LEGISLATIVE ASSEMBLY OF THE NORTHERN TERRITORY

Sessional Committee on Environment and Sustainable Development

Issues associated with the progressive entry into the Northern Territory of cane toads

Volume 2

WRITTEN SUBMISSIONS RECEIVED

October 2003

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SUBMISSION NO. 1A

Department of Infrastructure Planning and Environment, Parks and Wildlife Commission of the Northern Territory

Dr David Lawson, Director and Dr John Woinarski, Bioregional Assessment Unit

Transcript of Proceedings Accepted as Written Submission

15 April 2003 14:14:20

Madam CHAIR: All right, members of the committee, we'd like to thank Dr Dave Lawson and Dr John Woinarski for coming along today and discussing the incursion of cane toads into the Territory. Specifically as you know, our committee as you know, our committee is being tasked by the Northern Territory Government to look at, identify the problem and risks associated with the cane toads, to look at the potential extent and effects cane toads have or will have in the NT, to consider the cultural, socio-economic and other factors associated with the encroachment, identify current level of understanding and assess any need for public education and awareness programs, and then, apply ways to manage the environmental impact and discuss any community concerns and expectations in respect to the progressive entry. And it's our pleasure to have you here with us today, we're a friendly and frank committee, so you'll have plenty of opportunity to say what information you think would useful to us but you'll also find that very quickly we don't want to start asking questions…

Madam CHAIR: All right, so Dave, do you want to kick off for us?

Dr LAWSON: Right, first of all, this is one of the first one of these I've ever been to so, there's a lot of interest in my department with what actually goes on with this and I think you might like to know as a general feeling of, this is a good idea and it's about time we did something like this, so congratulations on whoever thought of it. As far as the cane toads are concerned, we brought as you can see, quite a lot of information with us and I asked John if he could supply me with some additional information because John is in charge of the bio-diversity group which looks at all the bio-surveys in the Northern Territory and I'm delighted to say that he volunteered to come along, I didn't actually have to push him at all, he actually volunteered.

Dr WOINARSKI: Keen as mustard.

Dr LAWSON: The way we would respond to this I think is to, I'll deal with the issues of perhaps the hands on wildlife management issues and John can ask the questions about the biology and the surveys and the bio-surveys that have gone on as baseline information that we've got already.

Madam CHAIR: Excellent.

Dr LAWSON: Because we are keen to give you the best picture we can. I am not a cane toad expert. While I run wildlife management I actually look after, as I'm sure you're aware, quite a lot of issues that relates to wildlife management although cane toads is on the list. My reading of the background information and my information about cane toads is that from a scientific perspective, the evidence is somewhat contradictory. And I think that is probably almost the crux of the problem that we've got.

The majority of background documentation that I have read would suggest that there seems to be a opinion that cane toads would have some immediate effects on the biota and that would probably be most extreme in the first two to three years of invasion but then that would quickly settle down. Now I think I'm going to qualify that opinion on one other observation that there seems to be a lack of substantive baseline information to compare post-changes too, in my opinion. And in a situation like that we're dealing rather with more than a little uncertainty, which is not helpful.

Now, people have asked us: why did we, if that's the background and my personal opinion, why did we go and do the quoll project? Well I think that was an exception to this uncertainty, I think that in terms of the Northern Quoll, certainly John's work in re-sampling in Kakadu National Park and I know you've got that report because Rex just said he's got it, that one, John was able to come with a pretty unequivocal statement that he was very concerned that the Northern Quoll might become extinct on the mainland in the Top End. And as far as I was concerned if someone like John says something as overt as that to me I pay attention and that's why we acted to try and move the quolls out or a population of them out to the islands. And I'm sure you've seen all the media and I know Delia was with us when we actually put some of that media together.

Now, in line with your points in your brief here, I think the identification of the problem is actually self evident: cane toads are coming across the Top End and there's very little, in fact nothing we can do to stop them, in my opinion. The risks associated with that as I say largely unknown. There will be some effects, some species will undoubtedly suffer more than others, there is a scientific sort of difference of opinion on how severe they might be but certainly there will be some effects.

The next point, on the potential extent and effects cane toads have or will have in the Northern Territory, again very

closely aligned with my first answer, they'll have some effect, I don't think we can actually predict reliably how much of an effect they will have on the biota of the Northern Territory. As I said, we will expect certain species to be affected more than others, certainly the Northern Quoll we thought about. Also getting some quite disturbing but anecdotal information about things like the large certain snake species, and even things like frilled lizards from the Katherine area. But to give you a definitive answer, I couldn't do that.

With cultural, socio-economic and other factors associated encroachment of cane toads in the Northern Territory, well Aboriginal people around Borroloola have learned to live with cane toads but that, I think is a glib answer and shouldn't be confused with the fact that they like that situation, they don't. I think there are gonna be some fall out in terms of bush foods for Aboriginal remote communities. Again we've got anecdotal evidence that some of the larger varanids when they disappear are very quickly noticed by Aboriginal communities and we might expect, although we don't know that that might lead to some socio-economic effects with greater dependency on store bought foods and the possible health effects that that might endanger in some of our more remote communities. The current level of understanding concerning cane toads is, I think, sometimes far off the mark. I think some of the public believe that cane toads are an absolute disaster and that we should be spending an awful lot of money just trying to stop them moving. I think there's a lack of understanding of how insidious this movement is and I think there's a lack of understanding of actually what we can physically do about it. There is a need for greater public education, but I also know that there are certain things, if you've got web access there is certain information on the web which is very up to date, very relevant and in pretty plain language but I think we can do better.

How to manage the environmental impact of cane toads in the Northern Territory: I think a combination of better public education, but also I would like to see more co-ordination amongst researchers and people like ourselves in a more strategic approach to the cane toad problem and by that I don't mean necessarily looking for a magical cure, although that is very important but simply in terms of managing the situation that is inevitably going to happen, probably within the next one or two years in Darwin. I think there are ways we could more productively harness our energies to make sure the appropriate talent is used in the right way and I think there's also a need to reassure the public that the resources that we are expending, we're doing it in a strategic way to get the best bang for our buck.

We are already moving down that line, I mean it was very

interesting, we had Peter in here before we came in, I think we are making greater connections with the university now. I think that's a really good positive thing, not just for cane toads but for a whole host of other things and I for instance am intimately involved now with the, I think they call it the High Level Task Force for putting the university and government together and certainly there's an absolute plethora of ways we can improve on that situation I'm sure.

The community concerns and expectations in respect to progressive entry: again tied up very much with the environmental education and just the information that the public's getting about cane toads generally, there are things we can do I think, we need to be a bit more proactive as I've said. Certainly the other problem about something like cane toad is the public tends only to react when they actually see it themselves, so if before, if you're in front of the invasion wave, you tend not to worry about it until you actually see them and I think that certainly I've seen, you can almost log the phone calls you get from the people that have actually been there, the cane toads roll over their properties and you suddenly get a phone call but the people in Darwin at the moment, they think oh the cane toad's coming yes, but what about not enough policemen and things like that, you know the public reacts to more immediate problems that they perceive I think.

So that's my quick response to your dot points. I'm sure we can expand on some of them.

Madam CHAIR: Thank you Dave. Before we go questioning Dave, John do you want to add?

Dr WOINARSKI: No, it was a reasonable review.

Madam CHAIR: Questions.

Mr BALDWIN: Co-ordination? You talked about co-ordinating all of those organisations, whether they're scientific groups or whatever, how do you see that happening?

Dr WOINARSKI: This is one good forum, surely.

Dr LAWSON: I think this is the start. I think, like I say, everyone I've described what's happening here, they've been very impressed with the idea. I think this is actually something you can build on. I think the actual nuts and bolts of who is involved would probably resolve around some member of Parks and Wildlife being you know sort of directed to take this on as a task, just as a co-ordinator and the reason I say that is because I think people do have an expectation that you know, governments generally should co-ordinate stuff and certainly with the improved relationships and the vastly improved communication with the university, I think that's

probably the start of that sort of co-ordination. I also think that we would probably get if we could start that off, and as I say, I think we have actually started off, the difficult thing is trying to get researchers in other parts of Australia to pay attention to this. I mean we're interested in the Northern Territory obviously but obviously the toads are mostly through Queensland now and we can learn a lot from you know, bringing in people who that have faced this over there and learn from their experiences. We are tending not to do that, we've tended to sort of try and sort the problem out ourselves, so I think there's probably quite a lot of cross pollination we can do that way and I really do think it needs you know, someone somewhere is going to have to bite the bullet and say, right the co-ordination's going to be done this way and maybe if this group suggests, orders, makes an imperative, recommend, that's the word I was searching for.

Madam CHAIR: We recommend parliament.

Mr BALDWIN: You know, I mean we're a short term, the Environment Committee will probably in the foreseeable future will always be there but for it to get into the hands on stuff, it just won't happen, it needs to recommend something that goes forward so I was interested in your views of what you see that being and who might be involved given that cane toads are a bigger problem than just the Territory.

Dr LAWSON: Oh, yeah, most certainly.

Madam CHAIR: One of the things that this committee's already considering is the scope I guess of that collaboration and one of the suggestions that's been put to us is it would have to include organisations such as Caring For Country through the Northern Land Council, that they're successful on the ground models and that they could have a role, what would you think about the viability of that suggestion?

Dr LAWSON: I don't think you can actually do anything about cane toads unless you did involve someone like the Caring For Country unit, after all we work very closely with them on all sorts of things like the quoll translocations we couldn't have done that without that co-ordination and I think the old idea that you know Parks and Wildlife somehow has to do the wildlife stuff on its own is gone. If it hasn't gone it certainly should have gone and I think there are a lot of people out there with very high skill levels in all sorts of different ways that could help to get the message across to communities, particularly remote communities but you know, you can actually learn to live with cane toads for instance, you might not like it but they are coming, there is nothing you can do about that, so learn to live with it and I think we can help people to understand that they can live with it.

Dr WOINARSKI: But more so than most issues, most environmental issues, I

think the research on the impacts of cane toads has been extremely fractured in the past and still currently. People have had very different agendas, very different sort of goals and very different research scopes and there hasn't really been any serious recent attempt to I guess bring them together and make sure that the research is complementary and compatible and that's probably hasn't been helped in the past by in some cases, personal antipathies, which is unfortunate.

Mr BALDWIN: Plus they're answering to different authorities and they are bound by different funding regimes, so I think that's the point here is that if you're going to set up something that is going to be effective and workable, whether it's looking at combining the research and / or looking at developing programs for minimising the effect, whatever they may be, biological or physical or whatever then how do you structure it well so that it does become effective rather than just another fractured part of the whole equation?

Dr LAWSON: Well I think that …

Madam CHAIR: People have taken that question away for further consideration as well, which you're also free to do Dave, we're on a fishing expedition, with I guess because we've been going since December we've been fortunate to gather a whole body of evidence to date and that's started to focus our minds on the next step which is the recommendations we make to parliament to drive it forward and give it a focus and a very real outcome orientated focus so that what resources are applied are applied with focus.

Dr LAWSON: My first reaction is that, our earlier discussions about the role of this particular group here, I don't want to be misinterpreted in my answer to that. I don't think this group is necessarily the one that will actually implement anything Tim, but I really do think that certain issues in the environmental sphere need the clout of a body like this to actually go to government and say, you've got a problem here boys, let's pay attention to it and let's think of some real practical things we can do to put it in place because to be completely blunt, it's ok for me to be the director of Wildlife Management but I'm a lone voice sometimes and it's very easy in the plethora of things you have to deal with in terms of looking after the people in the Territory, to actually get biodiversity right down the list.

So, I think that the clout of a group like this is welcomed and I also think that my initial reaction to it, to have somebody, a recommendation made that someone, somewhere takes the lead on it is probably, I'm not going to probably change that opinion but I also think that once you've done that, you've got to give that particular person or group of people room to maneuver and the resources to do it.

Madam CHAIR: And then possibly the report back mechanism to this committee.

Dr LAWSON: Yes.

Madam CHAIR: Which picks up that issue of clout I guess.

Dr LAWSON: It certainly does, I think what we're talking about here is an attention concentration really more than anything else. We've known about cane toads now for a number of years but we've been trying to do our little bits and pieces but as John said, at the moment it's very fragmented. A lot of it's got to do with personalities. This thing is too big to be you know influenced by personality, it should be that way, so I think that you know, I certainly would have no problem with this group making recommendations and really coming down saying, right, now you'll co-ordinate, this is a priority provided everybody else understood that that was the way it was and we could almost co-opt people into this sort of approach. It might be difficult with some of our interstate colleagues, particularly some of the researchers who are an interesting bunch of people to try and get to grips with sometimes. They are very strong personalities and they have very strong views.

Dr WOINARSKI: But in this case, I think with cane toads, apart from self interest, there's not the complication and different sectoral interest, I mean we all don't really like cane toads and we all want to minimise their impact on biodiversity, it's not something like feral cattle or buffalo or ……..pasture grasses. It's something we basically, we all should be struggling towards the same goals, so you would think it would be easier to co-ordinate and collaborate without that vested interest.

Mr BONSON: Just one thing, just touching on that idea of you know, research in Queensland, getting access to that and that being in communication and opening up that network that maybe hasn't been done properly in the past. Also there's the other side of the continent as well, Western Australia. Obviously they'd, we've had evidence to date that they've been very interested in things like donkeys and foxes and you know looking at how to deal with that and maybe bringing them on board as well. Saying you know, we've got this big area called the Kimberley, maybe there's access to resources and skills and etc that would obviously be something we could bring into this umbrella group that we're talking about?

Dr LAWSON: Like I said Mathew, I think that if you can find out where people with the practical knowledge and the skills are based, it doesn't really matter where they are, certainly Western Australia would, you would imagine would have a

vested interest in what's going on in the Territory because basically they're next. Having said that remember they might not have that, that far up there list because it's not there yet but certainly we'll have no hesitation at all about dealing with the Kimberly Land Council, the scientists from CALM, all agriculture Western Australian agriculture, whoever's most appropriate, as far as I'm concerned this is a problem. Let's see what we can do about it.

Dr WOINARSKI: That's probably very much I guess the Territory taking the lead in that case, if you've got the research capability in the Kimberley, it's miniscule in comparison to what's available here in Darwin and similarly I think land management in the Kimberley, on Aboriginal lands and pastoral lands it's far less well resourced than it is in the Top End so it's very much the Kimberley basically taking advantage of us I think which is a fine thing to do but it's not at this stage an equitable arrangement.

Madam CHAIR: In terms of the, some of the harm minimisation aspects on our species of fauna, the committee's heard evidence that the Northern Quoll was I guess if you like on the most critical need response position but the dwarf fresh water crocodile in the high country around the Liverpool River area was deemed to be also a species that's in the sort of high danger zone. I'd like to hear your comments on that and we've got goannas, snakes, the pig nosed turtle was discussed in terms of the Daly area, what sorts of responses do you think would be appropriate in terms of those sorts of species and one person suggested that it could be where you look at the smaller islands sanctuary for the quolls, that's worked and wouldn't work necessarily for goannas because of their perhaps impact on nesting sea birds but could the islands of Melville, Bathurst and Groote be potential for maintaining some species that are in the sort of high risk category?

Dr LAWSON: Yes, they could, however with those larger islands you've got much more human traffic and where you've got more human traffic you've got greater danger of seeding if you like, with cane toads through accidental movements of them. Now we have already made some signage to try and help alert people to the fact that the islands are, need special protection. I think that effort should be bolstered but some of the species you mention, for instance there's very strong anecdotal evidence that King Brown Snakes are very much affected by cane toads. Now whereas some of the Tiwi Islands might have been very happy for us to move a few quolls, it's quite something if you turn around and say … can you go and foster a few King Browns.

Mr BONSON: I suppose one of the things, why I'm so interested I suppose I'm hooked up now with this Western Australian concept is that a lot of the flora and fauna obviously is very

similar to what we've got here in the Territory and if we were able to develop some kind of minimisation of that spread and eventually we get to the idea that we have some, you know it was mentioned here earlier this afternoon about a biological effect of minimising cane toads, not necessarily wiping them out but you know as a long term plan, then you could bring species whether they're goannas or you know King Browns, where from Western Australia, if we were able to stop the advance here, to then repopulate what's happening here, so that's why I'm sort of like interested in that idea of you know working in with Western Australia and ……..

Dr WOINARSKI: That's certainly could happen for some animal groups but like it wouldn't affect the crocodiles that Delia talked about, the distinctive form in the Liverpool River for example, which doesn't occur in the Kimberley so that you might be able to do that for some, perhaps but by no means all. I guess Delia, we were attempting to prioritise with the quolls, the species that we knew was highly susceptible that we thought we'd have public support for that wouldn't have the impacts where it was moved to that's why we chose that as sort of the flag ship one. The Liverpool Crocodiles, I'm not convinced that's a species anyway, the evidence for that's equivocal, I think the evidence for complete loss of fresh water crocodiles because of toads is pretty equivocal, it certainly tends to be a short term decline but in most cases it seems that that's reversed after a few years.

I guess all zoologists have their pet animals that they work with and I know that some of the scientists from ERISS who have been working on fresh water invertebrates in that stone country of Kakadu are really concerned about some of that, you know there's a whole lot of really endemic, really specialised fresh water insects that are nowhere else in the world and that's in the dry season they contract to pools which are rapidly contracting anyway and then cane toads can basically pick them off very easily as they congregate there so that you know where ever you look, there's whole facets of biodiversity that could well be affected and perhaps far more seriously than we recognise at the moment.

So moving some things is possible but we're never going to be able move things like invertebrates or groups of species that we don't at the moment appreciate what the impact's going to be. An ideal solution is certainly to get rid of the toads or to minimise the numbers but that's not, to my way of thinking anyway, it's not going to be likely in the next few years.

Mr WOOD: I know we're talking about taking animals to islands but the islands themselves have King Browns on, I've met them and quolls, so to some extent we should also be placing emphasis on both making sure we do keep them, toad free

because they've already got animals that we can reuse I suppose. And I suppose the question I was going to ask was, it would have been easier to just let, work on maintaining the quolls on Melville and Bathurst Island than putting them on one of the smaller islands off the Arnhem Land.

Dr WOINARSKI: Yeah, I mean prevention of toads getting to anywhere obviously is going to be the best solution if it's possible. Quolls actually aren't on Bathurst or Melville, they like rocks and there's not enough rocks there. They're on Groote …

Mr WOOD: Used to eat my chooks! I know they like to eat chooks.

Dr WOINARSKI: Yeah, they certainly do. But yeah, they're on Groote at the moment and we've got to quarantine Groote from toads but I think that's going to be impossible you know, it's something which it would be great to happen but given the amount of barge traffic and boats and fishermen and yachties and stuff moving around, I just don't think that's got much security, much certainty about it. But yeah obviously the islands in this case are the most valuable conservation refuges almost that we've got and of course most of the islands in the NT are Aboriginal owned so it's very much a matter of working with the Aboriginal land owners to ensure that they appreciate those values and that the risk of toads moving to those islands is minimised.

Mr WOOD: I think the local government associations working with you about putting the signs up on the islands or I think Dave Norton from Jabiru Council raised that a couple of years ago and I think that's where the signage started anyway and you believe that needs more emphasis.

Madam CHAIR: Yeah, I was going to ask that question when you mentioned there needs to be a bolstering of the effort in terms of the existing islands, quarantining them to an extent. Do you have any suggestions along those lines that we could consider?

Dr LAWSON: Well we have already been just yesterday or the day before yesterday, I was informed that my new initiative project was approved so we do have some money now to engage shall we say more directly next year, in other words John and I don't have to rob other projects to get you know, to do this island work anymore, which is a bit of a relief. Certainly prior to that is to bolster this effort and we'll be working a lot closer, we're working closer with the NLC on that because there are certain needs for instance: we need, the signage was all in English. I think we need to put signage in language as well, we need to have a much more pre-emptive approach to community schools I think because some of the best people you can get to spot things out in the bush in remote areas are Aboriginal kids. So if we can get

at the kids we might have a sort of mini police force there.

Madam CHAIR: Like the junior rangers over there.

Dr LAWSON: Yeah the junior rangers have been very much urban based to date but there's absolutely no reason why they couldn't be expanded out there. I think that we put the signage out on boat ramps and you know the freight companies have been very helpful to date in taking the signage and speaking to their captains and saying please do this but there's a limit to what they can do and I actually agree with John, I think in some of those large islands, it's almost inevitable that you're going to get cane toads on those islands. That's not to say we shouldn't try of course and …

Mr BONSON: What about TV advertisements and things like that, radio etc you know lifting the profiles, I just noticed in this pamphlet here, 'Cane Toads, a Few Facts' and we're talking about you know we've had evidence that when the cane toads are coming, they come in these large numbers and they swarm and they have an effect on the area and they're still, what we're hearing from John today, there's scientific evidence up about whether or not they fight back, you know, native animals or whether or not they stay at a low number or they disappear or whatever, you know that's still up in the air I understand. And I'll just read this one paragraph here, it's got: 'While the arrival of cane toads is not expected to affect wild life greatly …' and then it goes on blah, blah, blah, so this is you know something that was produced and here we are saying to them, well it's not going to affect your wildlife but all the evidence we're hearing is at least at the very minimum, when they first hit your area, they're going to wipe out nearly everything and we're hoping you know the evidence is still out there, whether or not they're going to fight back. So, you know I don't want to seek your comment on this I suppose but does there need to be an upgrade in all these pamphlets, in the radio stuff and …

Dr LAWSON: Absolutely, the pamphlet that we put out for instance was a pamphlet that was designed to tell people that cane toads were coming. I think there's a need, that's that one probably, there's a need now to tell people what to do when they actually find them in their own back yards, for instance one of the social effects is going to be, as the wave hits Darwin and the rural areas, there's going to be, I predict this, that there's going to be a pretty high wave of phone calls, letters etc with people's domestic dogs getting affected. If a dog mauls a cane toad depending on the dog, he can die within 15 minutes. There's going to be a lot of people out there that are very upset that their pets are foaming at the mouth and they die before they can get them to vets. So, yes we've thought about upgrading that and we've also thought about contacting the vets to say, look, surely we should be more preemptive now and actually have a set of

posters maybe about what you can do for your domestic pets.

Madam CHAIR: Like wash their mouth out with water straight away, that sort of thing.

Dr LAWSON: Yeah, if you see any effects you know I mean there are certain breeds of dog that are more susceptible simply because they have a go at animals more, I mean if you've got a Jack Russell Terrier and you live out at Humpty Doo, you might as well change your dog breed.

Madam CHAIR: I've got a Jack Russell and a Labrador. No, no Labrador will eat anything in sight.

Dr LAWSON: Yeah well the Labrador might bring you a few presents in for before he … on your carpet yeah so, I mean that's all a social effect you know, it is going to cause a lot of angst you know, a lot of angst. Cats as well.

Dr WOINARSKI: Yeah well I think Mathew with respect to that pamphlet, I think we've been to date, hamstrung by the lack of systematic research that was done in Queensland initially. So there wasn't a really good baseline of information from Queensland that we could work from, almost all the material was anecdotal and fairly small scale stuff so that it was possible to read the literature on the scientific impacts of cane toads on wildlife and so that basically there's nothing damming or conclusive about it. Whereas the information we're getting now from the Territory is far more systematic and compelling I think and we can state now with far more conviction that we've got a reasonable handle on what the impacts upon wildlife are likely to be, at least for the vertebrates, so that I think the very disparate views that people had about cane toads in the past which ranged from you know this is one of the worst environmental catastrophes that's ever going to happen to Australia to this is entirely benign. They're certainly going to narrow it as we are getting far more information available now.

Madam CHAIR: And just on the promotional material, it's certainly something that the public and the awareness perspective is one of the areas we've been tasked with and I'd like to actually invite you to consider any dollar figure to the cost of a promotional campaign, revamping promotional material inclusive of material in language, signage etc because if we receive expert advise in that regard we're able to put that into the range of considerations that this committee then makes in terms of recommendations to parliament. Because at the end of the day, we all know people's ability to respond is often a resource driven issue and we need to, as a committee, start to very, consider the tick tacks to resources.

Mr BONSON: Probably radio, TV and maybe you know information out to schools and stuff like that to be probably incorporated in that as well?

Madam CHAIR: So, we could be more focused in our recommendations in certainly a variety of areas, so with various people who've come before the committee, we've actually in a sense tasked them back to go and provide more information if they're able to, if you're not, not a problem but if you can and you're willing to, that would be useful information.

Dr WOINARSKI: I guess this is another case where it's co-ordination of the efforts of different agencies and individuals, it's really important as well, it's not sort of the direct task of Parks and Wildlife to try to address all those constituents out there and it's a matter of picking out which of the various players involved, should target particular interest groups.

Madam CHAIR: Absolutely. Any recommendations in line that you'd be happy to provide to us and say well you know in this area you know, these people could perform these roles and in this area well we exist in and obviously we're very clearly looking for an opportunity for a collaborative drive as well. But so from the fine detail of the expected resource requirements because Parks and Wildlife, you've already I know been as you've said wiping various other programs to meet the need right now.

Mr BONSON: Well one of the things I suppose Delia's leading to is that the idea might be to you know develop some kind of working group, not so it's not always you know going to go back on you guys to actually deal with the issues and do all the work I suppose by yourselves, when we develop the idea of a working group and who's supposed to be on that we can resource it properly and away we go.

Dr WOINARSKI: No, we recognise that some people are better co-ordinators to different groups.

Dr LAWSON: Oh sure.

Madam CHAIR: We're travelling throughout the Territory in May to hold public hearings as well, so certainly the evidence that we gather through that public process will be far more expansive than the expert evidence we've had to date although everyone who has appeared to date has said: I am not a cane toad expert.

Dr LAWSON: There is no cane toad expert …….

Mr WOOD: Ian Morris must get, well on the way to being one, I think.

Madam CHAIR: He's a frog expert!

Dr LAWSON: You know, I mean a cane toad expert, I would put that down as Alex Hyatt who's in charge of the search for the bio-control in Animal Health Division of CSIRO. I contacted him before I came here and he'd be very helpful and I tried to get a copy of their report that they just supplied to Environment Australia but I had a very strange reply which I think it is important that you hear. I tried to pre-empt Environment Australia and sort of nudge their elbow and say you know I'm still waiting for the report and I spoke to a fellow over there and he said well, there's a problem there David, he said, because this is commercial in-confidence. Now my reaction to that was, cane toad research, paid for by the federal government, commercial in-confidence? Why? Are you actually going to sell it back to us if you find the cure for cane toads?

Mr BALDWIN: Because CSIRO is semi-commercial.

Dr LAWSON: Well I know that but commercial in-confidence, that didn't seem to stick right.

Mr WOOD: What comes first, the state of the nation or commercial in-confidence?

Madam CHAIR: We've been able to access some commercial in-confidence reports already, I'm not referring to that particular one but we seem to have little luck so we'll go digging there, thank you for that.

Dr LAWSON: Please do that yeah, because I'd like to see that.

Mr BALDWIN: I wouldn't hesitate to say it's not the first reaction you've had like ……. from Parks and Wildlife talking to Environment Australia or even CSIRO, it's an ongoing debate.

Dr LAWSON: That's true.

Mr BALDWIN: It also points to the factors that aren't evident in this whole thing.

Mr BONSON: Just one side of things, you know when this wave comes and hits Darwin you know are greater Darwin, 90 000 people, we've got 200 000 people here, obviously it's going to affect half the population in a very short period of time, and developing up packages to deal with it, you know there was a suggestion that maybe you know, your block of land, you might be able to somehow fence that off or quarantine that off from the possibility of having cane toads in there etc and I know my partner's a bit of a frog enthusiast and you know, she's worried about you know how we can keep the green frogs inside away from exposed etc from what's going on outside. Is there a possibility of developing up little packages where people can, who have an interest in the urban areas of Darwin rural areas, that can do something?

Dr WOINARSKI: Can I answer that?

Dr LAWSON: Yeah.

Dr WOINARSKI: We've offered suggestions which I think the Land for Wildlife scheme published a piece …

Mr BONSON: Sorry what was that?

Dr WOINARSKI: The Land for Wildlife Scheme operating out of Litchfield Council I think.

Mr WOOD: Yeah.

Dr WOINARSKI: Has publicised some of that and there's a series of moves that you can make to almost toad proof your block and it's things like cane toads like short grass which is sprinkled, so you're more likely to get fewer cane toads if you've got an overgrown garden with fewer water supplies. You know, some people like that, it's not my place and others don't. Cane toads

Dr WOINARSKI: The cane toads their sort of biggest flaw in their composition seems to be that they're not very good climbers at all, so it's impossible to have sort of perimeter fencing around your place which is solid, at least for a few inches that is. And I think that could work as well.

Madam CHAIR: About four inches?

Dr WOINARSKI: Yeah, I was trying for ten centimetres.

Madam CHAIR: Up to ten inches to be safe.

Dr WOINARSKI: Yeah, yeah, so I think that's either solid or really fine fly wire or shade cloth.

Madam CHAIR: Does shade cloth work as a barrier?

Dr WOINARSKI: I think so, it should.

Mr WOOD: Why does it have to be so fine?

Dr WOINARSKI: Oh simply because the toadlets, the baby ones are very small.

Mr WOOD: They wander along too. They're not just sitting in water?

Dr WOINARSKI: No.

Madam CHAIR: Once they get those little legs, they're out. They're moving around.

Dr WOINARSKI: So, you can reduce the chances of them actually coming into your gardens and stuff, there is no guarantee.

Mr BONSON: Obviously somewhere like Rapid Creek, which of course is going to be an issue in my electorate especially because it's fresh water, salt water stuff, I suppose if there's, you know, any proposals that you guys can work up, you can think of those little areas in urban Darwin that you know, I noticed …

Just to think about that concept because I would presume that that's going to be a perfect habitat for cane toads to go there and then suddenly everyone's walking past

Dr WOINARSKI: If you look outside the window and look at the landscapes of sort of this part of Darwin, it's all short lawns, irrigated and cane toads will love it, especially where there are lights overhead where the moths and other insects will congregate.

Mr BONSON: Actually there was some man in ……. when I was in Queensland that because they didn't have a very good wet season, that there weren't many cane toads round because I was looking for them and I didn't see them until I got to Brisbane. You know does that the answer David or do we think that's …

Dr LAWSON: Well the numbers certainly fluctuate between years and there's some hope that that might be a density dependent thing that occasionally they get too many and a lot of them starve or don't reproduce particularly well and certainly the dry periods, periods of dry wet seasons, yeah the numbers don't build up as much. I think there was some anecdotal information that numbers in Katherine over the last few months haven't been as high as they were the year before.

Mr BALDWIN: You don't see much in the wet because they, I assume they're dispersed more. In the dry, as soon as the wet stopped, two or three weeks ago, they were every where, everywhere.

Mr WOOD: So, Marrara Football ground is going to be an interesting place to play footie on.

Mr BALDWIN: Oh yeah, squish squash!

Dr LAWSON: I think one of the things they've done in Queensland too with constrained areas like Rapid Creek is that the local people have got together and they've actually got sort of cane toad task groups, they actually go out with buckets and collect the damn things you know. Now, you could argue well that's just a drop in the ocean, it's not going to really do anything in the big picture but I think you know, we shouldn't denigrate that sort of community effort and sort of encourage it, you know because there are certain places

where if you did have a physical collection, you probably could keep them reasonably toad free and it might be places like Marrara Stadium where you say, do things for the footie, let's get in there and collect the cane toads and certainly I mean, it might actually act as a little bit of a magnet for cane toads if you've got a nice irrigated footie pitch you know.

Mr WOOD: And lights.

Dr LAWSON: That's right.

Mr BALDWIN: That is where they love it. ……. on my lawn every night.

Madam CHAIR: They don't like astro-turf though, so I'll be fine.

Mr WOOD: Lawn bowls too.

Mr BALDWIN: Oh well that raises the question obviously in the whole information campaign thing, is that you won't stop people from trying to get rid of them and there's that humane aspect of how you should dispose of them. And it's going to have to be, we are going to have to say something on it in terms of public relations. You don't want to encourage kids going round with golf sticks and you know, beating the hell out of them. It's not only how they're dispatched, it's what you do with them then.

Madam CHAIR: I was told freeze bags.

Mr BALDWIN: That's what they promote in Queensland, in a big hurry.

Dr LAWSON: Yeah well I mean, the humane treatment of feral animals I think is sometimes overlooked and it shouldn't be, after all, if you look at it plainly, it's not the cane toad's fault it's a pest, is it? And it is actually a sentient animal, it can feel pain so I think that, I agree with you Tim, I think there's a very large responsibility on all of us to say, yes they are a pest, no we don't want them but don't be cruel to them. And certainly I think the most innocuous way to actually kill them is to use the freezer method. If you really want to be gentle, put them in the refrigerator first.

Mr BALDWIN: Get's the mothers and wives really hopping, I tell you, when you suggest that you've got all these live jumping things in these plastic bags and you just throw them in your freezer they go, 'Oh, whaaaa!' They'll just freak out.

Mr BONSON: One thing is the evidence we've got about the fox and donkey stuff and they're talking about the fox and they use baits. Now, you know we're talking about a disease, biological effect, you know has there been any development of a bait situation you know, a food product that these toads might eat? That you know they first invade into a water

area, we go and drop ten baits around it and they'd come out and they'd feed on it and they go to sleep.

Dr LAWSON: Not to my knowledge. I think the problem with cane toads is they'll eat more or less anything they can catch, so a cane toad specific bait would be I think almost impossible to find.

Madam CHAIR: It would kill every other species around that's eat anything like it, yeah.

Dr LAWSON: There are probable things we can try like the one thing we've been tossing around through my unit is that the one thing we noticed in the last two dry seasons in Darwin when we had the cane toads brought in, we think on removal vans, it was striking that in every instance they had these self watering pot plants in their possession and that's where we found the cane toads, so we've been toying with the idea of some sort of plastic thing that cane toads can get into so they can get refuge in it and then you could just pick it up and shove it in your freezer. And I'm sure if an entrepreneur there's a sort of couple of million dollars to be made there somewhere. We are still sort of toying with that but how effective it would be, we're not so actually certain but maybe we should have a play with that too.

Mr BONSON: Maybe something the NT Government can develop and fund the project.

Mr WOOD: Commercial in-confidence.

Dr LAWSON: We've already got a patented fox bait delivery thing that Glenn Edwards, our scientist in Alice Springs has just invented and that's, we've had great interest in that from Tasmania for obvious reasons, they've got foxes there, they want to get rid of them but they don't want to kill all their dogs, so we've got this bait delivery system which only foxes can access which is pretty normal, so it's not beyond us to actually think of …

Mr BALDWIN: How does it stop dogs from …

Dr LAWSON: Well it all came about when we were sitting and having a cup of coffee one day and we were tossing the ideas of foxes, dogs around and Glenn was actually holding a dogs skull and I picked up a fox skull and we looked at this and Glenn went 'Ah!' and he just literally sketched this little thing out and said I'm sure this would work. Basically it's just a narrow bait delivery funnel and a counter-weight that they can get their nose in and dogs can't. Now obviously if you've got a very small dogs, tough. As far as dingoes are concerned you see, dingoes can't get at these baits delivery devises whereas foxes can and we've done some field tests and there are some goannas that get pretty smart and try and get the bait out of there and cats can't get at them

because they're counterbalanced so, I mean you can think of things like this it is perfectly possible, you know you talk of ……you've got enough talent around, enough people who know what they're doing and you stick them in a room and say invent something, they'll probably come out with some idea. But this all comes back to this you know consolidation and getting the right people in the group you know.

Madam CHAIR: Which is where we're very keen to have any suggestions you have on that come back to us because I know it's something that you want to take some contemplation about. Getting back to humane ways of disposals, some people have said that a popular thing has been Dettol in a watering spray. What's your opinion?

Dr WOINARSKI: Very painful.

Dr LAWSON: Yeah we actually did some searching around for that and the consensus from the people that had looked at that was that it was an extremely painful way to kill the toads.

Dr WOINARSKI: If they had a voice you could hear them.

Dr LAWSON: And in fact we recommended just a few weeks ago, someone sent us a letter saying would we advocate this and we said: no we would not.

Madam CHAIR: So you'd advocate the freezer option, the fridge/freezer option and that's it?

Dr LAWSON: More or less, yeah.

Mr BALDWIN: Or an injection by a vet.

Madam CHAIR: The vets are already going to make a packet out of the dogs and cats.

Dr LAWSON: And if you did that you'd have an influx of vets to the Territory, I tell you, very quickly.

Mr BALDWIN: Can I get back to baseline data? Taking the discussion back a little bit, that's one of the things that's missing in the whole sort of debate on cane toads, you know, Queensland, 70 years of cane toads never did much in the early days. You're saying that we'll have a much better picture but are we doing scientific type baseline observations so that we can go back and post observations then and the pre-observations and post toad, so that we can go back and do the counts on the ground and all that sort of thing to see which animals have been affected? Or are we just doing from our general quantum of information in the Territory that we'll have a look afterwards and see if it's changed. How are we doing it, what are we scientifically?

Dr LAWSON: That's yours.

Dr WOINARSKI: We've, over the last decade or so developed a very systematic way of counting terrestrial wildlife in the Territory and we've got probably five to ten thousand hectare quadrats spread across the Top End in which we've censused, over a three night period basically all the wildlife, the vertebrate wildlife that occurs in those and that's extraordinarily detailed and comprehensive baseline from which we can monitor any change that's occurred or that occurs henceforth. And we've used that system Kakadu in that report that's just gave where we, two years ago we sampled I think it was 110 odd quadrants in exactly that same way in the bottom of Kakadu and almost or a bit over half of those were invaded by cane toads in the six months after we'd sampled them and then we went back last year and re-sampled them all again both the ones that were impacted by toads and the ones that hadn't and that gave us a very clear picture of basically what the changes in the fauna had been. It's a very powerful way of doing it, from that basically it was evident that the quoll was by far the most affected of that group of animals that we could sample.

So that's a terrific amount of information that we've got for pretty well all the vertebrate fauna that lives on the land, however we haven't done similar stuff for the aquatic fauna so the fish, the aquatic goannas and we haven't got anywhere near the same, almost no information about the invertebrates. So that's basically the work that Parks and Wildlife's done which can be used to assess quite precisely the effect of toads and we …

Mr BALDWIN: Are we going to get those quadrats down Borroloola way?

Dr WOINARSKI: They were a bit shy in the Gulf country but we got some, yeah.

Mr BALDWIN: So, were, they've obviously got some pre and post data that's sort of three years now since cane toads or whatever compared to the Kakadu ones which are …

Dr WOINARSKI: Yeah the best stuff for that part of the world and that's not entirely Borroloola but there's a good study by CSIRO on the Roper River area which was published, in 1999 and that used the same sort of approach. And that basically was, I can't remember, about 150 odd species and there are only three which seemed to show serious cane toad effects, the dingo, one dragon lizard and one frog I think. Basically that was the first evidence from the Territory that fauna on the whole aren't going to be hugely affected by cane toads.

As well as the work that we've done, there's work currently underway in Kakadu which is looking at radio tracking quolls and that's shown very much the same results that we've

got: that quolls are can't handle the toads. And there's also radio tracking work going on goannas, work being done on snakes by other agencies, so that you know the sum of the effort here is pretty substantial and should in a year or two give a very clear picture across most elements of bio-diversity and far better than whatever we got out of Queensland. But there are still things like invertebrates which no-one's looking at.

Mr BALDWIN: Yes, and aquatic as well.

Dr WOINARSKI: Yeah.

Madam CHAIR: Is fisheries looking at aquatic, have they got research areas in fisheries?

Dr WOINARSKI: Not that I know of, Arthur George from the University of Canberra's doing some work on pig-nosed turtles and some other …

Mr BONSON: What about barramundi and, we've had evidence of this thing that barramundi could be something affected as well?

Madam CHAIR: But we've also heard that it spits it out, doesn't like it.

Mr BONSON: Yeah exactly, so I'm just trying to get a clarification so obviously there is still a lot of contradictory information.

Dr WOINARSKI: We certainly don't work on fish, only on recreational. No, it is Fisheries responsibility.

Madam CHAIR: The fisheries in the NT, you're not aware of anything they are doing in that area?

Dr LAWSON: No, I spoke to Richard Sellers (?) just the other day about it and he seemed to be rather unconcerned about the barramundi question. He seemed to be convinced that barramundi just sort of spit the things out and certainly didn't seem to be any over concerned there at all, for the game fish, no.

Mr BONSON: And where's he getting that information from, is it anecdotal or is he getting it from Queensland or …

Madam CHAIR: We'll have to ask him.

Dr LAWSON: I don't know, that's all the told me.

Mr BONSON: I suppose there's another one of the issues that the Kimberleys, we've had evidence here that they're doing some large identification of crocodiles and stuff like that there, are you guys involved with that at all?

Dr WOINARSKI: No, that's Graham Webb.

Dr LAWSON: We're involved in it, just doing the permits and the regulation of it, but no, that is Graham's research.

Mr WOOD: Have you tried to list how many organisations have been working on cane toads? I mean if we were to go …

Dr LAWSON: That was a good question.

Dr WOINARSKI: There was a Dr Rod Kennett from Kakadu, Parks Australia actually compiled a list of current projects that are going on in the Territory, looking at the impacts of cane toads.

Mr WOOD: Just in the Territory yeah?

Dr WOINARSKI: Yeah.

Mr WOOD: And has anyone compiled it nation wide?

Dr WOINARSKI: Negative.

Dr LAWSON: Not to my knowledge.

Mr WOOD: If you're working at trying to bring a collaborative approach, we'd need to know who's working, to get the best value for money I suppose. There's money being put here, there and everywhere, it would be nice to know where it's going.

Dr LAWSON: The largest funding of course is, that we know of, is the federal initiative to look for the bio-control and that's what CSIRO and Animal Health in Geelong.

Dr WOINARSKI: Actually, no, Rick Shine's got more money than that.

Dr LAWSON: Has he?

Dr WOINARSKI: Yeah.

Dr LAWSON: I didn't know that. What has he got more than half a million?

Dr WOINARSKI: Oh yeah!

Dr LAWSON: Good old Rick, well there you go, I stand corrected.

Mr BALDWIN: What's he doing?

Dr WOINARSKI: He's looking at the … up here at Fogg Dam basically, looking at the impacts of toads on snakes and goannas to an extent and I think he's got several million dollars over a couple of years to do that.

Mr BALDWIN: Everyone else might know but who's he work for?

Dr WOINARSKI: He's University of Sydney. And they've got one of the world's best data sets on water pythons, they've marked every individual basically for the last 15 years. That's extraordinary and he's trying to demonstrate that there's rapid evolution in terms of adaptation to cane toads.

Mr BONSON: I take it that you guys would be interested maybe in sitting in a big round table having all the people that's presenting evidence to us, having big brainstorm session about where we could go from here? Rather than at the moment, we're individually getting piece meal evidence from different organisations. I always find that sometimes it's good to get everyone in the same room as well, that'd be interesting.

Dr WOINARSKI: It would be great to bring all the parts together I think.

Mr WOOD: Has there been a cane toad conference at all?

Dr WOINARSKI: There was this one at Jabiru that you've got …

Madam CHAIR: The ERISS report, the workshop?

Dr WOINARSKI: The workshop from about three years ago.

Madam CHAIR: The cane toad workshop, 8th September '98?

Mr WOOD: Was that the first one or has there been some before that?

Dr WOINARSKI: No, that's the only one…….

Dr LAWSON: Just one point about the Mathew's idea about a package, an information package, the one thing that I would also strongly urge that when we actually produce our public outreach material, very often there's this is put together by scientific staff and although I'd like to think that we're very erudite sort of citizens, we tend to sort of be a product of our training and I think it really is important to have more professional help in how that's presented. I mean you were talking Mathew about TV. Well we could probably give the relevant information about a TV type approach but I would hesitate that you put any of us on camera to actually do it. I'm trying to explain that you know the presentation of this stuff sometimes is perhaps not as catchy as it could be and we tend not to go for that sort of professional help simply because it is relatively expensive to do it that way. But I've often thought that that might be not to do it that way might be a false economy and to certainly on the occasions when we have actually gone out and said to professionals, there's the information, now get it out, they come out with some quite remarkable ideas that we wouldn't have even dreamt of and I think that's really important to bear that in mind too, that you don't just need scientists, you don't just need people from the NLC, you need people that are experts in getting the message across, you know, we tend to often

ignore that.

