BiodiversityWatch

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(incorporating Frogwatch and ReptileWatch projects)

# A HARM MINIMISATION STRATEGY FOR DEALING WITH THE CANE TOAD MENACE



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# 1 SUMMARY

I have spent a lot of time working on the cane toad issue in Nth Australia and have spent many thousands of hours in on-ground control work across the NT to the Kimberleys. I worked in the paid capacity as the Coordinator of the Cane Toad control initiative in the Northern Territory as the head of award winning FrogWatch and I have worked with the Stop the Toad foundation in WA. I set up and managed many cane toad control projects and I have also conducted population studies on toads using a mark recapture methodology which I wrote up as a part of my Masters in Environmental Management.

It is clear to me, that the numbers of toads and their impacts are quite different in different habitats and that a lot of the “research” has failed to really provide the knowledge we need to manage toads. From my investigations into the impacts of toads on native wildlife populations, it is important to control toad numbers to protect our biodiversity. It also appears to be feasible to make a difference.

I find it disappointing that governments, especially the federal government, have ceased funding efforts to understand the impacts of cane toads and the need for control and this has led to a situation where the impacts of cane toads in places like Kakadu and other areas has been ignored and wildlife devastation covered up.

By greatly reducing cane toad numbers in an area there appear to be benefits to a number of groups of native animals and nutrient flows within ecosystems. Sawyer (2010)

The control is feasible, in the wet dry tropical regions of the tropical north of Australia, because of the cane toads’ susceptibility to evaporative water loss forces them, to congregate on remnant water to survive long dry periods. This is causing massive congregations with unexpectedly high toad densities in tropical savanna. In one study the total estimate of the toad population per hectare was 11851. Based on the average mass of all toads in the study this represents a biomass of 1372 kg $ha^{-1}$(Sawyer 2017).

Whilst congregated, cane toads can be eradicated using a number of techniques including different types of fencing. If exclusion fencing is feasible in that location the toad population can be completely eradicated in a few days

Research is showing that cane toad eggs and metamorph stages are impacting on different species such as native tadpoles and small reptiles respectively and that these impacts can be almost eliminated in an area if the refuging population, predominantly breeding adult toads, is removed. Food competition and the numbers of native species predated will also be reduced by this strategy.

There are also strategies like clearing eggs, trapping tadpoles (using toad toxin as bait), and spraying metamorphs that can have a very big impact on recruitment through breeding.

The following documents some of the detail of this strategy and the research that supports it. This is not exhaustive as there are many other pieces of research of relevance.

# 2 BACKGROUND

It is clear from observation and research data that cane toads are having a significant impact on native wildlife across the savanna woodland systems of the north of Australia.

The impact is obvious when it comes to the damage they are causing to predator populations in these natural systems and this has been shown to be the case by research on species such as quolls (Oakwood 2008) and Goannas (Doody ).

Doody (2008) concludes “ We observed population-level declines in Australian predatory lizards caused by the arrival of an invasive species, *Bufo marinus*, at two sites along the Daly River. In contrast, there were no significant declines in populations of *Crocodylus johnstoni. Amphibolurus gilberti* populations increased substantially, presumably due to the losses in *Varanus panoptes*, a known predator of this species. These findings indicate that the invasion of *B. marinus* into this ecosystem caused a structural change in the lizard community. Changes in the abundance and community structure of these top predators may alter species-species interactions, in particular patterns of predation and competition, and the energy dynamics of the ecosystem. Recovery from low numbers, and possibly local extinction, may depend on the control of *Bufo marinus*, and/or the recolonization from individuals from the surrounding landscape.

Further personal communication with the author indicates follow up surveys showed some species, like panoptes, are no longer present at the survey sites.

For a more detailed discussion of the extent and detail of the problems see the WWF nomination of cane toads as a key threatening process. Glanznig and Webb (2003). The problems outlined in this document are happening as we write this strategy in 2019 and appear to be worse in many cases than indicated in the nomination document.

