THE PREDATOR PROBLEM AND PARA-AMINOPROPIOPHENONE (PAPP)

Predators adversely affect New Zealand's native biodiversity threatening the survival of many of our endangered bird species. Consequently New Zealand needs effective predator control programmes.

This short publication provides answers to commonly-asked questions about PAPP in the context of it being developed as a poison for predator control.

It is intended to assist those wishing to use PAPP for predator control, allowing them to assess the benefits and risks associated with its use. PAPP will complement existing tools and offer an alternative in some situations. Laboratory and field trials have demonstrated PAPP can be effective at controlling stoats and feral cats. PAPP is currently being evaluated for ferret control.

THE PREDATOR PROBLEM

Why are predators such a problem in New Zealand?

New Zealand wildlife evolved in the absence of mammalian predators. Birds have been particularly affected, with over 40% of the pre-human land bird species now extinct, and the proportion of birds classed as threatened is one of the highest in the world. Introduced species including feral cats and stoats are targeted to protect native birds. For example stoats are responsible for approximately half of kiwi chick deaths in many areas through New Zealand. Cats also to a lesser extent prey on kiwi chicks. The combined effect of these predators results in only 10% of kiwi chicks surviving to the age of six months. Young kiwi chicks are vulnerable to stoat predation until they reach about 1 - 1.2 kg in weight, at which time they can usually defend themselves. Control methodologies currently rely largely on labour-intensive trapping. Hence the development of a safe humane toxin for predator control is highly desirable.

ABOUT PAPP

What is PAPP?

PAPP is short for para-aminopropiophenone; PAPP is a new vertebrate pesticide that has been developed in New Zealand as a new tool for the control of stoats and feral cats.

PAPP was originally trialled in the 1960s as an antidote for human radiation poisoning. In historical pharmaceutical trials, PAPP was found to be specifically much more toxic to carnivores than to birds and humans. In the USA it has been investigated as a tool for coyote control. In Australia it will be used for field control of foxes, wild dogs and feral cats.

PAPP is a compound with the formula $C_9H_{11}NO$.

In New Zealand, PAPP was registered in 2011 for the control of stoats and feral cats.

Paste baits containing PAPP must be treated as potentially poisonous to non-target species and must be handled and dispensed as carefully as other types of toxic bait.

How does PAPP work?

PAPP is absorbed into the blood stream via the stomach after the bait is eaten. It causes a condition called methaemoglobinaemia. It acts by rapidly forming methaemoglobin (the ferric state of haemoglobin) which is unable to release bound oxygen. This creates a lethal deficit of oxygen in cardiac muscle and the brain. Death in stoats and feral cats usually occurs within 2 hours after eating a lethal dose. The animals become lethargic and sleepy before they die.

What is methaemoglobinaemia?

Methaemoglobinaemia is a disorder characterized by the presence of a higher than normal level of methaemoglobin in the blood. It is a form of haemoglobin in red blood cells that has a decreased affinity for oxygen. When methaemoglobin concentration is elevated in red blood cells, tissue hypoxia (lack of oxygen to tissue) can occur.

Normally, methaemoglobin levels are <1% (although some people with hereditary conditions may have higher levels). Methaemoglobinemia is also caused by some drugs such as local anaesthetics. Symptoms are proportional to the methaemoglobin concentration in the blood and include skin colour changes (with blue or grayish pigmentation) and blood colour changes (brown or chocolate colour) at methaemoglobin levels up to 15%. Moderate methaemoglobinaemia (< 30 % of total haemoglobin oxidised) causes discomfort (e.g headache) with severe methaemoglobinaemia (> 50 %) being possibly life threatening. Levels of methaemoglobin above 70% in the blood are usually fatal.

Who uses it and why use PAPP for stoat and feral cat control?

Land managers, pest control professionals and community groups can use it for stoat control to protect vulnerable native species from predation. The use of PAPP baits can complement traditional trapping and may enable better protection of native birds, such as kiwi, over larger areas.

PAPP provides an additional control tool targeted specifically at stoats and feral cats, species that are notoriously difficult to control. Trapping is labour intensive and prior to the registration of PAPP there were no poisons registered in New Zealand specifically for stoat control.

PAPP is humane in action, is not persistent in the environment and is unlikely to cause secondary poisoning, although care is needed to prevent dogs and pets from primary poisoning by eating baits directly. All pest control toxins have advantages and disadvantages that should be considered when deciding the appropriate control method to use. These are summarised for PAPP below.

Advantages	**Disadvantages**
Simple antidote	At present only available in a paste that has to be added to meat
Humane (very rapid action)	

Low secondary-poisoning risk	
Effective	

What does it look like and how is it used?