Mr WOOD: Do you still have a media, or did you ever have a media branch at Parks and Wildlife at one stage?

Dr LAWSON: We've got a, we always had a media officer because there's always been intense public interest in Parks and Wildlife per se, now we're part of the bigger department, there is a media unit and they're pretty professional and they do a good job, I think I contact them probably an average of two or three times a week for instance. As far as I know, there is only one professional journalist actually on that staff though, that's we've got on staff and we rely on them to see well, we'll sort of say well what about this for a media release and they'll say fine, they tailor it but I'm actually talking more than that. I'm actually talking about some really serious professional …

Madam CHAIR: Production.

Mr BONSON: Yeah I agree because you know unfortunately the way modern society is you know the examples of how the MBA market themselves all around the world with cross-culturally, it doesn't matter, South America, North America you know Africa, Asia, they are able to sell their product which is their MBA guarantee Michael Jordan, you know, Gator Ade whatever and I'm not saying obviously we go down that, we don't have the money probably to go down that path but we certainly need to be smart in certainly our concepts and I think yeah the younger generation unfortunately the medium is TV, you know radio to and extent but certainly TV and you know the people I know you know they'd get this and they'd have a look at it and maybe not digest information in it maybe not as quickly as they possibly TV with you. So I agree.

Dr WOINARSKI: Are you taking outreach material like that with you when you are travelling?

Madam CHAIR: Well there has been some debate about the quality of that one.

Dr WOINARSKI: Well yeah, no not that one in particular. But you're not taking literature with you and disseminating it?

Madam CHAIR: No, it's a fact finding, listening, absorbing tour de force of our highly entertaining committee.

Mr BONSON: That might be an idea to look at. Maybe we can take, we can talk about ……

Madam CHAIR: If the department has any information that you think is useful.

Dr WOINARSKI: What you're saying that pamphlet's not?

Dr LAWSON: Can we get something together for your next travelogue?

Madam CHAIR: We're travelling in May, what's the first date. Tuesday 6th May to Borroloola.

Mr BALDWIN: Half the places we are going have experienced cane toads.

Madam CHAIR: That's what I'm saying. That information is not relevant to the cane toad areas because they're living them I guess. It's that next stage of promotional material you are talking about. So it's a tight time frame. If you want to do a one page fact sheet, you know contact Parks and Wildlife on this number or whatever, however you as a department already deal with incoming queries, what's a good process to advise people of, whether those local ranger stations that you want to give that, we're going to Tennant Creek, Katherine, Jabiru and then Palmerston, Darwin and Litchfield.

Dr LAWSON: If you're after something succinct, there's a briefing note here that was done for our executive director and conservation and natural resources group which you can have a look at. I think there's some, that's pretty succinct and it was written by an expert. …And I think that's the sort of very brief stuff that you need to get a grip on. There is a practical consideration here though also because as I said earlier …

Mr BONSON: Well I don't have a real problem with this except for maybe that one sentence you know which say, apart from that it's all right.

Dr LAWSON: Already we're looking to upgrade that and turn it, now depending on what your group's going to do, I'm not going to waste effort. I mean if we are going to go and get this package together then there's no point in me doing that but I do need to do that if the process that we're talking about is going to take too long and the toad's actually get here, so we're really in a catch 22 situation.

Madam CHAIR: Yeah, we're fast tracking our body of information as a committee so that we can aim to give something to parliament hopefully by mid-year, at the latest because of the rate of impact and the ability for us to provide the advice to parliament then, speeds up the process of parliament making decisions on that.

Dr WOINARSKI: Get the report in before the toads get here.

Mr BALDWIN: As you know, that's going to leave a problem because whatever recommendations are concerning resources, which means money and then wait for another budget rounder, all that sort of stuff and consideration by

government and so, a thing like a pamphlet or an information package, really as a committee we're going to have to give consideration to how do you get it out there, what resources can be provided to get it out there far quicker than the whole government process and that's something I was going to raise later when we were in closed sessions because you could be waiting, we all could be waiting as we know government works any government, for another round of budget before you get the resources to go and produce the TV or the radio or the, and really it needs to happen quicker than that because the cane toads are, the first wave will be well and truly through by then. Pine Creek and beyond now, it's not going to take much longer.

Madam CHAIR: But if we get some advice on some promotional information out of say Parks and Wildlife on some estimates and costings, there's nothing to stop us from giving that information as preliminary advice to the minister responsible.

Mr BALDWIN: Oh no, that's what I was going to talk to you about, there needs to be a recommendation to government before the whole sort of finalisation on this group.

Dr LAWSON: So I'll just put the letters ASAP on all I've written here then.

Madam CHAIR: That would be a good one.

Dr LAWSON: Ok.

Madam CHAIR: Any other questions Committee members?

Mr BONSON: I'd just like to thank you guys just on behalf of myself for coming, it's been fantastic and you know you've been very informative for me. There's a lot of things I've found out that I didn't know before. That's all I wanted to say.

Dr WOINARSKI: Thanks.

Mr WOOD: I'll let the Chair do that.

Dr WOINARSKI: Can I just push a barrow?

All: Yeah.

Dr WOINARSKI: It's slightly tangential to this and that's that it's easy to identify the toad problem retrospectively but we're making the same mistakes consistently now and our descendents are going to have to pay for them. Toads they're obvious, you know they look ugly, nobody likes them and they're conspicuous but at the moment much of the Top End, much of the Territory has been degraded by things which are far less obvious, things like gamba grass, para grass and in some cases buffel grass and were still allowing these

problems to be introduced to our environment and probably their effects on our bio-diversity are going to be far worse than cane toads. So it's fine, we've realised that cane toads are a problem, 60 years, 70 years after their introduction and we should be using the cane toad as an example of not to fall into that same trap again and now we're still, five years ago, ten years ago we were proselytizing about these pasture grasses and saying that you know they should be spread everywhere in the Territory almost and it's going to be our sons and daughters that are going to be, going to have to deal with the problem that will come from those in years to come and to me cane toad's just a classic example of the lesson we should be learning is that we shouldn't be so stupid again. That one vested interest shouldn't introduce something which is going to affect all our lives. Anyway, that's just a bit of a tangent but I think to me, I mean that's what we should be getting out of this cane toad thing. We're not going to solve the cane toad problem itself but we should be looking more broadly from it.

Mr WOOD: I support that 100%. I looked at the weed list they sent out for comment and they had the yellow oleander, I've forgotten its proper name now, has a possible weed but they didn't have Gamba grass, I mean the difference is just like chalk and cheese. I know it's a pasture species but it's just everywhere. Because I've got a block of land at Adelaide River, it's just changing the landscape and it's just, I know they're spraying it but I just think …

Dr WOINARSKI: It's escaping far more quickly than they are spraying it.

Dr LAWSON: Just to add on to what John said for instance in the Territory, we don't have a process for actually reviewing any species that people might want to bring into the Territory and I think that's to our detriment. I think we should have some process in place that if people want to bring new varieties or new species into the Territory that there is actually a very clinical look at not only the potential economic benefits that that might accrue but also the possible harmful effects and in the past, I think I'm right in saying that for instance in so called improved pasture species have been brought in by agronomists and certainly in the six years I've been here Parks and Wildlife has very little if any, been involved in actually being asked an opinion on that when it's happened. I think that that is an insidious environmental problem, as John said, and I totally agree with that but we just don't even have the most basic processes you talking about the introduction rather than for actually trying to stop that at the moment.

Mr BALDWIN: A noxious weed list.

Mr WOOD: Madam Chair?

Madam CHAIR: I was going to say, what are the protocols elsewhere?

Dr LAWSON: Well in Western Australia they have a system whereby there is a 'weediness' index put onto a particular variety or plant before it's introduced and it's my understanding that anything that comes in has to go through this process of being assessed by this independent committee of experts, I hate that word but you know what I mean, people with experience in that respect but it includes people with and expertise in bio-diversity, it includes agronomists, it includes pasture scientists but what I'm trying to say, the process is not just one sided and I think John's predictions are actually unfortunately going to come true: that we are going to bear the effects of some of these introductions in a way that makes cane toads look like a walk in the park.

Mr WOOD: And I think just to back up that, look how long it takes to bring on a biological control insect into attack mimosa, takes years, yet you can walk in with gamba grass, that's it, I mean it was a classic example where it might be a good species but if some work had been done on it for instance perhaps to hybridize it so it didn't have viable seed as is done with some of the millets, it could have been just a use that old phrase, win/win situation but at the moment it certainly shows the so called theory of sustainable agriculture is a laugh, is a joke because someone else is now paying for the control of that particular species outside of where it was originally meant to grow.

Madam CHAIR: Well I'll raise this issue with the Minister for the Environment who also has primary industries. It's not in our terms of reference, so it can't be included in the recommendations but because it's been raised today I'll take it up.

Mr WOOD: Not so much Gamba grass but the introduction of species into the Territory. There should be some perhaps go …

Madam CHAIR: That's what I'm going to raise, the issue of we don't have any separate authority that looks at the introduction in the first instance, can something be introduced?

Dr WOINARSKI: That's certainly always far cheaper to solve the problem before it happens.

Madam CHAIR: And I'll, if by raising that, I'll suggest they look at the WA example but we can't formally recommend because it's not within our terms of reference but I will as the Chair of this committee because it's come up in this discussion, take it up with the Environment Minister.

Dr LAWSON: Well one thing I would draw attention to, related to cane toads and we touched on this in our conversation this afternoon, I think that John said, it's because they are warty and ugly, no body cares if they get controlled and you know

everybody would like to see them controlled. We have a very invasive species which are very attractive to some people and one of our most pressing problems at the moment are cats and in fact you might be interested to know that myself and Glenn Edwards have just motivated to bring the cat issue back to the Vertebrate Pest Committee who have in my experience and my opinion put this into the too hard basket and certainly this where politics comes into it because there are very powerful lobby groups that say, they wouldn't like so see a bio-control on cats for instance and yet the people in the Animal Health Division in Geelong tell me that it's perfectly feasible to work on a bio-control for cats but no-ones doing it because it's one thing to kill cane toads with a bio-control, it's another thing to kill you know your friendly moggie sort of thing.

Mr BALDWIN: I'll support you 100%.

Dr WOINARSKI: I know you would and that is a very important point about these sorts of controls.

Mr WOOD: George Brown tried to introduce it to the Australian Local Government Association, he wanted a levy on, and the big cities wouldn't support him at all.

Mr BALDWIN: No, the populations won't support it.

Madam CHAIR: There's a lot of cat voters out there.

Mr BALDWIN: Well there's a lot of urban people who don't see the damage that cats do because they physically don't live in rural areas and that's basically the bottom line, that's where your population is and where the sway is and where the vote is so it's unfortunate.

Dr LAWSON: That's right, the conundrum of your voting population, 90% think milk comes out of a bottle and that's your problem.

Madam CHAIR: Well this committee's not about to change the world folks.

Madam CHAIR: John and David on behalf of the entire Environment Committee and Environment and Sustainable Development Committee we want to thank you for your time here today, we found your information provided to us knowledgeable, and interesting and thought provoking. We hope that our recommendations will go some way to making your jobs a lot easier and we certainly appreciate the great body of work that yourself and the staff at Parks and Wildlife have been doing for Territorians for years now and into the future. Thank you.

Dr WOINARSKI: Thank you.

Dr LAWSON: Thank you.

Madam CHAIR: And thanks for saving the quolls.

SUBMISSION NO. 1B

Parks and Wildlife Commission of the Northern Territory
Ms Jailee Wilson

Submitted: 30 May 2003

RISKS AND POTENTIAL EXTENT IN THE NT

Cane toads (*Bufo marinus*) were introduced into eastern Queensland in 1935 and spread into the Northern Territory in 1982/83.

Potential Extent

Cane toads reached the Northern Territory (Nicholson River drainage) in 1982/83 and annual expansion of range since then has been estimated at about 30km/year. However, they appear to have spread more rapidly than this over the last 3-4 years, presumably because they have breached the large river drainages of the Top End. They have now colonised most of Arnhem Land, some of the Pellew Islands, the southern half of Kakadu NP and Katherine. The current "invasion front" extends from Ramingining and Pine Creek in the north, Victoria River Crossing in the west and Dunmarra in the south. At current rates, toads will colonise Darwin in the wet season of 2003/04. All of the mainland Top End is likely to be colonised by the end of 2004. Their potential distribution in Australia, based on suitability of climatic conditions, is shown below (Sutherst *et al.* 1996). The expanding distribution of the cane toads is being documented on the Frogwatch website (www.frogwatch.org.au).

Impacts on native fauna

There has been considerable dispute about the ecological impacts of cane toads, fuelled partly by the previous lack of comprehensive monitoring of wildlife populations. The most recent major review of potential impacts was by the Office of the Supervising Scientist (Van Dam *et al.* 2002). Of 151 predator species assessed 10 species were considered likely to be at risk, 12 species were considered at possible risk and the risk for 98 species were considered uncertain. Almost all authorities recognise substantial short-term impacts - an initial major decline of many vertebrate predators (especially including goannas, most snakes and northern quoll, but also including some crocodiles, turtles, fish and birds),

because of cane toad toxicity. There is some dispute about whether there is recovery in populations of these predator species in the years following the initial abrupt impact (with that putative recovery due to strong genetic or behavioural selection). The most recent evidence (data collected in 2002 from Kakadu by the Biodiversity Unit of the Conservation and Natural Resources Group of the Department of Infrastructure, Planning and Environment (see Appendix 1)) suggests that northern quolls may be especially affected. Observations from Queensland seem to indicate that quoll populations do not recover except in a small number of rocky sites. Thus there is a realistic possibility that this species may disappear from most of the mainland NT because of cane toads.

Terrestrial invertebrates used as food by cane toads are also likely to decline in abundance. There is evidence that a tapeworm found in the intestines of a snake declines following cane toad invasion. The toads consume most of the intermediate stages of the parasite which consequently are not transmitted to the ultimate host, the snake. There is little further work on the effects on invertebrates but, because of the cane toads large appetite, some effects could be considerable.

An assessment of impact of cane toads on the conservation status of Northern Territory vertebrates is shown below.

Scientific name	Common name	Status prior to consideration of cane toad impacts	Recommended new status
Dasyurus hallucatus	northern quoll	Near Threatened	Vulnerable
Pseudantechinus bilarni	sandstone antechinus	Least Concern	Data Deficient
Sminthopsis bindi	kakadu dunnart	Least Concern	Data Deficient
Sminthopsis virginiae	red-cheeked dunnart	Least Concern	Data Deficient
Antechinus bellus	fawn antechinus	Near Threatened	Data Deficient
Planigale maculata	common planigale	Least Concern	Data Deficient
Planigale ingrami	long-tailed planigale	Least Concern	Data Deficient
Macroderma gigas	ghost bat	Near Threatened	Data Deficient
Cyclorana australis	giant frog	Least Concern	Data Deficient
Limnodynastes ornatus	ornate burrowing frog	Least Concern	Data Deficient
Varanus panoptes	yellow-spotted monitor	Least Concern	Near Threatened
V. mertensi	Merten's water monitor	Least Concern	Data Deficient
V. mitchelli	Mitchell's water monitor	Least Concern	Data Deficient
V. primordius	Northern blunt-spined monitor	Near Threatened	Data Deficient
V. scalaris	Spotted tree monitor	Least Concern	Data Deficient
V. tristis	Black-tailed monitor	Least Concern	Data Deficient
V. glebopalma	long-tailed rock monitor	Least Concern	Data Deficient
V. glauertii	Kimberley rock monitor	Data Deficient	Data Deficient

V. indicus	Mangrove monitor	Least Concern	Data Deficient
V. baritji	Black-spotted ridge-tailed monitor	Least Concern	Data Deficient
V. acanthurus	Ridge-tailed monitor	Least Concern	Data Deficient
Acanthophis praelongus	northern death adder	Least Concern	Near Threatened
Pseudechis australis	king brown snake	Least Concern	Data Deficient
Pseudonaja nuchalis	western brown snake	Least Concern	Data Deficient
Enhydris polylepis	Macleay's water snake	Least Concern	Data Deficient
Demansia olivacea	olive whip snake	Least Concern	Data Deficient
Demansia vestigiata	black whip snake	Least Concern	Data Deficient
Demansia papuensis	Greater Black Whip Snake	Least Concern	Data Deficient
Rhinoplocephalus pallidiceps	northern small-eyed snake	Least Concern	Data Deficient
Tiliqua scincoides	common blue-tongued lizard	Least Concern	Data Deficient
Ixobrychus flavicollis	black bittern	Least Concern	Data Deficient

The high number of species changed to Data Deficient is a result of our lack of knowledge of the long term impacts on many species.

Current research

The Parks and Wildlife Commission has conducted research on cane toads since 1980. This work concentrated on how fast the cane toads were spreading, determining factors affecting population size, habitat requirements, food habits, interactions with native fauna, behaviour and activity patterns. Recently, there is some research effort directed at investigating ecological responses to toad invasion in the Northern Territory. This work includes:

- studies commissioned by Parks Australia on responses of quolls to toad invasion, and on monitoring of wildlife generally;
- a study by Wildlife International on the responses of freshwater crocodiles;
- a study commissioned by the Department of Defence on response of wildlife at Mt Bundey training area;
- studies on a range of goanna species by the Key Centre for Tropical Wildlife Management and researchers associated with Universities elsewhere in Australia and overseas;
- an examination by the University of Sydney of the initial impacts on snakes at Fog Dam and the subsequent mechanisms involved in population recovery, if this occurs; and
- studies on the response of native frogs by the University of Queensland.

CSIRO has supervised research extending for more than a decade on possible control mechanisms for cane toads. This work initially looked at biological control agents such as viruses and diseases. Their present work is focused on investigating ways to interfere with the metamorphosis process in tadpoles.

It can be seen that the majority of research is on the ecological effects of cane toads on native fauna. While this work is important and should be continued it does not give any immediate insights into how on-ground control could be undertaken. There is also scope for enhancing the collaboration between Frogwatch and the Parks and Wildlife Commission.

Cultural and socio-economic impacts

Many of the native wildlife species likely to be affected by cane toads (e.g. goannas, turtles, crocodiles) are important food resources for Aboriginal people living traditional lifestyles. Decline of this wildlife will erode that lifestyle and will lead to increased costs where dietary alternatives (i.e. store brought food) have to be found.

Cane toads will also degrade the quality of life of Territorians more generally. Many Territory residents appreciate their close contact with a largely unspoilt nature. High densities of a conspicuous and ugly animal pest will detract from that contact. Toads will flourish in and around swimming pools and ornamental ponds, and the lawns and shady gardens that are such a feature of Darwin are ideal toad habitat. Toads will prove a hazard for pets, and are likely to cause the death of at least some dogs.

Toads may also have some impact on Territory enterprises. Tourists may find the wildlife/wilderness experience somewhat diminished by the presence of large numbers of cane toads, although the limited information available suggests that this impact is likely to be minor. There is some anecdotal evidence that cattle may sicken from drinking water that has held high densities of toad eggs or tadpoles.

MANAGING THE IMPACTS

There is no short term solution to this issue. While this reality should be explicitly recognised, it should not be an excuse for complete inaction.

Control mechanisms

1. Physical removal is unlikely to be effective. A trial was conducted by Parks and Wildlife in the Gulf region in the mid 1990s. 3,253 toads were removed from three adjacent waterholes over a five night period but more than this number remained. Thus total eradication from an area would be extremely labour intensive, costly and only likely to be partially effective for short periods of time. A bounty system would not achieve control and would be costly.

2. It has been suggested that fencing may be effective in 'toad-proofing' part of the Territory mainland. Logistically, by far the most efficient place to do this is at Cobourg Peninsula, where exclosure fencing across the relatively narrow neck could protect an extensive area. Such action is under consideration by the Cobourg Board but there are reasonable concerns about the ability of any fence to exclude toads. If a location can be found that avoids watercourses (i.e. areas that would flood and negate any barrier) then such a fence may work. However its effectiveness would then depend on the likelihood that toads would not swim into the sea to get around such a fence (which would need to be made from a non-corrosive material where it entered the sea). Investigations on this would need to be undertaken. Also it would need to be assessed as to how diluted by freshwater the sea around the end of the fence would become in a high rainfall wet season (and thus breakdown any seawater barrier). Another problem with this concept at Cobourg is the transport of cane toads into the area aboard cars or trailers. They are many examples where cane toads have been transported in such a manner. Thus constant vigilance would be needed and practical experience shows that this is unlikely to be achieved.

Private landowners in the Darwin region may be able to fence all or part of their gardens to exclude toads. Toads do not jump or climb well and a smooth metal fence of 30cm height should exclude them. However the same weakness applies as to any other fence in that an open gate or a fence breach could quickly lead to invasion of the premises.

3. The most promising control mechanism is a biocontrol agent. CSIRO is researching the use of a genetically modified virus that would interfere with the metamorphosis of tadpoles. Since 2000, $1 million has been provided under the Natural Heritage Trust for this project and an additional $489,000 for the project was recently announced by the Commonwealth government. This work may take up to 10 years to develop. Such an agent would, however, need to be specific to cane toads otherwise it would also affect other non-harmful native toads elsewhere in the world.

4. The most practical mitigation conservation action is the "rescue" of representatives of the most susceptible species, and enhanced protection of some special areas.

While all of mainland Top End is likely to be colonised by toads in the near future, offshore islands are likely to be far more toad-proof (depending upon the frequency of human visitation and the quarantining measures in place). It is biologically feasible to use at least some of these islands as "arks". The Parks and Wildlife Service moved populations of northern quolls onto two islands (Pobassoo and Astell) in the English Company group off north east Arnhem Land in March 2003. This program had the support and involvement of the traditional owners. The government has provided funds for the next three years to further develop the role of islands as conservation arks for species that have suffered or are suffering from threatening processes on the mainland. This includes species that declined to extinction on the mainland of the Northern Territory prior to the arrival of cane toads.

This project has four main components.

a. Ongoing monitoring of the quolls already translocated. This will continually measure success of such efforts and provide valuable experience for other species that may be moved.

b. Selection of other species to be moved to islands. This depends on the degree of threat of the species and the habitat suitability of offshore islands. It will also depend on the willingness of the Aboriginal owners to accept such species. It is one thing to agree to having Quolls but quite another to have King brown snakes which are likely to be affected by cane toads but which are also highly dangerous to people.

c. The efficacy of this project will be broken down by poor quarantine standards. A co-ordinated effort to keep toads off islands is essential. This must include the development of appropriate operating procedures at mainland barge and other shipping ports, and broad communication to fishermen, Aboriginal landowners, yacht-owners etc. of information about toads and the need for vigilance about inadvertently moving toads in boats. An important part will be involving and supporting Aboriginal communities to maintain quarantine controls over islands that are free of cane toads and/or cats.

d. Initiation of discussions with the Aboriginal owners of long-term management of the islands for conservation purposes. This may be some form of protected status (National Park or Indigenous Protected Area) acceptable to the owners or some other management arrangement.

Public education

Learning to live with toads

There will be considerable public disquiet about the arrival of toads in Darwin. It would be appropriate that there is a substantial communication effort to anticipate this interest. The Parks and Wildlife Commission, Parks Australia, the Tiwi and Northern Land Councils, and Frogwatch have provided some communication material about toads and their impacts. This should be updated and include details on:

- the difficulty of control;
- the long term nature of the development of possible control measures;
- how to fence a swimming pool or a bush block to exclude cane toads;
- how to minimise food resources for them e.g. minimise area of green lawns, do not use outside lights at night;
- the most humane and efficacious procedures for killing toads; and
- information about their impacts upon biodiversity.

Impacts upon traditional Aboriginal lifestyle

While there is little that can be done to alleviate this problem, it is important that the issue is at least recognised. A response should be considered in collaboration with the Northern, Tiwi and Andilyakwa Land Councils. Appropriate education material should be produced in the relevant local language.

REFERENCES

Sutherst, R.W., Floyd, R.B. and Maywold, G.F. (1996). The potential geographical distribution of the cane toad, *Bufo marinus* L. in Australia. *Conserv. Biol.* 9: 294-299.

-van Dam, R.A., Walden, D.J. and Begg, G.W. (2002). A preliminary risk assessment of cane toads in Kakadu National Park. Supervising Scientist. Scientific report 164.

SUBMISSION NO. 2

Mr Michael Denigan, Mick's Whips and Leather Goods

PO Box 391
NOONAMAH NT 0837

24 April 2003

Sessional Committee on Environment and Sustainable Development

re: Progressive Entry into the Northern Territory of Cane Toads

Dear Committee

With the entry of cane toads into the Northern Territory, there is a loss of population of reptiles, including crocodiles , frilled neck lizards and goannas.

I believe that a small harvesting programme aimed at Safari type tourism, could be factored into the equation, which would help manage the effect of the cane toad on the crocodile population.

Frilled neck lizards will ultimately be hard hit. Perhaps an environmentally sustainable harvesting of frilled neck lizards and goannas could be established to prevent their demise.

Yours sincerely,

Michael Denigan

PS: I would be interested in participating in such projects

SUBMISSION NO. 3A

Environmental Research Institute of the Supervising Scientist
Dr Max Finlayson, Director

GPO Box 461
DARWIN NT 0801

1 May, 2003

re: Inquiry into Issues Associated with the Progressive Entry into the Northern Territory of cane toads

The Executive Officer
Sessional Committee on Environment and Sustainable Development

Dear Sir

Your call for submissions which appeared in the Northern Territory News on Saturday, 5 April 2003, refers.

This letter serves to advise that the Environmental Research Institute of the Supervising Scientist *(ERISS)* recently completed a report for Parks Australia North on the potential risks of cane toads entering Kakadu National Park. For your interest a copy of the report (Supervising Scientist Report 164) is enclosed. In doing this report we adopted the formal risk assessment protocol recommended by the Bureau of the Ramsar Convention on Wetlands.

The majority of the risk assessment undertaken involved identifying the problem, the potential extent and effects of the problem, the risk and subsequent recommendations on monitoring. Major information gaps relevant to predicting impacts and developing appropriate monitoring programs were also identified. The risk assessment was based on information from published and unpublished scientific and anecdotal reports. Information on Kakadu National Park was derived from relevant research projects undertaken in the Park since the early 1980s. A number of relevant Territory and Commonwealth agencies were consulted, as were relevant cane toad, native fauna and/or wildlife management experts from around Australia. Discussions were held with community members in the Borroloola and Mataranka regions to gain an indigenous/cultural perspective of the cane toad issue. The findings of these discussions are also enclosed (Internal Report 389).

We trust that these findings will be of interest to the Sessional Committee and, as an interested party in the region, confirm our willingness to discuss these issues further, as appropriate.

Yours faithfully

Dr C M Finlayson

SUBMISSION NO. 3B

Preliminary Risk Assessment of Cane Toads in Kakadu National Park, 2002

Environmental Research Institute of the Supervising Scientist
R A van Dam, D Walden and G Begg
National Centre for Tropical Wetland Research
Provided by Dr Max Finlayson

EXTRACT ONLY

For a full copy of Report contact ERISS
e-mail: publications@eriss.erin.gov.au
Internet: http://www.ea.gov.au/ssd/index.html
Full citation: van Dam RA, Walden DJ & Begg GW 2002. *A preliminary risk assessment of cane toads in Kakadu National Park.* Scientist Report 164, Supervising Scientist, Darwin NT.

EXECUTIVE SUMMARY

Background and approach

Cane toads *(Bufo marinus)* entered the Northern Territory (N'T) in 1980 from Queensland and are rapidly approaching Kakadu National Park (KNP), having recently been reported in the upper Mann River and Snowdrop Creek, approximately 15-30 km to the east of Kakadu National Park. Concern about the invasion of cane toads in Kakadu National Park has been highlighted on a number of occasions, and in 1998 participants at a workshop on the potential impacts and control of cane toads in Kakadu National Park conceded that a strategic approach for assessing and possibly minimising cane toad impacts should be developed. The first stage would be an ecological risk assessment to predict the likely extent of impacts of cane toads in Kakadu National Park and identify key vulnerable habitats and species. This information could be used to develop new monitoring programs and assess existing ones. This assessment is a direct result of Environment Australia's concern about the potential impacts of cane toads in Kakadu National Park.

The wetland risk assessment framework developed by *ERISS* for the Ramsar Convention was used to predict key habitats and the species most at risk. The majority of the assessment involved identifying the problem, the potential extent and effects of the problem, the risk, and subsequently making recommendations on monitoring. Major information gaps relevant to predicting impacts and developing appropriate monitoring programs were also identified.

The risk assessment was based on information from published and unpublished scientific and anecdotal reports. Information on Kakadu National Park was derived from relevant research projects undertaken in the Park since the early 1980s. A number of relevant Territory and Commonwealth agencies were consulted, as were relevant cane toad, native fauna and/or wildlife management experts from around Australia. Discussions were held with community members in the Borroloola and Mataranka regions to gain an indigenous/cultural perspective of the cane toad issue.

Identification of the problem

Since their introduction to Australia in 1935 to control sugar cane pests in Queensland, cane toads have spread naturally and with human assistance throughout much of Queensland, northern NSW and the Top End of the NT. The cane toad's preference for certain disturbed areas means that areas of degraded natural habitat have probably helped their spread. They eat a wide variety of prey, breed opportunistically, have a far greater fecundity than native anurans, and develop rapidly particularly in warmer waters. They tolerate a broad range of environmental and climatic conditions, can occupy many different habitats and compete for resources with many native species. Most significantly, they possess highly toxic chemical predator defences, with many experimental and anecdotal reports of deaths of native predators that have attempted to consume cane toads.

It is accepted that the cane toad will establish and spread rapidly in Kakadu National Park - a World Heritage area with Ramsar listed wetlands, well known for its spectacular wilderness, nature conservation values, rich diversity of habitats, flora and fauna, and cultural significance. There is serious concern that the World Heritage status of Kakadu National Park could be diminished if any of these attributes were adversely affected by cane toads.

The potential extent of cane toads in Kakadu National Park

Cane toads are likely to colonise almost every habitat type within Kakadu National Park. The saline regions of the coastal plains and deltaic estuarine floodplains will most likely support some cane toads at various times, although they are not likely to use these habitats on a permanent basis. Other less suitable areas include deep open water and/or flowing channel habitats and tidal regions of larger rivers (excluding riparian zones) which extend 70 to 80 km inland during the Dry season. The steady range expansion over the last ten years indicates that most wetland habitats are probably suitable as breeding habitat and also as Dry season refuges.

Patterns of dispersal within Kakadu will probably rely on the transport corridors and the major rivers and creeks. Dispersal rates within a catchment could be up to 100 km y-i. The current location of cane toads would indicate an initial progression down the South Alligator River catchment via its sub-catchments (e.g. Jim Jim Creek, Deaf Adder Creek). Invasion of other areas of the Park will likely depend on which waterways' headwaters are colonised first (e.g. Mary River, East Alligator River).

Maximum population densities of various cane toad life stages for limited areas of suitable habitat in Kakadu could be expected to be in the order of. 4000 to 36 000 eggs per metre of shoreline; ~15 to 60m^{-2} for tadpoles; 2.5m^{-2} for metamorphlings; and 2000 ha^{-1} for adults, depending on temporal and spatial factors.

The Dry season will see a gradual retreat of many cane toads from seasonally inundated wetlands. The vegetation and cracks in the black soils on the floodplains should offer sheltered, moist habitat during the mid Dry season. In the late Dry season, adult cane toads will congregate near permanent water with adequate shelter. Few cane toads would be present in the drier areas of the tall, open eucalypt forest and woodland habitats of the lowland plains. The first rains of the Wet season will stimulate dispersal and increased breeding activity. With the progression of the Wet season, cane toads will disperse into terrestrial habitats, namely the open forests and woodlands. When large areas of the floodplains are inundated, cane toads will be concentrated on the remaining dry ground, which may make them highly visible to Park visitors.

The potential effects of cane toads on Kakadu National Park

The potential effects of cane toads upon Kakadu National Park are outlined in six sections of this report: effects on predator species; effects on prey species; effects of resource competition; cultural effects; economic effects; and other potential effects.

Predators

The majority of information on cane toad impacts relates to toxic effects on predators. A substantial amount of literature exists on effects on individuals, but little scientific information is available on population effects. The degree of susceptibility of potential cane toad predator species in Kakadu National Park was determined using three criteria:

Definite: documented adverse effects upon populations of this species have been reported in the literature;

Probable: documented in the literature as having eaten cane toads or their early life stages and adverse effects on individuals reported, but not on populations;

Possible: documented in the literature or through expert consultation as eating, or thought likely to eat, native frogs or their early life stages, but effects of eating cane toads unknown.

A total of 151 species or species groups were identified under these criteria, covering a broad taxonomic range including aquatic invertebrates, fish, frogs, lizards, snakes, birds and mammals. Eleven species were considered *definitely* susceptible to cane toads, comprising 5 lizard, 3 snake and 3 mammal species. Sixteen species or species groups were considered *probably* susceptible to cane toads, while 124 species or species groups were considered *possibly* susceptible to cane toads.

Prey

Little information was available on effects of cane toads on prey species. Cane toad tadpoles have been observed preying on the eggs of some native frogs, though they are thought not to be significant predators of native anuran early life stages. Rather, cane toad tadpoles have been observed to feed mainly on cane toad eggs, algae and detritus, as well as scavenging upon dead animals and animal material which they will consume in preference to plant material. Juvenile and adult cane toads are generalist feeders, consuming almost any type of terrestrial animals, with ground-dwelling ants, termites and beetles usually dominating the diet. Some small mammals, birds, reptiles and frogs are consumed in very small numbers. No study has specifically investigated the impact of cane toads on communities of around dwelling arthropods. One general impact study reported a decline in beetle (*Coleoptera*) numbers, possibly due to cane toads. It is impossible to determine how many of the undescribed invertebrate species in Kakadu, many of which may be endemic, could be affected by cane toads.

Competition

Little information was available on competition between cane toads and native animals for resources such as food, shelter and breeding sites. The potential for

competition between cane toad tadpoles and native frog tadpoles (e.g. the ornate burrowing frog) appears to exist, although, several reports suggest considerable segregation of breeding sites. Competition between adult cane toads and frogs appears to be minimal, with the pattern of habitat and food exploitation differing markedly. The major factor separating resource use is the cane toad's heavy reliance on ground-dwelling ants, termites and beetles as ma or food sources. There has been some indication from the Roper River region of the NT of competition effects. In particular, some species of small reptile were found to decline in areas colonised by cane toads. A competition effect was suspected, but not confirmed. Two frog species (the brown tree frog and green tree frog) have possibly been linked to competition-related declines, although the evidence is not strong. It is possible that many other species within Kakadu, including endemic aquatic invertebrates, could be subject to competition by cane toads.

Cultural effects

Concerns for the decline in numbers of bush tucker species such as monitor lizards, snakes and turtles have already been noted by several Aboriginal communities in the NT. This decline is likely to have very significant impacts upon Aboriginal communities within Kakadu. Some traditional ceremonies in the Borroloola region have been altered to request the spirits to return these foods, and in some cases, totem species (e.g. freshwater crocodile). From experience elsewhere in the NT, it appears that Aboriginal people, by necessity, eventually grow accustomed to the presence of cane toads, although this does not necessarily diminish the underlying concerns of these people. Areas of human habitation in Kakadu including the township of Jabiru, Aboriginal communities, Ranger stations, tourist accommodation and camping grounds are expected to have high densities of cane toads. This will impact on outdoor recreational activities and, in some areas, increase the likelihood of pets being poisoned from mouthing or ingesting cane toads

Economic effects

Cane toads are unlikely to have an adverse impact on the general economy and tourism income of Kakadu National Park. The reactions to cane toads in the NT have ranged from disinterest to dismay. International tourists do not recognise toads as an invasive species. while visitors from Queensland are well accustomed to toads. However, tourists from other states express deep concern about cane toads, especially in World Heritage sites such as Kakadu. Tour operators in Kakadu share a similar concern. However, the major attributes of Kakadu continue to attract tourists, and are likely to overshadow any concerns about adverse economic impacts of cane toads.

Cane toads do have an economic value as dissecting specimens for research and education purposes, and as a supply for medicinal and leather products. Such industries exist in Queensland and will probably become established in the NT once cane toads are present in sufficient numbers.

Other potential effects

Another potential effect is the contamination of water supplies with rotting toad carcasses and the subsequent release of the toxins. There have been many reports of the poisoning of pets and poultry from drinking contaminated water. Experimental water-borne exposure of the toxin to various organisms has resulted in toxicity, but generally only at high concentrations.

The issue of potential impacts of cane toads on granivorous prey insects and resultant repercussions on Kakadu's native plants has been raised, although this is highly speculative. There is evidence, for example, that high densities of harvester ants can significantly reduce the density of speargrass *(Sorghum intrans).* In terms of plant-animal interactions, it is possible that subtle ecological changes could occur amongst other biota, and other flow-on effects.

Feral cats and pigs have been known to die from mouthing or ingesting cane toads. These animals cause damage to the native fauna and landscape of Kakadu, and any decline in their numbers would be considered a benefit. The reduction in numbers of predators such as varanids (goannas) and snakes could be of benefit to the several species of ground-dwelling/nesting birds in Kakadu, in addition to crocodiles and turtles whose eggs are preyed upon by other large reptiles.

Cane toads are known to feed on human faeces, and as a result they may harbour human strains of *Salmonella* and other bacteria. The eggs of human parasites are also spread via toad faeces. In areas where modem sanitation practices are lacking, the presence of large numbers of cane toads could represent a health hazard. Another health-related issue is the potential for substance abuse of the cane toad toxin, a habit forming practice that is established in northern Queensland and in countries such as Fiji.

Identification of the risk

The data on cane toad effects, distribution and densities are mostly inconclusive and/or show great variability. In addition, information on distributions and abundance of Kakadu animal species are deficient. Nevertheless, it is still possible to identify key habitats and also prioritise particular species based on the likelihood that they will be at greater risk from cane toads than other species, and their importance to the ecological and/or cultural values of Kakadu.

Identification of key habitats

Aquatic stages

In Kakadu. cane toads will breed in both temporary and permanent waterbodies and so their

Aquatic stages will be found in a variety of aquatic habitats. They will concentrate their

breeding activity during the wetter periods, although they are also known to breed during the Dry season. During the Wet season, when many of the major wetland habitats are inundated, *cane* toad breeding may be concentrated in the wetland habitats associated with the open forests and woodlands of the lowland plains.

Terrestrial stages

As the Dry season progresses, cane toads will move progressively from sites of temporary water to permanent water. The floodplains and sheltered habitats on the margins of floodplains and temporary or shallow billabongs will provide ideal cane toad habitat during the early to mid Dry season. The late Dry season will see high densities of cane toads near permanent water or moisture, including permanent billabongs and patches of monsoon rainforest.

The Wet season will probably see the highest numbers of cane toad metamorphlings, mainly around the moist margins of the waterbodies they emerged from. Wet season inundation of the major wetlands habitats will see

the majority of adult cane toads dispersing into the woodlands and open forests of the lowland plains. The vegetation within the woodlands will provide suitable shelter for cane toads during the Wet season.

Identification of species at risk

Predators
The initial susceptibility ranking of each of the 151 predator species identified as being *probably or possibly* susceptible to cane toads was further refined to a ranking of risk using exposure (i.e. available habitat overlap, feeding ecology, behaviour) and ecological/cultural importance status information. Four risk categories - *likely, possible, uncertain and unlikely* - were defined, being adapted from the original susceptibility criteria. Within these categories, different priorities were assigned.

The original 151 predator species were allocated a risk ranking accordingly. Ten species were considered *likely* to be at risk of experiencing population level effects, with the northern quoll being assigned the highest priority. The 9 remaining species including 5 lizards, 3 snakes, and one mammal were assigned high priority. Twelve species or species groups were considered to be at *possible* risk of experiencing population level effects, although none were listed as endangered or vulnerable, or thought to be notable (rare, or have restricted range, outstanding taxonomic interest, or uncertain or declining status) or flagship (ecological/cultural importance to Kakadu) species. Thus, all species were assigned moderate priority status. Represented in this category were two groups of aquatic invertebrates, 3 frogs, one lizard, 3 snakes, freshwater crocodile and 2 birds. Due to a lack of information, the risk of population level effects was considered to be *uncertain* for 98 species or species groups, although 21 of these were assigned high priority. These species include 3 fish, 3 frogs, 6 lizards, one snake, 4 birds and 4 mammals. The remaining species in this risk category were assigned moderate priority. These include two groups of invertebrates, 4 fish, 17 frogs, 9 snakes, 42 birds and 3 mammals. A total of 3 1 species were considered *unlikely* to be at risk of experiencing Population level effects (based on relevant ecological, feeding or behavioural information) and were assigned low priority. These included 11 fish, 18 birds and 2 mammals.

Prey
Quantitative data on impacts to prey species are scant, and very little can be concluded about the species or species groups at risk. Cane toads occasionally consume small vertebrates, but populations of these are not likely to be at risk. There is little doubt that termites, beetles and ants will be heavily exploited by cane toads in Kakadu. Due to the potentially high cane toad densities, and an individual cane toad's ability to consume up to hundreds of prey items in one night, ground-dwelling arthropods are at greatest risk. The potential impact of cane toads on endemic invertebrates is unknown. The only species known to suffer long-term population decline or extinction from the impact of cane toads is a tapeworm found in the intestines of a snake.

Competitors
The available experimental information suggests that some native frog tadpoles *(e.g. L. ornatus)* may be at risk through competition with cane toad tadpoles. However, observations suggest that native frogs rarely share

breeding habitats with cane toads, Although adult native frogs do not appear to compete with cane toads, the potential risk to native tadpoles represents a risk to native frog populations. Some of the smaller insectivorous reptile species of Kakadu may be at risk from competition for food resources by cane toads. but nothing more can be concluded.

Cultural, socio-economic and other risks

The major impacts on Aboriginal communities within Kakadu National Park will be a decline in some traditional foods and, in some situations, the alteration of ceremonies following declines of food and totem species. Aboriginal people elsewhere in the NT have accepted the presence of cane toads but still express concern regarding, the impacts. Aboriginal communities within Kakadu may also become accustomed to cane toads albeit most likely sharing the same concerns. Cane toads will congregate in areas of human habitation within Kakadu, and will be of nuisance value in these places, and will also represent a risk to domestic and semi-domestic dogs.'

Tourism, the major economic activity of Kakadu, is not at risk from the presence of cane toads, and visitor numbers will not decrease as a result. With predicted high numbers in Kakadu, there may be an opportunity to harvest them for commercial benefit.

Other potential effects of cane toads have been hypothesised, including the contamination of water supplies, secondary effects on vegetation communities, the spread of human diseases, and the substance abuse of cane toad toxin. Details of these potential effects and hence the risks posed by them are essentially unknown.

Uncertainty and information gaps

This assessment has highlighted that there are major information gaps contributing to a large degree of uncertainty about the potential extent and impacts of cane toads in Kakadu. These include: uncertainty about densities of cane toads in Kakadu, effects of fire and burning regimes, degree of land/habitat disturbance, and the extent to which the Arnhem Land escarpment and plateau will act as a barrier and/or be colonised; the lack of quantitative data on the impacts on animal populations, particularly in the Iong-term, quantitative data on Kakadu fauna populations and distributions as well as dietary information; incomplete knowledge of Kakadu's invertebrate fauna, many being undescribed and possibly endemic; unknown response and susceptibility of most Kakadu fish species; unknown competitive interactions with native frogs; unknown chemoreceptive response in snakes and their ability to detect cane toad toxins; conflicting and unclear information on freshwater turtles; insufficient information on conservation listed species; the lack of experimental or anecdotal evidence regarding effects on bats; and impacts to as yet unidentified endemic species.

Recommendations for additional surveys and monitoring

Priority habitats for monitoring

Seven major habitat types were identified for future monitoring: floodplain communities; swamp communities; monsoon forest; riparian communities; woodland and open forest communities; springs, soaks and waterholes; and escarpment/plateau pools.

