

Invasive animals – particularly foxes, cats, rabbits and rats – have caused or contributed to dozens of extinctions in Australia, and threaten many of our most vulnerable native species. Goats, pigs, horses and other hard-hoofed feral animals cause serious degradation.²

As with native species, climate change will benefit some invasive animals and cause others to decline.

However, because disturbance and stress to native species and ecological communities often benefit invasive species, and because climate change will bring new invasive threats, the overall threat from invasive species is likely to increase.

In many cases the increased threats from invasive species are likely to exceed the direct threats of climate change to native species.³

Here are some examples of what can be expected.

1. Range changes due to new temperature and rainfall patterns

New temperature and rainfall patterns may facilitate the establishment of new invaders and increase the impacts of others.



There is already evidence of this occurring. After existing along the Victorian coast for almost a century, European green crabs (*Carcinus maenas*) invaded Tasmanian waters after a run of unusually warm winters in 1988 to 1991.⁴ As the climate warms, cane toads are predicted to expand southwards,⁵ and cats may be able to spread to some islands currently too

wet for them that serve as sanctuaries from exotic predators.⁶ Tropical aquarium fish – the largest category of invasive animals in Australia – are likely to establish and spread further as waters become warmer.⁷

There are many changes afoot in the Australian Alps as temperatures rise. Foxes, hares (*Lepus europaeus*), house mice (*Mus musculus*), and feral horses (*Equus caballus*) are increasing at high altitudes.⁸ Bogong moths are arriving later, forcing endangered mountain pygmy possums (*Burramys parvus*), which eat them, to forage more widely. This makes them more vulnerable to predation by foxes, which also eat bogong moths.⁹

However, some invasive species will suffer. Higher temperatures will disadvantage rabbits because they need cool weather for breeding.¹⁰

2. Invasion opportunities with extreme events

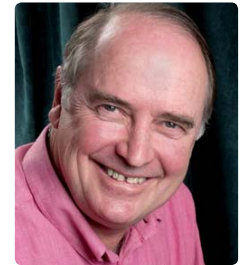
Climate change is predicted to increase the frequency or severity of extreme events, such as cyclones, floods, droughts and fires, to the benefit of some invasive animals.



By linking outdoor ponds with waterways and waterways with each other, floods spread feral fish, such as cichlids (*Cichlidae*) and carp (*Cyprinus carpio*).¹¹ Storms and cyclones can destroy fences, allowing animals to escape from deer farms, game reserves and zoos. During cyclone Larry more than 200 deer of various species escaped in the Wet Tropics.¹²

“The ultimate outcomes are expected to be declines in biodiversity favouring weed and pest species (a few native, most introduced) at the expense of the rich variety that has occurred naturally across Australia.”

– The Garnaut Climate Change Review¹



More fires could increase predation by cats and foxes on declining species, by removing protective vegetation cover.¹³ Predation after fires is believed to be reducing numbers of the endangered eastern bristlebird,¹⁴ and probably contributed to the disappearance of numbats from arid Australia.¹⁵ In Victoria, predation of endangered pygmy possums increased after fires on Mount Buller.¹⁶

After fires, feral herbivores can prevent regeneration. The entire population of the endangered tree *Nematolepis wilsonii* was destroyed during the 2009 Victorian fires. Fences are needed to protect replanted saplings from feral sambar deer,¹⁷ which are the tree's major threat.¹⁸

Feral animals can compromise the capacity of native species to survive droughts – by depleting limited resources and dominating refuge areas. Rabbits probably contributed to the decline of rufous hare wallabies during droughts in central Australia.¹⁹

3. Increased vulnerability to feral threats

The stress imposed by climate change is likely to increase the susceptibility of species to invasive animals. Increased fox predation on pygmy possums in the Australian Alps is an example of this.



The converse is also true – that species or ecosystems threatened by invasive species are likely to be more vulnerable to climate change. For example, the grazing pressure of rabbits, goats and other invasive herbivores reduces the resilience of native plants to drought.

Many marsupials – including bridled nailtail wallabies (*Onychogalea fraenata*), golden bandicoots (*Isodon auratus*), banded hare wallabies (*Lagostrophus fasciatus*) and rufous hare wallabies (*Lagorchestes hirsutus*) – which survive only in the northern parts of their former range – may be particularly vulnerable because they have suffered from fox predation in the southern parts of their range but may no longer be able to survive further north.²⁰

Human responses can increase threats

Some human responses to climate change may exacerbate feral animal problems. If water is spread between catchments to avert shortages, aquatic pests such as tilapia (*Oreochromis mossambicus*) will have an opportunity to spread.



Farmers struggling with drought or floods are less likely to control feral animals – this may have led to an increase in the abundance of some pest species in NSW from 2002-04.²¹ Invasive ants can be transported when debris is cleaned up after cyclones,²² and fire breaks and tracks created for fire control can serve as conduits for feral animals.²³

New agricultural products or the shift of agriculture to new areas can also increase the threat of invasive species. For example, farmers may farm goats, which may escape into the wild, or introduce new hardier breeds that are more invasive.

Invasive animals can increase emissions

Feral herbivores – including camels, goats, horses, donkeys, rabbits – emit potent greenhouse gases (methane, nitrous oxide) as a byproduct of cellulose digestion, accounting for more than 4% of estimated emissions in the Northern Territory.²⁴ Feral herbivores also indirectly increase emissions by limiting tree regeneration and thereby reducing carbon sequestration.



