STOP THE TOAD
KEEP WA CANE TOAD FREE

Seasonal Cane Toad Control Strategy

DISCUSSION PAPER

April 2007

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1 INTRODUCTION

The purpose of this discussion paper is to facilitate a process of planning for the next stage of cane toad control by the Stop the Toad Foundation (STTF). The aim is to compare what the organisations involved (including FrogWatchNT and Kimberley Toad Busters (KTB) have learnt from their observations and experience to date with the research and models to determine future control methodologies and the best strategies for successfully engaging communities.

In essence this is about putting a practical Kimberley/ Victoria River District (NT) perspective on the scientific and other knowledge in relation to cane toads and reviewing the progress that has been made to date.

The overall aim is eradication of cane toads from the control zone, the area between the western side of the Victoria River and the WA border in an attempt to stop cane toads penetrating into WA.

Furthermore it will detail in-field toad management strategies undertaken by STTF and FrogWatchNT and identify strategies to engage the Northern Territory community of Katherine.

Katherine is seen by STTF as a major linchpin in the battle against the toad. The Darwin community has been galvanised by the work of FrogWatchNT and are now active participants in toad control activities. West of Katherine the small communities of Victoria River and Timber Creek, and in WA, Kununurra, are now aware of the complexity of the issue and a number of people have become involved from these communities.

Several pastoral stations and remote Aboriginal communities have seen the work undertaken by STTF (Great Toad Muster 2006 and ongoing educational activities)), KTB (regular toad collection days and educational activities) and FrogWatchNT (high media profile in the NT and excellent educational activities) and as a result have either supported access to pastoral and Aboriginal lands or have been directly engaged in hand collection and trapping efforts.

2 SUMMARY

Combinations of trapping, fencing and hand capture have been used to remove cane toads from areas within a designated control zone. To do this, considerable on-ground activity has been achieved through the coordinated delivery of significant personnel and financial resources.

Cane toads are particularly vulnerable to dry conditions and they are not well adapted to the dry season (May – October) conditions in the region.

They have a number of behaviours that they use to cope with dry conditions and these behaviours can be exploited as a key element of control efforts.

During the ‘wet season’ (December – March) extensive rainfall can be experienced across the known toad frontline and flooding of river and creek systems can allow for the rapid dispersal of adult and juvenile toads.

Having said this it is important to note that very little is still understood about how effective dispersals are during flooding events given potential impacts from:

- salinity,
- toads in flooded areas potentially taking on too much water,
- predation of individuals or small groups by crocodiles, fish and birds
- the topography of much of the coastal areas north of the Baines River junction with extensive exposed tidal flats that offer little or no refuge for toads exposed on them during the summer heat.

There are also 'transitional' months during which rainfall can be received in isolated thunderstorms or from monsoonal low pressure systems during March – April, and the 'dry season' can be extended dependent upon climatic conditions to as late as November – December.

3 TOAD ECOLOGY AND BEHAVIOURAL KNOWLEDGE

Cane toads are very water dependent and are biologically ill equipped to deal with extended dry periods. This means they have developed behaviours which allow them to cope with dry conditions and STTF has successfully exploited these behavioural characteristics to remove significant numbers (>48K plus in 2006) of cane toads from extensive areas of the control zone.

Behavioural data from FrogWatchNT and from previous work undertaken by CALM (now DEC), KTB and STTF reconnaissance activities have allowed STTF to build a suite of strategies that are being incorporated into the battle against the toad invasion.

The major knowledge sets that have been developed include:

- The degree to which toads are reliant upon surface water at this time of year (in the current control zone)
- The importance of significant surveillance to identify refuge areas and wetlands that create landscape links for toad populations
- The requirement for multiple night busts (>4 consecutive) at individual locations to ensure that the majority of toads at a location are removed – this is based on knowledge that toads will not leave refugia every night
- The effectiveness of simple barrier fencing to direct/deflect toads into traps
- The effectiveness of 'black light' technology to attract toads to traps

4 ISSUES

There are many things STTF need to get a better understanding of and there is a need to keep an open mind about these as their relative importance from a control perspective is identified.

