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NSW Code of Practice and Standard Operating Procedures for the Effective and Humane Management of Rodents

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The NSW Codes of Practice and Standard Operating Procedures for vertebrate pests have been developed by the NSW Department of Primary Industries in collaboration with industry representatives and NSW government agencies. The documents have been endorsed by the NSW State Pest Animal Committee which comprises representatives from: Department of Primary Industries, Landcare NSW, Local Government NSW, Local Land Services, National Parks and Wildlife Service, Nature Conservation Council, NSW Farmers and RSPCA NSW.

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Preface

This document (Code of Practice (COP) and relevant Standard Operating Procedures (SOPs)) provides current information and guidance to government agencies, land managers and pest animal controllers involved in the management of rodents in NSW. The aim is for control programs to be conducted in a way that reduces the negative impacts of rodents using the most humane, target-specific, economic and effective techniques available.

Previously published and endorsed COPs and SOPs [1] available via the PestSmart website (https://www.pestsmart.org.au/) can provide general guidance for national use, but some of the content may now be out-of-date. This revision of NSW-specific COPs and SOPs [2] has been developed to provide the most relevant and up-to-date information to support best practice pest animal management in NSW. Outdated information has been removed, while new information has been added to reflect the advancements and changes specific to rodent management within NSW. For ease of use, the COP and SOPs for each species have been consolidated into one document; however, links are provided to allow printing of individual SOPs as required.

Contents

Introduction

All pest animal management must aim to minimise individual animal suffering while at the same time optimising the population impact of a control program. This requires use of the most humane methods that will achieve the control program's aims. Consideration of animal suffering should occur regardless of the status given to a particular pest species or the extent of the damage or impact they create. While the ecological and economic rationales for the control of pests such as rodents are frequently documented, of equal importance is an ethical framework under which these pests are controlled.

A **Code of Practice** (COP) provides overarching context and brings together the SOP procedures in context, and now in one document that specifies humane control options and their implementation. In this way, COPs encompass all aspects of controlling a pest animal species as determined by best practice principles, relevant biological information, guidance on choosing the most humane and appropriate control technique and how to most effectively implement management programs.

This COP provides state-wide guidance and is based on current knowledge and experience in the area of rodent control. It will be revised as required to take into account advances in knowledge and development of new control techniques and strategies.

Standard Operating Procedures (SOPs) ensure that an ethical approach (including the recognition of, and attention to, the welfare of all animals directly or indirectly affected by control programs) is uniformly applied to each pest animal control option. The SOPs are written in a way that describes the procedures involved and animal welfare issues applicable for each control technique, thus acting as a detailed guide to support best practice control programs.

Definitions and terms

Best practice management – a structured, consistent and adaptive approach to the humane management of pest animals aimed at achieving enduring and cost-effective outcomes. 'Best practice' is defined as the agreed principles and specific techniques at a particular time following consideration of scientific information and accumulated experience [3].

Euthanasia – literally means a 'good death' and usually implies the ending of suffering for an individual; however, when used in regard to animals it usually refers to the means by which an animal is killed rather than the reason for killing it [4, 5].

Humane – refers to an absence of (or minimal) pain, suffering and distress (e.g., a relatively more humane euthanasia method will cause less pain, suffering and distress than a relatively less humane euthanasia method).

Humaneness – level of welfare impact or welfare cost (e.g., assessing level of humaneness is equivalent to assessing welfare impact or cost).

Humane killing – the killing of animals using relatively humane methods in certain situations (e.g., animals used in research or pest management) for reasons other than to reduce their suffering.

Humane vertebrate pest control – the development and selection of feasible control programs and techniques that avoid or minimise pain, suffering and distress to target and non-target animals [6].

Pest animal – (also referred to as vertebrate pest) native or introduced, wild or feral, non-human species of animal that is currently troublesome locally, or over a wide area, to one or more persons, either by being a health hazard, a general nuisance, or by destroying food, fibre, or natural resources [7]. Refer to Vertebrate Pesticide Manual [8] for relevant governance and legislation information as applied to the control of vertebrate pests.

