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1 BACKGROUND

FrogWatch is a not for profit organization focused of raising environmental awareness, especially issues relating to frogs. FrogWatch has been active in the Northern Territory for since 1991 and has developed a very strong profile across the local community.

FrogWatch is dependent upon the voluntary efforts of members at all levels of our community. In 2004 we recognised the need to get some paid resources working for FrogWatch in order to organise action against cane toads in the NT. We are actively seeking the support of governments, businesses and individuals to provide us with the resources needed to galvanise public action against Cane toads. We have received invaluable support from the Northern Territory Government for a Cane Toad control initiative in the populated areas near Darwin.

Whilst our primary focus is on native frogs we have played a very significant role in raising community awareness about cane toads and their impact on native ecosystems.

FrogWatch has developed a number of traps that catch toads and have commenced trials of various traps using the one-way gate mechanism developed by Graeme Sawyer and Dave Wilson.

Clear-fingered one-way trap gate

FrogWatch has trialled traps in a number of settings, including remote bush locations and areas around dwellings as a part of their research into ways to minimise the impact of the cane toad invasion of the top end of the Northern Territory.

Image 1 – SuperTrap at Ringwood station trial site.

The trials showed that, during the dry season, traps can catch all the toads in an area around a house or block in a few weeks and that once the toads have been removed any new toads moving into the area seem to be quickly caught in the traps. Test sites have been kept relatively toad free by a single cage trap. Landowners have commented that they never see toads around the house anymore, except for those in the trap.

The larger cage traps would appear to be able to play a significant role in capturing toads on a broader scale. The Bonrook trial trap, in Dec 2004 - Jan 2005, captured 224 in the first week and 543 in total over 6 weeks. This was a single Supertrap (3 door) placed at the homestead area of a cattle station near Pine Creek in the Northern Territory.

Weekly Capture rates

Week l	Captures
1	224
2	130
3	80
4	42
5	39
6	24

The captures and observations of the station managers indicated a very significant and rapid decline in toad numbers around the area. This gave us hope that broader scale control was feasible. To test this we set up trap trials in a bush location at Mt Ringwood Station.

The FrogWatch ‘Supertrap’ trial at Ringwood station, 130kms south of Darwin, has shown that a large capacity, solar powered and automated trap systems can continually capture toads around a wetland and reduce the toad numbers in the area. The traps are capturing toads during the wet season as well as the dry season, which is a boost to our confidence that the traps will help to reduce cane toad numbers in areas where traps are used.

SuperTrap photographed at night

Somewhat surprisingly there has been no by-catch in the cage trap trials with in excess of 250 nights of trapping catching nothing but cane toads. It appears that we have an effective, manageable and species-specific cane toad trap.

These results invoke the possibility that the traps can be used as a broad scale control mechanism and play a key role in cane toad management and threat abatement plans.

This would particularly be the case if toad behaviour in the wet dry tropics makes them susceptible to control, especially in the dry season. Their need for water and ability to move indicates they will congregate on remnant water. Preliminary field observations and research support this.

Keeping toad numbers suppressed in areas where the blocks of land are small and there is a reasonable density of people would seem to be achievable.

Broader scale control or minimisation strategies also seems to be feasible leading to regional control strategies or larger scale eradication programs or threat abatement strategies, especially in significant wetlands such as those listed under RAMSAR or JAMBA agreements or in national parks. There is still further testing needed to verify the extent to which toads in an area will congregate on remnant water in the late dry season and as they become more hungry, their susceptibility to traps.

Part of the “catch”

2 METHODOLOGY

FrogWatch has set up traps on a man made dam on Mt Ringwood station 125 Km south of Darwin. The initial trap was set up on January 1 2005. See picture, image1, of supertrap above. The location is in hilly savannah woodland, see aerial photograph Image 2 below.

Image 2 Dam site 1 Trapping site. Just over 1km shoreline in the wet season.

A second trap was added on the eastern side of the dam on April 19 2005. A third trap was added on 26th May 2005.

The plan is to just use traps to see what impact they can have on the cane toad population at the site.

