Vandals in a Vulnerable Land

by Jack Kinnear, Dennis King and Keith Morris

When a wild species is introduced into areas where it does not naturally occur, it is known as an exotic species. When a domestic species reverts to the wild state, it becomes a feral species. When either begins to disrupt the native wildlife communities, it assumes the ecological role of a keystone species - and that can cause immense problems for wildlife managers.

Drifting sand: habitat degradation on Bernier Island caused by feral goats. Photo - Keith Morris ▲

IN May 1984, a radio message was received at the Wildlife Research Centre in Woodvale from a remote and desolate island at the northern end of Shark Bay. To the casual listener the message would have seemed curious, perhaps a little mundane; but to those experienced in wildlife management it heralded an important achievement. It announced that the last feral goat had been removed from Bernier Island.

As one Woodvale scientist recalls: "I remember thinking that maybe the wildlife is safe now, that maybe we've given them a chance to survive for a few more thousand years."

Introduced species can wreak havoc in Australian ecosystems. Bernier Island and its twin, Dorre Island, thin slivers of sand and limestone about 50 km off Carnarvon, were isolated by the rising sea about 8000 years ago. The sundering left alive only four marsupial and two native rodent species. They survived on the new islands and on the mainland, but the mainland cousins died out later after the arrival of Europeans.

The island populations were themselves threatened when sheep and domestic goats were introduced in the 1890s, and the goats became feral when the islands were abandoned a few years later. No systematic attempts were made to control goats until the 1950s, when the population was culled by shooting. From then onwards goat numbers were kept partially in check by periodic hunting forays, with support on one occasion from a group of the legendary Gurkha soldiers. To the relief of wildlife scientists, the goal was finally achieved through the use of traditional mustering methods and shooting with helicopter support.

What sort of damage had the goats done during the eighty-odd years of roaming the island? The most obvious damage was on the southern part of the island. It resembled the Sahara desert, complete with mobile sand dunes. Now perhaps a suitable habitat for camels, this part of the island was almost bereft of its vegetation.

The possible risk to the island's rare wildlife, and the damage to their habitat, are why the islands and their surviving fauna deserve a great conservation effort. Moreover, once we fully understand what

Photo - Jiri Lochman

went wrong on the mainland, it may prove possible to repopulate it using these island colonies as a source.

IMPACT

Problems caused by introducing foreign species into Australian ecosystems can sometimes be extraordinarily difficult to research. If an ecologist is asked to explain just how a feral or exotic species affects native wildlife, chances are that he or she would be hard pressed to provide specific answers. In some situations an answer may require a lifetime of research, or longer.

One thing is certain. Foreign species turn into ecological disasters when they become rampant predators of plants and animals, or when they compete with native wildlife. But while the consequences of excessive depredations are readily appreciated, the effects of competition are less familiar.

For ecologists, there are basically two kinds of competition. The first is *exploitative* competition for resources and essential things. If an introduced species wins a contest for something that a native species requires (e.g. food or shelter), the native species will decline and may even become extinct. The second kind of competition is more general, and if the competition is severe enough, the result is the same. It is known as *interference* competition, and refers to actions that affect the ability of wildlife to make a living. An example is overgrazing by goats or rabbits, which leads to erosion, soil loss and general environmental degradation. Whichever form the competition takes, it affects the birth rates or death rates of populations, or both; it may also interfere with the rearing of young.

But showing that this is what is actually happening may be a formidable task. On Bernier Island, for example, we know that the goats had reduced the southern parts to shifting sand, a classic example of interference competition. But what about the fauna? Had any species suffered an irreversible decline as the result of exploitative competition? Was there competition for food? Amazingly, the answer to these questions seems to be no. All of these precious native species are still there in reasonable abundance.

If there was competition going on, then it was not very strong - the kind of competition that is hard to detect, especially on a remote desert island. Research could take many years.

This highlights the difficulties faced by wildlife managers when they have to set priorities regarding the problems caused by introduced species. The fact that part of Bernier Island was blowing away was justification enough to remove the goats. But suppose there had not been such an obvious effect? Does one take action without such grounds?