Welfare – an animals' state as regards its attempts to cope with its environment [9]. Welfare includes the extent of any difficulty in coping or any failure to cope; it is a characteristic of an individual at a particular time and can range from very good to very poor. Pain and suffering are important aspects of poor welfare, whereas good welfare is present when the nutritional, environmental, health, behavioural and mental needs of animals are met. When welfare is good, suffering is absent [10].

Best practice in pest animal management

From an animal welfare perspective, it is highly desirable that pest animal control programs are efficient, effective and sustained so that pest populations are reduced to low levels and not allowed to recover, thereby avoiding the need for repeated large-scale killing. Over the last decade, the approach to managing pest animals has changed [3]. Rather than focussing on inputs, it is now realised that like most other aspects of agriculture or nature conservation, pest management needs to be carefully planned and coordinated with the aim of reducing to an acceptable level the damage due to pest animals i.e., the focus is on measurable economic and environmental outcomes. Pest animal control is just one aspect of an integrated approach to the management of production and natural resource systems and management of other factors may also be required to achieve the desired result. For example, for a lamb producer with limited resources, other factors influencing lamb production may include weed control, cover for lambs, ewe nutrition or rams that give a higher twinning rate. Unless pest animal control actions are well planned, collaborative and coordinated at the right temporal and spatial scales, individual control programs are unlikely to have long term benefits. When planning pest animal management, there are some important steps that should be considered (Braysher and Saunders, 2015 [11]):

1. Identify the trigger to undertake pest animal management. Is there a community or political pressure for action on pests and an expectation that pest animals should be controlled? Pest control is unlikely to be effective unless there is strong local or political will to take action and commit the necessary resources.
2. Identify the key group to take responsibility for bringing together those individuals and groups that have a key interest in dealing with the pest issue.
3. Identify the problem. In the past the pest was usually seen as the only problem. We now know that the situation is more complex. First, determine what the problem is. For example, it may be effects on native fauna, reduced levels of agricultural production, and complaints from neighbours or emotional stress from worrying about pest impacts. Several factors impact on each of these problems and control of pests are often only part of the solution.

4. Identify and describe the area of concern. Sometimes it helps to remove agency and property boundaries (nil tenure) so that the problem can be viewed without the tendency to point blame at individuals, groups or agencies. Property and agency boundaries can be added later once agreement is reached on the best approach.
5. Try to break the area into smaller management units for planning. These smaller units may be determined by water bodies, mountain ranges, fences, vegetation that is unsuitable for a particular pest or other suitable boundaries that managers can work to. While it is best to work to boundaries that restrict the movement of pests, this may not be practicable and jurisdictional boundaries, for example, the border of a Landcare group, may have to be used in combination with physical boundaries. Once the management units are identified:
    a. Identify as best you can, the pest animal distribution and abundance in each management unit.
    b. Estimate as far as is practicable, the damage caused by the pest or pests to production and to conservation.
    c. Gather and assess other relevant planning documents such as, recovery plans for threatened species and property management plans. Identify any key constraints that may prevent the plan being put into operation and identify all the key stakeholders.
    d. Develop the most appropriate pest management plans for each of the management units.

Implementing effective and humane pest animal control programs requires a basic understanding of the ecology and biology of the targeted pest, other species that may be affected directly (non-targets) or indirectly (e.g., prey species) by a control program. Managers should take the time to make themselves aware of such information by reading the recommended texts included in this document.

The NSW *Biosecurity Act 2015* and pest animal management

From 1 July 2018, the management of pest animals in NSW needs to account for the requirements and obligations under the NSW *Biosecurity Act 2015*. Everyone in NSW who deals with pest animals, including land managers (public and private), recreational land users, other community members and even visitors to the state must manage those pest animals where they present a risk to biosecurity in NSW.

There are some specific requirements relating to some pest species outlined under the Biosecurity Regulation 2017. For example, under the Biosecurity Regulation, it is illegal for a person to keep, move or release a feral pig, wild rabbit, feral deer or European red fox.

A number of documents are available to help land managers and other community members to understand which pest animals they must manage and how they can be managed. Central to these are the Regional Strategic Pest Animal Management Plans that set out the requirements for managing the impacts of pest animals.

Specific members of the Local Land Services' team can investigate if they suspect a person or organisation is not managing pests properly and are able to provide educational material outlining the biosecurity risks presented by the pest animals, and management actions that must be taken to manage the risk posed. If appropriate management action is not taken to

manage the pest animals, trained and authorised staff from Local Land Services can undertake enforcement action.