Priority species for monitoring

The species of most concern, and therefore a priority for monitoring, include quoll, sandstone antechinus, red-cheeked dunnart, brush-tailed phascogale, dingo, all of the varanid 1izards, northern death adder, king brown snake, western brown snake, ghost bat, black-necked stork, comb-crested jacana, Oenpelli python and freshwater crocodile. These are based on their rating, notability or listing as vulnerable, and also importance to Aboriginal people.

Given that many species assigned to risk category 3 were done so due to a lack of information about effects of cane toads, it is possible that further information could result in the re-prioritisation of some species.

Although risks to prey species are unknown, beetles, termites and ants should be considered for inclusion in monitoring programs.

Monitoring the possible effects of competition between cane toads and native aquatic invertebrates and vertebrates should be given high priority, particularly in escarpment/plateau pools where endemic species are known to exist. Similarly, monitoring for competitive effects between adult cane toads and insectivorous reptiles should also have high priority.

Priorities for addressing information gaps

A number of information gaps require addressing before more confident estimates of risks can be derived. Monitoring programs assessing the effects of cane toads upon Kakadu species will al lot,.. greater understanding of the risks. There is a need for appropriate baseline data, not just for cane toads but to monitor and assess other management issues that will arise in the future (e.g. other invasive species, fire and tourism). In addition, surveys should be conducted to identify, and map the distribution of the endemic species of Kakadu, particularly in the escarpment and sandstone regions. All survey and/or monitoring programs should concurrently measure cane toad abundances and habitat preferences. Other information gaps that could be addressed but are less of a priority, include the effects of fire on cane toads and the lack of information for particular species or species groups (e.g. freshwater turtles, red goshawk).

Evaluation of past and present monitoring programs

As it may be several years before all of Kakadu is occupied by cane toads (eg some escarpment/plateau habitats), it is possible that some new monitoring programs may have sufficient time to accumulate pre-cane toad (i.e. baseline) data. It is highly unlikely that new monitoring,, programs will have time to provide similar data for many floodplain and lowland habitats. Data from major past and present monitoring programs within Kakadu may provide an alternative, noting that they were developed with objectives other than cane toad impacts in mind.

Broad scale surveys

The two major fauna surveys of the last 20 years provided information on abundances, distribution and habitat preferences of birds, mammals, reptiles and amphibians in a range of habitats similar to those identified in this report. The information from these surveys is not appropriate to use as current baseline. However, the established sites provide the opportunity for re-sampling before cane toads arrive. Not all habitat types were included in these surveys.

A proposed representative re-sampling of the Stage 3 Wildlife Survey, which is hoped to be undertaken next Dry season could possibly provide one season of pre-cane toad data.

Ongoing monitoring programs

The only major ongoing fauna monitoring programs in Kakadu National Park are those associated with assessing potential environmental impact downstream of ERA Ranger Mine and the Jabiluka lease area. Monitoring programs are being conducted by ERISS and ERA/EWL Sciences (Energy Resources of Australia Ltd/Earth Water Life Sciences).

Aquatic macroinvertebrates are monitored at sites in the Magela Creek system (since 1988) and a number of control sites elsewhere in the Park. Sites from other areas have also been monitored regularly in the past (i.e. upper South Alligator River and Baroalba, Nourlangie and Gulungul Creeks). Though these studies were not designed for detecting cane toad impacts, inferences would be enhanced if cane toad invasion/distribution was monitored. Billabongs sampled in the Magela and Nourlangie Creek systems may provide information on (potentially vulnerable) freshwater snails.

Fish communities in the Magela, Nourlangie and upper East Alligator systems have been monitored annually since 1994, and data exist for fish migration patterns in Magela Creek from 1985 to 1996.

'Whole-ecosystem' monitoring by ERA/EWLS has also been conducted at sites in Swift, Magela and Nourlangie Creek systems. Zooplankton, macroinvertebrates, fish, frogs, reptiles, bushbirds, waterbirds and mammals were surveyed in 1994/95 and again in 2000/01.

Other surveys or monitoring programs

Other past programs may also con tribute to background information, including surveys of waterbirds on the Magela and Nourlangie floodplains. It has been proposed to re-survey the original Magela floodplain sites, in order to update/add to the existing information on birds.

Information from the CSIRO Kapalga fire study from the late 1980s to the raid 1990s will provide a useful basis for detecting and assessing impacts once cane toads arrive there. Mammals, reptiles and insects were sampled originally and were re-sampled for small mammals in 1999.

It will be very difficult to obtain adequate baseline data for a cane toad impact monitoring program. While the ongoing programs will be of some use, they are not necessarily targeted at the priority species identified in this report.

Risk management and reduction

Given the outcomes of the assessment, some relevant issues can be discussed that may assist Park managers in developing a risk management strategy.

Parks Australia North has already been active with regards to management of cane toad issues, having initiated a cane toad identification training program and rapid response strategy to manage human assisted incursions of cane toads. Additionally, frog recording stations have been established at four sites in Kakadu (and more are planned). Baseline data have been collected for the past two Wet seasons.

Very little will be able to be done to reduce cane toad numbers in Kakadu. Particular measures may prove effective in localised areas (e.g. townships, caravan parks), but efforts would need to be ongoing. Management of areas damaged by feral pigs may help reduce the densities of cane toads in pig-affected areas. Chemical and biological control methods are insufficiently developed at this stage.

It is recommended that Parks Australia North manage the invasion of cane toads initially by

i) ensuring that monitoring efforts are underway to assess the impacts of cane toads upon the natural and cultural values of Kakadu, and
ii) investigating measures by which cane toads can be managed on a localised basis.

The preliminary risk assessment provides a starting point from which Parks Australia North can determine the monitoring requirements for fauna. In addition, it provides an overview of the potential cultural and socio-economic impacts, which could be studied in greater detail by appropriate experts.

SUBMISSION NO. 3C

Report – ERISS/ PAN Cane Toad Risk Assessment – Katherine/ Mataranka and Borroloola
Environmental Research Institute of the Supervising Scientist
G Begg, D Walden and J Rovis-Hermann, 2002

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INTRODUCTION

In May 2000, while cane toads (plate 1) were known to be rapidly approaching the borders of the Kakadu National Park (KNP), a joint Environmental Research Institute of the Supervising Scientist ERISS/Parks Australia North (PAN) field trip was undertaken to obtain information about:

- how the presence of cane toads has affected the lives of Aboriginal communities;
- visitor perceptions about cane toads;
- the impact of cane toads in nature reserves such as the Elsey National Park; and
- the diet of cane toads (by obtaining a sample of cane toads from the Mataranka region).

The group consisted of Jacqui Rovis-Hermann, Dave Walden and George Begg (from ERISS*)* and Kathy Wilson, Beryl Smith and Ryan Barrawei (both Jawoyn Traditional Owners (TOs) for southern Kakadu) from PAN.

CONCLUSIONS

- In spite of a decline in a number of some traditional bushfoods, the lifestyles of Aboriginal communities do not appear to be seriously disadvantaged by the presence of cane toads. Nevertheless, the negative effects of cane toads can be sufficient for cultura1 and religious ceremonies of Aboriginal communities to be changed. As proved to be the case in Queensland, Aboriginal people eventually grow accustomed to the presence of cane toads and, in the realisation that little can be done to control or eliminate them, come to accept the need to co-exist.
- For a period of 4-5 years certain species of goannas and snakes are likely to be adversely affected. Their decline will negatively affect Aboriginal communities that are semi-dependent on their availability as a food supply.
- The mowed lawns, sprinkler systems, shaded gardens, swimming pools, playing fields, sewage treatment ponds and street lighting in the township of Jabiru will offer ideal conditions for cane toads. The lifestyles of people resident in the township can be expected to be significantly affected and there will be a high risk of household pets (dogs) becoming poisoned.
- Disturbed areas in the KNP such as caravan parks and camping grounds will be similarly affected.

RECOMMENDATIONS

It is recommended that once the cane toad risk assessment is complete:

- *PAN/*ERISS finalise a communication strategy to inform interested and affected parties about the potential impact of the cane toads in the KNP. This would avoid misinformation, unnecessary concern and be in keeping with the *'early invasion response strategy'* currently being established by EA (Greg Miles, Jabiru Rag 18.5.00).
- immediate attention is given to designing a cane toad monitoring program aimed at key species (e.g. *Varanus spp*) and key habitats (e.g. riparian zones).

OUTCOMES

In the latter part of 2000, cane toad identification and information sessions were conducted jointly by KNP and ERISS staff. Target audiences included KNP staff, Energy Resources of Australia staff, tourist operators (including hotel/caravan park/tourist village staff) and Aboriginal communities. People were briefed on all aspects of cane toad impacts and the identification of cane toads, including the eggs and tadpoles. Park managers have continued to inform these groups and the general public of the locations of cane toads, their impacts and what action to take if cane toads are sighted outside of their present distribution i.e. as part of the *'early invasion response strategy'.* Posters, bulletins and items in the local media and tourism newsletters all contribute to this education and awareness program. A cane toad 'flipbook' has also been prepared for Aboriginal communities. By the time of this report, cane toads were well established in some southern areas of the Park such as Kambolgie Creek, the Gunlom area and the upper Mary River catchment.

An autopsy on a freshwater crocodile found dead in Kambolgie Creek during February 2002, revealed that gastric haemorrhages consistent with violent stomach contractions were probably caused by ingestion of a cane toad (Northern Territory News 19 March 2002).

SUBMISSION NO. 4

Mr Dave Lindner, Private Citizen

PO Box 114
JABIRU NT 0886

6 May 2003

Toad invasion is happening and one priority stands out a mile in font for funding and implementation – keeping substantial areas of the Top End toad free.
The options are:-

1. Cobourg Peninsula (Gurig National Park the most important and urgent.

2. Large islands including Tiwi Islands, Croker, Goulbourn Wessels and Groote as second priority (nevertheless immediate priority).

3. Other islands closer to mainland and toad access as community support indicates (e.g. Elcho Milingimbi etc.).

Cobourg can be protected by barrier against overland toad invasion. The surveillance necessary for detection of transported toads them becomes similar to that necessary to protect insular land areas from toads.

The relocation of predators known to succumb to toad availability, quolls goannas snakes (king browns) and so on, to islands is vandalistic and of questionable long term success prospect.

Toad protection for Cobourg will require a rare single-mindedness of intention and should not be dressed up with job opportunity for locals and other distractions. As with the mimosa program of Kakadu good worker performance in a wide variety of field work situations, in surveillance and in barrier maintenance work with the toad prevention, will be required and people on site with aptitude will be valued.

As is often the case in a crisis science hasn't got the answers and current toad research is not looking for them.

Technology for toad attract & trapping and detection at transport terminals (communities, pearl farms, tourist resort and government stations), essentially accidental toad release & retrieval technology, needs to be researched without preconception impending scope of research.

The toad research priority – and it is extremely urgent, is for the foregoing requirement. Quarantine procedures need implementation now as toads are being transported between communities out of curiosity and as pets or as cockroach eradicators.

The attached statement on Cobourg was based out overnight in March and sent to John Christophersen of Cobourg Board of Management. Its ad hoc origins and limitations are re-emphasised in the proposition.

Both Cobourg people and I have additional ideas of implementation but the basic concept is still relevant.

Cobourg has unique significance in Australia plant and animal collecting history in the tropics and currently has international wetlands status.
With Federal and NT Government request and combined government and local resident determination Cobourg can be kept toad free.

The Cobourg families are close knit and land bridge notwithstanding I consider board determination would help ensure this area have the best prospect of toad free status of the peninsula and large island options.

SUBMISSION NO. 5

Mr John Christophersen, Cobourg Peninsula Marine Park Board of Management

THOUGHTS ON TOADS AT COBURG

Coburg Peninsula (I like the old spelling) can be protected from toads unless,

1. A massive sabotage release is effected undetected.

2. An extremely low probability introduction occurs such as a toad loaded natural log raft drifts across from adjacent mainland.

It may be reasonably assumed that indigenous vertebrate species occurring around the land rim of Van Diemen Gulf have similar genetic make up. Given the recent sea level rise history (8000 years) into what is now Van Diemen Gulf.

Many large species have sea crossing capacity (e.g. Varanus panoptes observed more than 5km from land north of Mount Norris Bay in 1970 Robert Cunningham was with me at the time and the healthy vigorous specimen was captured) and genetic isolation has not occurred since sea level rise – these species.

The land leasing arrangements for Gurig and Kakadu presumably include provisions of lessee obligation to protect the lands from preventable detriment.

At Kakadu toad detriment is not avoidable by known management technology. At Coburg toad detriment is avoidable excepting 1) and 2) previously cited.

In protecting Coburg from toads essentially identical species of animals vulnerable to toads and similar ecosystems impacted by toads at Kakadu will survive in Gurig Park. Gurig Park then becomes an animal bank for Kakadu. Savannah and other low land, land systems should toad eradication even be achieved in the future. Gurig people have the benefit of no toads and the very special historic status of Coburg to science is preserved.

Coburg has been dedicated to wilderness protection; i.e. presumably wilderness managed as it was by Aboriginal humans at the time of first outside world human contact.

If protected from toads it's value, already regarded as high because of historically important animal and plant collections in the 19th century, will be vastly enhanced to the rest of Australia and to Australian biological science. I proposed a toad barrier incorporated into a buffalo barrier boundary with Arnhem Land in 1969.

The written proposal raised no response or reply. I had collected reptiles in the Bowen River, QLD, and seen full plague toad infestation in early OLD wet season 1962/63.

I doubt other wild life section staff were familiar with this in 1969 and an NT invasion by toads was not remotely officially envisaged.

I gave no specification for "toad barrier" implementation. I mentioned the concept to others at times but probably more emphatically to John Christophersen at the buff farm than anyone else – In other words it never got pushed. When the proposal was raised

publicly a lot of anti joint management, anti John Christophersen derision emerged for a short time. I surprised people by being emphatically supportive.

For the first time I then contemplated seriously out of anger. I didn't contemplate the difficulty of vehicle born toads (or barge or aircraft/aeroplane) them though as people were laughing at the fence itself. I don't propose the following structure as a research idea. But if someone says no structure is feasible then I say this one is – not maintained by hot shot ranger gods of magnificent presence and impeccable qualification but mediocre effective reliability and no real dedication but maintained with prescribed procedures by personnel who don't claim but demonstrate an absolute determination to block toad access (Kakadu mimosa crew tradition).

The surveillance and maintenance intention is not negotiable and not to be put at risk by clash of egos and social experimentation it can be achieved. (Achieved?) Yes. Before a basic structure could be – in absence of likely better designs, I haven't researched this – Two separate fence lines cleared parallel across an appropriate section of the Coburg neck.

Each clearance to a width to accommodate a centre system of barriers, a track each side of land management (grading erosion control) space beyond 60m or more total width – probably 72m – standard minimum stock fence in bush, also depends on tree height.

Visit the buff farm and the difficulties of various inadequate clearing of land management consequences can be explained observed. Clearing to preclude tree fall impact is essential as cyclone periods will prevent effective surveillance and provide excellent toad movement conditions.
The barrier, should comprise:

1. an outer buffalo fence, 5 wire solar electric.

2. Perhaps 2 metres inside the stock fence a metre high sheet metal ground impeded fence. U.V resistant heavy plastic may be available – otherwise squatter tack heavy gal. Sheet or similar of regularly replaced lighter sheeting. Replaceable sections in beach front or mangrove sections of fence.

3. A second similar of lighter sheet barrier a metre inside the first (2) – simple a back up barrier.

4. A hundred metre or so no-toad-land then the foregoing (1)(2)(3) repeated with stock fence on the peninsula side of this structure.

Diagram

Vehicle access through fences:
1. Again a standard technology is not known to me, I haven't asked or researched. It may be available – a cattle grid concept for toads (maybe a rat proof design is known).

2. For Toyotas boat trailers etc. a sump oil bath under a carport type roof

Diagram

1. Grader access trucks dozers etc. (Army trucks and trucks etc.) Supervised access through special gates with cleared surrounds – or make Toyota facility bigger and more robust.

Toyota facility to have toad closure for wet season if oil drained out i.e. Exit barriers. Oil is only a bright idea.

Toads are few at the farm, there is a cyclone on and I'm busy I **will** test it in due course – also test toad endurance to sea water immersion – the last is important and is the reason for the double barrier line.

The foregoing would be a good retirement job for me except I prefer it here. It is not a big deal if you can break out of your mentality. It's absolutely peanuts against **letting** toads in.

Seaward barrier ends obviously into sea water or well into inter-tidal wet slope or beach frontage. In mangroves the barrier must proceed through all roots into deep channel as these areas can be fresh in neap tides in heavy wet season conditions.

The seaward sections could be curved to "collect" toads and guide them back uphill

Diagram

Vehicle barge or aircraft accidental transport of toads:

Toads falling off en route pose minimal toad invasion risk unless there is a real bad bump somewhere where it could be a regular event – a bay or deep creek crossing poses a higher but still small risk.

Destinations for vehicle, aircraft or barge unloading are the real risk areas for breeding toads to build up. Kids, sharp eyed and inquisitive around Araru type camps should pick up toads. Araru is a low breeding risk close to headland. Tourist facilities and Black Point are high risk and scheduled procedures of search and careful surveillance of cargoes at time of discharge will be essential to justify other toad precautions.

This includes Smith Pt airstrip – a wet season toad paradise. Pearl farm and Seven Spirits need maximum supervision.

The only realistic option at the pearl farm(s) may be installation of a toad proof – i.e. release proof inspection shed for incoming stores – or a barrier surrounded compound.

> REWARDS ARE NOT AN OPTION AND WILL LEAD TO REWARD SEEKING TOAD IMPORT.

It is very daunting. The stakes of toad free Coburg, Cape Don and Crocker are a challenging incentive.

Harold Cogyer - one of the CSIRO report authors is retired but active in the biological research fraternity and has input into award of research grants. His support or comment would be respected. Goff Letts is a Coburg fanatic – don't let his past politics preclude his possible support. Professor Jim Allen (retired) Professor John Mulvaney (still alive?) and Professor Chicken McKnackers might all throw in on this one out of pat Coburg contacts.

Some of the foregoing could be …. I'm out of touch these days. Modern researches are a bunch of … and I give them a wide berth. Woinarski's OK and I'm surprised at the Pobasso's exercise – he's probably at his wits end in futility on toads and I share that situation.

I do think its in National Interest. The board may activate action but then I think if it then adopts a co-operative, fully supportive, voluntarily participating role, (nevertheless stating that it expects government initiative) then the boards earlier perception of responsibility for wasting money if toads get established is no longer relevant.

Kakadu mimosa work costs $500 000 a year and its worth double that. It took unapproved use of Gagadju funds to get it up and running – and was worth it.

I'd be grateful that if I've totally overloaded some problem (I often do – let me know – I'd rather hear it from you then my mate …

IDEAS

A.C.F may have ideas on funding or the use of volunteer workers and donated equipment from south and Darwin. Is Murganella in a state to provide a base for operations?

The land barrier is achievable. Transported toad surveillance measures, as you've previously considered are the challenge. CCNT have almost never exhibited sustained excellence.

Individuals like Graham Talbot(?) put in dedicated performances when they leave an area, the work lapses. Crocodile management in Darwin harbour and tourist services at reserves 'cop it' if they don't perform – remote area management, often vandalism.

I think "1988" by Mr Graham(?) vividly shows the reality.
It's early (?) 12 Feb and I haven't heard of cyclone damage yet – presumably Paspaley could have lost millions – pity if, as he could have been a source of materials and or finance.

SUBMISSION NO. 6

Darwin City Council

Mr David Thiele, Operations Engineer and Mr Brendan Dowd, Director Technical Services

REPORT TO CHIEF OFFICERS GROUP FROM DIRECTOR TECHNICAL
Report No. 02TS0264DT:cs

CANE TOADS

Synopsis

This report provides an overview on how other Councils within Australia deal (or don't deal) with the cane toad problem and recommends that Council liaise with NT National Parks and produce Information sheets regarding Issues associated with cane toads.

General

There is surprisingly little information available on the practical management of the cane toad problem by Councils. The CSIRO is conducting research into the biological control of cane toads but liaise little to offer in terms of local management, The Queensland Museum appears to be an authority on the subject but mainly deals with distribution and differentiation from local species. Individual Councils in areas where the cane toad has been living for over 60 years such as Cairns City Council do not recognise cane toads as a problem, just a fact of life. More recently, invaded Councils on the east coast, such as Byron Bay, also do not actively seek to manage the issues as their residents appear to be resigned to the inevitability of the migration. The National Parks in NSW seek to control isolated breakouts of the toad rattier than trying to stop the natural front.

In Katherine, which was invaded about 12 months ago, they have not received any complaints or queries from residents and only one enquiry from a sweeping contractor who had environmental concerns about washing his machine out.

The Problems

The most obvious problem is road kill. The toads initially smell, make a mess and attract flies. After a short time they just become hard, flat, black marks on the road not conducive to revealing

They will take over short grassed areas especially leading up to waterways but they do not like thick reeds and rushes.

They can kill native wildlife if eaten will take over habitat and are a potential threat to pets such as cats and dogs.

They will eat pet food left out for animals and the cooler months they will shelter under timbers, sheets of iron etc.

Response to the Problem

Generally, Councils around the country are doing little about the issues. They generally refer all problems to the local Parks and Wildlife Department. In some areas, such as Lismore, the local Environment Centre run an annual Cane Toad

Muster where people are encouraged to go out with buckets to collect toads and a nominal bounty is paid per skin. In one area of Brisbane, Greening Australia run an annual Cane Toad Busting Night. There is some doubt as to the benefit of these events however community involvement and awareness is seen as a positive for the environment.

Expected Arrival
The NT National Parks predict that the toads could reach Darwin this Wet Season. They are moving faster than everyone is predicting.

What Can We Expect?
The NT National Parks do not appear to have prepared themselves for a public response to the invasion. The types of questions and issues that could be raised may include:

- How should we handle them?
- How should we kill them?
- Will Council remove squashed animals from roads?
- Has Council done anything to prevent their spread through Council controlled parks and waterways?
- Who should queries be directed to?
- Will birds be affected at the dump If they eat dumped toads - what is the contractor doing about it?

CONCLUSION:
It is difficult to appreciate the problems of the arrival of such a pest when in most cases the residents in affected areas appear to be resigned to the inevitability of the invasion and that nothing can be done about it.

It would appear that there is a fairly rapid invasion and then the numbers decline and stabilise over a number of years, Fluctuations will occur with seasons.

How Darwin residents will react is unknown. The NT National Parks does not appear to have any particular strategies in place but following our approach will investigate preparation of appropriate literature and responses.

Council has two options. They could refer all issues relating to this pest to the NT Government or they could take a more pro-active approach in terms of providing information. It is not recommended that staff respond to complaints of road kill or other dead toads but rather advise residents on how to deal with the matter.

Consultation
Ballina Council
Cairns City Council
Byron Bay Council
Queensland Museum
Parks and Wildlife NSW and NT
Katherine Town Council
CSIRO
Public Relations Officer

RECOMMENDATIONS
That it be a recommendation to Council:

- That Report Number 02TS0264DT:cs entitled Cane toads, be received and noted.

- That Council liaise with NT National Parks to produce appropriate Information sheets dealing with various problems associated with cane toads.

Any queries on this report may be directed to Dave Thiele on extension 618.

OPEN SECTION
Corporate & Economic Development Committee Meeting
Tuesday, 20 February, 2001 and Monday, 26 February 2001

10 GENERAL BUSINESS

10.7 LGANTAgenda Items for Discussion – Cane Toads

(LM/Ald Miller) COMMITTEE'S DECISION

- That the Committee resolve under delegated authority that an update be given to Councils by the Northern Territory Government, on the issue of Cane Toads in the Northern Territory.

DECISION NO.18\1382 (26/01/01) Carried

SUBMISSION NO. 7

Mr Dan Baschiera, Private Citizen

3 Tybell Street
WINNELLIE NT 0820

EXTRACT ONLY

THE CANE TOAD *BUFO MARINUS*

A Bio-pollutant that needs more research

The Cane Toad was introduced into Queensland 1935 to combat the cane beetle infesting the sugar cane – it failed. A prolific breeder, a single female toad can spawn a string of 40,000 eggs, 2-4 times a year.

The Cane Toad has so far not experienced the kind of ideal breeding condition in Australia as it has in Venezuela where it comes from. These being low grassed plains with permanent wetlands, well cracked mud flats, abundant food, tropical temperature and a regular wet season. This will change as it move north of Katherine and into our flood plains. To date there has been no research into any potential increase in its breeding rate once it arrives in these improved breeding conditions. Could the breeding rate in the Northern Territory exceed that of Queensland's and if so by how much? If it is 2-3 times the Queensland rate will this not prove disastrous to our tourism economy, barramundi fisheries, our health and our lifestyle?

Professor Mike Tyler from Adelaide University, one of Australia's top academics on amphibia, has stated that,

> "*The number of toads emerging in Kakadu will be far greater than we've experienced in Australia before*" (Bulletin).

Are we at high risk of seeing our northern wetlands swamped in a brown moving blanket of dominating amphibia? Is the quality of our outdoor territory lifestyle going to be reduced forever?

The Cane Toad is attracted to and consumes human and animal faeces and is a know carrier of many human parasites. This combined with the poor sanitation of fringe dwelling in the NT raises questions on community health. Will all of our waterholes – Berry Springs, Wangi Falls etc be at some risk from salmonella contamination? Will swimming pools have to be toad-proofed, and at what cost? Is real estate going to de-value?

Anything that moves and can be caught which will fit into the mouth of a cane toad will be eaten. As well as insects this means the young of all manner of fauna. Has the toad decimated the Frill Necked Lizard from the Gulf Country? How much of our native wildlife will disappear? Does this include the water birds in our wetlands? With a rapid breeding rate is every link in the food chain going to be

consumed or poisoned by billions of toads and tadpoles? Are the Frilled Neck Lizards and Northern Quolls at risk of becoming extinct?

The Cane Toad is poisonous at all stages of life. If a dog or cat bites a toad the poison enters the animal's system rapidly through the membranes of the mouth. Depending on the degree of poisoning the effects can be seen almost immediately and in some recorded cases, death has occurred within 15 minutes. Are our children at risk? Is there a long-term contact effect? How many of our native predators will disappear? Will singing cicadas be replaced by the drone of the toad?

Due to the Toad being labelled a pest as distinct to a menace both Territory and Federal Governments have ceased all funding into the research of the Cane Toad impact and in the search for a control. There is also the argument that wildlife will regenerate behind the Cane Toad swarms. Research methodology on the impact of the toad in the NT in this area has been limited. Research that has been conducted on its impact does not in my view as a professional researcher stand up to close scrutiny. The research methodology did not take into account all of the variables. There are such significant flaws that its result, in my opinion, - that wildlife will regenerate, could be based more on assumption than hard comprehensive evidence. Never the less it has led to the NT Government adopting a cost free 'Cane Toad Acceptance' strategy. If the concerns about a multiple breeding rate prove true (indicators and professional opinions are pointing in this direction) then there will be very little wildlife to regenerate and this is an extremely high risk gamble. We need a comprehensive research program not a gamble.

In fact we need to ask a lot more questions. For example given the high toxicity of cane toad tadpoles – what really happened to the Barramundi Fisheries of Queensland? What will happen to our fish stocks here?

Could this potentially be an environmental/ economic disaster of an unprecedented scale? Unchecked will the cane toad destroy the pristine values of our natural heritage and seriously damage the eco-tourism investment we hold in trust for future generation?

Uranium mining is not the greatest threat to Kakadu, - we can manage uranium mining. To date we have not managed the toad, it will manage us. Are the pristine values of Kakadu about to become history?

The fact that research has yet to provide an answer to the cane toad problem is no argument for doing nothing, is it an argument to find a solution?

THE CANE TOAD'S MOST EFFECTIVE DEFENCE IS NOT ITS POISON.

In fact it is you. You are the best defence the cane toad has. When humans are faced with two opposing views we tend to distort reality to either avoid one view or at least make it acceptable, bearable and comfortable. It is a human reaction that psychologists define as Cognitive Dissonance (Festinger 57). In the case of the cane toad the two opposing views are:

1. That the Cane Toad is an environmentally destructive, poisonous, bio pollutant
2. Because we can't manage it we have to live with it.

The general tendency, as demonstrated in Queensland, is to accept living with this biopollutant. To enhance this acceptance, we create anecdotal humour to help with our comfort zone, hence jokes about playing golf with toads abound.

In short, the most effective defence the Cane Toad has is our acceptance of its biological dominance. This means it will spread across Northern Australia, becoming a dominant species from Kakadu to the Ord River while we turn a blind eye and not resource any research or means to combat it. The cane toad is an insidious menace that could drastically alter the quality of our future and natural environment.

WHAT CAN WE DO?

1. Help Wildcare petition the government and industry to fund $millions into open-ended research on the toad. To look at al angles, biological, genetic, pathogens etc.

2. Alert community to slow the spread. The frontline has passed Katherine and is already in the lower parts of Kakadu.

3. Report any suspected sightings of cane toads. Do not kill them but capture them for identification as young toads are difficult to distinguish from the native *Uperoleiea* species.

4. Turn you gardens into Cane Toad-free sanctuaries in order to protect the genetic pool contained there in and buy time for science to come up with a solution. Fencing using 1cm hole bird wire at a height of 50cm should be sufficient.

5. Let the world know that the World Heritage Values of Kakadu are under dire threat.

6. Change community attitude from one of acceptance to one of resistance, **we have to turn and fight the toad now**.

Written by Dan Baschiera BA Sc. – prior eco-tourism operator/ lecturer and research consultant to the NT Government.

This campaign is funded by donations to Wildcare Inc.
Wildcare is a non-profit organisation run by volunteers.
Donations or enquiries can be directed to PO Box 464, Palmerston NT 0831

SUBMISSION NO. 8

Northern Land Council – Caring for Country Unit
Ms Robin Knox
Aboriginal Women's Land Management Facilitator

PROBLEMS AND RISKS ASSOCIATED WITH CANE TOADS

The degree to which cane toads will contribute to species extinction is not known as little research has been done, but the massive reduction in numbers of many animal species has been witnessed in areas already infested with cane toads in the Northern Territory. The presence of cane toads and the reduced numbers of animals is having a significant effect on the way of life of Aboriginal people in the Northern Territory.

Where cane toad populations are established they have severely reduced the availability of bush foods for Aboriginal people to hunt. The lack of animals to hunt has contributed to:

- reduced consumption of bush foods, which previously contributed to a healthy diet;
- loss of skills and knowledge about hunting and animals that were taught to the younger generation on hunting trips; and
- reduced mental well-being of Aboriginal people who are spiritually connected with their land and the animals that live on it.

LIVING WITH CANE TOADS AND THEIR EFFECTS ON COUNTRY

In the words of the Ngukurr Women Rangers:

> *Cane toads kill our goannas, snakes, fish and birds. They have taken over from ordinary frogs. We don't see very many green frogs, sand frogs, grass frogs and native toads.*
>
> *At Warrpani, our traditional country, Cherry has seen cane toads along the billabong. Geese, pelicans and cranes eat them and die. The women see dead pelicans and geese during the wet season.*
>
> *Before the toad came we used to eat goanna every week or every day, especially during the early dry. But now you can't find any, except water goanna, there is still big mob of them around, but they are going too.*
>
> *There are problems in the billabongs. When the cane toad goes in the water it pollutes the water. It impacts especially in the water, around the edged of the water. Pollution in the water.*
>
> *After the big rains this wet season (2003) there were millions of little cane toads around Ngukurr. The dogs keep away from them. We are frightened of the toads and we teach our children not to humbug with the cane toads. So you got to be with the children all the time.*
>
> *It's not our native animal. Since the toad came we hardly go fishing. Sometimes we take the fish out of the water and its not a healthy fish. Fish eat tadpoles and birds eat fish and everything starts dying. Even the wallabies are going away.*
>
> *During rain time people get frightened to walk the streets at night because there is cane toads everywhere.*
>
> *In the billabongs cane toads have taken over the freshwater crab holes. When we go looking for crab, we find only cane toads.*
>
> *The older people worry about the cane toads. They know what it has done to our land, the things we used to have. Our everyday use is not there anymore.*

Bush potatoes and chestnuts, things we dig for in the ground, they are not healthy too.

The cane toads also get in the pipes. Sewerage drains are always blocked.

In the future, everything will be gone from those cane toads.

Another concern has been about the possibility of dogs being poisoned from eating the toads, but the only reports 1 have heard have been that some dogs become glassy eyed from licking the toads.

Some women have also expressed concern that their young children may be poisoned from touching cane toads, so this is also worrying them.

CULTURAL, SOCIOECONOMIC AND OTHER FACTORS ASSOCIATED WITH THE ENCROACHMENT OF CANE TOADS

In the words of the Ngukurr Women Rangers:

People hardly go out hunting. They eat less bush meat and are depending on the shop for meat.

We fish in the river for healthy fish but fish in the billabongs is unhealthy. We don't go and fish there anymore, but also rubbish is polluting those billabongs.

Lillypods don't grow the normal (large) size anymore. Toads and other ferals are polluting the water.

There is less food to hunt and people are having to purchase more food from the shop, but their incomes have not increased with the arrival of the cane toad. As a consequence Aboriginal people may be obtaining less protein and experiencing reduced nutrition in their diet. If the people are not going hunting as often they may have reduced their activity and their exercise. Boredom and less time spent doing rewarding social activity (such as hunting) can have negative social consequences. If people cannot provide for their families they feel unfulfilled.

Hunting is also a way of passing skills and knowledge on to young people. With the reduced desire to go hunting, the opportunity for teaching is also lost.

Aboriginal people's spiritual connections with their land and animals contribute to their sense of well-being. Their identity is through their connection to their land and the animals that live on it. As the animals disappear they experience strong feelings of loss.

Aboriginal people also feel powerless to control the cane toad. They feel very sad seeing the effect it has on their land and animals. Such a feeling can contribute to depression.

These are just some of the negative social consequences that result from the cane toad's presence.

CURRENT UNDERSTANDING AND ASSESSING NEEDS FOR PUBLIC EDUCATION AND AWARENESS PROGRAMS

In the words of the Ngukurr Women Rangers:

People in Ngukurr don't understand. They are not aware of how the cane toad got to Australia. They understand only to stay away and that it is impacting on life in Ngukurr.

The young people don't care about the cane toads. They kill them. To them it's like a hobby. During rain time they wear shoes.

Over the past 4 years Aboriginal people have frequently voiced their concerns over the effects of cane toads moving into or towards their lands. In 2001 the NLC ran a campaign to raise awareness of the cane toad issue and the importance of trying to reduce the chance of cane toads reaching and establishing themselves on NT islands.

Keep Cane Toads off our Islands

Sixty metal signs were made and distributed to community councils and resource centres on islands and the mainland along the Arnhem Land coast and down as far as Borroloola (see attached copy). Communities and ranger groups were asked to erect the signs at airstrips and barge landings. We also distributed paper signs for stores, schools and health clinics.

Some months later follow-up phone calls were made to ensure signs had been erected. There may now be a need for new signs in some areas. Although no formal evaluation of this campaign has been conducted, from visiting many communities, there appears to be a good awareness of the negative environmental effects of cane toads and the importance of keeping them off islands.

People feel frustrated that they cannot do anything to eradicate the cane toads and become quite depressed when told that it may be ten years or more before we may have a biological control to assist in eradicating this pest. If Aboriginal people could be involved in measures taken to reduce the cane toad's presence around living areas they would feel less disempowered.

More information needed

People are interested in learning more about possible ways of reducing cane toad populations. They also want to understand where they have come from and what is being done about them. A similar information campaign could also be established to educate people of the enormous damage caused to native wildlife from feral cats that have escaped from populated areas and now live off wildlife and also endanger many species.

Community information, announcements and advertisements presented on Impaja Television and TEABBA radio would inform many people living in remote areas.

IDENTIFYING WAYS TO MANAGE THE ENVIRONMENTAL IMPACTS

Suggestions from the Ngukurr Women Rangers:

In Ngukurr, people use too much water. Children play with the water. It lets the cane toads keep on breeding. Control water use (around living areas)

Use pesticides on the lights or use different lights to keep the bugs away. (Hundreds of toads gather around lights at night to feed on insects attracted to the lights.)

Kill them in the community.

Go to the 'experts'. They have the knowledge and they can do something about those cane toads. The ranger women can talk to the 'experts', the scientists.

They are in the weeds in the billabong. We need to control the weeds in the billabong.

We use salt and Dettol to kill them in the community.

I have also heard that Domestos is frequently used as it is readily available. I have never heard of toads being put into the freezer in Aboriginal communities, the killing method suggested by Parks and Wildlife.

Investigate and publicise options for reducing cane toads in living areas
People do not like having to live with cane toads. If strategies for reducing cane toads in living areas can be devised, publicised and implemented this could relieve day to day discomfort experienced by people.

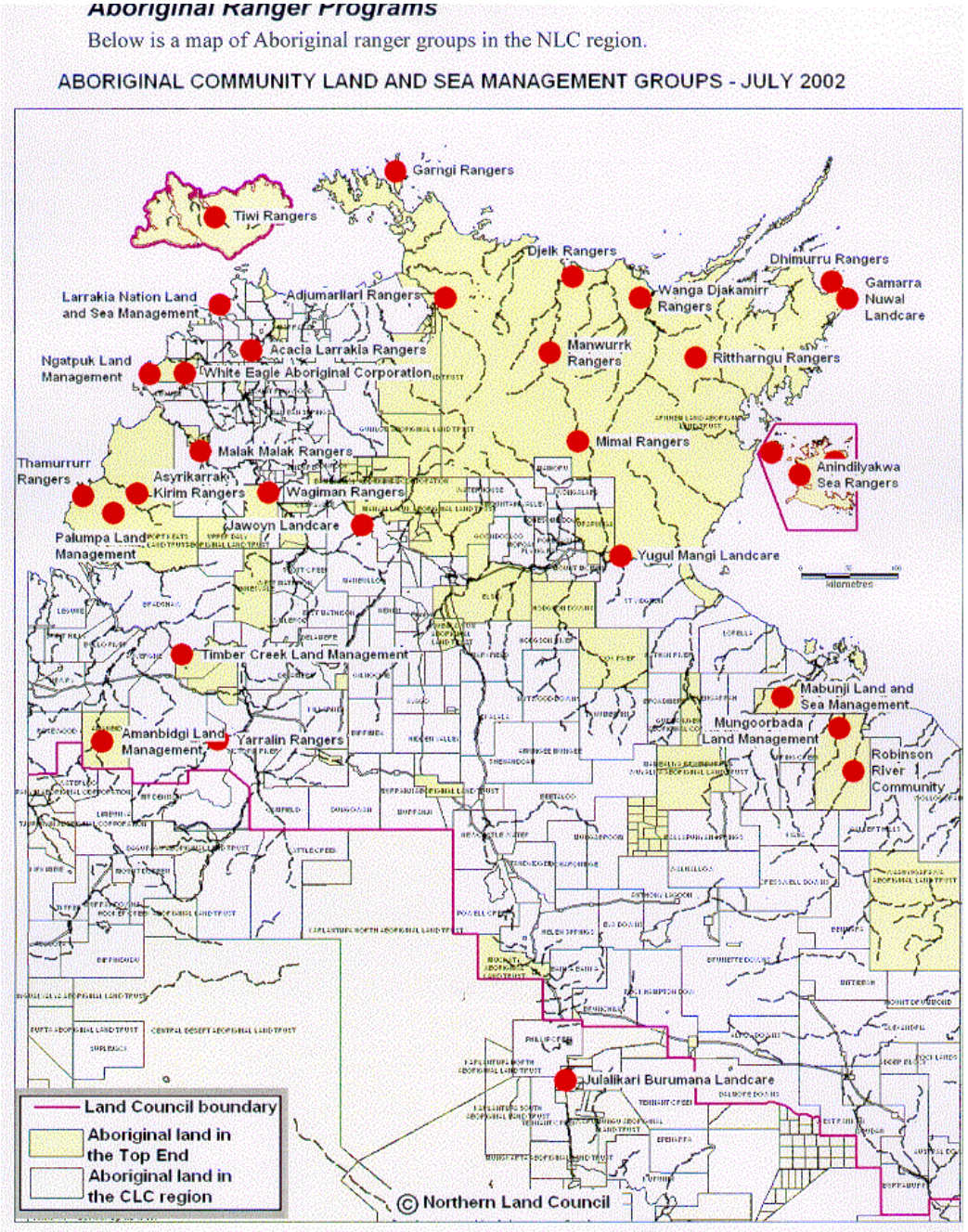
Trials to quarantine selected "no cane toad" areas
Selected billabongs and surrounding wetlands could be fenced to keep out cane toads as they are known not to jump higher than 300 millimetres. Such areas would constantly need to be monitored and the fence inspected for damage. These areas, if near communities, could be used as education reserves for Aboriginal people to pass on knowledge and hunting skills to future generations.

Slowing the spread of cane toads
Cane toads are reported to be capable of advancing at five kilometres per day. Attempts to slow the cane toad's advance westward may be achieved by fencing the headwaters of western flowing river catchments of the Northern Territory that have not yet been invested. If the cane toad's advance across the northern tropics can be slowed, scientists may be able to design a biological control before all the northern tropics are invested.

How Aboriginal people can help with cane toad solutions
Aboriginal people, who are living with the consequences of the cane toad invasion, have enormous knowledge of the toad's behaviour and habits. If any actions result from this inquiry, Aboriginal people living on the land can obviously contribute a great deal of knowledge and experience of living with cane toads. Through the Aboriginal ranger network there is an established group of environmental experts, some of whom would be interested in working on actions that may quarantine areas or attempt to slow the movement of toads to new areas.

Aboriginal Ranger Programs
Below is a map of Aboriginal ranger groups in the NLC region.

ABORIGINAL COMMUNITY LAND AND SEA MANAGEMENT GROUPS - JULY 2002



Some groups are well established, while other groups are needing more support and resources. By resourcing Aboriginal ranger groups in remote areas the government would be assured of an environmental safe guard to watch over country and report outbreaks of plants or animals that do not belong. Early detection and subsequent eradication of introduced species is particularly important in the sparsely populated areas of northern Australia. The involvement of Dhimurru rangers in controlling crazy ants in north east Arnhem Land is an example of a control program that is tackling a potentially disastrous pest before it spreads.

Characteristics of Aboriginal Ranger programs - points for consideration when Government employees work with Aboriginal Ranger groups

It is essential that activities with rangers are well planned and supported with:

- Flexible employment arrangements that are worked out in consultation with the local people on individual communities. Senior elders should be consulted and employed as advisors when and where available;
- Real wages for work (this may include part-time or seasonal options or top-up for CDEP workers);
- Day to day mentoring of personnel where appropriate (an example for such mentoring may mean working with rangers for a week or more and then returning every month for follow-up);
- Rangers sufficiently resourced with necessary materials to carry out the work; and
- Incorporate appropriate on-ground training, delivered on site or in the community.

CONCLUSIONS

The impacts of cane toads throughout the Northern Territory reduces people's quality of life and the value of any investment in preserving our conservation areas. The consequence of cane toads in the Northern Territory warrants immediate action and continued research to find a long-term control. Aboriginal people and their lifestyle is severely and significantly affected by the consequences of cane toads on their lands. Trials to assess the success of cane toad free zones should be begun immediately and expanded if successful. Aboriginal people have a role to play in such measures as they are extremely concerned about the effects of cane toads. Keeping cane toads off islands is an important message for everyone living or visiting the Northern Territory. Continued reinforcement in order to maintaining these islands as quarantine areas free of cane toads is required.


