

Managing feral animals and their impact on the rangelands



Photo courtesy of Bruce Rose



Photo © Cliff and Dawn Frith. ANTPhoto.com

Bali banteng (*Bos javanicus*)

Distribution in the rangelands

In Australia, the introduced species of cattle Bali banteng is confined to Garig Gunak Barlu National Park on Coburg Peninsula, north-east of Darwin.

Banteng numbers are rising fast. In 1978, their population was estimated at 1070. By 1985, it had risen to between 1500 and 3500, equating to a density of about 2.5 per square kilometre. Today, the population is estimated to be between 7000 and 9000.

Ecology

In South East Asia, the wild banteng is endangered, and some experts have suggested that Australia's feral population has high conservation value. However, Australia's banteng are descended from domesticated stock brought from Bali or Timor in 1849. In Bali, the banteng is the dominant domestic cow and the population is vast.

Domesticated banteng are also present in Java, Sumatra, Borneo, Sulawesi, Lombok and Timor. If these livestock were included in total population assessments, the banteng would not qualify as endangered under The World Conservation Union's criteria.

Australia's feral banteng are unquestionably domesticated livestock gone wild, with a gene pool influenced by selection for domestication. They are no more threatened than the tame banteng that pull ploughs in Indonesia's rice fields.

Impact

Banteng are causing substantial damage to Garig Gunak Barlu National Park. They are damaging foreshore dunes and altering vegetation structure. They have been observed browsing low-hanging trees, creating a distinct browse-line.

They also appear to affect lower vegetation on coastal plains and trample wetlands at the end of the dry season. They are similar enough to domesticated cattle to damage the landscape in the same ways.



Control

Banteng have long been recognised as an environmental problem. During the 1970s, their numbers increased dramatically and many were shot to reduce their impacts. In 1978, the shooting stopped and a fence was run across the Coburg Peninsula to limit their movements. They can multiply and cause damage within the fenced area, but they cannot spread.

A banteng cull is urgently required. No culling occurs at present, but big game hunters operating under licence shoot a few large bulls each year. The Traditional Owners of Garig Gunak Barlu do not want a cull because the banteng are a source of income—each trophy animal returns \$1000–\$2000 to the community.

The Northern Territory Conservation Commission has proposed a substantial cull of banteng females, which have no value to trophy hunters. Traditional Owners oppose this because they now expect to be paid for all banteng shot on their land. Only about five per cent of the banteng population is of trophy quality.

The need for a cull is especially urgent following Cyclone Ingrid's strike on the Coburg Peninsula in 2005. The cyclone stripped the park of vegetation and many banteng starved to death as a result. Culling would result in positive long-term outcomes for the Garig Gunak Barlu National Park and its Traditional Owners.

More information

Australian Government Department of the Environment and Water Resources

GPO Box 787, Canberra ACT 2601
Phone: 1800 803 772
www.environment.gov.au

Read the Invasive Animal CRC's 2005 report on managing feral animals in the rangelands at: www.invasiveanimals.com/images/pdfs/RangelandsLR.pdf



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Photo © Dave Watts. ANTPhoto.com

Camel (*Camelus dromedarius*)

Distribution in the rangelands

The feral camel is widespread in the western half of the rangelands, and numbers are rapidly increasing. Spreading through the Tanami Desert, they have been recorded as far north as Kununurra. In Western Australia, their range is expanding in the northern Goldfields, the northern Nullarbor, and, to a lesser degree, in the south Pilbara. In Queensland, camels are multiplying in numbers and spreading east in response to drought.

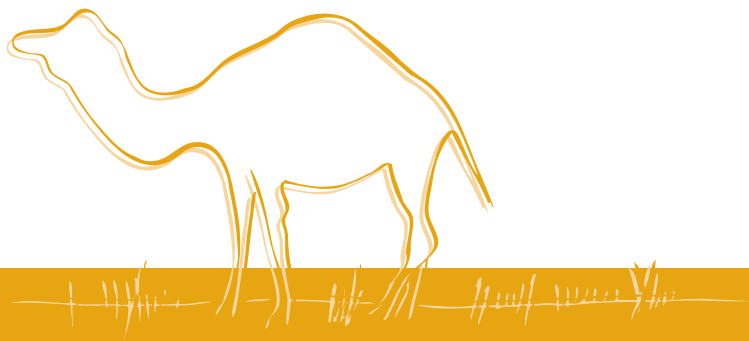
In 1969, Australia's camel population was estimated at 20 000; by 1995 it had risen to 100 000; and in 2006 it had risen further to 740 000. The Northern Territory camel population more than doubled between 1993 and 2001 and, if not controlled, could double again by 2009.

Camels degrade water supplies and alter vegetation. Multiplying rapidly, they are becoming a major threat to biodiversity in arid Australia.

Thousands of camels were imported into Australia between 1840 and 1907 to open up the arid areas of central Australia and Western Australia. For more information on their history and habits, read our Australia-wide fact sheet (see 'More information' overleaf).

Ecology

Camels are herbivores. During winter they can travel long distances from water, but in summer they need access to desert waterholes or bore drains. They will chew through plastic piping and knock over tanks, windmills, and fences to gain access to water. They can drink up to 200 litres in three minutes and have benefited from artificial water sources installed for domestic livestock.



Impact

Camels cause substantial damage to natural areas. There is strong anecdotal evidence to show that they alter vegetation by selectively browsing and removing plants.

They deplete scarce water supplies in remote deserts and they foul waterholes. They also contribute to the silting up of waterholes.

Control

Current management of feral camels focuses on culling, harvesting, and exclusion fencing. The approach is largely ad hoc and a strategic approach has yet to be developed and implemented. Given the rapid population growth of camels, land managers in the rangelands should cull or remove at least 10 per cent of the camel population on their property each year.