Animal welfare and humaneness

Pest animals continue to cause significant damage and risks to the environment, agricultural production and to public health. Each year hundreds of thousands of pest animals are trapped, poisoned, shot or otherwise destroyed because of the harm they cause [12]. For most people in today's society the management of pest animals is considered acceptable provided that such management is *humane* and *justified* [13]. However, some deficiencies need to be addressed, inhumane techniques replaced and new, more humane, alternatives developed. For further detail refer to RSPCA Policy E02 *Management of wild animals*.

The humaneness of an individual pest control technique is highly dependent on the way the technique is applied and on the skill of the operator involved. Attention to details such as timing and coordination of control, bait delivery, lethal dose rates, type or calibre of firearm and ammunition have significant effects on animal welfare and target outcomes of control programs. By standardising the way control methods are applied, many of the negative welfare impacts can be reduced or even prevented. This document (COP and SOPs) has been specifically developed to address this issue.

Where available, it contains a summary of the results of humaneness assessments for individual techniques included as SOPs. Assessments are carried out using a model developed by Sharp and Saunders (2008, 2011)[14,15]. The model provides a practical, general means of assessment that can be applied to any control technique. The goal of humaneness assessment is to evaluate the impact of a control technique on individual animals and to use this assessment to determine which methods are more or less humane compared to others.

Assessment of humaneness using the Sharp and Saunders model is based on the five domain approach to welfare assessment developed by Mellor and Reid (1994)[16]. According to this approach, potential or actual welfare compromise is identified in four physical or functional domains and one mental domain:

1: Nutrition – water or food deprivation, malnutrition.

2: Environmental – exposure to excessive heat or cold.

3: Health – disease or physical injury.

4: Behaviour – spatial or interactive restriction.

5: Mental or Affective State – includes impacts from the first four domains (e.g., thirst hunger, anxiety, fear, nausea, pain, boredom, depression, frustration, loneliness, distress) and any other cognitive awareness of external challenges leading to negative affective states.

When considering the humaneness or welfare impact of a control method, impacts are assessed in relation to nutrition, the animal's environment, its health or functional status, its behavioural needs and its overall mental status. As described by Sharp and Saunders (2008, 2011)[14, 15] and Beausoleil and Mellor (2015)[17] when data is available, actual impacts in each of the four domains are evaluated using a range of quantitatively assessed changes in behaviour and physiology along with pathophysiological indicators of functional disruption. Compromise in one or all of the physical domains is then used to infer potential negative

affective impacts in the fifth domain. As welfare is generally considered to be a state within an animal that most directly relates to what the animal experiences, the overall impact of a control method on the animal's welfare generally reflects impacts in Domain 5. When the model is applied to a range of different methods, these can be compared, thus allowing an informed decision on control method choice based on relative humaneness.

Humaneness assessment using the Sharp and Saunders model follows a two-part process: Part A examines the impact of a control method on overall welfare and the duration of this impact; and Part B examines the effects of the killing method on welfare (so is only applied to lethal methods). For example, with live trapping followed by euthanasia, both Part A and Part B are applied, but with fertility control only Part A is applied.

In Part A, overall welfare impact is assessed by looking at the impacts in each of the five domains as described above. In Part B, the killing method is assessed by examining the level of suffering and the duration of suffering based on the time to insensibility based on the criteria described by Broom (1999)[9]. Matrices are then used to determine the score for each part and then the two scores are combined to obtain the overall humaneness score.

Rodent management

Background

There are a number of rodent species that are pests in Australia. These are found in a wide range of habitats from natural to human-made, where they are often associated with agricultural regions and human habitation. Introduced rodents include the house mouse (*Mus musculus*), brown rat (*Rattus norvegicus*), black rat (*Rattus rattus*) and Oriental house rat (*Rattus tanezumi*). The Pacific rat (*Rattus exulans*) has also established populations on coastal islands in northern Australia. Several native rodents can also become pests, particularly in tropical and subtropical regions. These include the grassland melomys (*Melomys burtoni*), canefield rat (*Rattus sordidus*), pale field-rat (*Rattus tunneyi*), and the long-haired rat (*Rattus. villosissimus*).

