Vexing the Vixens

Once or twice a week, in Dryandra State Forest near Narrogin, some old wildlife magic is being recreated - thanks to a radical new way of dealing with predators.

BY JACK KINNEAR

As dusk falls, Joe and Ivy Van Den Elzen, minders of the tiny settlement at Dryandra, switch on a light and scatter some wheat at the back of their cottage. This ritual sets the scene for what is now an extraordinary wildlife spectacle - a gathering of woylies, a wildlife picnic.

When I last had the pleasure of witnessing this little spectacle, I counted up to 12 woylies busily foraging for the wheat. (The attendance record is 32.) These were noisy, tense little gatherings punctuated by hisses and grunts; but this is to be expected, for woylies are normally solitary animals with minimal social skills.

Now and then the tension is relieved as a dispute breaks out with much hissing and grunting; fur can fly and the little group may scatter into the darkness, only to reform almost immediately. The wheat is irresistible and tolerance reigns again, at least for a while.

I have seen similar evening picnics at a wildlife sanctuary in the Adelaide Hills in South Australia. There, I recognised some eastern States relatives of the woylie - the potoroo and the rufous rat-kangaroo. But emanating out of semi-darkness were also the unmistakable grunts of woylies, descendants of Western Australian woylies sent to South Australia many years ago.

None of these scenes would have been possible without one essential thing: the removal and the continued exclusion of introduced predators - the fox and the feral cat.

In the Adelaide hills predators have been excluded by constructing an electrified fence. In WA it is not practical to erect fences on the scale needed. Here, predators are excluded by an invisible fence - deadly fox baits containing of 1080 poison, periodically replenished by field officers from the Department of Conservation and Land Management (CALM).

This invisible 1080 fence works, for wherever we have done this, endangered mammals have increased. They become visible, part of the landscape once again. The strategy of erecting 1080 fences will lead to an increasing number of nature reserves and forest areas where fox numbers are reduced to a tolerable level. Within these, the predation-affected native fauna will increase.

However, fox control by baiting is only a short-lived solution; foxes are constantly ready to invade. So why bother trying? Why commit resources endlessly to a seemingly hopeless cause? There are two very good reasons. The first is that we know that when a mammal species drops out of sight, chances are it will disappear forever unless steps are taken to control introduced predators.

The second reason is that the future is not as hopeless as it would seem. Far removed from the bush, a new kind of high-tech biologist holds the key to our conservation problem. These biologists work with molecules instead of organisms; they are molecular biologists and gene engineers.

BIOLOGICAL CONTROL

Mention biological control and we think of a pest species in plague numbers. Numerically foxes do not exist at plague levels, yet they threaten Australia's unique wildlife, a national resource not yet fully appreciated.

Previous page:
What's for dinner tonight? Woylie, tammar, numbat?
Photo - R Knox

Left:
A rufous rat-kangaroo resting in its nest, which affords little protection from foxes.
Photo - Jiri Lochman

Below right:
The numbat is safe within its hollow log, but vulnerable when away from it.
Photo - Jiri Lochman

Below:
The woylie thrives when foxes are controlled.
Photo - Mogens Johansen

Right:
Forty per night; a reflection of fox abundance in Western Australia. Such numbers shot have little effect on the fox population.
Photo - Babs and Bert Wells

Below right:
When first released the myxoma virus killed 99% of the rabbit population. Rabbit numbers have been increasing since and currently myxoma virus is less than 50% effective.
Photo - Babs and Bert Wells

Biological control ('biocontrol' for brevity) traditionally involves releasing a species for the purpose of controlling another species. In biological terms, the objective is to release species capable of regulating (i.e. reducing) the population of the pest species.

In Australia, there have been some spectacular biocontrol successes. One example is the prickly pear cactus, which was imported into Australia. It quickly spread, creating an impenetrable cacti forest. Eventually, a moth from Argentina was released and it achieved control.

Spectacular and dramatic control of the rabbit in Australia was achieved by releasing the myxoma virus in 1951. Control was almost complete with the virus killing over 99 per cent of the rabbits.

Since then, however, the effectiveness of the virus as a controlling agent has declined, and rabbits are again a serious economic and ecological pest.

These dramatic results have tended to inflate the successes and to obscure the failures. The downside to biocontrol is that it is difficult to find and release, with safety, a species capable of regulating the numbers of another. Most attempts have failed.

This situation could well change as a result of advances in molecular biology and genetic engineering. Molecular biologists study processes within the cells of organisms. They are particularly interested in DNA molecules, which carry information. This provides a set of blueprints for cells to grow, to carry out some function, and to make copies of themselves.

