

# Niue Pig Management Plan



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for the Government of Niue, May 2016



**SPREP**  
Secretariat of the Pacific Regional  
Environment Programme

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The farmers, plantation owners and pig hunters who attended the 2 workshops and allowed access to their land to assess crop damage.

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Pete Peeti, New Zealand hunter, trainer, chef, television personality



*Uga: its protection is the primary reason for this programme*

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# EXECUTIVE SUMMARY AND RECOMMENDATIONS

Feral and wandering domestic pigs collectively cause significant environmental damage in Niue, chiefly to coconut crab populations, seedling coconuts, soil organisms, soil structure and fertility transfer. They also cause significant economic damage to plantations and domestic gardens.

Feral pig eradication on Niue Island would be impossible to both achieve and maintain in the current scenario of domestic pig management. Pig management practices vary from adequate to laissez faire, with constant escape and release from sties. This is due to lack of quality pig sty construction, high cost of supplied pig feed (which leads to pigs being released to forage in the wild), and logistical difficulty for most pig owners in maintaining regular pig watering and feeding regimes. Released domestic pigs interact with feral pigs and both wandering domestic and feral pigs contribute to the feral herd and in damage to crops and the environment. Any coordinated programme to improve pig management (housing, feeding, watering, etc) would take several years to be implemented to the stage where impacts on the feral pig herd and crop and environmental damage would be satisfactorily mitigated.

It is therefore recommended that no programme to eradicate feral pigs be undertaken or considered. Instead, a programme of permanent suppression to very low pig densities should be implemented, in parallel with a programme of assistance to domestic pig owners that will make permanent penning more attractive and sustainable. This needs to be augmented by a comprehensive official pig identification programme which will act as a strong incentive to keep pigs contained.

Four pig control methodologies (scientific hunting with specialised bred/trained dogs; sodium nitrite toxin; lured enclosure; snare) were tested, over 3 separate visits to Niue. The lured enclosure concept proved inappropriate for use in Niue due to pig population dynamics, telecommunication limitations and pig owner behaviour. Use of snares also proved unsatisfactory as it is both ineffective and inhumane.

The toxin programme was not fully completed but was trialled to proof-of-concept level (including modifications to suit local conditions and pig lure preferences) and proved to be most cost-effective and easily manageable. There remains a degree of reticence by locals to employ this method, which was not articulated but believed to be based on lack of meat recovery rather than fear of the toxin.

The scientific hunting programme was an unqualified success, with Government staff and a private hunter rapidly becoming trained in all aspects. The option is popular with the community as meat is distributed. The only drawbacks are the high cost of bringing suitable dogs to Niue to maintain a breeding programme; the moderately high cost, and lack of incentive for pig owners to contain pigs.

The surveillance of pig rooting, plantation damage, camera and hunting records, all show that the feral/wandering pig issue is largely confined to, and originates from, the eastern and north-eastern side of Niue, i.e. from Mutalau to south of Liku.

The feral/wandering pig population could be easily managed by 4-5 fully trained hunters with appropriate specialised dogs and adoption of GPS technology. This will necessitate bringing 2 additional dogs to Niue now and a further male dog every 3 years.

Hunting is unlikely to be able to lead to behaviour change in pig owners, as most meat is recovered, however use of a toxin programme is very likely to minimise release of adult pigs.

The preponderance of single pigs indicates that use of single catch pig traps might be beneficial on Niue. This option should be further investigated.

There are not sufficient feral hunted or snared pigs to account for the tallies included in the pig tail bounty, with most of the pig tail bounty being misappropriated on domestic rather than feral pigs. Many of these pigs may not have been hunted or snared. The bounty is therefore completely ineffective at reducing pig numbers and the budget (approximately \$5,000 pa) should be redirected at another pig control programme.

## Recommendations, in approximate order of importance

1. Scientific hunting with 4-5 trained staff and appropriate hunting dog breed is a preferred option for maintaining low numbers of wandering/ released/ feral pigs on Niue. The Niue Government should facilitate the programme by paying trained and approved hunters, from private and Government staff, \$20 per hour and funding this from the former bounty scheme. The Niue Government should ensure continuation of an effective hunting programme, by purchasing at least 1 female and 1 male hunting dog immediately from New Zealand, for hunting and breeding purposes. This should be augmented every 3 years with a new male dog to prevent inbreeding.
2. Use of encapsulated sodium nitrite toxin in coconut oil carrier, with split coconut lure, should be implemented as a pig control method, as this is an effective and cheap means of controlling wandering pigs of any type and is not subject to risks of programme failure (as is the hunting method), and would disincentivise pig owners to release pigs.
3. The current pig tail bounty is ineffective and being misappropriated and should be discontinued, with the budget reallocated to the scientific hunting programme.
4. The Niue Government should implement a programme of improved domestic pig management, to eliminate or at least greatly minimise release of pigs into the wild. This programme should include
  - survey of all current piggeries and sties, to ascertain actual number and condition
  - registration of all breeding piggeries, with adoption of containment and hygiene standards for these piggeries
  - mandatory earmarking (preferred) or eartagging of all pigs , and neutering of non-breeding boars
  - provision of advisory services by the Department of Agriculture, Forestry and Fisheries
  - provision of nipple water feeders and earmarking tool as incentives for every pig owner to contain their pigs.
5. A phone-in issues and complaints register should be kept by DAFF, to record all instances of plantation damage. This will act as a reliable measure of current unconstrained pig numbers and inform timing and placement of control programmes.
6. DAFF should use the current weekly radio service to communicate all programmes, incentives, regulations and promotion of the complaints register.
7. All management and control programmes should be introduced in a staged manner, commencing with hunting and/or toxin programmes, inspection and advisory services, followed by incentives, pig identification programme, pig neutering, and finally breeding piggery registration (if this measure is adopted).
8. The Niue Government should implement a research programme to measure uga numbers and densities in a number of habitats and areas. This programme should be conducted at the same time every year (e.g. when uga are most mobile) so that population trends can be measured. International conservation organisations should be approached to fund this work.
9. Data from the complaints register should be interrogated to determine trends in pig impacts on plantations, as this is a cheap and reliable arbiter of pig impacts across Niue.
10. Single catch cage traps should be trialled if scientific hunting and ESN toxin are not found to be effective or affordable. To do this, the Niue Government should contract a local steel fabricator to construct several single catch cage traps, to be trialled around plantations.
11. The lured enclosure technology should NOT be used in Niue at this time or in the foreseeable future, due to poor cellphone coverage and absence of large family groups of pigs
12. Snares of any type should NOT be used in any official control programme on Niue, and use of snares generally be strongly discouraged as it is not effective in controlling pig numbers and fails humaneness standards.