Rodents are typically highly fecund, with reproduction in natural settings correlated with rainfall and food availability. Females are capable of mating immediately after they have given birth and a new litter is born when the previous litter is weaned. The house mouse has a gestation period of only 19 - 21 days, the young are weaned at 21 days and can start breeding at 10 weeks of age. Females are capable of producing 10 - 12 litters per year, with litter sizes averaging 6 young (maximum 10). They have a life span of 1 - 2 years. Rats have a gestation period ranging from 21 - 24 days. *Melomys burtoni* has a mean litter size between 2 - 3 young, whilst the *Rattus* species generally have larger average litter size ranging from 4 - 7 young (maximum 10). Young rats are weaned after 20 days and can start breeding 5 - 12 weeks of age[21].

Small rodent species are primarily nocturnal, although they can be active during the day if there is shelter or when numbers are high. Most rodents typically spend the day in burrows or nests constructed in natural cavities, clumps of vegetation, or for some species in buildings and other areas of human habitation. Rodents consume a wide range of foods, including seeds, roots, stem piths, other plant material and some insects. Rodents occupy relatively limited home ranges depending on food availability and proximity to sheltered

areas; however, they can disperse over large distances as they are readily transported in goods and vehicles.

When conditions become favourable, rodent populations can build up to plague densities causing significant damage to agricultural production. In plague situations, house mouse numbers in crops have been recorded as high as 3500 mice/ha.

The greatest economic impact of house mouse plagues is on grain and cereal cropping, however other production systems, such as horticultural crops can also be seriously affected directly and indirectly. Mice can also invade piggeries and poultry sheds, consuming and contaminating feed stores and stressing livestock. In commercial and urban settings, they can also damage infrastructure, buildings, machinery, equipment, homes, business reputations and community and service facilities. The environmental impacts can include soil erosion, competition with native fauna, the depletion of native seed banks, disease transmission, and the build-up of predator populations.

The introduced black rat can be a serious pest in orchards and stored produce. This species can cause losses of up to 30% in macadamia orchards, and has been reported damaging citrus, avocado and banana crops. Along with mice and brown rats, black rats consume and contaminate stored produce and can cause major damage to equipment and infrastructure from their habit of gnawing on building materials and electrical cables.

In addition to the impact on agricultural production and commercial premises, rodents are carriers of a range of diseases that can affect humans and domestic animals; for example, salmonellosis, toxoplasmosis, leptospirosis, trichinellosis and typhoid.

For further information please see:

- PestSmart: https://www.pestsmart.org.au/pest-animal-species/mouse/
- https://grdc.com.au/resources-and-publications/resources/mouse-control

Primary and supplementary control techniques

Pest control programs must be cost-effective. The techniques used within a control program need to be complimentary to each other and lead to a maximum impact reduction, which often requires reducing pest animal densities to low levels over a large scale and maintaining this level of population suppression indefinitely. This leads to a situation where the need for ongoing control is minimised and rates of re-invasion reduced. Follow-up control programs, where the initial reduction is maximised, are also much cheaper to implement as the target population is relatively small. Control techniques can be seen as primary or supplementary based on the following general principles.

Primary techniques are those that can achieve rapid pest population knockdown over large areas in a cost-effective way. Supplementary techniques are generally only effective in helping to maintain pest population suppression once densities have already been reduced to low levels. For example, in the management of mouse plagues, broadacre application of zinc phosphide baits would be considered the primary method of crop protection and supplementary techniques such as habitat modification would be used to help prevent further invasion. For effective control regionally appropriate selection of at least one primary control technique and one supplementary control technique should be utilised to help satisfy general biosecurity duty requirements.

Spatial scale is also important. To achieve cost efficiencies and depending on the movement behaviour of the target pest, the area under control may need to be a collaboration of many adjoining land managers.

Poorly executed control programs can simply become sustained harvesting operations that do little to achieve long-term successful outcomes. This in turn can lead to sporadic implementation of crisis management programs where pest numbers have become unacceptable, but the outcome usually becomes sub-optimal. A rotation of primary and supplementary techniques can also be important. Pest animals can become familiar to a particular technique (e.g., bait aversion) that may require switching to another lethal method (e.g., trapping). Another factor to consider is timing of control operations. Time of the year can mean targeting a biological weakness in the pest animal (e.g., a period of food stress) when bait uptake might be maximised. Alternatively, application of control can align with the need for the commodity to be protected when it is most vulnerable e.g., when crops are ripening.