Managing a species like the feral camel in remote areas of the Australian rangelands presents many challenges. Extensive aerial culling over large areas of the rangelands, combined with harvesting, appears to be the only management strategy. Control needs to be intensified to reduce the expanding population. Commercial harvesting should follow the code for commercial mustering that the Standing Committee on Agriculture and Resource Management has developed (titled 'Model Code of Practice for the Welfare of Animals: The Camel').

Unfortunately, there are likely to be large expanses of country where no management occurs due to a lack of resources. These areas need supportive, enthusiastic local groups to manage the feral camel problem.

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Photo courtesy of John Baker

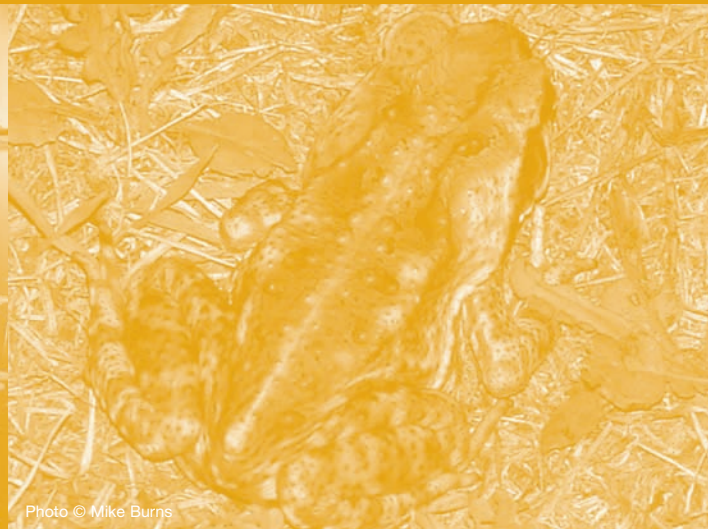


Photo © Mike Burns

Cane toad (*Bufo marinus*)

Distribution in the rangelands

The feral cane toad is increasing its spread across the rangelands. From eastern and northern Queensland, extending well inland, it entered the Northern Territory and has since reached the Top End, including Darwin and Kakadu National Park.

Still spreading in the Northern Territory, it is predicted that the cane toad will soon reach Western Australia. It is already present in New South Wales and global warming will assist its movement southward.

The cane toad is a native of South and Central America. For more information on its history and habits, read our Australia-wide fact sheet (see 'More information' overleaf).

Ecology

Cane toads occupy many habitats, such as rainforests, woodlands, grasslands, swamps, mangrove fringes, beaches, dry river beds, farmland and urban gardens. They always forage on open ground where they can see nearby movement of insects and other prey.

They dislike a thick understorey (tall grass, bracken, dense shrubs), but will forage along roads and walking tracks that pass through thick vegetation.

Although cane toads sometimes eat frogs, snakes, lizards, birds, mice, and other vertebrates, their diet mainly consists of beetles, termites, and ants.

Cane toads can produce up to 30 times more eggs than most frogs.

Impact

Cane toads are highly invasive animals that poison their predators and prey on native fauna. They also compete with native fauna for resources, such as food, shelter, and breeding sites.

Cane toads, their eggs, and their tadpoles are toxic to a wide range of predators including mammals, reptiles, frogs, fish, insects, and snails. Many animals find them distasteful and learn to avoid them, but others are fatally poisoned.

When cane toads enter a new region, deaths of their predators inevitably occur.

For example, evidence indicates that numbers of quolls, goannas, frill-necked lizards, and frog-eating snakes drop when cane toads arrive. Most of these species recover in time, but not necessarily to original levels.

Some native species are more threatened by cane toads than others. The quoll is fatally poisoned when it touches a toad with its mouth, and dramatic reductions in quoll numbers occur when toads invade quoll habitats. This has led to the disappearance of quolls from some sites.

In 2005, the Australian Government listed the northern quoll as endangered, and poisoning from cane toads was identified as the most significant threat. Monitored sites in Kakadu National Park have recorded a collapse in quoll numbers. As a result, quolls have been moved to offshore islands to protect them from cane toads.

Some snakes, including red-bellied black snakes, brown snakes, and death adders, die if they ingest toads.

Cane toad eggs and dead tadpoles prove lethal when eaten by the tadpoles of desert tree frogs, dwarf tree frogs, and ornate burrowing frogs. Where toads are very common, frog numbers may be suppressed to some degree, but native frogs do not disappear from sites when toads are present.

Eating cane toad eggs and tadpoles also poisons some species of fish, such as the fly-specked hardyhead, the banded grunter, the spangled grunter and the purple-spotted gudgeon. Other fish, including saratoga and common archerfish, are unaffected.

Toad tadpoles compete for resources with native tadpoles in small pools.

This is unlikely to lead to extinctions, but it might reduce frog numbers at some sites. It is very unlikely for any prey frog species to become rare because of toad predation at either the adult or tadpole stage.

Control

Failure to control the cane toad is due to a lack of methods that can be applied at a broad scale.

The development of biological control or a cane toad-specific toxin has some potential, but this will take some time.

Until better management tools are developed, little can be done to minimise the impact of toads. Land managers can protect their properties by collecting and humanely destroying cane toads and their eggs. Cane toad traps have been developed for use in suburban Darwin and are now on sale.

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Photo courtesy of Marc Ainsworth

Carp (*Cyprinus carpio*)

Distribution in the rangelands

The carp has become the most abundant large freshwater fish in Australia. Widely distributed throughout south-eastern Australia, it dominates fish communities in the Murray-Darling Basin and inland waterways of South Australia, including the Lake Eyre Basin.