## GLOSSARY

Acronyms and definitions of terms used in this report.

DAFF	Niue Department of Agriculture, Forestry and Fisheries
DOE	Niue Department of Environment
Domestic pig	Any pig that is owned and domesticated, whether contained in a sty or not i.e. may be stray at times
ESN	Encapsulated sodium nitrite (see below). This is sodium nitrite contained within a starchy polymer to disguise the salty taste
Feral pig	Any pig that is not owned and domesticated, is not husbanded in any way, and is unconstrained
GEF	Global Environment Facility, a financial mechanism for the United Nations Convention on Biological Diversity and other conventions.
GPS	Global positioning system device.
KBM	Koru Biosecurity Management
NISSAP	National Invasive Species Strategy and Action Plan 2013-20 (Draft)
Pig bounty	The payment made by Department of Environment to hunters for feral pig tails submitted to the Department, to signify feral pigs killed by the hunters
SN	Sodium nitrite. The common food preservative used in processed meat. In high doses it is toxic to mammals, particularly pigs
SPREP	Secretariat of the Pacific Regional Environment Programme
UNEP	United Nations Environment Programme



*Total cassava crop loss to pigs, despite electric fence designed to exclude them*

# INTRODUCTION

Feral and wandering pigs have been identified as having significant negative impacts on the ecology of Niue Island. Parkes, Yockney and Ikitoelagi<sup>1</sup> reported that, from data collected elsewhere, it is likely that feral pigs *"will alter vegetation structure and regeneration by directly eating plants and fruits and indirectly by rooting the soil. Pigs require protein in their diet, e.g., sows require c. 25% protein in their diet to successfully raise their young (Choquenot et al. 1996). Feral pigs on Niue must obtain some (or most?) of this protein by eating invertebrates (worms, insects and crabs), by preying on ground-nesting birds' eggs or by scavenging dead animals"*.

Parkes et al also reported that *"We have only anecdotal information on the extent of damage to crops. A few pigs can destroy an entire [taro] patch either by eating the tubers or because they find such cultivated soils attractive to root for invertebrates. Vanilla is a cash crop being grown on Niue for export. Vanilla essence is a recognised lure in baits for pigs and any damage to the vanilla vines or the trees used to support them can have serious economic costs – vanilla plantations are worth \$30,000 – 40,000 per hectare. The Niuean Government is planning to expand commercial agriculture as a means of supporting its economy and people. Damage from pigs may constrain investment in some crops"*.

Craw, Moverley and H Tongatule (2014, unpublished field survey) found extensive damage to coconut seedlings and also crab shell remains in native forest due to pigs, as well as extensive damage to plantations and gardens. Cassava crops in particular are targeted, followed by vanilla, yams, kumara and taro.

The Niuean Government, in its draft National Invasive Species Strategy and Action Plan 2013-2020 (NISSAP), has identified feral pigs as *"damaging forests and plantations and feed on native invertebrates"*. The NISSAP aims to *"increase public awareness of feral pigs' risks and impacts, review the existing pig management strategy, identify achievable management goals, redesign the programme and implement a revised pig management programme"*.

In September 2014, the Secretariat of the Pacific Regional Environmental Programme (SPREP) funded a scoping exercise (Koru Biosecurity Management, KBM), to determine options for feral pig control. This exercise identified four options, identified below. SPREP subsequently funded the Pilot Operational Plan for Feral Pig Management. The programme contained the following key elements:

1. Intensive hunting with dogs, using scientific GPS tracking technology and specialist finder dogs and no holder dogs.
2. Lured enclosures, utilising large pens with a drop-gate and automated bait feeders to lure pigs, and using cellphone technology to send real-time pictures to administrators who remotely trigger the drop-gate when all pigs in a group are inside the enclosure.
3. Snaring. This includes provision of improved steel impregnated cord for existing snare users.
4. Toxin trial. This involves use of encapsulated sodium nitrite in strictly controlled circumstances.