The answer is yes. To assume that competition is not potentially damaging carries great risks. A branch of mathematics, appropriately named "catastrophe theory", warns us that things can go bad ever so slowly, but that the system can collapse quite suddenly. The possibility that feral and exotic species can be concealed time-bombs must always be borne in mind in wildlife management.

THE HERBIVORES

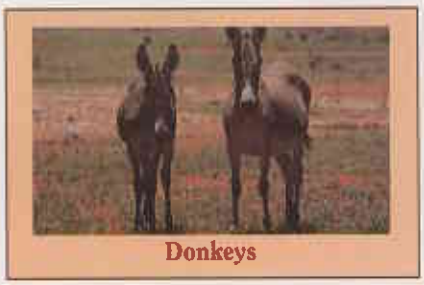
Although in some areas goats are a major problem (see box, p.48), the main imported plant-eaters are rabbits, donkeys, cattle, pigs and camels. The impact of camels has been described in *LANDSCOPE* (Summer, 1989-90).

Rabbits

Rabbits spread into Western Australia from south-eastern Australia during the late 19th and early 20th centuries and reached the limits of their current distribution by the 1930s. They now occur throughout the South-West and over most of the semi-arid regions of the State. They do not occur in the Kimberley. They even occur in the desert areas, where there is succulent food (saltbush) and shelter, such as under large granite rocks which provide sites for burrows.

Rabbits graze palatable plants, thus promoting the growth of less palatable species. Severe over-grazing can denude landscapes. The land can sometimes recover from this; the removal of rabbits from Carnac Island produced a marked recovery of the vegetation within three years. More often, however, the risk is that the damage is irreversible.

Rabbits may serve as the staple food of foxes, enabling the latter to survive in greater numbers in areas where they otherwise could not persist. The distributions of the two species in Western Australia are very similar. Foxes may have a greater impact on native prey species when rabbit numbers are low.



Donkeys

Donkeys were introduced into Australia in 1866. They were widely used as a pack or haulage animal, particularly in South Australia and Western Australia. Many were released to roam when motor vehicles became the dominant means of transport. Large feral herds formed, particularly in the Kimberley region of Western Australia, where they became widely distributed by the 1950s and 1960s. Since 1980, there has been an annual helicopter shoot in the southern part of the East Kimberley. By 1988 about 250 000 had been killed and the population, monitored by surveys conducted along aerial transects, had been reduced by an estimated 87%.

These statistics reflect how well donkeys have adapted to large areas of WA. One would expect that there is plenty of scope for interference competition, but the impact on native fauna or flora is not known.

Cattle

Beginning with the first settlers, cattle have become feral at various times throughout most of the State. In the Kimberley, feral cattle pose a threat to rainforest remnants. Undisturbed patches of rainforest escape the ravages of bush fires because they do not carry fires, but the activities of feral cattle open up rainforest patches and allow grasses to invade. The patches can then carry fire and are destroyed.

Cattle are very dependent on water and can only persist in areas with a reliable supply. They degrade the environment around natural water supplies severely, thus affecting wildlife dependent on such sites.

Feral Pigs

Feral pigs are descended from European domestic pigs which escaped or were abandoned. In northern Australia, they may come from south east Asian animals. Their distribution is patchy and discontinuous in Western Australia, where they are mostly restricted to the vicinity of watercourses and swamps. Pigs in WA are present in relatively low densities compared to eastern Australia.

Pigs eat almost anything, but their diet mainly consists of plant material. Their impact on flora and fauna is unknown; they probably consume some small fauna. Rooting of soil affects the soil fauna and reduces ground cover, and it can change the composition of some plant communities. Feral pigs are believed to spread dieback in forest areas.

THE PREDATORS

It was not very long ago that ecologists believed that predators performed a rather insignificant role in the operation of ecosystems. The effect of predators was thought to be to keep their prey alert, fit, and fleet of foot. Life was still not meant to be easy for their prey, but supposedly only the weak, the sick, and the old had to worry. The idea that predators might regulate prey numbers, or cause large population reductions or extinctions, was never taken very seriously. Instead it was believed that the balance of nature prevails, just as it does in a Walt Disney nature film.