KEEP CANE TOADS
OFF OUR ISLANDS
bony ridge
distinct ear
raised glands
fully webbed feet
Check your load
...stop the toad!
If you see cane toads on an island report them to NLC Caring for Country Unit, freecall 1800 645 299 or your community rangers, council, resource centre, or the Parks and Wildlife Commission.
CARING FOR COUNTRY
NORTHERN LAND COUNCIL

SUBMISSION NO. 9

World Wide Fund for Nature - FROGS! Program
Centre for Environment Education Australia Incorporated
Provided by Mr Stan Orchard, National Co-ordinator

GPO Box 528
SYDNEY NSW 2001

A SCIENCE AND EDUCATION PROGRAM TO CONTROL AND ERADICATE CANE TOADS IN THE NORTHERN TERRITORY

PROPOSAL

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EXECUTIVE SUMMARY

The proposed program will develop techniques and methodologies that will extirpate cane toad populations from the Northern Territory, and will also prevent them from reinvading. Skills and knowledge derived from this program will directly benefit, and be largely implemented by, Arnhem Land aboriginal communities. The program will quickly and efficiently move from an experimental design phase, to field trials, refinements, fabrication and deployment – all in concert with a broader strategy of communications, education, training and networking. A multi-disciplinary team approach to creative problem solving will result in a totally original system for managing ecological threats in Australia through the artful integration of applied science and communications. It will promote general awareness of the socio-economic and cultural benefits of maintaining healthy and diverse ecosystems and sustainable resource use among aboriginal communities in the Northern Territory.

While Aboriginal populations constitute about 2% of the total population of Australia, they account for 28.5% of the population of the Northern Territory. Existing problems affecting these people include low levels of marketable skills due to poor educational opportunities and meagre income levels ("Learning Lessons", NTDE, 1999). Their communities are scattered across the Northern territory in dispersed settlements of varying size.

Aboriginal communities in the Northern Territory have societies and cultures that depend upon a regionally distinctive ecological economy. Their nutritional needs continue to be met by hunting and gathering. Current ecological pressures that threaten ecosystem health, and consequently aboriginal lifestyles, include depletion of local traditional resources through over-harvesting, loss of traditional ecological knowledge,

habitat degradation through development-related activities such as roads and dams, as well as growing populations of feral and exotic species. The cane toad invasion will have a catastrophic impact on the ecosystems on which these communities depend by causing a drastic decline in the numbers of top predators such as pythons, quolls, goannas and crocodilians that are protein dietary staples of aboriginal people throughout Arnhem Land and Kakadu.

The proposed cane toad control and eradication program will help to ensure the sustainability of traditional aboriginal culture in NT. It will provide training and employment opportunities for Aboriginals in the development and implementation of the control program. The education program will also help to restore ecosystem health through improving general awareness of conservation and species management problems and solutions.

The Centre for Environment Education Australia (CEEA) proposes to control and eradicate the cane toad in the Northern Territory through the following scientific and educational activities:

- Develop, trial and implement techniques and methodologies for the total eradication of cane toads
- Educate and train volunteers and the general community to participate in the implementation of the control and eradication program

The project aims to:

- Establish technical capacity to map distributions and monitor populations on an ongoing basis
- Eradicate and exclude cane toads from ecosystems in Kakadu National Park, Arnhem Land and surrounding areas
- Develop new and exportable techniques and methodologies
- Provide a model and skilled workforce for cane toad eradication elsewhere in Australia and the world
- Develop materials, methods and networks to mobilise entire communities for environmental protection
- Promote awareness and adoption of paradigms for sustainable income and employment generation from similar societies elsewhere in the world

WHAT WE PROPOSE TO DO

The proposed program will develop and implement an integrated science and education initiative to control and eradicate the cane toad menace from the Northern Territory.

Rationale

WHAT HAS BEEN DONE?	WHAT HAS NOT BEEN DONE?	WHAT THIS PROGRAM WILL DO.
Queensland and NT problem analyses conducted and general recommendations made for more "open-ended" research	Recommendations ignored	Research direction will be strictly on application and development of techniques and strategies to contain and remove cane toad populations
Incomplete documentation of the current distribution and rate of expansion	Understanding the periphery of the distribution and pattern of invasion is key to effective eradication	A systematic atlassing approach will fill the gaps in currently fragmented understanding of cane toad

		distribution in NT, and will provide a blueprint for strategically blocking further advance of the invading toads and pushing back the perimeter of the distribution
A few local, community-based extermination projects have been carried out in Queensland and NSW but with limited success	Lacked a systematic and scientifically grounded strategy, e.g. preventing recolonisation of the exclusion zones	Our strategy will treat the NT toads as one population, and our approach will be similar to that employed by a highly successful one to eradicate Norway Rats from Alberta, Canada
An on-going CSIRO attempt to bioengineer a pathogenic organism	Inherently dangerous technique because it threatens native frog fauna and potentially other species groups as well	All techniques will be species-specific
Government funding has been directed towards pure rather than applied research	The emphasis has been on building the case for eradication rather than getting on with the job	This is an outcome-oriented, applied science program that will finally eradicate cane toads from NT
Northern Territory and Federal governments both legally designate the cane toad as a "pest" rather than a "menace"	Effectively prevents government funding from going towards researching the impact or the search for a means of control.	Governments will be lobbied to properly designate the cane toad as a "menace"
Political leadership has acknowledged the problem	Political commitment has not been sustained	The education and awareness components of the program will engage managers and decision-makers
Universities and research institutions have not really gone beyond documenting the ecological impact of the cane toad invasion	Almost no emphasis on applying research findings to the development of eradication techniques	Eradication techniques and tools will be created, trialed, applied, and optimised
Media coverage of the issue has been widespread	Media content has been superficial and sensationalist	Accurate, verifiable and up-to-date Information will be a major output of the program though our communications networks and education programs
General public is concerned about cane toad invasion and keen to get involved	Not networked or organised for concerted action	Program networks will improve awareness and understanding of the problem nation-wide.
Generally recognised that aboriginal communities will be the most negatively affected	No awareness, education or action campaigns or programs currently in place	The education components are aimed at informing and mobilising aboriginal communities towards ecological and cultural sustainability

Synopsis

Goals	1) An effective program is in place to eradicate Cane Toads (*Bufo*

	marinus) from the Northern Territory 2) Cane toad invasion no longer threatens aboriginal communities and ecosystems in NT, and region is technically and culturally resourced to effectively deal with any future invasion
Purposes	1) Develop effective control and eradicate techniques and a comprehensive program to implement them 2) Use unfolding ecological disaster - the Cane toad invasion - as an educational opportunity for programs to demonstrate the need for sustainability in NT and possible ways to achieve this
Timeframe	July 2002-July 2004
Intended Results	1)To eradicate cane toads 2) Establish capacity (manpower, infrastructure, methodology) to prevent cane toads from re-entering NT 3) Create and maintain conservation education and information network
Outcomes	1) Eradication of Cane toads 2)Trained and skilled workforce 3) proven strategy and techniques for cane toad eradication 4) Greater general awareness of conservation and sustainability issues 5) creation of communication networks 6) multiple effects at the political and policy levels

The principal components of the proposed program are:

- Science and eradication
- Education, communications, awareness and training

Activity Description

Science and Eradication

Core Strategy
The program is assured of success if the following four conditions are met. It is therefore essential that we develop a system that will enable us to:

1. remove cane toads from defined and delineated areas much more rapidly than the toads can recolonise from outside the area;

2. effectively block the recolonisation of areas once they have been cleared of toads;

3. kill toads much faster that they can be replaced through reproduction;

4. prevent any further migration and population recruitment of toads into the Northern Territory from Queensland.

Alberta Rat Control Model
There are many parallels between the Norway Rat (*Rattus norvegicus*) and the Cane Toad (*Bufo marinus*). For example, both produce many offspring per year, easily establish feral populations, continuously expand their distributions, are ecologically and economically destructive, are carriers of human parasites and pathogens, and both are non-native problem species in Australia. With this in mind, Australians can take heart in the experience of Alberta, Canada, where it has been conclusively demonstrated that concerted control and eradication programs, for even these most problematical of species, can be effective and sustainable.

The Alberta Government's Norway Rat Exclusion in Alberta website states: "Since 1950, the Province of Alberta, Canada, decided that the economic damage caused by populations of the introduced, verminous European rat (*Rattus norvegicus*) was unacceptable. This program has essentially kept the province rat-free. The success of this program means that the province has saved an estimated one billion dollars over 50 years in property damage, livestock losses, human suffering and health care costs, as well as contaminated and wasted food.

Success is achieved by eliminating invading rats within a control zone 610 km long and 30 km wide along the eastern border of the province. A systematic detection and eradication system is used throughout the zone to keep rat infestations to a minimum. Strong public support and citizen participation was developed through public education and a sound awareness effort. Although rat infestations within the interior of the province are minor, a rat response plan is in place to deal with a large or difficult case. Government preparedness, legislation, climate, geography, effective rat baits and close co-operation between provincial and municipal governments have contributed to the program's success.

The Government of Alberta currently spends $100,000 a year eradicating rats, with a thoroughness that probably saves Albertans something like $30 million a year in lost grain, spoiled food, damaged buildings, tattered clothing, killed poultry, stolen eggs and short-term extermination costs. Similar economic benefits can be expected from removing and excluding cane toads from the Northern Territory.

Existing Applicable Techniques and Methodologies

Contemporary techniques and methodologies for amphibian fauna atlassing, populations monitoring, field capture, handling and killing are comprehensively discussed and explained in "Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians", edited by Heyer *et al*. (1994) Smithsonian Press. In many respects, however, the environmental conditions that we will be confronted with in the Northern Territory will require innovations and adaptations to conventional protocols for field studies developed elsewhere in the world.

Applied Science and Eradication Program Methodology

All of our actions are directed towards the relentless, progressive killing of cane toads and the driving of their populations to total extirpation within the Northern Territory. The following steps can begin as soon as funds are made available, and will all proceed more or less concurrently:

1. Delineate, with accuracy, precision and high resolution, the distribution and density of cane toads. Determine their precise locations within the range and the outer perimeter of their distribution throughout the 'Top End' of the Northern Territory
   a. create **a toll-free telephone number** for people to report sightings of cane toads. When plotted, these will be coded as 'unverified reports'.
   b. build **a network of volunteer observers** composed largely of rural-based environmental, governmental and outdoors professionals and semi-professionals whose travel and fieldwork create unique opportunities to report cane toad sightings from remoter areas within the target region.

These reports will tend to be somewhat more reliable than sight records from the public, but they will nevertheless also require verification.

c. begin training **a Cane Toad Patrol** who will become conversant in the biology of cane toads and skilled in conclusively verifying the occurrence of toads at reported localities. They must be trained to find and positively identify all cane toad life stages, e.g. eggs, tadpoles, juveniles, adult males and adult females. They will verify sightings from the public reporting network by visiting the sites and will assess the biophysical nature of the site and the densities of toads at the site. Their GPS measured site records will be coded as 'verified'. Eradication skills and training detailed below (see 4a).
d. hire **a GIS Database and Reporting Manager** who will receive and plot the reports from the public, from the volunteer observers network, and from the Cane Toad Patrol. This person will oversee the quality control and synthesis of in-coming data and will interpret it for the rest of the program team and the public through up-dated maps, a website and routinely released reports.
e. a **Volunteers Co-ordinator** will work in concert with the Database Manager and the Cane Toad Patrol to enlist, expand and maintain a corps of volunteers to report cane toad sightings. A primary goal will be to maximise the geographical coverage of the target region.
f. develop **a media network** to broadcast to the public the latest information on the progress of the scientific program and to encourage public participation and vigilance.

2. Conduct an **in-depth analysis of the geography** of the NT and cane toad dispersal into the NT
   a. **identify topographical and other relevant geographical features** of the region that provide toads with unimpeded or impeded dispersal corridors, bottlenecks, dead-ends, or distributional fragments
   b. **plot the nature and extent of these geographical features** and develop a system that divides the region into a mosaic of fragments or isolates based upon the region's innate biophysical character
   c. **divide up the whole region into manageable units** in which eradication can be carried out in relative isolation from adjacent units
   d. **rank these geographical units based upon relative invasion rates** and identify locations where the perimeter is known to be most rapidly expanding or likely to expand – these will be given the highest priority
   e. **develop an overall systematic eradication strategy** that will halt further progress of the invading toads, contain them within the current limits, then systematically eradicate populations working from the perimeter

3. Begin an on-ground survey of the north eastern boundary region between the Northern Territory and Queensland.
   a. assess the logistical problems associated with maintaining **an effective 30 km wide by 150 km long Toad Control Zone** between Queensland and the Northern Territory, e.g. current extent of cane toad distribution; accessibility and manoeuvrability within the terrain; supply routes; seasonality factors, infrastructure.
   b. as quickly as possible, commence **an intensive systematic and sustained detection and eradication program** throughout the length of the Toad Control Zone to keep toad migrations into the control zone from within and without the Northern Territory to an absolute minimum. This

will isolate populations already established within the Northern Territory and prevent any further migration and recruitment from Queensland

c. set up an array of **remote sensing stations** to detect cane toad vocalisations within the Toad Control Zone

4. Apply eradication techniques and methodologies through the deployment of a fully trained **Cane Toad Patrol**.
   a. required skills include: use of GPS and map reading; basic habitat assessment and record keeping; outdoor safety; safe use of boats and vehicles in highly variable conditions; basic public relations; cane toad searching techniques; identification of all life stages and advertisement call of the cane toad and ability to distinguish this species from all native frog species in the region; deployment and maintenance of a wide variety of control and eradication techniques; a facility for, and interest in, finding cane toads in nature; reliability; killing and processing cane toads; an enthusiasm for the idea of participating in a control and eradication program.
   b. develop and trial a cane toad response plan to deal with particularly large or difficult cases.
   c. regular outings with, and feedback from, field staff to help the research and development team to understand their everyday problems and work on practical solutions.
   d. working from around the periphery of cane toad distribution, the Cane Toad Patrol will systematically detect and destroy populations and relentlessly push back the perimeter, such that the area occupied by cane toads in the Top End will rapidly decrease in area and progress through local extinctions towards the goal of total extirpation.

5. Assemble the Applied Science Research and Development Team at a workshop (see Experimental Design Workshop below) to pool scholarship, experience, ingenuity, wisdom and brainstorm on simple experimental designs leading to practical, environmentally-friendly solutions to problems related to finding, tracking, collecting, attracting, repelling, concentrating, excluding, trapping, and killing cane toads. The experimentation phase will commence immediately after the workshop. Most of these experiments will proceed very quickly from simple, short-term controlled experiments, to field trials, refinements, and extensive application.
   a. the National Co-ordinator for the WWF Frogs Program and a Science Advisory Panel will be take a lead role – these are Australia's leading authorities on frog biology
   b. researchers from James Cook University will be invited, who have already gained considerable field experience with cane toads in Queensland
   c. bioacoustics experts from the University of Melbourne and Harvard University may be invited.
   d. the engineering faculty from the University of the Northern Territory will be consulted on electronics, design, and fabrication issues
   e. the engineering faculty from the Royal Melbourne Institute of Technology may be engaged to make refinements to a remote sensing system
   f. the Northern Territory Museum, Tropical Savannah CRC, and the Zoology Department of the University of the Northern Territory will all be invited to the discussions
   g. a field research station needs to be set up within the Cane Toad Control Zone, and a controlled research facility in or near to Darwin

6. We must have the greatest possible freedom of action and movement within and throughout the Top End region. This is central to the success of the program. All indications suggest that an effective eradication program in the Top End would receive enthusiastic support from all quarters of the extended community. To achieve this we will need to approach a wide variety of landowners for permission to carry out our work on their properties – including various aboriginal land councils, different levels of government, national and state parks, Australian military, mining companies, farmers, ranchers, and individual private property owners.
   a. The Co-ordinator for Applied Science/Eradication and Co-ordinator for Education/Communications will work jointly with the Community Liaison Officer and regional consultants to negotiate these approvals through an on-going series of public and private meetings.

Experimental Designs Workshop

At the start, a workshop will be convened to bring together Australia's senior authorities in the science and biology of frogs/toads and relevant related disciplines. Participants will address a series of questions and work through a relational matrix (below). Our goal is to thoroughly examine and identify any and all innate behavioural attributes for each life stage of the cane toad (A-E) and then explore the possibilities that these might present in terms of developing specific eradication techniques and methodologies. At the end of the workshop we will have:

1. a comprehensive action plan for the research and development component
2. a clear set of priorities
3. an initial set of experimental designs
4. a timetable for all phases – experimentation, field trials, fabrication, training, application

Experimental Design Workshop Outline

1. What do we already know?
2. What do we need to find out?
3. How do we translate this knowledge into control and eradication techniques?
4. How would we design the most time-efficient experiments?
5. Is this technique cost-effective and time-efficient?
6. Is this technique suited to extensive applications?
7. What are the most effective techniques for each of the life stages?
8. What are the most effective techniques for each habitat type?
9. Which techniques will have the greatest impact on reproductive success and population survival?

	A. EGGS	B) TADPOLES	C) JUVENILES	D) ADULT MALES	E) ADULT FEMALES

1) TIME					
2) SPACE					
3) OLFACTION					
4) TASTE					
5) HEARING/ VOCALISATION					
6) SIGHT					
7) TOUCH					
8) DIURNAL BEHAVIOUR					
9) NOCTURNAL BEHAVIOUR					
10) SEASONAL BEHAVIOUR					
11) BIOMECHANICS					
12) MIGRATION/ DISPERSAL BEHAVIOUR					
13) FORAGING BEHAVIOUR					
14) REPRODUCTIVE BEHAVIOUR					
15) TEMPERATURE					
16) HABITAT/ECOLOG ASSOCIATIONS					
17) GEOGRAPHY e.g. aspect/slope/etc					
18) REPELLANTS					
19) ATTRACTANTS					
20) TERRESTRIAL BARRIERS					
21) AQUATIC BARRIERS					
22) TRAPPING					
23) SEARCHING TECHNIQUES					
24) REMOTE SENSING					
25) CAPTURE TECHNIQUES					
26) HANDLING TECHNIQUES					
27) KILLING TECHNIQUES					

Education, Awareness, Communication and Training

The educational components will be planned and implemented in tandem with the research components of the cane toad program. They will improve general awareness of the scope and impact of the cane toad problem, and broadly engage the community, formally and informally, in the process of solving it. A major objective of the education program will be to keep the Australian public fully informed on the intentions, developments and progress of this program. The cane toad education program will also include innovative programs that engage community interest and participation in sustainable development and the nurturing of ecological health.

The control and eradication of the cane toad in the Northern Territory will require the support and involvement of aboriginal communities throughout the region. Eradication and monitoring techniques and methodologies will need to be transferred to communities that range from settlements of high density to scattered groups of families across a large and often not easily accessible territory. The proposed educational programs will utilise state-of-the-art communications media to reach and engage these communities; thereby raising awareness about the need and value of ecological stability and sustainable management of natural resources in the area.

The proposed education components will blend scientific and management information with traditional knowledge and international best practice, to develop content and techniques in the delivery of educational programs. The program will also seek to engage the communities in a continuing dialogue on environment and sustainable development through links with similar societies elsewhere in the world.

The educational program will improve communication on practical issues of local relevance to the communities. It is expected that the dimensions of the cane toad problem will be significant enough to engage the attention, concern, avid support, and involvement of all stakeholders in the region, including non-aboriginal communities, policymakers, decision-makers, the student community and industry.

The following activities will form part of the education program designed to raise community awareness and ensure participation in the cane toad control and eradication program, while at the same time promoting a greater understanding of the need to be vigilant about ecosystem health issues.

The program will develop and trial specific model activities for integrating conservation goals with public participation. Direction for setting priorities and designing models will be derived from international best practice.

Past experience in the development and implementation of conservation education programs aimed at securing public partnership in similar hunter gatherer societies elsewhere in the world suggests that organised activities that support decision-making and build capacity for sustainable natural resource management can form the basis for long-term and self-sustaining community involvement in conservation goals.

The education program will document traditional knowledge and incorporate it with scientific and technical content developed by the research components of the program and use both traditional systems of education such as storytelling along with a variety of media.

WORK PLAN

Objectives/Outcomes

- Inform, educate and involve the community in control and eradication of cane toads
- Implement an innovative set of programs to engage community interest and participation in close alignment with the program of control and eradication of cane toads in the Northern Territory
- Develop and refine educational materials, methods and strategies
- Use unfolding ecological disaster as an educational opportunity for programs to demonstrate the need for sustainability in NT and possible ways to achieve this

Targets
The education components will extend beyond aboriginal communities in the Northern Territory to include all stakeholders. Full use of media and communications networks will be employed to attract the attention and interest of decision-makers and policy-makers, both in NT and federally.

Activities
The education, awareness and training programs will involve the following activities:

1. a) *Meetings/workshops*: This will be a primary means of informing communities about the cane toad menace and acquaint them with related ecological and socio-economic issues.
   b) *Number*: 12 each year (Inputs: workshop organiser/communication/ travel and expenses)

2. a) *News Feeder service*: The program will run a monthly news feeder service that will go out to newspapers, community news services, NGOs, government departments and schools. The feeder service will provide the public with progress reports coming out of the research, development and monitoring activities of the program.
   b) *Number*: 12 issues a year (Inputs: writing, editing, design, production costs, postage costs)

3. *Website*: The program will set up and maintain a website to provide progress reports, background information, and a public invitation to formally register and participate in the cane toad program. The website will also host discussions on issues relevant to the NT aboriginal communities.
   Number: 4 web debates each year (Inputs: writing, design, maintenance and uploading costs, travel and communication to improve material and quality of web discussions)

4. a) *Brochures and publications*: Informational brochures containing cane toad related information will be distributed and updated as new information is brought to light.
   b) *Materials* that can be used for improving communication on related issues will also be developed such as posters and booklets: 6 posters, 6 brochures and 6 booklets each year (Inputs: writing /design /illustrations/ printing/translation)

5. a) *Training workshops for workers/communicators*: Training workshops will be held to train and up-grade the skills of volunteers and staff involved in the cane toad eradication program. These workshops will be held at least once per month.
   b) *Number*: 36 each year (Inputs: venue hire, facilitation, registration, publicity)

6. a) *Video documentaries/presentations*: Video documentaries will be prepared on the cane toad issue and on related socio-economic sustainability issues for media and for viewing by the general public and as inputs for workshops.
   b) *Number*: 2 per year, 15-30 minutes each (film, editing, travel, script, commentary materials)

7. a) *Mobile exhibit*: A travelling exhibit containing artistic and scientific representation of ecological, socio-cultural issues relevant to the cane toad control initiative will be developed for viewing throughout the NT.
   b) *Number*: One per year (vehicle, design and content development of exhibits, posters, materials, translation into local languages)

8. a) *Theatre/folk media/community events*: Theatre and folk media will be employed in improving awareness and alerting the general public to ecological issues in NT. Traditional indigenous events will also provide an opportunity to get elders involved in the communication and awareness programs.
   b) *Number*: 2 performance units (Inputs: development of script and financing production)

9. *Eco clubs for children and youth*: Young people can be productively mobilised to participate in the cane toad control program through the establishment of eco clubs that will also promote ecological awareness and direct involvement in conservation activities.(inputs: Initiators, cost of meetings and activities)

10. *Lectures/discussion groups on sustainability issues*: Experts from around Australia and abroad will be invited to present lectures on sustainability issues and international best practice .(inputs: travel costs, accommodation, honorarium, organisation of lectures, publicity)

Initial Implementation

The science and eradication program and the education, awareness, communication and training program will be jointly co-ordinated and managed by the CEEA Science and Eradication Co-ordinator and the CEEA Education and Communications Co-ordinator.

July – August 2003:

1. Establish office and control centre in Darwin

2. Begin hiring and training staff

3. Continue background research

4. Begin making contacts throughout Arnhem Land – explaining the program to stakeholders and requesting their co-operation and permission to access their property as required

5. Commence mapping project

6. Invitations out for experimental designs workshop

September - October 2003:

1. Commence project activities as planned (details in the activity description above i.e. 1 newsletter each month, etc)
2. Convene the experimental designs workshop in Darwin

Activity and material inputs in the program are as follows:

Activity/Input	**a) Duration** **b) Frequency** **c) Quantity**	**Ready by**
Preparation of background	a) 6 weeks	September 2003

Activity/Input	a) Duration b) Frequency c) Quantity	Ready by
report (collection and analysis of relevant information)	b) 1 only	
Workshops/meetings	a) variable b) monthly c) 12	September 2003
Design and production of brochure/poster	a) 8 weeks b) annual c) 3,000	September 2003.
Website and creation of online resource service	a) 8 weeks	September 2003
Production of first issue of newsletter	a) 8 weeks - monthly thereafter c) 8 issues	October 2003
First web discussion	a) 12 weeks c) 3	November 2003
Training workshops for cane toad implementation	b) Semi-monthly to monthly	October 2003
Mobile Exhibit	c) 1	December 2003
Video documentaries	a) 12 weeks c) 2	December 2003
Street theatre	a) 14 weeks c) 2 units	January 2004
Lectures/discussions	b) Monthly c) 9	September 2003
Ecoclubs	To be determined	September 2003
Organisation of community events	b) Monthly c) Nine	September 2003
Preparation of materials for modules	On-going	October 2003
Resource persons/consultants for workshops and materials	As required	
Publicity (event announcements)	On-going	

Program Sustainability

Following the initial two-year period, the program will seek sponsorship for individual components of the program from governments and the corporate sector. The program will also seek core funding from international and regional organisations to cover costs of managing and administration where needed. Sponsorship is feasible once the component activities are established and their practical value demonstrated.

Resource Leveraging

The project leverages the networks, expertise and experience of CEE in India and Australia. CEE has the ability to take the lessons of this proposed program to 32 nations in the Asia Pacific region through its organisational networks - for example, as the national co-ordinator of GEF small grants program and its memberships in the IUCN, Asia Pacific Forum of Environmental Journalists, TVE resource networks, and its various collaborative projects with various international organisations. CEE brings its unique expertise and experience in field projects, including its regional training programs in environment education and communications.

The WWF Frogs Program will also offer its infrastructure, expertise and facilities as a minor co-sponsor of the activities in the proposed program.

PERFORMANCE MANAGEMENT PLAN

Evaluation

The Project will be evaluated according to indicators mentioned in the table below.

Key Performance Indicator	Target
System in place effectively mapping and monitoring changes in cane toad distribution as they happen	6 months
Activity on toll-free telephone number	Continuous activity
Cane toad distribution and density	Significant reductions after 12 months
Control zone established and eradication within the zone complete	12 months
Number of toads eradicated by Cane Toad Patrol	
Number of active volunteers from the community	Still growing after 6 months and 12 months
Number of articles in the media Radio programs: listener response Workshop and public event feedback Online resource hits on cane toad website	24 news items in media by July 2004
Program Interest	Sponsoring of events or activities
Cost Management	Zero budget deficit
Effectiveness	Program continue into 2005
Workshop and public event feedback	Survey Rating – High

Monitoring

The project will be monitored on a quarterly basis. One narrative report will be sent to the sponsoring agency at the end of each quarter. Consolidated annual statements shall also be prepared. At monthly meetings, all components of the project are regularly, reviewed by the project committee and shared with the sponsoring agency for its comments/suggestions. The sponsoring agents will be briefed on all aspects of the program on a regular basis and will solicit feedback on periodic reviews/monitoring reports.

Detailed reviews will be undertaken mid-term and at the end of the initial two years. The mid- term review will evaluate the project to ensure that it is proceeding on track.

Risk Management

All program risks will be tracked in a risk register. The risk register will identify each potential risk, its likelihood of eventuating, a mitigation strategy and the apportionment and delegation of responsibilities.

Risk	Likelihood	Mitigation Strategy	Responsibility
Distances and dispersed settlements may inhibit attendance /participation	Medium	Adjust strategy to use distance media	Program Management
Low uptake of communication training opportunities among aboriginal communities	Medium	Develop opportunities for long-term employment	Program Management through government departments and other organisations

Inability to access programs	Low	Strategy will allow and plan for low literacy and comprehension levels where found	Program Management

ORGANIZATIONAL CAPABILITY/PAST PERFORMANCE

Proponent

The Centre for Environment Education-Australia was incorporated as a not for profit association in Sydney in July 2001. It represents 18 years of experience, expertise and information resources in awareness building, education, communication and community initiatives. Its authority in the environmental field stems from its parent body, Centre for Environment Education in India (est. 1984) which founded the South and South East Asian Network for Environmental Education (SASEANEE) in 1992.

CEE Australia Incorporated is dedicated to raising awareness and supporting an informed and scientifically credible approach to environment and development issues in Australia and the Asia Pacific region. To this end, CEE Australia will develop and implement innovative educational programs based on scientific research, traditional knowledge and international best practice. Building on the strengths of its parent body, CEE- India, CEE-Australia is an autonomous entity with a management committee of specialists in environment education, conservation biology, communication, economics and finance. Additionally, membership by invitation provides access to a resource pool of expertise in a wide range of inter-related and relevant fields.

CEE, with its headquarters in Ahmedabad, India, has offices in the Northern, Southern, Eastern and Western zones of the country and its Asia-Pacific office in Sydney, Australia. CEE is the secretariat of the South and Southeast Asia Network for Environmental Education (SASEANEE), a joint program with IUCN, and currently runs a three-month certificate training program in Environmental Education for in-service professionals from the Asia-Pacific region in collaboration with IUCN and WWF-International. CEE is also the focal point for the South Asia Co-operative Environment Program (SACEP) and the national host agency for the GEF small grants program in India. CEE is the regional chair of the IUCN's education commission and is a member of the World Commission on Protected Areas. CEE received India's highest award for the year 1997 in recognition of the quality and impact of its contribution in the field of environmental education.

CEE brings experience and expertise in the field of conservation education in diverse and challenging contexts. CEE has an impressive legacy of developing effective materials, methods and strategies, and managing conservation education, awareness, training, livelihood support and communication programs for communities living in and around protected areas in rural, remote and fringe urban regions of India. This experience is especially relevant to the proposed Australian program, which will operate among multilingual, tribal, hunter gatherer societies whose cultures and socio-economic conditions reflect many characteristics in common with India.

Virtually all components of the proposed Australian program are already ongoing activities in India. Since 1985, CEE has been conducting annual training programs in environmental journalism, and has been organising and facilitating seminars and workshops at various levels on issues related to environment and development.

CEE hosts a website discussion on key issues in the area of environment and development in order to promote public participation in policy making, CEE's news feeder service has been operating successfully in India since 1985.

On the scientific side, and through the WWF Frogs Program, CEE brings to the project Australia's finest authorities on amphibian biology, conservation and education, and an established and unparalleled national network of conservation biology specialists and special interest groups. The WWF Frogs Program is the largest privately funded frog conservation program in the world.

Preparatory activities completed prior to submission of the proposal
As a first step in the preparation of this proposal, the project team convened a workshop in May 2002 in Darwin, Northern Territory, followed by a visit to Kakadu National Park and vicinity. That meeting and associated discussions provided an overview of:

1. Prevailing issues and constraints in educational materials and programs and their socio-economic impact on aboriginal communities in NT.

2. Resources at hand in terms of infrastructure, facilities, regional expertise, ongoing programs relevant organisations

3. Identification of needs in terms of infrastructure, activity support, permissions required, social protocols and regional expertise

4. An improved understanding of the state of the cane toad problem in NT

BUDGET FORMS

Budget Narrative
Details attached separately in Excel spreadsheet.

Financial Management System
CEE Australia uses MYOB. MYOB is a versatile, robust software accounting package.

Personnel Responsible for Accounting
Sarah White will prepare the account of CEE Australia monthly. Sarah has a Bachelor of Commerce Degree from the University of New South Wales. Sarah is also an Australian Certified Practising Accountant. Each year-end the accounts will also be prepared by an independent accountant. This will ensure that the accounts reflect a true and fair view of the organisation.

APPENDICES

Appendix One:

Budget Forms

SUBMISSION NO. 10

Keep Australia Beautiful Council
Ms Lorna Woods
Executive Director

kabclorna@bigpond.com

13 May 2003

Sessional Committee on Environment and Sustainable Development

Dear Committee

Having watched the proceedings yesterday I was surprised at the ordinariness of many of the presentations. 1 had expected to see a far greater presence and input from scientists and researchers and I expected to feel more confident that there would be a greater prospect of some practical answers - at least for the future. This is not a criticism merely an observation that left me feeling that we have in front of us a David and Goliath battle and sadly the money is on Goliath.

If the presentations in Darwin were indicative of the level of information available and tactics being applied to combat cane toads then clearly we are almost starting at the beginning it would seem. The suggestion that almost nothing has been done in Queensland in the way of studies or measures to eradicate toads is barely believable, however, 1 suppose it should not surprise us given Queensland's record on numerous other environmental fronts. (What a pity we can't sue 'em and obtain some compensation!)

Given Mike Tyler's suggestion that there is significant corporate interest at present that could translate to money that might find answers, then the urgent creation of a trust to gather such resources seems a priority. 1 would be happy to be active in the creation of such an entity.

EDUCATION
On the basis that there seemed to be an emphasis on education initiatives I have talked with my people today about incorporating some appropriate messages through the Territory Tidy Towns campaign. It is well known that Tidy Towns touches almost every community in the NT and has a regular participation base of a hundred and fifty with another hundred off-and-on participants. Homeland communities and associations are regular participants.

We could incorporate "CANE TOAD ERADICATION/CONTROL INITIATIVES" as a section that would attract points. We could also include information about the problem and give suggestions for methods of control.

We will also include a whole section on cane toads at our annual forum which takes place at the end of November. Indigenous communities are the main participants at this forum where participants are looking for good ideas and positive messages. A good presentation at this forum will have a valuable impact.

I noticed that your committee asked some individuals making submissions whether they would be interested in participating in a group focussed on "education" on the matter. In the event that such a group were formed I would be interested in participating on behalf of KAB.

Although KAB is short of funding this year (and as a consequence we will not be running a schools program) we are sure that the contact we have with communities could be invaluable. We are hopeful of finding sufficient sponsorship next year to run a schools program again and so our usual reach into schools will be re-established. We will certainly be interested in taking the messages to schools in 2004 if all goes well.

SUBMISSION NO. 11

Ecological Society of Australia
Dr Craig James
President

PO Box 1564
CANBERRA ACT 2601

15 May 2003

Sessional Committee on Environment and Sustainable Development

Dear Committee,

The Ecological Society of Australia is pleased to submit the attached document to the 'Inquiry into issues associated with the progressive entry into the Northern Territory of cane toads'.

If there are any questions arising from this submission, please direct them to myself, or the Executive Officer, Ms Tanya Howard, at the email addresses listed below.

Kind regards,

Dr Craig James
ESA President

EXPECTED IMPACTS

Van Dam *et al* (2000) reviewed the available knowledge of the impacts of cane toads (*Bufo marinus*) on native fauna. The report demonstrated:

1. Definite impact on the populations of 10 native predator species, including 2 mammals, 3 snakes and 5 varanid lizards.

2. Definite competitive impacts on one lizard and one frog species

3. Probable or possible impacts on an additional 19 fish, 26 frogs, 7 lizards, 13 snakes, 67 birds and 8 native mammals.

Van Dam *et al* (2000) also reported that cane toads would probably impact on snail and leech species, and possibly impact on water beetles and backswimmers. Other groups of invertebrates have been poorly studied, so extensive impacts on other groups cannot be excluded, with the possibility of cascading effects throughout the ecosystem. Of most concern are possible impacts on seed-harvesting ants. Ants are one of the most important components of the cane toad diet. Reductions in the abundance of seed-harvesting ants may alter plant community dynamics leading to long-term vegetation changes (Van Dam *et al* 2000).

Furthermore, Ross Alford (James Cook University, personal communication) has suggested that competitive effects may be substantially greater than reported in van

Dam et al. (2000). Toads that aggregated around permanent water in the dry season were nutritionally stressed, which may indicate food shortages. Other insectivorous species that are also dependent on the resources around permanent water may therefore be disadvantaged, including small reptiles and birds (Alford, pers. comm.).

REFERENCE

van Dam R., Walden, D, Begg, G. 2000. van Dam RA, Walden DJ & Begg GW 2002. *A preliminary risk assessment of cane toads in Kakadu National Park.* Scientist Report 164, Supervising Scientist, Darwin NT.

RECOMMENDATIONS

The Ecological Society of Australia is convinced that extreme impacts of cane toads are certain for some species, and likely for many others. ESA acknowledges that the fauna of the Northern Territory is a national asset because it is relatively intact compared with southern and eastern Australia. In view of the expected impacts on some species, and uncertainty in the possible impacts on many other native species we urge that the following actions be taken.

ESSENTIAL AND IMMEDIATE ACTIONS

1. As a matter of urgency, establish a research program to evaluate the impact of cane toads using exclosures.

   A research program should include the establishment of a replicated series of fenced refuge areas ahead of the invasion front. Exclosures are essential to provide refuges for susceptible species and to experimentally determine impacts of cane toads. An experimental approach is essential to refine our knowledge of the impacts of cane toads as quickly as possible, and without the ambiguity inherent in uncontrolled monitoring.

   As a first step, ESA recommends that a scoping study be immediately undertaken to establish possible geographic areas that are suitable for fencing. A comprehensive examination of all areas within the expected geographic range of Cane Toads is required. This would provide a basis for weighing up costs against potential biodiversity benefits, and for designing a well-replicated experiment. The implemented design should include elements that examine the impact of creating habitat islands and active management may be needed to minimise the impacts of isolation on local populations. An assessment of the effectiveness of fence designs for excluding cane toads will also be needed. Fenced “islands” and toad-free offshore islands will form a complementary archipelago of refuges for toad-sensitive species.

   In addition, Coburg Peninsula should be immediately fenced off because this area unambiguously offers the best ratio of fence to protected-area in the Northern Territory, and is under imminent threat of Cane Toad invasion (within the next 1-2 years).

2. Develop, and enforce strict quarantine measures to protect toad-free islands and exclosures.

   Toad-free areas need to be carefully protected by preventing inadvertent or deliberate introduction. In addition, a toad-survey regime permitting the early recognition of quarantine breaches is essential for all toad-free refuges. Refuges without monitoring resources will be vulnerable to extensive, probably irreversible, invasion.

IMPORTANT ACTIONS FOR A COMPREHENSIVE RESPONSE

3. Provide a co-ordinated approach to research and monitoring of cane-toad impacts.

   A rigorous program of research should ensure appropriate and comparable data are collected, and ensure that all research priorities are addressed.

4. Using replicated experimental approaches, test methods for locally reducing cane toad abundance.

   One possible approach to locally reducing toad abundance could exploit the need that cane toads have for shelter near to permanent water to survive the dry season. Artificial shelters near dry season water holes could act as traps, allowing many adults to be exterminated. This may be an effective method on leasehold and aboriginal lands.

   The efficacy of community involvement in reducing toad numbers could also be established experimentally (with replicated treatment and control neighbourhoods). If toad numbers can be suppressed in urban areas, then urban bushland and wetlands may become important wildlife refuges.

   Research into the chemical ecology of cane toads should be encouraged and supported. Cane toads appear to rely on olfaction to locate food and anecdotal evidence suggests that they may also use olfaction to identify potential mates. Baits or traps that emit toad-specific odours may attract toads, and so offer a useful way to locally reduce toad abundance.

   If effective manual removal methods can be developed it would offer a potential alternative to the use of fencing for creating refuges. Manual removal could also be used to create experimental toad free areas for comparison with matched toad-infested areas.

5. Distribution of a comprehensive toad and ground-frog identification brochure.

   Experience in Queensland shows that the community is prepared to be involved in toad extermination but lacks sufficient information, resulting in the culling of native frogs and tadpoles erroneously. Information provided to the community needs to detail all life history stages and provide enough detailed information so that the distinctions between toads and ground dwelling frogs are clear. Information about how to kill toads ethically, and eliminate cruelty, should also be provided.

6. Provide support for long-term research into potential biological control mechanisms.

   Any such mechanisms must undergo comprehensive testing to ensure that the control is completely toad specific, with no risk of mutating to become virulent to native species. The long-term nature of this research should be recognised by funding bodies, to ensure there is no political pressure that may lead to a premature release of inadequately tested biocontrol agents. An extremely cautious approach to the timing of the release of biological control agents should be adopted.

   Given the profound ecological impacts, and the financial burden that has resulted from the uninformed introduction of cane toads, the ESA emphasises that the

introduction of additional exotic species and the spread of existing exotic species should be subject to very stringent regulation.

The Ecological Society of Australia is in a position to develop and co-ordinate national research priorities into cane toad ecology, impacts and remediation, in a neutral political environment. To begin this process, the ESA is prepared to host a meeting that would elaborate on recent toad research, bringing together a wide range of experts from around the country. The meeting would help to foster the synergy needed to develop a national approach to research, and for setting research priorities.

Submission prepared by: Don Driscoll, University of Tasmania

Other contributors: Ross Alford, James Cook University; Rob Floyd, CSIRO Entomology; Gordon Grigg, University
of Queensland; Meri Oakwood, University of New England; Deborah Pergolotti, Frog Decline Reversal Project Inc;
Jonathan Webb, University of Sydney.
Final version endorsed by the ESA Council: 14th May 2003.

SUBMISSION NO. 12

Professor Gordon Grigg
Professor of Zoology,
University of Queensland
Department of Zoology and Entomology, School Of Life Sciences

ggrigg@zen.uq.edu.au

15 May 2003

Sessional Committee on Environment and Sustainable Development

Dear Committee

I have become aware of this enquiry only in the last few days, so this submission is both hasty and brief. As a member of the original 'Kikkawa Committee' and also the CSIRO Cane Toad Advisory Committee until its demise, I could have put together a much larger effort, but this brief will have to suffice.

Attached is a brief synopsis of a study which we (Andrew Taylor, Hamish McCallum, Graeme Watson, Les Fletcher and myself) have been undertaking in the Roper River Valley since 1996 and in Kakadu National Park since 1998, measuring the effect of the arrival of toads on the calling activity of native frogs.

I would be grateful if that document can be tabled before the enquiry.

I would also like to make several points for the consideration of the committee:

It has been an ongoing frustration for many scientists and other concerned people that there has been so little willingness to fund research into the likely impacts of cane toads and, particularly, into possible methods of control or containment to stop the continuing spread. It was a Bob Hawke election promise that Cane Toads would not reach Kakadu (!). Indeed, the small amount of funding with which we began our study in 1996 came from what was left over from funds provided to CSIRO as a consequence of that promise. Sadly, promising viral work at AAHL in Geelong, begun from the same funding source, was not funded after the election of the present Coalition government.

1. What funding has been and is available for research related to Cane Toad impact and possible control has been small. Our own work, for example, runs on a shoestring and donated time. Most of the studies that have been undertaken so far have been too short term and too underfunded.

2. The study we now have underway in the Roper Valley and at Kakadu could be significantly expanded, to a new area. It is time now to start getting further base-line data ahead of the expanding front. Maybe the Kununnurra area would be a suitable site. The technique developed for this study is now through its development phase, well proven and returning reliable and useful data. Although we have been very limited by resources and, in particular, by the amount of time my colleagues and 1 can spend on it because of ‘our day jobs’, it looks as though it is going to return significant results. I urge the committee to give consideration to recommending an expansion of this study, properly resourced, perhaps in concert with other work.

3. More broadly, I urge the committee to recommend as a matter of urgency the initiation of well resourced research programmes into Impacts, Containment, and Control. Some government officials in recent years have been downplaying the likelihood of deleterious effects, which has made it too easy for earlier governments to look away. Data now accumulating suggests that some deleterious effects are certain and, because the native fauna of northern Australia is such a nationally significant asset, whatever can be done to protect it, should be done.

Thank you for your consideration,

Yours faithfully,

Gordon Grigg

IMPACT OF CANE TOADS ON NATIVE FROGS, ROPER RIVER VALLEY & KAKADU NATIONAL PARK

Gordon Grigg[1], Andrew Taylor[2] and Hamish McCallum[3]

EXECUTIVE SUMMARY

Since 1996 in the Roper River Valley and since 1998 in Kakadu National Park, we have been monitoring the calling activity of native frogs at 16 sites using automatic recording systems based on technology similar to voice recognition which was developed specially for this study.

All our data for Kakadu is, until the 2002-03 wet season (not yet downloaded), baseline data, before the arrival of toads. In the RRV we have some pre-toad data and much post-toad data.