Rodent management methods

Constant monitoring and early intervention are integral parts of an organised and ongoing rodent control program, as once rodents are in plague proportions, there is little that can be done to control populations and significantly reduce damage. Routine on-farm management actions (such as monitoring, rodent-proofing buildings and storage areas, farm hygiene, control of stubble and other potential ground cover, correct sowing practices and elimination or reduction of grain spillage) are all preventative control techniques which can be used by landholders to control rodent populations and reduce the potential for sudden increase in numbers. By necessity, this monitoring and control effort must be sustained. Non-lethal techniques available include deterrence strategies, such as taste aversion, and repellents. There has been considerable research effort investigating the feasibility of fertility control for rodents; however, further work is required before this technique is available for use in Australia.

In commercial premises and domestic homes, practices should also be in place to deter and prevent rodent invasion, including monitoring, rodent-proofing buildings and storage areas (seal cracks, windows and doors, and keep doorways closed), preventing rubbish, weed and debris build-up, and keeping food preparation areas clean and tidy. Commercial premises can benefit from a proactive pest management approach by employing a pest control company to conduct routine monitoring, as rodents can nest in spaces that are not immediately visible.

The most commonly used lethal rodent control techniques are baiting and trapping. There are different techniques available depending on the location and scale of the problem (i.e. localised or broadacre, in-crop, crop perimeter, or around building / storage areas). Fumigation of rodents is restricted in its application. Appropriate licences and permits are required to control any of the native rat species.

Cost-effectiveness, humaneness and efficacy for each control technique are useful in deciding the most appropriate strategy. A brief evaluation of the humaneness of control techniques follows:

Humaneness of control techniques

Deterrence, rodent-proofing and habitat modification

Humaneness of rodent control can be improved by limiting the number of animals that need to be controlled by lethal means. Removing rodents is usually only a short-term solution as the area can be quickly re-populated by offspring of surviving animals and immigrants. For long-term population reduction, techniques need to be employed to reduce the maximum population density that could be sustained by the area, or to exclude or deter the rodents. Reducing the potential carrying capacity can be achieved by minimising access to food and water, controlling weeds (particularly large-seeded weeds), and reducing harbourage and nesting sites. Physical barriers and rodent-proofing are important techniques and can be very effective.

Other deterrents include encouraging predators into the area (e.g., placing perches in crop areas to encourage native raptor activity[18]). Predators generally will not eradicate an established population but can deter new arrivals and slow the rodent's population growth rates. Potential unintended effects of predators on native species also need to be considered. Some chemicals such as aluminium ammonium sulphate or ultrasonic repelling devices may act as localised deterrents to protect specific areas or foodstuff; however, there is little scientific evidence to support these claims. Reducing the availability of foodstuffs may increase young rodent mortality. Predators may cause fear and chemical deterrents may cause some temporary irritation, both possibly affecting non-target animals as well. However, overall, the use of barriers (rodent-proofing) and other deterrence strategies are generally regarded as more humane alternatives than lethal control methods.

Fertility control

Fertility control (in concept) is seen as a preferred method of pest control as it offers a potential humane and target-specific alternative to lethal methods for reducing or limiting population densities. There has been considerable research effort investigating the feasibility of fertility control for rodents in Australia through virally-vectored immunocontraception (VVIC). Researchers produced a viral vector that sterilised female mice, but transmission of this virus in natural populations was inadequate. The main welfare problem with this approach is that it is delivered by a virus that causes infection, and sometimes disease, that can take a chronic course. ContraPest is a fertility control technology developed in the US to chemically induce early menopause in female rats via flavoured liquid bait delivered in a bait station; however, this product is not yet registered for use in Australia. Even if a registered fertility control agent was available for rodents in Australia, during plague situations an immediate reduction in numbers and impacts is required, and this can only be achieved through lethal control (baiting and mass-capture traps) combined with removal of food and shelter sources.