However, modern research has revealed that in natural communities and ecosystems, predators can play an important role in how the communities are maintained. Some predators have been shown to be keystone species. Remove a keystone predator from a wildlife community and some species may become rare or extinct, while other species, previously inconspicuous, become dominant. This power to regulate natural communities has been conferred by evolutionary processes.

By removing keystone predators, ecologists have documented that profound changes can occur. Some interesting questions follow: what happens when we add a predator to an ecosystem? And what has happened in the cases of the exotic predators that have been introduced into Australian ecosytems? The answers to these questions will depend on whether a given predator has become a keystone species.

Black Rat

Rats have had a severe impact on many wildlife species throughout the world, particularly on islands. One species of rat, the black rat or ship rat, has proved to be very damaging.

The black rat was almost certainly among cargo unloaded from the First Fleet in Sydney Cove in 1788, and may have been introduced earlier to other coastal localities from shipwrecks. It is now found around most of coastal Australia, and throughout most agricultural areas. It does not penetrate the arid interior because of its high water requirements. In WA, several islands off the Pilbara and Kimberley coast also support introduced populations, primarily from careened or wrecked pearling vessels during the late 1800s. Along the north-west coast, introduced rat populations occur in the Lacepede Islands (north of Broome), Bedout Island (north of Port Hedland), several of the Montebello Islands, and those around Barrow Island.

The effect of the black rat on Australia's vegetation and wildlife has not been well documented. Elsewhere, its impact has been very severe, particularly on island faunas. Many of our islands are nature reserves and important seabird nesting sites. Black rats prey on eggs and chicks and may damage vegetation on these islands.

On the Montebello Islands, black rats were introduced in 1896 after the wreck of a schooner. The rats quickly colonised most of the islands and became such a pest for the resident pearlers that cats were introduced to control the rats. Unfortunately the cats preyed instead on the native marsupials, the golden bandicoot and spectacled hare-wallaby, both of which disappeared from the islands shortly afterwards. Even the British atomic weapons tests in 1952 and 1956 failed to eradicate either the rats or the cats.

On Middle Island just south of Barrow Island, black rats and golden bandicoots have coexisted for the last 100 years. This suggests that competition is not occurring, or that it is not very intense. The problem is perplexing. Is the rat a keystone species? Should the ecologist recommend action?

The eradication of rats and other exotic species on remote islands is often an expensive undertaking. However, the exceptional conservation values of our island nature reserves demand that this is done. An advantage is that once an exotic species has been removed, further invasion can be prevented relatively easily.

To date, the Lacepede Islands, Bedout Island, Prince, Double, Boodie and Pasco Islands (around Barrow Island) have been baited with complete success. Some islands still require rat eradication programs. The rats and cats on the Montebello Islands must also be eradicated before the spectacled hare-wallaby and golden bandicoot can be reintroduced there.

Feral Cats

Feral cats in Australia are an ecological enigma. We simply do not know what the cat is doing to the fauna or what it has done in the past. One would presume that they must be doing some damage, but the scientific facts are not available to support such a view.

There are some reasons to suspect that cats reached Australia before European settlement as shipwreck survivors, and possibly through early Asian trade links in the far north. The fact that desert Aboriginal tribes have a proper name for the cat and that they hunted cats suggests a long association. In 1896, desert explorer David Carnegie encountered Aboriginal women foraging and noted that they had killed a cat.

The diet of feral cats has been studied extensively, and it has been found that they eat a very broad range of items. When prey are not available, cats will scavenge. It is not uncommon to find cat stomachs full of insects. Feral cats kill rabbits for food, and the remains of a wide range of native mammals, birds and reptiles have been recorded from cat digestive tracts. Despite these findings, one can point to cats and wallabies coexisting quite happily in some places, or so it would seem. Rottnest Island provides an example: feral cats and quokka wallabies both thrive, as do tammar wallabies and feral cats on nearby Garden Island.