It is also clear that the impact of cane toads is variable with different stages of the cane toad life cycle having impacts on different native wildlife. For example, some of the small varanid species such as *Varanus mitchelli* are not impacted by adult cane toads and show no significant decline in the first year of invasion but their population is devastated when small metamorph cane toads flood their habitat.

Research by Dr. Sean Doody (2003) on the Daly river showed that large varanids, such as *V. panoptes*, declined sharply in the first year of cane toad invasion but populations of smaller varanids, such as *V. mitchelli*, did not decline until the second year as breeding occurred and small toads were present.

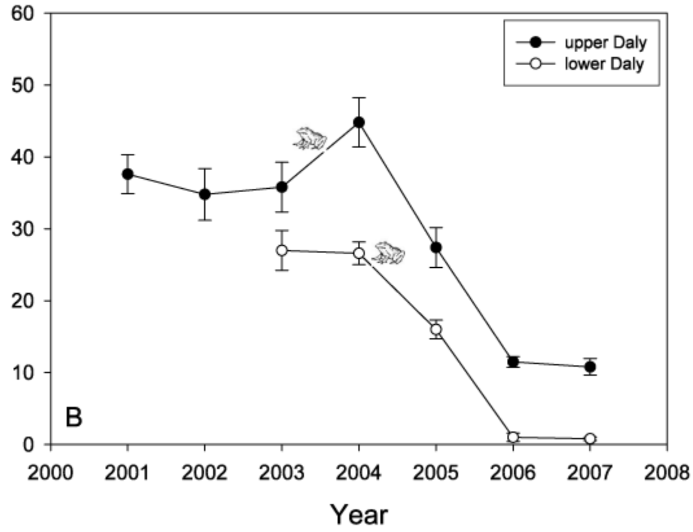


*Figure 1 - Graph from Doody showing declines of V.Panoptes and V.Mitchelli*

These broad declines are also supported by observations from a wide range of people including aboriginal people still living a semi-traditional lifestyle in Arnhemland. (Ian Morris pers comm.).

Cane toads are listed as a key threatening process under federal legislation because of killing native predators through lethal toxic ingestion, predation by cane toads impacting on many small invertebrates and vertebrates, and competition with native species for food, shelter and breeding resources.

There is also significant concern at the way cane toads are disrupting natural cycles such as predator-prey relationships and nutrient cycles.

As an example, predation of pig nosed turtle eggs by Varanids ceased after cane toads became common in the area.