The population of cane toads at a second dam about 2.5 Kms from the trapping site is being used as a comparison. Spotlight surveys of the entire perimeter of each dam, taken on the same night, are used as comparisons samples of the population at each location

It was our expectation that the trapping site would have significantly less toads by the end of the Dry season compared to the control site, and the subsequent build up of toads will be slower on the trapping site than at the control site in the following wet season.

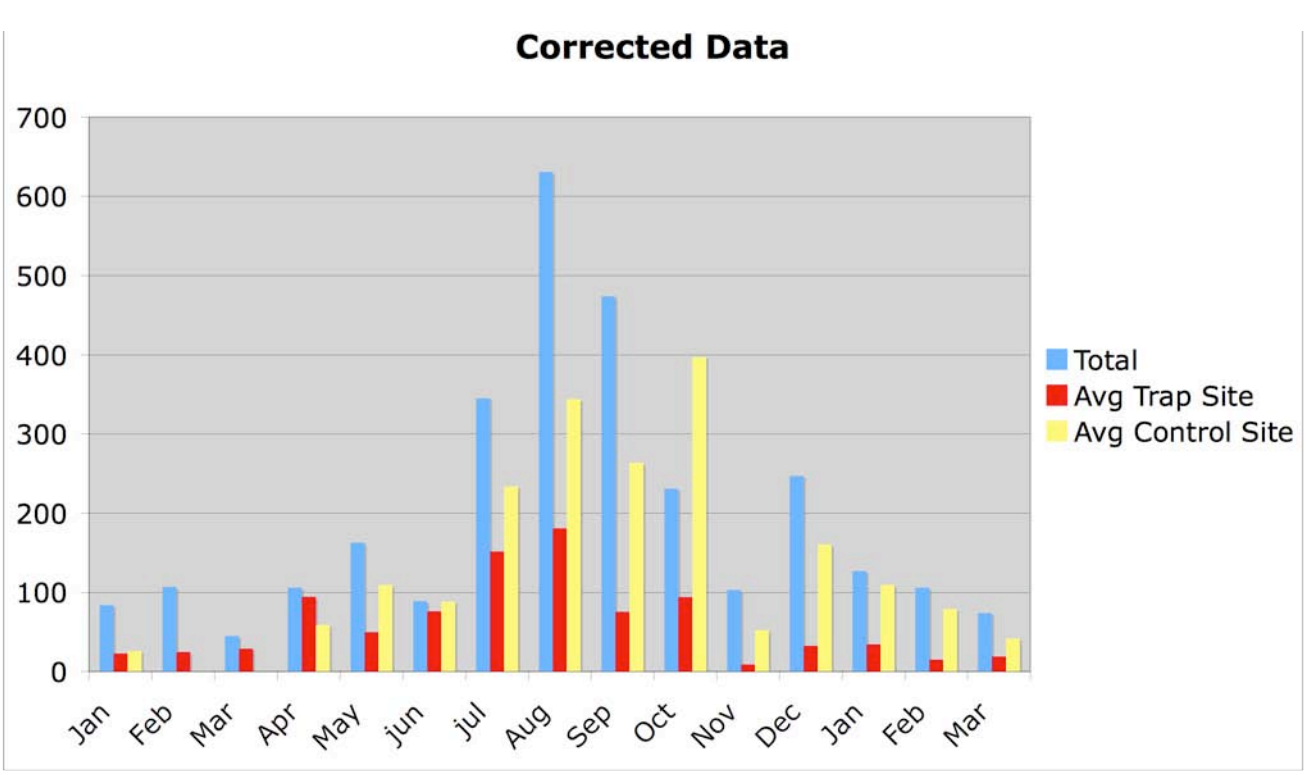
Traps were set with lights to attract the toads. A range of fluorescent lights have been trailed, including Black light UV and White light tubes. All types of lights caught toads but the UV lights appear to work better. We are currently testing Black light Insect and Black light Blue wavelengths of light.