Included are:

- How effective are the tidal mudflats as barriers to toad movement during the early 'wet season'; 'dry season'; during flood events?
- The toad fence trial is demonstrating an apparent effectiveness as a management tool –STTF believes it is also time to identify wetlands at risk
- STTF believes it is time to commence negotiations with pastoral land holders, NT Government and Aboriginal communities about likely locations for an extended fencing trial. This should primarily include all man-made waterbodies - to take them out of the equation as their effectiveness as toad refuge areas during the extended dry season has been demonstrated..
- Initial observations would support a combination of major targeted toad management activities towards the late dry season supported by strategic

fencing on an all-year basis and a roll out of a significant number of traps that are continually in situ. This approach could be supported by encouraging localised employment to monitor /maintain traps and fences and undertake reconnaissance as directed e.g. Muyalee Women's Rangers. (STTF believes this is a cost effective strategy and has a number of positive social and economic outcomes for small communities)

- That it appears reasonably certain that the Bradshaw Base is a feeder area for toads to cross the Victoria River into the control zone and further north. STTF believes that more can be done in this area to reduce populations or provide protection to the buffer zone.
- The obvious importance of galvanising the Katherine Community to become part of the strategy (initial community leader discussions have indicated a willingness to become involved). This is important in maintaining community awareness as Katherine is the effectively the last stop for many travellers to WA. Encouraging participation from this travelling resource could become a significant component of assistance in the management of toads.

Existing control methods that have been developed by FrogwatchNT in the Northern Territory such as the light traps and 'super traps' catch cane toads during the wet season and will probably be very successful at localised control of toads, particularly during the extended dry season experienced in the NT and the Kimberley region. (Sawyer,G, 2004,pers.comm., 16 Dec.)(Seebacher and Alford 2002)

The traps can be effective in a number of circumstances including localised control (around dwellings in towns) and on deflection fencing (where toads are deflected along the fence line into the trap) and their use could be extrapolated to cover broader scale areas such as the invasion front (particularly around waterholes/wetlands in conjunction with strategic fencing).

Instead of promoting a concessionary attitude to toad control, management agencies are encouraged to adopt a proactive role and incorporate the use of large numbers of traps and on ground people resources into a management strategy for toads.

Every toad disposed of via a trap or hand collected is one less likely to breed, consume threatened wildlife or kill predatory wildlife such as the varanid lizards.

Hand collection (particularly associated with events like GTM 2006) and traps used in conjunction with barrier fencing will slow the invasion front of toads and buy much needed time to develop suitable biological controls.

People are particularly effective at changing environments to suit their needs – this same skill should be brought to bear on the cane toad issue. It is important that efforts should be directed to significant physical control of toads in the Northern Territory with the aim of reducing the likelihood of infestation in Western Australia.

TOAD ACTIVITY

The percentage of toads active in an area on any given night varies considerably. This has significant implications for activities such as toad control. Toads in refuge sites are

unlikely to be found. (5-80 % Alford).[1] If so we are hand collecting only a percentage of the toads in the area that are out of their refuge sites, this gives rise to the question as to how often we need to 'bust' an area in a repetitive fashion to eradicate toads.

An estimate of 6 nights has been suggested based on research from Alford that indicated the need for toads to rehydrate on a regular basis. (Cohen & Alford 1996; Seebacher and Alford 2002) Alford indicated that toads denied access to suitable rehydration opportunities died within 4 days.

In their natural habitat (Venezuela) toads emerge only every 2-3 nights whereas in some NT conditions they may emerge every night. Observations during the GTM 2006 demonstrated that repetitive night hand collection was necessary to increase confidence that the majority of toads had been removed from collection sites.

This is thought to be related to food availability and so it has been anticipated that as the insect numbers decline as the Dry season sets in the toads will become hungrier and come out of their refuges more often.

(*The effects of ambient temperature and humidity also needs to be considered as does the effect on toad emergence of cool/cold winds that can be experienced over the northern Australian tropics during the mid dry season*)

FrogWatchNT research indicates toads do lose physical condition as the dry season progresses but the degree to which this is a problem for the toads is unclear. (There have been recent media reports of toads in Queensland suffering from lung worm parasites)

Toads are also not all present at one time in the night. FrogWatchNT have cleaned a billabong edge of cane toads only to come back 4 hrs later and found even more toads.

Research (Schwarzkopf & Alford,1996) *et al* indicates toads may stay in their refuge for 3 days and potentially even up to 6 days, *but not more than 6*, without emerging. This has implications for toad busting strategies in particular:

- If toad refuge time is increased by cold weather in the mid dry season this will have significant implications for strategy at that point in time. Observations by STTF staff and communication with others involved in the control effort indicate a very significant impact on visible toad numbers by cold night time temperatures.

- The soil and atmospheric moisture influence on toad activity also appears very strong.

- In some areas of the control zone this impact (reduced soil and atmospheric moisture) is likely to be so strong it will force all toads to leave that area or die from moisture loss.

The verification of these factors should be a focus of reconnaissance as such locations may provide significant defensive lines which can be reinforced by STTF activities leading to effective eradication and to impacting upon the westward movement of cane toads.

(Conversely, determining at what stage of ambient relative humidity (RH - atmospheric moisture) toads are encouraged to leave refugia to feed or rehydrate could ensure an effective strategic based approach to hand collection on nights when RH is forecast to reach an identified level. Not to confuse temperature function of RH, we also need to plot the temperature against the RH because it may be a combination of the two which triggers activity.)