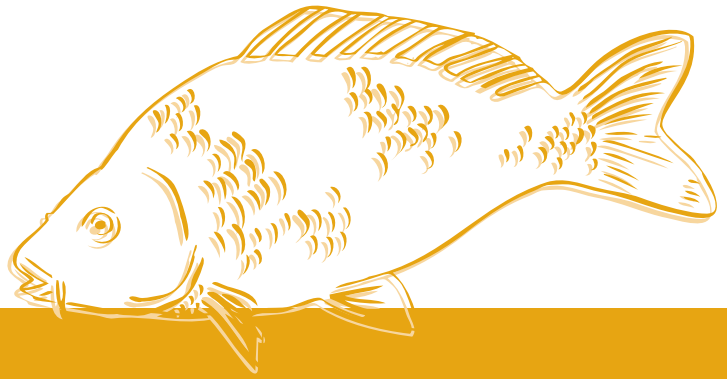
A New South Wales Fisheries survey shows that carp comprise more than 80 per cent of total fish biomass within much of the Murray-Darling Basin, and as much as 96 per cent in some regions.

The occurrence of carp in temporary or intermittent wetlands can be highly sporadic and dependent upon the drying and wetting cycle. They may spread across many more of Australia's waterways and become even more widespread.

Ecology

Carp prefer warm, still water with a silty bottom which makes it easy for them to forage for food. They feed mainly by sucking in mouthfuls of mud, silt, and aquatic vegetation from the banks and bottom of their habitat and straining out the inedible sediment with their gill rakers and muscular soft palate.

Human activities—changing river flows, increasing of nutrient run-off, and clearing streamside vegetation, for example—have led to disturbances in many inland aquatic habitats of the southern rangelands. These disturbances are ideal for carp. Their broad environmental tolerances, including the ability to thrive in highly polluted or low oxygen water, allow them to prosper in these changed habitats.



Impact

Carp are widespread throughout southern Australia where they dominate the aquatic fauna. Although perceived as the number one introduced fish threat to inland waterways, the extent of their impact is still unclear. They have been accused of reducing water quality, destroying aquatic vegetation, spreading disease and parasites, eroding stream banks, and competing with native fish for food.

By increasing the muddiness of water, carp limit the amount of light that can get through, thereby damaging many aquatic plants. Their feeding behaviour may also increase nutrient levels. Such damage can threaten endangered species and change ecosystem function.

Carp compete with native species for food and habitat space such as spawning sites. Since they spawn earlier than many native species, they may exclude smaller species from their preferred spawning areas in vegetated habitats.

The carp's diet overlaps to some degree with that of native species. Despite the strong likelihood of competition, there is currently no documented evidence of carp displacing native fish species in Australia.

Both carp and native species have the same preferred habitat—snags and areas of slow-flowing water. It is possible that large schools of adult carp force smaller, native fish from their preferred habitats.

A number of parasites and disease organisms in carp pose a risk to native species.

Control

Australia invests heavily in research and development to control carp. Currently, land managers generally rely on manually extracting, poisoning or excluding carp from areas. These methods are expensive and only effective in smaller areas.

Much of the debate about managing carp focuses on controlling the population rather than reducing the carp's impact. This focus may direct resources away from more susceptible and inherently valuable areas such as areas with threatened species or recently invaded pristine areas.

Focus on reducing the impact will prove more effective and economical in the long term. The most likely future solutions to reducing carp impacts on biodiversity are viral biological control or the 'daughterless technology' where carp only produce male offspring.

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Photo courtesy of Invasive Animals CRC

Cat (*Felis catus*)

Distribution in the rangelands

Feral cats are found throughout the rangelands, except in dense habitats such as rainforests and mangroves. They reach their highest densities in open arid environments supporting abundant small mammals (especially young rabbits) and reptiles. They are uncommon in eucalypt forests and woodlands.

Cats have been in Australia at least since European settlement, and may have arrived with Dutch shipwrecks in the 17th century. For more information on their history and habits, read our Australia-wide fact sheet (see 'More information' overleaf).

Ecology

Feral cats can multiply quickly. They have higher reproductive potential than foxes or dingoes, breeding first at 10 months old and then breeding continuously under good conditions at any time of the year. Their numbers can increase quickly after a drought break, and during rabbit and rat plagues. They can produce three litters of up to eight kittens each per year.

Unlike dingoes, feral cats do not need to drink, instead taking moisture from their prey. They will take prey weighing up to two kilograms, but their greatest impact is on smaller species.

Impact

Feral cats have an important impact on biodiversity, but the level of that impact remains uncertain and contentious. Some experts believe that cats are responsible for the extinction of many mammals and for declines in native bird populations; others disagree. The polarised opinions and lack of definitive studies preclude an accurate assessment of the impact of feral cats.

Feral cats have eliminated colonies of bilbies, burrowing bettongs, and rufous hare wallabies reintroduced to mainland sites, sometimes thwarting whole reintroduction efforts. They are blamed for the extinction of the pig-footed bandicoot, desert bandicoot, white-footed rabbit-rat, and several species of hopping mice.

The recovery plan for the endangered Julia Creek dunnart, confined to grasslands in north and central Queensland, identifies feral cats as a key threat. Further research is needed to determine whether cats pose a serious threat to the declining populations of rodents and bandicoots in northern Australia.

Feral cats are often thought to pose a serious threat to birds. Species within the rangelands that may be at risk of feral cat attacks include the mallee fowl and the night parrot.

In arid areas, feral cats eat large numbers of reptiles, but Australia's reptiles appear to be remarkably resilient to new impacts, and very few species are listed as threatened. The Great Desert skink (*Egernia kintorei*) may be threatened at some sites.

While feral cats are most likely to pose a threat as predators, they can also compete with native fauna and transmit parasites such as toxoplasmosis. Toxoplasmosis may have contributed to declines in quoll numbers. The parasite also infects bandicoots.

Control

Management of feral cats in the rangelands should focus on protecting areas and species of high conservation value. Land managers should use an integrated approach. Exclusion fencing surrounded by a buffer zone—maintained through trapping, shooting, and tracking of individual cats—should prove effective around conservation areas.

