

## Euthanasia of Reptiles in New Zealand: Current Issues and Methods

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### Abstract

Current best practice for euthanasia of reptiles in New Zealand involves overdosage with either an inhalation anaesthetic agent (e.g., halothane) or appropriately diluted sodium pentobarbitone solution. Particular care is needed to ensure that a "euthanised" reptile actually is dead.

**Key Words:** euthanasia, gecko, halothane, humane, pentobarbitone, skink, tuatara, turtle.

### Introduction

In addition to the tuatara, *Sphenodon spp.*, New Zealand has both geckos (*Hoplodactylus spp.*; *Naultinus spp.*) and skinks (*Cyclodina spp.*; *Oligosoma spp.*) as native terrestrial reptiles. Using Frye's (1991) classification of chelonians as tortoises if they live on land, terrapins if they live both on land and in freshwater, and turtles if they live in the sea, New Zealand has no native tortoises or terrapins and no endemic turtles. (In New Zealand and Australia, terrapins are often called turtles.) However, a number of exotic chelonian species, and to a lesser extent some exotic lizard species, are bred as pets in New Zealand, having been introduced (often from Australia) before the current bans on their importation. These and other species (including terrestrial snakes) may be encountered as a result of illicit or unintentional introductions into New Zealand. Crocodylians and some other exotic reptiles may be held as exhibits in zoos in New Zealand. New Zealand has no endemic terrestrial snakes and the importation of snakes into this country is prohibited.

Euthanasia (i.e., humane killing) of reptiles may be necessary to relieve what we assess to be intractable suffering in diseased or injured native species, for collection of type specimens for museum collections, or for the destruction of exotic species. The aim should be to achieve euthanasia as rapidly and effectively as possible, given the practicalities of the particular circumstances.

Euthanasia of reptiles is complicated by their varying ability to breath-hold and to tolerate anaerobic conditions and extremes of cold (Beaver and others, 2001). It can be extremely difficult to determine whether a reptile is dead, and recovery of apparently dead animals can occur (Mader, 1996). The particular technique chosen will also depend on the size and type of reptile and on the intended later use of the body.

Some techniques previously used for the euthanasia of reptiles are no longer considered acceptable. These include freezing, drowning in fixative solutions, intra-coelomic (i.e., body cavity) injections of some undiluted commercial euthanasia solutions (or of other chemicals), and decapitation. In particular, the assumption that decapitation results in rapid unconsciousness is disputed, for it seems that the brain of a reptile can remain viable for

up to an hour after decapitation (Cooper and others, 1984; Cooper, 2003). [In mammals, electrical waves have been recorded from the brain for short periods after decapitation and there has been debate as to whether these waves were indicative of sensibility (Reilly, 1993).]

### Recommended Procedures

The techniques recommended are grouped below; first according to types of agents, and then according to sizes and types of reptiles. The recommendations are believed to reflect current best practice. Advances in our knowledge of the neurophysiology of reptiles are required to confirm the efficacy of the techniques; meanwhile, comments on the recommendations will be welcomed by the present authors.

Euthanasia of a reptile should not be initiated without first ensuring that any necessary consultation with the Department of Conservation (DoC) and/or the Ministry of Agriculture & Forestry (MAF) has occurred, and that all possible practicable subsequent good use of the reptile's body will be made.

#### A. Techniques Grouped by Types of Agents

##### 1. Overdose with inhalation anaesthetic agents

Volatile anaesthetic agents such as halothane ("Halothane BP VCA", Vetpharm, New Zealand) or isoflurane ("Aerrane", Baxter Healthcare Ltd, Auckland) can be administered to reptiles via chambers or sealed masks. In small reptiles this method will induce unconsciousness quickly (i.e., within five minutes) and death should follow relatively quickly (15-20 minutes in most species). In reptiles with a strong ability to breath-hold (especially terrapins, tortoises and turtles) "masking down" can take up to several hours and is therefore not practicable. In all cases, care must be taken to ensure that the dosed animals actually are dead, and not simply deeply anaesthetised.

The above agents are only available under the direct supervision of a veterinary surgeon. Operators should take care to avoid exposure of human personnel to these agents, and proper venting of gas chambers should be carried out after the euthanasia.

Other inhalation agents, such as chloroform (which is carcinogenic) or ether (which is highly flammable) are not recommended. It is important to avoid direct contact with solutions of either chloroform or ether.