KBM visited Niue 3 times subsequently in 2015 to test the effectiveness and community acceptability of these 4 methodologies. Reports were provided on progress and a synopsis of these reports is included below. This Plan is a direct result of the Pilot Programme.

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<sup>1</sup> "Sustainable Management of Feral Pigs on Niue", John Parkes, Ivor Yockney and Metric Ikitoelagi; NZ Landcare Research and Niue Department of Agriculture, Forestry and Fisheries, 2005. Landcare Research Project No. 161107. Report No. 373 NIU 11071204

## CONTEXT OF NIUE ISLAND

The strategic advantages existing on Niue for feral pig control and improved domestic pig management include:

- The ecological driver, i.e. health of coconut crab (uga) populations, is supported by all of the community. Uga are revered as a treasure.
- Damage caused by pigs affects almost all of the community. Uga are harvested by the community, there is an economic driver for change.
- All of the community appears to accept that pig impacts need to be drastically reduced i.e. uga predation by pigs is acknowledged by all. There is overwhelming support for a pig management programme on Niue.
- No other large animals are present that could be affected by any control programme.
- The small size of Niue and its very strong community ethos make it suitable for a unified national approach. Despite a strong village focus, the locals have stated that they prefer a single overall programme rather than a series of village-based programmes.
- Topography and conditions are generally favourable for control programmes. There are many roads and tracks, and vehicle access is never more than 1 km away.
- The legislation is broadly appropriate to deal with legal and jurisdictional issues regarding feral pig control. It must be noted that the legal status of wandering domestic pigs is unclear, at least in the minds of the community.
- Lower current population means fewer piggeries than previously, making programme success easier to achieve.
- The community will support a united programme approach, provided that it includes a method or methods that can be used successfully without significant disruption to their lives.
- Programme administration could be achieved within a multi-agency framework – the government agencies are very cooperative.
- Many piggeries could be made secure and attractive for farmers to contain pigs in permanently, by provision of simple measures e. g. permanent water; or if owners did not have to keep breeding pigs that are essentially unproductive
- The community accepts that domestic pigs are doubly problematic – causing damage to crops and uga, and adding to the feral herd.
- Data from trail cameras, damage to crops, and surveys by the New Zealand hunters, all point to the feral/wandering pig issue being generally confined to the east of Niue, in the Mutalau to Liku area.

The challenges on Niue for feral pig control and improved domestic pig management include:

- Many domestic piggeries (200-300, no census figures known). Many of these have poor security. Most do not have permanent water supply, which means that owners need to visit the sties 2 or 3 times per day to care for the pigs. This often leads to owners letting pigs out when they are going to be absent.
- Convenience of having domestic pigs unconfined. Feed supply is unreliable and commercial feed is very expensive. This is the single biggest issue and unlikely to be overcome in the short-medium term.
- Close interface between feral and domestic pigs - will allow for feral pig numbers to recover very quickly after any control programme implemented, and rules out Niue-wide feral pig eradication as an option.
- Lack of definition/description of feral vs. wandering domestic pig and consequent lack of information on damage caused by feral pigs vs. damage caused by wandering domestic pigs.
- Lack of one-agency management responsibility, with minor confusion within the community regarding the roles of DOE, DAFF and Police.
- Pig farmers sometimes release surfeit of piglets and sick pigs, typically males.
- Pig identification scheme trialled but not carried on with – this may have caused some scepticism re official commitment to future programmes.



- The pig tail bounty is popular but not effective. The number of claims has been dropping over time but pig impacts are rising. There is clear evidence of domestic pig inclusion. The bounty is essentially a political solution rather than a technical solution.
- The perception amongst pig owners that allowing pigs free range, at least for part of their lives, assists with good pig health as the pigs augment their diet with grubs, roots etc.
- Accurate monitoring of coconut crab population (i.e. outcome monitoring of pig control programme) would be very difficult. Any improvement in crab numbers (after pig control measures) would not be immediate, would be difficult to measure, and is likely to be affected by crab harvesting.

A clear picture emerged that feral pig eradication is impossible in the current scenario of widespread domestic pig ownership and laissez faire management. Even if domestic pig management practices were to improve radically, eradication would be impossible to achieve, due to the difficulties currently faced by pig owners. It is therefore imperative that no programme to eradicate feral pigs be undertaken. Instead, a programme of permanent suppression of feral and wandering pigs, to a very low density i.e. near zero net impact, should be implemented. This needs to occur in conjunction with a programme of assistance to domestic pig owners that will make permanent penning more attractive and sustainable, underpinned by a regulatory framework. This needs to be augmented by a comprehensive official pig identification programme which will act as a strong incentive to keep pigs contained.



*Typical Niue piggery*

## PILOT PIG MANAGEMENT PROGRAMME

Koru Biosecurity Management (KBM) travelled to Niue 3 times in 2015. In the first of these trips (April 2015), one lured enclosure was built and two toxin trial sites established. Four surveillance cameras were deployed and three local staff trained in their use. Excellent data was collected on wild pigs' bait preferences and foraging habits. The snares proved ineffective and their use did not meet appropriate humaneness standards. DOE and DAFF staff worked very well together on the entire project and community liaison and support were excellent. Potential issues identified included poor cellphone coverage (to enable full use of the lured enclosure) and difficulty in undertaking research on pig impacts on uga. An interview was filmed and shown on BCN TV. A workshop was held with local hunters, which identified a lack of suitable dogs on Niue, lack of scientific hunting approach and a low number of hunters, most of whom were over 50 years of age. A very useful meeting was held with DAFF Director Brendon Pasisi, where many relevant matters were raised.

