Killing off alien invaders – with maths

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Environmental scientists are using a new mathematical model to ensure that feral pests are well and truly beaten.

Developed by scientists at The ARC Centre of Excellence for Environmental Decisions (CEED), the model minimises the risk of pests and weeds 'bouncing back' after they're seemingly eradicated. This will allow Australia's native wildlife and plants to be truly free from these invaders, which include feral foxes and cats, cane toads, and weeds.

It can also ensure that scarce public conservation funds are better spent, as governments and environmental managers can better determine when to stop eradicating these invaders, says Professor Michael McCarthy from CEED and The University of Melbourne (UniMelb).

"Many eradication programs fail, often because the eradication program is prematurely wound up," says Prof. McCarthy.

For example, the program to eradicate bitterweed – a daisy that poisons livestock and competes with native plants – was halted four years after the weed had seemingly disappeared. Many years later, a small infestation of the weed was discovered at the original site.

This shows that an invasive species may still be around, in hiding, even if it hasn't been seen for years, Prof. McCarthy explains. "On the other hand, we have limited conservation funds, and it's difficult to justify continuing an eradication program if the species hasn't been found.

"Till now there hasn't been a good way to quantify how certain we are that the invader is wiped out, or to determine the costs, benefits, and risks of continuing or halting an eradication program."

To solve this problem, the CEED researchers developed a mathematical model that predicts whether – and how long – an eradication program should continue when a species is no longer detected, the cost of doing so, and how likely it is that the invader will 'bounce back'.

The team used data from an eradication program that targets foxes on Phillip Island, Victoria. These feral animals threaten much of the island's wildlife as well as its tourism industry, and are the number one menace to little penguins on the island, which have been reduced from ten colonies to one by fox predation.

"Since 1980, environmental managers have searched, hunted, baited, and trapped these foxes across most of the island," says Prof. McCarthy. "This campaign seems to be working, with the number of foxes detected having decreased substantially in recent years.

"The managers at the Phillip Island Nature Parks expect to stop detecting foxes in the near future, and they want to work out how long they should continue the eradication program after foxes are no longer detected."

In the model, the researchers included the amount of time, effort, and money spent on the program, as well as the estimated number of foxes seen and killed.

After predicting the number of remaining foxes on the island, they found that it will take six years of continued management to be 90 per cent certain that these animals have been eradicated, and nine years of continued management to be 95 per cent certain.

While it's very unlikely we will ever be 100 per cent certain that an invasive species has been eradicated, the penalty for mistakenly assuming success can be high, Prof. McCarthy warns.

"Using the Phillip Island eradication program as an example, ending the program prematurely could jeopardise decades of effort and millions of dollars that were put into it. A return of the foxes can also further damage the tourism industry in the island, where 500,000 tourists visit each year to watch the penguins.

"The model will help determine the costs, benefits, and risks of continuing or winding up an eradication program. Governments and environmental managers can then make a much sounder decision based on how certain they want to be that the species is gone."

More information: Rout, T. M., Kirkwood, R., Sutherland, D. R., Murphy, S. and McCarthy, M. A. (2014), "When to declare successful eradication of an invasive predator?". *Animal Conservation*, 17: 125–132. DOI: 10.1111/acv.12065

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