Lethal baiting

Lethal baiting is an important component of rodent control programs; however, poisons do not usually cause a humane death. Depending on the poison used, target animals can experience pain/sickness and suffering, sometimes for an extended period, before death. Any

dependent young in the nest will be left to die of dehydration and/or starvation. Non-target animals, including native species, cats, dogs and stock, can be exposed to poisons either directly by eating the baits intended for rodents (primary poisoning) or through the scavenging of tissues from a poisoned animal (secondary poisoning). Baiting campaigns should be well designed and carefully implemented to minimise non-target effects. Poisons currently used for rodent control in Australia include first and second-generation anticoagulants, zinc phosphide, and cholecalciferol. Sodium monofluoroacetate (1080), although commonly used against other pest species, is not available for rodent control in NSW. It is permitted in Tasmania and currently registered for off-label use in hoop pine plantations in Queensland. The use of strychnine as a rodenticide is no longer registered in Australia.

Anticoagulants

Anticoagulants are the most common poisons used for domestic rodent control as they are effective and easy to use; however, they have significant animal welfare impacts on target rodents and potentially non-target animals. There are two broad categories of anticoagulants: the indandiones and the hydroxycoumarins. Most anticoagulants registered in Australia belong in the latter group. Warfarin was the first important anticoagulant used against rodents, and along with coumatetralyl, is a 'first generation' anticoagulants. These compounds generally require high concentrations and consumption over consecutive days to accumulate a lethal dose. Second generation compounds were developed to overcome the problem of genetic resistance to warfarin and are far more toxic with a more prolonged effect than first generation compounds, requiring lower concentrations in baits, and are lethal after a single dose. Second generation anticoagulants registered in Australia are brodifacoum, bromadiolone, difenacoum and flocoumafen. Other registered anticoagulants are diphacinone (an indandiones-classed anticoagulant) and difethialone (an unclassed anticoagulant), although this latter compound is restricted to professional use only.

Anticoagulants act by interfering with the Vitamin K-1 metabolism which effects blood clotting and the daily repair of blood vessels which in turn leads to internal haemorrhaging. The degree and duration of any suffering of animals depends on the site and severity of this haemorrhaging, which is influenced by the dose received, the compound used and the individual animal's genetic predisposition. Bleeding *per se* is not painful but the accumulation of blood in enclosed spaces generally is. Symptomatic periods can range from a few hours to, more commonly, 1-3 days, with a maximum of 4-5 days. Poisoned rodents show clinical effects of external bleeding, pale extremities, bloody diarrhoea and internal haemorrhaging at multiple sites throughout the body, causing moderate to severe pain and distress. They show reduced activity levels (making them vulnerable to predation), anorexia, hunched postures and some develop paralysis before death. Time to death can range between 1-8 days, with animals ingesting lower doses taking longer still to die. Sub-lethally dosed animals can be ill or disabled for a considerable period causing both animal welfare and secondary poisoning hazards. There is little difference seen in symptomatic periods and time taken to death between the many available anticoagulant compounds.

Because of the high risk of poisoning non-target animals, anticoagulant baits should only be placed in areas that are inaccessible to domestic animals, livestock and wildlife including birds. Anticoagulants such as brodifacoum, difenacoum and bromadiolone are available in a wide variety of baits for use in a range of situations, e.g., domestic homes, industrial,

commercial and agricultural buildings. Because of the slowness of their action, prompt veterinary intervention can often save domestic animals (i.e., cats and dogs) that have ingested anticoagulant baits. However, there is a high risk of secondary poisoning of wildlife due to the prolonged persistence of most second-generation anticoagulants in the tissues of poisoned dead rodents and the ability of these compounds to progressively accumulate in the liver of predators and scavengers over time.

Zinc phosphide

Zinc phosphide is the most commonly used rodenticide after anticoagulants, and it also has significant animal welfare impacts. It is an acute poison that kills after a single dose and is used when a rapid reduction in the rodent population is required. It can be deployed for broadacre, in-crop protection, using accurately calibrated aerial or ground application equipment. In NSW it can also be deployed at commercial and industrial premises including grain storage and food production facilities (external to buildings), using ground application. Individual site risk assessment must be completed before any baiting proceeds in these situations. Refer to registered product labels for further instructions.