Effective population control over large areas will only be possible with the development of a toxin (which is currently being actively researched) or biological control.

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Photo courtesy of Invasive Animals CRC

Cattle (*Bos taurus*)

Distribution in the rangelands

Feral cattle are widespread in the rangelands, occurring mainly north of the Tropic of Capricorn, in national parks, and on grazing leases that are not adequately fenced. Their number and range are difficult to determine because they occur in regions that also carry domesticated cattle. The distinction between feral and domesticated cattle often blurs, because in some areas domestic cattle regularly go feral, and in other areas feral cattle are regularly mustered.

Feral cattle have been reported in the Hamersley Ranges and the Ashburton and Fortescue drainages of the Pilbara; the King Leopold Ranges of the southern Kimberley; the Gulf Country of the Northern Territory; and north-western Queensland.

Many national parks, reserves, and Indigenous-owned lands in Australia are populated with feral cattle. These cattle are most obvious when they occupy national parks and other reserves, although branded domestic cattle often feed in parks as well.

Feral cattle seriously degrade habitat, especially riparian habitats in the Kimberley region where they are the most damaging feral pest.

Ecology

Feral cattle occur in semi-desert such as the Tanami Desert, woodland, riparian forest, and rainforest.

Impact

The damaging impacts caused by domestic cattle include erosion, degradation of riparian zones, loss of palatable plants, increases in unpalatable plants, and spread of weeds. When feral cattle populations grow large or concentrate around a few watering points, they are capable of causing the same harmful impacts as domestic cattle, and more.

Feral cattle are the most damaging feral animal in the Kimberley, where they pose a serious threat to the survival of monsoon rainforest remnants. Strays from pastoral leases wander along watercourses deep into national parks, where they breed and trample fragile riparian habitats and vine thickets.



The vine thickets are a rare and highly significant habitat, representing the rainforests that once occurred widely in the region when the climate was wetter.

Cattle camp inside the thickets, damaging them by browsing and trampling. Removing all the foliage within reach, they increase light levels which helps exotic buffel grass, other weeds, and native grasses to invade rainforest edges and cattle trackways. These grasses can fuel very hot fires that kill rainforest trees.

By degrading large numbers of Kimberley rainforest patches, feral cattle pose a threat to snails, spiders, reptiles and birds. Other feral animals are scarce or non-existent in the Kimberley rainforest sites.

Overgrazing by feral cattle in Lakefield National Park on the Cape York Peninsula is degrading wetland systems, which are critical for wildlife. The cattle are difficult to control because the landscape is remote and difficult to access. The problem is compounded by the large numbers of domestic cattle grazed in the park. Many of the feral cattle are mustered under contract to nearby graziers.

Northern Queensland's Forty Mile Scrub National Park contains a dry rainforest with very high conservation value. The appearance of billygoat weed inside the dry rainforest probably ties in with damage caused by feral cattle in the park.

In Kakadu National Park, Traditional Owners value small herds of feral cattle as a meat source. The impact of these cattle on conservation values has not been assessed, but appears to be minor compared with the impact of horses and burgeoning numbers of feral buffalo.

Control

Controlling feral cattle is a complicated issue for land managers, mainly because of the sometimes blurred distinction between domestic and feral cattle.

State laws prohibit the culling of cattle unless it can be shown they are not owned by anyone—a requirement that is difficult to meet.

Feral cattle control is a problem in national parks because inadequate fencing often results in domestic cattle straying in from adjoining properties.

Land managers should ensure that their land is properly fenced. This is an effective method of controlling cattle and protecting land. For example, in Barlee Range Nature Reserve in Western Australia, a clay pan supporting sensitive vegetation was fenced against donkeys, stray cattle, and especially feral cattle. The vegetation improved dramatically once feral cattle were fenced out.

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Photo courtesy of Brian Boyle and Game Council New South Wales

Deer

Distribution in the rangelands

Australia is home to five species of feral deer.

Fallow deer (*Dama dama*) and red deer (*Cervus elaphus*) are widespread throughout south-eastern Australia, with a limited distribution in the rangelands. Herds of both species are present near Port Augusta in South Australia, in north-eastern New South Wales, in southern Queensland, and in mid-eastern Queensland near Rockhampton.

One population of sambar deer (*Cervus unicolor*) is present in the Top End of the Northern Territory.

Four or five populations of rusa deer (*Cervus timorensis*) have established in the rangelands, including one near Townsville, one west of Mackay, and one near Rockhampton.

About 13 populations of chital deer (*Axis axis*) are known to inhabit the rangelands: two near the Gulf of Carpentaria in Queensland, 10 in inland regions of north and central Queensland, and one in central-western New South Wales.

Sambar, rusa and chital deer are native to southern Asia. Red and fallow deer are native to Europe.

All five species of feral deer have the potential to spread even further and populate larger areas of the rangelands.

Ecology

Deer live in grassy forests. They like to hide in thickets and feed in glades. Their habitats include rainforest (rusa and sambar species), eucalypt forest (all species), and farmland. Grass is their preferred food, but they also eat the leaves of herbs, shrubs and trees, bark, and some fruits.

Impact

Deer cause serious environmental degradation when they reach high numbers. Where deer density is high, diversity and abundance of plant species is lower. Their increased numbers are causing problems in many parts of the rangelands.

Chital deer in the Charters Towers area cause significant damage, grazing vegetation to bare ground.



Pest plants such as rubber vine, Chinese apple, and parthenium flourish in areas where chital are not adequately controlled. Chital deer enter cropland to feed at night and damage the natural environment by rubbing their antlers against saplings.

Rusa deer cause environmental damage by overgrazing, browsing, trampling, ring-barking, dispersing weeds, creating trails, concentrating nutrients, accelerating erosion, and degrading water quality in creek and river systems. Rusa could potentially cause as much degradation in the rangelands as feral horses, donkeys, buffalo, and domestic cattle do now.