Dietary evidence incriminates feral cats as predators of native fauna, but such evidence does not help us decide if the cat has assumed a *keystone* role (performing a key role as a predator in its effect on species diversity and numbers); that is, we still do not know if feral cats threaten any native species. A great deal more research is needed of the type used on studies of fox predation.

THE KEYSTONE FOX

The Fox

Foxes were introduced into Victoria in the 1860s for sport, and native fauna has suffered ever since. It is a classic example of an introduced species with *invasive* properties. It spread rapidly,

reaching WA by the early 1900s. During the next 25 years it colonised the whole of the State except for the North Kimberley region.

As it swept through the State it left a trail of destruction, which contributed to the collapse of the mammal fauna. In its wake, scattered populations of different species survived in refuges, though they have been under siege ever since. This was never very evident, because other disturbances were going on at the same time. There were rabbit plagues, droughts, land clearing, grazing, and so on, which led to widespread habitat destruction and fragmentation.

Despite all these disturbances some recent ecological research has implicated the fox. The keystone role of the fox was demonstrated by studies involving five rock-wallaby populations persisting on isolated rocky outcrops in the central Wheatbelt. Wherever foxes were controlled, the rock wallabies increased.

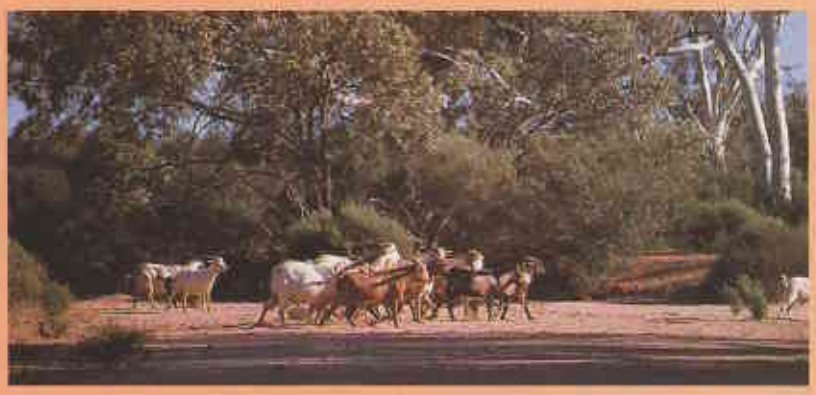
This response pattern to fox control has now been observed in six other marsupial species, all differing in lifestyle and habitat. In all cases, effective fox control has led to substantial population increases. These results confirm that the fox is a keystone species, and not surprisingly; because it did not evolve as part of any Australian community, its role has been negative and destructive.

KEYSTONE INVADERS

Many conservation problems in Australia are caused by introduced species. Such species may act as predators, competitors or pathogens (causing disease). To explain how foreign species impact on wildlife, we have introduced some ecological concepts and knowledge gained from studies on natural undisturbed ecosystems.

What has emerged is this. Foreign species which create serious conservation problems have two essential characteristics: they assume the role of a keystone species, and they are invasive.

Keystone species regulate populations; they can control numbers and affect the composition of species in a community. Native keystone species promote diversity and species richness, and some ecologists believe they foster stability. In contrast, foreign keystone species are destructive; they simplify and destabilise. If they are invasive, their impact and influence is widespread.



FERAL GOATS

Goats arrived in Australia with the First Fleet, and were widely kept by early settlers for milk, meat and fibre. Escapees or deliberately released animals have created large feral populations over most semi-arid pastoral regions in Australia. Their favourite habitat is rough, hilly country or thick scrub where there is abundant shelter, adequate surface water and an abundant supply of preferred food plants.

Goats can have a profound effect on their habitat, as a result of feeding on particular species of trees and shrubs. They are, however, less damaging than are rabbits or sheep, because of differences in feeding habits. A study by the Agriculture Department is under way near Kalgoorlie into the effect of goats on rangelands.