The location of such areas continues to be a major focus for STTF field observations and planning (see Buffer Zone discussion below)

4.1 TEMPERATURE THRESHOLDS

Toads respond to cold temperatures by remaining in refuge areas and so the temperature as well as the moisture levels will impact on the number of toads that are going to be active on a given night.

- STTF/DEC need to gather information using appropriate technology to quantify this impact and find out what the cane toad's response is going to be to cool nights in the dry season.

Personal observations (G.Sawyer) indicate that in some periods of cold weather toads at Ringwood Station emerged from their refuge burrows and logs but did not move to the edge of nearby water bodies but tended to remain close to the refuge area.

- One trap trial with a field trap caught 50 toads in a night when placed right next to a major refuge site.

Preliminary observations in the area in April/May 2006 confirm cold night time temperatures stop significant numbers of toads being active in an area. Observations from the DEC, KTB and STTF field staff as well as personal communication with Larry Ford (AgWA) confirm this, as do observations in August 2006 when toads became active at Auvergne Lagoon during a visit by STTF and KTB to determine toad presence. (It appeared that the trigger was an increase in RH and 'dew' occurring.)

STTF and DEC need to confirm the levels of this effect and the actual temperature thresholds.

- Some observations indicate increased toad activity in the late afternoon and early mornings which could be a change in normal toad behaviour due to them being unable to feed during the cold nights.

Examples

Joe Creek. There were toads in the area in the 2005 late dry and they appeared immediately the humidity increased and rain started and then commenced breeding during the first run off. .

A 48 mm toad (approx 20 weeks of age) found at Sandy Creek during mid-February 2006 is an indicator that toads were breeding on Sandy Creek during 2005 Dry Season.

Possibly both these examples indicate a permanent water hole or toads refuging at the junction of Joe and Sandy creeks with the East Baines River where they were not discovered by reconnaissance.

This reinforces the need to understand the triggers to toad activity (as against refuging) as these are essential to knowing when to best deploy on-ground control activity

4.2 REFUGES AND TOAD MORTALITY

Dry conditions and poor day time refuges may lead to significant mortality of cane toads (Zug and Zug, 1979).

This may be the case in areas of the control zone on the cracking soil plains where refuge sites would appear to be limited. (see Buffer Zone Discussion below) Adult toads are too large to access the deep cracks in the soils and burrows and hollow logs (apart from those associated with wetlands such as Freshwater Mangroves, *Barringtonia actangulata*) would appear to be scarce in this habitat.

Significant mortality in such areas may be a determinant in establishing a buffer zone; an area the toads will not be able to penetrate.

During the 'wet season' these cracking clay soils can absorb a significant volume of water which effectively cause the soil to 'swell' until it can absorb no more, then 'run off' begins.

Toads at this time of year possibly use dense stands of vegetation growth, exposed tree root systems, rocks and fallen trees as refuges. There appears to be an aversion to moving through dense vegetation and toads have been observed to actively seek open spaces to seek prey.

Understanding these behavioural components will be critical in deciding the boundaries and locations of control zones.

It is important to continue to encourage people in the area to report observations of toad activity and to clarify subtle aspects of their behaviour.

4.3 RECONNAISSANCE

It is vital to identify locations toads have colonised during the 2006-2007 wet season.

This will help to determine the effectiveness of toad control measures implemented during the Great Toad Muster© 2007 and assist in planning future strategies.

Significant effort needs to be put into this work in the early part of the 'dry season.'

Reports from the DEC, Kimberley Toad Busters, Muyalee Rangers and other parties such as Parks and Wildlife Rangers, Aboriginal communities and pastoral station workers and fishermen should also to be encouraged.

Reconnaissance methods could include:

- Aerial surveillance and ground truthing where necessary
- Audio recording surveillance
- Audio (real time) surveillance
- Tadpole/ metamorph surveys
- Sentinel traps
- Refuge traps
- Spotlighting
- Sniffer dogs (helicopter/sniffer dog combo!)
- Indirect: Water audit, refuge audit, map based (and ground truthed by sampling) refuge estimates.

4.4 TRACKS

Cane toads leave quite distinctive tracks in sand and mud and these can be used during daytime surveys to identify areas where toads are active. Not all soil types provide tracks but most places in the control zone have fine sand and soft mud, especially around the edges of water and on well used tracks around waterholes.

Traditional owners and indigenous people may have skills to bring to bear in this area.

Scats of cane toads are quite distinctive and can be used as an indicator of the presence of toads in an area.

4.5 LANDSCAPE AND MOISTURE

Topography and vegetation can be a key guide to the location of moisture and hence likely toad populations.

It is essential to get the best understanding of this using the available resources such as maps and weather data; but just as relevant are the experiences and knowledge available from people 'on the ground who know the country' and have observed at the micro level. Aboriginal traditional owners and stockmen and pastoralists are all holders of aspects of this knowledge.