The second trip (July 2015) focused on hunting with master hunter Glen Osborne, training of local hunters, fine tuning of the lured enclosure electronics, collection of pig distribution/age/ sex/breed data from cameras, and deployment of lure for the toxin trial. The enclosure trap mechanism operated very reliably, and was able to be triggered by cellphone text (from Niue and New Zealand) every time. However the inability of the Niue network to send cellphone pictures remained problematic. There was also a complete absence of pigs in the area (in contrast to before the enclosure construction), indicating that local pig owners were confining their pigs. Camera data was analysed, showing that most pigs were domestic breeds and in good condition. A reticence was detected to use of the toxin, which appeared to not be based on use of sodium nitrite (which is commonly used to cure pork) but on deployment leading to loss of recoverable meat.

The scientific hunting programme was very successful, with local hunters Kala Ogatau and Huggard Tongatule learning quickly how to master the GPS technology and how to use dogs effectively. The dogs brought from New Zealand were very disciplined and effective. Hunting success proved far improved over traditional methods. A second workshop and training session was run by Glen for local hunters, which identified that most pigs are caught with snares rather than hunted with dogs. Of the hunted feral pigs, the large preponderance of boars and their breed, and the lack of family groups (80%+ singles, contrasting sharply with worldwide data), suggests that these pigs were almost all released male piglets. The very poor condition and low number of feral sows, low family group numbers, and lack of feral breed pigs recovered, indicates very low recruitment rates within the feral pig population.

There was a very low level of crop damage recorded on this trip, in contrast to earlier, indicating that wandering domestic pigs are responsible for most crop damage and that owners were confining pigs in anticipation of the hunting programme. Successful pig control will therefore need to include a domestic pig management programme.

The third trip (September 2015) featured enhanced hunting and training by New Zealand experts Glen Osborne and Pete Peeti. This was extremely successful, with 4 local hunters trained in GPS and dog use. Distribution of a lot of pork made the programme very popular with the community. The general absence of crop damage further reinforced that most of the problem is due to wandering domestic pigs. The New Zealand hunters refined original estimates of wild pig numbers on Niue, believed to now be 100-200 maximum and likely to be closer to 100. The lured enclosure trial ended without success, due to continuing poor cellphone coverage and lack of pigs in the area. The toxin trial was very successful in terms of establishing coconut oil as a reliable and stable lure, and in getting pigs (and no other animals) to open the closed bait boxes. This method is very cost-effective.

Meetings were also held with Dr Josie Tamate, Director General, Ministry of Natural Resources, and Ross Ardern, New Zealand High Commissioner to Niue, where programme progress was discussed. Two short segments for Niue television were filmed and interviews given for the local newspaper.

## Scientific hunting with dogs

### Recommendations

- Scientific hunting with 4-5 trained staff and appropriate hunting dog breed is a preferred option for maintaining low numbers of wandering/ released/ feral pigs on Niue. The Niue Government should facilitate the programme by paying trained and approved hunters, from private and Government staff, \$20 per hour and funding this from the former bounty scheme.
- The Niue Government should ensure continuation of an effective hunting programme, by purchasing at least 1 female and 1 male hunting dog immediately from New Zealand, for hunting and breeding purposes. This should be augmented every 3 years with a new male dog to prevent inbreeding.

### Approximate cost of an ongoing scientific hunting programme

At present, the hunting programme is maintained by volunteer effort. Costs are limited to vehicle and dog management items. If hunters were to be paid a normal commercial rate (say \$20/hour), then a programme is likely to require 2 hunters for 4 hours per day, 1 day per week for 40 weeks. This would cost \$6,400 pa minimum. The cost of purchasing good quality dogs is approximately \$2,000 each + \$700 freight to Niue (i.e. \$5,400 in year 1, + \$2,700 every 3 years). It is assumed that dog feeding costs are nil and any damaged dogs would be put down or retired i.e. there would be no veterinary costs. The programme might cost slightly more initially but, provided that additional measures are implemented to minimise pig release, then the total costs of a hunting programme are likely to be as follows.

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024
Labour	\$6,420	\$6,420	\$6,420	\$6,420	\$6,420	\$6,420	\$6,420	\$6,420	\$6,420
Vehicle running costs	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500
Dog purchase	\$4,000			\$2,000			\$2,000		
Dog freight	\$1,400			\$700			\$700		
Ammunition, 1 <sup>st</sup> aid kits, misc.	\$200	\$100	\$100	\$100	\$100	\$100	\$100	\$100	\$100
<b>Totals</b>	<b>\$13,520</b>	<b>\$8,020</b>	<b>\$8,020</b>	<b>\$10,720</b>	<b>\$8,020</b>	<b>\$8,020</b>	<b>\$10,720</b>	<b>\$8,020</b>	<b>\$8,020</b>



*Glen Osborne, with hunters Kala and Hele after a night shoot*

## Discussion

The pilot hunting programme was an outstanding success, both in terms of pigs culled and in training locals to hunt effectively. 31 pigs were culled in 14 days over the two trips. The progress made with training the local hunters (Kala and Huggard) was excellent, with them and several others (Dan, Hele) becoming proficient with GPS use and general hunting techniques. This small number of hunters was sufficient to maintain the programme and this has continued satisfactorily after the New Zealand hunters returned. This is due to increased hunter efficiency due to use of new technology, and the overall low number of feral/wandering pigs on Niue.