Having learned how to read the blueprints, molecular biologists have also learned how to change the plans. They can remove genes and add them. Most importantly, they can transfer genes between different organisms, because the genetic code is universal. By adding, removing or transferring genes, we can make an organism do things to suit our purpose. Thus, molecular biologists can engineer an organism's genetic makeup.

Before we move on to apply this new kind of engineering to pest control, the only molecular biology we need to remember is that genes carry the instructions for making proteins. And further, if we put a gene into other organisms such as viruses or bacteria, they will make that protein when they divide and replicate.

REVOLUTIONARY SOLUTION

Ideally, we would like to exterminate the fox from Australia. But this is probably not possible at this stage. Failing that, we can thin out foxes to a level which permits the fauna to exist in reasonable numbers - that is, at population sizes which promote long-term survival. There are three ways to do this: increase the death rate, lower the birth rate (by making foxes infertile), or both.

The second option is best, because it is merciful as well as effective and practical. The objective is to prevent fertilisation in an unobtrusive, humane way. The method selected is ingenious: scientists propose to sterilise foxes by using a virus as a living vaccine.

Clearly, biocontrol through molecular biology is a new, revolutionary approach to the problem of a species out of control.

Fertilisation occurs when the genes carried in the sperm unite with the genes in the egg. The attachment sites consist of special proteins, chains of smaller molecules (amino acids) linked together.

Now, suppose we inject these proteins into a female fox. The immune system responds; it makes antibodies to the proteins and these antibodies bind to the proteins we injected. But in addition, and here is the trick, some antibodies detect identical proteins on the surface of the eggs in the fox's ovaries. These antibodies bind to those sites where sperm have to attach. Thus fertilisation is prevented, because the antibodies made by the fox's own immune system clog the sites.

A clever trick, but not quite clever enough. There is a flaw: we can't go about the countryside vaccinating female foxes, because they do not cooperate! What we need is a delivery system that achieves the same thing without human intervention.

Again the molecular biologists have the answer, because they can swap genes. All we have to do is find a virus which infects foxes and insert the gene with codes for the attachment site proteins into it. The engineered virus is released.

If all works well, many female foxes will not breed successfully. As time passes, we will find that the population consists mainly of adults and that the population has declined; with few cubs being born, dying adults are not being replaced. Control will have been achieved.

This new approach to biocontrol was conceived by Dr Hugh Tyndale-Biscoe, Chief Scientist with the CSIRO's Division of Wildlife and Ecology. Initially it was to be applied for the purpose of improving rabbit control, but as the impact of the fox became known from studies in WA, the fox was included. It may well be applied to other species, for example the house mouse, which periodically reaches plague numbers in eastern Australia, and the feral cat.

PROSPECTS OF SUCCESS

The task of implementing and coordinating this new approach to biocontrol is daunting. It requires scientists from many different disciplines and institutions. It also takes time and money. Initially, the only funds allocated to fox control and research in Australia

Right:
Tracking a predator: a fox fitted with a radio collar, is about to be released.
Photo - Tom Leftwich

Below:
Since the arrival of the cunning fox, the native mammal fauna have declined.
Photo - R Knox

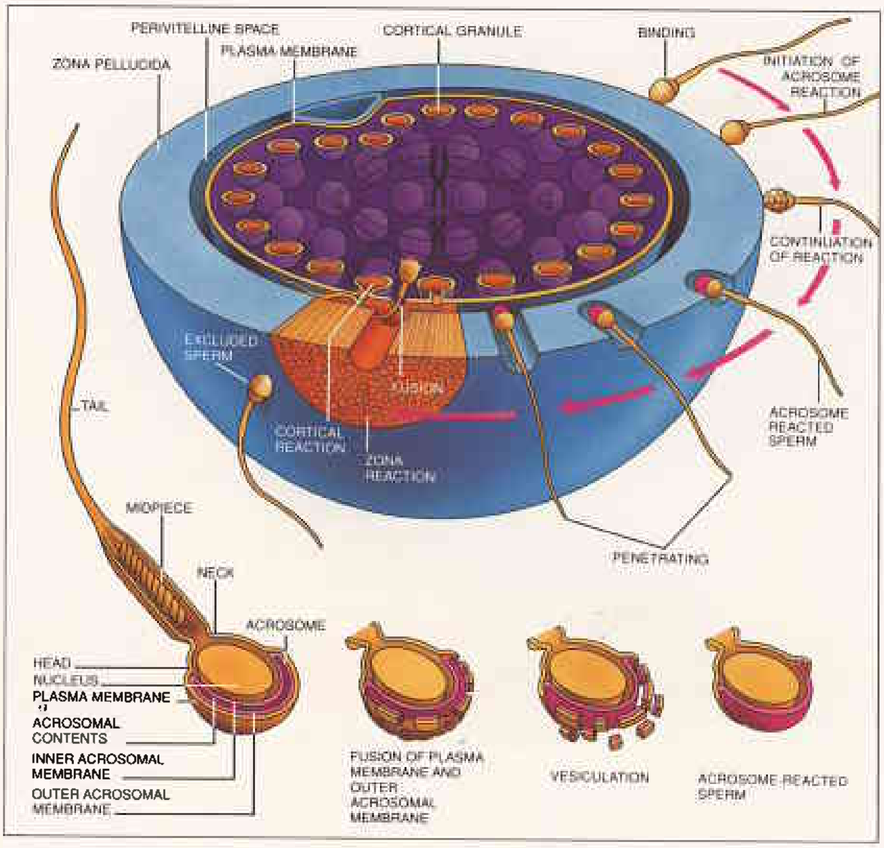
were provided by CALM and by the Endangered Species Program of the Australian National Parks and Wildlife Service (ANPWS). But because of the magnitude of the task, the Commonwealth Government announced in December 1991 that funds for a Cooperative Research Centre (CRC) had been granted for the specific purpose of developing and implementing the Tyndale-Biscoe approach to biocontrol.