Little is known about the impacts of sambar deer in the rangelands. Closely related to the rusa deer, they are slightly larger, suggesting their impacts might be very similar, but more solitary. They eat fruit and could compete with native fruit eaters for food.

When fallow deer reach high densities, they become serious pests. They compete with kangaroos and wallabies for food, add to total grazing pressure, spread weeds, contribute to erosion, and degrade water quality. Their numbers are low now but, like other deer species, their range has expanded dramatically as a result of recent translocations and escapes from deer farms.

Little is known about the impact of red deer in the rangelands. Rutting stags in the Brisbane River catchment rub their antlers on trees and shrubs, sometimes removing the bark of saplings from ground level to two metres up the trunks. In pine plantations, they have killed saplings of up to six metres tall.

They degrade water quality, compete with native and domesticated grazers, and spread weeds. In 1995, only four populations were known in Australia, but today there are more than 65.

Control

Management strategies for feral deer are still in their infancy. A key priority must be to prevent deer escaping from farms and forming new populations or bolstering those already in the wild. This would make the eradication of small new populations achievable. Where populations are well established, containment through sustained control efforts may be a better use of resources. However, if the deer are causing socio-economic or environmental damage, eradication should be the goal.

In general, for the purpose of conservation, shooting is the most cost-effective option unless large herds can easily be trapped and transported. Trapping and mustering may be useful for small, newly established herds, but are unlikely to be suitable for long-term control of large deer populations.

Eradication of small, isolated populations before they increase should be attempted. Tighter control and greater responsibility for escapes from deer farms is also necessary.

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Photo courtesy of Invasive Animals CRC

European red fox (*Vulpes vulpes*)

Distribution in the rangelands

The feral fox, or European red fox, occurs throughout the southern half of Australia, as far north as the Great Sandy Desert; and in the Tanami Desert, the Gulf country of Queensland, and north Queensland. It is absent from Cape York Peninsula, parts of central Queensland, the Top End of the Northern Territory, and the Kimberley.

The fox is a major predator, responsible for the extinction of several marsupials and the threatened status of other species. In some situations, foxes do help to control rabbits.

The European red fox was deliberately introduced to Australia in 1855 for recreational hunting. For more information on its history and habits, read our Australia-wide fact sheet (see 'More information' overleaf).

Ecology

Foxes use a wide range of habitats, including wet and dry eucalypt forests, heathlands, alpine woodlands, farmlands and arid plains. They sleep in excavated dens beneath rocks, fallen trees and buildings, and in enlarged rabbit burrows.

Impact

The fox has plausibly been blamed for the extinction in the rangelands of the western quoll, numbat, burrowing bettong, brush-tailed bettong or woylie, desert bandicoot, and, although the evidence is limited, the red-tailed phascogale.

It is likely to have played a major role in other extinctions, such as the lesser bilby and the desert rat-kangaroo, but information is lacking because there were few observers at the time.

In the rangelands, the fox now appears to pose a major threat to the following rare and threatened species: black-footed rock-wallaby, yellow-footed rock-wallaby, brush-tailed possum, bush stone-curlew, Fitzroy River turtle and Burnett River snapping turtle.



In the Tanami Desert and south-western Queensland, the fox appears to pose a serious threat to bilbies. However, bilbies remain reasonably common in the Gibson or Great Sandy Desert despite fox predation.

The fox preys on the following threatened species, although it is not their main threat: malleefowl, plains-wanderer, little tern, and ground parrot. The fox poses a threat to the Great Desert skink by digging them out of their warrens. It also threatens the endangered Julia Creek dunnart; Bladensburg National Park is baited against foxes to protect the dunnart.

In Western Australia and Queensland, foxes prey heavily on the eggs of marine and freshwater turtles. Some marine turtle nesting sites in Queensland are baited to reduce fox predation.

Predation remains a very serious problem in Queensland for the following species: Fitzroy River turtle, Burnett River snapping turtle, flat-back turtle and green turtle. Other rare freshwater turtles, such as the endangered Gulf snapping turtle, may also be at risk.

Control

Aerial baiting of foxes has proved effective over large areas, provided the risk of bait uptake by native fauna is minimal. This method is ideal when using 1080 baits in south-western Australia, where native species have developed a natural tolerance to this poison. It is cost-effective and works well in remote or inaccessible country.

Elsewhere in Australia, native species do not exhibit 1080 tolerance, and integrated ground-baiting programs using buried baits is labour-intensive, yet very effective. All baiting campaigns require sustained efforts from land managers, who should take advantage of environmental conditions, such as droughts or floods, for maximum effectiveness.

If research into new fox-specific toxins is successful in developing a bait that can be aerially delivered, fox control throughout the rangelands will be greatly improved. Population control over vast areas will become practical.

In areas of high conservation value, costly exclusion fencing can be effective in protecting the enclosed biodiversity, especially when combined with a baited buffer zone. Foxes that breach the fence can be trapped or shot, but this will only be effective for short-term control in small areas.

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Photo courtesy of Invasive Animals CRC

Goat (*Capra hircus*)

Distribution in the rangelands

Feral goats are widespread in the rangelands, especially in arid and semi-arid regions. The numbers in some national parks are large. In one year, 50 000 feral goats were removed from Yathong National Park in New South Wales (few now remain), and, over a 10-week period, 6000 were removed from Currawinya National Park in south-west Queensland. In the Pitjantjatjara lands of north-western South Australia, Indigenous residents recently released feral goats into an area they did not formerly occupy. Dingoes are likely to eliminate these goats.

The feral goat is a damaging pest. It seriously degrades native habitats, eliminating rare plants and competing with rare native fauna. Its numbers are increasing in Western Australia and New South Wales, and probably in Queensland. Goats require more attention in temperate Western Australia and western New South Wales.

