Viwa Feasibility Report

ERADICATING CANE TOADS (*Bufo marinus*) AND PACIFIC RATS (*Rattus exulans*) FROM VIWA ISLAND, FIJI.

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Viwa Feasibility Study Report

Report Date 28 February 2004

Published by:
The Department of Biology
The University of the South Pacific
P.O. Box 1168
Suva, Fiji Islands

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Executive Summary

The main goals of this report are:

1) **To determine the feasibility and value of eradicating cane toads and rats off Viwa Island.**

2) **To protect the Fijian ground frogs on Viwa Island from extirpation.**

Historically, the Fijian ground frog (*Platymantis vitianus*) was distributed throughout Fiji but has been extirpated from most its range thanks to the arrival of introduced predators such as the small Indian mongoose (*Herpestes javanicus*). Currently, the Fijian ground frog (FGF) is **extant on only four mongoose-free islands**, Taveuni, Ovalau, Gau and Viwa. Viwa is the **smallest and most vulnerable population** of the four islands with the FGF's and we believe this population is **under further threat from another invasive species, the cane toad (*Bufo marinus*).** Currently, no cane toads (CT) exist on the island of Gau and the FGF's on Gau are much larger in size and considerably more numerous than on any of the other three islands where CT's and FGF's exist. This leads us to believe that CT's are limiting FGF's. To test this hypothesis, **we propose that CT's be eradicated off Viwa**, as it is the smallest and most accessible island with both species.

Removing the CT's will be problematic but there are a number of techniques that could be effective to eradicate these pests. To date, **nobody has seriously attempted to eradicate CT's** before and this unique opportunity will provide us with a chance to test which method(s) is needed to remove CT's from an area. The best approach to eradicate these pests will involve an **integrated pest management plan**, combining the advantages of mechanical, biological and quite possibly chemical methods, while avoiding their respective disadvantages through careful planning. Thus, **we are confident** that we can eradicate CT's off Viwa.

Pacific rats, (*Rattus exulans*) are also possible predators of FGF's, **and they should be removed from Viwa,** as these rats are also **a health and nuisance threat** to the people. Even though many organisations around the world have experience removing rats off small islands like Viwa**, some concerns** have been raised about the use of toxins in the environment and whether invasive weeds will bounce-back once the rats have been removed. As toxins may also be used to assist in eradicating CT's, there is an urgent need to resolve this issue, especially on an island with an endangered species and people. Fortunately, there is plenty of research into this issue from around the world and we believe we can answer this question without having to conduct any extra experiments in Fiji.

However in the meantime, a **small exclosure experiment** should be carried out on Viwa so we can experimentally evaluate the impacts of CT's and rats on FGF's. If rats and CT's are found to be a limiting factor on FGF's, then we recommend that the **rats be eradicated but only after we eradicate the CT's** (provided the issue about toxins in the environment has been resolved). The other issue that requires immediate attention is the development of some biosecurity **policies and measures to prevent any possible re-invasions.**

Another option is to **eradicate rats off another island** without any endangered species or people on it but this option will not reveal whether rats are predators on FGF's. We also recommend that **information from other eradication projects in the tropics be shared** with this project e.g. material from the SPREP rat eradication project on the islands of Nu'utele and Nu'ulua in Samoa.

Cats (*Felis catus*) are considered a threat to FGF's. Their removal is warranted but not an immediate priority. Dogs (*Canis familiaris*) are another potential threat to FGF's but their removal would be for political reasons to help the local islanders rather than for ecological reasons. It should be pointed out that the **rat, cat and dog eradication should not hinge on the success of the CT toad removal project**. If rats are found to be predators on FGF's they should be removed immediately after the CT eradication programme.

The people of Viwa have given their permission to proceed with the eradication work and a strong relationship has been established and provided we involve the islanders in every step of this process we will continue to have their total support. Irrespective of the scientific findings, both CT's and rats are unwanted pests on Viwa and the islanders see their removal as a positive move to help restore the original fauna. It is envisaged that a project manager from Viwa be appointed to oversee the bulk of the work, **most of which will be carried out by the islanders themselves.** Additional supervision and expertise will be provided from USP and other vested parties. USP will have two students working on Viwa this year.

Finally, to ensure the survival of these frogs, **a FGF recovery programme** should be developed that incorporates many of the suggestions put forward in this feasibility report. A recovery plan and group is necessary if we are to ensure the survival of the FGF's and for establishing protocols for translocating FGF's to new locations.

If we can successfully eradicate CT's and rats off Viwa then this project would have **significant global conservation implications.** We appreciate there are a number of uncertainties with this project but there is also a realisation that if nothing is done then this critically endangered population of frogs will go extinct. Therefore, **the risk of doing nothing is not an option.**

Key Recommendations for Immediate Action

Recommendation 1.

That before toxins are used we need to know what environmental harm may result from their use, what type of toxins should be used to kill CT's, and what are the best methods for delivering these toxins to the target animals? This will involve bait acceptance trials, toxicity tests, and diets studies for all species concerned.

Recommendation 2.

That before any eradication programme takes place; we need to collect sufficient scientific data to evaluate the impacts that CT's and rats may have on FGF's. This will involve establishing exclosure plots, and surveying Viwa's FGF, CT, rat and animal populations.

Recommendation 3.

That biosecurity measures and controls be imposed before any eradication work takes place. This will involve border controls between the mainland and Viwa and an educational campaign.

Recommendation 4.

That a viable captive breeding programme be established at Kula Ecopark, Fiji, to preserve the genetic structure of the FGF's. This will involve developing translocation procedures and examining the genetic biodiversity of FGF's.

Recommendation 5.

That a FGF recovery plan be written. This would cover the distribution and abundance of FGF's, threats and conservation status, past research and conservation efforts, all the current research priorities, management objectives and a work plan with due dates for completion of work.

Please note: the Viwa Islanders will be involved in every recommendation suggested above.

Contents

FEASIBILITY REPORT FOR THE FIJIAN GROUND FROG

1. INTRODUCTION

The Fijian ground frog (*Platymantis vitianus*) is listed by the IUCN as critically endangered (IUCN 2003). There are the only two extant endemic amphibians in Fiji, the larger ground frog and the smaller tree frog (*P. vitiensis*) (Morrison, 2003; Pernetta & Watling, 1978).

Ground frogs once lived throughout Fiji but now only survive on islands without mongoose. A giant Fijian ground frog as big as *Discodeles guppyi* (from the Solomon Islands) also once lived in Fiji but it is not certain when this frog went extinct (Worthy, 1999). However, introduced predators such as the Pacific rat (*Rattus exulans*) may have been one of the agents for their decline and they may have also helped limit the current population of FGF's.

The Fiji Biodiversity Strategy and Action Plan (FBSAP 1999), reports little research has been done on the frog(s) in Fiji and virtually nothing is known about their breeding, ecology or behaviour (Gorham, 1971; Ryan, 1985). However, a team of USP students headed by Joape Kuruyawa with funding from BP International has just returned from a 3-month survey (Dec 2003-Feb 2004) of the four known islands with FGF's. Their results on the distribution and abundance of the FGF's will be published once the data has been analysed (J. Kuruyawa *pers comm*.).

2. DISTRIBUTION AND POPULATION TRENDS

Ground frogs were once distributed throughout Fiji. Their decline may have started well before European colonization as the Fijians ate the frogs and introduced the Pacific rat (Ryan, 2000).

The BP team found FGF's on Ovalau, Taveuni, Gau, and Viwa and they heard anecdotal reports of FGF's on Koro, Laucala, Qamea and Kadavu (J. Kuruyawa *pers. comm*.). However, these islands were surveyed back in the early 1980's and nobody knows whether these FGF's are still present. Of the four islands with FGF's, Gau Island is the only island without CT's. This year, Alivereti Naikatini (a technician at USP), surprisingly found two FGF's in Waisali Reserve on Vanua Levu. Previously, they were thought to be extirpated from Vanua Levu.

No FGF's are kept in captivity, here or overseas – or at least there are no records of any.

3. CAUSES OF DECLINE AND THREATS

Mongoose (*Herpestes javanicus*), along with a further two species of rat (*R. rattus, and R. norvegicus*), cats (*Felis catus*), dogs (*Canis familiaris*), pigs (*Sus scrofa*), goats (*Capra hircus*) and cane toads (*Bufo marinus*) were introduced by European colonists and together (along with habitat destruction), these invasive species have been the main agents for the decline of FGF's and other species in the Pacific (Atkinson, 1985; Courchamp et al., 2003; Gorman, 1975).

Nobody knows when the FGF's disappeared from Viti Levu but indirect evidence points to the arrival of the mongoose, as no FGF's (except for a small population in the Waisali Reserve on Vanua Levu) exist where mongoose are present (Pernetta & Watling, 1978).

FGF's still exist where cats, rats and CT's live but probably at lower densities than they would if these invasive species were not present. The recent survey by the BP Conservation Team found that there were generally more FGF's on Gau Island than on the other three islands with both FGF's and CT's (J. Kuruyawa *pers. obs*.). They also reported that the FGF's were considerably larger on Gau than found elsewhere. Although this data has yet to be analysed statistically, this anecdotal evidence suggests that CT's may quite possibly be a potential threat to the long-term survival of the FGF's.

4. LONG TERM RECOVERY GOAL

The genetic diversity of the FGF's will be maintained by returning all existing populations to their natural levels and establishing new wild populations of FGF's throughout their pre-human range as components of healthy ecosystems.

5. OPTIONS FOR CONSIDERATION

WHICH OPTION IS THE PREFERRED OPTION TO TAKE?

Option 1. Do nothing. Leave the known populations alone.

Option 2. Maintain existing populations but do not establish new wild populations nor increase public accessibility to the ground frogs.

Option 3. Maintain and pursue eradication programmes of CT's toads, rats, cats and dogs of Viwa. We should also consider a captive management (e.g. a **Head-Start** programme) to encourage public awareness and raise funds for the future of the ground frogs in Fiji. This will also be useful for maintaining genetic variability and having frogs to reintroduce to other previously known FGF islands.

KEY QUESTIONS FOR THE FEASIBILITY STUDY

1. Is eradicating one or more of the invasive vertebrates on Viwa Island feasible
2. How might eradication (and biosecurity) be achieved?
3. What are the implications or eradicating these animals and how should these be addressed?
4. What actions should be taken, and by whom?

6. VIWA ISLAND

Viwa Island is approximately 30kms northeast of Suva and 10 kms north of Nausori. The departure point for the island is the Bau Landing some 3 kilometres away. The nearest land to Viwa is Viti Levu, which is 900 m away, and Bau Island that is more than 1.5 km away. At low tide the distance between Viti Levu and Viwa may only be 800 m. There are two main landing points on the island and the use of these depends upon the tide.

