological and conventional control measures.

Implications for agriculture

When Glen Saunders, Barry Kay and David Choquenot, of NSW Agriculture, looked into the early effects of RHD on agricultural production in 1995–99, they found evidence that the impact has been generally positive.

Although the disease seems to vary in effectiveness from region to region, they saw that at some monitoring sites there were already benefits.

At Euchareena on the Central Tablelands of NSW, they calculated that RHD had enabled extra wool production worth $7–24 per hectare on a site previously heavily infested with rabbits.

This assumed compensatory pasture growth offsets the effects of rabbit grazing by various amounts. That is, their calculations took into account that as a pasture is grazed, it tends to grow more to compensate for the loss of shoots.

At a site near Bathurst, however, RHD had no appreciable effect on rabbit densities during the study, reflecting the patchy effect on rabbit populations in some landscapes.

Broadly speaking, Saunders and his colleagues found that land management agencies (such as Rural Lands Protection Boards in NSW) have reported improved pastoral conditions and hence pasture production since the advent of RHD. This is particularly so in the rangelands where rabbit numbers and rabbit competition with livestock were previously high.

Drought protection and reduced soil erosion are considered important consequences of the disease.

They suggest that graziers are in a much better position to cope with droughts where grazing pressure from rabbits has been reduced. Drought protection and reduced soil erosion are considered important consequences of the disease.

On the down side, the wild rabbit fur and meat trade have been adversely affected, but the long-term consequences will depend on patterns of rabbit recovery (or perhaps further decline) after the initial impact of RHD.

Conversely, rabbit farmers are likely to get a boost, albeit with the additional cost of vaccination against the virus. Both are relatively small industries.

Another possible negative impact is proliferation of woody shrubs, such as cypress pine, hop bush and sticky daisy bush, which in the past have been partly kept in check by rabbit browsing. But this control by a pest animal of native plants, often regarded as woody weeds in pastoral lands, is a complex matter and it will take time to see how it pans out.

In many parts of the country, dependence on 1080 poison for rabbit control has declined dramatically since RHD arrived. This reduces costs for farmers.

Authorities, though, urge landholders to continue using conventional rabbit control measures such as warren ripping in order to capitalise on reduced rabbit abundance.

A rabbit plague in the far north of South Australia before the advent of RHD.

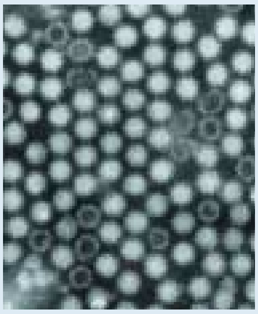
The scientists conclude that although benefits of RHD to agriculture are starting to emerge, it is unlikely that decreased rabbit abundance will lead to increased stocking rates.

For the moment, the main benefits are likely to be in sustainability of pastoral lands and ecosystem rehabilitation, rather than increased animal production. Given the extent of pastoralism across the continent, this outcome of RHD control is cause for cautious celebration.

Caution is advisable because we know from the myxomatosis experience that RHD may give us just a 10–15-year window of opportunity before rabbits again bounce back.

A mystery ailment

In 1984, an unknown rabbit disease appeared in China. In just nine months it swept through commercial and domestic rabbitries across about 50 000 square kilometres of the Republic, threatening the world's largest rabbit meat export industry.



Above: an electron microscope view of a calicivirus.

Investigators initially suspected the disease was caused by a parvovirus. It was brought under control thanks to a vaccine developed from the livers of infected rabbits. Two years later, though, a mystery disease struck domestic rabbits in Italy and soon appeared in other European countries.

At first it was thought to be due to a toxin or fall-out from the Chernobyl disaster. But by 1988, the link with the novel disease seen in Chinese rabbits was realised and research into the new viral pathogen began.

Now known as rabbit haemorrhagic disease (RHD), the affliction spread quickly. European virologists demonstrated that the disease, which can kill rabbits in days, was caused by a type of calicivirus.

Caliciviruses tend to be small and round and characterised by 32 cup-shaped surface depressions that give them an unusual appearance when viewed with an electron microscope. Their gene pool consists of a single strand of RNA.

But where did RHD come from? Scientists considered three possibilities. The virus could have jumped from hares to rabbits, since a new disease called European brown hare syndrome, (also a calicivirus), had also appeared, although this wouldn't solve the origin of the hare virus.

Alternatively, a previously harmless virus in rabbits could have changed into a disease-causing virus. Or perhaps an unknown virus from another species had transferred to the rabbit, as in the case of myxomatosis, which was obtained from South American cottontail rabbits and used to control European rabbits.

It is most likely that the new disease, RHD, in fact originated from a previously harmless calicivirus of rabbits that underwent a spontaneous change in its genetic make-up.

Fortunately, the often fatal virus has remained host-specific, to date being reported in no other species, an important quality for a biological control agent.

MORE ABOUT RHD IMPACTS:

Cooke BD and Fenner F (2002). Rabbit haemorrhagic disease and the biological control of wild rabbits, Oryctolagus cuniculus, in Australia and New Zealand. *Wildlife Research*, 29:689–706.

Holden C and Mutze G (2002). Impact of rabbit haemorrhagic disease on introduced predators in the Flinders Ranges, South Australia. *Wildlife Research*, 29: 615–626.

Sandell PR (2002). Implications of rabbit haemorrhagic disease for the short-term recovery of semi-arid woodland communities in north-west Victoria. *Wildlife Research*, 29:591–598.

Saunders G, Kay B, Mutze G and Choquenot D (2002). Observations on the impacts of rabbit haemorrhagic disease on agricultural production values in Australia. *Wildlife Research*, 29:605–613.