STTF and FrogWatchNT have developed good working relationships with The Northern Land Council (NLC) Caring for Country Unit in Timber Creek. The NLC is developing maps of water points based on communication with traditional owners and this data will be able to be integrated with data from DEC, Kimberley Toad Busters, STTF and FrogWatchNT.

Of further assistance would be a commitment from DEC and NT Parks and Wildlife to undertake interpretation of satellite imagery for the buffer zones and surrounding areas to help identify water points, topographical features that are potential barriers and soil and vegetation types.

4.6 LIFE STAGES AND BEHAVIOUR DIFFERENCES

In order to eradicate cane toads from areas of the control zone we need to continue the development of a data base of observations of the different life stages of toads and bring control strategies together that will assist in determining the best methodologies for targeting toads at all growth stages.

(There are also potential safety concerns with entering water bodies (particularly during the warmer months) with the likely presence of saltwater crocodiles, feral pigs and wild cattle. It should be recognised that these animals have attained mythical stature as to the threats they present. However with soundly managed safety strategies field workers can operate safely.)

4.6.1 EGGS

Cane toads are likely to breed throughout the year as has been the case in the Top End.

Eggs can be removed from water within 24-36 hrs of deposit but the terrain and visibility in the water mean it is unlikely that the majority of eggs will be discovered.

Egg removal should be used where viable but it is unlikely to be a major part of control efforts.

4.6.2 TADPOLES

Cane toad tadpoles may be evident in water bodies throughout the year.

Tadpoles can be removed from the water by using nets but the effectiveness of control is uncertain. Research by Alford suggests that removing some of the tadpoles only results in bigger stronger metamorphs which are more likely to survive the juvenile stage and become adults.

Tadpole control should only be a priority in areas where there is going to be a greater than 90% eradication result. This is possibly the case in the dry season. During the Great Toad Muster© 2007 tadpoles will be removed as a matter of course from the primary buffer zone.

4.6.3 METAMORPH (<30MM SNOUT-VENT LENGTH, SVL)

At this stage of the life cycle cane toads are at their most vulnerable and this is where the bulk of natural mortality occurs.

Metamorph toads are very small and quite susceptible to water loss. They are also diurnal (daylight active) and congregate in huge numbers.

As tadpoles develop their fourth leg and get ready to emerge from the water they congregate in areas where the water is most shallow and there is a gently sloping bank.

This effect can be quite strong and even though tadpoles may be spread around the edge of a waterhole the metamorphs may only emerge at one or two points.

This has obvious implications for control, both in terms of collecting tadpoles and in terms of destroying newly emerged metamorphs.

Metamorph cane toads move away from the edge of the water at a very slow rate, only a few centimetres a week and need to have moisture to survive.

- In dry periods such as experienced in the Kimberley and NT, it appears that they are unable to move away from water for any length of time and they remain concentrated near water as a result.

- Control methods should be continually investigated but placement of artificial refugia, especially ones with added water, has been demonstrated to have a medium level of success. Type and placement are critical to encourage the metamorphs to congregate. The use of chemical spays would appear to be another option, however, residue and side effect issues need to be evaluated. Chlorine bleach works well and is thought to be reasonably safe in small amounts.

- Toads of this size can be collected during hand capture activities and some devices such as nets and motorized garden leaf blowers can increase the effectiveness.

Often large numbers of these metamorphs are within a metre of the edge of the water and can be pushed into the water with a blower, by stamping on the ground or by

flushing them with water (eg throwing buckets of water over them). Once in the water they are very easy to collect with a net.

4.6.4 JUVENILE (30-59MM SVL),

At this stage cane toads become much more mobile and can spread further away from water bodies although they are still very water dependent.

Large numbers of toads in this size range have been caught in cane toad traps even though they can pass through the wire. It would appear that they are refuging in the traps because of the moisture and cover.

It may be possible to cover the larger mesh holes in the traps with a finer mesh to actually capture these sizes of toads in the traps.

The by - catch of native species is less than I in 100 trap nights (DEC 2006) with the current traps and an evaluation will need to be made to determine if the smaller mesh would significantly increase the risk to native species.

Toads at this size can also be captured by hand.

During this stage the toads become more nocturnal in their habits.

4.6.5 SUB-ADULT (60-89MM SVL)

At this point the toads are behaving like smaller versions of the adult toads and are basically nocturnal.

They are susceptible to trapping and hand capture.

4.6.6 ADULT (>90MM SVL)

Trapping and hand capture, especially once dry season congregations have occurred, are currently the most effective ways of controlling mature cane toads.

There are a number of biological and behavioural traits which can be exploited to achieve high levels of control.