The island is 0.6 km^2 (60 ha) and has a maximum elevation of 49m (Figure 1). It can be traversed with relative ease, as there are many tracks. Even where there are no tracks, one can still move around without too much difficulty. Viwa has one main settlement with 25 houses (97 people normally live on the island but another 150+ Viwa Islanders live on the mainland). There are two other houses on the island, although only one is occupied.

Although there are six streambeds on the island they only flow during the wet season. When we visited Viwa (theoretically the beginning of the wet season) none of the streambeds had any water. There are four permanent ponds on the island. These were originally used for bathing and washing clothes. However, their current state indicates that they are not being utilised and indeed are probably only useful as toad and mosquito breeding ponds. The villagers drink mainly rainwater but some people also have deep wells with brackish freshwater. These wells act as "attractants" to the toads, which seek water in to hydrate and reproduce. These wells often have adult toads in the bottom of them and it is doubtful whether an adult toad could escape but a juvenile metamorph might be able too.

The island has no real sandy beaches anywhere but does have small rocky outcrops and ledges going to the water's edge. There are extensive mangrove (*Rhizophora* spp.) populations in the southwest and northeastern areas (Figure 1). Viwa still has some good forest cover but many of the trees are human-dispersed fruiting varieties such as; maqa (or mangoes; *Mangifera indica*), weleti (or pawpaw; *Carica papaya*), uto (or breadfruit; *Artocarpus altilus*), vudi (or banana trees: *Musa* spp.), niu (or coconut trees; *Cocos nucifera*), ivi (or Tahitian chestnut trees; *Inocarpus fagifer*), vadra (or Pandanas; *Pandanas vitiensis*), and vuturakaraka (or poison fish tree; *Barringtonia asiatica*).

The general lifestyle of the people on the island is subsistence fishing and cultivation. The main crops grown are: dalo (or taro; *Colocasia* Spp.), tavioka (or cassava; *Manihot esculenta*), uvi (or yams; *Discorea alata*), the giant taro (*Alocasia macrorrhiza*) and swamp taro (*Cyrtosperma chamissonis*). Since the time of my first visit two years ago, there has been a large increase in forest clearance to plant crops. However, even with this clearance for crops over a half of the island is still forested, albeit with fruiting trees and some common invasive plants such as vaivai (*Leucaena leucocephala*) and kauboica (or lantana; *Lantana camara*).

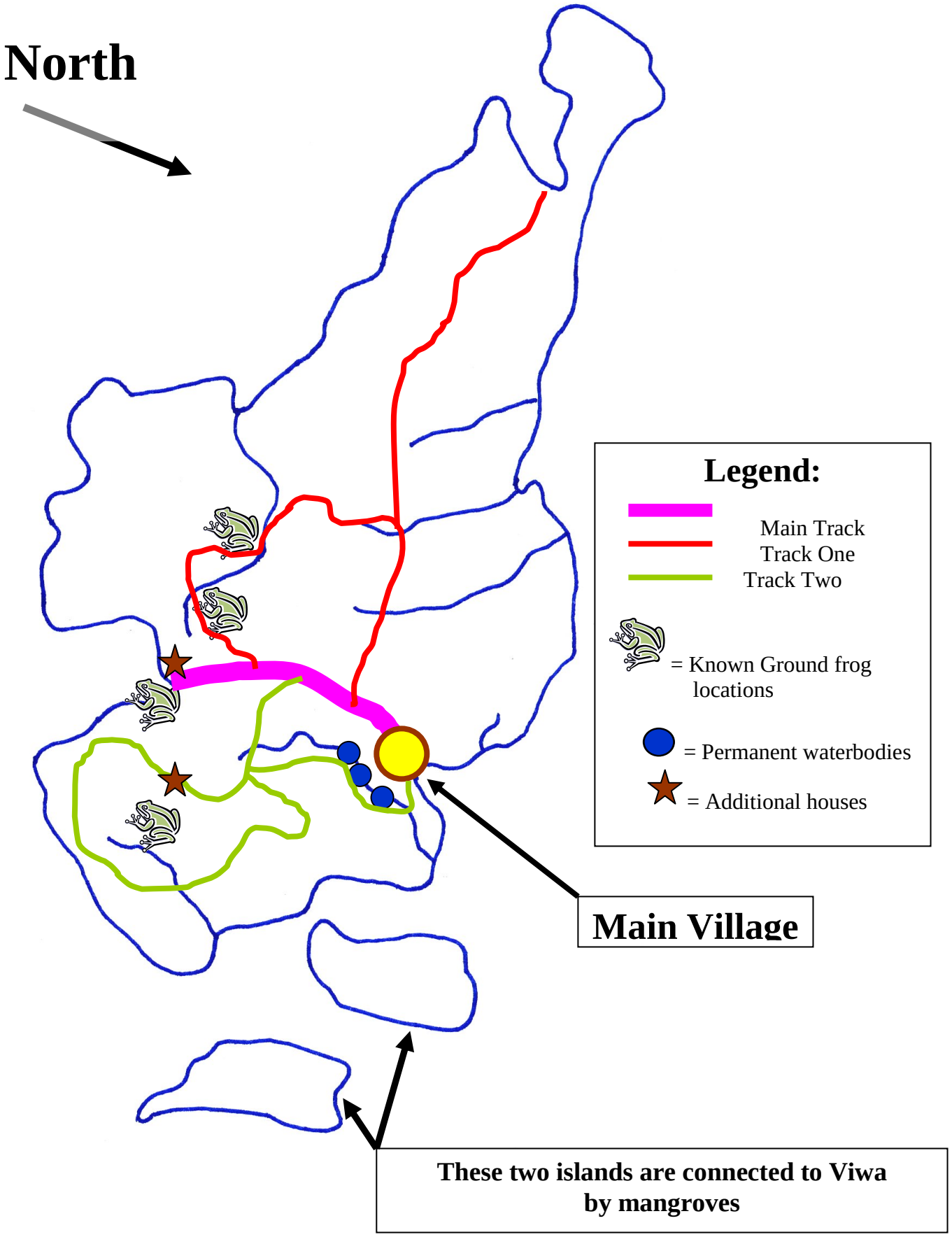
The native herpetofauna consists of; the pacific boa *Candoia bibroni*, the oceanic gecko (*Gehyra oceanica*), the pelagic gecko (*Nactus pelagicus*), the brown-tailed copper-striped skink (*Emoia cyanura*), the blue-tailed copper striped skink (*E. impar*) and the Fijian green tree skink (*E. concolor).* The banded iguana (*Brachylophus fasciatus*) has also been observed on the island (by the villagers) but in all our time searching we never saw it.

Several regionally important birds live on Viwa (Table 1); they are; the golden dove (*Chrysoenas luteovirens*), many coloured fruit dove (*Ptilinopus perousii*) and banded rail (*Gallirallus philippensis*). Because of the large number of fruiting trees, 24 species of bird have been recorded which is unusually high for such a small island.

Table 1. Birds on Viwa as recorded by C. Morley in April 2002.
All birds are native except the two mynah species, bulbuls and spotted doves.

Common Name	Scientific Name
Common mynah (I)	*Acridotheres tristis*
Jungle mynah (I)	*Acridotheres fuscus*
Bulbul (I)	*Pycononotus cafer*
Grey-backed white-eye	*Zosterops lateralis*
White-rumped swiftlet	*Aerodramus spodiopygia*
Orange-breasted honeyeater	*Myzomela jugularis*
Barking pigeon	*Ducula latrans*
Slaty monarch	*Mayrornis lessoni*
Fiji goshawk	*Accipter rufitorques*
Reef heron	*Egretta sacra*
Vanikoro Broadbill	*Myiagra vanikorensis*
White-collared kingfisher	*Halcyon chloris*
Spotted dove (I)	*Streptophella chinensis*
Wattled honeyeater	*Foulehaio carunculata*
Triller	*Lalage maculosa*
Swamp harrier	*Circus approximans*
Woodswallow	*Artamus mentalis*
Fiji Shrikebill	*Clytorhyrchus vitiensis*
Banded rail	*Gallirallus philippensis*
Golden dove	*Chrysoenas luteovirens*
Many coloured fruit dove	*Ptilinopus perousii*
Barn owl	*Tyto alba*
White throated pigeon	*Columba vitiensis*
Red-headed parrot finch	*Erythrura pealii*

Figure 1. Distribution of Fijian ground frogs, tracks and permanent breeding sites for cane toads on Viwa Island.



7. ISSUES AND ACTIONS - CANE TOADS (CT)

Issue 1

Q. Is eradicating cane toads on Viwa Island feasible?

A. Yes, we expect the likelihood of success to be high if executed over a sustained period.

PLEASE NOTE: that all work (ACTIONS) will be done in conjunction with the **local people of Viwa Island**, even if this action has been assigned to another party.

Due to the high fecundity and long-life span of CT's toads the feasibility of eradicating CT's toads is difficult to assess as this work has never been seriously undertaken anywhere else in the world.

Many practical eradication techniques have been suggested (See Report 2; Aim 3) and a few other researchers (see the emails in the Appendix) have also provided some useful information. We appreciate that there is a huge knowledge gap when it comes to choosing an effective eradication technique and we will need to adopt an integrated pest management approach, combining the advantages of mechanical, chemical, physical and biological methods, while avoiding their respective disadvantages through careful planning.

We would like to emphasise the point that until we try eradicating CT's we will never know which method(s) will provide us with the best solution. Fortunately, many of the techniques suggested are not expensive but they are labour-intensive and time-consuming.

Some preliminary research questions need to be answered before any eradication work is started. Many of these questions can be determined quickly and cheaply using good experimental design protocols.

1) Will cane toads consume ground laid baits?
2) Are cane toads susceptible to the second-generation anti-coagulant brodifacoum? (or any other known poisons?). If they are susceptible – at what level of poison?
3) Are cane toads susceptible to citric acid or acetic acid sprays?
4) Are cane toads susceptible to copper toxicity? (e.g. copper sulphate).
5) What amount of rotenone (or deris dust) is required to poison a large water body?
6) Can people on Viwa identify the eggs produced by cane toads?
7) Can people on Viwa identify toad calls?

ACTION: Yet to assigned. This could involve students from USP, Griffith University (GU) and/or another university/NGO and the people from Viwa Island.

8. ISSUES AND ACTIONS - CANE TOADS and FIJIAN GROUND FROGS

Issue 2

Very little is known about FGF's or CT's in Fiji and our concern is that our well-intended actions could impact on the FGF population. Therefore, we need a field programme to investigate the current status of the FGF's and CT's before any eradication work is carried out.

1. Identify and map the distribution, abundance and habitat preferences of Fijian ground frogs on Viwa Island.

   ACTION: To be done by Nunia Thomas (an MSc. Student, USP).