The community clearly supports hunting, as a significant amount of meat is returned to the families and for cultural events. Almost all of the pigs caught on both trips were domestic breeds, in good-to-excellent condition, and the recovered meat was of high quality despite being mostly boar meat. This indicated that most of the pigs were 2-4 years old and very few older than 5 years, which was confirmed by assessment of teeth number and condition.

The hunting option is clearly very popular with staff and others, therefore is likely to be continued indefinitely without morale slipping, provided that a supply of appropriate dogs can be maintained.

The major risk to maintaining a hunting programme is the cost and logistics of supplying suitable dogs. The New Zealand hunters (Osborne and Peeti) believe that local dogs lack the necessary characteristics to make them suitable for hunting. The ideal breed is a greyhound x cattle dog of proven hunting stock, i.e. one that can run fast, work all day but not engage the pigs directly. The dogs do not need to be a bulldog breed or crosses of these breeds, as the GPS technology obviates any need to have a bailer-type dog. Indeed this type of dog would be much more likely to be damaged or killed by the large Niuean boars, and would be a community liability if allowed to breed on Niue.

Bringing dogs to Niue and returning them to New Zealand is unaffordable due to veterinary and quarantine charges (approximately \$7,000 per dog). Therefore the option of using New Zealand hunters on a regular basis, even if they are volunteers, is not sustainable. Local hunters using local dogs is the only sustainable hunting option. It would therefore be necessary to send 1 suitable male dog and at least 1 other bitch up to Niue permanently (thereby avoiding the returning quarantine costs). A further male can be sent every 3 years to avoid inbreeding. In this way, a supply of suitable hunting dogs can be maintained. It cost approximately \$2,000 (all-up) to send a dog one way to Niue.

The other limitation to long term success of a hunting programme is likely to be lack of behaviour change amongst pig owners, as most meat is recovered and returned to the community.



*Hunters Huggard, Dan and Hele with a boar with large tusks*

# Encapsulated Sodium Nitrite Toxin

## Recommendation

It is recommended that use of encapsulated sodium nitrite toxin in coconut oil carrier, with split coconut lure, should be implemented as a pig control method, as this is an effective and cheap means of controlling wandering pigs of any type and is not subject to risks of programme failure (as is the hunting method), and would disincentivise pig owners to release pigs.

## Approximate costs of an ongoing toxin programme

The costs of this programme are essentially labour and vehicle mileage, with the toxin, bait boxes, signage etc being of minor cost. 10kg pails of ESN cost \$400, which equates to 300 doses, i.e. a 2-3 year programme. This product is already in stock at Niue. Bait boxes are on hand. An additional 2 boxes and replacements could easily be made on Niue. Coconut oil carrier cost approx. \$100 pa. Split coconut lure is free and available. The labour component (including coconut cutting) would likely be 12 hours per week for one operator, fortnightly for 10 months of the year. Assuming a rate of \$20/hr, the labour cost would be \$4,800 pa. Vehicle running costs would be considerably less than for a hunting programme, as only 6 bait boxes would need to be serviced and occasionally relocated.

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024
Labour	\$4,800	\$4,800	\$4,800	\$4,800	\$4,800	\$4,800	\$4,800	\$4,800	\$4,800
Vehicle running costs	\$500	\$500	\$500	\$500	\$500	\$500	\$500	\$500	\$500
Toxin		\$400		\$400		\$400		\$400	
Coconut oil lure	\$100	\$100	\$100	\$100	\$100	\$100	\$100	\$100	\$100
Totals	\$5,400	\$5,800	\$5,400	\$5,800	\$5,400	\$5,800	\$5,400	\$5,800	\$5,400



*Bait box, with original grain/fish oil lure*

## Discussion

Encapsulated sodium nitrite (ESN) is registered for use in New Zealand as a pig toxin, in specially designed bait boxes that can only be opened by pigs. The New Zealand conditions were included in Niue and supplemented by use of cameras to detect any pig behaviours differing from that in New Zealand. The Niue situation proved to be unique in that no family groups of pigs were recorded (84% of the visits were single pigs, 12% were in pairs, 4% were in groups of three), and none of the lures effective in New Zealand, Australia and the US were effective in Niue. However coconut is a good lure and coconut oil (a soft solid at ambient temperatures) proved to be extremely effective, easy to use and available. As an oil, it prevents

the encapsulation from denaturing and it is also rainfast. The pigs demonstrated a preference for the oil over coconut flesh, which is itself an excellent lure.

A great deal of data was obtained from the trail cameras on pig movements, breeds, numbers, age, sex etc.