PAPP comes in one form – a paste. It is coloured green as a deterrent to birds and as a warning to people.

Small pea size dollops are enclosed within mince, and the baited mince placed in tunnels or bait stations.

- A toxic dose for stoats is approximately equivalent to 35 mg of paste (10mm if dispensed from a syringe or a quarter to half the size of a normal pea if from a syringe container). For cats a larger amount, 200 mg, of the same paste is required.
- For stoats, The dose is enclosed within 5-10 g minced raw meat dyed green, preferably rabbit, (i.e. 1-2 teaspoonsful),). For cats, the dose is enclosed within 10-15 g minced raw meat dyed green.

PAPP is a single-feed poison as only one bait will need to be eaten by a stoat or a cat. Pre-feeding with non-toxic green-dyed minced meat for one to two weeks before laying bait is strongly recommended to maximize bait uptake for stoats and must be undertaken for cats.

In areas occupied by weka and kiwi or other birds that may consume meat baits, the bait stations need to be of a design that will exclude these non-target species.

Baits should be checked not more than 48 hours after placement and replaced until no more is taken. On the completion of a control operation all remaining toxic baits should be recovered and buried.

Are there other target species for PAPP?

The registration for the control of stoats and feral cats may be extended in the future to include ferrets. Research is underway testing the effectiveness of PAPP at controlling ferrets.

What are the welfare implications of using PAPP?

One of the drivers for developing PAPP has been animal welfare. A humane death has been identified as a very important aspect of wild animal control. When delivered at a lethal dose, rapid induction of high levels of methaemoglobin quickly induces death with minimal symptoms of distress.

Research has shown the symptoms of poisoning are similar in both feral cats and stoats. The onset of symptoms of poisoning and time to death are swift in comparison to the anticoagulant toxins or 1080. The sequence of behavioural changes in animals is consistent with our understanding of the toxicology of PAPP, namely that the compound is rapidly absorbed and quickly induces methaemoglobinaemia.

Stoats and feral cats that were sub-lethally dosed recovered without any adverse effects being observed.

Are there restrictions on the use of PAPP?

Only persons who are Approved Handlers and hold a Controlled Substance License (CSL) may purchase and use PAPP.

PAPP must be used in bait stations. On completion of the control operation, remaining toxic baits must be recovered and buried.

Signs must be erected at every normal point of entry to the area where PAPP is to be used. The signs must remain in place until the baits are retrieved or until any other legal requirement affecting signage has been complied with.

Department of Conservation and pest control professionals also have strict codes of practice covering operating procedures that incorporate their experience in risk management and best practice built up over four decades of using toxins in New Zealand. The Department of Conservation has also produced a comprehensive 'Quality Conservation Management' system for all its pest control operations, to ensure high operational standards. The Department of Conservation's consent is required for all pesticide operations on lands administered by the Department, and regional councils closely monitor all operations.

Do other countries use PAPP for animal pest control?

In the USA it has been investigated as a tool for coyote control. In Australia it will be used for field control of foxes, wild dogs and feral cats. Registration for field use in Australia is expected in 2012/13.

Does PAPP persist or accumulate in the soil?

PAPP is water–soluble. This means that if any bait falls out of a bait station the PAPP will be easily leached into the soil by rain. PAPP is mobile in soil and readily biodegradable with OECD test results showing it degrades within a month. PAPP appears to have similar biodegradability and solubility as cyanide and 1080. Any PAPP leaching from uneaten baits is broken down into non-toxic naturally occurring substances. Consequently, PAPP does not accumulate in the soil, as some pesticides do (DDT, for instance, can last in the environment for decades).

Will PAPP pollute water supplies?

PAPP is initially being developed for use in bait stations. Baits will be placed in the stations away from waterways so contamination is most unlikely. For example, in the recent Waitutu trial 90 baits were placed out (one per station) at one time over an area of approx 800 hectares and each bait contained approximately 0.04g of PAPP in a meatball type bait. In total there was no more than 4g of PAPP in the field at one time, so soil or water contamination would have been limited and most unlikely.

How toxic is PAPP to humans and pets?

Humans, dogs and other pets will be poisoned if they eat PAPP bait. Veterinary treatment for PAPP poisoning is possible, though it has to be prompt, so it is obviously preferable to keep pets and working dogs away from baits.

The risk of non-target exposure is reduced by using PAPP in tunnel bait stations which allow access by stoats and feral cats but restrict access for other species.