Goats arrived in Australia with the First Fleet in 1788. For more information on the history and habits of the feral goat, read our Australia-wide fact sheet (see 'More information' overleaf).

Ecology

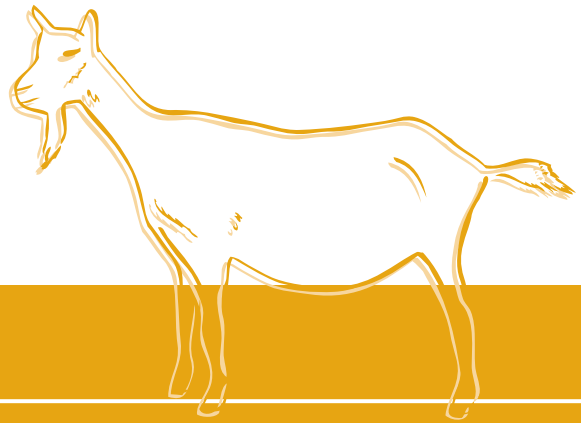
Feral goats prosper in sheep-producing, dingo-free regions. Landholders often keep feral goats on grazing lands as an alternative source of income.

Impact

Feral goats negatively impact the rangelands in three ways: they degrade habitats, eliminate rare plants, and compete with rare fauna.

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) declared competition and land degradation by feral goats a key threatening process.

Feral goats can occur at densities of up to 40 per square kilometre. In high numbers they can denude vegetation, especially on rocky slopes—a preferred habitat. By standing on their hind limbs, goats can remove foliage high on shrubs and trees. They are more damaging than sheep because their diet is very varied, incorporating grasses, herbs, shrubs, and trees.



The damage that feral goats cause includes erosion on steep hills, pollution of water supplies, and alteration of vegetation succession. Farmers in many sheep-producing regions are turning to goats as a second source of income, and this shift in land use practice is leading to widespread landscape degradation.

In north-western New South Wales, goats are widely considered the worst pest. They alter vegetation succession over wide areas by removing seedlings of favoured plants such as quandongs (*Santalum* species) and rosewood (*Alectryon oleifolius*).

Feral goat grazing poses a threat to the rare Baratta wattle (*Acacia barattensis*) and spidery wattle (*A. araneosa*), which are both confined to the goat-inhabited Flinders Ranges. Goat grazing also poses a threat to salt pipewort (*Eriocaulon carsonii*), which grows around springs in South Australia. Goats are likely to threaten other rare plants in the rangelands.

Goats compete with threatened malleefowl, and probably with rock-wallabies, for food. Goats and rock-wallabies favour similar rocky environments, and goats in high numbers compete with yellow-footed rock wallabies. They have similar diets, but goats have the advantage of being able to reach tall plants.

Control

Most feral goats in Australia live on sheep farms. Their fate, both short and long term, will be determined by how sheep farmers perceive the risks and costs or benefits of managing goats.

Eradication is the most efficient way of dealing with small colonies of feral goats, which have the potential to expand their

range into unoccupied territory. Management strategies including both aerial shooting and mustering will achieve the highest population reductions for the minimum net cost.

In inaccessible terrain, aerial shooting is the only successful control technique. Mustering, while less expensive, does not reduce goat populations to the same extent as aerial shooting. The cost effectiveness of aerial shooting depends on the price of goats at the time.

Trapping should only be used during dry times in places where access to water is controllable. The Judas technique of trapping goats (using radio-collared goats to locate groups of goats, then culling the group) is expensive and usually inappropriate, except in areas where native flora and fauna can only be protected with extremely low goat densities.

More information

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Read the Invasive Animal CRC's 2005 report on managing feral animals in the rangelands at: www.invasiveanimals.com/images/pdfs/RangelandsLR.pdf

Read our Australia-wide fact sheet on the feral goat (2004) at: www.environment.gov.au/biodiversity/invasive/publications/goat/index.html



Managing feral animals and their impact on the rangelands



Photo courtesy of Allan Fox



Photo courtesy of Territory Wildlife Park

Horse (*Equus caballus*) and donkey (*Equus asinus*)

Distribution in the rangelands

Australia has the world's largest population of feral horses, estimated at up to 600 000.

Feral horses and donkeys are widespread in the rangelands of the Northern Territory and South Australia. The Northern Territory, particularly the Gulf region and Victoria River District, is home to about 265 000 feral horses. They are also present in Kakadu National Park. Scattered herds occur in Western Australia but their numbers are low; they are scarce in the Kimberley region because they are susceptible to the poison of toxic crotalaria plants.

Scattered herds of feral horses also occur in Queensland, including in national parks such as Archer Bend, Rokeby-Croll Creek, Staaten River, Mount Elliott, White Mountains, Lakefield and Carnarvon. A serious pest, these feral horses are degrading the landscape and harming threatened mammals.

Once a major pest in northern Australia, causing erosion and defoliation, feral donkeys are now largely controlled at great cost. They are still a major problem in parts of the Northern Territory and Western Australia, where their control requires more attention.

Horses evolved in the land between Eastern Europe and Central Asia, while donkeys are native to North Africa. Horses became feral around Sydney by the 1830s. For more information on their history and habits, read our Australia-wide fact sheet (see 'More information' overleaf).

Ecology

Feral horses are best adapted to open plains, but they also use rugged country. Habitats include semi-desert plains, rocky ranges, spinifex hills, sandhill country, mulga woodland, open forest, swamps, salt plains and beaches. Horses must drink at least once a day in summer, and every second day in winter. They can increase in population by 20 per cent a year.

Feral donkeys are found mainly in hilly and rocky landscapes, especially in remote and rugged areas that people rarely visit.

Impact

Land degradation from donkeys and horses is a serious issue for the Victoria River Basin. Horses degrade landscapes and appear to compete with native mammals for food. For example, major food plants of the endangered central rock-rat are also palatable to horses.

