

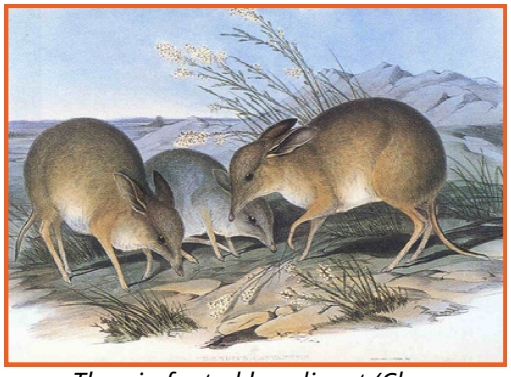
Double trouble: climate change and invasive species

Living in a warmer, wilder, weedier world

Climate change is expected to drive some native plants and animals to extinction by making their homes too hot or dry and leaving them nowhere to go. But for many species, an earlier and greater danger is that climate change will help invasive species spread and do more harm.

Invasive species are already the main cause of extinctions in Australia, especially of animals. They are also a major cause of declining native species and damage to ecosystems and First Nations culture. A national assessment found that, in many cases, invasive species helped by climate change are likely to do more harm than climate change itself [1].

Australian animals lost to invasive species:



The pig-footed bandicoot (Chaeropus ecaudatus) is one of 36 Australian mammals driven extinct by invasive species.

- **36 of 40 extinct mammal species**, mostly due to cats and foxes (31 species), with the rest lost to black rats, a parasite they carry, and wolf snakes. Across much of Australia, most native mammals weighing 35 grams to 5.5 kilograms have vanished. Some survive only on islands free of cats and foxes, or behind fences.
- **4 of 8 extinct bird species,** mainly killed by black rats on islands.
- **All 6 extinct frog species,** due to disease caused by chytrid fungus.
- **All 3 extinct lizard species** (one extinct, 2 surviving only in captivity), killed by wolf snakes on Christmas Island.
- **Both extinct fish species**, one extinct in the wild due to predation by brown trout and one probably lost to an introduced disease.

Why invasive species will gain

Climate change will create winners and losers, and invasive species will be among both. Cane toads are expected to spread further south, while higher temperatures will make it harder for rabbits to breed [6,7]. But overall, invasive species are likely to cause more harm, for several reasons.

- **They adapt.** Many invasive species are generalists that cope with, or exploit, change and disturbance [8,9]. Many weeds, for example, are weedy because they grow across a wide range of climates.
- **Extreme events open doors.** Weeds colonise ground bared by drought, fire and cyclones, and foxes and cats hunt animals that have lost their shelter [10–12]. Floods carried carp through the Murray–Darling river system, where they now dominate, and spread athel pine hundreds of kilometres along the Finke River in central Australia [13,14].

- **Native species will be weakened.** Plants and animals stressed by heat, drought or other impacts of climate change are less able to compete with invaders or resist disease. During drought, for example, southern hairy-nosed wombats are more prone to mange caused by an introduced mite [15]. When native plants die, fast-growing weeds often take their place [16]. The reverse is also true: species already under pressure from cats, foxes, goats or deer will be less able to adapt to a changing climate.
- **Weeds attract birds needed by native plants.** To shift in response to climate change, many native plants rely on birds to disperse their seeds. But birds such as currawongs, figbirds and silvereyes often now feed instead on the fruit of weeds like camphor laurel and privet, spreading weed seeds instead.
- **Control efforts will weaken.** Farmers struggling with extreme weather, and governments facing other climate costs, are likely to spend less on controlling invasive plants and animals [17]. Some herbicides, including glyphosate, and some biological control agents are predicted to operate less effectively [18,19].
- **Our responses can create new invaders.** Hardier, drought-tolerant varieties of plants that are already weedy, invasive biofuel crops such as giant reed, and farming moving north into new regions all bring new risks of invasion [20,21].

How climate change will make invasions worse

- **More fire:** In northern and central Australia, gamba, buffel and other invasive pasture grasses fuel fierce fires hot enough to kill trees, perpetuating tan expanding dominance [22,23]. More frequent fire under climate change will speed this process.
- **Warmer and wetter:** At least 65 native plants are at 'very high' risk of extinction from the devastating disease, Phytophthora dieback [24]. Its spores travel in flowing water, so more summer rain in the south-west and warming in subalpine areas in the south-east would favour its spread, risking more extinctions [25].
- **Stronger cyclones in the tropics**: Gardens in Queensland's Wet Tropics hold many exotic rainforest plants that have not yet escaped. Cyclones that damage forests and cause flooding could give them an opening to invade [12].
- **Warmer mountains:** As the climate warms, foxes are moving higher in the Australian Alps, threatening the endangered mountain pygmy-possum and broad-toothed rat. Weeds will move upslope too [12,26].
- **Warmer water:** Most aquarium fish come from the tropics. As rivers and lakes warm, more become suitable for fish that escape or are released [27,28].

Invaders that heat the planet

Some invasive species add to climate change, although this has had little research. (A few have the opposite effect [29].)

- **Flammable grasses** such as gamba grass, mission grass and buffel grass drive hotter, more frequent fires that kill trees, which means less carbon stored [22,30].
- **Some weeds** speed the release of carbon from soil [31]. Willows growing in wetlands release methane drawn from the mud [32]. Introduced earthworms can also reduce soil carbon [30].

- **Feral grazing animals** – buffalo, pigs, goats, deer, donkeys, horses and cattle – produce the greenhouse gases methane and nitrous oxide. By damaging wetlands and trees and stopping forests from regrowing, they may also reduce carbon stores [30,33,34].
- **Introduced insects and plant diseases** have the potential to turn some forests from carbon stores into carbon sources [35]. If myrtle rust spreads to all suitable areas in Australia, it could reduce national carbon sequestration by 1.6%, an annual value loss of more than $340 million [36].

Problems that feed themselves

Some interactions between invasive species and climate change are especially worrying because each problem makes the next one worse.

- **Grass and fire:** Gamba, buffel and other invasive pasture grasses fuel intense fires, then spread in their wake [22]. As climate change brings more fire, the result is more grass, more dead trees and more emissions.
- **Cyclones and vines:** Cyclone damage lets exotic vines such as blue thunbergia and turbina smother rainforest. The vines stop the canopy recovering, leaving the forest more exposed to the next cyclone [12].
- **Disease and drought:** Phytophthora dieback leaves trees less able to survive drought and fire. Dead trees release carbon, and weeds take their place.
- **Despair and inaction:** The more invasive species take hold, the more people feel the problem is too big to tackle. Climate change deepens that sense of hopelessness. Keeping people motivated is itself a climate challenge.



Grass fire burns in an open area. Photo: CSIRO, CC BY 3.0.

How to respond

Invasive species are likely to cause more extinctions in Australia even without climate change. Climate change makes dealing with them more urgent. We need to:

1. **Help native species adapt** by reducing the invasive threats they already face, especially for species likely to decline under climate change, and in places likely to become climate refuges.
2. **Target invaders likely to benefit from climate change** – for example, by removing potential weeds from trade, and by focusing research and control on plant diseases and flammable pasture grasses.
3. **Prevent harmful new introductions,** including those caused by our responses to climate change. This means allowing species to be released only if assessed as low risk (a 'permitted list' approach), and assessing the invasive risks of new varieties and breeds of invasive species, biofuel crops, other species proposed for widespread planting, and native species moved to new areas.
4. **Control invasive species that add to emissions,** such as flammable weeds and feral grazing animals, and make sure plants used for carbon offsets and biofuels are not invasive

More info & references available here.