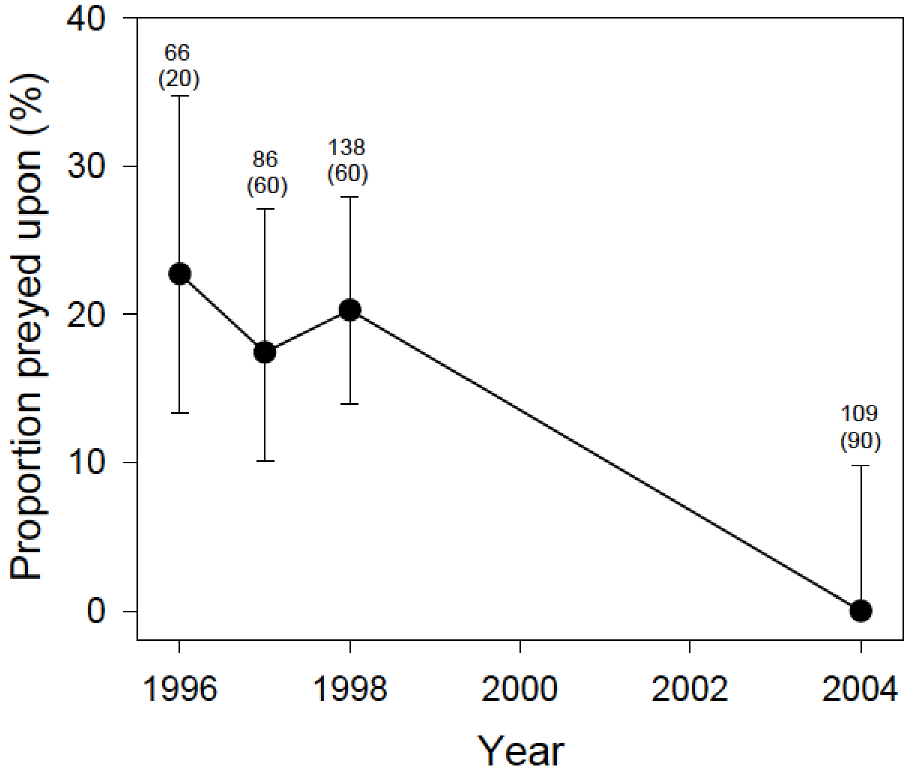


*Figure 2 - Pignose nest predation changes from Doody 2004*

Annual predation of pig-nosed turtle (*Carettochelys insculpta*) eggs by *V. panoptes* at the impacted site, showing 'typical' predation rates prior to the cane toad invasion (~20 %) compared to no predation after cane toads arrived.

Another example is the impact of toad eggs. Research has shown native frog tadpoles did not avoid cane toad eggs, but grazed on eggstrings until they had penetrated the gelatinous string and consumed the fertilized eggs inside, after which they always died (Crossland and Alford 1998). It is clear that if large numbers of cane toads are in an area at the start of the wet season significant volumes of eggs are going to be laid.

Some of our research is suggesting that the impacts cane toads have, through taking food that native species would normally be exploiting and taking over refuge places, is probably having a severe impact on many other species.

As an example, there were approximately 2.3 tonnes of toad biomass removed from a project site in 2009 during a research project conducted by Frogwatch in 2009 Sawyer (2009)

This broad and widespread impact should be removed or minimised if at all feasible. and what follows below shows that it is feasible. Perhaps toads cannot be eradicated from all areas of Australia, but they can be removed and kept out of specifically designated areas, such as National Parks.

The research reports that we have seen and research we have conducted make it clear that there are things that can be done which reduce or locally eradicate a cane toad population and are very likely to reduce the impact cane toads are having on native ecosystems.

Analysis by Alford (2006) has indicated that there is some sound basis to the belief control action can have a population level impact on toads. His conclusion is :-

- This indicates that, far from the situation often suggested in the popular media that "nothing kills cane toads," they actually experience extremely high mortality rates, which only need to be increased slightly to halt their spread or even reduce their populations.

Based on our research findings about control methods, other research data and observations we have developed a model of eradication based on a harm minimisation strategy to try to minimise the impact of toads on native species and ecosystem processes. We believe it is imperative that we act on it now.

# 3 RESEARCH BASIS FOR MODEL

Cane Toads have no defence against evaporative water loss (EWL) and so they are not well equipped to cope with long dry periods. In parts of the Wet Dry tropics this is a major problem for them to overcome because they need to find a moisture source.

These toads have no special morphological or physiological mechanisms to prevent evaporative water loss (Wygoda 1984)

Research shows toads loose water and can die once they lose approximately 52% of their body moisture or 40% of their body weight through evaporative water loss. Krakauer (1970)….

Environmental conditions place major constraint on cane toads and dry environmental conditions and the lack of suitable diurnal retreat sites are the major sources of mortality for adult cane toads (Zug and Zug 1979)

Cane toads do not drink, but take up water through their permeable skin on their lower surface. They do not hibernate or aestivate during the dry season, and because of their continual need for water, they are forced to remain in or near moist habitats during dry periods (Cohen and Alford 1996).

The end result of this is that cane toads are forced to congregate on moisture sources for lengthy periods in the dry season in the wet dry tropical areas or in long dry spells and droughts in other parts of Australia. Whilst constrained at a refuge point by this EWL deficiency cane toads do not seem to move from a water source Preliminary research and observations confirm that the toads do not venture more then 400m away from a refuge site at this time. Letnic (2009)

Because of this refuge effect it is possible to eradicate all toads from an area by removing them from such a refuge site. New toads will not move into a site until the moisture levels in the general area are restored by rain giving toads the freedom to move from site to site.