STTF and FrogWatchNT have refined the processes to achieve local eradication on a broad scale across the control zone. (Report on Great Toad Muster (GTM) 2006)

5 BUFFER ZONE

The ongoing identification of specific areas within the control zone that feature especially difficult conditions for cane toads (including tidal flats, black soil plains with minimal permanent water, buttress type rock barriers and highly saline areas) is a priority as they will provide us with the ability to focus activity in areas where the most success in stopping the westward movement of toads can be achieved.

(Some suggested zones are shown below.)

Such “natural barriers” may be crucial to making the overall task achievable as they will significantly reduce the areas where control work needs to be carried out.

There are examples of these “natural barriers” in the control zone and with appropriate supplementary control strategies they may become the single most important element in the overall strategy. (See Cedar Lagoon outcomes GTM Report 2006)

Toads have major physiological weaknesses in their response to water loss and have no physiological mechanism to prevent dehydration. As quoted in Lever p16 - 17 “ Krakauer , 1970a and Zug and Zug (1979) considered that desiccation plays an important role in the mortality of cane toads in seasonal tropical regions.

This is supported by observations reported to FrogWatchNT, especially in the **Katherine Region of the NT**

Lever (2001) also states “*since cane toads do not dig their own refugia, the existence of shelter is essential for their survival*. “

These factors may combine with specific habitat types to make some areas very difficult for toads to survive the extended dry season.

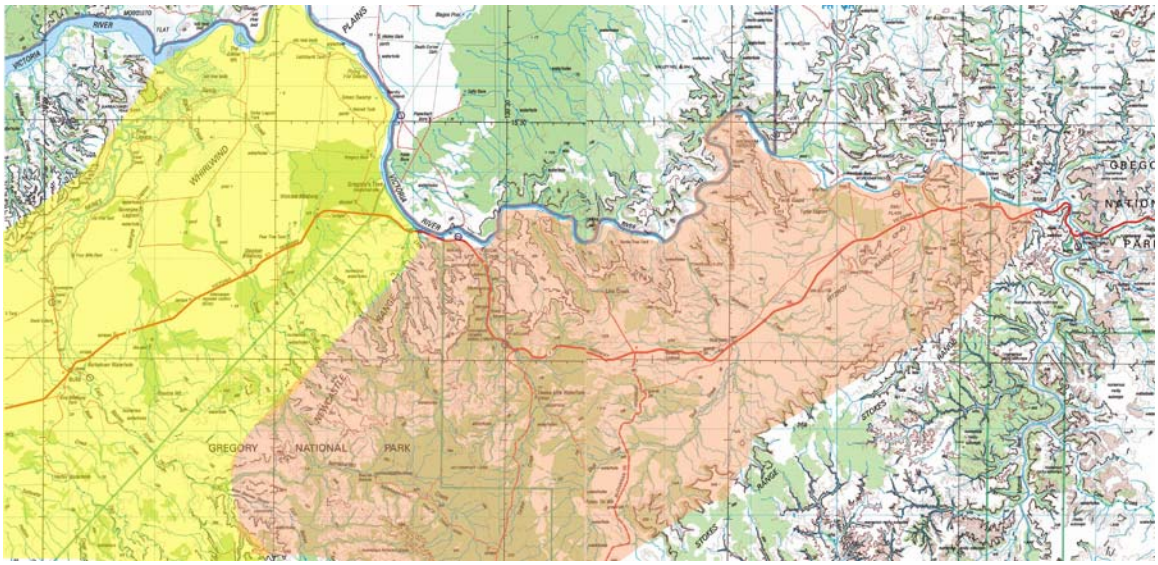
Some of the soil types and habitats in the region are much less suited to cane toads than others in that they do not retain much soil moisture and provide few refuge areas such as rocks, burrows and hollow logs.

Areas of black soil that are non self-mulching and characterised by *Melaleuca minitafolia*, *Gutta perchia*, and *Bahunia sp* need to be studied closely as preliminary indications are that toads will not survive in those areas without moisture

There are significant such areas along the Baines River floodplains and the area around Timber Creek.

These have been mapped in detail as areas to set up a buffer zone and significant establishment and ongoing work has been undertaken to establish the feasibility of creating such a buffer zone where the toads can be removed each year.

Current buffer zone locations are shown below.



The yellow region is the primary buffer zone and the pink region the secondary buffer zone.

The primary buffer zone is an area between the Pinkerton Range to the west and the Newcastle Range to the east.

First priority in the 2006 Dry season was to clear the primary buffer zone. The second priority was to clear the secondary zone as time and resources allowed.

In 2007 the zones will be reassessed following the wet season.

All available information on toad incursion will be considered and surveillance should be conducted along as much of the toad front-line as practicable.

It is intended to undertake another significant hand collection effort in the late dry season given the major success of the Great Toad Muster 2006. Special effort will be made to examine the areas cleared in 2006 to better understand the implications of toad reinfestation of the buffer zone.