##### 2. Injection of sodium pentobarbitone solution

Injection of sodium pentobarbitone at a dose of 100 mg/kg into the body cavity, or intravenously, or by intracardiac injection will result in anaesthesia followed by death. The simplest technique is to inject the pentobarbitone solution into the heart or body cavity and then keep the reptile at room temperature until death is confirmed. Use a small diameter hypodermic needle to minimise any possible

distress to the animal. Other barbiturates and undiluted commercial solutions for euthanasia are likely to cause pain at the injection site and are not recommended unless given intravenously.

Pentobarbitone is effective but relatively slow (often up to 30 minutes) to take full effect. If the reptile is cold or is moribund with poor circulation, the drug will take even longer to take effect.

Injected barbiturates will cause histological tissue damage after death and are not recommended in small reptiles when tissues for microscopic examination will likely be taken at a subsequent post mortem examination of the reptile.

Pentobarbitone is now only available in New Zealand as commercial euthanasia solutions ("Pentobarb 300" and "Pentobarb 500", National Veterinary Supplies, Auckland) of 300 mg/ml and 500 mg/ml, respectively. The 300 mg/ml solution should be diluted, using water-for-injection or normal saline solution, to no more than 75 mg/ml prior to use in reptiles. This dilution of the commercial product is recommended to alleviate peritoneal irritation. These drugs are only available for use by or under the direct supervision of a veterinarian.

### 3. Combined sedation and euthanasia

This approach is useful with the larger reptiles, and is especially useful when the reptile is dangerous or difficult to handle, or when an owner is present. Sedation can be achieved by intramuscular injection of either ketamine ("Ketamine Injection", Parnell Laboratories New Zealand Ltd, Auckland) at 100 mg/kg, or zolazepam/tiletamine ("Zoletil", Virbac Laboratories (NZ) Ltd, Auckland) at 25 mg/kg of each component. Either drug should be injected 20-30 minutes before attempting euthanasia, and the animals should be kept at room temperatures to facilitate drug uptake and distribution.

The sedative used will immobilise the animals and allow euthanasia to be performed using either inhaled anaesthetics or injections of pentobarbitone solutions. All of these drugs are only available for use by or under the direct supervision of a veterinarian.

### 4. Decapitation followed by immediate pithing of the brain

This technique provides the most rapid mechanical means of euthanasia, but it should be used on a conscious reptile only when no alternative is available and the animal needs to be killed immediately. It is an acceptable technique for ensuring death after an animal has been deeply anaesthetised.

The decapitation procedure must be performed quickly and completely. Pithing of the brain within the severed head is difficult in small reptiles and terrapins and needs to be extensive. Alternatively, the brain of a small chelonian may be pithed by passing a probe rapidly through the roof of the animal's mouth (McArthur, 2004). The possibility exists that a conscious reptile might experience severe pain before loss of consciousness supervenes. The decapitation may spoil a body for museum purposes and pithing renders the brain unsuitable for post mortem examination.

### 5. Massive head trauma

The use of concussive head trauma is another mechanical means of euthanasia reported as being feasible for reptiles of less than one kilogram body weight (Anonymous, 2003). For this technique to be effective, the reptile's head must impact against an unyielding surface with sufficient force to produce immediate unconsciousness. The brain of the reptile should then be destroyed immediately by pithing or by crushing the skull. This method should only be used when the use of other methods is not possible. Decapitation following concussion is not considered suitable as reptiles may recover consciousness, but can be used in combination with immediate extensive pithing of the brain.

Shooting, by captive bolt or bullet, can also be used to produce sudden, massive destruction of brain tissue. However, in most instances the small size of the reptile's brain makes accurate aiming difficult. In addition, free bullets are likely to be hazardous to humans and any other nearby animals and to cause damage within the surroundings.

## B. Techniques Grouped by Size and Type of Reptile

### 1. Skinks, geckoes and tuatara

The two techniques recommended for use in these species are the use of inhalation agents and the injection of pentobarbitone solution. Either can be used with or without prior sedation of the reptile.

These smaller reptiles have a limited ability to breath-hold and they can be reliably euthanised by inhaled anaesthetic agents. To protect the operator, the procedure should be undertaken under a fume hood or in some other well ventilated area.