There are a number of techniques that can be used to eradicate a cane toad population from a given site and these will be explained in the next section.

# 4 REMOVAL TECHNIQUES

The effectiveness and relative cost and labour efficiency vary across the removal techniques. The nature of the terrain and weather also help to determine the best approach to use at any given site.

Where it is feasible exclusion fencing is the most effective toad removal strategy.

Community engagement is a very powerful and available resource that can be managed successfully both in urban settings as demonstrated by the Frogwatch (frogwatch.org.au) Community Cane Toad Control initiative in Darwin and events like the Stop the Toad Foundation Great Toad Muster. Many thousands of community volunteer time was generated by these projects and significant project work was delivered at a very low cost.

## 4.1 HAND COLLECTION

Hand collection, or 'toad busting' as it is commonly known, involves people out at night picking up toads and removing them. The method can be deployed in most sites although safety issues can be a concern in areas where there are steep and broken banks, slippery mud and hazards like saltwater crocodiles present. The method can be used to eradicate a site but a significant effort is required to achieve eradication.

It is important to understand toads are not active every night with research supporting this. Research (Schwarzkopf & Alford,1996) *et al* indicates toads may stay in their refuge for 3 days and potentially even up to 6 days, *but not more than 6*, without emerging.

On a given night only a percentage of the cane toad population is likely to be active and they are active at different times of the night, with the bulk active soon after dark. Research indicates on average, only 31 percent of the population was active each evening, and 50 percent was the highest level of activity observed. Zug and Zug (1979)

Indications are that control work with people hand collecting toads and cane toad traps (Sawyer 2006) can reduce the population of toads significantly and probably prevent the worst of this impact from occurring.

There are cases where this technique has been used to eradicated toad sites but in excess of 15 nights

## 4.2 TRAPPING

Trapping trials have shown significant removal rates of around 74% of the refuging population Sawyer (2006) and this can assist with the removal of toads from an area. Solar powered traps can be left in the field for extended periods and can also be useful additions to fences to slow down or stop the movement of cane toads into an area.

Fences boost the effectiveness of traps in a manner similar to the way drift fences increase captures in trapping.

Traps are especially suited to areas where regular visits are not feasible. Traps with appropriate water and shelter systems can be left in the field for long periods as toads live indefinitely in the traps.

Research into sound attractants is showing some promise (Lin Schwarzkoph pers comm.) in improving the effectiveness of the current light based traps. Unfortunately, loss of funding for cane toad work has meant this technique has not been funded in Nth Australia.

*Figure 3- Cane toad trap in operation Ringwood station*

## 4.3 Fencing

We have developed two different types of fencing strategies. These involve using shade cloth or similar material to create fences cane toads cannot pass.

### 4.3.1 Exclusion Fences

Exclusion fences are erected around a water body to deny cane toads access to water. When cane toads come out of their refuge places to rehydrate in the evenings, they are blocked from water by the fence and will stay along the fence trying to gain access to water.

Research using exclusion fences to eradicate populations of cane toads shows this method to be more effective than other techniques and it can lead to total eradication of toads from a site in a matter of days. Reports of field trials in the 2007, 2008 and 2009 Great Toad Musters conducted by the Stop the Toad Foundation show the success of exclusion fencing. STTF (2008).

Further Research by Dr Mike Letnic shows this technique is very effective with complete removal of cane toads from certain areas.

### 4.3.2 Barrier Fences

Barrier fences are long open ended stretches of fence designed to block cane toad movement into an area. Research by FrogWatch has shown them to be very effective and that they make toad busting more effective. Sawyer (2009a).Research, utilising radio tracking, conducted by Dr Mike Letnic Letnic (2009) verified that the use of the fences ware locally eradicating cane toad populations in semi arid areas of the NT.