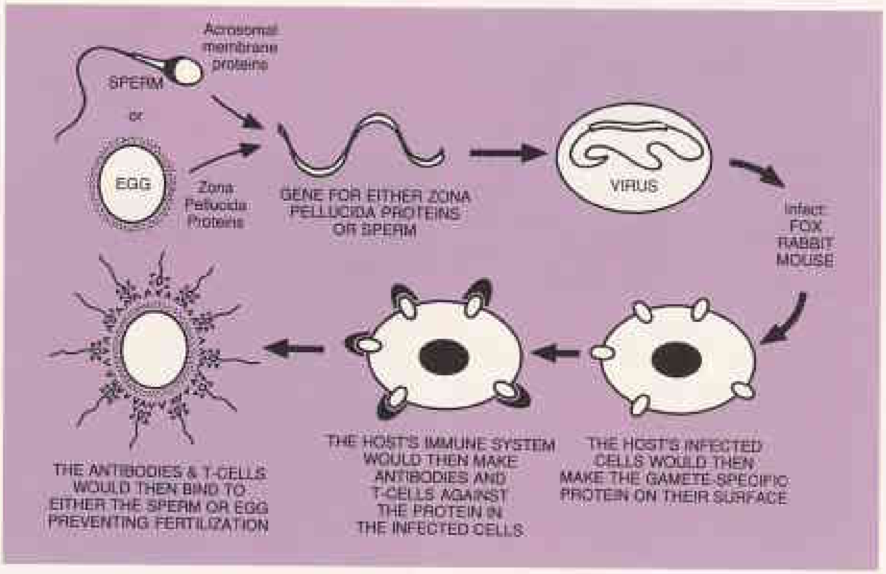
Scientists from four institutions are involved: the CSIRO Division of Wildlife and Ecology, CALM, the Australian National University, and the Agriculture Protection Board (APB). The CRC will grow as more scientific expertise is required. Special committees of experts have agreed to act in advisory roles. In addition, the CRC's educational component enables students to be trained and to carry out research for present and future benefits.

Eventually, the rabbit and fox will be brought under control. Nobody believes it will be easy. Immunologists see major problems in tricking the immune system. Given that a virus is engineered to carry the sperm attachment gene, the product of this gene (the protein to which sperm normally attach) may be ignored by the fox's immune system; that is, hardly any antibodies may be made. What we want to do is to provoke the immune system to make buckets of antibodies so that all of the sites where sperm can attach are completely coated by antibodies. It may be necessary also to engineer a 'panic gene' whose purpose is to stimulate antibody production, and insert that into the virus as well.

There are numerous other unknowns that have to be conquered. Nonetheless, there are already runs on the board. Work on the rabbit is off to a promising start, because the molecular biologists already have a virus which they can engineer - the myxoma virus that was released and produced the disease myxomatosis in rabbits. Dr Ron Jackson of the CSIRO has determined the particular DNA sequence of this virus. Moreover, he has engineered the virus, having found a site where it will be possible to insert a gene. The next step is to make and insert the gene that tricks the immune system.

Outside of the laboratory, ecologists are researching those aspects of rabbit





Top:
The sequence of events from the time a sperm binds to an egg through to fertilization. As soon as the sperm binds, the acrosomal reaction begins as it penetrates the egg. Antibodies to the protein on the zona pellucida (the outside of the egg) would block the "binding" sites of the sperm. Alternative approaches to immuno-contraception would include antibodies that attach to the acrosomal proteins (the outside of the sperm), which would also block binding, or antibodies that would attach to the tail of the sperm interfering with motility, thus preventing the sperm from swimming to the egg.