Reducing the impacts of invasive animals and preventing their spread are essential to increasing the capacity of native species and ecosystems to adapt to climate change. See the Invasive Species Council fact sheet 'Policy solutions for climate change and invasive species'.

Endnotes

- 1 Garnaut R. 2008. The Garnaut Climate Change Review. Final Report. Commonwealth of Australia. www.garnautreview.org.au/index.htm.
- 2 Booth C. 2009. Invasive Species: One of the Top Three Threats to Australian Biodiversity. Invasive Species Council. www.invasives.org.au.
- 3 Steffen W, Burbidge A, Hughes L, Kitching R, Lindenmayer D, Musgrave W, Stafford Smith M, Werner P. 2009. Australia's Biodiversity and Climate Change: A strategic assessment of the vulnerability of Australia's biodiversity to climate change. Technical synthesis of a report to the Natural Resource Management Ministerial Council commissioned by the Australian Government. Canberra: Department of Climate Change. www.climatechange.gov.au/impacts/biodiversity_vulnerability.html.
- 4 Thresher R, Proctor C, Ruiz G, Gurney R, MacKinnon C, Walton W, Rodriguez L, Bax N. 2003. Invasion dynamics of the European shore crab, *Carcinus maenas*, in Australia. *Marine Biology* 142: 867–876.
- 5 Kearney M, Phillips BL, Tracy CR, Christian KA, Betts G, Porter WP. 2008. Modelling species distributions without using species distributions: the cane toad in Australia under current and future climates. *Ecography* 31: 423-434.
- 6 Steffen W, Burbidge A, Hughes L, Kitching R, Lindenmayer D, Musgrave W, Stafford Smith M, Werner P. 2009. Australia's Biodiversity and Climate Change: A strategic assessment of the vulnerability of Australia's biodiversity to climate change. Technical synthesis of a report to the Natural Resource Management Ministerial Council commissioned by the Australian Government. Canberra: Department of Climate Change. www.climatechange.gov.au/impacts/biodiversity_vulnerability.html.
- 7 Low T. 2008a. Climate Change and Invasive Species: A Review of Interactions. Canberra: Biological Diversity Advisory Committee.
- 8 Green K, Pickering CM. 2002. A scenario for mammal and bird diversity in the Australian Snowy Mountains in relation to climate change in Koerner C, Spehn EM, eds. *Mountain Biodiversity: a Global Assessment*. London: Parthenon Publishing.
- 9 Pickering C, Good R, Green K. 2004. Potential Effects of Global Warming on the Biota of the Australian Alps. Canberra: Australian Government Greenhouse Office.
- 9 Ken Green cited by Low T. 2008a. Climate Change and Invasive Species: A Review of Interactions. Canberra: Biological Diversity Advisory Committee.
- 10 Climate change impacts on pest animals and weeds. Department of Agriculture, Fisheries and Forestry; Bureau of Meteorology; Meat & Livestock Australia. August 2008.

- 11 Low T. 1999. *Feral Future: The Untold Story of Australia's Exotic Invaders*. Ringwood, Victoria: Viking.
- 12 Kaufman O. 2006. Hungry aftermath. *Australian Geographic* 85: 109.
- 13 Gill AM, Woinarski JCZ, York A. 1999. Australia's biodiversity - Responses to fire. Biodiversity Technical Paper No. 1 Canberra: Environment Australia.
- 14 Lindenmayer D, MacGregor C, Wood JT, Cunningham RB, Crane M, Michael D, Montague-Drake R, Brown D, Fortescue M, Dexter N, Hudson M, Gill AM. 2009. What factors influence rapid post-fire site re-occupancy? A case study of the endangered Eastern Bristlebird in eastern Australia. *International Journal of Wildland Fire* 18: 84-95.
- 15 Friend JA. 1990. The Numbat *Myrmecobius fasciatus* (Myrmecobiidae): history of decline and potential for recovery. *Proceedings of the Ecological Society of Australia* 16: 369-377.
- 16 Low T. 2008a. *Climate Change and Invasive Species: A Review of Interactions*. Canberra: Biological Diversity Advisory Committee.
- 17 Victorian Bushfire Reconstruction and Recovery Authority. 2009. *Rebuilding together: A statewide plan for bushfire reconstruction and recovery*.
- 18 Murphy AH, White M, Downe J. 2006. National recovery plan for the Shiny Nematolepis *Nematolepis wilsonii*. Victorian Department of Sustainability and Environment.
- 19 Lundie-Jenkins G, Corbett LK, Phillips CM. 1993. Ecology of the rufous hare-wallaby, *Lagorchestes hirsutus* Gould (Marsupalia: Macropodidae), in the Tanami Desert, Northern Territory. III Interactions with introduced species. *Wildlife Research* 20: 495-511.
- 20 Low T. 2008b. *Climate change and invasive species: a review of interactions*. Canberra: Department of the Environment, Heritage, Water and the Arts. www.environment.gov.au/biodiversity/publications/interactions-cc-invasive.html.
- 21 West P, Saunders G. 2007. *Pest animal survey: 2004-2006. A review of the distribution, impacts and control of invasive animals throughout NSW and the ACT.*: NSW Department of Primary Industries. <http://www.invasiveanimals.com/publications/research-reports/index.html>.
- 22 Low T. 2008a. *Climate Change and Invasive Species: A Review of Interactions*. Canberra: Biological Diversity Advisory Committee.
- 23 Ibid.
- 24 Discussion Paper on NT Climate Change Issues. Department of the Chief Minister. June 2008.