With demonstrated effectiveness of the barrier fences and 'black light traps' there is now a significant suite of management tools that can be brought to bear on the toad invasion.

6 CONTROL MODEL

Toads are expected to stop moving across country as the available surface moisture disappears as the Dry season sets in.

They will continue to move along corridors of creeks and rivers but this movement will be restricted when compared to wet season movement.

There should be little westward movement during this period as the creeks mainly run south to north and the tidal influenced Victoria River has a significant saline density north from Timber Creek in the dry season.

Once this cessation of movement has occurred toad populations become much more vulnerable to control work.

The indicators that support toad rehydration and movement such as climatic effects and ambient moisture RH should be documented for the area but these would appear to significantly change only a few weeks after the rains cease.

The impact of dew on lengthy movement is unclear but it does provide toads with enough moisture for rehydration.

Finally, toads refuge near permanent water and significant congregations will occur on water bodies (including man made dams) allowing localised eradication to be achieved by control work.

In these cases it is important to recognise the types and density of refuge areas adjacent to these water bodies as this can provide an indication of potential toad numbers likely to be using the site.

- This refuging occurred in the control zone from approximately August 2006 through to mid December 2006 when significant rainfall occurred across the

VRD. This confers with data from the Ringwood research site where it appears to be July- August.

It could actually occur much earlier in the Timber Creek region (and 2007 is shaping up to be a 'dry' wet season). This process will vary from season to season and the late wet season rains in 2006 did impact on the process and pushed the GTM 2006 into the later part of the year.

Exploiting this congregation behaviour is again the key part of the GTM 2007strategy.

Trapping and toad busting become more effective later in the dry season as the toad population is more confined and accessible as vegetation is reduced at the edges of waterholes and billabongs are covered in short vegetation in areas where water has receded. These areas make ideal feeding zones for cane toads.

6.1 BASIC MODEL

The underpinning tenet of the programme is that toads closest to crossing the WA border are the greatest threat and thus will receive the highest priority for control efforts.

The first priority will be to clear the Primary Buffer Zone, followed by the Secondary Buffer Zone (based on the outcomes of reconnaissance activities and feedback from as DEC and KTB).

The plan is to start on the western side of the infestation and work back towards the eastern side.

Traps will be moved onto water points and identified control locations and as toads congregate multiple night hand capture activities and deflection fencing will be used to supplement the traps to remove toads from the area.

Once this is completed some of the traps will be moved onto the next site with several left at the site to perform a monitoring function.

Surveillance and sniffer dog support will also be used to ensure a site remains clear.

7 TOOLS

- Hand capture
- Traps
- Fencing

7.1 HAND CAPTURE

Large numbers of volunteers (>120) contributed to the GTM 2006 with over 48000 cane toads hand collected from strategic waterholes within the control zone.

This community engagement is a key aspect of the seasonal strategy. Groups like STTF, FrogWatchNT and KTB have refined this model for the Wet Dry tropics and have shown it can remove significant numbers of cane toads. (KTB claim to have collected over 100,000 toads using this method at sites they have visited)

There are a number of issues relating to the technique's effectiveness in relation to the number and timing of such activities required in an area to achieve eradication.

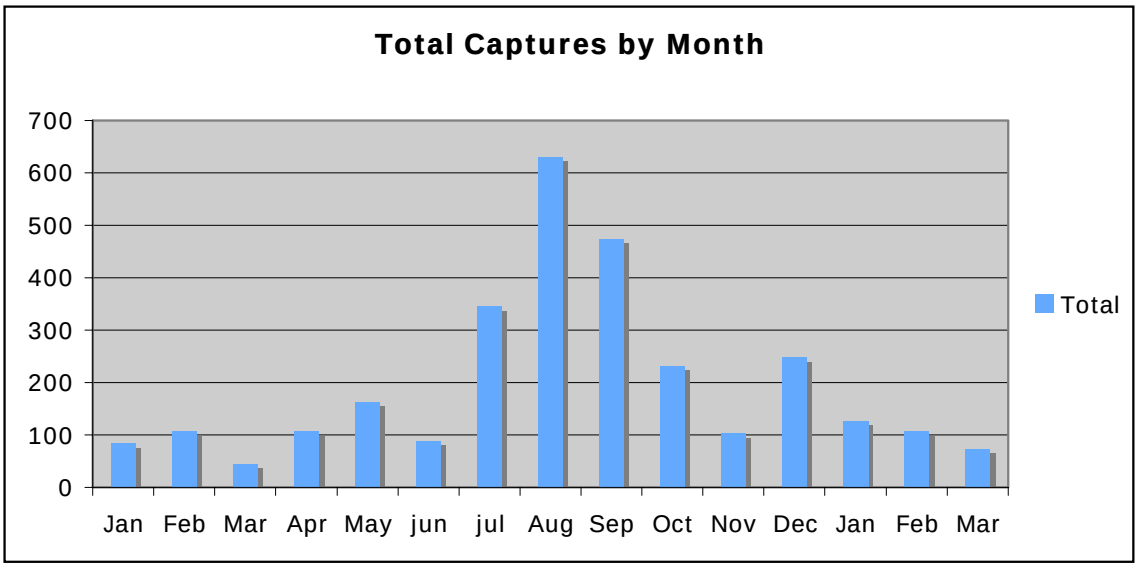
(*These have been reported upon in the GTM 2006 report and STTF believes that that significant component of success requires repetitive nights collection activities at water and refuge areas)*