Horses spread weed seeds in their dung and on their coats. In Kakadu National Park, mission grass infestation is a major management concern and Kakadu land managers act quickly to control infestations. Mission grass seedlings have been found in horse dung; horses may be spreading the weed into remote parts of the park where it will proliferate before it can be found.

Donkeys once occurred at very high densities (up to 10 per square kilometre) in the Kimberley region and Victoria River region of the Northern Territory, where they were blamed for extensive erosion, especially in rugged hills. Major culling operations have reduced their numbers, but they remain a major problem in the Victoria River Basin and in areas north of Katherine. Land degradation from donkeys and horses is the major environmental issue for the Victoria River Basin.

North and east of Katherine, on Jawoyn Indigenous lands, donkey numbers are very high; densities are especially worrying in the Beswick Land Trust area (397 000 hectares) and the Eva Valley Land Trust area (Manyalluk, 174 000 hectares). Here, donkeys have damaged hundreds of Indigenous art sites by sheltering under overhangs. These donkeys are also, presumably, causing biodiversity losses, and urgently need culling in these areas.

Degradation from donkeys has been noted as a key threat to the integrity of the Davenport and Murchison Ranges in the Tanami Desert region—a highly significant refuge area for biodiversity.

Control

Land managers should initially use control methods with the least financial risk, such as trapping feral horses and donkeys on the flats, before using more risky and expensive methods. Using funds from the sale of the meat, land managers could then follow up with more costly control methods, such as helicopter mustering or aerial shooting. Aerial shooting, while expensive, is the most effective control method in many areas of the rangelands due to inaccessible terrain.

More information

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Read our Australia-wide fact sheet on the feral horse and the feral donkey (2004) at: www.environment.gov.au/biodiversity/invasive/publications/horse/index.html



Managing feral animals and their impact on the rangelands



Photo courtesy of Invasive Animals CRC

Pig (*Sus scrofa*)

Distribution in the rangelands

Feral pigs are widespread in the rangelands of New South Wales and Queensland. They are also found in the top third of the Northern Territory and along some river systems in Western Australia, especially in the Kimberley. They are still spreading in the Northern Territory and have only recently reached the Arafura Swamp in Arnhem Land.

Feral pigs are damaging pests that degrade habitats, spread disease, and compete with animals for food. They prey on rare plants and animals, including the eggs of endangered turtles on Cape York Peninsula.

The pig is native to Europe, Asia and North Africa. For more information on its history and habits, read our Australia-wide fact sheet (see 'More information' overleaf).

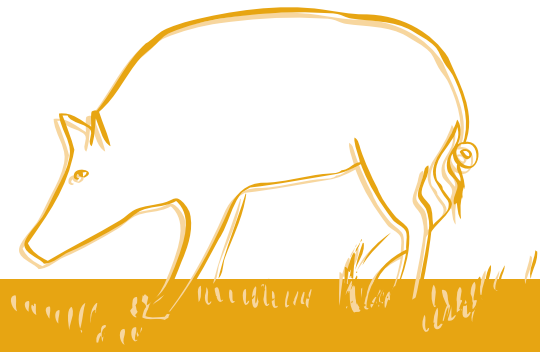
Ecology

Feral pig numbers are highest along river systems, especially those with thickly-vegetated swamps. Pigs also do well in rainforests. They cannot tolerate heat and in the hotter parts of Australia they are found only where there is deep shade and water for wallowing. They are not found in arid areas except where there are large, well-vegetated wetlands.

Impact

Feral pigs pose a major threat to biodiversity by preying on other animals, degrading habitat, competing with other animals, spreading disease and spreading weeds.

They threaten the following rare animal species: the rock-rat, the southern cassowary, the loggerhead turtle, the hawksbill turtle, the flat-back turtle, and the red-finned blue-eye. The animals of greatest concern are the olive ridley turtle and the flat-back turtle. Pigs are also a threat to the northern hairy-nosed wombat and the black-breasted button-quail.



Pigs threaten rare plants, such as salt pipewort (*Eriocaulon carsonii*) and the Darwin Palm (*Ptychosperma bleeseri*). They also spread the seeds of major weeds.

Control

As is the case for other feral animals that have a market value, the level of feral pig control varies with community attitudes and market prices.

The most effective control methods for land managers in the rangelands are aerial shooting and aerial baiting. These methods are cost-effective over a vast and remote landscape.

In more localised areas, ground-baiting and fencing are effective and, as long as there is road access, trapping can be a useful additional control tool.

Snaring is not recommended in Australia; the cost is prohibitive and it has a high impact on animals other than pigs.

Land managers may allow hunting and harvesting of feral pigs on their land, but the effectiveness is unknown.

Biological control, especially if self-disseminated, could have logistical advantages but the potential impact on the commercial pork industry would need to be understood.

Land managers should seek to maximise the benefit from environmental conditions. For example, control will be easier and more effective in times of drought when feral pigs are forced to congregate around a small number of water sources and when food is scarce.

Conversely, baiting campaigns following rain may be ineffective due to the new-growth ('green pick') available to the pigs, and shooting may be more effective.

More information

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Managing feral animals and their impact on the rangelands



Photo courtesy of Invasive Animals CRC

European wild rabbit (*Oryctolagus cuniculus*)

Distribution in the rangelands

The feral rabbit, or European wild rabbit, is widespread in the rangelands, although it is not found in the far north of the country. It is most common in New South Wales, South Australia and southern Queensland. Although it once had a large presence on the Nullabor, it is now sparse in the Western Australian rangelands.

Abundance has been greatly reduced in the rangelands by rabbit haemorrhagic disease (RHD) and myxomatosis, although numbers may be returning in some regions.

The rabbit is native to Spain and Portugal. For more information on its history and habits, read our Australia-wide fact sheet (see 'More information' overleaf).

