

Who's afraid of the big bad toad?

In 1935, agricultural scientists from the Bureau of Sugar Experiment Station near Cairns committed one of the great blunders of biological control. They brought 102 cane toads from Hawaii to Cairns, and released their progeny. Ignoring the beetles they were meant to eat, these warty South American interlopers have spread across more than a million square kilometers of tropical real estate, leaving a trail of environmental destruction in their wake. The southern front is moving only slowly through northeastern New South Wales, but the western front accelerated as it moved through the Northern Territory. With the first wet-season rains of 2008, Western Australia will join the list of Australian states that are reluctant hosts to this most unwelcome invader.

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So, are the toads unstoppable? Ecologically-based research has given us a new arsenal of weapons, such as toad-specific parasites and pheromones, providing a glimmer of hope for toad control.

The toad's high public profile and its predicted impact on biodiversity spawned millions of dollars in research funding, and enthusiastic community "toad-busting", yet failed to slow the toads' invasion. CSIRO was the primary recipient of funding, and spent several years researching toad biology and pathogens in the animal's native range in Venezuela, and several more years trying to construct a genetically-modified virally-vectored toad-killer. The work hit technical snags and looks unlikely to continue – perhaps fortunately. Many have pointed to the risks of ecological catastrophe if a genetically-engineered toad-killing virus escaped Australian shores to massacre toads in their native range. Community attempts at toad control have been equally frustrating – despite massive effort, the toad front has continued to sweep westwards. A single female cane toad can produce up to 30,000 eggs in a single clutch, so the mathematics of population reduction are formidable.

In the midst of this doom and gloom, a new approach to toad control has emerged from an unlikely direction: 'pure' research. For more than 20 years, the Australian Research Council has funded my research on the ecology of reptiles at Fogg Dam, midway between Darwin and Kakadu National Park. The work was designed as "pure" research, but we ended up in the right place at the right time. As the cane toad invasion front raced westwards, it became clear that the knowledge base and infrastructure at Fogg Dam provided a unique opportunity to find out exactly what cane toads are doing and what effects they have on the Australian fauna.

Remarkably, the massive prior expenditure of public money on cane toad research had mostly gone to targeted attempts to kill or remove toads. Apart from Ross Alford's group at James Cook University, few people had tried to understand toad ecology or behaviour. And as soon as we started work on these topics, opportunities for new approaches to toad control began to accumulate like toads around a cowpat. In particular, we soon found features in which cane toads differ from Aussie frogs (Australia doesn't have any toads of its own) – a critical issue if control attempts are to avoid collateral damage to native frogs. For example, cane toads are

very picky about where they breed, preferring shallow sun-exposed pools surrounded by open ground; so that planting grass up to the edges of your backyard pool may be a more effective toad deterrent than going out every night with a golf club. And the more we can concentrate toad breeding, the more the toads will help us by controlling their own numbers through competition and cannibalism.

More importantly, we have found that cane toad tadpoles communicate with each other using specific chemicals. For example, a frightened or injured cane toad tadpole releases an "alarm pheromone" that warns its fellow tadpoles to flee the danger. If we consistently add this "alarm pheromone" to pools, about half the toad tadpoles are so stressed



out that they die – and the ones that survive turn into toadlets so small that they are vulnerable to predators and drying out. And best of all, the tadpoles of native frogs don't react to these chemicals.

Even more encouraging is our work on lungworm parasites. Laboratory trials show that these nematodes can kill up to 30% of the tiny toads they infect, and our genetic work has recently shown that the parasite in cane toads is a different species than that in the native frogs. So again, we have a chink in the toad's armour – a way to target control efforts at toads without risking collateral damage to frogs. And lastly, many of the native predators that we expose to toads in laboratory trials have proved to be much smarter than we expected – so long as the first toad they try to eat is a small one (so it isn't a fatal meal), animals like fishes, frogs and small marsupials quickly learn to stay away from cane toads. As a result, releasing a few small toads slightly ahead of the main invasion front (which consists entirely of large and hence lethal toads) might teach predators early enough to let them survive the amphibian onslaught.

It's early days yet for these new approaches to toad control, and the toad is a desperately difficult adversary. Nonetheless, our emerging arsenal of anti-toad weapons reinforces the value of basic research in suggesting answers to "applied" questions.

Taking the time to understand the enemy – that is, to conduct detailed ecological studies of a threatening pest – ultimately may pay greater dividends than spending money on untested methods, or on a high-tech search for silver bullets.

► For more information about cane toad research: www.canetoadsinoz.com