The impact of cats in Australia

Cat origins

Domestic cats are descended from the African wildcat *Felis lybica*. They were domesticated in Egypt and the Middle East around 4000 years ago, and have since been extensively moved around the world by people. They now occur on all continents except Antarctica, and on many of the world’s islands.

The domestic cat’s scientific name is *Felis catus*. There have been many categorisations for domestic cats, relating to their lifestyle, or the extent to which they are socialised, owned and cared for. However, the simplest categorisation is ‘pet cat’ for cats that live in a household and are owned and cared for by people and ‘feral cat’ for everything else. Feral cats can live in our towns and cities as well as in remote areas of the Australian bush. Feral cats and pet cats are exactly the same species.

Quick Facts

National cat population:
- Pet cats - 3.8 million pet cats
- Feral cats in urban areas - 0.7 million
- Feral cats in the bush - 2.1 million (up to 5.6 million after good rain)

Cat occurrence in Australia:
- 99.9% of total land area
- 92% of total island area
- Average density of feral cats in the bush, on the mainland, is 1 cat per 3 km² but reach appreciably higher densities in arid areas and on small islands
- Densities (of feral cats and pet cats) are much higher in urban areas

In Australia every day cats kill:
- Mammals - 3.1 million (mostly native species in the bush; mostly introduced species in towns)
- Birds - 1.1 million (almost all native species)
- Reptiles - 1.8 million (almost all native species)
- Frogs – 254,620 (all native species)
- Invertebrates – 2.9 million

Average number of mammals, birds and reptiles killed per cat:
- A feral cat in the bush - 748 animals/year
- A feral cat in urban area - 449 animals/year
- A pet cat that can roam and hunt - 186 animals/year
**Cats in Australia**

Domestic cats were introduced to Australia with the First Fleet in 1788, with many subsequent introductions around the mainland and to many Australian islands. Cats spread rapidly across Australia: historical records and genetic analyses show that cats colonised the entire continent (7.7 million km²) within 70 years. Cats now occur in all habitats, from alpine areas in south-eastern Australia to the arid deserts of central Australia. They cover more of Australia and occupy more habitats than all other introduced mammals, such as foxes and rabbits. Cats also occur on nearly 100 Australian islands, including most of the largest islands. They are present on over 92% of Australia’s combined island area.

We estimate that the cat-free area in Australia comprises only around 8000 km² – about 0.1% of the Australian land mass. These cat-free areas are (small) havens for the many threatened species for which cats (and foxes) are the main cause of decline and endangerment. These havens are either islands or fenced areas on the mainland.

**Islands**

Cats never made it to some Australian islands, and cat populations that managed to establish on 25 islands were later eradicated. Over 590 islands (covering 5,539 km²) are known to be cat-free; the real number is probably much higher but most of these potentially cat-free islands are small, and would not add much in terms of total island area.

**Fenced exclosures**

Over recent decades, cats have also been eliminated from 21 fenced exclosures (covering 2377 km²) on the Australian mainland, established for the protection of predator-susceptible threatened mammal species.

**How many cats are there in Australia?**

There are 3.8 million pet cats in Australia. The feral cat population in our towns and cities is estimated at 0.7 million, but it could be as high as 2.5 million. Towns and cities support a high density of feral cats, including cat ‘colonies’ at sites such as rubbish tips and skips, or intensive farms that offer abundant food sources.

Based on extrapolation and modelling from studies which have estimated cat densities at about 100 locations spaced across Australia, the feral cat population in the bush is estimated at 2.1 million, but fluctuates between 1.4 million in dry-average years to 5.6 million after widespread and extensive rainfall events across arid Australia. These rainfall events cause rapid increases in prey populations (such as native rodents), and the cat population increases quickly in response to the resource boom. The average density of feral cats in the bush across the mainland is 0.27 cats/km², but fluctuates between 0.2 and 0.7 cats/km².

The density of feral cats is higher on islands, especially smaller islands, which often have abundant food resources for cats, including seabird colonies.

![Map of Australia showing average-dry and wet conditions](image)

*The density of feral cats in the bush fluctuates depending on weather conditions, increasing strongly after widespread rain across inland Australia. Credit: Legge, et al 2017*
What do cats eat?