The results from the RRV are provocative. The number of frog species calling per station declined markedly between the beginning of the study in 1997-98 and 2001 2002. This pattern was consistent at each of the 10 stations and suggests that toads may well have a detrimental effect on frogs. However, because of confounding variables and gaps in the data, combined with the short period before toads arrived, we cannot be sure. We certainly cannot say that there is no effect. The weight of our evidence is that, during the five years of our study, there has been a decrease in frog calling activity at our sites (both in terms of species present and days each species calls). The data from the Kakadu study will be very important because they will provide an independent replicate study, against a longer pre-toad base-line.

Brief synopsis of study and results to date, May 2003.

We have been monitoring the calling activity of native frogs in two study areas with the aim of making comparisons before and after the arrival of Cane Toads. The areas are along the Roper valley Highway east of Mataranka, where we monitor at 1 0 sites at known wetland habitats Table 1), and within Kakadu National Park where we monitor at six sites (Table 2). The six Kakadu sites are replicated pairs in each of three habitats, savannah woodland, rocky stream and floodplain.

[1] Department of Zoology & Entomology, University of Queensland
[2] School of Computer Science and Engineering, University of New South Wales
[3] Department of Zoology & Entomology, University of Queensland

Monitoring calling activity of frogs over long periods is not simple, especially as we wanted a method that recorded hours of data night after night in order to accommodate the variability in the wet-dry tropics. Most frog species are active only after heavy rainstorms, which occur patchily in both time and space. We therefore developed and deployed a novel automated censusing technique using machine learning technology to identify frogs by their calls. Identified calls are logged to memory automatically, along with environmental data. The information is then downloaded and analysed at the end of each wet season.

The monitoring systems are (except for two) mounted in hollow steel poles approximately 5m high. A solar panel, microphone, rain gauge, microphone and thermometer are mounted on the top of the pole, which contains the recording device and rechargeable batteries. At two sites we have mounted the equipment on a metal tripod/quadripod, for easier installation. Throughout the wet season, each station turns itself on at dusk and logs calling intensity, rainfall and temperatures for 3-6 hrs, at intervals of approximately 11 minutes. The software is capable of identifying the calls of more than 20 species of frogs, as well as Cane Toads, on an intensity scale of 0-3.

Monitoring at the Roper Valley sites started in the 1997-98 wet season. All of these sites are now within the toad's expanded range, indeed the invasion happened much more rapidly that we would have liked. We can now report a preliminary analysis of the results of the arrival of the toads.

Monitoring within Kakadu National Park commenced in the 1998-1999 wet season, with four sites active. Before the 2000-2001 wet season we installed two more sites. During the current wet season, which has seen the arrival of the toads at Jabiru, we have six sites active. So for Kakadu, at this stage, we have four wet seasons of 'before toad' data at four sites and two seasons at the two newest sites. The results we got from the Roper Valley study area were provocative but not conclusive, so the Kakadu data will be very important.

Results from the Roper Valley study area

The experiment followed the general principles of a BACI ('before-after, control-impact) design. We have five pairs of recording stations along the Roper Highway, about 25 km apart, from Mataranka to the end of the bitumen 110 kilometres east. We hoped that pairs of sites would be successively overrun by toads each year, so that we would have before toad-arrival and after toad-arrival data for most pairs, and data in most years from sites with both toads present and toads absent, so that we could allow for overall between-year variation in frog calling frequency.

The much more rapid invasion of the toads than we expected, or wanted, meant that the western pairs were all engulfed within the space of the third wet season, so we had a shorter than desirable before-toad phase. Also, equipment failures in this developmental system led to some sites at which data were not recorded, leaving gaps in the data. However, a very large amount of data was collected, and some patterns emerge.

The number of frog species calling per station declined markedly between the beginning of the study in 1997-98 and 2001-2002 (Figure 1). This pattern was consistent at each of the 10 stations. However, before this decline can be attributed unequivocally to the invasion of cane toads, a number of potentially confounding variables need to be considered. The shading on the graph

indicates when we think toads reached each station, based largely on observations of toads on the roads. Our stations record toads, and mostly back up the information from the roads, but a software problem meant that there were some false positives in the first season. Figure 1 shows that some of the declines in species calling occurred before we detected toads as being present. Another problem is that the sampling effort differed between seasons and stations (see table 1), because of equipment failures. A further consideration when considering sampling effort is that frogs do not call at all in dry conditions, and thus the number of days of recordings may not be an accurate representation of the 'true' sampling effort. Linked to this are differences between wet seasons, both in terms of total rainfall and number of rain-days.

The data suggest that toads may well have a detrimental effect on frogs, but because of confounding variables and gaps in the data, combined with the short period before toads arrived, we cannot be sure. But these are very provocative results. We certainly cannot say there is no effect. The weight of our evidence is that, during the five years of our study, there has been a decrease in frog calling activity at our sites (both in terms of species present and days each species calls). The Kakadu data will be very important, as they will provide an independent replicate study, and we will have at least three years pre-toad data at each site.

When we look at individual species of frogs, there have been statistically significant and substantial declines in the number of records for at least 7 of the species we have been monitoring, with possible slight increases in 2. For the remainder, 5 show no clear evidence of a trend, and in 5, there is so little data we can say nothing. As can be seen in the number of calls for some of the species (figures 2-5), there is a lot of variation between stations and wet seasons, so we need to be cautious at this stage about blaming cane toads for these changes.

Figure 1: Number of frog species calling at each station

Stations are ordered in distance pairs from East to West (top to bottom). The shading indicates wet seasons when cane toads were known to have reached each site. The number of recording days varied from 62 to 148 days, as is shown in the table below the figure.

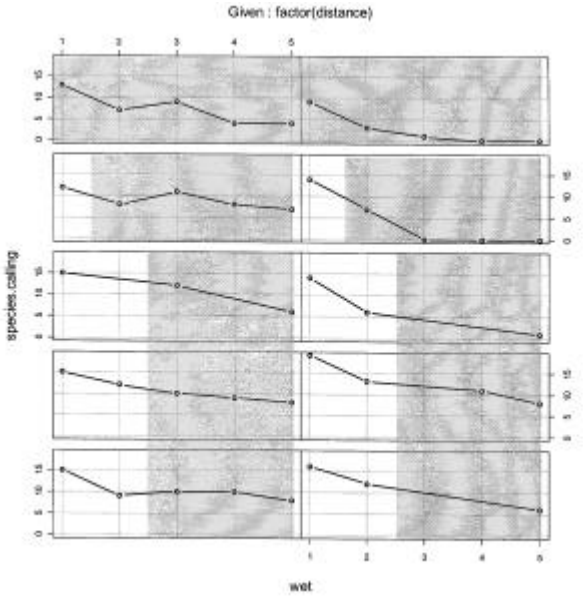


Table 1: Days of records, for each Station in each wet season "Distance" is the distance from the station closest to Mataranka. The order of the stations matches the figures, reading left to right, top to bottom.

			Wet Season (1997-98=1)				
	Name	Distance	1	2	3	4	5
	Birch	106.3	188	132	62	119	148
	Andrewartha	105.4	188	132	64	119	148
	Church	82.1	188	132	76	119	148
	Turing	80.5	182	132	107	119	148
	Bibron	65.7	190	132	NA	NA	148
	Dumeril	64.3	189	NA	134	NA	148
	Lovelace	35.3	181	132	NA	119	148
	Babbbage	34.5	190	132	82	119	148
	Huxley	1.6	188	128	NA	NA	148
	Darwin	0	191	129	78	119	94

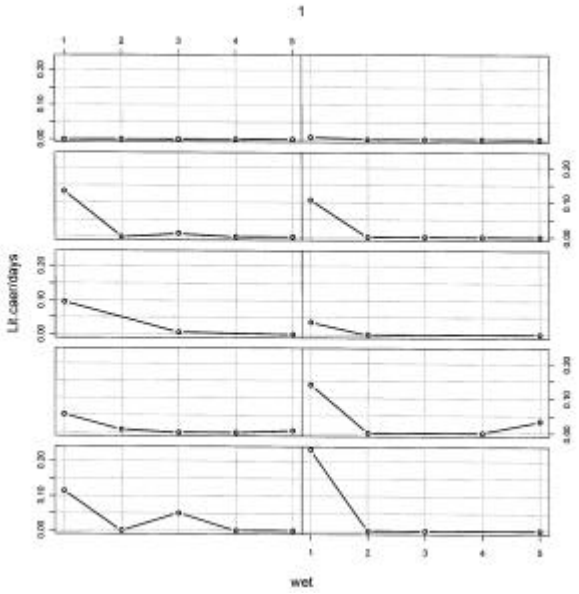


Figure 2: The proportion of days each wet season of records with the green tree frog *Litoria caerulea* present, for each station.

Sites furthest from Mataranka are at the top. This decline is statistically significant, but note that most of the decrease occurs before we are certain that cane toads arrived at the sites

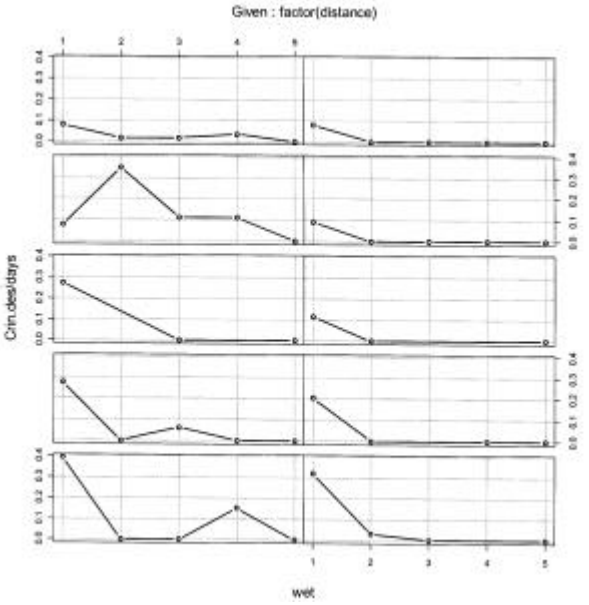


Figure 3: Proportion of days each wet season of records with *Crinia deserticola* present, for each station.

Sites furthest from Mataranka are at the top. This decline is statistically significant, but note again that most of the decrease occurs before we are certain that cane toads arrived at the sites

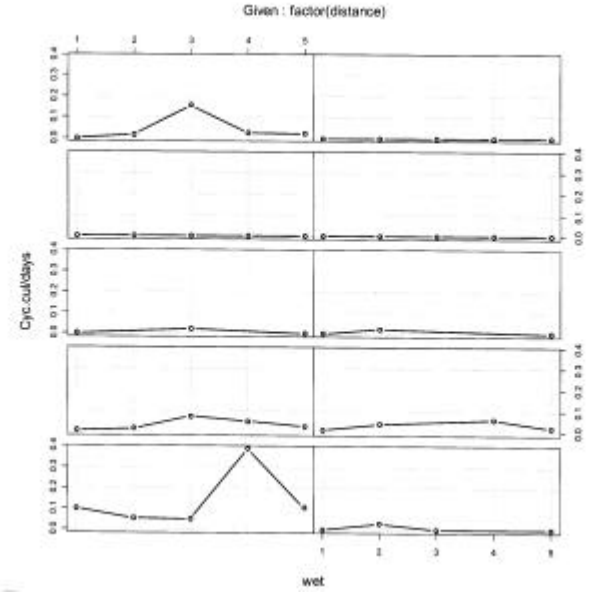


Figure 4: Proportion of days each wet season of records with *Cyclorana cultripes* present, for each station.

Sites furthest from Mataranka are at the top. This is one of the very few species for which the number of records has increased during the course of the study.

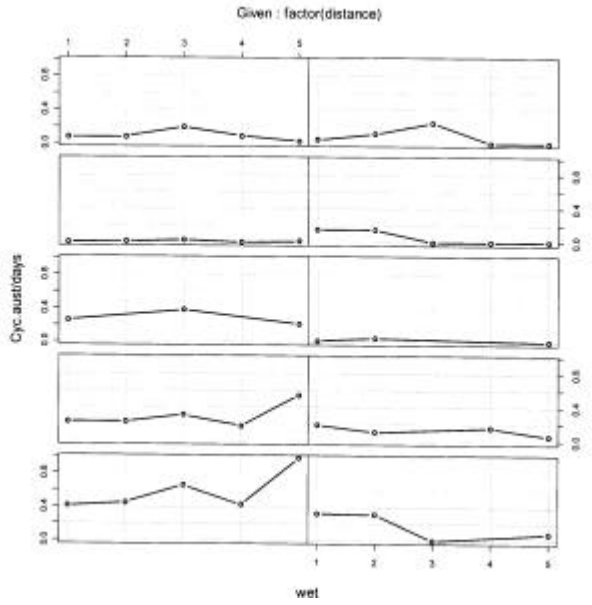


Figure 5: Proportion of days each wet season of records with the giant burrowing frog *Cyclorana australis* present, for each station.

Sites furthest from Mataranka are at the top. The proportion of days on which this species was recorded remained similar through time at each site.

ACKNOWLEDGEMENTS

This study was initiated in the Roper River Valley with a research grant from the CSIRO Cane Toad Advisory Committee and expanded to Kakadu National Park, and continued in the Roper River Valley, with funding and 'in-kind' support from Parks Australia North. We are particularly grateful to Environment Australia staff at Jabiru NT for their keen assistance throughout.

We are grateful also to Les Fletcher, now retired from the University of Queensland, and Graeme Watson, now retired from the University of Melbourne for their continuing assistance in the project., Les for his engineering skills, Graeme for his knowledge of NT frogs.

SUBMISSION NO. 13

Northern Territory Chamber of Commerce and Industry
Ms Carole Frost
Chief Executive Officer

GPO Box 1825
DARWIN NT 0801

15 May 2003

Sessional Committee on Environment and Sustainable Development

Attention: Ms Delia Lawrie, Chair

Dear Ms Lawrie

The Chamber is pleased to attach our submission for the Sessional Committee on Environment and Sustainable Development regarding issues associated with the progressive entry into the northern territory of cane toads. Please direct any questions to myself or to Mark Noonan (environment advisor) on telephone 8936-3100.

Yours sincerely

Carole Frost

Thank you for this opportunity to participate in the inquiry into issues associated with the progressive entry into the Northern Territory of cane toads.

The NT Chamber of Commerce & Industry (NTCCI) is the Territory's largest employer association, representing approximately 1500 members from across the Territory and from a wide cross section of Industry including tourism, construction, agriculture, cattle and the environmental industry. Our members employ approximately 22,000 employees or 26.5% of the total workforce with a large number employed in the tourist sector.

One of the services provided by the NTCCI is through our Environmental Division, where we employ a number of environmental advisers who provide environmental support to members and the wider business community.

There has been no detailed study on the impacts of cane toads on Northern Territory businesses. Anecdotal evidence suggests that the probable direct economic impacts of cane toads on business will be uncertain in the near future, but the indirect effects will become more evident in the next two to five years.

It has been suggested that cane toads have not affected tourism in places such as Queensland and Fiji where beaches are their main attraction. The effects of cane toads on tourism in the Northern Territory are uncertain due to its predominantly nature-based

attractions. Of particular concern are the impacts on 'affluent adventurers', who are particularly attracted to pristine environments.

Cane toads will certainly impact Northern Territory businesses in relation to requirements for sound and current toad management advice. Without appropriate governmental support structures and mechanisms, cane toad management will be of particular concern to tour operators, wildlife park operators, crocodile farmers and certain livestock farmers.

Some business requirements, in relation to cane toads, are as follows:

1. A need for a central co-ordination point on cane toad issues, maintaining an accessible and comprehensive knowledge base.

2. A formalised set of networks and forums that enable information flow (both nationally and Territory-wide). These are important tools to help manage the risks to businesses from cane toads. Problems, solutions and issues can be quickly discussed by like-minded people and acted upon. This will provide businesses with a process for effectively addressing unforeseen problems.

3. Standard procedures and advice on issues relating to handling, control, quarantine, isolation and health.

We strongly encourage the NT Government to:

1. Dedicate resources to the establishment of a Northern Territory co-ordination point for cane toad issues. This should service the whole of the Northern Territory.

2. Establish a network with all state governments affected by cane toads.

3. Establish or participate in national cane toad networks, to combine the efforts and resources of researchers, businesses and individuals across Australia who have an interest in cane toads.

4. Develop and publicise standardised and practical procedures for addressing with the health, handling and control aspects of cane toads.

5. Develop cane toad eradication, quarantine and control measures in close consultation with businesses and industry representatives.

The NTCCI strongly feels that cane toads in the Territory present some very serious issues that can only be addressed by people, business and government working together. The NTCCI has a great deal of experience in information dissemination, event management and networking as well as facilitating co-operation and co-ordination between business and government. With this in mind, the NTCCI is keen to offer its support and services where necessary to address the threat of cane toads in the Northern Territory.

SUBMISSION NO. 14

Northern Territory Tourist Commission
Mr Richard Austin
Destination Development Nature-based

GPO Box 1155
DARWIN NT 0801

16 May 2003

Sessional Committee on Environment and Sustainable Development

Dear Committee

Thank you for the opportunity to provide comment on the effects cane toads may have on the tourism industry and, in particular, Kakadu National Park.

Due to the lack of past qualitative and quantitative research into the effects cane toads have had on other environmentally sensitive areas, it is impossible to accurately state what effect the cane toad will have on tourism in Kakadu National Park. This belief is due to no organisation or individual being able to state with certainty what effect the cane toads will have on the native flora and fauna.

Whilst it is inevitable that some species will be taken to the point of extinction, the exact extent of this will not be known until the cane toad arrives. The Northern Quoll is the most likely to be effected by the arrival, however due to their nocturnal activities very few visitors come in contact or are aware of the Quoll. Several species of lizard, snake and the dingo are also high on the list and while visitors are interested in viewing such animals, they are not the main focus of their visit. The one positive is that the feral cat is also listed as high. The reduction in numbers of this introduced species may lead to an increase in population of the native wildlife that are usually part of the cats' staple diet.

The visual impact of cane toads will be high, in particular where activities are undertaken in the evening, around waterways or in urbanised areas. Campgrounds with watered lawns, shady trees and lighting will attract large numbers of toads and this will detract from the overall visitor experience. Waterways and wet areas will also attract large numbers and be visible during the day. However the majority of international visitors will not identify the cane toad as an introduced species that is doing untold environmental damage. Instead they will associate it with any other native frog. A concern would be that if visitors are told about the cane toad, they may take it into their own hands to cull as many as possible. This could lead to a number of problems including the wrongful culling of similar looking frogs including the Marble, Northern Spade Foot and Ornate Burrowing Frogs. Each of these will already be in danger from the introduced species, without human interference depleting their numbers further.

Queensland has contended with the cane toad for many decades with no noticeable effect on tourism. The toads have not acted as a deterrent to visitors travelling to national parks and reserves in this State and while many species may have disappeared from the infested areas, the remaining wildlife still provides a high level of satisfaction to visitors.

The NT Tourist Commission strongly believes that every possible measure should be taken to control the influx of and also limit the impact of the cane toad in Kakadu National Park. The Tourist Commission however, can not, due to limited data, accurately state what effect the invasion of cane toads will have on the tourism industry.

Any downturn in tourism due to the cane toad will be another hit to an industry that is already hurting from recent world events.

Yours sincerely

Richard Austin

SUBMISSION NO. 15A

Environment Australia – Parks Australia North
Mr Peter Cochrane
Director of National Parks

INTRODUCTION

Environment Australia (EA) is the Commonwealth portfolio that advises the Commonwealth Government on policies and programs for the protection and conservation of the environment. Of particular relevance to this inquiry, EA;

- manages Commonwealth reserves, including Kakadu National Park which is managed by the Director of National Parks and Aboriginal traditional owners;
- conducts research in the Alligator Rivers Region of the Northern Territory, through the Environmental Research Institute of the Supervising Scientist (ERISS);
- administers the *Environment Protection and Biodiversity Conservation Act 1999*, which includes provisions relating to threatened species and threatening processes;
- manages the Natural Heritage Trust, jointly with Agriculture, Fisheries and Forestry – Australia. The four programs and ten areas of activity under the Natural Heritage Trust are listed at Attachment A.

Some information has been provided to the inquiry verbally by Kakadu National Park staff, members of the Kakadu Board of Management and by the Director of ERISS. This submission supplements the information provided at the hearings.

This submission addresses the six terms of reference for the inquiry, as listed in the call for submissions.

THE IDENTIFICATION OF THE PROBLEM AND RISKS ASSOCIATED WITH CANE TOADS IN THE NORTHERN TERRITORY AND THE POTENTIAL EXTENT AND EFFECTS CANE TOADS HAVE OR WILL HAVE IN THE NORTHERN TERRITORY

Extent of cane toad invasion

Cane toads were introduced to coastal Queensland in the 1930s and arrived in the Northern Territory in the early 1980s. Parks Australia, the division of EA which jointly manages Kakadu National Park with the Aboriginal traditional owners of the park, has kept records of reported sightings of cane toads since their arrival in Kakadu National Park. EA does not have centralised records of cane toads elsewhere in the Territory or in other States.

Cane toads arrived in the southern end of Kakadu National Park in 2001 through the Katherine River drainage system. They are now well-established in the upper reaches of the East Alligator, South Alligator and Mary Rivers. In Kakadu, cane toads are moving generally north-west and downstream. They have advanced very rapidly in the wet seasons and more slowly in the dry seasons.

Since early 2003, a few individual cane toads have been found around Jabiru. As at May 2003, cane toads have been sighted within Kakadu as far north as Mudginberi and as far west as Cooinda. They are now well established at least as far north as the Nourlangie Rock area in the Nourlangie Creek catchment.

Based on these records, within Kakadu cane toads are spreading north-west at a rate of about 60km per year. EA considers it likely that cane toads will continue to spread at a similar rate across Kakadu and the rest of the Top End of the Northern Territory, much of which affords suitable habitat and abundant food resources for cane toads.

Effects and risks of cane toads

Cane toad biology is well documented as a result of many years' research into biological control methods. The key features of cane toads that lead to significant effects on Australian native species are their toxicity to potential predators, their fecundity, their ability to disperse over long distances and their adaptability to a wide range of habitats and prey species.

The immediate effects of cane toad interactions with humans, domestic animals and many Australian native species are known from anecdotal evidence and research. Because cane toads produce a toxin that is lethal to most Australian native species, animals that attempt to eat cane toads, or their eggs or tadpoles often die. Cane toads also consume a wide variety native species, mainly invertebrates, as prey. Because of their large numbers and wide range of prey items, it is likely that cane toads compete with native species for food but little is known of these competition effects.

The toxin is also potentially lethal to humans, domestic dogs and cats if ingested, however humans tend to avoid contact with the toads and are easily educated about the dangers. Some domestic pets are killed by contact with cane toads but many learn to avoid them. As a result, cane toads do not pose a significant direct risk to human or domestic animal populations.

Based on the toxicity, fecundity, migratory behaviour and adaptability of cane toads, EA considers that it is highly likely that cane toads will adversely affect populations of many native species in the Northern Territory. However, until recently there had been little research conducted on the indirect and long-term effects of cane toads on Australian native species and ecosystems. As a result, there is as yet little quantitative data on the likely long-term effects of cane toads on native species and ecosystems.

This lack of quantitative information was of increasing concern to EA and the Kakadu Board of Management as cane toads approached Kakadu and no biological control method had been found. Consequently, EA took the following steps to identify the likely effects of cane toads on native species in the Kakadu region.

ERISS prepared a preliminary risk assessment of the impact of cane toads (ERISS has submitted this report to the Inquiry). This risk assessment rated northern quolls, several goanna species and several snake species as most likely to be seriously affected by cane toads. Many other species are also likely to be adversely affected.

Parks Australia contributed funds to extend a frog monitoring program, being conducted by Dr Gordon Grigg, University of Queensland, into Kakadu (see synopsis of Roper River area work at Attachment B). None of the monitoring sites in Kakadu had been reach by cane toads as at May 2003.

Parks Australia engaged Dr John Woinarski, NT Parks and Wildlife Commission and Ms Michelle Watson to conduct a series of fauna surveys in Kakadu, at sites that had been surveyed up to 25 years ago, to examine faunal changes since the

last surveys and again after the arrival of cane toads. In November 2002 a preliminary report on this study provided the first quantitative data available that quoll numbers drop rapidly with the arrival of cane toads. This lent considerable weight to anecdotal evidence from Queensland that quolls disappear abruptly with the arrival of cane toads. As a result, Environment Australia, the NT Parks and Wildlife Commission, the Northern Land Council and Aboriginal traditional owners collaborated to translocate about 60 quolls from the mainland of the NT to islands off Arnhem Land. This initiative is discussed further below.

The summary of a report recently received from Ms Watson and Dr Woinarski is at Attachment C. To date, surveys of 110 sites in the southern region of Kakadu have shown substantial declines in numbers of northern quolls where toads have invaded. Less substantial declines were found for a range of other species including the terrestrial gecko *Gehyra nana* and the pale field rat. Encouragingly, some species including the northern brown bandicoot, dingo, many bird species and most frogs showed no change or a relative increase.

Parks Australia also commissioned a more detailed study of northern quolls, which is being conducted by Dr Meri Oakwood. This study has also provided data indicating a dramatic decline in quoll numbers where cane toads have arrived (summary of progress report is at Attachment D)

Parks Australia supported a behavioural study of tree goannas, conducted by Dr Sam Sweet, which showed that these two species are unlikely to be seriously affected by cane toads. Parks Australia is supporting a pre & post cane toad study of sand goannas, conducted by Dr Dan Holland.

Dr Rod Kennett of EA compiled a reference list of studies conducted and in progress in the Northern Territory that have provided or may provide data on the effects of cane toads on native species. This has been updated for submission to this inquiry (Attachment E).

Since cane toads arrived in Kakadu, staff have been collecting specimens for examination of stomach contents, which have comprised a wide variety of invertebrates. Park staff have also recorded observations and/or collected specimens of native animals that have apparently died in attempting to eat cane toads, which have included death adders, goannas and freshwater crocodiles.

In summary, there is now scientific as well as anecdotal evidence that cane toads cause substantial declines in northern quoll populations. EA considers that there is a significant risk that quoll species across northern Australia may become locally extinct in areas that cane toads invade. It is likely that cane toads will cause substantial declines in other species including some goanna and snake species. Many other predator, prey, competitor and co-habiting species are also likely to be adversely affected. To date there is insufficient information to quantify the likely extent of declines of any affected species other than northern quolls, or to estimate the potential future recovery of any species.

THE CULTURAL, SOCIO-ECONOMIC AND OTHER FACTORS ASSOCIATED WITH THE ENCROACHMENT OF CANE TOADS INTO THE NORTHERN TERRITORY

Some of the species most likely to be adversely affected by cane toads are of considerable economic and cultural significance to Aboriginal people in the Northern Territory.

EA is of the view that a substantial decline in goanna or turtle populations would have a significant impact on the local economy of Aboriginal communities within Kakadu and elsewhere in the Northern Territory, as both are important traditional food sources.

Traditional owners in Kakadu National Park have expressed worries about the potential decline in goanna, snake, turtle, freshwater crocodile and barramundi populations, amongst other animals. These animals have a central role in Aboriginal culture and kinship systems, and many Aboriginal people feel strongly affiliated to these animals. Substantial declines in these species would cause grief, exacerbate Aboriginal people's worries about the health of their country and in time may lead to loss of knowledge about the species and their ecological and cultural significance.

Recent visitor surveys commissioned by EA in Kakadu National Park have indicated that one of the main reasons that tourists visit the park is to see wildlife, including crocodiles and goannas. A decline in visitors' perceptions of wildlife in Kakadu and elsewhere in the Top End could lead to decreased visitor satisfaction, although much of the wildlife is not readily visible to the casual visitor.

IDENTIFYING THE CURRENT LEVEL OF UNDERSTANDING CONCERNING CANE TOADS TO DATE AND ASSESSING THE NEED FOR PUBLIC EDUCATION AND AWARENESS PROGRAMS

In Kakadu, EA found that before cane toads arrived, many but not all residents had some awareness of the existence and likely arrival of cane toads, and that they contain toxin that is potentially harmful to humans, domestic pets and other animals. The level of awareness appeared to be lower amongst people with limited English literacy skills, and consequently EA prepared a picture booklet about cane toads and distributed it to Aboriginal residents in Kakadu. (A copy of this booklet has been provided to the Inquiry.)

In 1998/99 The NSW Big Scrub Environment Centre Inc undertook a *Cane Toad Control and Public Education Project* that was funded through the Landcare program of the Natural Heritage Trust. The project focused on educating the NSW North Coast community about cane toads.

EA suggests that it would be useful to conduct an initial education program, particularly in Aboriginal communities across the Top End, to minimise the risk of children or adults suffering harm from contact with cane toads. There will be a need for continuing education program to encourage people not to transport cane toads to areas which have not yet been reached by toads, and especially to areas that would otherwise remain free of cane toads, such as offshore islands and any other areas that can be isolated from the spread of toads.

Public education methods that should be considered include picture booklets, posters, videos, television advertisements and documentaries.

IDENTIFYING WAYS TO MANAGE THE ENVIRONMENTAL IMPACT OF CANE TOADS IN THE NORTHERN TERRITORY

Broadly, EA considers that the main ways to manage the environmental impacts of cane toads are, in priority order, to:

1. identify one or more biological controls to reduce cane toad populations;

2. institute strict quarantine measures in designated areas, e.g. islands or peninsulas, to keep them toad-free as long as possible;

3. educate people to reduce the likelihood that they will transport cane toads to new areas;

4. try to conserve breeding populations of species threatened with extinction by cane toads, through translocation or captive breeding if necessary and appropriate;

5. conduct research to obtain more information about environmental, social, cultural and economic impacts in order to guide priorities for future impact mitigation measures; and

6. increase co-ordination and momentum of research and control measures.

Biological control of cane toads

CSIRO was commissioned by the Commonwealth in 1990 to undertake and manage a cane toad research program. The Commonwealth provided $1.25 million over three years with some of the States contributing a further $90,000. In 1993 the Commonwealth provided additional funding of $2 million, which finished in December 1996. In 1996/1997, the first year of the Natural Heritage Trust, the Commonwealth provided $120,000 to fund the program to June 1997, to finalise some work not previously finished.

Although much valuable research was undertaken in this period between 1990 and 1997, no methods were identified that would specifically target cane toads and enable broad-scale control of them in Australia. In summary, while the research identified viruses from Venezuela that would control cane toads in Australia, laboratory trials showed that the same viruses also killed native Australian frogs.

In late 1998 the then Minister for the Environment, Senator the Hon Robert Hill, sought a reassessment and further national commitment to undertaking research into the biological control of cane toads. Based on this initiative a new CSIRO research project, also funded from the Natural Heritage Trust, began to investigate a mechanism to disrupt the development of tadpoles to sexual maturity.

Since 2000 the Commonwealth Government has provided to CSIRO nearly $1.5 million from the Natural Heritage Trust to support that research program. The research being undertaken by CSIRO may take up to 10 years to complete and there is no guarantee that this research will result in a biological control method to control cane toads.

The project is progressing well with CSIRO advising of success in isolating possible genes and viruses that could be considered for use in preventing cane toad tadpoles from developing. Further details about the project are at Attachment F.

Quarantine toad-free areas

Until an effective biological control of cane toads is developed, the only method of conserving an entire ecosystem from the impact of cane toads would be to exclude cane toads from the area by natural or artificial barriers and quarantine measures. This would not be economically or practically feasible on a large scale but may be warranted in specific, small areas of northern Australia, particularly those that are suitable for conservation of species most at risk from cane toads.

EA considers that there would be value in Northern Territory, Western Australian and Commonwealth research and management agencies assessing whether there are relatively undisturbed islands, peninsulas or other areas of high conservation value from which it would be economically and practically feasible to exclude cane toads. If it were feasible, it would be desirable from a conservation standpoint to maintain representative areas of the bioregion as toad-free. This would involve:

- assessing the risk of toad colonisation of islands within the potential biological range of toads, including identifying what islands have been colonised, when and how and what factors facilitate or hamper cane toad colonisation of islands;
- examining whether any mainland areas could be kept toad free (for example, by patrolled fences across narrow peninsulas);
- developing and instituting quarantine measures to prevent cane toads arriving on islands, including search and capture methods to locate any cane toads that enter toad-free areas;
- raising public awareness of the need to prevent toads being transported to islands;
- involving Aboriginal people in patrolling quarantined areas for cane toads and in preventing their spread to quarantined areas.

Public education to minimise transport of cane toads

As noted previously, there is a need to carry out public education to encourage people to make sure they do not transport cane toads to quarantined areas or areas which have not yet been reached by toads. It is important not to hasten the colonisation of new areas by cane toads, in the hope that biological control or other factors will reduce or halt the spread of cane toads before they reach all suitable habitat in Australia.

Conservation of species that may be threatened by cane toads

Translocation and captive breeding

As noted previously, data obtained from research in Kakadu in 2002-3 suggest that northern quoll numbers decline rapidly as cane toads arrive in an area. These findings prompted Parks Australia, the Parks and Wildlife Commission of the NT and the Northern Land Council to collaborate in relocating a small number of northern quolls to islands, offshore from Arnhem Land, where cane toads are not present. The quolls were translocated from a number of areas across the Top End, including Kakadu. The Commonwealth Government provided an NHT grant of $28,000 to support the involvement of Indigenous communities in this project.

Where studies indicate a substantial risk that the survival of a species may be threatened by cane toads, EA considers that it would be prudent to try to conserve breeding populations of species through translocation or captive breeding. These measures can play a role in safeguarding species from specific threats until that threat can be controlled.

Listing of threatened species

Listing of threatened species under State, Territory or Commonwealth legislation can potentially facilitate a strategic approach to conservation measures and an increased commitment by government agencies to implementing conservation measures.

Threatened species may be listed in the Northern Territory under the *Territory Parks and Wildlife Conservation Act 2000* (TPWC Act) and/or nationally under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The northern quoll is not currently listed and has not been nominated for listing as threatened under the EPBC Act. It has been nominated for listing as vulnerable in the Northern Territory under the TPWC Act.

To list a species under the EPBC Act, a nomination must be submitted for assessment by the Threatened Species Scientific Committee. This Committee provides advice to the Commonwealth Minister for the Environment on whether species meet the criteria for listing as a threatened species under the Act. The Minister is required to consider the advice of the Threatened Species Scientific Committee before making a decision on listing a species.

Once a species is listed under the EPBC Act, a recovery plan must be prepared for that species, either by the Commonwealth or jointly with State/Territory governments. The Commonwealth must implement the plan in Commonwealth areas and seek State/Territory cooperation to implement it elsewhere.

Listing of cane toads as a key threatening process

An introduced animal species, such as the cane toad, may be listed as a key threatening process under the EPBC Act if it "threatens, or may threaten, the survival, abundance or evolutionary development of a native species or ecological community". Foxes, rabbits, feral cats and feral goats are examples of currently listed key threatening processes.

If cane toads are to be listed as a key threatening process under the EPBC Act, a nomination would need to be submitted and assessed by the Threatened Species Scientific Committee, which would then advise the Minister on whether the threatening processes meet the criteria for listing under the Act. There is no nomination currently before the Committee to list cane toads as a threatening process.

Once a key threatening process has been listed, the Minister may have a threat abatement plan prepared, if that is a feasible, effective and efficient way to abate the process.

Research into cane toad impacts

Although cane toads have been present in Australia for nearly 70 years, there is still very limited information about the impacts of cane toads on native species and ecosystems. Some biological surveys are in progress in Kakadu as described above, and elsewhere in the NT as outlined in Attachment E. Further information is needed to assist governments in setting priorities for conservation of species and ecosystems likely to be adversely affected by cane toads.

It would be beneficial to obtain more information about the long-term as well as short-term environmental, social, cultural and economic impacts of cane toads. The types of research that would be useful include biological surveys and interviews of Aboriginal people in areas in which cane toads have recently arrived.

Northern Territory, Western Australian and Commonwealth research and management agencies should consider the need for information about cane toad

impacts when developing their long-term and annual research and survey work programs and budgets.

Co-ordination and facilitation of cane toad impact mitigation and research
EA is aware that some submissions to the inquiry have recommended the establishment of a cane toad task force. EA considers that there is scope for improved co-ordination and increasing the momentum of research into cane toad impacts and measures to minimise such impacts. It is important, however, that any such mechanism does facilitate and does not impede or delay progress in addressing cane toad impacts, and is cost effective.

Mechanisms that may delay progress include large co-ordinating committees with many stakeholders who are required to reach consensus before projects commence. Mechanisms that may facilitate action include a small scientific task force, an information exchange network and/or designated co-ordinators for cane toad-related activities in land and wildlife management agencies.

Northern Territory, Western Australian and Commonwealth research and management agencies, researchers, indigenous groups and environmental groups should examine ways that they can contribute to exchanging information, minimising duplication of effort and increasing the momentum of work relating to cane toad impacts.

COMMUNITY CONCERNS AND EXPECTATIONS IN RESPECT OF THE PROGRESSIVE ENTRY INTO THE NORTHERN TERRITORY OF CANE TOADS GENERALLY

This submission has noted the concerns expressed by Aboriginal traditional owners in Kakadu National Park about the environmental and cultural impacts of cane toads. EA shares these concerns, and is taking action to gather information about cane toad impacts, contribute to initiatives such as the quoll translocation project, and disseminating information to Kakadu residents and visitors. EA is concerned at the potential impact of cane toads on ecosystems and communities across the Top End. EA will continue to work collaboratively with NT agencies, research institutions and Aboriginal people on identifying and addressing the environmental and social impacts of cane toads.

Attachments
A: Natural Heritage Trust programs and areas of activity
B: Grigg toad synopsis
C: Summary of Watson & Woinarski report May 2003
D: Meri Oakwood report February 2003
E: List of researchers
F: Summary of biological control project

ATTACHMENT A

Natural Heritage Trust programs and areas of activity

Natural Heritage Trust Programs

- The Landcare Program will invest in activities that will contribute to reversing land degradation and promoting sustainable agriculture.

- The Bushcare Program will invest in activities that will contribute to conserving and restoring habitat for our unique native flora and fauna which underpins the health of our landscapes.
- The Rivercare Program will invest in activities that will contribute to improved water quality and environmental condition in our river systems and wetlands.
- The Coastcare Program will invest in activities that will contribute to protecting our coastal catchments, ecosystems and the marine environment.
- Together these programs will invest in the ten Natural Heritage Trust areas of activity, which are:

1. protecting and restoring the habitat of threatened species, threatened ecological communities and migratory birds;

2. reversing the long-term decline in the extent and quality of Australia's native vegetation;

3. protecting and restoring significant freshwater, marine and estuarine ecosystems;

4. preventing or controlling the introduction and spread of feral animals, aquatic pests, weeds and other biological threats to biodiversity;

5. establishing and effectively managing a comprehensive, adequate and representative system of protected areas;

6. improving the condition of natural resources that underpins the sustainability and productivity of resource based industries;

7. securing access to natural resources for productive purposes;

8. encouraging the development of sustainable and profitable management systems for application by land-holders and other natural resource managers and users;

9. providing land-holders, community groups and other natural resource managers with understanding and skills to contribute to biodiversity conservation and sustainable natural resource management; and

10. establishing institutional and organisational frameworks that promote conservation and ecologically sustainable use and management of natural resources.

ATTACHMENT B

Impact of Cane Toads on Native Frogs, ROPER RIVER VALLEY & Kakadu National Park
Gordon Grigg**,** Andrew Taylor **and** Hamish McCallum

See Submission No. 12 in this volume

ATTACHMENT C

Vertebrate monitoring and re-sampling in Kakadu National Park, 2002

Project RS10

Report to Parks Australia, March 2003.
Michelle Watson and John Woinarski

SUMMARY
This report provides information on a range of studies undertaken in 2002, that involve aspects of monitoring and re-sampling of the terrestrial vertebrate fauna of Kakadu National Park.

Assessment of short-term impacts of cane toads upon the terrestrial vertebrate fauna
The terrestrial vertebrate fauna was sampled in 110 quadrats in the Mary River district of KNP in the dry season of 2001. Cane toads were not present in any of these in the dry season of 2001, but colonised parts of the district including 77 of these quadrats in the wet season of 2001/02. We re-sampled all 110 quadrats in the dry season of 2002, and here compare changes in abundance from 2001 to 2002 in the set of toad-invaded quadrats and in the set of 33 quadrats that hadn't yet been reached by toads ("control" quadrats). This study design allows us to quarantine much of the variation between sampling periods that is unrelated to toad invasion.

The resulting data base included records of 122 frog, reptile, bird and mammal species that were recorded from at least 5 quadrats over the sampling period. Of these species, 112 were recorded in toad-invaded quadrats following that invasion.

The most marked change in the vertebrate fauna was the highly significant decline of northern quolls in the toad-invaded quadrats. None were caught in quadrats that toads had invaded, whereas 41 individuals had been caught at 17 of these quadrats in the previous year.

There were less substantial declines observed for a range of other species including pale field-rat and the terrestrial gecko *Gehyra nana*.

In contrast, some species showed a relative increase in toad-invaded quadrats. These included many bird species, most frogs and the feral pig.

There was little or no evidence of decline for some species for which some concerns had previously been raised. These included northern brown bandicoot, dingo, most frog species, blue-winged kookaburra, kingfishers, pheasant coucal, dollarbird, grey shrike-thrush, magpie-lark and butcherbirds.

Some caution is required in the interpretation of this study. We obtained insufficient data for some species that may be affected by toads, including some of the small dasyurid species, raptors, goannas and elapid snakes. We analyse results for very many species, so there are likely to be some Type I ("false-change") errors. Some factors other than toad impacts may have contributed to the results (e.g. a higher proportion of control sites being burned). Our results consider only short-term impacts. The more important longer-term impacts may be very different, with

possible recovery of species initially affected or, conversely, possible ongoing and compounded decline of some species initially showing only minor impact.

Re-sampling of a landmark sandstone fauna survey: Little Nourlangie Rock (Nawurlandja)

In 2002, we re-sampled the mammal fauna at the stone country site for which the most quantitative historic information was available. This baseline was a 3-year study (1977-80) by Begg and colleagues at Little Nourlangie Rock (Nawurlandja). We replicated their methodology and trapping area as tightly as possible, at two sampling periods (April and July). In comparison to the same sampling periods in the 1977-79 study, we observed a significant decline in overall mammal numbers and in three of the four individual mammal species recorded by Begg. Based on the results from the 1977-79 study, we should have trapped 28 northern quolls from our 2002 trapping effort (whereas we caught two), 139 sandstone antechinus (whereas we caught 41) and 30 Arnhem rock-rats (whereas we caught 0). In contrast, numbers of the smallest and least specialised mammal species, the common rock-rat, were significantly higher (63 captures in 2002) than the expected tally (33).

These results may be evidence of a long-term decline in the sandstone mammal fauna, or they may be evidence of a shorter-term response to fire history. The results offer some support for a short-term decline in at least the year following fire in this habitat. Longer-term trends can be deciphered only with further periods of monitoring.

Re-sampling CSIRO Kakadu Stage I & II fauna survey sites: mammals

In 2002, we re-sampled the vertebrate fauna at 16 sites (each with three quadrats) originally sampled between 1980 and 1983 as part of the Kakadu Fauna Survey. These 16 sites comprise most of the lowland eucalypt forest and woodland sites of that original study. All are in the northern half of the Park. None had been colonised by cane toads in either the baseline survey or at the time of our re-sampling.

In this report we describe results for the mammal fauna. These results show remarkably little change in the native mammal fauna across these 16 sites, with indication of change only for the northern brown bandicoot (relatively small decline). In contrast, there was major decline for a range of feral mammals from 1980-83 to 2002.

This set of results should be treated with some circumspection, because the amount of data (in the baseline and re-sampling) is relatively meagre. However, they do contrast substantially with previous results from Kapalga, and from the results at Nawurlandja reported elsewhere in this report, and offer some optimism for the KNP mammal fauna.

These results will be analysed in more detail subsequently. Vegetation at the 16 sites is currently being assessed, which will allow us to examine changes in the fauna at the site level, and whether this relates to vegetation change over this period.