Clinical signs of poisoning generally appear rapidly, with animals showing reduced activity within one hour. Zinc phosphide produces phosphine gas in the stomach, which upon absorption can lead to chemical corrosion and congestion of the body's organs, respiratory distress, diarrhoea and changes in activity levels. Poisoned animals may kick at their abdomens with their hind feet and show postural changes indicative of severe abdominal pain. The symptomatic period can last for several hours, with final symptoms including convulsions and paralysis. Time to death can be either rapid (8–24 hrs) or prolonged (24–72 hrs), with death usually occurring because of cardiac and respiratory failure.

There is no antidote for zinc phosphide poisoning, so non-target animals can be at risk during a baiting campaign. There is some potential for secondary poisoning as the compound persists in the poisoned rodents' stomach for several days; however, it does not accumulate in the muscle or other tissue, nor within the predators themselves and has a distinctive odour which many scavengers avoid. So long as the single dose eaten is not too great, predators will experience no ill long-term effects.

Cholecalciferol

Cholecalciferol is a form of Vitamin D_3, and is an acute poison, readily formulated as a one-feed bait delivered by lockable bait stations. It can be deployed in and around buildings only and is used primarily when there are anticoagulant resistant rodents present. The effects of accidental poisoning are difficult to reverse; therefore, non-target animals are also at risk during a baiting campaign. However, as cholecalciferol is quickly metabolised within the rodent's body and the animals tend to consume relatively small amounts, there is little risk of secondary poisoning. Calcium metabolism in birds is well-buffered against disruption due to the requirements of egg production. Consequently, most birds are highly tolerant of cholecalciferol which reduces the risk of non-target poisoning.

Similar to anticoagulants and zinc phosphide, poisoning with cholecalciferol has significant animal welfare impacts. The onset of clinical signs of acute poisoning can appear within 14 hours, but usually take 24-48 hours. Poisoned rodents become lethargic, cease eating and grooming, become weak, dehydrated, and anorexic. They take on a hunched posture and

show signs of severe discomfort. The primary causes of death are kidney failure and haemorrhaging from the calcification of blood vessels and internal organs. Death usually takes a few days after the onset of symptoms, typically 3-5 days after baiting, although periods of up to ten days have been recorded. Sub-lethally dosed rodents can recover but are likely to be ill and anorexic for a period of several days up to two weeks.

Trapping

All traps have the potential to cause injury and some degree of suffering and distress. Traps that contain an animal (live traps) can cause fewer injuries than traps that restrain an animal (e.g., glue board traps). Traps that are designed to kill extremely rapidly (break-back/snap traps traps) or cause instant stunning (electrocution traps) are considered to be among the most humane methods of rodent control if they are well-designed and used and monitored appropriately. Because of the low efficacy of trapping rats and mice and the high labour costs of trapping, the use of traps is generally limited to small-scale infestations.

The trap devices discussed below are those that are commercially available to pest controllers and/or the general public. In addition, there are many home-made trap designs, including ones that pose significant animal welfare concerns such as those that involve mass trapping and drowning of animals.

Live box (or cage) traps

Animals caught in a live trap are not likely to experience significant injuries unless they make frantic attempts to escape. As well as injuries, trapped animals can suffer from exposure, thirst, starvation, shock, capture myopathy and predation; therefore, traps must be placed in a suitable area protected from extremes of weather and inspected at least once a day. Trapped animals should be approached carefully and quietly to minimise panic, further stress and risk of injury. All introduced species of rodents and only those native species that are designated pests must be killed as soon as possible after capture using manually applied blunt force trauma to the head. Other methods of euthanasia in domestic situations may include euthanasia at a veterinary premise. Non-target animals that are caught and not severely injured should be released at the trap site only, as translocation to an unfamiliar area can raise potential welfare issues. If the non-target animals are injured, but may respond to veterinary treatment, such treatment should be sought. Severely injured non-target animals should be killed humanely.

Glueboard traps

The use of these traps is considered inhumane and unacceptable due to the intensity and duration of suffering experienced by rodents whilst trapped. Animals become stuck to the glue by their feet, body, head and fur and will panic and try to escape. This can result in severe injuries to limbs and skin and in some cases suffocation. In addition, trapped animals are at risk of exposure, thirst, starvation, shock, capture myopathy and predation. The longer they are left on the trap the more severe the welfare impacts will be. A significant concern is that rodents are often left to die a slow and painful death on the glueboard rather than quickly and humanely euthanased.