Cats are carnivores, only eating meat, and mostly only from prey they have killed themselves. They take a very wide range of prey, including invertebrates, frogs, reptiles, birds and mammals. Cats eat a range of prey from small beetles to mammals almost as large as themselves (up to about 4 kg which is the size of small wallabies). Some individual cats specialise on particular prey species. Worldwide, and in Australia, mammals make up the bulk of cats’ prey, but this varies widely between sites and is influenced by the availability of prey. Virtually all cats, even well-fed pet cats, will hunt and kill wildlife if given the opportunity.

Impact of cats

Domestic cats are considered one of the most damaging invasive species worldwide, causing impacts from predation, disease transmission, hybridisation (with native wildcats, in Europe and Africa), and competition. Globally, cats are considered to have contributed to the extinction of at least two reptile, 40 bird and 21 mammal species – over one quarter (26%) of the total extinctions of these groups since the year 1600. Currently, cats are contributing to the imperilment of at least 360 threatened reptile, bird and mammal species worldwide, about half of which are species restricted to islands.

In Australia, about 34 mammal species have become extinct since European settlement – a rate of mammal extinctions far greater than anywhere else in the world. Cats have been primary contributors to about two-thirds of these extinctions. Examples include marsupials like the pig-footed bandicoot, the lesser bilby, the Nullarbor dwarf bettong, the desert rat-kangaroo and the broad-faced potoroo; and native rodents including at least four species of hopping-mice, two species of rabbit-rat, and the lesser stick-nest rat.

Cats have also been primary agents in the extinction of some Australian birds that are restricted to islands, such as the Macquarie Island parakeet and Macquarie Island buff-banded rail.
Evidence of the impact of cats

There is extensive evidence of the impact of cats on Australian native species.

Many historical mammal species extinctions corresponded to the spatial and temporal spread of cats across the continent.

Many native species (for example, the greater stick-nest rat and banded hare-wallaby) now persist only in areas that have remained cat-free (such as some islands, and the more recent fenced exclosures), and are unable to persist if cats are present.

There are also examples where species disappeared from islands after cats were introduced, but after the cats were eradicated, the same native mammal species have been successfully reintroduced to the islands (such as the western barred bandicoot and Shark Bay mouse to Faure Island in Shark Bay).

There have been many reintroduction attempts for threatened mammals on the mainland, and a key factor that determines whether an attempt is successful is whether cats are present or not.

Species that have become extinct, or whose populations have been most severely reduced, are mostly of the favoured prey size for cats, that live on the ground (rather than in trees), and that live in areas of sparser vegetation (where it is harder to escape predators).

Many studies of the biology of Australian wildlife species have documented high rates of mortality from cats.

Many studies of the diet of cats have shown that they take large numbers of many wildlife species, including highly threatened birds, mammals and reptiles.

The historic and ongoing impacts of cats on Australian wildlife are far more severe than for wildlife on any other continent. This is probably because Australian animals have evolved without cat-like predators, many Australian animals have low rates of reproduction so their viability is readily compromised by an efficient predator, and because cats are so pervasive and such adaptable hunters.

How many Australian animals do cats kill?

How estimates are calculated

We have estimated the toll of cats on native (and introduced) animal species by: (i) collating all the local and regional cat diet studies carried out in Australia (about 100 studies, which examined about 10,000 cat diet samples, and with studies collected across a wide range of Australian environments); (ii) modelling and extrapolating from these to derive a spatial layer of the variation in numbers (and types) of animals killed per cat; and (iii) multiplying this by the (spatially variable) number of feral cats in Australia. From these analyses, we can determine the numbers of different types of animals killed by cats in different parts of Australia, and then sum these to derive national tallies.

This approach relies on some assumptions: for example, that the fraction of carrion (i.e. pre-killed animals) in the cat diet is small (which is reasonable, as cats much prefer to eat freshly-killed prey); and also that the numbers of animals killed by feral cats but not eaten is also small. Information on the diets of pet cats, and feral cats living in towns, is patchier than for feral cats in the bush.