Re-sampling of the Stage III (Mary River district) fauna plots: frogs, reptiles and birds

This study reports change in the frog, reptile and bird faunas at 263 quadrats in the Mary River District between a baseline sampling in 1988-90 and subsequent re-sampling in 2001. It counterpoints results for the mammal fauna at these sites

described in our previous report (Woinarski *et al*. 2002). The frog fauna showed some changes, including significant increases for the froglet *Crinia bilingua* and the introduced cane toad, but significant decreases for *Cyclorana australis* and *Limnodynastes ornatus*. Changes in the reptile fauna included a few cases of possible identification mismatches between the sampling periods, but less clearly explained significant increases for three species (*Gehyra australis, Cryptoblepharus plagiocephalus* and *Menetia greyii*) and significant decreases for eight species (*Diplodactylus stenodactylus, Delma borea, Lophognathus gilberti, Carlia triacantha, Ctenotus decaneurus, Ct. spaldingi, Ct. vertebralis* and *Glaphyromorphus isolepis*).

The major changes observed for reptile and frog species were largely unrelated to the invasion of cane toads to a small proportion of the quadrats sampled in 2001.

Changes in the bird fauna were clouded by significant inter-observer variability, which provides a timely caveat for protocol in monitoring programs. With the removal of this variability (through stripping of the large data set to only those cases that used the same observer in both time periods), results are substantially clearer. There were major declines from 1988-90 to 2001 for a group of irruptive species (banded honeyeater, bar-breasted honeyeater, varied lorikeet and red-backed button-quail) that were particularly abundant in the first time period. There were also less significant declines for a number of other species, most notably the two trunk-gleaning insectivorous birds (black-tailed treecreeper and varied sittella). In contrast, there were only two species that showed significant increase over this period.

These results reveal some of the pitfalls that may compromise a monitoring program. More importantly, they reveal that most fauna populations undergo population fluctuations of varying magnitude, and that it is almost impossible to interpret change from a baseline to a single subsequent re-sampling period. Longer-term trends can be discerned from "natural" fluctuations only by a series of monitoring periods.

Vertebrate sampling at fire monitoring plots

During 2002, we provided baseline fauna survey information for 36 of the established KNP Fire Monitoring Plots, increasing the tally of these 135 plots with fauna survey data from 21 (in 2001) to 57 now. The 2002 sampling substantially increased representation across the various districts of the Park, and more equitably across major habitats. Sandstone habitats are still relatively under-represented, and these are the main priority for sampling in 2003. A composite data base for all sampled plots has been prepared as a CD for all Park Districts.

Ongoing priorities

This work has considerably extending knowledge of the condition and trend of Kakadu's terrestrial vertebrate fauna. Additional activities are proposed under a continuation of this contract to 2003. Priorities for work beyond 2003 include:

- longer-term monitoring of the impacts of cane toads (and of the change in predator communities that they may engineer);
- targeted survey to obtain more information on species not well sampled by our conventional sampling protocol (notably including some small dasyurids, raptors, emu and snakes);
- targeted surveys to more precisely describe the condition and trend of threatened fauna; and

- continuing accumulation of fauna data from the established fire monitoring plots.

ATTACHMENT D
THE EFFECT OF CANE TOADS ON A MARSUPIAL CARNIVORE, THE NORTHERN QUOLL, *DASYURUS HALLUCATUS.*

Progress Report, February 2003
Meri Oakwood
Ecosystem Management
University of New England
Armidale NSW 2351

SUMMARY
Northern quoll populations in Kakadu National Park are considered to be at risk of local extinction with the invasion of the introduced cane toad. In 2001, two study sites were chosen where monitoring of the effect of cane toads on northern quolls could occur: near East Alligator Ranger Station and near Mary River Ranger Station.

In December 2001, cane toads were reported approximately 15km from the Mary River Ranger Station site, consequently radio-tracking of northern quolls commenced there in January 2002. Cane toads arrived at this site in very low numbers in March 2002. Between January and June 2002**,** 40 female quolls were radio-tracked for varying periods of time. Of these, 14 were tracked to the site of their death. An additional two dead quolls were found opportunistically. Thirty one percent of these deaths appeared to have been caused by cane toad poisoning.

As the dry season progressed, the toads became cryptic and quoll mortality that appeared to be caused by cane toads ceased ("normal" mortality still occurred). In consideration of funds available, radio-tracking then ceased, the plan being to recommence in the next wet season.

Trapping indicated that the quoll population at Mary River was demonstrating the normal pattern (a slight decline) throughout the dry season up until early October, however the December and January trapping trips revealed that a sudden decline had then occurred. Normally, the wet season is a time of high quoll abundance as the juvenile quolls become independent and enter the trappable population. Examination of rainfall records showed that rain began in the area in the middle of October. It appears likely that with the rain, the cane toads emerged from their refuges and despite their low numbers at the site, were numerous enough to affect the quolls. In contrast, the non toad-affected East Alligator site still has very high quoll abundance, with large numbers of juveniles. These results support the anecdotal evidence from Cape York that quoll populations are severely affected by toads.

ATTACHMENT E

Summary of current studies on cane toad impacts on native fauna in the Northern Territory

This is an informal list of researchers who are undertaking studies that will provide data on the impact of cane toads on native fauna. It was derived from discussions between Parks Australia staff, NTU staff, PWCNT staff and other researchers. It should not be regarded as a definitive list as it is possible that other projects that will contribute information on the effects of cane toads may have been missed.

Taxa	Location	Agency/person responsible	Type of study	Status	Notes
Varanus spp.	Kakadu National Park	Dan Holland Jabiru 89792415, DCHPARS@aol.com (in conjunction with Key Centre Tropical Wildlife Mgt - NTU)	Radio telemetry study, pop. size estimates and road surveys of goanna sightings	In progress	Intensive radio tracking study of ca. 50 individuals of *V. panoptes*, plus captures and sightings data on *V. gouldii*, *V. mertensi* and *V. mitchelli*
Varanus spp.	Near Darwin and Maningrida	Tony Griffiths & Tim Schultz (NTU-KCTWM) tony.griffiths@ntu.edu.au	Radio telemetry study	In progress	
Dragon (*Lophognathus temporalis*)	Near Darwin	Tony Griffiths & Tim Schultz (NTU-KCTWM) tony.griffiths@ntu.edu.au	Mark-recapture	In progress	
Varanus tristis *and* Varanus scalaris	Kakadu National Park	Sam Sweet sweet@lifesci.ucsb.edu	Radio telemetry study	Complete	Behavioural ecology study indicated little likely temporal or spatial overlap between foraging goannas and juvenile (prey-sized) toads in woodlands distant from water. However both species are likely to be impacted where their home range overlaps wet habitats that can support toad breeding or toadlet activity. *V. tristis* at greater risk as home range is ca 12 ha cf to ca. 1 ha for *V. scalaris*.
Frogs	Roper River and Kakadu National Park	Gordon Grigg, Uni Qld ggrigg@zoology.uq.edu.au	"Toadpoles" - automated frog call recording devices.	In progress	Ten sites (five pairs) between Mataranka and 120 km east on Roper valley Hwy. Six sites within KNP replicates in each of three habitats. Counts of relative abundances based on calling frequencies will allow detection of gross changes in frog populations before and after toads.
Frogs and reptiles	Mary River	Kerry Beggs & Peter Whitehead, NTU Peter.Whitehead@ntu.	Habitat and fauna surveys	In progress	Yield data on herp/toad interactions and toad capacity to exploit grasslands of different

Taxa	Location	Agency/person responsible	Type of study	Status	Notes
		edu.au			ground cover/stem densities and hence the species that will be at risk.
Frogs	Sites within and close to the Darwin region	Keith Christian, Jeanne Young & Lorrae McArthur, Faculty of Science NTU Keith.Christian@ntu.edu.au	Visual encounter and call surveys at specific field sites.	In progress	Visual encounter and call surveys at specific field sites. Data have been collected from September 2000 for pre cane toad estimates of the relative abundance of native species at several sites. Data will continue to be collected for this study until 2004 and will provide baseline data for a number of native species in the Darwin area.
Dusky rats (Rattus colletti)	Fogg Dam ,/ Adelaide River floodplain	Thomas Madsen & Beata Ujvari, University of Sydney Thomas.Madsen@zoo ekol.lu.se	Mark-recapture study	In progress	Cane toads are suspected to become one of the major predators on these native rodents. Dusky rats are a predominant food item for many species of reptile including Water Pythons and a decline in rats may impact significantly on the floodplain fauna.
File snakes (Achrocurdus arafurae)	Djukbinj National Park / Adelaide River floodplain	Thomas Madsen & Beata Ujvari, University of Sydney Thomas.Madsen@zoo ekol.lu.se	Mark-recapture studies and genetic studies	In progress	File snakes do not feed on amphibians, however, this taxon may become indirectly affected if their main prey (catfish) will be affected by the arrival of the toads.
Water pythons (Liasis fuscus)	Fogg Dam	Thomas Madsen & Beata Ujvari , University of Sydney Thomas.Madsen@zoo ekol.lu.se	Mark-recapture study	In progress	Water pythons will most likely not feed on cane toads but this taxon may be strongly affected by a decline in dusky rats due to toad predation (see above).
Snakes and frogs	Fogg Dam	Rick Shine & Greg Brown, University of Sydney, 02 93512222 rics@bio.usyd.edu.au	Long term surveys and mark-recapture studies.	In progress	Long-term surveys and mark-recapture studies of water pythons (*Liasis fuscus*), keelbacks (*Tropidonophis mairii*) and slatey-grey snakes (*Stegonotus cucullatus*). Also have longterm data from nightly surveys on abundances of other snakes, and native frogs.
Terrestrial fauna (skinks, frogs, small mammals, birds)	Kakadu National Park	John Woinarski & Michelle Watson, Parks and Wildlife NT John.Woinarski@nt.gov.au Rod Kennett Kakadu NP Rod.Kennett@ea.gov.au	Small mammal trapping, pitfall trapping, spotlight counts and bird counts	In progress	Reports being provided to Parks Australia under consultancy arrangements.

Taxa	Location	Agency/person responsible	Type of study	Status	Notes
Terrestrial fauna (reptiles, frogs, mammals, birds, invertebrates)	Mt Bundey Training Area (1050 km^2, about 120 km southeast of Darwin; abuts KNP)	Department of Defence, CSIC – NT/K, Infrastructure, Robertson Barracks (Tony Law). Project conducted by Laurie Corbett, EWL Sciences. laurie.corbett@ewlsciences.com.au	Wet and post-wet season surveys (in 2002	Study completed. Report inquiries should be directed to Tony Law, Dpt of Defence, Robertson Barracks.	Methods included small mammal trapping, pitfall trapping, spotlight counts, diurnal searches, dingo tracking, bird counts; using standardised survey methodology at 24 sites in four major habitats. The study targeted the following indicator species/aggregrates: • Predators eating cane toads: dingo, quoll, predatory birds (eg. forest & red-backed kingfishers), snakes and large goannas; • Prey eaten by cane toads: beetles and other invertebrates; • Competing aggregates of species (for food and breeding resources): frogs; and • Indirectly impacted species aggregrates (food eaten by cane toads): small reptiles particularly skinks.
Terrestrial fauna (reptiles, frogs, mammals, bushbirds, invertebrates) and aquatic fauna (micro-invertebrates, macroinvertebrates, fishes, waterbirds)	Ranger and Jabiluka mining leases in the Magela Creek catchment; reference sites in the Nourlangie Creek catchment of KNP.	ERA Ltd - Ranger Mine. Project conducted by Laurie Corbett, EWL Sciences.	Wet and dry season surveys in 1994/95 and 2000/01.	Study completed. Report completed on 1994/95 data. Draft report for all data currently in preparation.	Methods included small mammal trapping, pitfall trapping (vertebrates & invertebrates), spotlight counts, diurnal searches, bird counts; using standardised survey methodology. The data set comprises records from the same sites using similar methods, and thus provides information on changes in species richness and relative abundance over time (6 years). Any future planned monitoring surveys will provide information on cane toad impacts with allowance for natural temporal changes in richness & abundance.
Terrestrial fauna (reptiles, frogs, mammals, bushbirds, invertebrates) and aquatic	Bradshaw Field Training Area (8710 km^2 about 600km southwest of Darwin.	Department of Defence, CSIC – NT/K, Infrastructure, Robertson Barracks (Tony Law). Baseline surveys	Wet and dry season surveys 1996-99.	Study with several reports completed. Inquiries about the reports	Methods included small mammal trapping, pitfall trapping (vertebrates & invertebrates), spotlight counts, diurnal searches, bird counts; using standardised survey methodology.

Taxa	Location	Agency/person responsible	Type of study	Status	Notes
fauna (fishes, waterbirds)		conducted by Laurie Corbett, EWL Sciences.		should be directed to Tony Law, Dpt of Defence, Robertson Barracks.	The data set comprises pre-impact baseline against which planned future monitoring surveys will provide information on cane toad impacts.
Terrestrial fauna (reptiles, frogs, mammals, bushbirds, and invertebrates.	Kapalga (about 650 km^2) in KNP	CSIRO TERC, Darwin. Surveys conducted by Laurie Corbett.	Fourteen wet and dry season surveys (1988 – 95)	Study completed. Several reports available from CSIRO, TERC Darwin.	Methods included involving small mammal trapping, pitfall trapping (vertebrates & invertebrates), spotlight counts, diurnal searches, bird counts; using standardised survey methodology. Extensive data set (20,000 records over 8 years) that may be useful as a pre-cane toad baseline incorporating natural temporal variation in richness and abundance. These data were collected as part of an investigation to understand fire impacts; but as few significant fire impacts were recorded, the data should be useful to understand natural temporal variation in richness and abundance. Any future monitoring surveys will provide information on cane toad impacts.
Small mammals	Darwin	Brooke Rankmore, Owen Price, Peter Whitehead (PWCNT and NTU) owen.price@nt.gov.au	Mark recapture studies	In progress	

Taxa	Location	Agency/person responsible	Type of study	Status	Notes
Quolls	Kakadu National Park	Meri Oakwood Uni of New England envirotek@hot.net.au Rod Kennett Kakadu NP Rod.Kennett@ea.gov.au	Density estimates and radio telemetry	In progress	Two sites (EAR and MRR) selected. Monitoring of toad invasion at MRR occurred over 2001/2002 wet season. Substantial declines in quolls reported at the MRR site following toad arrival.
Freshwater crocodiles and fish	McKinlay River	Grahame Webb Wildlife Management International gwebb@wmi.com.au	Mark recapture study	In progress	Original survey and estimates from 1980s compared to recent survey results pre and post toads will provide estimates of changes in densities and mortality rates. Will also be able to quantify changes in varanid predation rates on freshwater crocodile eggs as toads arrive. Also examining distribution of fish species in billabongs from 1978 onward so should be able to quantify losses.
Freshwater turtles (*Chelodina rugosa* and *Elseya dentata*)	Near Darwin	Tony Griffiths and Peter Whitehead KCTWM - NTU tony.griffiths@ntu.edu.au Rod Kennett Kakadu NP Rod.Kennett@ea.gov.au	Mark recapture	In progress and planning	Original survey and estimates from 1980s compared to recent survey results pre and post toads will provide estimates of changes in densities and mortality rates
Freshwater turtles (*Chelodina rugosa*)	Maningrida and surrounding floodplains	Uni Canberra/NTU Arthur Georges Damien Fordham georges@aerg.canberra.edu.au fordham@aerg.canberra.edu.au	Mark recapture and harvest rates by Aboriginal hunters	In progress	Provide data on population changes and impacts on Aboriginal hunting success.
Toad prey species	Kakadu National Park	Anne Ferguson Kakadu NP Anne.Ferguson@ea.gov.au	Mark recapture	In progress	Toads stomachs sampled monthly

ATTACHMENT F

Summary of the Current CSIRO Biological Control Research Program

The basic principle underlying the CSIRO research relate to differences in some of the key body systems between the adult cane toad and the tadpole. The immune system, digestive system and blood system are all very different between the adult and tadpole. This indicates that genes exist that are critical to triggering the metamorphosis from one stage to the next.

By selecting and expressing one such adult gene early in the tadpole stage, the tadpole's system should see it as a foreign entity and initiate an immune response

against it. That response would then interfere with metamorphosis and prevent the tadpole from maturing and reproducing.

To deliver the gene to the tadpole, the researchers are looking for a natural virus, a ranavirus, specific to amphibians and fish that can act like a 'taxi' or 'courier'. The virus itself needs to be weakened (attenuated), so that its effects will not similarly influence amphibians and fish. The gene, rather than the virus, will affect the tadpole.

SUBMISSION NO. 15B

Environment Australia – Parks Australia North
Dr Rhondda Dickson
Acting First Assistant Secretary, Land, Water & Coasts Division
Follow-up Submission

GPO Box 787
CANBERRA ACT 2601

16 July 2003

Ms Delia Lawrie MLA
Chair
Sessional Committee on Environment and Sustainable Development

Dear Ms Lawrie

I refer to the video conference held on 19 May 2003 concerning the *Inquiry into issues associated with the progressive entry into the Northern Territory of Cane Toads.* During the meeting I offered to provide additional information for members of the Committee.

Attached, please find the additional information. I trust that it will be of assistance to members of the Committee and the Inquiry overall. If you have any further questions concerning the information attached please contact Mr Robert Moore, Assistant Director, Threats & Threatened Section, by phone on (02) 6274 2272 or by email robert.moore@ea.gov.au

Yours sincerely

Rhondda Dickson

INTRODUCTION
In a video conference held as part of this inquiry on 19 May 2003, Environment Australia agreed to provide some additional information to the Sessional Committee on the following issues (as noted on page 14 of the video conference transcript).

1. Past funding offers from the Commonwealth to the Territory in terms of cane toad research that had not been taken up or accepted

2. A comparison between research of other feral animals and cane toads

Each of these issues is addressed below.

PAST FUNDING OFFERS FROM THE COMMONWEALTH TO THE TERRITORY IN TERMS OF CANE TOAD RESEARCH THAT HAD NOT BEEN TAKEN UP OR ACCEPTED.
Environment Australia provides the following information:

- During 1999 Environment Australia informally sought the views of the Northern Territory Parks & Wildlife Commission. The Commission advised that further work on a biological control of cane toads was not considered warranted and did not intend funding such work. The Commission considered that from the range of vertebrate pests that required management for conservation reasons, a significant number would be accorded a higher priority than cane toads.

- In August 1999 the Northern Territory wrote to the Commonwealth concerning progress with the CSIRO cane toad biological control project and any other Commonwealth cane toad control proposals.
- In October 1999 the Commonwealth wrote to the Northern Territory seeking their involvement in a national approach to co-fund a renewed research and development effort to control cane toads. The Northern Territory responded providing qualified support to co-fund research and a development program for cane toad control, depending on the quality of the application received.
- In February 2000 the Commonwealth advertised nationally for expressions of interest to undertake a research program for biological control on cane toads. Based on the results of this process, the Commonwealth decided to proceed directly with CSIRO and funded an initial two year project. This research project was the subject of discussions with the NT inquiry on 19 May 2003, and which recently received additional funding under the Natural Heritage Trust.

A COMPARISON BETWEEN RESEARCH OF OTHER FERAL ANIMALS AND CANE TOADS

Based on a preliminary evaluation of the information available to adequately address this request, it was decided that it may be useful to provide a snap shot of some of the funding provided for one nationally recognised pest species. The feral rabbit was selected to provide a useful comparison to the cane toad, as the rabbit calicivirus disease (RCD) research is one of the most recent vertebrate pest biological control project conducted in Australia.

The following figures provide conservative estimates of the total costs that would have been involved. Importantly, the information provides an indication of some of the major contributions made by the Commonwealth and State \Territory Governments.

Starting in July 1991, when the initial three-year laboratory project with CSIRO commenced, to the 1999/2000 financial year, a summary of known funding is outlined in Table 1.

Table 1

Contributors	1991-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00
Commonwealth	$750,000	$1M	$1M	$950,000	$950,000	$375,000	$375,000
				$650,000			
States & Territories	unknown			$950,000	$950,000		
Industry	unknown			unknown	unknown	unknown	unknown
Total	$750,000	$1M	$1M	$4.5M		$375,000	$375,000
Contributors	1991-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00
Commonwealth	$750,000	$1M	$1M	$950,000	$950,000	$375,000	$375,000
				$650,000			
States & Territories	unknown			$950,000	$950,000		
Industry	unknown			unknown	unknown	unknown	unknown
Total	$750,000	$1M	$1M	$4.5M		$375,000	$375,000

(All funding amounts are approximations.)

In summary, over about a ten year period the total contracted funding provided by industry stakeholders, the Commonwealth and State/Territory Governments for RCD research was approximately $8 million. This amount does not include any in-kind contribution that may have been made, e.g. CSIRO estimated that from 1991 - 1995 their in-kind contribution to the program was $2.3 million.

For cane toads, over about a ten year period the total contribution made mainly by the Commonwealth is approximately $4.7 million. Beginning in 1990 the Commonwealth provided $ 1.25 million over three years with some of the States contributing a further $90,000. In 1993 the Commonwealth provided an additional $2 million to the program that finished in December 1996. In 1996/1997, the first year of the Natural Heritage Trust, the Commonwealth provided $120,000 to fund the program to June 1997 to finalise some work not previously finished. Since 2000 the Commonwealth has provided approximately $1.5 million from the Natural Heritage Trust to support a new biological control program with CSIRO.

SUBMISSION NO. 16

Power and Water Corporation
Mr Kim Wood
Managing Director

GPO Box 1921
DARWIN NT 0801

15 May 2003

Executive Officer
Sessional Committee on Environment and Sustainable Development

Dear Sir

Re: Inquiry into issues association with the progressive entry of cane toads into the Northern Territory

I am writing in response to the call for submissions by the Sessional Committee on Environment and Sustainable Development, on issues associated with the progressive entry of cane toads into the Northern Territory.

At this stage, Power and Water believe that there are no significant issues associated with the introduction of cane toads on power generation, power distribution, or sewage reticulation and treatment. However, there are a number of concerns with the potential impact of cane toads on water supply systems, which are outlined in the attached internal report.

The report highlights that cane toads pose:

1. A low level of risk to well managed and adequately maintained drinking water supplies;

2. A potential risk to Aboriginal outstations or individual centres with a low level of borehole protection standards or maintenance; and

3. A certain risk to aquatic ecosystems and habitats within Darwin River Dam and other protected catchments.

The 'Framework for Drinking Water Quality Management" recommended by the National Health and Medial Research Council, and adopted by Power and Water, identifies audit of water supply headworks and maintenance of preventative barriers to potential contamination as a key feature of water quality protection. It is believed that Implementation of this framework by Power and Water will adequately protect water supplies from issues associated with the entry of cane toads into the Northern Territory.

However, as part of the Committee's recommendations it is suggested it may wish to highlight the importance of source, and particularly bore head protection as a means of preventing the degradation of smaller scale water supplies.

Finally, whilst it is not anticipated to cause any harmful impact on the water quality from Darwin River Dam for water supplies, there will almost certainly be an impact on the near shore habitat and native species currently within that zone. With that view Power and Water intends to engage with the Parks and Wildlife Division of the Department of Infrastructure, Planning and Environment and research bodies (such as Northern Territory University) to more fully understand and monitor those impacts.

If you have any queries please contact Mr Paul Heaton, Manager Water Facilities on telephone (08) 8924 7359.

Yours sincerely

Kim Wood

AN INVESTIGATION INTO DRINKING WATER QUALITY RISKS ASSOCIATED WITH CANE TOADS IN THE NORTHERN TERRITORY, MAY 2003

Table of Contents

INTRODUCTION

This report investigates the possible risks cane toads in the Northern Territory pose to drinking water quality and supply sources. The reason for this investigation is to provide a rationale as to whether the Power and Water Corporation (Power and Water) require to put forward a submission to the Legislative Assembly of the Northern Territory for an "Inquiry into Issues Associated with the Progressive Entry into the Northern Territory of Cone Toads", The report also provides recommendations for future action by Power and Water on cane toad issues.

Introduced cane toads have been identified as an environmental hazard and a major threat to tropical Australian native fauna. Their poison has been the cause of death to most native animals and pets in Australia. The poison does not pose a severe threat to humans, but more of a nuisance. Limited research and experience have also shown that cane toad toxin does not pose a significant risk to water quality in large water

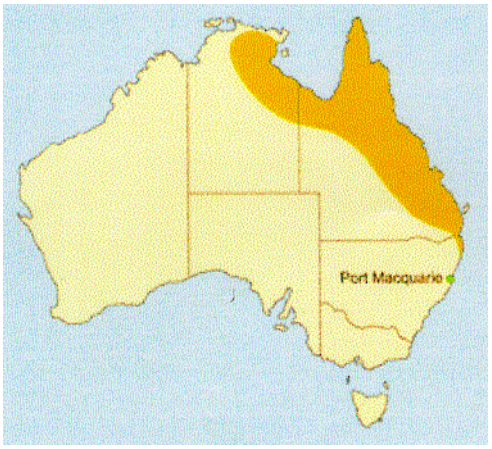
bodies and well managed drinking water supplies, but more an issue in open boreholes and watering troughs.

Information in this report has been gathered through literature reviews and personal communication with personnel from Cairns Water, Environment Australia and James Cook University (see Appendix 1).

CANE TOADS: BACKGROUND

Cane toads *(Bufo marinus),* also known as American toads or giant toads are native to North, Central and South America. They were introduced into Australia in the 1930's to control the grey-back cane beetle and the frenchies beetle that were affecting the cane sugar industry (Speare, 1997). Cane toads were unsuccessful in controlling grey-back cane and Frenchies beetle numbers; instead their capacity to breed excessively resulted in an uncontrolled spread of these amphibians throughout coastal Queensland, coastal northern New South Wales and coastal Northern Territory. Figure 1 illustrates areas in Australia effected by cane toads. As a result, cane toads have emerged as a pest in Australia endangering native wildlife and a nuisance to humans.

Figure 1: Cane Toad Distribution in 2002



Source: *Cameron, 2002*

Cane toads are commonly found in coastal heaths, rainforests and mangroves and rely on wetlands, billabongs, irrigation canals and livestock watering dams in dry periods (Cameron, 2002).

Cane toads secrete a poisonous liquid from glands behind each ear when handled or attacked. This liquid contains bufotoxin, which is a mixture of poisonous liquids and is primarily cardio-active (Vanderduys & Wilson, undated). This toxin is also present in the bones, muscles, organs, eggs and tadpoles of the cane toad (Speare, 1997). Australian native fauna and domestic pets have been killed by eating or mouthing cane toads. The toxin is also absorbed through mucous membranes, i.e. eyes, mouth and nose (Comeron, 2002). Therefore, when handling cane toads this may cause temporary blindness, inflammation and intense pain in humans.

Cane toads spread to the Northern Territory from Queensland in 1980 (Van Dam et a[, 2002). Their spread rate has been estimated to be between 30-50 km/ year and are present in coastal Northern Territory from Queensland border to the south bank of Roper River (Speare, 1997).

RISK TO WATER QUALITY

The presence of bufotoxin in water secreted by eggs, tadpoles and adult cone toads may pose a potential risk to water quality (Van Dam et al, 2002). However, only a limited amount of studies or research has been conducted in this field. Since the introduction of cane toads in Queensland, there have not been any water contamination or quality issues to drinking water supplies as a result of cane toad toxins till date (Clayton, Cairns Water, *pers. comm.,* 2003). Most reports have been related to poisoning of poultry and pets as a result of drinking water from boreholes and water troughs contaminated by bufotoxin (Van Dam et al, 2002). This is because during breeding periods larval and adult toads die in these water bodies and release toxin upon death. Furthermore, rotting toad carcasses in water bodies contaminate the water with its subsequent release of cytolitic toxins (Freeland, 1984).

The cause of death for most adult toads in boreholes, water troughs or irrigation canals is by drowning. Their limited capacity to jump or climb barriers and walls results in them being trapped and eventually drowning (Waiden, Environment Australia, *pers. comm.,* 2003). Therefore it is unlikely for cane toads to be trapped and drowned in large dams and reservoirs where they have access to and from the water at all times. However, if they are trapped and drowned in large water bodies due to exceptional circumstances, toxin levels will be reduced considerably due to the large volume of water and sufficient mixing in the water source (Van Beurden, 1980). Therefore, smaller water holes and stagnant water are at potential risk from cone toad toxins compared to larger water bodies (Alford, James Cook University, *pers. comm.,* 2003). In addition the threat cane toads pose to bore water supplies will depend on the maintenance and protection of the bore itself. If drinking water supply bores are well protected and managed, the effect cane toads will have on drinking water quality will be negligible (Clayton, Cairns Water, *pers. comm., 2003).* Toads and frogs have access to elevated tanks via pipes (Waiden, Environment Australia, *pers. comm.,* 2003). However, water tanks can largely be protected from cane toads by maintaining frog flaps and ensuring that all hatches are sealed properly.

Cane toads are known to be carriers of human strains of bacteria leg. *salmonella* as a result of consuming human faeces (Van Dam et al, 2002). Van Dam *et al* (2002) has identified this to be a potential health hazard especially in areas with poor sanitation and water services. However, only a limited amount of studies and research has been conducted to assess the health risks cane toads pose to humans through water consumption. Taylor *et al* (2000) indicated that *salmonella* identified in workers from a construction site in Central Queensland may have been a result of mice or toads in the water tank. However, this variety of *salmonella could* not be isolated in cane toads. Furthermore, the lack of protection of the tank resulted in this waterborne outbreak of *salmonellae.* O'Shea *et al* (1990) tested cane toads in Townsville region and found about 13% carrying *salmonella species* in their gut. If cane toads defecate in water sources there is a possibility for the water to be contaminated with *salmonella* (Speare, James Cook University, *pers. comm.,* 2003). However there have been no record or studies showing the risk of Salmonella being present in water at a concentration sufficient to cause disease. Speare (2003) also indicates that this could be a significant risk to water supplies in remote Aboriginal outstations where there is inadequate maintenance and treatment of water before consumption.

Barton (James Cook University, pers. comm, 2003) stated that there has been one record of cane toads acting as a carrier of nematode eggs through its faeces. However, the potential for nematode contamination in water through the environment (soil) is recorded to be much higher than through cane toads. Furthermore, most of the viruses carried by cane toads have been identified to be a risk to cold-blooded aquatic wildlife, such as the *Bohle iridovirus* which kills barramundi, and not to humans (Barton, James

Cook University, *pers, comm, 2003).* There has been no evidence of cane toads passing any other pathogens to humans (Speare, James Cook University, pers. comm. 2003).

Experience has shown that cane toads have not affected drinking water quality in Cairns, where the presence of cane toads is significantly greater than in the Northern Territory, Appendix 2 provides a comparison of the level of treatment of surface water supplies in Queensland towns affected by cane toads compared with centres supplied with surface water in the Northern Territory.

Although the degree of treatment of surface water supplies in Queensland is generally greater than the Northern Territory, this is largely a reflection of a lower degree of catchment protection. As mentioned above, the possibility of large water bodies, such as the major surface water supplies in the Northern Territory, being contaminated by bufotoxin is negligible.

As a result of the adoption and progressive implementation of the 'Framework for Management of Drinking Water Quality" by Power and Water, drinking water supplies are protected from external risks to reduce water contamination and ensure safe drinking water quality. This ongoing management of drinking water supplies by Power and Water minimises the risks of cane toads entering drinking water sources (especially bores) and further affecting drinking water quality in the Northern Territory.

RISK TO ENVIRONMENT

While cane toads are not considered a direct threat to water quality within large surface reservoirs, Darwin River Dam does represent the largest permanent fresh water body in the Northern Territory. Recent studies have indicated a significant diversity of terrestrial species and habitats within its protected catchment boundary. However, no study has been undertaken to date of the aquatic species or nearshore habitats. The imminent arrival of cane toads within the catchment may provide a significant opportunity for researchers to study the impact of the introduction of cane toads on a stable, protected environment over a number of years.

CONCLUSION

The above discussion clearly indicates that cane toad toxin pose insignificant risks to well managed drinking water sources and supplies.

Cane toad toxins have been identified to be more of a threat to native Wildlife and a nuisance to humans. The solubility and low concentrations of bufotoxin in large water supply sources poses no risk to drinking water quality. Water quality risks are only associated with smaller water sources such as watering troughs, unprotected bore holes and stagnant water pools where cane toads breed, get trapped and eventually drown.

Although this investigation indicates that cane toads do not pose an immediate risk to drinking water quality in the Northern Territory, the unknown risks they pose to the natural environment and drinking water quality through *salmonella* contamination suggests the need for more research to be conducted in this field.

RECOMMENDATIONS

Drawing from the findings of this investigation it is recommended that Power and Water provide a submission to the Legislative Assembly highlighting:

1. The low level of risk that cane toads pose to well managed and adequately maintained drinking water supplies.

2. The potential risk that cane toads pose to Aboriginal outstation or centres with low borehole protection or maintenance regimes.

3. The potential to consider research on the effects cane toads can have on the aquatic ecosystem at Darwin River.

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Vanderduys E. and Wilson S. (2000) *Frogs 2., Cane Toads,* Queensland Museum, Brisbane, Australia.

APPENDIX 1

List of Personnel Contacted

Name	Organisation	Mode of Contact	Date
Dave Waiden	Environment Australia	Phone and e-mail	29/04/03
Diane Barton	James Cook University	e-mail	07/05/03
Ian Clayton	Cairns Water	e-mail	29/04/03
Peter Mockry	Citiwater (Townsville Thuringowa)	Phone	12/05/03
Richard Speare	James Cook University	e-mail	08/05/03
ROSS ALFORD	James Cook University	e-mail	01/05/03

APPENDIX 2

Comparison of Surface Water Supplies and Treatment Levels in Queensland Towns Affected by Cane Toads and Surface Water Supplies in the Northern Territory

Surface Water Supplies and Levels of Water Treatment in the Northern Territory

Location	Source	Treatment	% of Water Supplied
Darwin	Darwin River Dam	Chlorination + Fluoridation	90*
Katherine	Katherine River	Conventional Treatment** + Chlorination + Fluoridation	90*
Pine Creek	Copper Field Dam	Coarse Filtration + Chlorination	70*

** Chemical addition, flocculation, sedimentation and filtration.

*Remainder of supplies are sourced from groundwater.

Surface Water Supplies and Levels of Treatment in Queensland Towns Affected by Cane Toad

Location	Source	Treatment	% of Water Supplied
Cairns	Copperload Dam (Lake Morris)	Flocculation + Sand Filtration + Chlorination	100
Townsville Thuringowa	Ross River Dam	Filtration + Chlorination + Fluoridation	100

Source: Clayton, Cairns Water, *pers. comm.,* 2003 and Mockry, Citiwater (Townsville Thuringowa), *pers. comm.,* 2003).

SUBMISSION NO. 17

World Wide Fund for Nature: Arid Rangelands - Threatened Species Network, Alice Springs

Ms Colleen O'Malley, Threatened Species Co-ordinator

PO Box 2796
Alice Springs, NT 0871

20 May 2003

Sessional Committee on Environment and Sustainable Development

re: Inquiry into Issues Associated with the Progressive Entry into the Northern Territory of Cane Toads

Dear Committee

The Threatened Species Network (TSN) is grateful for the opportunity to comment on issues of concern relating to cane toad invasion in the NT and commends the committee for recognising the seriousness of the issue and for initiating this public inquiry.

TSN is very concerned about the impacts of cane toads on native fauna and habitat quality for biodiversity generally, and believes that in the absence of any intervention there are threatened or rare species such as the Northern *Quoll (Dasyurus hallucatus)* whose survival on the NT mainland is under serious threat.

The Threatened Species Network would like to make the following recommendations with regard to critical actions that need to be implemented to reduce the potential impacts of cane toad invasion on biodiversity, and in particular on rare or threatened species and on habitat critical to their survival.

RECOMMENDATION 1

That the NT government invest in biosecurity and education programs aimed at ensuring cane toads do not invade islands that may play a critical role as potential refuge areas for biodiversity negatively impacted by cane toad invasion on the mainland

Given the absence of effective control or exclusion measures for cane toads, the most critical action needed is to implement rigorous quarantine measures and education programs to ensure toads do not colonise islands in the Northern Territory that may provide potential refuge for species likely to be seriously impacted on due to toad colonisation of mainland habitats.

Partnerships between NT government agencies, Aboriginal Councils and Traditional Owners responsible for particular islands will be necessary to ensure sound understanding of biosecurity proposals for island habitats and to manage procedures for transport of cargo and people between islands and the mainland. Similarly there will need to be education campaigns targeting the onshore fishing industry and recreational boating groups to prevent inadvertent introduction of toads to islands.

RECOMMENDATION 2
That the NT government invests resources into rigorous monitoring programs to study both the short- and long-term impacts of cane toad invasion on a wide range of native species

> Currently there are few monitoring programs in place to assess the short- or long-term impacts of cane toad invasion on mainland biodiversity, or their impacts on species that are important to Aboriginal or Torres Strait Islander people either for cultural reasons or as a food resource. The absence of data on these impacts means that it is very difficult to predict likely biodiversity trends attributable to toad invasion, identify habitats at risk, calculate the environmental cost of toad invasions, or to assess the economic impact on native species valued by indigenous communities.

RECOMMENDATION 3
That the NT government invests considerably more resources into recovery programs for native fauna likely to be significantly impacted on by cane toad invasion

> Preliminary data from biodiversity monitoring programs in Kakadu NP show that there are several species, including the Northern Quoll, which undergo rapid and significant population decline as cane toads invade their habitat. For species determined to be at risk of local extinction, or serious decline, it will be necessary to implement recovery programs aimed at securing populations of these species in habitats protected from invading cane toads.
>
> Because of the speed at which cane toad invasion is progressing through habitats in mainland NT, it is important to ensure that the necessary at-risk species recovery planning and funding strategies are in place within a very short timeframe to ensure effective implementation of these recovery programs.

I would be happy to expand on any of these issues should you require it.

Yours sincerely,

Colleen O'Malley

SUBMISSION NO. 18

Dr Rod Kennett
Jabiru

PO Box 518
JABIRU NT 0886

21 May 2003

Sessional Committee on Environment and Sustainable Development

Dear Committee

In regard to the Inquiry into Issues Associated with the Progressive Entry into the Northern Territory of Cane Toads, I offer the following comments.

SUMMARY

Cane toads are of significant concern, particularly amongst Indigenous people in the NT. Cane toads are also of significant threat to wildlife and may have serious consequences for species of conservation significance as well as human health.

Cane toads have colonised much of the NT, and most of the NT population will need to learn to live with toads until an effective bio-control agent is developed. However there are some areas, especially offshore islands, that remain toad free and an important opportunity exists to establish measures that will ensure that key areas remain toad free. Co-ordination of existing research activities as well as new research initiatives are urgently required to better understand the impacts of cane toads on wildlife and people in order to develop appropriate management responses.

SUMMARY OF RECOMMENDATIONS

- Establish a cane toad taskforce
- Identify toad free areas within the NT with a focus on offshore islands, and determine their feasibility as permanent toad free locations
- Establish measures (quarantine, monitoring, eradication) to prevent cane toad introduction to and colonisation of offshore islands, especially the Tiwi Islands and Croker Island
- Undertake research on the cultural and economic impact of cane toads on Indigenous communities in the NT (and possibly across the northern WA), as a basis for advising indigenous communities on management responses (e.g. limitations to traditional harvest)
- Develop effective communication tools to prevent the unnecessary spread of cane toads (especially to toad free areas), and to raise awareness about the potential impacts of toads on wildlife and people.
- Direct Government support (training, finance) to Aboriginal ranger programs to assist them in addressing the spread and impact of cane toads
- Review the progress and expected outcomes of existing cane toad research projects in order to identify where additional funding is required

Develop new research projects that will provide us with a better understanding of the impacts of cane toads on key species of cultural and conservation significance.

Formation of a cane toad taskforce

The possible formation of a cane toad taskforce has been suggested during the public meetings held by the committee.

Given the urgency of the situation (i.e. cane toads have colonised >50% of the NT), the need for collaboration across sectors (government agencies, local government, land councils, universities etc), and the lack of NT government co-ordination of cane toad management and research in the past, the formation of a task force with appropriate powers and resources would be a useful step in dealing with the cane toad problem.

I suggest the taskforce be kept small (perhaps a max of 5) otherwise it will be too cumbersome, meetings will never happen and little will be achieved. The team should be selected on the basis of scientific and technical expertise and communication abilities and work under the leadership of a suitable qualified scientist or manager. To expedite establishing the team they could be seconded to NT government positions for 18 months or 2 years with a review at the end of 2 years. NT government should be prepared to pay salaries unless the member's current employers can support their involvement, although this should not be a consideration in team selection.

The role of the taskforce should be to undertake, commission and fast-track research, technical reports, feasibility studies, literature surveys etc, and to implement capital works where necessary. Positions on the taskforce should be full-time and the team should be adequately resourced to operate effectively in short time frames. The taskforce should report directly to the NT Environment Minister.

Representation on the taskforce might include individuals from Parks and Wildlife, research (possibly an NTU researcher), Commonwealth government, the Indigenous community, and the Northern Land Council. The taskforce should be provided with office space where the group can work together to ensure constant communication between team members and focus on the cane toad issues.

The Commonwealth Government should be asked to nominate representatives from appropriate agencies, e.g. NAQS, EA, CSIRO who would be required to make responding to and communication with the task force a priority.

The Western Australian government will be extremely interested in the development and outcomes of the task force, toad control measures and impact studies. To ensure rapid transfer of knowledge to WA conservation authorities, WA government representatives could be invited to the taskforce as observers. Similarly representatives from indigenous bodies in WA could be invited to participate as observers to the taskforce to ensure that indigenous people are kept informed.

Establishing toad free areas

Cane toads will have colonised all suitable habitat in the NT long before an effective means of control is developed. Establishing toad free areas is the only means of saving some areas from toad impact but they will require substantial funds to establish and maintain. Maintenance costs will include maintenance/upgrading of barriers as new technology and/or engineering options are developed, funding for dedicated patrol teams, and ongoing education and communication.

A bio-control agent for cane toads is believed to be at least 5-10 years away but we should be prepared for it to take 2 or 3 times as long as that. Toad free areas should only be established in concert with a government commitment and adequate resourcing to maintain them for as long as is required to develop alternative control measures.

Islands offer the most cost-effective means of establishing toad free zones as the seawater barrier hampers toad colonisation and reduces the probability of toad 'hitchhikers'. However, toads have already colonised many islands presumably under their own steam or through intentional or accidental carriage in boats or planes. There are little data on how toads have got to islands or even what islands they are on.

I would recommend undertaking an immediate risk assessment of cane toad colonisation of all islands within the potential range of toads. This would include identifying what islands have been colonised, when and how and what factors facilitate or hamper cane toad colonisation of islands. (Having advocated a risk assessment process, there are several islands such as the Tiwi islands and Croker Island that are obvious places to immediately instigate cane toad quarantine measures. I would not delay implementing such measures while waiting for the risk assessment to be completed)

Establishing toad free areas should not be considered in cases where the risk assessment suggests that cane toad colonisation is likely through unassisted transport e.g. short distance between island and mainland, transport in flood debris or flood water from nearby rivers etc,

Conservation or biodiversity values should also be considered in the selection of toad free areas.

Once an island is identified as being currently free of toads and of low risk of toad invasion then a comprehensive toad quarantine plan should be developed. This should include identifying all points of entry both by regular transport services and private boats, local land holders, communities, existing ranger programs, existing quarantine measures etc.

Mainland areas where toad travel can feasibly be stopped at a barrier such as at the neck of a peninsular should also be considered. I understand that the committee will receive submissions about a toad barrier on the Coburg Peninsula.

Toad containment, control and quarantine measures

Research is needed into the most effective methods for control, identification and destruction of toads that invade toad free areas or breach quarantine zones. This could include artificial refuges and water points, patrols and searches, fences and barriers etc. Toads are believed to possess olfactory capabilities hence there may have been some research (or at least speculation) into the use of chemical attractants or pheromones to locate toads. These may be useful when used in addition to physical barriers and should be explored.

Barges are likely to be a major source of accidental toad carriage to islands. Measures might include surrounding barge landings with a cleared area and a toad proof fences and artificial refuges and watering points, attractants such as lights (toads attracted to insects as food sources) or chemical attractants (see above), as well as inspections and quarantine periods of unloaded materials to detect any hidden toads.