Image 3 Dam site 2 Control site

3 RESEARCH OUTCOMES

Results from the placement of the traps on the shoreline of the dam on Ringwood station is that traps can limit the build up of toads. Compared to the nearby control site the numbers of cane toads at the trapping location have been reduced significantly, approximately 74%. The total capture to date (Apr 2006) is 2990 toads.

Results have shown a build up of numbers as the surface water decreased at the end of the Wet season (Late April 2005). This build up continued during July and August. The trials have also shown an increase in the effectiveness of the traps in terms of the capture rate and the impact on the population at the trapping site compared to the control site.



The graph below shows the result from the trial site.
The blue lines show the **total** monthly captures, the red line shows the **average** of the monthly counts on Dam 1 (trapping site) and the yellow bars show the **average** counts for Dam 2 (the control site). Note there were no counts on the control site in Feb and March due to access issues during the wet season.

The toad population would appear to have been significantly reduced by the trapping to date, approximately 70%. We have used the traps alone and no other mechanisms and are confident that we could accelerate the process by using more traps and some manual control measures such as toad musters.

The low capture rate in March is probably due to a combination of long grass making the lights harder to see and the fact that insects were so prolific that the insect ball at the trap was larger than the trap. This meant toads could get a feed of insects without going into the traps.

The jump in toad numbers in April was probably due to the onset of the dry season and much of the ephemeral surface water vanishing causing the toads to move in on the more permanent water sources. The significant jump in numbers in July-August coincides with smaller waterholes in creeks and shallow wetlands drying up. This would support the idea that toads will congregate on permanent water points but further research is needed to verify the extent of this. Observations indicate it is a very strong effect.

The capture of toads appears to be decreasing the toad population significantly at site 1 (red Bars) compared to the control site (Yellow bars). The capture rate is increasing as the Dry season progresses. Counts indicate approximately 74 % reduction to date.

4 PRELIMINARY DATA ANALYSIS

The following statistical analysis looks at the results.

1. **Is there a significant change in numbers over time for supertrap captures, trapped site observations, and control site observations?**

4.1 CAPTURES (MONTHLY AVG)

There appears to be a significant 2nd order polynomial trend from January 2005 to March 2006 (P < 0.0444) suggesting an increase in toad captures during the dry season and a decline in toad captures during the wet season.

Regression Summary
capture.2 vs. month

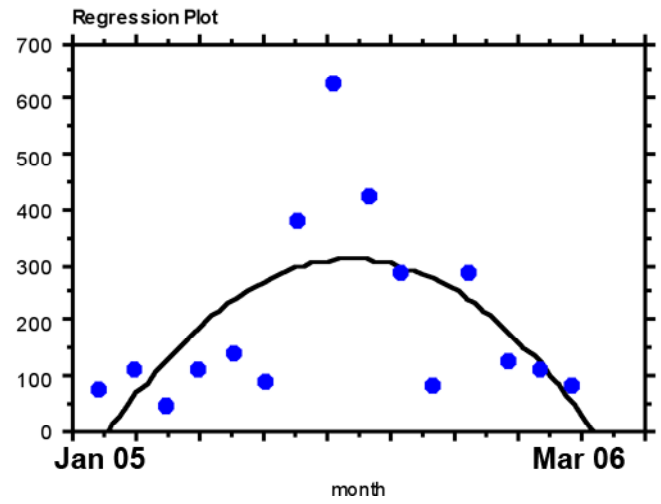
Count	15
Num. Missing	55
R	.636
R Squared	.405
Adjusted R Squared	.306
RMS Residual	138.822

ANOVA Table
capture.2 vs. month

	DF	Sum of Squares	Mean Square	F-Value	P-Value
Regression	2	157304.160	78652.080	4.081	.0444
Residual	12	231257.573	19271.464		
Total	14	388561.733			

Regression Coefficients
capture.2 vs. month

	Coefficient	Std. Error	Std. Coeff.	t-Value	P-Value
Intercept	-8826529.259	3147049.544	-8826529.259	-2.805	.0159
month	.006	.002	392.957	2.804	.0159
month^2	-8.583E-13	3.062E-13	-392.834	-2.803	.0160



4.2 SIGHTING TRAPPED SITE (MONTHLY AVG)

There appears to be a significant 2nd order polynomial trend from January 2005 to March 2006 (P < 0.0198) suggesting an increase in toad sightings during the dry season and a decline in toad sightings during the wet season at the trapped site.