Findings

Overall, cats in Australia eat more than 2 billion reptiles, birds and mammals each year. Mammals are the most commonly eaten of these prey items, for all types of cat (pets and ferals), with more than one billion mammals killed by cats in Australia every year.

Most of the animals killed are native species. The percentage of native animals in the diet depends on whether the cat lives in the bush or in towns, and the type of animal prey. For example, nearly all of the reptiles and birds killed by feral cats in the bush are native species, whilst most mammals killed by pet cats in towns are introduced species.

This annual toll translates to 1.8 million reptiles, 1.1 million birds, and 3.1 million mammals killed every day in Australia by cats.

Most of this toll is caused by feral cats living in the bush (72%), but feral cats in towns, and pet cats, also kill large numbers of animals.

Fencing has been used successfully, to exclude cats and foxes from small areas on the mainland, into which threatened mammals can be translocated. Photo: Wandiyali Restoration Trust
The number of vertebrate animals killed per cat is highest for feral cats in the bush, at 748 animals every year. Feral cats in towns kill fewer vertebrate animals per capita (449 animals per cat per year) because intentionally or otherwise humans also provide them with some food. Individual pet cats kill fewer still, at 186 animals per cat per year. However, because feral cats in towns and pet cats live at higher densities than feral cats in the bush, their kill rates per square km are actually much higher.

Cats also kill introduced birds and mammals, especially rabbits and house mice (in southern Australia), however they rarely control populations of these introduced pests. High densities of rabbits and introduced rodents also allow cats to reach high densities, which means that even if those cats take only a small proportion of native animal species in their diet, the toll on native species will still be high. Cats will also switch prey types, so if management or weather conditions lead to rapid decline in numbers of rabbits and introduced rodents, large numbers of cats will then switch to consume mostly native animal species.

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**Summary of the population sizes of cats and their average predation rates on invertebrates, reptiles, frogs, birds and mammals, across Australia.**

<table>
<thead>
<tr>
<th></th>
<th>Feral cats in bush</th>
<th>Feral cats in towns (heavily modified environments)</th>
<th>Pet cats that roam and hunt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall population size</td>
<td>2.1 million</td>
<td>0.7 million</td>
<td>2.1 million</td>
</tr>
<tr>
<td>Area in which this type of cat lives</td>
<td>7.63 million km²</td>
<td>57,000 km²</td>
<td>29,683 to 54,201 km²</td>
</tr>
<tr>
<td>Overall take of invertebrates per year</td>
<td>769 million</td>
<td>317.3 million</td>
<td>Unable to derive an estimate</td>
</tr>
<tr>
<td>Average number of invertebrates killed per cat per year</td>
<td>371</td>
<td>453</td>
<td>Unable to derive an estimate</td>
</tr>
<tr>
<td>Average number of invertebrates killed per km² per year</td>
<td>101 invertebrates/km²/year</td>
<td>5567 invertebrates (rounding up)</td>
<td>Unable to derive an estimate</td>
</tr>
<tr>
<td>Overall take of reptiles per year</td>
<td>466 million (&gt;99% native species)</td>
<td>130 million</td>
<td>82.9 million (100% native)</td>
</tr>
<tr>
<td>Average number of reptiles killed per cat per year</td>
<td>225</td>
<td>180</td>
<td>40</td>
</tr>
<tr>
<td>Average number of reptiles killed per km² per year</td>
<td>61 reptiles/km²/yr</td>
<td>2280 reptiles/km²/yr</td>
<td>1530–2790 reptiles/km²/yr</td>
</tr>
<tr>
<td>Overall take of frogs per year</td>
<td>92 million</td>
<td>Unable to derive an estimate</td>
<td>1.01 million</td>
</tr>
<tr>
<td>Average number of frogs killed per cat per year</td>
<td>44</td>
<td>Unable to derive an estimate</td>
<td>0.48</td>
</tr>
<tr>
<td>Average number of frogs killed per km² per year</td>
<td>12 frogs/km²/year</td>
<td>Unable to derive an estimate</td>
<td>19–34 frogs/km²/year</td>
</tr>
<tr>
<td>Overall take of birds per year</td>
<td>272 million (99% native species)</td>
<td>44 million</td>
<td>118 million, (68% native)</td>
</tr>
<tr>
<td>Average number of birds killed per cat per year</td>
<td>129</td>
<td>62</td>
<td>56</td>
</tr>
<tr>
<td>Average number of birds killed per km² per year</td>
<td>36 birds/km²/year</td>
<td>772 birds/km²/year</td>
<td>2170-3960 birds/km²/yr</td>
</tr>
<tr>
<td>Overall take of mammals per year</td>
<td>815 million (56% native species, but highly variable)</td>
<td>149 million</td>
<td>189 million, (35% native)</td>
</tr>
<tr>
<td>Average number of mammals eaten per cat per year</td>
<td>393</td>
<td>207</td>
<td>90</td>
</tr>
<tr>
<td>Average number of mammals per km² per year</td>
<td>107 mammals/km²/yr</td>
<td>2610 mammals/km²/yr</td>
<td>3490–6370 mammals/km²/yr</td>
</tr>
<tr>
<td>Overall take of all vertebrate animals</td>
<td>1550 million (77% native species)</td>
<td>323 million</td>
<td>390 million, (62% native)</td>
</tr>
<tr>
<td>Average number of animals killed per cat per year</td>
<td>748</td>
<td>449</td>
<td>186</td>
</tr>
</tbody>
</table>
The patterns of cat tolls on native wildlife varies between groups and habitat types.