Input a graph

7.2 TRAPS – A VARIETY OF STYLES OF TOAD TRAPS ARE CURRENTLY IN USE AND THEIR APPLICATION IS PART OF THE OVERALL SUITE OF TOOLS THAT ARE USED IN LANDSCAPE MANAGEMENT OF TOAD POPULATIONS

7.2.1 STRATEGY

The Dry season includes the peak times for toad capture in the trials to date. Capture rates increased significantly during the dry season in trap trials in the Northern Territory near Adelaide River as seen by the graph below.



7.2.2 DATA

Data collected from traps across the control region to date needs to be analysed to determine a strategy to maximise toad captures during the future Dry seasons. Placement near water (within 3 meters) works best in similar situations in other parts of the NT in the dry season.

Different models need to be investigated in order to get the best results. Different types of traps will be used across the range of needs. This is an adaptive strategy that STTF has adopted and will be responsive to climatic, Relative Humidity (RH) and other impacts as assessments develop.

7.2.3 OFFENSIVE TRAPPING

Offensive trap-lines are traps placed in a manner to maximise toad captures. The traps need to be placed in areas toad frequent such as edges of water bodies and refuge places and at strategic points along deflection fencing.

These sorts of trap deployments also need to be placed on appropriate creek systems.

Traps need to be placed within metres of the edge of water to maximise their effectiveness. They also need to be serviced to keep the clear 'fingers' clean and moving freely.

This type of trapping will be of most importance during the dry season but will also have applications during the wet season in conjunction with other management tools (such as fencing).

7.2.4 SURVEY OR SAMPLE TRAPPING

Grid patterns and trap-lines have traditionally been used to monitor animal numbers in an area. This type of trap set can be used to monitor toad numbers in an area when parameters are determined based on existing and developing research.

7.2.5 EARLY WARNING OR SENTINEL TRAPS

Traps with Black light UV appear to be particularly effective at attracting toads and should be set up in areas of possible toad incursion ahead of the front line to help identify when toads get to an area.

These types of lighting systems have been applied to traps based at the fencing trial on the Gregory Tree access road and are already proving their worth.

7.2.6 OTHER TRAP RELATED ISSUES

Lining traps to capture juveniles and sub adults and development of mechanisms to trap these life stages of toads.
The use of fencing as "drift lines" to move toads towards traps and enhance their effectiveness is being investigated at the fencing trial in the NT. It is important **that signage indicating the purpose and functional application of the fencing trial is established by July 2007.**

8 FENCES

Fencing has been mooted as an exclusion mechanism for cane toads but this has yet to be tested on a large scale.

STTF has advanced plans to put in place a number of trial fences and to also trial the way they can be used to supplement existing cane toad control activities such as trapping and toad busting.

A 4.2 km fence has been attached to an existing station fence along the road from the Katherine Highway to the Gregory Tree car park. The major components and effects of this fence are:

- high quality nylon shade cloth which has a 15 year UV resistance rating
- a number of black light UV toad traps
- the fence is maintained by the Muyalee Womens Rangers group from Timber Creek; an Aboriginal group associated with the NLC (the STTF supports the activities of this group and (through its association with FrogwatchNT – not sure about this – we pay GS to do this??) contributes to ongoing training of participants in this program)

- very few impacts have been reported concerning the effects of the fence line upon native wildlife. The fence itself at its maximum height is only approximately 50-60 centimetres. Macrofauna such as wallabies have no trouble negotiating this barrier and numerous observations have been made of native skinks (*Ctenotus sp*) easily climbing the fence, small marsupial mice and Australian frogs in the genus *Litoria* sitting on the top of the fence and snakes (pythons) moving along the barrier.
- Some outlandish claims have been made in Kununurra media about the impacts on native wildlife but none can stand up to serious scrutiny.
- The original idea of the fence was attributed to Mr Jeff Hayley, who proposed the 'Hayley Line' in 2004.
- Toads that meet the fence are observed to move along it until they meet a strategically placed series of traps (traps are placed in complimentary format on the east and west sides as it has been observed that toads are not just moving in one direction (west) but are also moving randomly in all directions including east.
- There are some minor maintenance issues that require ongoing monitoring including; repairing holes caused by unknown damage; replacing vandalised componentry, backfilling of areas impacted by soil removal associated with minor water flows and closing section joins with cable ties or similar to prevent toads 'squeezing' through sections.