Fences greatly increase the effectiveness of toad busting and joining control strategies together can increase the effectiveness and efficiency of control measures.  The graph below shows data from the Great Toad Muster comparing toad busting with a fence (red bar) to toad busting without a fence (blue bar) on the first and second night at a site. It is obvious that fences greatly increase the efficiency of toad control activities.

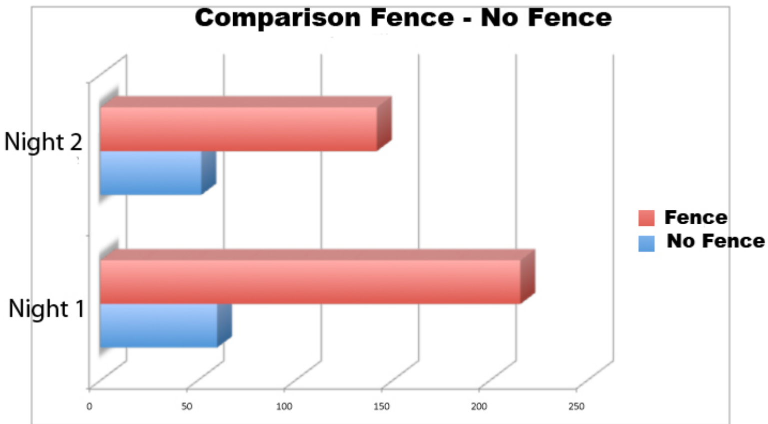


*Figure 4 - Comparison of toadbusting with and without fencing*

## 4.4 Shooting of Cane Toads

Shooting with an air rifle has proven an effective control method during The Great Toad Muster and Frogwatch research on Ringwood station.  The air rifles have been equipped with a red dot laser sight and once correctly zeroed this makes the process of shooting toads very quick and effective.

As an example, in a test on August 16th 2009 a shooter with the single shot air rifle shot toads at a rate of approximately 140 toads per hr.  A shooter with a gas operated repeating air rifle shot toads at a rate of 230.5 toads per hr.

The shooting technique also allows toads in the water to be culled safely, especially in areas where the land formation is dangerous or difficult to move through, or where crocodiles make working around the edge of the water too risky.

The shooting technique moves the point of euthanasia to the point of capture and this changes several key problems with other techniques of toad control.

It avoids the problem of bagging up toads and then carrying these heavy bags around the site. This not only significantly reduces the amount of physical effort and time required by the removal process but it reduces the risks of injury to people working. Carrying 20-30 kg bags in muddy environments with sloping and uneven ground is risky and forces people to work more slowly. It often means that you need two people working together, one carrying the bag and the other catching. Even trying to catch a cane toad that runs away while you have a 15kg bag of toads in one hand is difficult and many toads escape in areas where there is difficult terrain to bust. Shooting removes this problem as people do not need to move right up to the toad but only to get within a couple of metres.

The shooting technique would also appear to be humane as when done correctly the toads are dead instantly. There are good visual markers on the toads indicating the best place to shoot and the response triggered by shooting gives a clear indication if the toad is not dead.

## Image – Shot cane toad showing ideal shot placement

Toads shot in the spinal column in the area between the parotoid glands die instantly and lunge forward and have completely relaxed limbs. The shot also destroys major blood vessels. If the shot is misplaced and the toad not dead, there is visible tension in the limbs. A follow up shot will then be required.

A .22 calibre air rifle was used for most of the work although a .177 calibre air rifle seemed to work just as well. The .22 was used in most cases as it had a heavier pellet and slightly greater diameter, giving better effectiveness. Complete penetration of the pellet though the toads' body was the norm.

The red dot laser sight makes the process much quicker than with sights you have to look through and most shooting was done from the hip rather than shoulder.

Shooters were able to work for over 5 hours without fatigue.

## 4.5 CONTROL OF EGG STAGE

Control of eggs is effective in some habitats but is generally too time consuming and ineffective because of the vegetation and visibility in murky water. It can be useful in urban ponds and similar locations but is not viable in the bush at a landscape scale.