2. Determine the breeding sites and reproductive phenology of Fijian ground frogs on Viwa Island.

   ACTION: To be done by Nunia Thomas (an MSc. Student, USP

3. Identify and map the current land-use on the island, and initiate a long-term management plan to protect breeding sites from disturbance by local villagers on Viwa Island.

   ACTION: To be designated. This will involve Nunia Thomas, the Fijian Affairs Board (FAB -Alivereti Bogiva), and the Provincial Roko Tui (local government administrator)

4. Identify and map the distribution and abundance of CT's on Viwa Island.

   ACTION: To be done by Nunia Thomas (an MSc. Student, USP).

5. Determine the breeding sites and reproductive phenology of CT's on Viwa Island.

   ACTION: To be done by Nunia Thomas (an MSc. Student, USP).

6. Establish a frog recovery group to develop a recovery plan for the long-term survival of the FGF's.

   ACTION: Yet to be assigned. This should involve Fijian representatives, frog experts, wildlife management and conservation experts, ISSG personnel, and academics.

7. Ascertain at what time of year would it be best to target CT's in an eradication campaign

   ACTION: Yet to be assigned. This should involve Fijian representatives, frog experts, wildlife management and conservation experts, ISSG personnel, and academics.

9. ISSUES AND ACTIONS - MAMMALIAN PREDATORS

Issue 3

Q. Is eradicating Pacific rats on Viwa Island feasible?

A. Technically, the operation to remove Pacific rats off Viwa is feasible.

However, there are a number of issues that must be first resolved (as outlined in Report 1). These include:

Approval.

Approval has been sought and given by the chief and people of Viwa.

ACTION: This is an on-going process. It will only be after continual consultation with the Village Chief, Turaga ni Koro (village administrator) and talanoa (discussions) with the people and the Fijian Affairs Board (Alivereti Bogiva) that the final decision can be made, however, we see no problems in the future. Indeed, the islanders are extremely eager for this work to be done.

1) **What other approvals are required under Fijian Law?**

   No other approvals are required as we are already working through the Fijian Affairs Board and local Provincial Council (Roko Tui's = Provincial chief).

2) **Is any form of central or local government consent required?**

   No, the Fijian Affairs Board is acting as the central government representatives. Ultimately, the final decision is with the landowners themselves and we have their full support at this stage in the proceedings.

3) **Can the necessary toxins be imported into the country?**

   Yes, providing we seek approval through the Ministry of Health. However, some concerns have been raised about the environmental impact of using toxins in Fiji. We will need to clearly show that these toxins are safe before we can proceed with any rat or CT poison campaigns.

   It should also be pointed out that toxins, such as second-generation anti-coagulants like brodifacoum, might also be the key to eradicating CT's so the question about their impact on native species requires urgent attention. Much of this information will come from research work elsewhere, rather than setting up new trials here in Fiji. Once, this matter has been resolved and we establish if rats are a problem (see Issue 4) then we recommend that the rat eradication programme on Viwa occur after the CT work has be done.

MAMMALIAN PREDATORS - *Issue 4*

Q. Should rats be eradicated off Viwa?

A. Yes, their removal is warranted based on ecological, political, and health grounds.

However, Pacific rats (*R. exulans*) have been in Fiji for well over 1000 years but we have no scientific data on whether they are FGF predators. Although rats have not driven FGF's on Viwa extinct (thus far), we believe they are suppressing FGF numbers. Support for this view comes from many examples where rats have been eradicated and reptile numbers have subsequently increased.

We acknowledge that there is mounting evidence in the published literature of the impacts of rats on islands from around the world, but some concerns have been raised about using toxins to kill the CT's and rats and whether the removal of rats will create some sort of invasive weed bounce-back. Therefore, we need to justify the use of toxins in an eradication programme and to state that they will not cause any undue harm to any native species.

To assess if CT's and rats have an impact on FGF's a small exclosure experiment could be carried out. The exclosure experiment should have the following 3 treatments: 1) rats and FGF's but no CT's, 2) CT's and FGF's but no rats, and 3) FGF's but no rats or CT's. The first treatment will allow rats to move in and out of the exclosure but will prevent CT's getting in. A simple, but low, wire mesh fence to stop the CT's hopping in will suffice. The second and third treatments will be more difficult but rat proof fences have been developed in New Zealand that could be utilised. In the second treatment CT's would be present with FGF's and in the third treatment, no CT's or rats will be present. Control plots of the same size, as the exclosures will have all 3 species present.

Because of their historical coexistence, we believe we should target CT's first before we remove the rats. This will give us time to collect information on the safety of toxins for the Fijian Government and to develop some better non-toxic CT eradication techniques. A second option is to trial a rat eradication programme on another island without any endangered species or people on it to show the results of removing rats and to assess any environmental changes. However, this project will not inform us if rats limit FGF populations.

Rats are unlikely to eat CT's because of their toxicity; however, if we eradicate rats first then we may face problems of prey switching by Pacific boas that can consume FGF's. If we can remove CT's first we believe that native skink and gecko numbers will also benefit (increase) and so the prey switching scenario may not be as important as boas normally eat geckos.

Finally, the people of Viwa consider rats to be a major pest as they eat their crops and stored foodstuffs. Rats are also a well-known health risk to people (e.g. spreading leptospirosis) and thus, there are strong political and health reasons to eradicate the rats off Viwa.

ACTION: A rat exclosure experiment should demonstrate if CT's and rats are a threat to FGF's. If rats are found to limit FGF's then a rat eradication programme should be carried out but only after the CT eradication work. In essence, we should set up a monitoring programme as part of a before-after-control impact (BACI) design. In the meantime, rat eradication work in Fiji could be assessed on a separate non-inhabited island (e.g. Macuata Island in Ra, north of Viti Levu). This island is 40 ha, has a similar altitude, and is almost the same distance from the mainland as Viwa.

MAMMALIAN PREDATORS - *Issue 5*

Q. What is the best method to eradicate the rats?

A. We recommend hand broadcasting of brodifacoum bait around the island but within the village we recommend using bait stations.

An aerial application would be an even better method of distributing the bait around Viwa but it is more expensive due to the cost of hiring a helicopter and getting a bait–spreading bucket from New Zealand to Fiji. Nevertheless, it is still a viable and very practical option.

July-September (the dry season) is probably the best time to conduct a rat eradication programme on Viwa, as this is probably the period of greatest food stress for the rats. However, this needs to be tested.

An additional question that requires answering is whether the Pacific rats in Fiji will take the same baits used in the New Zealand rat eradication programmes?

ACTION: Run several trials of non-toxic rat baits in representative 1-hectare areas on Viwa Island. The purpose of these trials should be two-fold; firstly, to confirm bait acceptance by Viwa rats, and secondly, to assess bait take by non-target species (both desirable non-targets, for example, birds and other pest species, for example CT's). We also need to establish when the greatest food stress period is on Viwa. To be done by USP (or others) in full consultation with DoC personnel.

MAMMALIAN PREDATORS - *Issue 6*

What are the threats to operational success?

a) Bait

We will need to investigate whether the toads will out-compete the rats for the baits. If the toads consume the baits (which may or may not be poisonous to them) they may deprive the target species of the baits required to kill them. Therefore, we may have to consider revising the bait application rates in order to cater for the great abundance of toads? However, this may not be a problem if we eradicate the CT's first.

Will the current baits used in New Zealand be palatable to Fijian rats? Rats in Fiji are more likely to be caught using burnt coconut than peanut butter and rolled oats, which is used in New Zealand. Therefore, we will need to determine if rats in Fiji will consume the cereal or fish paste baits used elsewhere.

ACTION: Many of the questions of bait application and consumption can be answered with bait preference trials in captivity and in the field (e.g. after the work on other tropical Pacific Islands such as Macuata Island and Nu'utele and Nu'ulua Islands in Samoa).

b) Non-target species

Banded rail (*Gallirallus philippensis*) are present on Viwa and possibly purple swamphens (*Porphyrio porphyrio*). Both these ground birds would be susceptible to direct and indirect

poisoning from brodifacoum. What other birds may take the surface bait also needs to be examined.

It is highly unlikely that FGF's will consume the bait pellets but this must be tested. However, secondary poisoning of Pacific boas may be problem, although they generally do not eat already dead prey.

ACTION: The non-toxic trials would demonstrate which birds and whether FGF's would consume the ground-sown baits. After several discussions with the local landowners and several bird specialists in Fiji, namely Dr Dick Watling (Environmental Consultants Ltd.) and Dr Guy Dutson (Birdlife International), the unintentional loss of a few birds would be acceptable if the overall health of the ecosystem improves as a result of the eradication of rats and CT's. Indeed, increased bird survival is seen as positive outcome of the removal of these invasive pests.

c) Risks to Human Health.

In New Zealand, DoC would be reluctant to hand broadcast brodifacoum baits in an area of permanent human habitation or places where food animals are kept. The major risks on Viwa would be young children eating baits directly, people handling baits and not washing their hands properly afterwards, chickens, pigs and goats ingesting sub-lethal doses of toxin and later being consumed by humans.

We believe that with proper management and care in bait dispensing and handling, that the short-term inconvenience of not venturing into the hand-dispersed bait zone will outweigh the costs of rats on the island. Viwa is fortunate in that it is close to the mainland and as everyone on the island has relatives nearby they could simply stay with them should they not wish to be inconvenienced. However, should people decide to stay on the island we would advise them not to handle any baits if the went into the poisoned zones and confine their livestock until it is safe to venture to go around the island again. We also recommend that some people be paid to pick up dead rat carcasses and bury them outside the village. In the village (and inside the houses) bait stations should be used instead of spreading the bait by hand. Intensive trapping before placing the bait stations out in the village is recommended.

ACTION: This issue needs to be discussed thoroughly with informed representatives of the local community before they can be expected to make a final decision on whether the operation should proceed. If the villagers leave the island for a period then many of the human health issues can be avoided. Discussions with the Fijian Affairs Board and village representatives may take some time.

d) Reinvasion.

Viwa is only 900 m from the shores of Viti Levu yet mongoose, ship rats and Norway rats have not arrived in the past 100 years. This is promising for an eradication programme as it signals that reinvasion by Pacific rats (and CT's) is remote. However, because of the boat traffic between the mainland and Viwa there is always a possibility of an incursion. Cane toads would be less likely to reinvade (as they were deliberately introduced in the past) than rats.

ACTION: Biosecurity protocols will need to be fully implemented (and practiced), and as most cargo is manhandled onto boats already this should not be too much of an inconvenience to the Viwa islanders. Discussions with the Fijian Affairs Board and people of Viwa can develop a biosecurity policy for the island.

MAMMALIAN PREDATORS - *Issue 7*

Q. Should cats and dogs be eradicated?

A. Yes, as both cats and dogs are considered a serious threat to FGF's.

Both species are able to prey directly on FGF's impinging on their survival, especially if their numbers increase as predicted with the eradication of CT's.