Regression Summary
c1avg vs. month

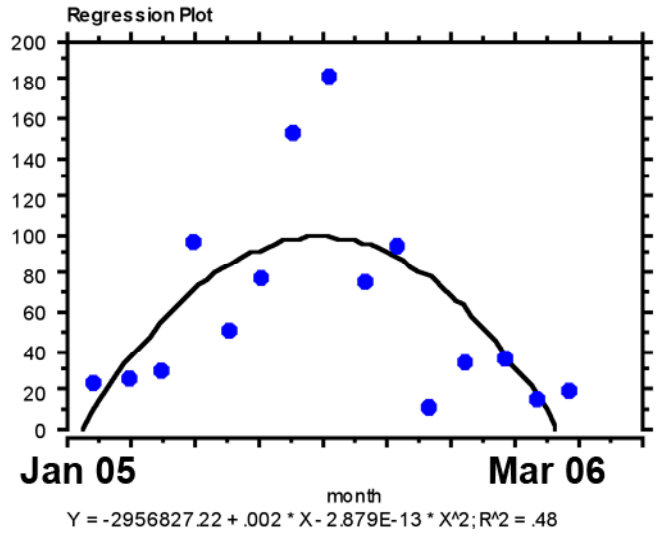
Count	15
Num. Missing	55
R	.693
R Squared	.480
Adjusted R Squared	.393
RMS Residual	40.185

ANOVA Table
c1avg vs. month

	DF	Sum of Squares	Mean Square	F-Value	P-Value
Regression	2	17885.132	8942.566	5.538	.0198
Residual	12	19378.081	1614.840		
Total	14	37263.213			

Regression Coefficients
c1avg vs. month

	Coefficient	Std. Error	Std. Coeff.	t-Value	P-Value
Intercept	-2956827.220	910984.487	-2956827.220	-3.246	.0070
month	.002	.001	425.363	3.247	.0070
month^2	-2.879E-13	8.863E-14	-425.515	-3.248	.0070



4.3 SIGHTINGS CONTROL SITE (MONTHLY AVG)

There appears to be a significant 2nd order polynomial trend from January 2005 to March 2006 (P < 0.0437) suggesting an increase in toad sightings during the dry season and a decline in toad sightings during the wet season at the control site.

Regression Summary
c2avg vs. month

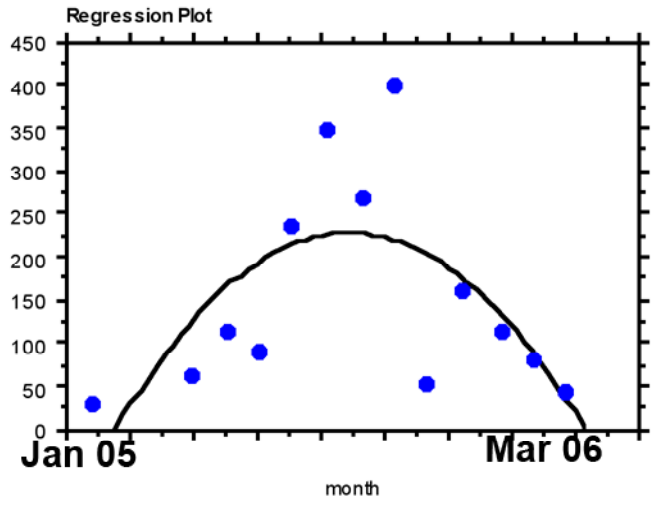
Count	13
Num. Missing	57
R	.682
R Squared	.465
Adjusted R Squared	.358
RMS Residual	96.912

ANOVA Table
c2avg vs. month

	DF	Sum of Squares	Mean Square	F-Value	P-Value
Regression	2	81740.604	40870.302	4.352	.0437
Residual	10	93919.907	9391.991		
Total	12	175660.511			

Regression Coefficients
c2avg vs. month

	Coefficient	Std. Error	Std. Coeff.	t-Value	P-Value
Intercept	-6905040.676	2346523.964	-6905040.676	-2.943	.0147
month	.004	.001	396.480	2.942	.0147
month^2	-6.713E-13	2.282E-13	-396.430	-2.942	.0147



2. Is there a significant difference in densities between the trapped site and the control site?

A paired t-test (comparison of means) shows a strongly significant difference when considering all (raw) data, and a significant difference when considering monthly averages. However, this simply shows that there is a significant difference in the densities sighted at each location over time.