## 4.6 CONTROL OF TADPOLES

Tadpole traps can be very effective in removing tadpoles from a site. I have done a number of trials of this technique and had very positive responses in some habitat types although success has varied in running water and larger water bodies.

*Figure 5- A cane toad tadpole trap in situ*

The first trial was a backyard pond, which had cane toad tadpoles in it in July/August 2012. Commercial mesh prawn traps were used in the trial using dog food and toad toxin as bait. The toad toxin was collected from the parotoid glands of frozen cane toads.

The traps removed 1083 tadpoles from the pond and no metamorphs were recorded emerging from the pond. 698 tadpoles were captured in the dog food bait and 358 were caught with the toad toxin bait, 27 were caught in the control trap with no bait.

The second trial was in a 400 metre section of drain/ creek in Leanyer.

A combination of funnel traps and prawn traps were used in the trial, both with the same bait. The drain was a typically difficult environment for manual control because the tadpoles were distributed along a significant section of the drain with vegetation and rocky sections.

The traps collected 16116 tadpoles and just 67 metamorphs were collected from the site.

10566 were caught in funnel traps and 5550 were caught in the prawn traps. Whilst the funnel traps were more successful we did catch 1519 tadpoles in a prawn trap baited with toad toxin in one capture session. We intend to do more investigation into ways to bait the prawn traps as they are readily available and do not need to be constructed like the funnel traps.

Initially we trialled the dog food and toxin baits but after catching 1089 tadpoles with dog food and 6848 with toad toxin we baited all traps with toad toxin for the remains of the trial.

On the basis of our trials it appears that the toad toxin is a better bait and that it attracts less fish than the dog food baits. Both do work however.

In another trial in Marrara over 16,000 tadpoles were collected in one trap in one night. After 4 nights no further tadpoles were seen and no metamorphs were recorded at the site.

*Figure 6 - over 16,000 tadpoles from one trap in one night.*

Control of Metamorph toads.

*Figure 7 - Thousands of metamorph toads emerging from a water body in Darwin.*

Whilst it is preferable to control the tadpole stage and not let toads develop to this point that is not always feasible. At this point netting can be used effectively by just running nets along the edge of the water. Once the metamorphs are on dry land spraying can be very effective. Care needs to be taken with the spray used so as to not impact on aquatic organisms.

# 5 STRATEGY ELEMENTS

By removing cane toads from a site, it is predicted that the impact of cane toads will be lessened in these areas. By targeting toads in refuge sites the toad numbers in the nearby areas will be reduced.

Mark recapture data from Frogwatch research (Sawyer 2008) showed cane toads were not moving from sites early in the wet season breeding period and are therefore likely to be breeding close to where they refuged for the previous dry season. This means local eradication is likely to result in significantly less cane toad breeding, egg laying, tadpoles and metamorph toads than if no reduction of numbers was achieved.

Impacts on native tadpoles, turtles and other species that eat toad eggs, and the impacts from metamorph cane toads on small reptiles are likely to be significantly reduced or eliminated.

In one case study (Sawyer 2009) a site cleared of cane toads was not reinvaded for over 3 months into the following wet season and native frogs bred at the site with no competition from cane toads during that period.

Further into the following wet season very low numbers of cane toads were present at the site. Visits revealed just 4% of previous year toad densities 6 months later.

# 6 SUMMARY

Cane toads can be removed from a site or their numbers dramatically reduced with a number of techniques involving manual control. Exclusion fencing is the most effective where it can be used.

Whilst it is too early to tell how significant the benefits to native wildlife populations will be there is a lot of evidence to suggest the impact will be lower than if nothing is done to reduce cane toad numbers and impacts.

There is increasing evidence that the competition effect will be the mechanism through which cane toads impact on many species.

A biological or genetic solution to cane toads may still be 10-20 years away. We don't have that time and we can't afford to sit around and wait. Our response to the toad threat is a practical one. We have the management tools. It's time we made it happen.

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