The Niue procedure was:

1. install cameras at all bait box sites to observe pig behaviour, numbers, etc
2. place split coconut, with and without coconut oil, in open bait boxes and adjacent to the boxes until pigs find the lure
3. from that point place split coconut and oil lure only in the open boxes, refilling as necessary
4. when pigs are feeding from the open boxes, lower the box lids until they are 100 mm or less from fully closed, refilling boxes as necessary
5. when pigs are opening the box lids, leave the lids totally closed, refilling as necessary
6. at this point, mix ESN with the oil and place in split coconuts in closed boxes.

The last stage was not implemented due to lack of time and other Niue staff priorities, however all other stages worked perfectly, i.e. pigs quickly learned to open closed boxes, and most did this within one night rather than three. Given that ESN is a very effective toxin proven in trials and in the field in New Zealand, it can be stated with confidence that ESN can be used, with coconut oil as a carrier, in the bait boxes, as an effective tool for pig control on Niue.

ESN in bait boxes is an extremely cheap and easy method of pig control. Other than humans, only pigs can open the boxes, making the method very safe. Provided that bait boxes are deployed in the bush some distance from human habitation, and include signage, then risk of non-target poisoning is negligible to nil. There would be no need to use existing trail cameras at bait box sites, however the collection of further data would be beneficial to refining the methodology (placement, seasonal variations in abundance etc).

Probably half or more of the pigs visiting bait boxes are likely to be wandering domestic animals. This will mean that some pig owners will suffer the consequences of a toxin-based programme, at least initially until they learn to keep pigs in sties permanently. This also means that the toxin technology will act as a strong driver for behaviour change amongst pig owners, i.e. to keep their pigs contained.

*Below is a series of three pictures taken at night that demonstrates that pigs will readily open closed bait boxes. These shots were taken on the first night of deployment at this site. The pig knocked the strut away and immediately reopened the box. Pre-feeding may therefore only need to occur over 1 night rather than 3, i.e. toxin can be deployed on night 2 rather than night 4.*



**8.38 pm. Pig encounters coconut and oil in open bait box, which it begins to feed on**



*8.44 pm. Pig withdraws, allowing box lid to close*



*8.45pm. Pig reopens box lid immediately to resume feeding.*

Use of ESN needs to follow the New Zealand rules as set out by the Environmental Protection Authority. These can be found in the Reference Section of this Plan, and include signage, public notification, training of users, recording of all deployment and kills, and provision of antidote (methylene blue).

## Lured enclosures

### Recommendation:

It is recommended that the lured enclosure technology NOT be used in Niue at this time or in the foreseeable future, due to poor cellphone coverage and absence of large family groups of pigs

### Discussion

The lured enclosure programme was beset by technical and pig owner behavioural issues throughout. Although the enclosure drop-gate could be triggered remotely very reliably (from anywhere worldwide), the methodology depends on digital pictures being able to be sent by text, so that the system administrator can make real time decisions on when to trigger the gate. Local coverage was generally too weak over most of Niue to allow for pictures to be sent via cellphone. The lured enclosure cannot be trialled properly or used until the lack of cellphone picture capability is remedied.

In addition, since the enclosure was built, there were no pigs recorded in either of two cameras placed on existing pig runs in the vicinity, nor any coconut lure (or other lures) taken, nor evidence of damage to crops in the area. This all despite use of coconut as a lure proven elsewhere on Niue. This indicates that the presence of the enclosure has acted as a strong incentive for local pig owners to keep pigs penned. It is therefore unlikely that the enclosure technology would ever be useful in reducing pig numbers on Niue, despite its very low (labour and ammunition only) running costs.

Furthermore, the data extracted from cameras deployed throughout Niue, and the reports from hunters, indicates a general lack of family groups of pigs. As the lured enclosure is specifically designed to catch all members of a family group, rather than single pigs, the use of this technology is not now considered appropriate for Niue, where the pig problem is mostly due to single wandering domestic pigs and escaped/ released single pigs rather than family groups of feral pigs. This is in clear contrast to most other countries (e.g. USA, Europe, New Zealand, Australia) but may be typical of small well-populated Pacific islands where pigs are the most significant food source and are widely kept but casually managed.



*Construction of the lured enclosure drop-gate, showing electronic gate trigger at top*





*Construction of lured enclosure, showing automatic feeder and water tank to supply trough*

## **Use of Improved Snares**

### **Recommendation**

It is recommended that improved snares NOT be used in Niue, and furthermore that the use of snares generally be strongly discouraged as it is not effective in controlling pig numbers and fails humaneness standards.

### **Discussion**

A selection of improved snare materials (stainless wire cord, galvanised wire cord, steel-impregnated plastic cord) was trialled. All proved superior to the traditional nylon monofilament and braided cord materials, in terms of not being broken by pigs. However camera evidence showed that many pigs are aware of snares and have become wary of them. Success rate with snares is low, with fewer than 1 catch per 30 trap nights. In addition, their use by staff and the community was generally laissez faire, with snares being set and left for 3-6 days or longer before revisiting. In two recorded cases, pigs survived 4 and 6 days respectively after being snared. Niue has recently signed up to an international animal welfare standard so it is likely that the use of snares may come under scrutiny. In any event it would be strategically advisable to develop alternatives to snares.

# FURTHER ALTERNATIVE CONTROL METHODS

## Single catch cage traps

### Recommendation

Single catch cage traps should be trialled if scientific hunting and ESN toxin are not found to be effective or affordable. To do this, the Niue Government should contract a local steel fabricator to construct several single catch cage traps, to be trialled around plantations.