Two approaches to immuno-contraception, both working on the same principle. A gene for either the zona pellucida proteins (of the egg) or the acrosomal proteins (on the head of the sperm) is introduced into the virus. The virus infects the target, in this case a fox, which produces antibodies to the protein. These antibodies would bind to sperm or egg and prevent fertilization.

and fox biology which we need to understand to successfully engineer a controlling virus. Theoretical studies are in progress. CSIRO scientists Roger Pech and Graham Caughley have constructed models which predict the requirements and conditions that have to be met for effective biocontrol. Their models have highlighted the need to study the social system of rabbits and foxes.

HITTING THE TARGET

All genetically engineered organisms must satisfy stringent regulations and conditions before the release of such agents will be allowed. We need to establish that any engineered virus is safe and specific for the target species we seek to control, but we expect that all conditions will eventually be met.

One of the reasons for this belief is that molecular biologists have the ability to devise techniques that are highly species-specific. This ensures that only foxes are affected and not domestic dogs or dingoes. Undoubtedly, the task for meeting these requirements will be time-consuming.

CALM scientists in collaboration with research scientist Peter Thomson of the APB are committed to the fox control program. Pioneering studies on the fox by CALM, supported by ANPWS, have already laid the foundations for future work.

While the fox has been studied extensively in Europe and North America, it has been largely ignored in Australia. It is extraordinarily difficult to study, being a secretive, wary animal; anyone who works on them learns to appreciate the phrase 'as cunning as a fox'.

With so much to learn about foxes, it is easy to get side-tracked. Mathematical models based on epidemiology, which is about epidemics, are helping us focus on the important things. In releasing an engineered virus, we seek to cause an infertility epidemic among foxes.

We need to know how abundant foxes are. We need to know their life span, the size of their litters, how far the young move when they strike out on their own. Of importance is the number of times foxes meet, for this determines the likely spread of the virus through one infected fox infecting others.

When an engineered organism is released, CALM and the APB scientists will play a prominent role. If it were possible to release an engineered virus today, research carried out by CALM scientist Dr Dave Algar would provide the ways and means for assessing its effectiveness as a biocontrol agent.

BIOCONTROL BENEFITS

If we can control the rabbit and the fox, we can expect a number of benefits. There should be changes in the flora; the affected fauna would increase; re-introductions would be feasible; fauna management costs would be greatly reduced. Ecologists could address conservation problems without having to contend with the intruding species' confounding impact.

There would be tourism benefits. At present, except for kangaroos, koalas and a few other species, our unique mammals are a visual non-event because of introduced predators. Biocontrol would bring economic benefits by increasing the diversity of species available for display within their natural habitats.

But perhaps best of all, biocontrol would allow us to gather up our families and head for places like Dryandra Forest to observe a wildlife picnic, without uninvited guests. ■

A CALM scientist fitting a radio collar to a fox caught in the Gibson Desert.
Photo - Ray Smith

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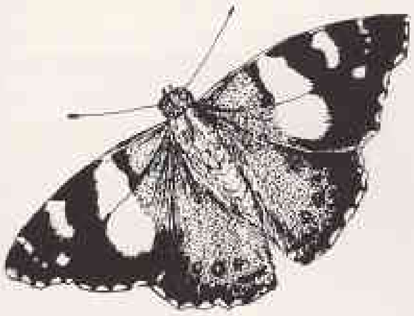
LANDSCOPE

VOLUME SEVEN NO. 4 WINTER ISSUE 1992

You don't have to go far from Perth to enjoy the peace and quiet of the bush. The forest is right on our doorstep. See page 10.

The increase of births in captivity for cockatoos seemed promising, but was it related to the upsurge in 'birdnapping' in the wild? To Catch a Thief *explains how forensic experts unravelled the mystery. See page 28.*



Painted ladies, northern admirals, southern admirals and Western Australian skippers - not the stuff of a sailor's dream, but all members of the butterfly family. See page 23.

Our native animals are prey to introduced species. While baiting gives them a fighting chance, scientists are looking for more long-term, humane solutions. See page 16.

The bilby has many names, including ninu and dalgyte. Ninu Magic *tells the story of this shy animal and its remarkable survival skills. See page 43.*

FEATURES

REGULARS

COVER

*The red-tailed black cockatoo (*Calyptorhynchus magnificus*) is one of several cockatoos native to Western Australia. These spectacular birds nest in tree hollows and can be found in the woodlands and grasslands of the south-west of Western Australia.*

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