Sub-lethal doses (80mg or 100mg) administered orally to 51 human volunteer subjects produced methaemaglobinaemia concentrations ranging from 2% to 48% and whilst few side effects were reported ingestion of even these small amounts of PAPP must be avoided. This amount of PAPP (80mg or 100mg) could be obtained by eating 1 meat bait containing 200 mg of paste for cat control. Eating 2 or 3 baits, or ¼ to ½ gm of PAPP paste or 150 to 250 mg of PAPP powder could induce lethal or near lethal level of methaemaglobinaemia in some individuals.

It is very important that young children are kept away from bait stations and from bait. Hence baits must be used in appropriately designed bait stations and located with limited access thereby limiting access to young children and small animals. As with all other toxic baiting practice bait should be placed in such a way and with appropriate signage to prevent access.

PAPP at sub-lethal doses is known to be rapidly eliminated by different animals. Should there be exposure (by ingestion) to the bait, then elimination of PAPP residues would probably occur within 12 hours at worst, and most likely within 1-6 hours of any game species or livestock ingesting a sub-lethal amount of bait. There would be no risk or negligible risk of procurement of contaminated game meat which might be harvested at a later date.

What is the treatment for PAPP poisoning?

Methaemoglobinemia can be treated with oxygen and methylene blue. A 1-2% solution (1-2gm/ 100 ml) can be administered at 1 to 2 mg/kg intravenously slowly over five minutes followed by an intravenous flush with normal saline. This may need to be repeated in severe cases. Methylene blue restores the iron in haemoglobin to its normal (reduced) oxygen-carrying state.

Cases of nitrite poisoning, which has the same mode of action as PAPP in dogs and cats have been treated successfully with methylene blue. For cats a single dose of 1.5 mg/kg has been found to be safe and effective in reversing methaemoglobinaemia.

Can PAPP cause sub-lethal effects?

PAPP, like any other poison, has the potential to cause sub-lethal effects if exposure occurs above certain levels. If PAPP users follow simple controls and safe handling practices, they should not suffer any symptoms of PAPP poisoning

What is the risk to livestock or game?

There is potential for PAPP to be toxic to livestock, so farm stock should most certainly be kept out of areas where poisons are used for pest control until the risk of poisoning has passed. However, given the large body weight of most livestock species compared with the pest species being controlled (200 kg)the risks are likely to be low.

Sub-lethal doses of PAPP are eliminated from the tissue of animals that survive accidental exposure within one to two days.

What is the risk to dogs?

Dogs are vulnerable to PAPP in baits and must be kept out of areas where PAPP baits are being used. If this is not possible, dogs should be kept under control and muzzled until signage states the area is safe.

Small dogs (3 to 4 kg) could conceivably ingest a toxic dose of PAPP from a bait targeting feral cats.

They may be exposed by scavenging feral cats or stoats killed by PAPP. It can take three to six months for carcasses to degrade, and even longer in cold or dry conditions. However, the secondary poisoning risk to dogs from PAPP is far less than that from 1080 and is generally unlikely to occur. 'Low risk' does not imply 'no risk' so pets and farm dogs should be discouraged from eating potentially poisoned stoat carcasses. If a pet is suspected to have eaten a PAPP bait, immediate veterinary assistance should be sort.

What is the risk to birds?

Birds are less susceptible to PAPP compared with stoats and feral cats. However, some species of bird can be adversely affected if they directly eat bait. Weka that ingested PAPP during a trial became subdued and lost their appetite for a period. So it is still important to limit birds' exposure to PAPP by usinge bait stations that exclude them.

Risk to birds such as hawks that scavenge carcasses should be low given the rapid elimination of PAPP by excretion in the target species and further breakdown in carcasses following death, and also because a large bolus dose is needed to induce toxicity.

What is the risk to other species?

Further research on all non-target species including reptiles is being planned.

THE CHOICES – PAPP OR OTHER PREDATOR CONTROL TECHNIQUES?

What other predator control methods are available?

Sustained management of stoats is usually undertaken using kill traps. Stoats are also sometimes targeted using aerial 1080 operations, relying on secondary poisoning of stoats through scavenging rodent and possum carcasses.

Feral cats are controlled in different parts of New Zealand using leg hold traps, cage traps and through 1080 in fish baits.

PAPP can be used in a meat bait to directly target stoats and feral cats.

How do we know predator control is successful?

There are two types of monitoring for success:

1. The impact of a control operation on a predator population can be assessed by indexing the populations abundance either by looking at the decline in trap catch, or by using an independent index such as tracking tunnels.
2. Outcome monitoring. This requires measuring/assessing whether native bird populations in the area are recovering as a result of the control.

USEFUL CONTACTS

Who to contact for more information?

- The National Possum Control Agencies (NPCA) can also help with information: phone (04) 499 7559 or email npca@xtra.co.nz

- Connovation Ltd can be contacted at 09 215 4345