Ecology

Rabbits favour woodlands with sandy soils in which to burrow, and range in habitat from deserts to subalpine pastures. They feed mainly on grasses and herbs, but during drought will eat the leaves and bark of shrubs and trees.

Impact

Rabbits are one of Australia's most destructive feral pests. They are responsible for massive losses of native vegetation and subsequent erosion. They destroy rare plant species, eat away protective vegetation, compete with native mammals for food and burrows, and are a source of food for foxes and feral cats.

Rabbits have transformed the vegetation over substantial areas of Australia by consistently removing mulga seedlings.

They are considered competitors of the rufous hare-wallaby, the rare yellow-footed rock wallaby, the rare MacDonnell Ranges population of brushtail possum, and the threatened malleefowl. On the Nullabor, they damage the habitat of the slender-billed thornbill, the rufous fieldwren and the striated grasswren.

RHD and myxomatosis have greatly reduced rabbit numbers throughout the rangelands, and in most regions, native vegetation is responding dramatically. Mulga is a major habitat for wildlife in arid Australia and a lack of regeneration in parts of South Australia and New South Wales

remains a serious concern. Low summer rainfall slows down the growth of mulga seedlings, leaving them vulnerable to rabbits for many years.

In western New South Wales, problems are also evident outside the mulga zone. In Kinchega National Park, few new plants are appearing, and some suckers are not surviving rabbit browsing. The situation in New South Wales is compounded by large numbers of goats and kangaroos, which also like to browse these plants.

Rabbits are an important food source for native birds of prey and for foxes and feral cats.

When RHD spread across Australia, there was concern that native birds of prey would decline dramatically, and that abundant foxes and cats, deprived of their main prey, would exact a heavy toll on rare native fauna. There have been some declines in birds of prey but not to a serious extent. Rare native species are not known to have suffered from increased fox and cat predation.

Control

Rabbit control is a contentious issue because some communities see them as a resource. Commercial shooters harvest rabbits, and some Indigenous communities use them as a food source.

Rabbits can be present at very low numbers and still have a significant impact on the environment. The relationship between rabbit density and damage is not well understood and this is a major hindrance to effective control for conservation purposes. Until we identify densities that result in acceptable levels of damage, land managers should continue

to aim for the lowest rabbit densities that current control methods can provide.

In the arid and semi-arid rangelands, broadscale ripping programs are the recommended follow-up method for controlling disease outbreak where rabbits live in warrens. Ripping is generally the most cost effective non-biological method of rabbit control, and also the longest lasting.

In areas that are difficult to rip or where rabbits do not live in warrens, land managers should use fumigation and/or strategic poisoning. In these areas, biological control offers the most cost-effective control method, especially when followed up with mechanical and chemical control methods.

To minimise costs and maximise benefits, land managers should target their efforts towards periods when rabbit numbers are lowest (e.g. during drought).

More information

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Managing feral animals and their impact on the rangelands



Photo courtesy of Allan Fox



Photo courtesy of Territory Wildlife Park

Swamp buffalo (*Bubalus bubalis*)

Distribution in the rangelands

The swamp buffalo is a large feral pest that causes massive habitat disturbance. Populations were greatly reduced in the past but are now multiplying and spreading, especially on Indigenous lands, and this is a serious cause for concern.

In the Top End of the Northern Territory, the animal can reach densities as high as 34 buffalo per square kilometre. Bulls sometimes travel as far east as Townsville, Queensland; as far west as Broome, Western Australia; and as far south as the Northern Territory's Tanami Desert. They continue to spread through parts of the Northern Territory.

The swamp buffalo is native to South East Asia. For more information on its history and habits, read our Australia-wide fact sheet (see 'More information' overleaf).

Ecology

Because of its need to drink regularly and to wallow or bathe on hot days, the swamp buffalo is mainly confined to floodplains with permanent water sources. In comparison to cattle, it is larger, more aquatic in behaviour, and more destructive in its habits.

Impact

Swamp buffalo cause massive disturbance to natural habitats when they occur in high numbers. Especially significant are the swim channels created when buffalo push their way through muddy plains. The fresh water required by aquatic plants drains away, allowing seawater to penetrate up to 35 kilometres inland. This leads to the death of large stands of paperbarks and associated wetland plants, such as lotus lilies and wild rice, a staple food of magpie geese. Levees have been bulldozed into place to stop this happening but buffalo have sometimes broken them down.

Many different plant species and habitat types are impacted by grazing and environmental damage inflicted by the swamp buffalo. Buffalo deplete stands of common reed, native hymenachne, and pandanus. Unlike cattle, buffalo pull out plants before they eat them, causing greater damage. They push over palms (*Livistona* species) and eat the crowns. By causing erosion, they kill paperbarks, Leichardt trees and bamboo.

Swamp buffalo are contributing to the massive decline in the area of pandanus thickets in northern Australia. They are also degrading monsoon rainforests, killing large trees by trampling them and by changing the water levels, and promoting invasion by weeds, such as hyptis and cassias.

Buffalo may be destroying the eggs of the pitted-shelled turtle, a large freshwater turtle with a limited distribution. They pose a threat to the endangered yellow chat of the Alligator Rivers region by destroying its habitat. Their activity may also threaten the sea-eagle, the orange-footed scrubfowl, the pheasant coucal, the white-gaped honeyeater, and the vulnerable water mouse (or false water rat).

By removing native plants and disturbing soil, buffalo spread the seeds of mimosa, hyptis and other weeds, aiding their invasion of the rangelands.

Control

Given the rising buffalo numbers in the north of Australia, management actions should be applied now to keep buffalo densities low, instead of waiting until numbers rise and the cost of control increases substantially.

Aerial culling is by far the most effective method of controlling buffalo in remote regions. In more accessible areas, land managers could muster the buffalo prior to culling and help to partially offset the control costs. The Judas technique—using radio-collared buffalo to locate groups of buffalo—could be used to help locate herds and reduce searching times for helicopters.

More information

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