Impacts on Aboriginal people

Many of the species that are likely to suffer major declines following cane toad invasion are great cultural, spiritual and economic significance to Aboriginal people. Yet this aspect of the cane toad invasion has been largely overlooked or unacknowledged. I would consider that more attention be paid to this aspect of the invasion. Given that cane toads now cover much of the NT, this kind of study might be best done in collaboration with government and indigenous organisations in WA.

I am aware of Aboriginal communities that are currently discussing the need to modify hunting practices on species that are adversely affected by toads. Essentially this may require that hunters reduce or stop hunting some species to promote the species' prospects for recovery from severe population depletions caused by toads. These are significant sacrifices being considered by Aboriginal people yet government conservation authorities are poorly prepared to advise people on rates and extent of declines and the rates or indeed likelihood of population recovery for many culturally significant species.

To ensure that cultural impacts and Aboriginal attitudes are given due weight in determination of policy in regard to Cane Toads, a research program should be established that considers the following aspects:

- Surveys among Aboriginal people at sites varying in history of Cane Toad invasion (from long-invaded to presently cane toad-free). Collate information in regard to:
  a. time of arrival of cane toads in their lands;
  b. changes in fauna observed since arrival of toads;
  c. observations of faunal interactions with toads relevant to impacts;
  d. assessments of fauna most severely affected by toads;
  e. impacts of faunal change on traditional foraging and hunting activity; and
  f. other impacts on traditional lifestyles.

- Describe Aboriginal attitudes to cane toad invasion and the need for control, giving particular regard to views of the seriousness of impacts on traditional practice or important sites. Relate those views to time since cane toad invasion and the traditional significance of species thought to be most severely affected by cane toads.
- Involve Aboriginal people in survey work and cane toad control activities. Encourage communication among Aboriginal groups in relation to cane toad impacts and their cultural significance.
- Compare information provided by Aboriginal informants with results of concurrent studies to assess the impact of cane toads on native fauna.
- Review all government and non-government literature, advice and programs aimed at reducing spread of cane toads with special focus on preventing transport to islands.
- Assess potential role of indigenous land management agencies or Land Councils in conducting monitoring programs to prevent spread of cane toads to islands.

Role of Aboriginal people in cane toad management

The majority (if not all) potential "toad-free" areas are on Aboriginal land. Clearly, the involvement of Aboriginal people is essential in identifying, establishing and maintaining toad free areas and toad quarantine measures. As with other quarantine and conservation issues, the cane toad problem highlights the

enormous value of a robust, trained and well-resourced network of Aboriginal ranger programs and organisations across the NT.

The Cane toad problem provides an opportunity and impetus to government to assist the development of Aboriginal ranger programs and to make an ongoing commitment to resources and training for Aboriginal ranger programs.

Appropriate funding, training and support should be made available for Aboriginal ranger organisations to engage in a full range of cane toad management actions including (not exclusively) consultations and education programs, fauna impact studies, quarantine patrols and measures, and 'search and destroy' missions where toads breach quarantine barriers.

Education Programs

Many Aboriginal communities in the Top End are already dealing with toads as a human health issue. I personally am not aware of any deaths from toads but have no information on other human health issues. The committee should be in a position to make decisions on this following its public hearings in remote areas. If human health issues are significant then it may be necessary to initiate an education program about potential dangers to human health posed by handling and ingestion of toads

There will be a need for continuing education program aimed primarily, but not exclusively, at indigenous people to encourage people to make sure they do not accidentally or deliberately transport cane toads to areas which are currently toad free, and especially to areas that would otherwise remain free of cane toads, such as offshore islands and any other areas that can be isolated from the spread of toads.

I understand that the NLC Caring for Country Unit has undertaken some education activities but the program lacks adequate resources.

Public education methods that should be considered include picture booklets, posters, videos, television advertisements and documentaries.

Impacts of toads on native fauna

Although cane toads have been present in Australia for nearly 70 years, there is still limited information about the impacts of cane toads on native species and ecosystems. Progress in the NT has been hampered by a lack of NT government support for and co-ordination of impact studies. Despite this there are a number of studies currently underway in the NT assessing the impact of toads on native fauna. I am aware that a list of current studies has been provided with the submission from Environment Australia. The proposed task force should play a lead role in providing co-ordination and communication between researchers and of research results to relevant agencies, organisations, communities and the public. Given that many existing initiatives currently receive no government funding, the progress and expected outcomes of existing research projects should be reviewed with the aim of identifying projects that require assistance as well as identifying gaps and initiating further research as necessary.

Bio-Control of Cane Toads

The recent experience of foxes being released into Tasmania indicates that island quarantine probably can't be maintained forever. Some form of bio-control will

presumably be necessary both to reduce mainland populations and to control outbreaks in toad free areas.

My understanding of the current research into bio-control measures is that it at least 5-10 years before the control agent is ready for testing. There will then need to be rigorous testing before release and it is likely that it will be the subject of considerable public debate. As the committee will have access to the latest information on bio-control including independent scientific experts it would be timely to provide a public education information on issues such as the time frame for development and to release; prospects for success of the technique; what the testing procedure is and what are the risks to native wildlife and ecosystems associated with releasing the control agent.

Dr Rod Kennett

SUBMISSION NO. 19

S J Reynolds, Private Citizen

sjrnt@email.com

16 May 2003

Sessional Committee on Environment and Sustainable Development

Dear Committee

TOAD TASK FORCE

Cane Toads are invading the Top End at a rapid rate. After taking nearly a decade to cross the Gulf they are now spreading throughout the tropical north, rapidly populating the woodlands, rivers and forests of the Top End. Toads have already reached Katherine and the southern parts of Kakadu, they have been reported as far north as Pine Creek, and it is anticipated that they will reach Darwin in the near future.

Anecdotal evidence and scientific studies clearly show that Toads have a devastating effect on wildlife. Large, predatory species are particularly at risk, but a wide array of native species will be affected. With no natural enemies and a high reproductive rate, it is anticipated that the Toads will spread widely and leave in their wake a tale of ecosystem destruction. Significantly, Toads have the potential to strongly affect the backbone of the Northern Territory economy - the Tourism Industry, with flow on effects throughout the entire community.

Immediate action needs to be taken to curb the spread of the Toads. To date there has been no comprehensive, large scale effort to try to stop or even slow the invading hordes. Although with current control methods elimination of toads may be an unachievable goal, it should at least be possible to slow or halt their northward incursion. This would allow much needed time for research into methods of effective control.

The emphasis of the Toad Task Force should be to slow the 'toad front' on its forward march. This first wave of invaders is made up of large, mobile individuals that are relatively few in number; hence they can be contained. If Toads can be prevented from establishing new populations then the rate of spread will be significantly reduced.

It is proposed that a Toad Task Force (TTF) be established with the following objectives:

- reduce the rate of spread of toads in the Top End
- eliminate toads, toad eggs and 'tadpoles' wherever encountered
- eliminate newly established toad infestations preserve the integrity of parks and wilderness areas ascertain principal pathways of spread and invasion investigate habitat use and site selection to aid in detection
- investigate the biology of toads with a view to devising methods for population control
- document the effect of toads on wildlife
- raise public awareness of the effects of toads on wildlife and the potential for harm to pets and children

- establish an information service, website and toad hotline
- enhance quarantine measures to prevent human-assisted transportation
- encourage community participation in slowing the spread of toads through the establishment of a TTF notification service

S J Reynolds

SUBMISSION NO. 20

The Bush Nursery / Northern Territory Horticultural Society – Katherine
Mr Ian and Mrs Elizabeth Clark

PO Box 507
Katherine NT 0851

23 May 2003

Sessional Committee on Environment and Sustainable Development

Dear Committee

We do not need to appear before the commission unless it is deemed necessary.

1. We have identified a number of problems with Cane toads in our nursery. The toad will burrow into seed trays and we lose quite a few seedlings because of this. The only alternative is to put the trays on a higher stand. Ponds and water features are not recommended if they are on ground level as they will foul the water. They do seem to notice the difference between water that is chlorinated and plain water. We have never had a cane toad fall into or are near our chlorinated water. They can climb the height of a bathtub but cannot get out. They will also fall into a trench and not be able to climb out. The ecology has changed in the nursery. We have noticed more ants and in the last couple of weeks dead rats and an increase in the animals e.g. bandicoots. Natural predators of some animals have decreased. No large goannas only smaller ones and less snakes. There are also less native frogs. Just a couple here and there, but not as many as there used to be.

   With or without the use of plastic mulch in the production of fruit and vegetables it has been found that the cane toad burrows into the soil where the drippers are killing the seedling plants.

2. The effect of the toad on growers and nursery people is an extra cost in production. More problem insect gaining a foothold. Other animals that do not eat toads will increase e.g. bandicoots, because the natural predators have taken a hammering since the toad appeared.

3. Aboriginal people may not be able, to hunt their traditional animals until it is proved that the populations have returned to a good number again. Fishing stocks in the river seem to be down.

4. There is not enough information on the toads to date. A few pamphlets came out in the beginning but it did not mention any of the toad's habits that we should have been told about e.g. they will climb the height of a bathtub. Their poison ability. Their egg laying capabilities, effect on domestic dogs and how to cope with it. How to distinguish between native frog eggs and toad eggs. The smell they have alive or dead. Spraying 'Dettol' has been suggested as a means of killing the toad then you have to look for the dead toad. The flies come for miles.

5. We are managing the environmental impact of the toads by collecting them each evening and recording the amounts we catch. We have noticed an increase in the

size of the toads. In the beginning they were small to medium. Now there are distinctly 3 sizes - small, medium and very large. The very large have appeared in the last two weeks. We have had toads now since December 2001. Katherine town has had them since March/ April.

6. Community concerns range from helplessness and a lack of understanding about the toads. There is not enough information for people to access. Some people have taken the attitude that the problem is too big and that we have to learn to live with it.

Thank you

Mr Ian and Mrs Elisabeth Clark

SUBMISSION NO. 21

Dr Greg Brown, University of Sydney, School of Biological Sciences

PO Box 441
HUMPTY DOO NT 0836

Executive Officer
Sessional Committee on Environment and Sustainable Development

re: Cane Toad Inquiry Public Hearing

Dear Sir

Belatedly here is a written copy of my submission to the cane toad committee.

Greg Brown

SUBMISSION TO THE INQUIRY INTO ISSUES ASSOCIATED WITH THE PROGRESSIVE ENTRY INTO THE NORTHERN TERRITORY OF CANE TOADS

The research group that I am associated with, headed by Professor Rick Shine, has been awarded a 5-year grant by the Australian Research Council to study the effect of cane toads on reptile populations in the Top End. Our goal is not to find a means of controlling toads but rather to document the ecological effects that toads have on native animals. Over several decades, cane toads have spread hundreds of kilometres across Australia yet biologists have little idea of what effect they have on native animal populations. Anecdotal reports abound, though, and these suggest that snakes and lizards become noticeably rare or even disappear after the arrival of toads. We hope to carefully document what happens to reptile populations following the cane toad invasion into the Top End and detail, for the first time, the ecological impact of a novel toxic prey item on its predators. As the toads continue to expand other localities may then have a better idea of what they can expect.

We received Commonwealth funding for this study because we have been conducting long-term mark recapture studies on various reptile populations (water python, death adder, keelback snake, slatey-grey snake, Macleays water snake, file snake and snake-necked turtle), mainly around Fogg Dam, for the last 5 to 10 years. These studies have provided detailed information on the sizes of the populations, their age structures, reproductive rates, growth rates etc. Because the studies have been going on for such a long period we also have an understanding of how population parameters vary seasonally and from year to year. Thus, we have a good deal of 'background' information to which we can compare any changes observed after the arrival of toads. At present, there are 10's of thousands of individually marked snakes on the Adelaide River floodplain. Many of these snakes were first marked as babies and have been recaptured and released repeatedly over the years. We have followed their movements, growth rates and reproduction over most of their lives. For some individuals we can trace though three generations of their family and identify their parents and siblings. And now we are waiting to see what will happen to them when they encounter a novel and deadly toxic prey item.

In addition to the populations of reptiles which we study intensively, marking and measuring each individual, we have, over the last five years, conducted nightly surveys of frogs and other snake species. We go out each night at the same time and follow the same route and count what we see. Simply counting animals is not as robust a method of monitoring populations as marking them in some way (because you can't tell if you are counting the same individual on different nights). Nonetheless, because we have been carrying out these standardised surveys for so long, they will allow to detect and measure population declines of a wide range of species.

Although cane toads have spread through numerous Australian communities, there is no detailed information on how they effect populations of animals that are likely to try to eat them. Most commonly, anecdotal reports describe long or short-term reductions in snake and lizard species soon after the arrival of cane toads. We can look in Queensland today and see there are still snakes and lizards. But because there is no information on reptile population sizes or species diversity before the toads arrived we cannot assess the toads impact other than to conclude that they did not kill everything. Now, we have the opportunity to see what happens to well-studied populations of predators subsequent to the arrival of cane toads. It offers a unique opportunity to study their impact in detail.

As we wait for the arrival of cane toads at Fogg dam we continue our studies and surveys. In the meantime, we are also carrying out studies on captive animals to allow us to make an initial assessment of what might happen when toads arrive. First, we want to determine which species of snakes will try to eat cane toads when they see them. Second, we want to determine how badly each species is affected by toad toxin.

The preliminary results of these studies are not encouraging for reptiles. We found that most snakes attempted to eat cane toads that were placed in their cage. Furthermore all the lizards, snakes and turtles we tested were all badly effected by toad toxin and individuals are likely to die if they swallow a toad or, in some cases, even if they bite one. There are two exceptions to this. Keelback snakes far more resistant to cane toad toxin than any other Australian snake. Slatey-grey snakes are less resistant than keelbacks still much more tolerant of toad toxin than any other species.

Taken together, these preliminary results lead us to expect that most of the local populations of predatory reptiles are at risk from cane toads. In some cases, its not clear how the results of these lab studies will translate to the wild. For instance, common tree snakes specialise in eating frogs and they will readily eat cane toads. They are also extremely sensitive to toad toxin. However, as their name implies, they spend most of their time in trees where they are unlikely to encounter toads. Thus, their habitat preference may mitigate their other susceptibilities to toads.

Even species that are not directly harmed by cane toads may be detrimentally affected by their presence. Native frogs and small lizards for instance, may not be able to compete with large numbers of cane toads for food or limited shelter sites. It is unknown how cane toads will impact other species through higher order interactions such as these.

In addition to studying the effect of cane toads on reptile populations, we will also study the toads themselves when they arrive. Coastal floodplain habitat such as at Fogg dam should provide excellent conditions for toads and we want to monitor how rapidly their population builds, how often they are able to reproduce and what they are feeding on. We also plan to radio track a large number of toads to monitor what habitats they prefer

and which animals attempt to eat them in the field. By closely monitoring the toad population we may also be able to notice any unusual episodes of mortality among them.

At this point, we expect that many species of snake and other large reptiles in the Top End will be detrimentally affected by the arrival of cane toads. Populations of keelback and slatey-grey snakes (two species which we study intensively) are likely to be less effected than other species. Although the impact on most species is likely to be severe, we cannot say how severe. The fate of populations of susceptible snakes depends on several unknown factors. It depends on how much variation there is among individual snakes in their readiness to try to eat a cane toad and on individual variation in how badly toxin effects them. We expect that once breeding populations of cane toads become established and large numbers of eggs, tadpoles and small toads appear, there will be immediate dramatic declines in many populations of reptiles. Until we actually witness the extent of these short-term population declines we won't know the longer-term prognoses. Individuals that won't attempt to eat toads or that are less effect by the toxin may survive the initial impact.
Eventually, populations may rebuild from these individuals and the offspring may display the characteristics (e.g. avoidance of toads, toxin tolerance) that allowed the parents to survive the presence of cane toads.

This submission to the committee attempts to identify possible ecological effects of the arrival of cane toads. The real extent of the cane toads effects will not be known until they arrive. But, when the toads have arrived, our research will provide a detailed account of what effects they are having on reptiles and frogs. The world is unlikely to come to an end when cane toads reach Darwin's rural area, but we think its inevitable that several species of reptiles and likely some native frogs will become much rarer and some may even disappear. Such impacts may only be noticed by biologists, naturalists or people who spend a lot of time in the bush. People who limit their outdoor activities to backyard barbies are unlikely themselves to notice a serious decline in, for instance, ornate burrowing frogs or death adders. What everyone will notice is the toads themselves. They are likely to reach extremely high initial population densities and they are large and conspicuous animals that many people find unpleasant. Until people become accustomed to the presence of toads, they might affect enjoyment of outdoor activities for some. Ecotourism might conceivably be adversely affected by the presence of large numbers of toads or decline in populations of iconic animals (frill-necked lizards). Aboriginal communities that rely heavily on bush tucker may be affected if populations of goannas or turtles decline permanently.

Dr Greg Brown

SUBMISSION NO. 22

Dr Bill Freeland, Private Citizen

PO Box 1944
Palmerston NT 0831

28 May 2003

Sessional Committee on Environment and Sustainable Development

CONTENTS

SUMMARY

The Northern Territory has an over twenty-year involvement in cane toad management and research. During that time it contributed more to the cane toad issue than any other State/Territory, and relative to its budgetary capacity, the effort compares favourably with that of the Commonwealth Government.

As with all introduced organisms the cane toad has and will continue to impact of the biodiversity of the Northern Territory. While it will never be possible to know the nature and extent of every impact on the Territory's biodiversity, more is known about the cane toad's biology and ecology than virtually any other free living Territory species except rabbits, cats, dingoes and possibly the red kangaroo.

There is no known effective method to control cane toads and biological control is a long distant and uncertain future reality.

My recommendations for Territory action in relation to cane toads are:

- continue the provision of information to the public so that people may be informed and supportive of government's actions;
- continue to remove accidental cane toad incursions well in advance of the
- existing range;

- continue to use signage and other means to limit the probability of cane toads being moved to islands;
- continue with and be more publicly accountable for the translocation of Quolls to islands;
- continue to examine the practicality of establishing a cane toad proof fence across the neck of the Cobourg Peninsula; and
- continue to support the Parks Australia and Territory park monitoring programs.

These recommendations are not new, having been around for some considerable time. They are however a balanced assessment of the cane toad's impacts relative to the other nature conservation issues facing the Territory. These issues include the following:

1. The camel population in Central Australia is growing rapidly and is uncontrolled and causing damage that may never be rectified e.g. quondongs.

2. The donkey population in the VRD in being put under control, but feral populations in the Gulf Country continue to grow unchecked.

3. The post-BTEC remnants of the water buffalo population are growing and expanding rapidly.

4. Fire across much of the Territory continues to manage us rather than us manage it, even though advances have been achieved.

5. Gamba grass continues to spread through the Top End, and not withstanding the excellent effort of Rangers in Litchfield and other National Parks, constitutes a far greater threat to the Territory's flora and fauna than does the cane toad.

6. Buffel grass continues to spread across the semi-arid lands at a great loss to conservation.

7. We continue to maintain massive infestations of Mimosa.

8. The recent DIPE annual report notes that there are 201 Territory species that are probably threatened with extinction, yet there are only three management programs to deal with the problem (there was a recent release of two more for public comment) and recovery management is conducted of no more than a handful of species.

9. The recent DIPE annual report failed to provide the people of the Territory with any clear understanding of the outcomes of fire, weed and feral animals throughout the park system, a notable decline in accountability and transparency.

10. The Territory's system of parks and reserve rates poorly in terms of nationally agreed criteria of comprehensiveness, adequacy and representativeness when compared to other States and Territories.

11. The recent increase in turnover of Rangers within the Commission is undermining the experience and knowledge base (particularly T2 and T3 levels) of future operations. This, plus an apparent drop in attractiveness to outside applicants, appears caused by low wages relative to other jurisdictions, poor remote area support (they were excluded from the new budget's improvements for teachers, nurses etc), poor remote communications and a significant decline in moral.

12. There has been a tardiness in the application of regional planning procedures to regional land development e.g. the recent annual report noted production of a regional nature conservation plan for the Daly Basin, yet nothing seems to be being done other than a vacating of the moral high ground while land clearing begins.

To become involved in a multi-year program of research with primarily scientific outputs would deny the greater conservation needs that are amenable to rectification. To become involved in multi-year research for biological control of the cane toad, properly a Commonwealth responsibility, would similarly be a diversion of pubic attention from the more serious issues (as well as being highly speculative).

INTRODUCTION

The Sessional Committee has received submissions providing much detail on the introduction of the cane toad, its spread and known and likely impacts. In particular the paper by van Dam, Walden and Begg (2002) provides a sound summary of current knowledge although the methodology leads to some unfortunate conclusions (e.g. black duck and the leaf-eating brush-tailed possum identified as possibly at risk when they are abundant throughout the cane toad's range in Queensland). Inevitably there have been developments since the paper was produced (Watson and Woinarski, 2003). It is not my intention to replicate this evidence.

My intention is to:

- document the history of Northern Territory involvement in cane toad research and management (including research findings that would otherwise not be available to the Committee) over the past 20 some years;
- evaluate the state of knowledge of the cane toad,
- evaluate options that have been proposed for management of the cane toad,
- describe the types of research that could be done as well as what those researches would contribute to our understanding and management; and
- examine the priority of cane toad research and management relative to other nature conservation issues impacting the Northern Territory.

Attachment A provides information on my background and involvement with cane toad research and management.

Attachment B is provided for the committee's interest. It is from the minutes of the Seventh Conference of Cane Toad Pest Boards, held in Ingham, Queensland on 1 May 1937. The paper documents the status of cane toads in Queensland at that time and their response to the Commonwealth Government's order to halt further purposeful geographic spread of the cane toad. The Commonwealth's concern was that cane toads would consume large numbers of beneficial insects. The paper also notes that as yet there had been no noticeable impact of cane toads on the grey-backed beetle problem.

I believe it is important to remember that introduction of the cane toad was conducted according to the procedures and understanding of the day. Procedures were similar to those involved in the introduction of a range fungi, microbes and insects for the control of prickly pear and other weeds. We know next to nothing of what these introduced organisms are doing now, and even the role of the *Cactoblastus* moth in prickly pear control is open to question. In simple terms Australia's currently rigid quarantine procedures are the consequence of a long process of learning through mistakes and

slowly accumulated understanding. It would be inappropriate to castigate the people who introduced the toad: they were well meaning, dedicated and operated according to the dictates of their time.

It was not until 1947 that the above Cane Pest Boards received their first notification of trials of chlorinated hydrocarbon insecticides: a solution they welcomed. Would we have done the same if we had been there? The recent introduction and purposeful spread of Gamba Grass in the Northern Territory is indicative of our continuing to make seemingly foolish decisions about the introduction of noxious foreign organisms.

No one wants or wanted the cane toad in the Northern Territory. All introduced organisms impact on the environment and some have discernible and even significant social impacts. The issue of what to do about any one species of introduced organism is inevitably determined by the scale of the organism's environmental and social impacts relative to the other environmental and social issues of the time, and the potential cost effectiveness of mechanisms proposed to manage the organism's impacts.

NORTHERN TERRITORY INVOLVEMENT IN CANE TOAD RESEARCH AND MANAGEMENT

The Northern Territory's involvement in cane toad research and management dates from the beginning of the 1980s when a series of surveys was undertaken to determine the species' then distribution and annual advance. I inherited this program when I took up duty as Senior Wildlife Research Officer with the then Conservation Commission in 1983. The cane toad crossed the border at Wollogorang Station that same year.

In 1984 I was instructed to undertake a review of the available literature and produce a technical report for submission to the Standing Committee of the then Council of Nature Conservation Ministers (CONCOM) (I was given two weeks), and further develop a research program on cane toads.

The report was produced (Freeland 1984). It was based on Griffith University's collection of virtually everything ever written on cane toads and covered all known aspects of its biology anywhere in the world, the species multiple introductions outside its native range, and an assessment of its likely impacts on Australia's native fauna and possible economic impacts.

The hypothesis was that cane toads have a significant negative impact on the Australian fauna i.e. the null hypothesis to be disproved was that "the cane toad has no significant effect on the native fauna". There were no data other than a series of anecdotes. However I encountered a range of cane toad ecological mythologies i.e. things that people deeply believed but for which there was no sound (but sometimes suggestive) supporting evidence. The mythologies included: cane toads have devastating impacts on frogs, snakes, goannas, native marsupials etc; populations of cane toads entering new areas undergo rapid growth, achieve extraordinary densities and subsequently crash; cane toads in newly colonised area are of exceptionally large size and become smaller at some later time; cane toads along the east coast of Queensland are really skinny, cane toads act like vacuum cleaners and virtually eliminate ground dwelling arthropods etc.

A risk averse approach dictated development and implementation of a structured research program while efforts were made through CONCOM to gain national support for a larger research effort. The Northern Territory implemented a policy of ensuring the extermination of any reported, accidental introduction of cane toads outside the existing

range. This seems to have been highly successful. The Territory also began production of brochures providing the public with the capacity to identify toads, urging them to take steps not to unwittingly move toads about in their vehicles and equipment and to call the Commission should they believe they had found a toad. These policies continue to this day.

The research effort was structured to support the development of a national effort and was composed of Phase 1:

- quantification of the rate of spread so as to allow prediction of the time likely to expire prior to the toad's conquest of various parts of the Territory;
- description of cane toad populations across a broad span of times from initial colonisation to determine if the populations underwent massive growth and decline phases, whether colonising toads were of large size and whether east coast toads were skinny;
- could the above patterns be explained by food availability or parasitism?;
- were urban east coast toads similar to those in rural areas?;

and Phase 2

- were there significant impacts on frog communities around billabongs in the dry season (the time of greatest likelihood of strong competition for food?;
- what were the impacts on the Northern Quoll?
- were there impacts on communities of ground dwelling arthropods?;
- did the behaviour of metamorphling cane toads render them vulnerable to possible control measures?;
- what were the habitat preferences of native frog and cane toad tadpoles i.e. what was the likelihood of there being negative interactions at the larval phase?;
- what were the impacts on goanna populations?; and
- what were the impacts on freshwater crocodiles?.

The Territory's Phase 1 research.

- provided a good indicator of natural rates of colonisation (accurate to the Roper River where human assisted transportation clearly intervened to speed the process e.g. predicted date of colonising Katherine was 2003 yet it arrived there in 1999);
- demonstrated that the hypothesised growth and decline phases of colonising populations did not occur within 19 years of colonisation;
- revealed a similar absence of temporal pattern in body size;
- clearly indicated that east coast toads were skinny and lived in depleted populations; and demonstrated that
- the patterns could not be explained by food availability or parasitism by single or multi-celled parasites.

Subsequent study of a single population over 12 years has since shown there was no consistent temporal pattern in population density or body condition. Both population size and body condition fluctuated wildly (Attachment 3). Population density was dictated by wet season (especially December) rainfall while body condition was related to rainfall during May to June. More December rains resulted in more toads in the dry season, and toads were fatter with more rain in May-June.

Phase 1 was completed in time for it to provide a basis for a CONCOM co-ordinated approach to cane toad research. This involved the Commonwealth and affected States/Territories. Prior to any consideration of importing an agent of biological control (which has massive inherent risk) it was believed critical to first:

- develop a population model of cane toad populations so as to be able to predict which life history phase was most likely to provide the best target for biological control, and to provide a capacity to predict the likely effectiveness of a control agent prior to its release;
- document the pathology and parasites (viral and otherwise) of cane toads in Australia and determine whether the east coast decline was pathogen related; and
- gain a greater understanding of cane toad impact on the native fauna.

These studies were undertaken with James Cook University developing the population model and undertaking the pathological work, and the Northern Territory continuing its proposed research program on impacts (as well as working with Queensland University on the toad's protozoan parasites).

The research effort was successful in that the model was developed, the pathology completed and more information gained on toad impacts. There were however management difficulties associated with gaining the promised funding and the effort terminated. This lead to CSIRO's assuming a dominant role with Commonwealth funding in 1990.

The Territory's Phase two research:

- found no impact on frog communities around waterholes in the dry season;
- demonstrated that the cane toad occupies a niche not present in those frog communities;
- found that native frog and cane toad tadpoles rarely (far less than by chance alone) inhabit the same water body;
- demonstrated cane toad tadpoles have distinct habitat preferences (differing from those of native frogs) and the potential for competition between them and native frogs is very limited;
- found there could be no assessment of impacts on the Northern Quoll because in spite on long search and much trapping, none could be found (the species was in decline long before the advent of the toad in the Territory) adjacent to areas occupied by the cane toad;
- demonstrated rapid decline and probable extinction of a native species of tapeworm and an associated destabilisation of frog communities (Attachment 4);
- found from a preliminary sorting of specimens that there was no impact on the species richness or abundance of ants during the first year of toad colonisation (only done for riverside habitat i.e. the area most intensively used by cane toads) but the full four year, three river and three habitat study died when I requested that the samples be shipped to me in Queensland and the vials were inappropriately packed and smashed in transit);
- documented drastic decline in a population of large bodied goannas following cane toad invasion, with recovery over two years (Attachment 4);
- found that while freshwater crocodiles force fed cane toads die on average in 3 hours, when 12 hungry freshwater crocodiles were housed (pond and adjacent dry area) with 12 cane toads for one week all crocodiles survived, but only 5 toads survived (most of the toad carcasses had been consumed following shredding)(the crocodiles seemed in good condition); and

- from a search of the literature it was found that snake species (including frog eating specialists) on islands of the Queensland coast survived on islands with or without cane toads (Attachment 5).

Although not contributing to a model of cane toad tadpole habitats under the environmental conditions of the Gulf of Carpentaria lowlands, there is a factor that may become more important in Kakadu and similar habitats. In the Gulf country cane toad tadpoles were found in habitats that averaged 2.6% (n =60) cover by macrophytes whereas the native species average was 9.9% (n = 56). There was very little macrophytic vegetation in the habitats examined in the Gulf Country whereas they are more abundant further north on the floodplain environments.

Following the above research the CSIRO initiated its faunal study (Catling *et al.,* 1999), population and pathology studies in South America, and pursued a mechanism for biological control. CSIRO responsibility is appropriate given that the cane toad is a national problem not simply a Territory problem, and that biological control using microbes is beyond the Territory's budgetary capabilities and facilities.

Meanwhile the Territory began to develop and implement monitoring on parks (including regular surveys of freshwater crocodiles) and collaborated with Land Councils to develop signage to assist in preventing introduction of cane toads to off-shore islands.

It was sometime in 1998-2000 when I made two related but different proposals to the Cobourg Peninsula Sanctuary and Marine Park Board. The first was for a much needed wash-down facility for all vehicles entering the Park so as to minimise the probability of introducing weeds, especially Gamba Grass. While the Board approved the concept, the issues of uncertainty about a suitable location for the facility and the Board's refusal to have Traditional Owners subject to the requirement for vehicle wash-down resulted in the proposal being costed but not pursued.

The second proposal was to examine the possibility of a cane toad exclusion fence across the neck of the peninsula. This would require a facility for inspection of vehicles for toads, which could not be resolved until there was resolution of the location of the weed wash-down facility (one such location would provide for happier users and efficiency).

Various aspects of design (e.g. the fence, entry etc) were examined. This included the conduct of trials to determine whether cattle grids were capable of preventing cane toad access. A double grid with an appropriate system of culverts would provide for simplified vehicle access and prevent toad access, but further trials are advisable. To my knowledge the feasibility of the concept has not been examined further.

Assessment of the feasibility of any such fence requires a detailed examination of possible alignments and the likely frequency of tree-fall across fences on those alignments, determination of the most suitable material for the fence (it would need to be a significant depth below ground as well as having a sun-exposed, above-ground component) and resolution of the difficult problem of what to do about the tidal parts of the fence. To minimise damage from pigs, banteng, water buffalo and possibly horses and macropods, the toad fence would need to be co-located with a fence meeting BTEC requirements (i.e. similar to the existing fence). It would also require resolution of the problem of location of the wash-down/toad search facility and the agreement of Traditional Owners to use the facility just like everyone else.

The Parks & Wildlife Commission jointly funded and conducted the establishment of the Kakadu monitoring plots. This includes the most recent report by Watson and Woinarski (2003) as well as more detailed work on the Quoll.

The discovery of chytrid fungi infecting native frogs (and probably causing a series of extinctions of frog species) and cane toads in Queensland raised the prospect of cane toads possibly having introduced the fungi to the Northern Territory, with potentially significant impacts beyond those caused by the cane toad alone. Northern Territory samples of cane toads, native frogs from within the cane toad's range and native frogs outside the cane toads range were collected by Parks and Wildlife Commission staff and analysed by James Cook University. No chytrids were found.

After a considerable period of planning and preparation the Commission, in collaboration with the Northern Land Council, Traditional Owners and Parks Australia undertook the introduction of Quolls to islands off the Territory's coast i.e. places that will hopefully remain free from cane toads. This effort is highly commendable.

Translocation of native species outside their native ranges and reintroductions of threatened species within their former ranges are serious and highly technical matters that raise numerous questions related to both the potential for success of such activities and the potential of translocations in particular to have adverse environmental impacts. This is one of the reasons the Territory's legislation provides the option to develop of Plans of Management dealing with management of native species. This is the only way serious issues of public concern can be addressed in an open and accountable fashion. Because of the absence of a Plan of Management I am unable to determine whether some issues of serious concern were dealt with. I assume they have been but will briefly outlines what to me are the major concerns.

In the recent geological past the islands used for the translocations were part of the mainland and as they appear to contain habitat suitable for Quolls, can be assumed to have once had quolls. The questions is why did these populations become extinct, and if this is the long term fate of the translocated quolls, what management practices are to used to prevent that fate?

The islands appear to be relatively small and of necessity are likely to have an even smaller area of habitat suitable for quolls. Is that habitat large enough to sustain a population of Quolls of sufficient size to minimise the probability of long term population extinction. The smaller a population the higher it's probability of random extinction, and unless it can reach and be maintained at its Minimum Viable Population Size the probability of extinction is close to certain.

Populations introduced to small islands can underdo rapid growth utilising an initially abundant food source, only to rapidly "over-shoot" and crash with an again a high probability of extinction if the island is not large enough. The islands have been the subject of fauna surveys and these data could have been interpreted so that the public had confidence in the potential survival of the Quoll population and what if any would be the adverse impacts on native species on the islands.

My final concern is that individuals taken to the island may have been individuals subjected to de-worming or other health control procedures. Animal populations without their parasites and pathogens loose a critical mechanism for population regulation and the consequences can be disastrous. Similarly, the stability of ecological communities as a whole may be a consequence of parasites and pathogens, particularly those associated with predators (e.g. the Quoll) and having live cycles impacting on more than

one trophic level (Freeland 1993)(Attachment 4). We know nothing of the treatment of the animals prior to their introduction to the islands.

The translocation was conducted with the best of motives and intentions and undertaken by highly professional and dedicated people. It was however totally lacking in public accountability and transparency.

Over the past 20 years the Northern Territory made a major contribution to cane toad management and research in Australia. That commitment was greater than that of any other affected State/Territory. If referenced to budgetary capability, the Territory's effort compares favourably with the Commonwealth's input. The Territory should be proud of its efforts.

THE STATE OF KNOWLEDGE OF THE CANE TOAD

Freeland (1984) quoted 200 published papers on the biology/ecology of the cane toad, and this did not include all papers written on cane toads. In 2002 van Dam *et al.,* quoted an additional 52 works on cane toads published since 1984. Their paper was focused on Kakadu and cane toad impacts and did not quote numerous other publications e.g. pathology, parasites etc. In total there would be somewhere over 300 publications dealing in some substantive manner with cane toad biology/ ecology. This number of publications is greater than that for any other terrestrial free-living animal species in the Northern Territory other than perhaps rabbits, horses, cattle, dogs (including dingoes) and the red kangaroo.

There are detailed accounts of the cane toad's rate of spread. potential Australian range; environmental physiology; toxicology; reproductive biology; breeding behaviour; life cycle; growth movement patterns; pathology; parasitology; food habits, foraging behaviour., activity patterns, survivorship; population biology, long term population trends; habitat use by larval, metamorph, juvenile and adult stages; niche relationships with native Australian frogs; successful and unsuccessful predators-, and as good as if not better understanding of its impacts on the native fauna than we have for any other introduced animal or plant.

Although the nature and extent of our understanding in each of the above areas is variable, it is correct to say that we know more about the cane toad that we know about any of the Northern Territory's threatened species, or even any our native faunal species other than perhaps the red kangaroo (and dingo if we include knowledge of wolves and dogs).

The issue is how much additional information and hence research do we need for which purpose and what is the priority of that research? As a conservation manager I assume that the purpose must be for the management/control of cane toad populations. The answer to which kinds of research are appropriate to this end depends on:

- the types of options available for management/control of cane toad populations.,
- what kinds of research are possible and what kinds of understanding would they provide; and
- how would these kinds of understanding help us deal with the issue?

PROPOSALS FOR CANE TOAD MANAGEMENT/CONTROL

Management of cane toads has two components. One is dealing with public attitudes and understanding of the cane toad and its potential impacts, the other development/application of measures to limit spread or control populations.

The measures to ensure public access to information on the cane toad are documented above, as are measures to improve understanding of possible impacts and to aid in prevention of dispersal to islands off the coast.

Over the past twenty years there have been very few proposals of mechanisms to control or eradicate the cane toad.

People who have attempted to eradicate cane toads by physical removal from waterholes have rapidly concluded that total or even local eradication is not a practical option. Constant vigilance and never ending removal in a small locality is practical if you want to put in a massive never-ending effort, but the result would be control with continual invasion from outside areas.

A proposal was made for funding the use traps that selectively eliminate cane toads. One proponent wrote to the Parks and Wildlife Commission but when I asked to provide detailed information on the effectiveness of the trap, the specificity of the trap to cane toads and if possible the style of construction, he wrote to say this would require a large grant for construction, travel to the Northern Territory and trialing of the trap. In the absence of more substantive information it was inappropriate to fund the proposal.

Another proposal was made for the study of pheromones that might act as an attractant or otherwise influence cane toad behaviour in ways that would aid control. Again the proponent failed to provide a detailed research proposal (experimental protocols etc as is usual) or provide a clear indication of how such technology could be applied (again as would usually be expected in such a proposal). The work was not funded.

The above proposals for control or eradication have a common weakness. The problem with cane toads is not one of "How do we find them?" They are conspicuous and congregate in large numbers in highly predictable locations. The problem is one of the large numbers in which they occur, the rapid rate of production of recruits to populations and the wide distribution across often extremely remote areas that are difficult and expensive to access.

The feasibility requirements for establishing fencing to exclude cane toads from peninsulas or large areas of mainland habitat have been discussed above. If fencing proves feasible I would not advocate its application at the scale of an urban housing allotment. Any fence that excludes cane toads would also impound species such as blue tongue lizards and other skinks and small organisms. The establishment of small isolated populations would increase the risk of random population extinction in individual backyards, as well as the potential for inbreeding depression and extinction in the longer term. It would be inappropriate to fence anything other than a very extensive area e.g. the Cobourg Peninsula is certainly sufficient.

The option that has received the majority of serious attention is that of biological control. There is no comprehensive statement of what this option requires to be successful, or the likelihood of an appropriate agent being discovered or developed. The greatest issue is that use of such an agent could potentially cause a greater conservation problem than that caused by the cane toad. It was this problem that dictated the structure of the early CONCOM sponsored research.

A successful agent for the control cane toads needs to be capable of frequent transmission to cane toads, to have impacts specific to cane toads, to persist over broad geographic areas without human interference and to cause highly significant

mortality or debilitation of cane toads such that cane toad populations were reduced to levels that eliminate at least the most serious impacts on the native fauna.

RESEARCHES THAT COULD BE UNDERTAKEN

One of the few certainties about the cane toad's invasion is that there is no shortage of individuals who seek funding for their private research from government nature conservation agencies, or even employees of government agencies who seek to justify their activities on the basis of dealing with the cane toad invasion. The determination of which, or any of the proposed researches are to be funded requires a sound understanding of what is known about cane toads, what can be learnt from what kinds of research, and whether the things we can learn are in any way helpful to our management of cane toad populations or the public response to the invasion.

The following things are know about the cane toad's impact on nature (and I do not believe these things to be controversial in any manner).

- Cane toads impact heavily (perhaps leading to extinction) on populations of the Northern Quoll.
- Cane toads are toxic to and hence can kill a variety of native animals.
- Cane toads eat large numbers of prey items, particularly insects.
- Cane toads may reduce the size of some native populations.
- Cane toads are likely to cause the extinction of at least one species of proteocephalid tapeworm and in consequence there may be destabilisation of some frog communities.
- Cane toads appear to severely impact on populations of some large bodied goanna species, but these populations appear to recover.
- Cane toads kill some freshwater crocodiles yet they persist in large populations in areas where there are cane toads, and are known to successfully consume cane toads in nature.
- The vast majority of the Territory's species will persist following cane toad invasion.

In determining research priorities it is critical to remember that no matter how many resources are channelled into the effort, it is impossible to ever know the truth about the cane toad's past or future impacts on the vast majority of the thousands and thousands of native species present in the Northern Territory (and it is inevitable that there will be many). The prioritisation is about determining which impacts and species will be investigated and which control mechanisms deserve more serious treatment.

Investigating Impacts: Broad-scale biological surveys and efforts to monitor ecological communities are the primary mechanisms used to date to estimate cane toad impacts (e.g. Catling *et al.,* 1999; Watson and Woinarski 2003).There are major difficulties associated with these types of assessment (see discussions in Watson and Woinarski 2003). They centre on the inherent temporal/spatial variability of natural populations, the confounding influence of patchy temporal and spatial occurrence of fire, weeds and feral animals other than cane toads (uncontrolled confounding variables), frequently very small samples sizes for many species, the statistical difficulty of dealing with multiple analyses of many species from the same data set (i.e. Type 1 Error = falsely accepting an impact when one does not exist), and the standard, fixed quadrat approach allowing assessments of only the sampled quadrats rather than providing statistical applicability to the area as a whole.

A good example of the vagaries of weather and possibly other variables in confounding our understanding of possible cane toad impacts is the frog call monitoring project

conducted on behalf of Parks Australia. The declines reported to date can not in any sense be attributed to cane toads or any other variable, and do not allow for rejection of the null hypothesis that cane toads have no impact on frog communities. Hopefully future results will be more revealing.

The above difficulties make interpretation survey/monitoring data extremely difficult and uncertain. For example Catling *et al.,* did not find the gecko *Gehyra nana* (it probably never in recent times existed in the area), whereas Watson and Woinarski (2003) found a negative impact. Both these studies reported negative impacts on Gilbert's Dragon, yet the species can be frequently observed to be common in areas of the Gulf Country that have had cane toads for 10 years (Freeland personal observation). Catling *et al.,* (1999) found impacts on the frogs *Litoria rubella and L rothii whereas* Watson and Woinarski (2003) found none. Nor did Freeland and Kerin (1988) find impacts on these species in their detailed niche analyses and experimental population reductions. Watson and Woinarski (2003) found a weak decline in the dragon *Diporiphora bilineata, Catling et al.,* (1999) did not find it at all yet there are records of its persistence nine years post cane toad invasion (Freeland personal observation). For most of van Dam *et al's* (2002) species at risk, either one, the other or both studies did not find the species (often because of the species' distributions) or there were insufficient records to allow analysis. These types of results do not allow for a clear renunciation of the null hypotheses that cane toads have no impact on the species concerned. A risk averse conclusion might be to suggest that more detailed work needs (i.e. needed to disprove the null hypothesis) to be conducted on species observed to exhibit consistent patterns of decline in the cane toad's presence.

Watson and Woinarski (2003) produced data demonstrating that the Northern Quoll disappeared from the sampled quadrates following invasion by the cane toad. These data are clear and unequivocal circumstantial evidence of cane toad impact. When supported by the results of work demonstrating death of Quolls cane toads in Kakadu, it is clear that the null hypothesis can be rejected.