Any eradication plans to target cats and dogs will likely include poison baits and traps.

ACTION: Cat and dog eradication should wait until the rat eradication project starts. Eradicating cats and dogs should be done at the same time as eradicating the rats to avoid these larger predators switching to FGF's.

It should be pointed out that rat, cat and dog eradication should not hinge on the success of the CT removal project. To achieve the optimum survival scenario for FGF's we recommend that <u>all</u> these invasive species be eradicated from Viwa. That is, if we find we cannot eradicate CT's for some unknown reason, we still recommend that the rats, cats and dogs be eradicated.

10. ISSUES AND ACTIONS - FIJIAN GROUND FROGS (FGF) - *Issue 8*

No research has been done on the impacts of the potential threatening species (cane toads, Pacific rats, feral cats and dogs and Pacific boas) on the Fijian Ground Frog (FGF).

Proposed Actions

1. Establish protocols to prevent the invasion of mongoose onto Viwa. (Includes detection and removal protocols should mongoose arrive)

   ACTION: Yet to be assigned. This could involve Dr Craig Morley, FAB, National Trust of Fiji, and Wildlife Conservation Society (WCS).

2. Develop captive husbandry techniques to breed and maintain a population of FGF's in captivity as a precautionary tool in the event that mongoose accidentally invade the island.

   ACTION: An approach has been made to Kula Ecopark, Sigatoka, Fiji to house and develop a captive breeding population of FGF's. The park owner (Philip Felsted) has experience in other captive breeding programmes, such as for the critically endangered crested iguana's, peregrine falcons and the endangered shining parrots. Currently, the park houses several other herpetological species such as banded iguanas, hawksbill turtles and Pacific boas. Taronga Park Zoo in Australia and the National Trust of Fiji supports the crested iguana programme and San Diego Zoo in the U.S supports the peregrine falcon programme.

   The people on Viwa have given their consent for some frogs to be removed from their island but before any animals are translocated into a captive management programme we need to establish the abundance and demographic status of this population. We must also consider the standard translocation protocols if these frogs are placed in captivity. Alternatively, a captive population could be maintained at USP in one of our breeding areas.

   The people involved in this process would be the people of Viwa, Kula Ecopark, The National Trust of Fiji, WCS and USP.

3. Examine the evolutionary history of FGF's in Fiji by comparing the genetic variability within and among the 5 known extant populations (Viwa, Ovalau, Taveuni & Gau, and the small population in the Waisali Reserve on Vanua Levu).

   ACTION: Yet to assigned. This could involve students from USP, Griffith University (GU) and/or another university, and the National Trust of Fiji

4. Examine the diet of FGF's and CT's throughout the year, to evaluate dietary overlap, and the potential risk of competition and direct predation between these species.

   ACTION: Yet to assigned. This could involve students from USP, Griffith University (GU) and/or another university/NGO.

5. Examine the invertebrate food available to FGF's and CT's throughout the year, to identify seasons where competition may be high.

   ACTION: Yet to assigned. This could involve students from USP, Griffith University (GU) and/or another university/NGO.

6. Experimentally remove CT's from Viwa Island and measure the response of the FGF population.

   ACTION: To be designated. This is the crux of the whole project but this cannot be done until many of the issues above have been undertaken. Nevertheless, much of this work will be done by the Viwa Islanders in conjunction with USP and other vested parties including WCS, The National Trust of Fiji and people from the Suva Region.

11. SUGGESTED TIMETABLE FOR ACTION

2004

- Examine the palatability of rat baits to CT's experimentally in captivity and in the field **(Cane toads: Issue 1, No. 1)**

- Ascertain which agents of decline (poisons) will be best to eradicate CT's **(Cane toads: Issue 1, Numbers 2-5)**

- Start training Viwa islanders now to identify CT eggs and calls **(Cane toads: Issue 1, Numbers 6-7)**

- Identify and map the distribution, abundance and habitat preference of FGF's and CT's on Viwa **(Cane toads and FGF: Issue 2, No. 1 & 4)**

- Determine the breeding sites and reproductive phenology of FGF's and CT's on Viwa **(Cane toads and FGF: Issue 2, No. 2 & 5)**

- Produce a current land-use map for Viwa. **(Cane toads and FGF: Issue 2, No. 3)**

- Develop a FGF recovery plan **(Cane toads and FGF: Issue 2, No. 5)**

- Provide an answer as to whether toxins are detrimental to native species **(Mammalian predators and Cane toads: Issue 3, No.1, and Issue 4)**

- Obtain data (literature) on any weed bounce-back work after rat eradication programmes **(Mammalian predators: Issue 4)**

- Construct exclosure plots to test whether CT's and rats impact on FGF's **(Mammalian predators: Issue 4)**

- Examine the palatability of rat baits to Pacific rats on Viwa experimentally **(Mammalian predators, Issue 5)**

- Visit Samoa to help oversee and learn from the rat eradication work **(Mammalian predators: Issue 6a)**

- Start discussions on biosecurity measures to prevent invasions of mongoose (and re-invasions of rats and CT's) **(Cane toads: Issue 6d and Issue 8 No.1)**

- Develop captive husbandry techniques to breed and maintain a population of FGF's in captivity at either Kula Ecopark or USP **(FGF: Issue 8, No. 2)**

- Examine the genetic structure of the extant populations of FGF's **(FGF: Issue 8, No. 3)**

- Start examining the diet of FGF's, CT's and Pacific boas on Viwa
  (FGF: Issue 8, No. 4)

- Start examining the invertebrate food available to FGF's and CT's
  (FGF: Issue 8, No. 5)

2005

- Produce a report on the outcome of the bait acceptance and toxins trials
  (Cane toads: Issue 1, No. 1; Mammalian predators, Issue 5)

- Have an answer to the question of using toxins in the environment
  (Mammalian predators: Issue 3c and; Cane toads: Issue 4)

- Publish findings from the work undertaken by Nunia Thomas on FGF and CT distribution, abundance, breeding sites and reproductive phenology of FGF's and CT's
  (Cane toads and FGF: Issue 2)

- Publish a FGF recovery plan
  (Cane toads and FGF: Issue 2, No. 5)

- Continue exclosure study and monitoring of FGF's
  (Mammalian predators: Issue 4)

- Begin eradication of Pacific rats on Macuata Island. This will involve monitoring the response of the vegetation, bird and reptile populations (include monitoring one other control islands where Pacific rats have not been removed). Produce a report on the success/failure of this operation
  (Mammalian predators: Issue 4)

- Have an established breeding population in captivity
  (FGF: Issue 8, No. 2)

- Begin physical removal of CT's on Viwa and monitor the response of FGF's
  (FGF: Issue 8, No. 6)

2006

- Continue CT removal and FGF monitoring on Viwa
  (**FGF: Issue 8, No. 6)**

- Publish findings from exclosure plots
  (Mammalian predators: Issue 4)

2007

- Continue CT removal and FGF monitoring on Viwa
  (FGF: Issue 8, No. 6)

- Continue monitoring the response of the vegetation, bird and reptile populations on Macuata Islands where Pacific rats have been removed
  (Mammalian predators: Issue 4)

2008

- Examine CT removal and FGF monitoring on Viwa
  (FGF: Issue 8, No. 6)

- If rat eradication operations were successful on Macuata Island, begin to eradicate rats, cats and dogs on Viwa
  (Mammalian predators: Issues 4-7)

2009-10

- Ascertain if CT and rat removal experiment on Viwa is successful
  (FGF: Issue 8, No. 6)

- Continue monitoring the response of FGF's, vegetation, bird and reptile populations on Viwa
  (Mammalian predators: Issues 4-7)

- Publish all findings

12. BUDGETARY CONSIDERATIONS AND REQUIREMENTS

For this project to proceed it will require money for: (not ranked in any order)

General

1) Vehicle transport costs to and from Suva
2) Boat transport costs to and from Viwa Island (includes transport around the island and for pick-up and drop-off of personnel and goods)
3) Per diems (accommodation and subsistence costs for all field workers)
4) Sevusevu's and Tautau costs for each trip (Fijian customary practice).
5) Finance for translation services (for interpreters in the village, when in discussion with the local landowners about the project and progress, and for a final report in Fijian)
6) Travel and accommodation costs (for overseas experts and consultants)
7) Report production costs (printing, publishing charges and time for report writing)
8) General administration costs (USP, GU and ISSG overheads, photocopying, telephone charges, fax costs, photographic costs etc.)
9) First aid kits and safety issues (medical supplies, cellphone)
10) Field guides (for the researchers and students)

Equipment for cane toad/frog work

11) A "mapping GPS" handheld recorder and batteries
12) Torches and batteries
13) Payment to villagers for collecting toads (wages or rewards)
14) Materials for drift fences, poisoning toads
15) Portable generator, fuel and freezer (to freeze the collected toads = most humane method of killing the toads)
16) Genetics study of the frogs (includes costs of genetics work and materials and for a Fijian student to do this research in Australia - 2 years minimum required)
17) Transportation and housing of captive frog population (Kula Ecopark or USP)
18) Bait preference trials (materials, labour etc.)
19) Costs for developing "other" methods to eradicate toads (poisons, traps etc.)
20) Field training costs to teach villagers how to identify toad calls and eggs
21) PIT tags and scanners for marking and identifying frogs

Mammal eradication work

22) Rats traps (during pre-poisoning period)
23) Costs of rat toxins, bait stations, distributing the toxin around the island, transporting the toxin to Fiji and picking up dead rat carcasses for burial
24) Rat eradication work on Macuata Island (feasibility report, eradication costs and monitoring work)
25) Costs to oversee rat eradication work in Samoa
26) Costs associated with penning livestock during poisoning campaign
27) Costs associated during poison campaign (e.g. by restricting people's movements they will not have access to their foodcrops)
28) Costs associated with trapping (or poisoning) cats and dogs
29) Costs of running non-toxic rat bait trials on Viwa (includes studying the up-take of baits by non-target species).

30) Development of a biosecurity protocol between the mainland and Viwa.

General research costs

31) Finance for projects (includes equipment, student scholarships etc.)
32) Map production (distribution and habitat preference study)
33) Visits to other non-inhabited islands for possible rat eradication work
34) Costs associated with frog and toad diet study (e.g. invertebrate study and taxonomy work)
35) Costs of interloans and acquisition of journal articles

Contingency Costs

36) For unplanned and unexpected issues resulting from the study.

NOTE:

For the work to begin as suggested in 2004 (see the timetable under Section 12), funds are needed immediately.

13. CONCLUSION

Viwa Island has been identified in the Fiji Biodiversity Strategy Action Plan as one of the two highest priority islands to protect in Fiji, along with Yadua Taba, which has the crested iguana and some of the last remaining dry-forest. Viwa has one of the last remaining populations of Fijian ground frogs and to this end, these frogs must be protected. Their critically endangered status is accurate so we need to assure their future.