The most reliable technique for a single animal is to pack an appropriate hypodermic syringe barrel (5ml, 10ml, or 20 ml), or an anaesthetic mask, with cotton swabs soaked in an inhalation anaesthetic agent (usually halothane) and place the reptile's head and shoulders inside. Concentrated halothane can damage plastics, so do not allow it to contact the plastic of a good anaesthetic mask. Manual restraint of the reptile is required and continued until anaesthesia develops. The reptile should then be left in place for at least 5 minutes after its respiratory movements cease.

Alternatively, anaesthetic-soaked cotton swabs and several reptiles together can be placed inside a small, gas proof, sealed container. Multiple animals can be euthanised safely in this way, provided that overcrowding and mixing of species is avoided, to minimise stress to the animals. The container should be vented carefully to avoid operator exposure to the gas when the container is opened after the animals are dead.

### 2. Marine reptiles

Marine reptiles which may be found in New Zealand's coastal waters are generally limited to five species of turtle (the leathery turtle, *Dermochelys coriacea*; the loggerhead turtle, *Caretta caretta*; the green turtle, *Chelonia mydas*; the hawksbill turtle, *Eretmochelys imbricata*; and the Olive Ridley turtle, *Lepidochelys olivacea*) and two species of sea snake (the banded sea snake, *Laticauda colubrina*, and the yellow-bellied sea snake, *Pelamis platurus*).

The turtles have a capacity to breath-hold for prolonged periods (Westera, 2004). Intra-coelomic injections of pentobarbitone solution, with or without prior sedation, are recommended for euthanasia. The brains of turtles are small, and euthanasia by gunshot is not recommended.

Both species of sea snakes found in New Zealand waters are venomous and extreme caution should be used when handling these animals. Euthanasia is best achieved by injecting pentobarbitone solution.

### 3. Non-native reptiles

#### (a) Terrapins and tortoises

These animals are possibly the most difficult reptiles to euthanise by using gaseous agents, given their prolonged breath-holding. Intra-coelomic injections of barbiturates are effective, and are best combined with a sedative. (The exotic red-eared terrapin, *Trachemys scripta elegans*, is often kept as a household pet in New Zealand.)

#### (b) Snakes

Live snakes are found occasionally in New Zealand, associated with materials unloaded at wharves: MAF should be notified immediately. Venomous snakes (e.g., death adder, *Acanthopis antarticus*) are best euthanised by intra-coelomic injections of sodium pentobarbitone solution. Prior sedation is advisable when there is danger to humans in giving an intra-coelomic injection. Never handle or inject a venomous snake without the snake's head being adequately controlled by a competent assistant.

Non-venomous snakes, such as pythons (e.g., Calabar python, *Calabar reihardtii*) can be euthanised by inhalation anaesthesia or sodium pentobarbitone injection, with or without prior sedation, depending on their size and ease of handling.

#### (c) Large lizards

A small number of collections of large exotic lizards (e.g., including, variously, green iguanas, *Iguana iguana*; bearded dragons, *Pogona spp.*; Australian dragons, *Ctenophorus spp.*; and Australian dragon lizards, *Amphibolurus spp.*) are maintained in New Zealand.

Injections of sodium pentobarbitone solution, or combined sedation and inhalation anaesthesia are recommended, particularly with larger and more dangerous lizards (if brought into New Zealand), such as the Australian monitor lizard, *Varanus breviceaudatus*, which can exceed 2 m in length.

#### (d) Crocodilians

Australia has two species of crocodiles: a freshwater crocodile, *Crocodylus johnstoni*, and a saltwater crocodile, *Crocodylus porosus*. Small specimens can be sedated with ketamine or zoletil and then euthanised by injection of sodium pentobarbitone solution. Larger specimens should be approached with caution, and a captive bolt gun or a regular rifle may be required, with careful attention to the safety of operators and observers: the weapon should be aimed just caudal to the animal's eyes, close to the dorsal midline, and the bolt or bullet should be directed toward the underside of the head, just caudal to the jaw on the opposite side.

## Confirmation of Death

A conservative approach to declaring death in reptiles is advisable. Cessation of respiration is the most obvious sign of deep anaesthesia or death. When hypothermic or deeply anaesthetised, reptiles can have a respiration rate which is measured in "minutes per breath" rather than breaths per minute. Respirations are most easily seen by opening the (anaesthetised) animal's mouth and observing the glottis for some minutes.