All of this shows that there can be *interference* competition with wildlife. There is also evidence that implies that *exploitative* competition is occurring, as both goats and rock-wallabies eat the same food plants. It is also possible that goats and rock-kangaroos compete for shelter sites such as caves.

A potential long-term impact of goats on rock-wallabies is apparent at a study site near Exmouth. Goats feed on the coastal plain and shelter in a rocky gorge, which carries a small population of rock-wallabies. A dense layer of goat droppings carpets the gorge, fertilising the rock-wallaby habitat. The food plants of rock-wallabies may thus be displaced by unpalatable plant species. This means that rock-wallabies will eventually have to forage further away from their rocky shelters, becoming more vulnerable to foxes.

It can be very difficult to identify a foreign keystone species, because its impact may be very subtle. Research generally needs to be long-term. It required 12 years of research to gather sufficient evidence to show that the fox is a keystone species.

PROSPECTS

When keystone species have a restricted distribution, eradication may be possible. CALM has successfully done this for numerous islands and the effort is continuing.

Widespread invasive species, e.g. rabbits and foxes, can only be controlled locally. Fox management programs are now operational on selected nature reserves to protect rare and endangered mammals. Reintroductions of native mammals have proved successful under fox control, and more are planned.

The cost of wide-area control is prohibitive. The only long-term solution is some form of biological control. In proposing this, we are taking into account the great advances in molecular biology and biotechnology. Research which aims to exploit these advances is in progress, with the object of bringing the rabbit and the fox under control.

A light is now beginning to glow at the end of the tunnel. With vigilance and further research, the light is going to get brighter for our wildlife.

Jack Kinnear and Keith Morris are from the CALM Wildlife Research Centre, Woodvale.
Dennis King is from the Forrestfield Laboratory, Agriculture Protection Board.

In the central Kimberley, a screw-pine-surrounded creek - just one of the threatened areas in this fragile frontier. Turn to page 22.

LANDSCOPE

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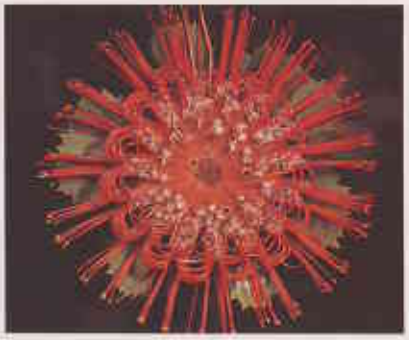

Public awareness and involvement is vital in the conservation of WA's rare and endangered flora. Page 49.

Ten WA mammal species have become extinct in the last 200 years. What can be done to ensure no more are lost forever? Page 28.

Until 1984 more was known about what was underneath the Nullarbor than what was on top. But with such a vast area to study, where do we start? See page 16.

Forests protect our environment. They also provide timber. How do we strike a balance? Turn to page 35.

FEATURES

A RANGE OF REEFS
BARRY WILSON 10

SCOUTING THE TREELESS PLAIN
NORM MCKENZIE 16

THE FRAGILE FRONTIER
CAROLYN THOMSON, CHRIS DONE AND ALLEN GROSSE .. 22

THE DISAPPEARING MAMMALS
ANDREW BURBIDGE AND TONY FRIEND 28

FORESTS FOR THE FUTURE
SYD SHEA AND ROGER UNDERWOOD 35

VANDALS IN A VULNERABLE LAND
JACK KINNEAR, DENNIS KING AND KEITH MORRIS 44

GROWING IN A WILD STATE
DAVID COATES AND NEVILLE MARCHANT 49

REGULARS

IN PERSPECTIVE 4

BUSH TELEGRAPH 6

ENDANGERED
THE BINDOON STARBUSH 21

URBAN ANTICS 54

SPECIALS

KIDS AND TREES
ARBOR DAY 1990 POSTER COMPETITION 26

COVER

Dolphins and whales are perhaps the best-known inhabitants of Western Australia's coastal waters. But this unique area is also home to an astonishing range of marine flora and fauna, from sea-turtles and coral reefs in the north to sea-grass banks and great white sharks in the south. See page 10.

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