**Invertebrates**
- Cats frequently eat invertebrates, but these form a relatively small proportion of their diet by mass. Cats may pose a threat to some large-bodied, range-restricted invertebrate species.
- The favoured prey groups of feral cats in Australia are grasshoppers, beetles and butterflies.

**Reptiles**
- There are records of cats eating about one quarter of all Australian reptile species, including 11 species listed as nationally threatened.
- The toll of reptiles is greatest in arid areas of Australia.

**Birds**
- There are records of cats eating 30 native frog species in Australia.
- Further research is required to clarify the conservation significance of cat predation on frog populations in Australia, including on 51 threatened species.

**Mammals**
- There are records of cats eating over half of all Australian mammal species, including 50 species listed as threatened.
- The overall toll of mammals is greatest in areas with lower temperatures, in non-rocky habitats, and on the mainland and large islands (rather than small islands).
- However, the toll of native mammals is highest in northern Australia and wetter parts of eastern Australia, and lowest in southern and dry parts of Australia; the toll of introduced species (e.g. rabbits, house mice) is geographically opposite.
- The likelihood of being killed by a cat is highest for native mammals that aren’t bats, live in low rainfall areas, non-rocky areas, and/or are of intermediate size (35-5500 g, peaking around 400 g), such as mulgaras, stick-nest rats, and barred bandicoots.

The number of species preyed on by cats will be much greater than the available diet studies suggest. For example, some species have not been reported as eaten by cats because these species have small distributions and it is less likely that a cat diet study has taken place within that distribution.
**Cat-borne diseases**

As well as preying on wildlife, cats carry diseases that can affect native animals, livestock, and people.

In Australia, cats are the only primary host of the protozoan parasite *Toxoplasma gondii*, which causes the disease toxoplasmosis. This parasite (and the disease it causes) was not present in Australia prior to the introduction of cats. Toxoplasmosis causes death, debilitation or altered behaviour (that increases predation risk) of infected wildlife species (mostly mammals and birds), with its occurrence now reported in many threatened species. Toxoplasma infections in livestock can cause illness and abortions.

Humans are also susceptible to toxoplasmosis. The responses in infected people are highly variable, ranging from no symptoms, to mild flu-like symptoms, through to spontaneous abortions or foetal abnormalities in pregnant women. Toxoplasma infections may also trigger a range of mental illnesses.

Other cat-borne diseases with impacts on livestock production and/or human health include sarcosporidiosis (caused by another cat-hosted protozoan parasite called *Sarcocystis* spp.), infections from cat roundworm *Toxocara catis*, and bacterial infections from cat scratch disease *Bartonella henselae*.

**Management options**

Management options for cats vary depending on whether they are feral cats living in the bush or in towns, or whether they are pets.