This demonstration project has the potential to impress upon the Fijian people (and many others) that conservation in the South Pacific is beneficial and that invasive species should not be tolerated. With careful planning, continued consultation and organisation we believe we can increase the survival potential of the FGF's by ridding Viwa of two of the worst invasive species in Fiji. However, we also realise that there is no quick panacea to the current problem(s), indeed, much of our work will be quite experimental as this type of project has never been attempted before.

Our recommendation is that CT's be eradicated first followed by rats, cats and dogs at a suitable time in the future. Both reports attached by Mike Ambrose (DoC) and Dr Marc Hero (Griffith University) offer insightful information into how this project should proceed and some of the likely obstacles we will encounter. Although we are faced with a challenge it is not insurmountable because of the cooperation by the islanders and the fact that the island is only 60 hectares. Furthermore, natural invasion by species like mongoose and ship rats has not occurred before and this suggests that we can be certain that we can keep Viwa predator-free for a long time in the future.

The methods to eradicate rats, cats and dogs used elsewhere around the world are relatively straightforward but there are some questions about the use of toxins in Fiji and whether there will be some weed bounce-back once rats are removed. These questions need to be answered before we proceed with the eradication work. In the meantime, an exclosure experiment is recommended to investigate whether rats limit Fijian ground frogs on Viwa and a trial poisoning campaign be done on a separate island without any endangered species or people on it.

Eradicating the CT's will test all our ingenuity and skill as they are formidable breeders and so we must first learn how to reduce their numbers. Successful eradication of CT's from Viwa will be a world first and will provide foundation management and research protocols for the control and eradication of introduced amphibians around the world. This will take time and experimentation but our research team is committed to the success of this project. We sincerely hope that the funding agencies will see the potential in backing this project.

14. REPORT ONE

Viwa Island Eradication Feasibility Assessment – November 2003

Mike Ambrose

Introduction

This assessment is based on observations during a two-day visit to Viwa Island and information provided by Viwa Islanders, USP staff and students.

The feasibility of eradicating rats (*Rattus exulans*), feral cats and dogs has been assessed. In addition, a possible eradication plan for cane toads has been discussed.

Summary

Viwa, in eradication technology terms, is a relatively small island with moderate topography and easy access. There is no reason why techniques, already proven in New Zealand, for the eradication of pest mammals, should not also be successful on Viwa. There are, however, issues that are unique to Viwa that need to be carefully considered before a decision to proceed can be made and before any eradication prescription can be developed. In order to provide some focus for these considerations, it can be taken as a given that any eradication attempt for rats (and probably cats and dogs also) will involve the use of toxins as the primary tool.

Issues

Approvals

The families of Viwa have title to the land and ownership of all that the Island contains. They appear to be supportive of an eradication attempt, in principle, but this support would need to be confirmed once an operational plan had been developed and at least some representatives of the Islanders had been made familiar with all the risks and possible costs associated with the plan.

What other approvals are required under Fijian laws? Is any form of central or local government consent required? Can the necessary toxins be imported into the country?

Target Animals

Which pest species should be included as targets for an operation? With the conservation of the native ground frog being the desired outcome the removal of at least rats and cats is suggested but will any significant benefits accrue unless the cane toad problem is also addressed within an eradication framework that offers a reasonable chance of success?

The Viwa Islanders themselves have suggested that dogs also be eradicated. This is certainly achievable but is perhaps not central to the desired conservation outcome.

Eradication Methods

The NZ Department of Conservation experience is that successful rodent eradication can be achieved by delivering a suitable toxin, in a palatable form, in sufficient quantities, inside every rodent territory on an island at the same time.

The most effective toxin, for rats, used to date is the second-generation anti-coagulant brodifacoum delivered in a cereal pellet at a concentration of 20 parts per million. In New Zealand this type of bait is produced by Animal Control Products Limited in Wanganui and carries the trade name Pestoff 20R. It is assumed that this is the bait that would be employed on Viwa.

Methods of applying the bait that can be considered are aerial application from a helicopter with an underslung spreader bucket, hand spread by personnel on the ground and presentation of baits in bait stations set out in a fixed grid. Each option carries its own costs and benefits and it is only by considering these in the Viwa setting that a preferred technique can be prescribed. There are several factors on Viwa that may pose a greater risk of operation failure than anything that is commonly encountered on New Zealand islands so the inclination must be to choose a method that offers the greatest chance of operation success and only compromise this where absolutely necessary to address important non-target wildlife and human health issues.

Aerial bait spread, using properly calibrated equipment, DGPS guidance and an experienced pilot is the method most likely to deliver bait to all rats on Viwa within the required timeframe. It can be argued however that such an approach would be an overkill on a small island such as Viwa where the added accuracy benefits do not justify the extra expense. It may be that the resources required for aerial bait spread are simply not available in Fiji at a reasonable cost.

Hand broadcast of bait, if done accurately, has the potential to be just as effective as aerial application and there is certainly nothing about the topography of Viwa that would preclude the use of this option. The logistics of shipping bait to the Island, moving it around on shore and getting it out on the ground in one hit would be more difficult than the aerial option but there is nothing that would be insurmountable.

Attempting to eradicate rats on Viwa with a bait station grid would be the most expensive option and, in my opinion, the option with the highest risk of failure. Bait stations may still be considered if risks to human health and non-target wildlife cannot be adequately managed under another option.

An eradication plan for cats and dogs is likely to include toxins and traps.

Threats to Operation Success

It is apparent that there is huge knowledge gap when it comes to trying to choose an effective eradication technique for cane toads on Viwa. This has implications not only in falling short of the desired conservation outcome if toads cannot be removed but possibly also for the effectiveness of the rat eradication. Will toads take rat bait and, if so, do bait application rates have to be reassessed in order to cater for the great abundance of toads? In some locations is it possible that the toads would be so numerous and voracious that they could deny rats access to bait?

Cereal baits are palatable to rats on New Zealand islands and they have also been freely taken by rats on Maninita Island, in Tonga. Can it be assumed that the same will apply on Viwa? Does the range of alternative food sources and, in particular, the presence of the village on Viwa pose a threat to comprehensive bait take by rats?

Successful rodent eradications in New Zealand exploit seasonal climatic variances and their effects on breeding cycles to target rats when they are in their lowest numbers and are most active and least discerning in their hunt for food. On Viwa it is unlikely that the climate ever causes a food shortage for rats and the evidence suggests that the rats breed all year around. Each of these factors undoubtedly increases the risk of operational failure but not necessarily to an extent that could be considered significant.

Non-Target Risks

The effect of the chosen eradication method on significant native species needs to be considered. There are Banded rail and possibly also Purple swamp hen on Viwa. Both would be susceptible to direct and indirect poisoning from brodifacoum. Would these birds need to be moved off the Island, during an operation, or would it be acceptable to run the risk of killing them? Which native forest birds could also be expected to take baits (if they were surface laid) and is there anything else that would be affected by scavenging poisoned rat carcasses (Goshawks)?

What about the native ground frogs that the operation would be intending to benefit? There is the suggestion that they would not be at all likely to consume cereal bait pellets directly but the possibility of invertebrates taking bait and passing the toxin onto the frogs certainly needs to be considered.

Risks to Human Health

This is the issue with the greatest amount of concern attached to it. In New Zealand DOC would be reluctant to hand broadcast brodifacoum baits in an area of permanent human habitation or places where food animals are kept. The major risks on Viwa would be young children eating baits directly, people handling baits and not washing properly afterwards and chickens, pigs and goats ingesting sub-lethal doses of toxin and later being consumed by humans. Brodifacoum is not particularly effective at poisoning humans with relatively large quantities having to be ingested or absorbed before any symptoms of poisoning would become apparent, nevertheless it is still a risk that should be managed to, as far as possible, eliminate any amount of toxin entering human systems.

This issue needs to be discussed thoroughly with informed representatives of the local community before they can be expected to make a final decision on whether the operation should proceed. There is a medical doctor in one of the families on Viwa – this man would be a key link in understanding the possible consequences of toxin use in the community and, if the operation were to proceed, his involvement would be important to clearly explain the restrictions that would have to be put in place.

On the face of it, the risks to human health are significant enough to warrant the use of bait stations in the village area at least and the fencing in of any chickens, pigs or goats that may be taken for food. The village would seem to be an area of very high rat density with rats present throughout all of the houses. Bait station spacings would have to be very close (possibly inside each house also) and there may be a good case for trapping extensively before hand to reduce the number of rats that will die from brodifacoum within the village.

Locals told us that wild chickens (those that wander beyond the confines of the village) are not taken as food but this would have to be confirmed.

Prevention of Reinvasion

It is promising that, despite being only 900 metres from the shores of Viti Levu and despite having had no quarantine measures in place to date, Viwa appears to be free of Ship rats and Norway rats. That is not to say that incursions by these species and mice have not occurred – just that a breeding population has not been able to establish on the Island.

It is likely that the availability of only small boats to bring people, stores and building materials to the Island has been its saving grace. The need for each and every item to be individually manhandled onto boats and ashore is probably a quarantine measure in its own right. It would be pure guess work to say how long rodents could be kept of Viwa under the current circumstances, suffice to say that it would not be a matter of 'if' a rat species or mice got back there but 'when'. There are certainly some simple and inexpensive measures that could be put in place to improve the quarantine situation but these would still fall a long way short of being effective border control and what guarantee would we have that any efforts made now will be continued diligently through future years and decades?

Conclusions

Issues That Relate Directly to the Feasibility of the Project

1. Can an effective eradication plan be developed for cane toads? If a suitable, toad palatable, toxin cannot be found I don't believe there is much hope of eradicating them by other means. In my opinion the size of the Island precludes physical removal by collecting or killing individual toads. Denying the toads' access to breeding habitat for their entire 10-12 year lifespan would also be a difficult thing to achieve. Toad traps perhaps have some potential but such an approach would be so experimental that it could scarcely be called an eradication attempt.
2. Is there any merit in still eradicating introduced mammals if the toad situation cannot be dealt with?
3. Can approvals be obtained to import and use the required bait for rat eradication in Fiji?
4. Will the Viwa Islanders still support the project once they know what risks it involves and what temporary and permanent changes it may mean for them?
5. Are the funding agencies still prepared to back the project knowing that there will always be a risk of reinvasion that cannot not be totally managed?

Work that would be needed to address issues

1. Trial cereal baits with brodifacoum for palatability and toxicity to cane toads. Other bait formulations (e.g. fishmeal pellets) and toxins (e.g. 1080) could be trialed if this combination is not particularly effective. A comprehensive check should be carried out in the first instance to confirm that this work has not already been done elsewhere.
2. Run a trial application of non-toxic rat baits in a representative 1-hectare area on Viwa Island. The purpose of this trial should be two-fold – firstly to confirm bait acceptance by Viwa rats and secondly to assess bait take by non-target species (both desirable non-targets and other pest species).
3. Follow up with Fijian authorities on the question of importing and using brodifacoum rat baits

4. Develop a draft assessment of environmental effects that goes into greater detail about preferred techniques and issues. Such a document should form the basis for further discussions and final agreement with the Viwa Islanders. The draft AEE should be peer reviewed, possibly by the DOC Island Eradications Advisory Group.