The demonstrated disappearance or presence of a species post-invasion by cane toads is unequivocal. If this measure is used then the Northern Quoll is the only terrestrial vertebrate known (in all of Queensland and the invaded portion of the Northern Territory) that may be unable to persist in the presence of cane toads. Establishing more surveys or community monitoring styles of researches in addition to those already established seems unlikely to add greatly to our knowledge of cane toad impacts.

In terms of management these studies have offered the opportunity to knowledgeably undertake the translocation of Northern Quolls to islands, and to keep the pubic informed on the known real impacts. The value of these short term studies needs to be appreciated when dealing with particular species (e.g. local endemics, rare, threatened) thought possibly to be at genuine risk and not amenable to the gross survey technique.

If conducted appropriately intensive monitoring of individual populations can provide evidence of probable cane toad impacts. Spot-light surveys were established to monitor freshwater crocodiles in the Elsey National Park and Nitmiluk National Park prior to the arrival of the cane toad. In both cases individual crocodiles were known to have died, presumably because of cane toad ingestion (such frequent death had not been seen before). The pre and post invasion data were analysed but no downward trend in the population could be detected. This was interpreted as the survey method producing data with an inherently wide variability precluding detection of any trend. A similar situation occurred in the Parks & Wildlife Commission's aerial monitoring of saltwater crocodiles. On detailed analysis the data produced from helicopter surveys proved

incapable of allowing for detection of downward trends in sufficient time to allow for management intervention (Stirrat *et al.,* 2001). In spite of its practical advantages, the technique was dropped in favour of the more sensitive spotlight surveys.

The Parks & Wildlife Commission's work with goannas is an example where a population was found to suffer sudden mortality, population decline and recovery following invasion by cane toads. The study could and for scientific reasons should be repeated and amplified (see below).

A similar study was proposed using a population of freshwater crocodiles that has long been used in a capture-mark-recapture population study. The proposal was excellent. However it is already known that some freshwater crocodiles die from cane toads, that populations of the species persist many years post-invasion, and indeed a similar capture-recapture study was conducted by Queensland National Parks and Wildlife on the species post-invasion by the cane toad (the only toad related finding was that freshwater crocodiles occasionally successfully ate cane toads).

A more informative study (both scientifically and as an aid of better community appreciation of the likely consequences of the cane toad invasion) would have been one designed to make best use of what we already know. An investigation of the hypothesis that freshwater crocodiles survive and are able to feed on cane toads because they evolve improved mechanisms for dealing with cane toad toxins would be of great scientific merit.

The hypothesis is amenable to study using toxicity tests on young crocodiles incubated in captivity from clutches collected from rivers that had no cane toads and rivers that had cane toads for varying lengths of time. It would allow for determination of within and among-clutch variability in ability to deal with the toxins in relation to time since toad colonisation, and allow the opportunity to follow the process through colonisation of one of more river systems. The capture-recapture study would be a useful adjunct to this study.

The above type of study is of profound scientific interest and I was please to support a recent ARC proposal for work of this nature. The work of Dr. Richard Shine and his group on pythons, goannas etc is important, but it will not increase the capacity to do something about toads even if they should uncover problems far exceeding anything we currently know about. The major beneficiaries of the work are likely to be science, pubic understanding and Rangers who will have some great new stories to tell Park visitors.

The Ecological Society of Australia's complex, replicated series of exclosures to study competitive effects is similarly of great scientific interest. Ignoring the problem posed by fire, feral animals and other physical disruptions that plague such experiments in the Top End, the work should be funded. but as with the above detailed studies, that funding is most appropriately provided by a scientific funding body rather than a nature conservation agency. The results are likely to be interesting and of scientific merit, but will not aid in cane toad management.

INVESTIGATING CANE TOAD CONTROL

Other than some minor works needed for investigating the practicality of cane toad proof fences, the only serious proposal for control of cane toad populations is the possibility of developing biological control. I have previously listed the criteria against which any proposed agent should be measured. I am not qualified to comment on the molecular biology involved in the current research.

There is however a need for better public understanding of what is involved in this research: the risks and the nature of the specific triggers for the work to cease or be continued. The following issues may be of assistance in developing a more structured understanding of what will need to be involved.

1. Given that the attempted immunological disruption of cane toad metamorphosis has not as yet been successful, how much work (time and resources) is required before it is know whether it is possible?

2. The work should cease if the compound causing disruption of cane toad metamorphosis has the same impact on native species.

3. If a virus specific to cane toads is to be used as a carrier then it will need to be demonstrated that it is species-specific in its host selection.

4. How common are species of virus that are host specific to individual amphibian species? Or do they tend to infect an array of amphibian and fish species?

5. If a virus that is not host-specific is to be used as a carrier (i.e. a possibly effective way of maintaining the modified virus in nature after it has removed all or many cane toad larvae/ metamorphlings), its potential for survival in nature will be related to competition with the normal wild virus. To assess potential for success prior to release it is critical to:

    - have a sound understanding of virus's natural temporal/spatial patterns of prevalence, transmission and impacts in nature now (this determines whether a particular carrier virus is in fact worth the effort of the genetic engineering (if rare, episodic or pathological, survival of the modified virus is problematic).
    - determine the competitive interactions between the normal wild virus and its genetically modified relative (i.e. relative rates of replication and persistence in hosts. competition between the viral strains in hosts; and relative rates of transmission among hosts).

    6. Augmentation of the temporal and spatial occurrence of the virus through man-assisted dispersal of the modified virus should not occur unless it can be demonstrated that the virus's normal, pathological effects to frogs and fish are inconsequential.
    7. The stability of the genetic modification will need to be well demonstrated.

Only CSIRO can provide information on how they plan to deal with these issues.

The biological control effort will require a massive amount of work and great expense, may have a high probability of failure due to epidemiology constraints and may pose profound dangers to native frog and fish communities unless the issues are dealt with effectively.

Even if the epidemiological constraints prove inconsequential, the modified virus proves permanently stable and toads die in large numbers there is no guarantee that the conservation outcomes (need to be clearly defined) we are seeking will be delivered. We can not afford fall in the hole of simply assuming that somehow it will all get better.

How many toads or what proportions of toad populations need to be eliminated prior to achieving "recovery" of native species or ecological communities? How do we measure recovery when the impacts noted are extinction, accommodation through rapid natural selection, or essentially can not be measured? A goanna lives a long time, as does a cane toad. You do not need many toads per unit area for a goanna to find one within a relatively short period of time.

My personal view is that the above issues need clarification so as to improve the public's appreciation of the endeavour's inherent difficulties. It is quite possible that even with this clarification; a lot of resources could be expended without there being any conservation benefit.

WORKING OUT THE PRIORITIES

The above discussion relates to what we know about the cane toad, its interaction with nature in the Northern Territory and Queensland and possible options for management and future research. In the best of all world's cane toads would be our only conservation issue and the Parks and Wildlife Commission could devote greatly enhanced resources and effort to solving the problems. Unfortunately nature conservation in the Northern Territory is not in such a fortunate position. The priority for cane toad research and management needs to be evaluated against expenditure proposed to deal with the following issues and probably many more problems.

1. The camel population in Central Australia is growing rapidly and is uncontrolled and causing damage that may never be rectified e.g. Quondongs.

2. The donkey population in the VRD in being brought under control, but feral populations in the Gulf Country continue to grow unchecked.

3. The post-BTEC remnants of the water buffalo population are growing and expanding rapidly.

4. Fire across much of the Territory continues to manage us rather than us manage it, even though advances have been achieved.

5. Gamba Grass continues to spread through the Top End, and not withstanding the excellent effort of Rangers in Litchfield and other National Parks, constitutes a far greater threat to the Territory's flora and fauna than does the cane toad.

6. Buffel Grass continues to spread across the semi-arid lands at a great loss to conservation.

7. We continue to maintain massive infestations of Mimosa.

8. The recent DIPE annual report notes there are at least 201 Territory species that are probably threatened, yet there are only three management programs to deal with the problem (there was a recent release of two more for public comment) and recovery management is conducted on no more than a handful of species.

9. The recent DIPE annual report failed to provide the people of the Territory with any clear understanding of the outcomes of fire, weed and feral animals throughout the park system, a notable decline in accountability and transparency.

10. The Territory's system of parks and reserve rates poorly in terms of nationally agreed criteria of comprehensiveness, adequacy and representativeness when compared to other States and Territories.

11. The recent increase in turnover of Rangers within the Commission is undermining the experience and knowledge base (particularly T2 and T3 levels) for future operations. This, plus an apparent drop in attractiveness to outside applicants, appears caused by low wages relative to other jurisdictions, poor remote area support, poor remote communications and a significant decline in moral.

12. There has been a tardiness in the application of regional planning procedures to regional land development e.g. the recent annual report noted production of a regional nature conservation plan for the Daly Basin, yet nothing seems to be being done other than a vacating of the moral high ground while land clearing begins.

All of the above deficiencies are readily amenable to management. All have clearly and easily definable goals and objectives. All are in urgent need of attention. Relatively little is being done to rectify the deficiencies, many of which pose a far greater threat to the Territory's biodiversity than does the cane toad.

Against this background I see the Territory having only a limited capacity to respond to the cane toad invasion.

To become involved in a multi-year program of research with primarily scientific outputs would deny the greater conservation needs, and inevitably be viewed as an attempted diversion of attention from the more or equally serious problems that can be readily addressed.

To become involved in multi-year research for biological control of the cane toad, properly a Commonwealth responsibility, would similarly be a diversion of pubic attention from the more serious issues (as well as being highly speculative).

My recommendations for Territory action in relation to cane toads are:

- continue the provision of information to the public so that people may be informed and supportive of government's actions;
- continue to remove accidental cane toad incursions well in advance of the existing range;
- continue to use signage and other means to limit the probability of cane toads being moved to islands;
- continue with and be more publicly accountable for the translocation of Quolls to islands;
- continue to examine the practicality of establishing a cane toad proof fence across the neck of the Cobourg Peninsula; and
- continue to support the Parks Australia and Territory park monitoring programs.

These recommendations are not new, having been around for some considerable time. They are however based on a balanced assessment of the cane toad's impacts relative to the other nature conservation issues facing the Territory.

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ATTACHMENT 1

Author's Background and Involvement in Cane Toad Research

I gained a B.Sc. and an M.Sc in zoology from the University of Queensland. My Ph. D. is from the University of Michigan. Ann Arbor, where my doctoral dissertation was on the behaviour and ecology on rainforest primates in Uganda, East Africa. My research interests centre on the roles of plant-animal and animal parasite interactions in population dynamics and structuring ecological communities. I have a low interest in the ecology of introduced animals as it impacts on conservation of natural systems, and as a tool for improving scientific understanding of ecological communities.

My interest in cane toads *(Bufo marinus)* began in 1983 when I took up the position of Senior Wildlife Research Officer (i.e. responsible for the research unit) with the then Conservation Commission of the Northern Territory. I continued then existing research on cane toads through until 1991 when I became Division Head, Wildlife with the Commission. I was subsequently (1992-94) Director, Conservation Strategy Branch for the then Queensland Department of Environment and Heritage. Since then I have been Division Head, Wildlife, Deputy Director; and Director of the Parks & Wildlife Commission of the Northern Territory until my dismissal in 2002.

ATTACHMENT 2

An excerpt from the minutes of the Cane Pests Board meeting held in Ingham Shire Hall, 5 May 1937

BUREAU OF SUGAR EXPERIMENT STATIONS
5 May 1937.

Delegates will no doubt remember that during the last conference we were labouring under a ban, imposed by the Federal Government, which restricted the distribution of toads to the Cairns, Gordonvale, Innisvale and Tully districts. While this ban gave us the opportunity to stock up those districts in great detail, it affected rather harshly those districts where grub damage was not sufficiently widespread and serious to warrant the first toad liberations being carried out there, but where, nevertheless grubs were serious in localised areas. Growers in these areas subsequently found themselves in the position of desiring a liberation of toads, but that we were unable to make liberations in their areas by virtue of the existence of this ban.

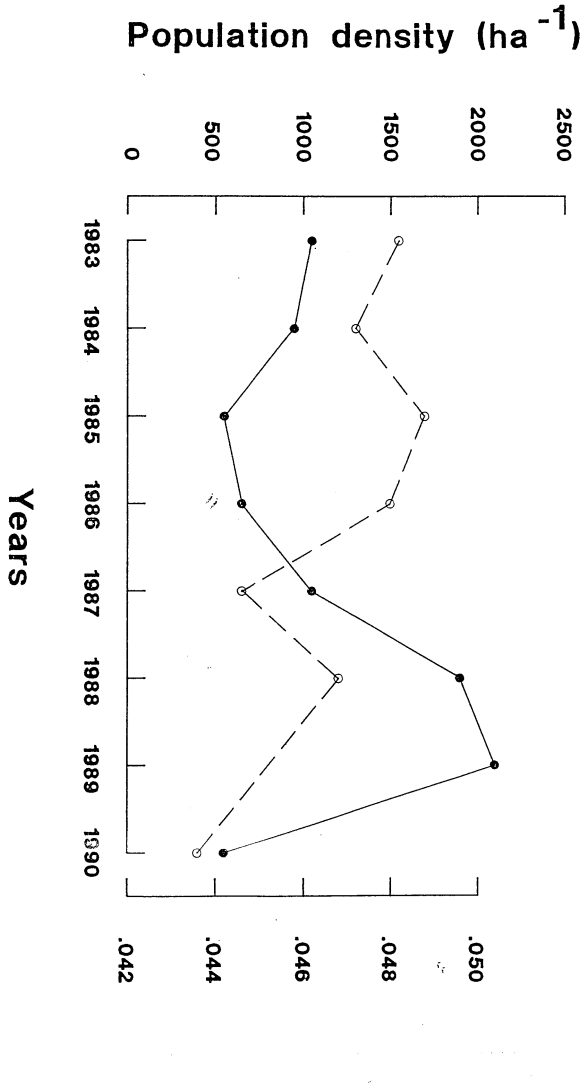
Accordingly we took this matter up further with the Health Department who are responsible for the administration of the Quarantine laws. After analysing the excreta of toads collated in this district under a variety of conditions, and dissecting a number of toads caught similarly, we presented to the Health Department the details of what they had eaten, with the result that the ban was finally lifted in September of last year. Since then toads gave been liberated in Mossman, Babinda, Ingham, Bambaroo, Giru, Ayr, Mackay, Bundabarg and Isis districts.

It is pleasing to note that the first Australian-bred generation have commenced breeding, and toadlets are now plentiful in are4s where the toads were originally liberated. Egg strings can occasionally be found in the pools along the Little Mulgrava whilst the same pools harbour thousands of tadpoles. Breeding has been taking place there continuously since last December. Records of breeding have come from other places in the Mulgrave, Hambledon, and Innisfail districts, and toad populations in those places will soon take a sudden rise. We have, therefore, discontinued liberations in these districts ever since toads from the first liberations become mature, as any further liberations at this juncture would not add appreciably to the already existing populations there. We plan to continue extensive liberations in the central and southern districts for some time, so that having once established big population in those areas, there should be no need to make further liberations there next year.

With regard to the usefulness of toads against Greyback beetle pest, it is much too early to judge their efficacy yet. Certainly they could have had very little or no influence on the beetle pest last year because during the lighting period the number of mature toads at large which be capable of eating a Greyback beetle would then be too stall. However, it is possible that during the coming year, in localised areas, we may gain some idea of their possible effects. I refer particularly to the Little Mul-

ATTACHMENT 3
Changes in the population density and body condition of cane toad at the Dip Waterhole, Westmoreland Station, Queensland over eight years following colonisation in 1982.

Population density is indicated by a solid line with body condition by a dashed line. There is no significant trend with time since colonisation for either population density or body condition. Additional data were gathered for the twelfth year postcolonisation and did not alter the results.



ATTACHMENT 4

Freeland, W. J. 1993. Parasites, pathogens and the impact of introduced organisms on the balance of nature in Australia. Pages 171-80 in CONSERVATION BIOLOGY IN AUSTRALIA AND OCEANA, ed by C. Moritz and J. Kikkawa. Surrey Beatty & Sons, Chipping North

EXTRACT ONLY

Parasites, pathogens and the impacts of introduced organisms on the balance of nature in Australia

W J FREELAND

ABSTRACT

Since colonisation by Europeans, Australia has experienced the highest rate of extinction of mammals of any biogeographic region in the world. The proposition is put that the majority of these extinctions reflect the instability of ecosystems that have a paucity of co-evolved host-parasites relationships. Food web analysis has shown that parasites are potentially the greatest source of stability in natural communities. Extinction of complex life cycle parasites during the Pleistocene and Holocene, man's subsequent addition of parasites lacking co-evolved relationships with Australian host species, deletion of parasites and introduction of animals without their predators and the majority of their parasites may have destabilised Australian ecosystems, making extinctions inevitable. Those holding responsibility for the management of the fauna and its continuing extinctions cannot afford the luxury of simply establishing reserves containing habitat appropriate to particular species. If the Australian fauna is to be preserved for posterity, it is essential that managers become involved in the deliberate restructuring of parasitic communities.

Key words: parasite, community stability, introduced organisms, extinction.

ATTACHMENT 5

Goannas were located and captured with the assistance of Annie Isaacs (an elderly Traditional Owner for the study areas) and her trained goanna dogs. Time to location of a goanna is used to indicate the abundance of goannas with data presented as mean and their 95% confidence intervals (short periods to location indicate a higher abundance of goannas than do longer time periods). Control areas (adjacent areas free from cane toads) remained constant through the period and are reported as a single mean.

Year	Cane Toads	Mean (minutes to location)	95% confidence interval
1989	Absent	32	27
1990	Present	103	73
1991	Present	56	36
1992	Present	38	26
Control	Absent	35	44

ATTACHMENT 6

Species of snake (Boidae, Coiubridae, Elapidae) known from 7 islands off Queensland's eastern coast that have no cane toads and 11 islands that have cane toads. Data are

derived from the literature and Queensland museum records. Frog eating species are denoted with an *, with each species noted as whether it is present in the Northern Territory (NT Species) or has a similar species in the Northern Territory (NT Genus). Records for toad infested island were taken following cane toad invasion.

Of the total 42 coastal snake species only 17 (40%) were classed as frog eating species. 21 species (50%) were found on islands and 11 (73%) of these were frog eating species. The 6 frog eating species found on islands free from cane toads were also found on islands infested with toads. Six frog-eating species were not found on any island. Three of these latter species belong to genera present in the Territory and 3 to genera not found in the Territory.

Species	Number of islands **without** cane toads	Number of islands **with** cane toads
BOIDAE		
*Liasis maculosus** (NT Genus)	3	6
Morelia amenthistina	0	1
M. spilota (NT Species)	1	6
Colubridae		
Boiga irrgularis (NT Species)	0	5
Dendrelaphis calligaster	0	1
*D. puncutulatus**	5	9
*Stegnotus cucullatus** (NT Species)	0	1
*Tropidonophus mairii** (NT Species)	0	3
Elapidae		
*Acanthopis antarcticus** (NT Species)	1	6
Cacophis harriettae	0	4
Demansia psammophis (NT Genus)	0	3
D. torquata (NT Genus)	3	4
*Hemiaspis signata**	0	2
*Hoplocephalus stephensi**	0	1
Notechis scutellatus (NT Species)	0	1
Oxyuranus scutellatus (NT Species)	0	1
*Pseudechis australis** (NT Species)	0	1
*P. phorphyriacus**	0	4
Pseudonaja textilis (NT Species)	1	2
Rhiniplocephalus nigrescens (NT Genus)	0	2
Vermicella annulata (NT Species)	0	1

SUBMISSION NO. 23

Dr Michael Mahony, University of Newcastle, New South Wales

michael.mahony@newcastle.edu.au

29 May 2003

Sessional Committee on Environment and Sustainable Development

Dear Committee

I am a biologist at the University of Newcastle NSW. In the early 1990s I proposed a bio-control method for Cane Toads to the CSIRO Cane Toad control committee. At that time they were heavily committed to finding a disease to control toads.

The approach I proposed is rather unique and I consider has as many chances of success as the other methods proposed then and currently under investigation. I am critically aware that there is not likely to be one silver bullet that will solve the problem of the cane toad and I am not about to claim that the approach I put forward is guaranteed to work. There is considerable research to be completed, but I believe it has possibilities.

I have attached a user-friendly outline of the concept. If you would like more details I would be happy to provide them.

Sincerely

Dr Michael Mahony

CONTROL OF CANE TOADS BY THE STERILE MALE APPROACH

Background

The release of Sterile Males to control populations is one approach that has proven to be successful in a small number of cases involving insects. The concept is based on the principle that any control method must be specific to the organism that is targeted. A feature that is specific to any organism is that males and females mate only with members of their own species. If there is a means by which the majority of males can be rendered sterile then most matings will fail to produce offspring.

This method has been most effectively applied to insects (e.g. screw worm fly, mosquitoes). The general approach is to swamp a population with sterile males so that the eggs of females will not be effectively fertilised.

This method works most effectively in organisms that are not highly mobile, where reproduction is restricted to one copulation, where reproductive potential is high, and the life cycle relatively short. The method has not been applied to vertebrate pests because they often do not meet these criteria. However, the Cane Toad meets some of these criteria. It has a high reproductive potential, copulation, as far

as is known, is restricted to one single mating with a single partner per season, and adults are relatively sedentary around established breeding sites.

It is postulated that an effective way to control a highly fecund species, such as the Cane Toad, would be to reduce their reproductive potential. The aim of this project is to investigate genetic methods to produce sterile male Cane Toads that have libidos equal or greater than normal males. This project does not aim to study whether the population dynamics of the toad are amenable to this approach. We have taken the position that it is first necessary to determine whether sterile males can be produced, before this question should be considered.

Apart from offering the possibility of a multi-pronged attack to control the toad, the proposal has the following advantages.

- It does not involve introducing viral pathogens or the testing of specificities of any pathogens (i.e. it does not involve introducing a disease to kill toads or the need to test a large array of native animals to ascertain whether the disease is harmless to them).
- It does not require a vector (i.e., there is not need to have a means to spread an introduced disease).
- It does not involve genetically engineered pathogens.
- The method of producing triploids does not require any harmful reagents.

Objectives

To produce sterile male toads that have a normal libido and seek to mate females. We aim to determine whether this can be achieved by producing triploid males that grow normally and have normal testes with respect to the production of male hormones, but which produce abnormal sperm. When these males mate with a female their sperm are either not capable of fertilising eggs or development will not proceed. Triploidy is known to result in sterility in numerous animal groups.

To achieve this outcome a number of steps must be shown to be possible in the Cane Toad.

Firstly, experiments need to be conducted to show that triploid animals can be produced. We have already successfully produced triploid cane toads using the simple method of cooling cane toad eggs immediately after fertilisation. The technology that would need to be geared up is already applied in some sections of the aquaculture industry. Methods successful used on fish and frogs include cold, heat and pressure shock, and the use of some specific biochemicals.

Secondly, we would need to demonstrate normal growth and development of triploid toads.

We have grown triploid cane toads through the larval stage to beyond metamorphosis and there is no major impediment to the concept at this stage of the life cycle. We have not grown young toads through to adulthood to confirm that this is possible.

Thirdly, if triploids toads grow to adulthood we would need to assess whether they have normal libido (hormone profiles and microscopic examination of testes) and demonstrate that any sperm produced are abnormal.

Another related matter that would be clarified in these steps and one that offers considerable potential for other means of biological control is the means of sex determination in cane toads. For the biocontol method we propose it is critical that only sterile males are produced. The sex determination mechanism in toads is not known, but it would be determined in step three above. This is a complex matter for which we have provided a brief outline at the end of the document.

Research approach and proposed methods

Two methods offer the greatest possibility to obtain large numbers of viable and hormonal competent but sterile triploids:
Production of triploids by shock treatment,
Production of triploids via intermediate tetraploidy.

1. Production of triploids by shock treatment

   Step one
   Artificial stimulation of gravid females to lay eggs. Achieved by hormonal injection of gonadotrophin.

   Step two
   In vitro fertilisation of eggs with sperm suspensions. Achieved by standard protocols.

   Step three
   Shock treatment of eggs immediately following fertilisation to prevent the extrusion of the second polar body from the egg. This effectively produces a diploid egg, with the incorporation of the sperm nucleus the zygote will be triploid. Triploids should grow and develop as normal but be sterile. Shock treatment usually involves sudden temperature or pressure change.

   Step four
   Monitoring growth and development of the triploids.

2. Production of triploids via intermediate tetraploidy
   Step one & two are the same as above.

   Step three
   Following fertilisation of the eggs shock or chemical treatment (Colchicine) applied at the time of first cleavage to produce autotetraploid individuals. Success tested by chromosomal analysis. Growth and development of the tetraploids needs to be investigated.

   Step four
   Tetraploids crossed to diploids (*in vitro* fertilisation) will produce triploid offspring.

Work Plan

1. Production of triploids by shock treatment

   Step one
   Artificial stimulation of gravid females to lay eggs.

   We have developed the necessary protocols in our laboratory with the cane toad.

Hormonal induction of ovulation and *in vitro* fertilisation with testicular spermatozoa are established procedures that have been used for many years with Anurans (Rugh, 1962; Hollinger & Corton, 1980; Fontdevila *et al*., 1991). Induction of ovulation is a critical event for IVF in Anurans as only oviductal oocytes are capable of fertilisation.

Ovulation in *Xenopus laevis* and the Bufonidae has been achieved by either injection of gravid females with homologous pituitaries (usually 1 to 6 pituitaries, depending on the species, sex and season) or with mammalian gonadotrophin such as HCG (Rugh, 1962; Carbada *et al.,* 1989; Verhoeff-de Femery & Griffin; Omata, 1993). For the Bufonidae (e.g. *Bufo japonicus* and *B. arenarum*) recent IVF work has tended to rely on homologous pituitaries for induction of ovulation (Carboda *et al.,* 1989; Omata, 1993). At least seven species of the Bufonidae have been successfully ovulated using pituitary extracts (Rugh, 1962; Omata, 1993).

Step two
In vitro fertilisation of eggs with sperm suspensions.

We have developed the necessary protocols in our laboratory with the cane toad.

Collection of motile, viable spermatozoa for IVF is generally achieved by the maceration of testes into amphibian Ringer's solution of low osmotic pressures (Hollinger & Corton, 1980) in the region of 50-100m Osm kg^{-1}. Very high fertilisation rates (in the order of 90%) can be obtained in Bufonidae and *Xenopus* with IVF using hormonal induced oocytes and testicular sperm (Hollinger & Corton, 1980).

We have established basic IVF as a routine technique with *Bufo marinus* using pituitary extracts for ovulation and testicular sperm. IVF procedures work well with *B. marinus* after initial experimental work to optimise conditions.

Work we have conducted shows that viable and motile testicular sperm from *B. marinus* may be collected at any time of the year (and activated in media of low osmotic pressure). However, mature oocytes are only available from females during the breeding season (August - March). We will attempt to further refine our basic IVF procedures for *B. marinus* by attempting to induce ovarian growth and oocyte maturation in non-seasonal females using gonadotrophin and oestradiol treatments (Wallace & Bergink, 1974; Wallace, 1985; Kwon *et al., 1991).* We will also investigate other hormonal procedures for the induction of ovulation and testicular sperm release using HCG (Hollinger & Corton, 1980; Verhoeff-de Fremery & Griffin, 1989), progesterone (Wright, 1961; Schuetz, 1971), and dopamine and adrenalin (Minucci *et al* 1993), as well as investigating the use of arginine vasotocin (AVT)(=oxytocin) to induce oviposition (La Pointe, 1977).

Step three
We have developed the necessary protocols in our laboratory with the cane toad.

Shock treatment of eggs immediately following fertilisation to prevent the extrusion of the second polar body from the egg.

This effectively produces a diploid egg, with the incorporation of the sperm nucleus the zygote will be triploid. Shock treatment usually involves sudden temperature or pressure change (see Nishioka & Ueda, 1983, and reference therein). We have successfully used cold temperature shock to produce triploid cane toads. This method is not optimal and the use of pressure treatment as used on a large scale in the aquaculture industry may be most effective.

Mature triploids have been obtained in numerous urodeles and anurans (see Kashiwagi, 1993, for a review). For example in three species of *Hyla* and four species of *Rana*, triploids were obtained by exposing eggs to low temperatures of 0 - 2^{o}C for two hours, 20 minutes after insemination (Nishioka, 1972; Nishioka & Ueda, 1983; Kawamura, 1951a,b; Kawamura, Nishioka & Okumoto, 1983; Kashiwagi, 1993). Standard practice in the production of triploid salmon and trout is to use of hydrostatic pressure for a period of two hours, thirty minutes after artificial fertilisation (Purdom, 1983), but heat shock has also been successfully applied (Johnstone, 1985; purdom, Thompson & Lou, 1985).

Using cold shock on artificially inseminated eggs of *Rana rugosa*, Kashiwagi (1993) produced 82% triploid offspring. The majority of these were raised to sexual maturity. No significant differences were observed between the triploids and control diploids in development and growth rate. All the triploids were male or hermaphrodites, which transformed into males, indicating that in this species the male is the heterogametic sex. IVF using sperm from eleven of these triploid males with eggs (2272) from normal diploid females resulted in 6% forming tadpoles, of which only one reached metamorphosis, i.e., they are effectively sterile. Chromosome counts revealed that the majority of the tadpoles were aneuploid.

Female heterogamety has been reported in two species of the genus *Bufo (B. bufo* and *B. japonicus*)(Ponse, 1942; Muto, 1952). Muto (1952) found that the majority of triploids raised from cold-treated or heat-treated eggs were females. It is highly probably that in these species triploid females are ZZW or ZWW, and males ZZZ. If this is also the case in *B. marinus* it will be necessary to produce a stock of sex-reversed males (genetically male ZZ, but phenotypically female). This can be achieved by surgical removal of the testes in the sexually mature male toad. The Bidders organ which is located in the anterior part of the testes is the incompletely involuted cortex of the embryonic gonad. It has been compared to the rudimentary ovary. Furthermore, the Mullerian duct has been conserved. When the testis is removed, the Bidder's organ develops into a functional ovary and the Mullerian duct enlarges. Injection with female hormones would be expected to enhance the success of such animals.

Step four
Monitoring growth and development of the triploids.

This step has not been conducted in our laboratory.

Growth would need to be compared with the developmental stages of control diploids. Chromosome counts could be made on small sections of epithelium taken from the tail. The extracts are soaked in a hypotonic, colchicine solution for three hours and then squashed is acetic acid orcein stain. Measurements of erythrocytes and specific staining of the nucleolus organiser region in the nuclei can be used to determine the ploidy of individuals (Mahony & Robinson, 1981). Histology would follow standard procedures.

2. Production of triploids via intermediate tetraploidy

   Step one & two are the same as above.

   Step three
   Following fertilisation of the eggs, shock treatment will be applied at the time of first cleavage to produce autotetraploid individuals. Another approach to obtain tetraploids is the use of mitotic arresters such at colchicine at the time of first cleavage. Success will be tested by chromosomal analysis. Growth and development of the tetraploids will be examined.

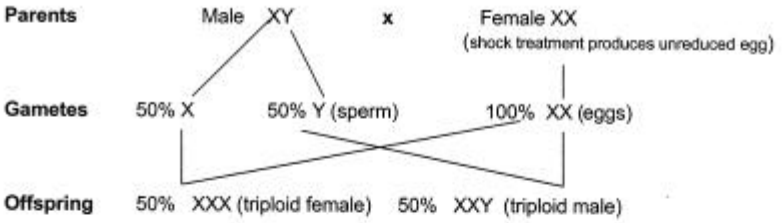
   Step four
   Tetraploids crossed to diploid (*in vitro* fertilisation) will produce triploid offspring. Similar problems of sex determination to produce all male triploids as outlined above would need to be considered.

BACKGROUND INFORMATION

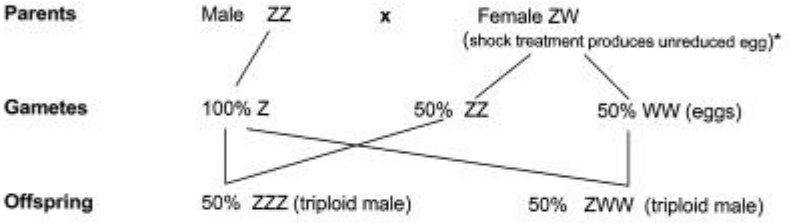
What is the sex determining mechanism of cane toads?
Heteromorphic sex chromosomes do not occur in *Bufo marinus* (Schmid, 1978). In *Bufo bufo* and *B. japonicus* the female is known to be the heterogametic sex (ZW)(Ponse, 1942; Muto 1952). If this is also the case in *B. marinus* it is predicted that half the triploids produced from diploid (ZW) females will be female. Although it is possible that one dose of the male determining gene (on the Z) will result in all male triploid offspring (see diagram below). If this is the case then all offspring will be sterile males. If this is not the case it may be desirable to produce sex-reversed females that are genetically ZZ, which when fertilised by a normal sperm (Z) will result in all male triploid offspring (ZZZ) (see diagram below). This leads to the possibility of producing all male triploids by sex reversal of the homogametic sex, thus avoiding any wastage of animals and the need to sex triploids. If the homogametic sex is the female, then treatment with testosterone during development, should result in a male which is genetically female. If however, the homogametic sex is the male, surgical removal of the testes will enable the bidders organ to develop and a female which is genetically male will be the result (Schmid *et al, 1991).*

Below is the basic schematic of the production of triploid sterile males based on chromosome manipulation.

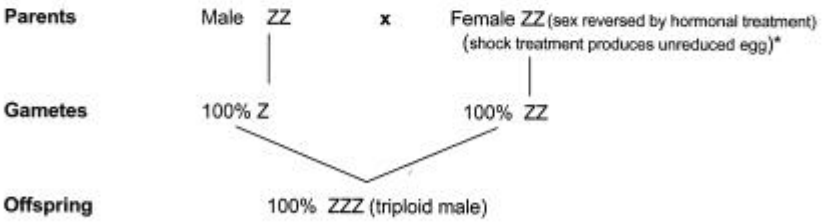
Production of triploid males if the Male is the heterogametic sex.



Production of triploid males if the Female is the heterogametic sex



Production of triploid males using sex reversed males, if the female is the heterogametic sex.



*(this assumes the second polar body is retained in the shock treatment. It is also possible to prevent first cleavage of the zygote and produce polyploid individuals).

SUBMISSION NO. 24

Ms Faith Woodford, Private Citizen

faith.woodford@nt.gov.au

2 June 2003

Sessional Committee on Environment and Sustainable Development

Dear Committee

I attended the public inquiry regarding cane toads that was held in the Litchfield room in Darwin in May 2003. I subsequently had to fly to Alice Springs and was unable to place a submission to the Committee by the due date.

My main concern for the inquiry to consider is that cane toads are destroyed humanely. I believe appropriate advertising will need to be given to the public about how to combat this problem and not to think that a 9 iron is the appropriate way of disposing of cane toads.

Some of the speakers that spoke that day said 'humane' treatment was to place cane toads in the freezer or by using Dettol. I have been advised that in fact both of these treatments are inhumane. I am not knowledgeable in this area, but I have spoken to Mr Mauricio Perez-Ruiz who is an expert in this area and can advise you accordingly.

Mauricio can be contacted on: 39756 or mobile number 0401 112 522.

I apologise for using my work email address, but at this late stage, it is the quickest way for me to send to you this information. The views expressed in this email are my own personal views.

Regards,

Faith Woodford

SUBMISSION NO. 25A

Tiwi Land Council, Mr Frederick Mungatopi
Chairman

PO Box 38545
Winnellie NT 0821

17 July 2003

Chair
Environment and Sustainable Development Committee

Dear Chair

Re: Exclusion of the cane toad and other pests from Tiwi Islands

BACKGROUND
By virtue of their isolation, having the Northern Territory's highest rainfall, and being at Australia's northern extreme, the Tiwi Islands have a unique biota including a number of endemic species and sub-species. These unique natural resources support a number of developing economic opportunities including tourism, recreational fishing, arts and craft production, aquaculture and forestry.

The Tiwi Islands have been free of many of the exotic pests and diseases that occur on the Northern Territory mainland. Unfortunately, however, we are now discovering new outbreaks of introduced weeds and feral animals. Increasing traffic between Darwin and the Islands, and the impending arrival of the cane toad in Darwin are placing the flora and fauna of the Tiwi Islands at great risk.

Our fledgling aquaculture and forestry enterprises are vulnerable to attack from exotic pests and diseases that may already occur elsewhere on the mainland. Outbreaks are often found only after extensive damage has already occurred, and single incursions could destroy these emerging enterprises.

For these reasons, it is an urgent priority that we install and maintain a high standard of quarantine facilities and procedures for the Tiwi Islands. It is anticipated that cane toads will reach Darwin during the 2003/04 wet season, and it is imperative that we do all in our power to protect the Islands from their devastating impact.

CURRENT SITUATION
The most common means of introduced species reaching the Tiwi Islands is through freight and luggage, the majority of which travels by barge from Darwin. We sought and received specialist advice from consultants and Government, who suggested the construction of wash down facilities and quarantine holding areas. It is the first attempt in Australia to provide a cane toad barrier of this type, and our advice is that it is an achievable goal.

An effective quarantine holding area will require metal fencing, metal shelving and an undercover storage area. Access in and out of the area will be over specially designed grids that prevent cane toad access. It is anticipated that goods received at the Barge

premises will progress through quarantine wash down and/or visual inspection before premises being placed in the quarantine holding area. They will then be loaded on the barge in one operation before transport to the Islands.

In 2002 we applied for and received funding from the Aboriginal Benefits Account and Indigenous Land Corporation for quarantine activities and facilities. Some of this money was earmarked for public awareness material and activities, which has been carried out. A further $150,000 (ABA) and $80,000 (ILC) was provided for wash-down facilities and associated infrastructure. Our advice at that time was that this would be sufficient for the required facilities.

With further research carried out by Professor Mike Tyler and industry representatives, it has now come to light that a suitable wash-down facility that will provide consistent cleaning operations will cost in excess of $300,000. A fenced quarantine holding area with above ground storage and undercover storage is additional.

In response to this information, we are currently seeking sponsorship from relevant organisations that may be able to provide materials for the additional infrastructure required, as well as engineering expertise and advice. To date we have had no success.

We are committed to keeping cane toads and other pests off the Tiwi Islands, and have received national media attention for our efforts so far. We are also well aware of our time constraints, with the possibility of cane toads reaching Darwin during the 2003/04 wet season, and are making every effort to have facilities in place before that time.

Any assistance you may be able to provide through your Committee would be greatly appreciated, and would also support the NT Government's aim to keep offshore Islands cane toad free.

If you would like to discuss this personally, our Secretary Land and Resource Development, Kate Hadden would be very happy to talk to you. She can be contacted direct by telephone on 8999 4423.

We look forward to hearing from you.

Yours sincerely

Frederick Mungatopi
Chairman

cc. Marion Scrymgour, Member for Arafura

SUBMISSION NO. 25B

Tiwi Land Council, Ms Kate Hadden
Environment and Heritage Officer

CANE TOAD PUBLIC AWARENESS ACTIVITIES – TIWI ISLANDS

The Tiwi Land Council is developing a training package consisting of a videotape by Professor Tyler, a CD and audio cassette titled "Frog Calls of the NT", various pamphlets and fact sheets on cane toads, and stuffed specimens. Tiwi land Council staff will deliver the package, and training will be ongoing through schools, men's centres, women's centres and environmental health workers. Training will also extend to mainland partners such as Tiwi Barge Services.

There is a high degree of literacy among the Tiwi people, and some knowledge of the toad problem on the mainland already existed through reading the NT News and watching TV. To augment this, and to develop awareness of the specific threat to the Islands, the Tiwi Land Council placed articles in the local media (Tiwi Times) during the first half of 2001. These articles were entitled "The Cane Toad Story", and were printed over a number of issues as a series.

Articles concentrated on what cane toads were, their history, why they are a problem, how to identify them and what could be done. They also highlighted the similarities and differences between cane toads and native frog species. These articles will be repeated once cane toads reach Darwin.

After publication of "The Cane Toad Story" the toad became a regular topic of conversation among the Tiwi, adults and children alike. Land Council staff and government visitors to the Island communities were frequently queried on where the cane toads were "now", and how they could help stop their arrival on the Islands.

A metal sign was also developed with the Parks and Wildlife Commission and donated to the Tiwi land Council. Signs showed a picture of a cane toad, and a message to keep them off Islands. Signs are prominently displayed at all barge landings, airstrips and approved fishing/camping spots on both islands.

A 'Tiwi" cane toad poster in traditional art style is being produced by local artists, and will be printed and widely distributed before October 2003.

The Parks and Wildlife Commission carried out a Junior Ranger camp on Melville Island which included cane toad activities, and Coastcare carried out cane toad activities with schools as part of their environmental education programmes. These activities will be ongoing.

Public awareness has also been a focus on the mainland, where much of the Islands' goods are sourced. Shipping companies, airlines, businesses, contractors, recreational organisations, basically anyone travelling or shipping goods and equipment to the Islands must know about the environmental dangers of cane toads and their responsibilities in stopping their migration.

The risk of cane toads reaching the Islands provided the catalyst for developing and distributing generic quarantine brochures and bookmarks. These have been distributed to tourist organisations, tackle shops, fishing associations, barge and airline charter

companies and regular service providers who visit the Islands. They are also included in tender documents, in correspondence to contractors and other visitors, and handed out with access permits.

The metal cane toad signs have also been posted at mainland barge premises where goods are delivered for transport.

Tiwi Land Council issues permits for non-Tiwi to visit the Islands, and these permits are now watermarked with the message "keep cane toads out!"

TIWI ISLANDS CANE TOAD ACTION PLAN
28 MARCH 2001

ACTION	RESPONSIBLE PARTY	BY WHEN	PROGRESS
1. Regulations			
Territory Parks and Wildlife Conservation Act	NT Govt	As required	N/A
Insert clauses in contractual agreements with companies, contractors etc.	Tiwi	As required	As required
2. Awareness			
Tiwi Islands			
Articles in Tiwi Times	Tiwi	from June/July 2001	Completed & ongoing
Tiwi Poster	Tiwi	by October 2003	In preparation
Signs at barge landings	Tiwi	by October 2003	Completed
Junior Ranger activities	Parks & Wildlife	from June/July 2001	1 completed; ongoing
Mainland			
Brochures for shipping companies, relevant businesses, contractors, relevant recreational organisations etc.	Tiwi	2003 dry season	Completed
Information sheets attached to permits	Tiwi	from 2003 dry season	Completed
Signs at barge landings, airline terminals etc.	Tiwi	by October 2003	Completed
3. Training			
Cane toad identification	Tiwi with advice & assistance from Parks & Wildlife Service	2003 dry season	In preparation
Identification of likely hiding places	"	"	"
Monitoring for cane toads	"	"	"
Eradication methods	"	"	"
4. Implementation			
Tiwi Islands			
Monitoring incoming freight	Tiwi/Business operators	from when cane toads reach Darwin	Ongoing
Monitoring freight premises and buildings	"	"	"
Identifying other areas where cane toads might enter Islands	Tiwi with advice & assistance	by 2003 dry season	Completed
Monitoring other likely areas (campsites etc.)	Tiwi	by 2003 dry season	Completed & ongoing
Reporting sightings	To Councils	from when cane toads reach Darwin	Ongoing
Eradication	Tiwi/Business operators	As required	As required
Mainland			
Construction of washdown bay and exclusion storage areas	Tiwi Barge	by end of 2003 dry season	In progress
Monitoring outgoing freight (add a box on consignment notes certifying that the goods have been inspected for cane toads?)	Shipper/Shipping company	from when cane toads reach Darwin	In progress
Monitoring mainland premises and buildings	Shipping company	"	"
Reporting sightings	To Parks & Wildlife	"	Ongoing
Eradication	Shipping company with advice & assistance from Parks & Wildlife	"	As required

Notes:
Parks and Wildlife intend to implement a structured education, awareness and eradication program at their discretion. It will cover all barge companies and airlines. We will need to lobby them later in the year to make sure this happens before cane toads reach Darwin, to ensure all areas relevant to the Tiwi Islands are included, and to ensure collaboration in areas of mutual concern.
(Advice from PWCNT 2001)