**Feral cats in the bush**

Cats are difficult to control; their wariness makes them hard to trap and shoot at large scales. They prefer to hunt live prey, so the traditional poison-baiting used on dogs and foxes is often ineffective. However, Australian scientists and pest managers have made substantial headway in recent years at understanding when some control options are most effective, and also at developing new control options.

There is no one cat management approach that is easy and effective across large landscape areas, but there are many options to control cats and their impacts, and the best combination to use will depend on local conditions. Key management approaches include:

**Poison baits**: Strategically using new cat landscape-scale poison-bait options, such as the existing Eradicat baits (which have been used successfully especially in the southwest of WA) and developing new formulations including History and Curiosity baits.

**Manage introduced prey species**: Implementing landscape-scale control for introduced prey (e.g. rabbits), to try to reduce cat density. Many native mammal species increased rapidly in distribution and/or abundance after the release of calicivirus, which reduced rabbit populations and therefore also cat populations. Reducing introduced prey needs to be carried out carefully, if there is a risk that cats could ‘prey-switch’ and increase predation on native species for a short period after the introduced prey are removed.
Management options (continued)

**Maintain cover for native animals:**
Managing fire and grazing to maintain or increase ground cover, as dense ground-layer vegetation offers more shelter for native wildlife and this reduces the hunting efficiency of cats.

**Support ranger programs:**
Supporting Indigenous ranger groups to control cats directly (by hunting), and indirectly (through fire and introduced herbivore management).

**Retain dingoes:** Having dingoes active in an area may reduce cat impacts, either by reducing their density or changing their activity patterns. Retain dingoes in landscapes where possible (e.g. where there is no conflict with pastoral activities).

**Trapping and shooting:** Although labour-intensive, trapping and shooting may be feasible for protecting native species at key sites.

**Guardian dogs:** Developing novel ways of repelling cats and other introduced predators from sites that are important for the conservation of cat-susceptible threatened species, such as by using guardian dogs.

**New technologies:** Using new poison-delivery technology for use in specific situations, such as the Felixer traps, or Toxic Trojans.

**Biotechnologies:** Exploring the potential for biotechnologies, such as gene drives, immunocontraception and disease to deliver effective cat management tools for the future.

Some native mammal species are so cat-sensitive, that we need immediate actions to prevent further species’ extinctions. This would include intensively controlling cats at key sites that support cat-sensitive species, for example by using an appropriate mix of shooting, trapping, and poison-baiting.

In addition, the network of cat-free islands and fenced exclosures has been critical for preventing extinctions of many Australian mammal species. It needs to be maintained and expanded so that all cat-susceptible species have adequate levels of protection. Island havens have been particularly successful at preventing extinctions, as they are less expensive to establish and because cats are unlikely to recolonise. However, predator-proof fencing is particularly valuable for protecting species that live in habitats that are not represented on islands.

All management options aiming to reduce the impacts of cats need to be undertaken as strategically and humanely as possible, be carefully targeted, and comply with relevant legislation and by-laws.

**Work with engaged members of the public**
While strategic feral cat control is best undertaken by targeted pest management programs, emerging evidence suggests that members of the public make a significant contribution to feral cat control.

Engaging with, educating and supporting key groups, such as sporting shooters, may help to increase the effectiveness of feral cat control.

**Feral cats in towns**
- Remove sites with abundant food for cats: fence off dumps, intensive animal farms and any other sites that might support cat colonies.
- Remove populations of feral cats from towns with trapping programs.
- Discourage the community from feeding ‘stray’ cats.

**Pet cats**
Even well-fed cats can and will kill wildlife. Bells do little to limit this predation, and keeping cats indoors at night simply shifts their predation into the daytime.
- Keep pet cats indoors or in contained areas outdoors at all times (many options are commercially available) – it’s safer for your cat as well as for wildlife, as it won’t be hit by a car, get into fights, pick up a disease or get lost. Contained cats tend to be healthier, live longer and incur fewer vet bills.
- Desex your cat.
- Consider expanding the use of bylaws to make cat containment or cat prohibition mandatory, especially in areas with cat-sensitive wildlife species nearby.