Mike Ambrose
NZ Department of Conservation
20 November 2003

15. REPORT TWO

Dr Jean-Marc Hero

Senior Lecturer in Vertebrate Ecology

Griffith University

INTRODUCTION

To date, little is known about the distribution and abundance Endangered (IUCN Little Red Data Book, 2002) Fijian Ground Frog (FGF), *Platymantis vitianus* (Morley et al. 2003). Five extant populations (Viwa, Ovalau, Taveuni & Gau, and the small population in the Waisali Reserve on Vanua Levu) are known. Extinction of FGF populations from other islands is believed to have resulted from the introduction of the small Indian mongoose (Morley unpublished).
One remaining population on Viwa Island is small in size and potentially threatened with extinction. This small island (60 ha) is an ideal size to examine the impacts of the introduced Cane Toad on this species and evaluate and attempt an eradication of this species. This report evaluates the threats and actions required to ensure the long-term recovery and survival of the isolated FGF population on Viwa Island.

AIMS

The primary aims of this research report are to:

1. Identify the preliminary research needed to evaluate the current distribution and abundance of Fijian Ground Frogs and potential threatening species on Viwa.
2. Identify and evaluate the potential threatening species on Viwa include: human modification of habitat, cane toads, feral cats, Pacific rats, feral dogs and pacific boas. Identify additional research needed to assess the impacts of these species, and the success of any eradication program. If the potential for impact is high and/or the cause and effect has been demonstrated, a feasibility of control methods (and their risks) are presented.
3. Evaluate the actions for controlling potential threats and the risks involved. Including practical and feasible land-use management practices to minimize the populations (and subsequent impacts) of Cane toad& Pacific Rats.

Each of these aims will be presented below, followed by a list of actions needed to implement the stated aim. A proposed timetable for the completion of tasks is also presented.

AIM. 1.
DISTRIBUTION AND ABUNDANCE OF GROUND FROGS, AND POTENTIALLY THREATENING SPECIES ON VIWA ISLAND.

To date no research on the potent impacts of the proposed threatening species (Cane Toads, Pacific Rats, of the Fijian Ground Frog (FGF) have been executed. Preliminary information is presented as follows:

- On Viwa Island Ground Frogs are principally found in moist gullies, where reproduction is expected to occur (Fig. 1). Infrequently, individuals are encountered in areas outside of these moist gullies on ridges and on rocky ledges found on the outer edges of the island (Morley, Morrison & Hero, *pers. obs*.).

- Cane Toads (*Bufo marinus*) are found in high density throughout the island, and where they co-occur with Ground Frogs outnumber them by at least 10:1 (*pers. obs*.). In the dry season (November 2003), reproductive activity (tadpoles & metamorphs) was observed at several human constructed ponds adjacent to the Viwa village (Fig. 1). Historically these ponds were used for washing and drinking water, however as they are now contaminated with excess nutrients and they are no longer used for that purpose. It is expected that Cane Toads could also breed in ephemeral ponds that may form along the semi-permanent streams that flow in the wet season (November - April).
- Pacific rats (*Rattus exulans*) are in high density within the village, however, are expected to be widespread throughout the island (Morley & Ambrose *pers obs*.). This species was introduced into the Fijian Islands over 3,000 years ago and its current role in maintaining the natural balance of Fijian ecosystems is poorly understood.
- Feral cats (*Felis catus*) are on the island (Morley *pers. obs.).* They are expected to prey directly upon adult and juvenile FGF's, however their density & distribution are unknown.
- Feral dogs (*Canis familiaris*) are reportedly on the island (Morley *pers. obs.).* They could potentially prey directly upon adult and juvenile FGF's, however their density and distribution are unknown.
- Pacific boas (*Candoia bibroni*) are found on the island. They may be a natural predator of FGF's however their density and distribution are unknown (*pers. obs.).*
- Human agricultural activity has cleared parts of the island and is an immediate threat to the FGF's (Morley, Morrison & Hero, *pers. obs.).* Identification and protection of refuge and breeding sites by local villagers is an essential component for maintaining the long-term integrity of FGF's on the island.

Proposed Actions (Aim I)
Surveys should be conducted to:

8. Identify and map the distribution, abundance and habitat preferences of Fijian Ground Frogs throughout the year on Viwa Island.
9. Determine the breeding sites and reproductive phenology of Fijian Ground Frogs on Viwa Island.
10. Identify and map the current land-use on the island, and initiate a long-term management plan to protect breeding sites from disturbance by local villagers on Viwa Island.
11. Identify and map the distribution and abundance of Cane Toads on Viwa Island.
12. Determine the breeding sites and reproductive phenology of Cane Toads on Viwa Island.

AIM 2:
POTENTIAL THREATS TO THE FIJIAN GROUND FROG ON VIWA ISLAND

No research on the impacts of the potential threatening species (cane toads, feral cats, Pacific rats, feral dogs and pacific boas) on the Fijian Ground Frog (FGF) have been executed. Potential threats are as follows:

- The small population size of FGF's on Viwa (*pers obs.)* suggests this population is vulnerable to the small-population paradigm and the extinction vortex (Caughley 1994, Caughley & Gunn 1996). The population is further at risk due to its isolation and the lack of adjacent islands with populations of this species. The nearest known population of FGF's are on Ovalau Island however time since isolation and the genetic relatedness of these 2 populations is unknown. FGF's may have evolved in isolation to be Evolutionary Significant Units (Moritz 1999) or separate species.
- Human agricultural activity is a potential threat to suitable habitat for FGF's. Identification and protection of breeding sites by local villagers is an essential component for maintaining the long-term integrity of FGF's on the island. Human impacts are *Definite* and assistance

should be provided to the villagers to develop a long-term management plan to protect the FGF from direct human impacts.

- The small Indian mongoose (*Herpestes javanicus*) has been introduced to many islands of Fiji however has not been recorded on Viwa Island. Considering the proximity of the island to the mainland (less than 1 km) the potential for invasion must be considered. The potential impacts of Mongoose are *Definite* and village should be consulted to develop a long-term management plan to protect the FGF.
- The principal impact of Cane Toads with FGF's is competition for food. Additionally Cane Toads may directly predate upon juvenile and immature FGF's. Furthermore toxic Cane Toad metamorphs could be consumed by FGF's resulting in poisoning them. The high densities of Cane Toads relative to FGF's suggests potential for negative impacts of CT's on FGF's are *Probable,* and *Cane Toad eradication is recommended*.
- No information is available on the potential impacts of Pacific Rats on Ground Frogs. Pacific rats are principally herbivorous and insectivorous. Subsequently they may compete with Fijian Ground Frogs for invertebrate prey items. Direct predation on juvenile FGF's by Pacific Rats is possible; however no evidence has been demonstrated. If rats are removed a serious consideration is the potential for Pacific Boa to switch prey from rats to FGF's. Hence rat removal may indirectly have a negative impact on FGF's.
- Feral cats are reportedly on the island, and are expected to prey directly upon adult and juvenile FGF's. The potential for negative impacts of feral cats on FGF's are *Probable,* and *eradication is recommended*.
- Feral dogs are reportedly on the island. They could potentially prey directly upon adult and juvenile FGF's. The potential for impacts of feral dogs on FGF's are *Possible,* however *eradication is not justified at this stage*.
- Pacific boas are found on the island. The diet of Pacific Boas is principally lizards (skinks & geckoes) in the juvenile stages with an ontogenetic shift to birds & Pacific Rats in the adult stages (Harlow & Shine 1992). Pacific Boas may be a natural predator of FGF's on Viwa however their density, distribution and impacts on FGF's are unknown. Considering the arboreal nature of the Pacific Boa it is unlikely to have a direct impact upon FGF's. The potential for negative impacts of Pacific Boas on FGF's following the removal of Pacific Rats are *Possible,* and *examining the potential for these indirect effects is recommended.*

Proposed Actions (Aim II)

Research is needed to:

7. Assist villagers to identify and protect breeding habitat for the FGF on Viwa Island.
8. Establish protocols to prevention the invasion of Mongoose onto Viwa.
9. Establish protocols to detect and remove any Mongoose arriving on the island.
10. Develop captive husbandry techniques to breed and maintain a population of FGF's in captivity as a precautionary tool in the event that Mongoose are accidentally invade the island.
11. Examine the evolutionary history of the FGF in Fiji by comparing the genetic variability within and among the 5 known extant populations (Viwa, Ovalau, Taveuni & Gau, and the small population in the Waisali Reserve on Vanua Levu).
12. Examine the diet of FGF's and Cane Toad's throughout the year, to evaluate dietary overlap, and the potential risk of competition and direct predation between these species.
13. Examine the invertebrate food available to FGF's and Cane Toad's throughout the year, to identify seasons where competition may be high.
14. Experimentally remove Cane Toads from Viwa Island and measure the response of the FGF population.

AIM 3.
FEASABILITY OF ERADICATING CANE TOADS ON VIWA ISLAND:

The eradication of Cane Toads from Viwa is likely to have a positive impact on the Fijian Ground Frog. Eradication of Cane Toads before the eradication of Pacific Rats is essential to allow an experimental evaluation of the success of the Cane Toad removal. Removal of Pacific Rats from Viwa is not justified and if enacted in unison with Cane Toad removal it would confound the results.
Eradication of Cane Toad is problematic due to the high fecundity and long life–span of Cane Toads. An eradication programme will require:

1. Physical removal of all remaining individuals through systematic search and capture of Toads throughout the island.
2. Investigate the potential for poisoning Cane Toads throughout the island.
3. Removing permanent breeding sites.
4. Establishing and maintaining trapping stations for the capture and removal of Cane Toads along the semi-permanent streams.
5. Poisoning waterbodies if egg and or larvae of Cane Toads are encountered.
6. Establishing protocols to prevention the reinvasion of Cane Toads.
7. Establish protocols to detect and remove any new toads arriving on the island.

The feasibility of a Cane Toad removal programme is difficult to assess, as Cane Toad eradication has not been attempted anywhere else in the world. Providing all breeding sites have been identified and the removal programme is actively executed for 5 –10 years I expect the likelihood of success is high.