### Discussion

DAFF Director Brendon Pasisi suggested that single catch cage traps be investigated as an option. This was done. Current models available in New Zealand are very heavy and bulky and cannot be readily dismantled. The cost of bringing these traps to Niue would be high. It would be a simple matter to have cage traps built in Niue by a steel fabricator or engineer/welder, using steel mesh. A prototype had been built by a man at Lakepa that we inspected. If the trip mechanism could be made slightly more robust then this trap should be trialled. Traps need to be at least 2 metres long, 1.2 metres wide and 1 metre high. If traps are small, pigs will be unlikely to enter as they will not be able to turn around inside. The mesh will need to be 75-100 mm grid, constructed of 4mm steel or larger, and extending on all sides and floor. The door should be of equivalent or more robust construction so pigs will be less likely to test it. The door locking mechanism needs to be of the highest possible strength and preferably holding the door rigid.

Catching pigs in a single catch trap requires:

- deploying the trap at the site for several days or weeks, without bait, to get pigs used to its presence
- baiting with the food most favoured by pigs. This is normally the crop most damaged, plus split fresh coconuts. Small portions can be placed outside the trap with a large portion placed inside the trap, at the far end
- killing the pigs as soon as possible after they are caught, to avoid other pigs learning that the cage is a trap. If this is not followed, then trap efficacy drops very quickly.
- cleaning the trap before redeployment, if pigs are killed in the trap, to prevent pigs from becoming trap-wary.

Single catch cage traps can be useful as long as they are able to be moved frequently.



*Types of cage traps that might be suitable for Niue*

# DOMESTIC PIG MANAGEMENT ON NIUE

## Recommendation

The Niue Government should implement a programme of improved domestic pig management, to eliminate or at least greatly minimise release of pigs into the wild. This programme should include:

- survey of all current piggeries and sties, to ascertain actual number and condition
- registration of all breeding piggeries, with adoption of containment and hygiene standards for these piggeries
- mandatory earmarking (preferred) or eartagging of all pigs, neutering of non-breeding boars
- provision of advisory services by the Department of Agriculture, Forestry and Fisheries
- provision of nipple water feeders and earmarking tool as incentives for every pig owner to contain their pigs.

## Approximate cost of Programme

Provision of an earmarking tool (\$30 each for bulk purchase) to every pig owner would cost \$6,000 to \$9,000. Provision of nipple watering systems would be approximately \$15-\$45 per piggery (average \$25) i.e. \$5,000 to \$7,500. This would mean a one-off cost of \$11,000 to \$16,500, depending on actual number of piggeries.

## Discussion

As described above, the pig issue on Niue is essentially one of illegal domestic pig release, of unwanted (mainly boar) piglets and periodic release of other pigs to save labour and feeding costs and for convenience when owners are absent. This is evidenced by the high incidence of pig disturbance adjacent to many piggeries. Most released pigs will tend to return to be fed so few are ultimately lost. Simple escape from piggeries is therefore unlikely to be a major contributor to the problem.

The problem of illegal release can only be solved by compulsory registration of breeding piggeries and a mandatory requirement to earmark (or eartag) all pigs and neuter all non-breeding boars. Pig identification would work to ensure owners kept pigs contained in sties/piggeries to avoid criticism, fine or claims for damage. The ID system should preferably be a registered earmark rather than eartag, as it would be cheaper to implement and more permanent. Tags can tear out or be removed, but earmarks are permanent. Every family or piggery can be assigned an earmark and a marking tool. Over 700 earmark combinations can be created.

Compulsory registration of all breeding piggeries, when combined with pig ID, would work to greatly improve sty construction and security. A strong case can be made for a change in legislation, to permit ownership of breeding pigs only by registered breeders, within secure facilities with high hygienic standards, e.g. concrete floors and improved breeding. Pig owners could buy sow or barrow weaners for approximately \$50 - \$60 (suggested by DAFF Director as a starting point for consideration), which would mean no feed wasted on non-fattened breeding boars and sows. Disease in piglets would be largely pre-empted (many current piggeries have dirt floors and disease in young piglets is common). The issue of feral pigs would quickly be eliminated as no boars would exist outside of registered secure piggeries.

A key issue for most pig owners is the need to visit sties two or three times daily to provide water. This lack of permanent watering systems could be overcome by DAFF providing nipple water feeders so sties would only need to be visited once daily or less for feeding purposes, and the supply of permanent water would lead to better pig health and faster growth rates.

An advisory and inspection service should be implemented by DAFF for all piggeries, to ensure pig identification is being undertaken. This will also assist with management of disease issues.

Agency responsibility should ideally be given to one government department overall - to manage feral pig research and control programmes, and domestic pig identification and containment programmes. This would also better deal with the disjoint between feral and domestic pig impacts.

### Case study - Liku piggery

On 16 September 2015 an inspection and hunting party, including the Director and Minister, hunted at Liku, in a bush block immediately behind a large piggery. There was a huge amount of pig rooting around the piggery and into the bush to a distance of 200 metres, and thinning further out. A 40 lb black and white domestic breed sow in good condition was tracked and shot within 200 metres of the piggery. This pig was identical in age, condition and size to others in the piggery. Some split coconuts were observed on the ground outside the cages, indicating that unconfined domestic pigs were being fed or at least had access to feed. The large amount of pig rooting indicated that 3-4 domestic pigs would be wandering outside the piggery at most times.