Individual datapoints: Paired t-test ($P < 0.0001$)

Paired t-test
Hypothesized Difference = 0

	Mean Diff.	DF	t-Value	P-Value

Monthly average: Paired t-test ($P < 0.0054$)

Paired t-test
Hypothesized Difference = 0

	Mean Diff.	DF	t-Value	P-Value

3. Is there a correlation between captures and counts at the trapped site and the control site?

4.4 CAPTURES V COUNTS TRAPPED SITE (MONTHLY AVG)

There is a strong relationship ($P < 0.0003$) between supertrap captures and the number of toad counts at the trapped site.

Regression Summary
c1avg vs. capture.2

Count	15
Num. Missing	55
R	.805
R Squared	.648
Adjusted R Squared	.621
RMS Residual	31.782

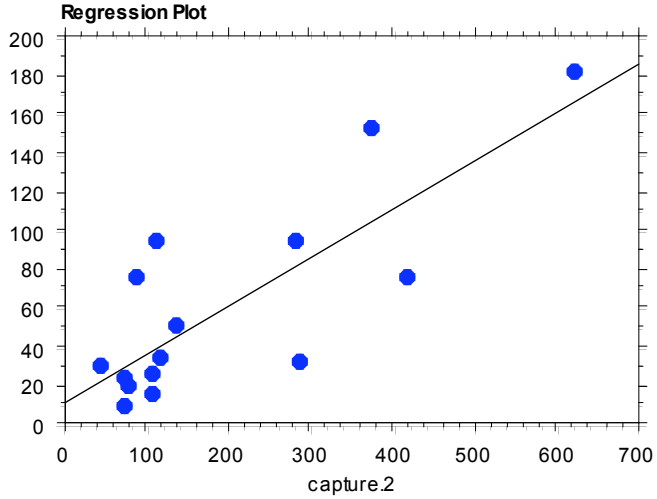
ANOVA Table
c1avg vs. capture.2

	DF	Sum of Squares	Mean Square	F-Value	P-Value
Regression	1	24132.050	24132.050	23.891	.0003
Residual	13	13131.163	1010.089		
Total	14	37263.213			

Regression Coefficients
c1avg vs. capture.2

	Coefficient	Std. Error	Std. Coeff.	t-Value	P-Value
Intercept	11.854	12.910	11.854	.918	.3752
capture.2	.249	.051	.805	4.888	.0003

Regression Plot



Y = 11.854 + .249 * X; R^2 = .648

4.5 CAPTURES V COUNTS CONTROL SITE (MONTHLY AVG)

There is a strong relationship (P < 0.0003) between supertrap captures and the number of toads spotted at the control site.

Regression Summary
c2avg vs. capture.2

Count	13
Num. Missing	57
R	.844
R Squared	.712
Adjusted R Squared	.685
RMS Residual	67.851