IMPLICATIONS OF ERADICATING PACIFIC RATS ON VIWA ISLAND

Pacific Rats and FGF's have co-existed on the Fijian islands with the Fijian Ground Frog for over 1,000 years. The potential for impacts of Pacific Rats on FGF's are *Possible*, however *eradication of Pacific Rats is not justified at this stage*. Experimental removal of Pacific Rats should be replicated on adjacent islands (without FGF's) to examine the impact of their removal on vegetation assemblages and lizard assemblages. Following removal of rats and a measure of their impacts, Cane Toad eradication and the introduction of FGF's would be advisable to develop a robust population of FGF's in the region.

1. Examine the diet of Pacific Rats to determine the potential impact of this species on FGF's.
2. Examine the diet of Pacific Boas and the likelihood that they will switch to eating FGF's if Pacific rats are removed from the island.
3. Experimental removal of Pacific Rats should be initiated on adjacent Islands (not Viwa) and an experimental evaluation of the impacts of this species on the natural ecosystem evaluated. Following the successful removal of Pacific Rats on nearby islands, their suitability as potential habitat for supporting the FGF should be investigated and wherever possible FGF's from the captive population reintroduced (and monitored to evaluate their success).

As Pacific Rats and FGF's have probably coexisted on Viwa for thousands of years – there is no urgency to remove rats from the island.

Disadvantages are: Removing rats at the same time as removing Cane Toads will not allow us to evaluate the impacts of each of these potentially threatening species on the Fijian Ground Frog. While this is not of immediate concern for the FGF's on Viwa it is important for determining recovery actions on other islands with FGF's.

Advantages are: the only advantage to removing Pacific Rats and Cane Toads at the same time is the possibility that CT's will consume the rat baits and this will help eradicate Cane Toads. This is only hypothetical and experimental trials are urgently needed to determine the likelihood that CT's will consume rat baits.

SUGGESTED TIMETABLE FOR RECOVERY ACTIONS

2004

- Determine the distribution and abundance of Ground Frogs, and potentially threatening species (Cane Toads, Cats, Pacific Rats and Pacific Boas) on Viwa.
- Determine time of year and location of breeding activity for FGF's on Viwa.
- Examine the diet of FGF's, Cane Toads and Pacific Boas on Viwa.
- Examine the genetic structure of the extant populations of FGF's.
- Establish a captive population of FGF's on Vitu Levu.
- Examine the palatability of rat baits to Cane Toads experimentally.

2005

- Begin eradication of Cane Toads on Viwa and monitor the response of FGF's.
- Begin eradication of Pacific Rats on at least 3 nearby islands and monitor the response of the vegetation, bird and reptile populations (including monitoring an equal number of control island where Pacific Rats have not been removed).

2006-2010

- Continue Cane Toad removal and FGF monitoring of on Viwa.
- Continue monitoring the response of the vegetation, bird and reptile populations on islands where Pacific Rats have been removed.

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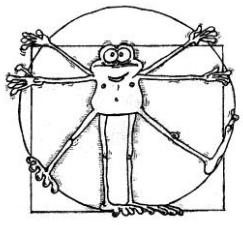

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APPENDIX

16. EMAIL COMMENTS, IDEAS AND SUGGESTIONS FROM AMPHIBIAN EXPERTS

From Dr. Michael Mahony (Newcastle University, Australia).

I do not known of any successful eradication project from a large or small area. The size of the island (Viwa) you are dealing with would give me confidence that you should have some chance of success.

In the city of Brisbane community groups have done big round ups of cane toads but they are not able to eradicate them. I suppose they can reduce the number of large adults for a period but the number gradually builds up again. However, I am not aware of any grey literature that provides any report on these efforts.

How would I go about getting rid of cane toads from Viwa? As you point out because the native Platymantid is a direct developer you have an advantage.

The idea of using people power to collect the adult toads is great and is most likely to be the best method. You may be able to remove most of the larger adults. The small juveniles are likely to be the most difficult to deal with and logistically that is where you would need the assistance of the locals. The juveniles are tiny but will grow and replace the adults and in a few years and you will be back at square one. In a sense the problem comes down to how many breeding sites there are and their shape and size. If breeding sites are limited and you can use a drift fence with a pit line you may be able to catch any adult moving to a pond and any juvenile leaving the pond.

If you have some funds for the project a way of catching adults may be to set up large pit traps near to ponds. The pit traps would need to be a reasonable size, at least as large as a bucket, bigger if possible.

As for the tadpoles. How many ponds or waterbodies are on the island? If you could study a few in some detail and see what other aquatic fauna relies on them you may be able to use a poison to kill the cane toad tadpoles. A suitable poison might be rotenone (or deris dust) a powder derived from the roots of a plant that is used to kill fish. it can be purchased realtively cheaply in Australia where it is sold by plant nurseries for killing fungus on plants. Unfortunately it also kills most organisms with gills (most invertebrates probably). If your waterbodies do not support a great number of other organisms it may be feasible to poison the cane toad tadpoles.

Best of luck, it sounds like a great project.

Cheers, Michael Mahony

From Dr Rick Speare (James Cook University, Australia).

Fascinating project! Great to hear someone trying this approach. It is likely to be much more effective in suitable areas than biocontrol. Physical removal has never been evaluated. After the first cane toad control project (1988-89) we recommended that physical removal be scientifically evaluated, but it was not sexy enough I think to be seriously considered.

Rick Nattrass ran a control program in Brisbane using physical removal, so he can give you details on what techniques he found effective. The Brisbane program lapsed owing to the effort involved, but it was a good way to get people to look around at the bush at night. Keith McDonald also organized a program at Lizard Island when they found toads there. He used recordings of male calls as an attractant. I have a report on this. (Anon. 1988. Cane toads on Lizard Island. Newsletter of the Lizard Island Research Station, Great Barrier Reef 14: 11.) This was 100% successful. I think they found 5 toads in all. I can get a copy of the paper made possibly and forwarded to you. I am currently on sabbatical in Ireland, but my PA in Townsville, Jill Anderson, can make a copy. Both Keith and Rick are still with Parks and Wildlife. keith.mcdonald@epa.qld.gov.au & rick.nattrass@epa.qld.gov.au.

How?
Mortality in tadpoles and metamorphs is quite high as you know. So I wonder if the focus should be on adults. They are certainly easy to catch, and may be able to be attracted to a central point. Eggs are worth while targeting since they are also easily collected and available over a narrowly defined period in highly specific locations. If you target metamorphs and tadpoles, you may be collecting animals that would have died anyway.

The other downside of metamorphs is the large numbers. Hayman Island had a problem with cane toads and started paying staff. Some of the staff collected advanced tadpoles and raised them. However, this could have been solved by the Hayman Island management by using a sliding scale proportional to size rather than the same amount per "toad".

Payment? Difficult decision. You certainly need to employ a local cane toad organiser; a champion for the program. How else it is organised will depend on the dynamics of the community and your funds.

How would I do it? Few general comments:
1. target adults particularly females
2. collect at night by hand
3. kill by freezing
4. Plot locations of each toad and concentrate efforts on high yield sites
5. Prevent egg laying by intensifying effort during breeding and at breeding sites.
6. Collect any eggs laid
7. Evaluate effectiveness of attracting males and females to key sites to maximize collection effort.
8. Evaluate traps.

Missing opportunity of biocontrol: No worries! Pure pipe dreams! A biocontrol agent will not be available any time within the next 10 years I suspect, if ever.

Tadpoles:
Many amphibian tadpoles are quite susceptible to copper toxicity. We did think about using this on Hayman Island, but there is no data on susceptibility *of B. marinus* tads to copper. Typically copper sulphate would be the compound used. This has been widely used as a molluscide in

schistosomiasis control programs. So perhaps similar approaches could be used once the lethal dose for B. marinus tads had been determined.

Resources:
I've emailed Jill to see if she can find the Lizard Island paper.

Is the project specific for Fiji? I was surprised earlier this year to find *B. marinus* in Funafuti, Tuvalu. I didn't realise that it had got there; presumably on building materials.

Kind regards

Rick

From Keith McDonald (Parks and Wildlife Service, Australia).

We did remove cane toads from Lizard Island but there was no established population. The toads had come in with garden material from the mainland to the resort and we were on the spot immediately. Before breeding started we were able to catch the few toads which were restricted to the resort garden area and not in the adjacent national park. Islands in the Whitsunday's were a much different with toad populations established on inhabited and uninhabited islands. The uninhabited islands had free standing water for part of the year while the inhabited islands had impoundments for resort water supply. We have never been successful in removing toads from these islands.

A small, uninhabited NP island with one well near Cairns has toads but to date they have not been removed. The dense tropical vegetation has made detection difficult as well as providing good hiding places. The difficulty in tropical areas is the summer monsoonal rain replenishes rock pools above high water and, although the water is brackish, it does not deter toad breeding.

People tried removing toads from urban areas in Brisbane but this failed because of recolonisation and people not prepared to continually harvest toads. It was a novelty at first but could not be sustained because of lack of long term public interest. It may well be possible to remove toads from a .6 km2 island but you would need to control the breeding site as well as physically remove the toads and sustain continuing interest.

Some resorts on the mainland have used low mesh fencing around pools to deter breeding cane toads but this techniques also excludes native ground frogs. However on a small island it maybe effective in the short term in assisting in catching toads.

Alex Hyatt at the CSIRO Australian Animal Health Laboratories in Geelong has been investigating control agents such as a virus for the cane toad. May I suggest you contact him to find out the current results. I do know one virus experiment was abandoned as it transmitted to native species. However, I believe another line of research is currently underway but have not been informed of the results. There was some ethical concerns with the technique to be used to transmit the virus.

From Dr Peter Harlow (Herpetologist: Taronga Park Zoo, Australia).

(1) Viwa Cane toads: I have spoken to several cane toad workers in Australia, and although there was lots of work done on investigating biological controls (mostly virus's), none are successful. I'm afraid that it looks like hand collecting toads and netting out tadpoles might be the only options for Viwa. After the initial hand collecting has been completed, if the villagers were to concentrate on collecting every calling male, that would seriously impact on the surviving populations reproductive potential.

I note that Viwa has "extensive wetlands".....this is a real problem. If it had only ephemeral watercourses then you could seasonally net and/or poison tadpoles. However I'm sure that repeated hand collecting of adults and sub-adults over several years will decimate the toad population.

Lots of work on cane toads has been done at James Cook Uni in Townsville, contact Rick Speares via his home page at: http://www.jcu.edu.au/school/phtm/PHTM/staff/rsbufo.htm , I'm sure Rick has lots of good ideas for this project, or for info on cane toad tadpole ecology try Prof. Ross Alford at: ross.alford@jcu.edu.au

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From Dr Jean-Marc Hero (Griffith University, Australia).