*The hunting party adjacent to the Liku piggery, with the sow caught*

## Pig tail bounty

### Recommendation

The current pig tail bounty is ineffective and being misappropriated and should be discontinued, with the budget reallocated to the scientific hunting programme.

### Discussion

The pig tail bounty system has been in place for over 8 eight years, and has not achieved any significant reduction in wandering/feral pig numbers or their impacts on plantations. The bounty is popular and believed by some people to be effective in preventing feral pig numbers from reaching plague proportions. There is no evidence to indicate that the bounty is having any impact whatsoever on feral/ wandering pig numbers, and in this regard the bounty can be seen as a political measure, not an effective pig control measure.

The survey of hunters undertaken by Glen Osborne showed that very few pigs have been hunted every year on Niue. There are not sufficient feral hunted or snared pigs to account for the tallies included in the bounty. Therefore most of the bounty is being spent on domestic rather than feral pigs. Several pig owners have admitted to submitting tails from slaughtered domestic pigs. The bounty is therefore irrelevant as a control measure. The pig tail bounty budget (approximately \$5,000 pa) should be redirected at a pig control programme that has been proven to be successful, in this case the scientific hunting programme. This transfer would be both popular and cost-effective.

# PROGRAMME MONITORING

## Advisory and Community-Based Monitoring Programmes

### Recommendations

- A phone-in issues and complaints register should be kept by DAFF, to record all instances of plantation damage. This will act as a reliable measure of current unconstrained pig numbers and inform timing and placement of control programmes.
- DAFF should commence a piggery advisory service, to inform owners of appropriate pig management regimes, incentives and regulations.
- DAFF should use the current weekly radio service to communicate all programmes, incentives, regulations and promotion of the complaints register.
- Whatever programmes are adopted, they will need to be introduced in a staged manner. This should commence with inspection and advisory services, followed by incentives, pig identification programme, pig neutering, and finally breeding piggery registration (if this measure is adopted).

### Discussion

Whatever programmes are adopted, the community will need to know what is being done to deal with feral pigs and what rules will affect them e.g. if pigs will be shot/ poisoned/ trapped if they get out, and what rules will govern the keeping of pigs. This is best delivered by the current and excellent weekly radio service from the DAFF office, which was extremely effective in communicating the initial surveys and pilot control programmes, and getting hunters and plantation owners to the workshops.

When pigs are eventually properly marked or tagged, a simple phone-in Issues, Risks and Complaints Register should be kept by DAFF recording all complaints received from the community or anyone else regarding all parts of the programme. It should also record all issues and risks raised by anyone inside or outside of the programme management. The register would act in a very direct way to obtain better compliance by pig owners. Most people own or are dependent on their gardens and plantations and these are not always the same people as the pig owners. Also damage to one plantation may not be due to the owners' pigs as the plantations are usually far removed from the sties which are close to home. This peer driven complaints system is far more likely to result in improved behaviour than complaints from Government officials.

DAFF and the Police should monitor community concerns and programme elements should be introduced in a staged manner so as to raise pig management standards in a sustainable and calm fashion, and avoid community discord. The piggery inspection regime should be implemented first, followed immediately by incentives, then the ID programme, regulations on pig neutering and registration of breeding piggeries.

## Outcome Monitoring

### Recommendations

- The Niue Government should implement a research programme to measure uga numbers and densities in a number of habitats and areas. This programme should be conducted at the same time every year (e.g. when uga are most mobile) so that population trends can be measured. International conservation organisations should be approached to fund this work.
- Data from the complaints register should be interrogated to determine trends in pig impacts on plantations, as this is a cheap and reliable arbiter of pig impacts across Niue.

## Discussion

The primary objective of the programme is protection of biodiversity values in Huvalu Conservation Area. A priority concern is the health of uga populations. Evaluation of the different control approaches as described above, although accurate in terms of output monitoring, is not a worthwhile measure of overall programme success. This is because feral pig populations typically recover extremely quickly after control programmes. Pig control programmes elsewhere typically achieve quick population knockdown followed by rapid recovery. It is therefore imperative to measure the outcomes of the programme, along with pig control success. Uga population is the best ecological arbiter existing on Niue.

Direct field survey of uga population by DOE and/or DAFF staff should be implemented and continued annually, at the same time every year. This could commence as part of a Masters or PhD study, and/or assistance from one of the international conservation organisations.

Another outcome monitoring measure is trends in pig impacts on plantations and gardens. A key community driver for pig control is plantation damage, a very important economic factor on Niue. Plantations and gardens are spread very widely on the island, as are pig impacts. Because ecological and economic impacts are caused by feral and wandering domestic pigs, any variation in pig impacts on gardens and plantations would be a useful outcome measure. Data from the public complaints register would be a cheaply obtainable and reliable guide to programme success, provided that the register was maintained and promoted appropriately.

Feral pig monitoring on its own would not need to be done, as it is the impacts of feral and wandering domestic pigs together that is important, not actual pig numbers or densities.



*Glen Osborne brings pig to DOE, Director Sauni Tongatule and Emeline approve*

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