Cessation of cardiac function is more difficult to establish. Commonly, no heartbeat is audible even in normal, unanaesthetised reptiles. Electrocardiograph tracings are unreliable, because reptiles can survive episodes in which their heart rates drop to "several minutes per beat" (Mader, 1996; Westera, 2004). In larger reptiles, doppler blood flow analysis may be useful. The absence of deep pain responses to stimuli such as toe clamping with forceps may help to determine that an animal is at least deeply anaesthetised but, again, is not a reliable indicator of death (Close and others, 1997). Thus, there is no completely reliable technique currently available for confirming that an intact, overdosed reptile has died shortly before examination.

If the reptile is to be preserved in a fixative solution for museum or diagnostic purposes, it is advisable to check the deeply anaesthetised animal for lack of visible respiratory movements and absence of deep pain responses, and then perfuse the animal with the preservative solution (while there is no doubt that the anaesthesia remains deep). If the reptile's body is not to be fixed, it is best to place the animal in a sealed container, refrigerate and check again 24 hours later for the absence of respiration and deep pain responses, before disposing of the body.

## Disposal of Cadavers

The bodies of native reptiles which have been euthanised, if they are not being sent for post mortem examination or being used directly for museum purposes, should nevertheless still be treated with respect, and incinerated or buried. The bodies of exotic reptiles should be referred to MAF. (MAF is likely to have been already consulted.)

When barbiturate solutions have been used in the euthanasia, it is important to ensure that the now-toxic body of the reptile cannot be eaten by another animal. There are, for example, recorded fatalities in dogs which have eaten pentobarbitone-loaded tissues which operators have discarded from other animals. There may also be the wishes of local iwi to respect in regards to disposal of the body.

In all cases which do not already involve MAF or DoC, it is worth checking with the local DoC office, or the DoC wildlife health co-ordinator before disposing of the body. It should be remembered that the body of an uncommon species may be worth archiving in a museum or the New Zealand Wildlife Health Centre. The method of euthanasia used will often depend on the ultimate use of the body, so it is preferable to clarify this use before beginning the euthanasia.

## Discussion

The word "euthanasia" is composed of the Greek terms "eu", indicating good, and "thanatos", meaning death: a "good, gentle death" is thus our overriding objective and depends on the efficient use of a rapid and dignified procedure, with the safety of the operators also important (Morton, 2004).

The recommended use of sodium pentobarbitone solution is consistent with observations within the Massey University Veterinary School that red-eared terrapins overdosed intra-coelomically with a 60 mg/ml solution became progressively sedated, without any signs of distress or excitement, and then quietly died.

Williams (2004) has outlined the limitations of using carbon dioxide for euthanasia in several groups of animals. The present authors have no experience of using this technique in reptiles, but the use of carbon dioxide in these animals would be subject to the same breath-holding limitations as apply with other inhalation agents (Close and others, 1997).

The use of adequate procedures for euthanasia under field conditions (especially on off-shore islands with difficult access) may present some problems. In instances in which it is necessary to euthanise a sentinel animal and/or an animal with an irreversible chronic disease, it may be feasible (because native reptiles are of small size) to transport the live animal to the mainland and then, preferably, to a veterinary hospital for sampling and euthanasia. Many of the protozoal and metabolic diseases of reptiles are only able to be diagnosed by examining fresh faecal smears and other samples from a live animal (McInnes and others, 2004).

This approach can involve some conflicts for people who may desire to treat the sick reptile. Treatment will be likely to kill infective organisms, alter antibiotic sensitivities and cause histological changes within the animal's body - all of which could impede a precise diagnosis which might be needed in order to help other reptiles in the group from which the individual was taken.

In the field, tissue samples are usually placed in 70% alcohol solution, because the transport and use of 10% formalin solutions is generally regarded as hazardous to humans, even although formalin is a better fixative than alcohol. Regardless of the location and technique used for euthanasia of a reptile, the possibility of an infection being zoonotic (i.e., transmissible from the reptile to human beings) should be always kept in mind.

## Conclusions

Methods of killing previously advocated for reptiles have included techniques which are now regarded as possibly producing significant pain and suffering before unconsciousness occurs, and these should be avoided. The techniques outlined above may, in their turn, be superseded as our knowledge of reptilian neurophysiology improves. Meanwhile, the present recommended best practice is to use inhaled anaesthetic agents and/or injection of sodium pentobarbitone solution.

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*Comments/criticisms/suggestions relating to the above summary will be welcomed and should be sent to the senior author (E-mail: B.Gartrell@massey.ac.nz).*

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