1. Wherever possible fill in any artificial waterbodies where they breed
2. Get locals to remove them from waterbodies that cannot be removed
3. (helps to target calling males - but it is the big females that lay up to 30,000 eggs that are your problem)
4. Controlling eggs is possible by removing them.
5. Controlling larvae is extremely difficult - but as there are no other frogs you could dipnet them out.
6. Re-vegetating around the waterbody margins deters toads - but makes it harder to see them.
7. Ask locals to euthanase any toads they encounter by putting them in the freezer - tell them it is for the frog - and they may not ask for any monetary reward.
8. Fencing of the ponds is also an idea - but they can climb well so if you add some shelter sites within the fenced area it could also act as a trap!

It would be essential to establish a frog-monitoring programme for a year or two before Toad removal so you can measure the frog recovery (if it happens).

17. AUSTRALIAN FACT SHEET ON CANE TOADS

Cane toad (*Bufo marinus*)

Cane toads, introduced into Australia to control beetles that were destroying sugar cane crops, are still spreading across Australia. They failed to control the cane beetles, and became a major pest themselves. Cane toads can harm native wildlife by eating small animals and poisoning larger predators that try to eat them. Household pets are also at risk from poisoning. So far, there is no known way to control cane toads across large areas, but scientists are searching for a biological control agent that is specific to the toads.

History

The cane toad is a native animal of South and Central America. In the early 1900's they were widely exported in an effort to use them as a biological control against insects infesting sugar cane crops. In 1935, about 100 cane toads were shipped from Hawaii to Gordonvale, in northern Queensland. However, there had not been an adequate assessment of whether the toad would be able to do the job it had been imported for, and after the release it was found that the toad could not control the beetles. Instead, it quickly established itself as another pest animal.

Since then, the range of cane toads has expanded through Australia's northern landscape at 27-50 kilometres a year. Cane toads had reached Brisbane by 1945, Burketown in north-western Queensland by the early 1980s, Iron Range on the Cape York Peninsula by 1983 and the tip of the Cape by 1994. By 1995 they had reached the Roper River, in the Gulf of Carpentaria in the Northern Territory; by March 2001 had reached Kakadu National Park. In 2003, cane toads were established at Yamba and Port Macquarie on the north coast in New South Wales after being introduced at Byron Bay in about 1965.

The cane toad continues to expand its range southwards at about 1.3 kilometres a year, and is also spreading across the tropical north towards Western Australia. They can be accidentally transported to new locations, for example, in pot plants or loads of timber.

Ecology

The cane toad forages at night in a wide variety of habitats. It is a ground-dwelling predator and eats any prey that it can fit into its mouth, including small lizards, snakes, frogs and their tadpoles, marsupials and mice, snails, and terrestrial and aquatic insects. It even takes food left out for pets. Cane toads can use their keen sense of smell to find food and breeding mates.
Cane toads need constant access to water to survive. Instead of drinking, they absorb water through the skin on their belly - from dew, moist sand or any other moist material, including areas deliberately kept moist with their own urine. If forced to stay in flooded conditions, cane toads can absorb too much water and die. They can also die from water loss during dry conditions. In Australia there are no specific predators or diseases that control cane toads.

Cane toads can breed at any time of year but seem to prefer the weather conditions that occur with the onset of the wet season. They will lay their eggs in temporary or permanent, still or slow-moving waters with the females laying 8000-30 000 eggs at a time. In comparison, native frogs mostly lay fewer than 1000 eggs. Cane toad eggs hatch in two or three days and the tadpole stage lasts between four and eight weeks. In tropical conditions, the toadlets can reach adult size within a year, but may take twice that long in colder climates.

Impact

The toad is poisonous in all its life stages, from egg to adult. Adult cane toads produce venom from glands over their upper surface, but especially from bulging glands on their shoulders - these exude the venom when the toad is provoked. While some birds and a few other native predators have learned to avoid the

poison gland of adult toads, almost anything that eats the toad rapidly dies from heart failure. The poison is absorbed through body tissues such as those of the eyes, mouth and nose, so that even mouthing the toad can cause death.

The recent arrival of cane toads in Kakadu National Park has been linked to a marked decline in native predators in the park, especially northern quolls (Dasyurus hallucatus) and large goannas. Household pets are also at risk.

Cane toads may also eat native animals, with a heavy impact on some species, particularly those that are already threatened. Adult cane toads may compete with native animals for food (particularly insects) and shelter, for example under rocks and logs. Cane toads may also outcompete native frogs for breeding sites, and their tadpoles may outcompete native tadpoles because they are produced in such large numbers. Cane toads readily eat faeces and, where human hygiene is poor, the toads have been known to transmit diseases such as salmonella.

Control

It is possible to control cane toad numbers humanely in a small area, such as a local creek or pond. This can be done by collecting the long jelly-like strings of cane toad eggs from the water or by humanely disposing of adult cane toads. Control is best at the egg or adult stages, because cane toad tadpoles can easily be confused with some native tadpoles, which could be accidentally killed. This approach to cane toad control requires ongoing monitoring of the creek or pond. Fine-mesh fencing can also assist in keeping cane toads from ponds that are in need of special protection.

At present there is no broad scale method available to control cane toads in Australia. Researchers are attempting to identify a biological control agent, such as a virus, that is specific to cane toads. They are also looking at the toad's impact on native fauna to try to clarify its significance as a pest and also to aid in diagnosing better ways to manage their impact and spread.

18. PRESS RELEASE: AUSTRALIA

K0209 20 September 2003

NEW HOPE IN WAR ON CANE TOADS

The Federal Minister for the Environment and Heritage, Dr David Kemp, today gave a $200,000 funding boost to fight the cane toad threat.

"The Howard Government is keen to support innovative new projects focused on researching ways to control the cane toad which is threatening Australia's biodiversity," Dr Kemp said.

"This funding follows a review report which found CSIRO's world leading research into finding a biocontrol for cane toads is progressing well and offers good hope for a long-term solution.

"This is encouraging news in the face of what seemed to be the unstoppable march of the cane toad – with no real leads in sight.

"My department will call for expressions of interest for research projects by the end of the year."

The cane toad was originally introduced to Queensland to kill pests in cane fields in the 1930s. Since then, the cane toad has spread south as far as Port Macquarie in NSW, reached Kakadu National Park in 2001 and continues to expand its range southwards and north-west. Current estimates show cane toads are spreading at around 27 kilometres a year.

"The Howard Government has so far invested around $3.5 million into this ground-breaking research," Dr Kemp said. "The project has achieved a world first – successfully inserting cane toad DNA into an amphibian specific virus. By inserting the modified virus into a cane toad tadpole, it is hoped that the immune response will prevent the toad from reaching adulthood and maturing to the reproductive stage.

"At the same time, the Howard Government is funding leading edge research in Kakadu National Park which is gathering real evidence about the impact of cane toads on native species. Although this will not halt the spread of the cane toads, the information gathered from these projects will help land managers protect native species that lie in the path of this feral pest."

Experts and stakeholders, including members of conservation groups and research organisations, will attend a workshop early next year to continue to take this world-leading research forward. Any biocontrol agent that is developed for release will be specific to the cane toad and will not affect other species.

"The CSIRO project will take up to 10 years to develop a biocontrol agent and to be sure that we can release it safely, but it is vital the work continues if we are to protect our native wildlife," Dr Kemp said.

Future release of the biocontrol agent would be controlled by the Office of the Gene Technology Regulator (OGTR), after an extensive program of consultation with community groups.

The report is available from the Department web site at www.deh.gov.au/biodiversity/invasive/pests/canetoad or by contacting the Community Information Unit on 1800 803 772. An information sheet on the cane toad is attached.

Media contact: Catherine Job 02 6277 7640 or 0408 648 400

19. THE INITIAL PROPOSAL

The aim of this project is to protect the reptiles of Viwa – especially the critically endangered Fijian ground frog (*Platymantis vitianus*). The smallest and most vulnerable population of these frogs is on Viwa Island.

The main threat facing the ground frog probably comes from the cane toad. They are extremely numerous over the whole island. One hypothesis is that cane toads out-competes the ground frog for food and resources, so by removing the toads we aim to improve the survival rate of the frogs. To increase the likelihood of a conservation benefit we will also have to eradication Pacific rats (*Rattus exulans*), feral cats (*Felis catus*) and feral dogs (*Canis Familiaris*) at the same time.

Complete removal of the toads would be a world-first and a great step forward in ensuring the survival of the ground frog in Fiji. This project will raise the profile of the ground frog and conservation in Fiji and could conceivably be the start of a beneficial programme for many other community conservation projects. Perceiving the ground frog as a conservation icon will empower the people to take a greater responsibility for the continued preservation of the ground frogs.

Advantages (in undertaking this project):

1. Viwa is one of only four islands left which provide habitat for the ground frog.
2. A team of student researchers from USP has completed an initial abundance survey of the ground frog and other reptiles in September 2002 and 2003.
3. Viwa is small (60 ha) and easily-traversed.
4. Viwa only has one village. The local residents are very supportive about saving the ground frogs and removing the toads, rats, feral cats and dogs.
5. Groups of local people from Suva (e.g. USP) can regularly travel to Viwa on "toad removal expeditions". I'm sure we could attract many volunteers.
6. Viwa is easily accessible from Bau Landing (Viti Levu). Bau Landing is only 30 minutes drive from Suva.
7. There are major "hot spots" of reptile activity on the island. If necessary these areas could be fenced off.
8. The island would make a good eco-tourism location for viewing ground frogs and ground birds – although numbers would need to be limited.

Disadvantages:

1. Because of its proximity to Viti Levu (which has mongoose) there is a risk that they will invade Viwa. However, this risk may be low (and manageable) as no invasion has been recorded to date.
2. No one has attempted to eradicate cane toads before.
3. Targeting cane toad tadpoles and eggs in the waterways will be difficult. Fortunately ground frogs do not undergo a tadpole stage – destroying tadpoles and eggs from waterways may therefore be undertaken with minimal risk to the ground frogs.

20. RESEARCH PRIORITES FOR RECOVERY PLAN

1) To understand the taxonomic relationships of FGF's in Fiji and elsewhere.

2) To better understand the Fijian knowledge of the FGF's.

3) To establish practical methods to census FGF populations and to monitor population trends.

    a) To develop best practice methods for marking FGF's (i.e. using PIT tags rather than toe-clipping)

    b) To investigate the sex ratios in wild populations and their implication for population variability

    c) To better understand the determination of age and sex in FGF's (especially the juveniles)

4) To establish population models for the four known populations in Fiji where size of population, loss of heterogeneity and biased sex ratios may pose a threat to the ground frogs' viability.

5) To understand the animal husbandry techniques required to maintain a breeding population of FGF's in captivity.

6) To study the diet of wild FGF's and cane toads.

7) To investigate the existence and the role of commensal micro-organisms and parasites.

8) Investigate the potential impacts of introduced vertebrate pests on FGF's from:

    a) Cane toads
    b) Rats
    c) Cats
    d) Dogs

9) To investigate changes in the FGF population (including size, class, structure and density) after removal of introduced vertebrate pests.

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