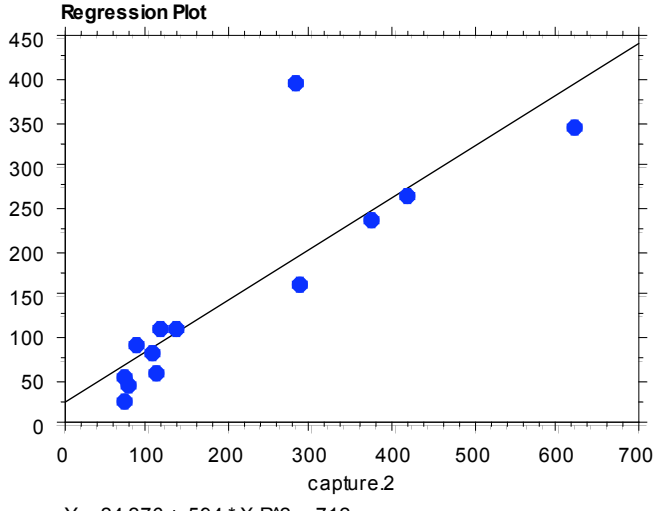
ANOVA Table
c2avg vs. capture.2

	DF	Sum of Squares	Mean Square	F-Value	P-Value
Regression	1	125018.574	125018.574	27.155	.0003
Residual	11	50641.937	4603.812		
Total	12	175660.511			

Regression Coefficients
c2avg vs. capture.2

	Coefficient	Std. Error	Std. Coeff.	t-Value	P-Value
Intercept	24.276	30.774	24.276	.789	.4469
capture.2	.594	.114	.844	5.211	.0003

Regression Plot



4.6 MULTIPLE REGRESSION – TRAP EFFECT

The two figures above show that supertrap captures show a strong relationship between toad counts at both trapped and control sites. However, a multiple regression tests which of these two relationships is the strongest. Here, the relationship between captures and trapped site counts (count1) is much stronger than the relationship between captures and control site counts (count2). This suggests that the number of captures has a strong relationship with the number of toads seen at the trapped site, but much less so at the control site. This supports the hypothesis that toad trends at the trapped site are different to the control site, and suggests that trapping is affecting toad trends.

Regression Summary
capture vs. 2 Independents

Count	42
Num. Missing	28
R	.469
R Squared	.220
Adjusted R Squared	.180
RMS Residual	52.376

ANOVA Table
capture vs. 2 Independents

	DF	Sum of Squares	Mean Square	F-Value	P-Value
Regression	2	30145.470	15072.735	5.495	.0079
Residual	39	106985.101	2743.208		
Total	41	137130.571			

Regression Coefficients
capture vs. 2 Independents

	Coefficient	Std. Error	Std. Coeff.	t-Value	P-Value
Intercept	22.930	13.014	22.930	1.762	.0859
count1	.414	.179	.452	2.309	.0263
count2	.008	.066	.023	.119	.9060

5 OBSERVATIONS

We have a number of observations and findings which we are hoping to follow through on with additional research and trials at other sites.

During the late dry season in the Wet dry tropics cane toads are very susceptible to trapping with light based traps.

Male captures are much more prevalent than female captures close to water (less than 10m from edge) during the wet season.

There were differences in the counts at the trapping site early in the trial indicating that the trap was reducing the number of toads on that side of the dam. Consistently

the count was lower on the trap side. In the week when the light failed and no toads were caught the numbers were more even.

A second trap was added as it was apparent the toads on the eastern side, the right of the image above, were not moving to the trap during the wet season when insects were plentiful. It was unclear what distance the traps will attract toads from and we had a trap on each side making a trap every 500 metres of shoreline approximately.

This trap was set 30 metres from the edge of the water to see if more females would be caught. Preliminary indications are that females toads are keeping back from the edge of the water but appear to be moving in to the edge more as the dry season sets in.

A third trap was added in late May to cover a specific location at a major refuge site near the dam.

6 QUESTIONS

Would other controls such as increasing the number of traps and manual control supplements increase the rate of toad removal?

What combination of lights needs to be used to maximise capture at different times of the year?

What other attractants can be used to supplement the effectiveness of the lights as lures. We have used dead toads with some positive outcomes.

Are multiple small traps more effective than fewer large traps or vice-versa?

7 CONCLUSIONS

It appears that FrogWatch traps can be used to significantly reduce cane toad numbers around water bodies in tropical savannah and this should now be tested on a broader scale in significant wetlands in national parks.

The traps are humane and cane toad specific. Managing and monitoring of the traps is easy and traps only need checking once every few weeks. As long as water is maintained in the traps the toads appear to flourish in the traps coming out to feed on insects each night.

We are hoping to verify these results with additional research during 2006 – 07