Since the establishment of the fencing trial 587 toads have been removed from traps associated with the fence.

Fencing should increase the effectiveness of trapping and hand capture. Traps placed along the fence-lines should capture a significant number of toads that are deflected along the fence-lines,

The fence-lines will also provide field operatives with strategic lines to work against and will hold toads in an area making them more vulnerable to control activities.

Fences or multiple fence lines augmented with traps and periodic toad collection activities may be the only way to control or prevent toads entering terrain that is very difficult to access for either trapping or 'toad busting'.

9 MISCELLANEOUS TECHNIQUES

- **Fire** - Grass fires at Mareeba Wetlands (NT) have been observed to have high mortality on toads, especially without suitable refuge nearby. Native frogs appear well adapted to escape these fires. (*Fire – use of fire or exploitation of existing fire to control toads are techniques that require ongoing monitoring*.)

- **Chemical** – delivery of toad poisons via a variety of vectors. Spraying, introduction to waterways, baits etc. Some leads, such as Lavender beetles and native fish poisons, are yet to be fully explored.

- **Sniffer dogs** may be very useful for quickly determining the presence or absence of toads from a given system and therefore making intensive toad control methods more efficient. They may also have a role in targeting individual toads in difficult terrain, e.g. scree slopes and thickets.

- **Sniping** – the use of low calibre (.17 or .22 cal) air rifles was trialled during the GTM 2006 with excellent results. There are a number of legal, access and safety issues associated with using firearms in this context, however the STTF have fully investigated these requirements and established safe operational procedures. Essentially sniping is used as a 'mop up' tool for difficult to access toad refuge areas – particularly those areas associated with Freshwater Mangrove thickets (Freshwater Mangroves produce an irritant towards the end of the dry season when they flower which is possibly designed as a predator response mechanism to reduce impacts from large macrofauna destroying heavily nectared flowers)

10 HITCHHIKER THREAT ABATEMENT

This strategy element is related to the STTF Hitchiker strategy and promotes the engagement of groups such as volunteers, school groups and campers in overnight campgrounds collecting cane toads and placing them in Supertraps or 'toad detention facilities' in these locations.

Placing traps in these locations and toad proofing of stock and general freight transport yards and similar locations will provide significant protection from hitchhiker toads.

The recent and ongoing 'resource boom' in WA is also providing threats to the security of WA given the large volumes of mining machinery and supplementary equipment being shipped into WA. Toads have been found in machinery and freight loads in the NT and in containers of bananas sent to Perth from Queensland.

11 ON-GROUND OPERATIONS AND COORDINATION

Planning and control work would ideally be coordinated amongst all of the groups involved in toad control to achieve best results. This would include the identification and prioritisation of control targets as well as determining resourcing decisions .

The Kununurra Cane Toad working group sub committee involving DEC, KTB, FrogWatchNT and STTF would appear to be the logical point for this, however this group has only met twice in 18 months

It is the STTF's firm opinion that a coordinating group needs to be established and maintained as a matter of urgency if the efforts and good will of all groups working to fight the cane toad in Northern Australia are to be maximised.

Through its association with them the STTF could bring the input of the Timber Creek Women's Rangers, the Northern Land Council Caring for Country Unit (NLCCCU), and the Ngaliwurru-wuli Aboriginal Association to compliment the management strategies that are required to impact on toads including:

- The requirement for ongoing maintenance of in-field equipment (traps, lighting systems and fences)
- The necessity to further engage strategically placed communities and industry groups into the battle
- The importance of significant lead times to plan and develop major attacks against toad populations in the control zone

- The need to undertake westward surveillance from the control zone in preparation for the 2007 Great Toad Muster©
- The requirement for ongoing governmental support at all 3 tiers

11.1 MAJOR TOAD MUSTER EFFORT LATE DRY SEASON

The concept of establishing base camps across the region in the late Dry season (September to October) and using these as bases from which large numbers of volunteers can work to remove any remaining toad populations has been implemented successfully during the GTM 2006.

This type of activity requires major resourcing and logistical effort (and needs to be delivered at the end of the normal tourist season).

STTF have demonstrated that it is possible to train team leaders and enlist and manage substantial volunteer effort to have a major impact on toad populations while these populations are effectively stationary and concentrated onto rapidly depleting water resources.

FrogWatch NT and other experienced locals also provide support to supervise the volunteers who sometimes have little experience in the region and limited understanding of the environment and its dangers.

12 REFERENCES

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