Glueboards are made from squares of wood, plastic or stiff cardboard coated with highly adhesive glue. When an animal crosses the trap, it becomes stuck by the feet and fur. Trapped animals suffer from instant and prolonged pain and distress, followed by dehydration, hyper- or hypothermia, hunger and trauma resulting from panic and attempts to escape, such as forceful hair removal, torn skin, and broken limbs, and sometimes self-mutilation when animals are held for long periods. The use of glueboard traps is banned in the ACT and Victoria. In Tasmania their use is restricted to food manufacturing premises by professional pest controllers, who recommend checking the traps at least every 24 hours. Currently, in all other states and territories (including NSW), glueboard traps are currently available for use by the general public, with no regulation on trap monitoring.

If glueboards are used, trapped animals should be approached carefully and quietly to minimise panic, further stress and risk of injury. Trapped target rodents must be humanely euthanased as soon as possible after they are caught. It is not acceptable to leave animals to die on the board as they are likely to die slowly from dehydration, exposure, starvation or exhaustion. The most suitable method for the euthanasia of rodents caught on glueboard traps is manually applied blunt force trauma to the head. Non-target animals can be released by soaking the area with vegetable oil. If not severely injured these animals should be released at the trap site only, as translocation to an unfamiliar area can raise potential welfare issues. If the non-target animals are injured, but may respond to veterinary treatment, such treatment should be sought. Severely injured non-target animals should be killed humanely.

Break back/snap traps

Break-back/snap traps are spring-powered devices with a flat treadle or bait pan which releases a metal loop or plastic jaws that close down on the target. They kill by striking the back of the head or the upper cervical area with sufficient impact momentum to cause cranial or upper vertebrae fracturing, rendering the animal immediately insensible before death. The impact momentum generated by a trap causes physical damage, e.g., to the nervous system, blood vessels and organs and the clamping force of the trap can also cause death by occlusion of blood vessels supplying the brain. Alternatively, if the bar falls across the body it can cause thoracic compression resulting in asphyxiation.

Well-designed break-back/snap traps that aim to crush the skull are more humane and efficient and usually cause irreversible loss of consciousness within one minute. Badly designed traps, traps that are not set properly or traps incorrectly baited can result in animals being injured rather than killed, which will cause prolonged pain and distress. To minimise the suffering of any injured animals it is necessary to check traps at least daily. Non-fatal injury can also occur if a larger non-target animal triggers the trap. If not severely injured these animals should be released at the trap site only, as translocation to an unfamiliar area can raise potential welfare issues. If the non-target animals are injured, but may respond to veterinary treatment, such treatment should be sought. Severely injured non-target animals should be killed humanely. Tunnels or trap stations which enclose the break-back/snap trap should be used to protect no-target animals from injury whenever possible.

Stretched rubber ring traps

Ring traps utilise an expandable rubber latex ring which releases around the rodent's neck/chest area when it enters the baited tunnel-shaped trap. *Nooski*™ rat and mouse traps were designed in New Zealand and have passed the NZ standard for humane traps (traps cause irreversible unconsciousness within 180 secs). They are designed to kill quickly by constricting the trachea and the blood vessels that supply the brain and are considered to be a humane alternative to other traps and poisons. Data from a range of sources (manufacturers, research groups, and animal welfare organisations) indicates that there is no chance of injuries to target (0%) or non-target animals (0.001%), and a 100% death rate with an average time to irreversible unconsciousness of 20 sec (5 to 30 sec range) [19]. However, there have been no published, peer-reviewed studies.

Electrocution traps

Electrocution traps consist of a box structure with an opening for entry. The rodent is enticed by bait to stand on a floor consisting of two plates which act as terminals. When a rodent bridges these two plates it receives an electric shock transmitted via the feet. Although many of these devices have appeared over the decades, there is little published information on their efficacy and humaneness. It is unclear if the shock causes unconsciousness in the animal before it experiences the pain of severe muscle constriction, ventricular fibrillation and respiratory distress caused by this type of death; however, the time taken to death is usually quick (probably less than 2 minutes). Electrocution traps have the potential to be relatively humane since there is no need for handling and death can be relatively quick. However, the devices have been shown to have poor efficacy and can fail to kill shocked rodents. Animals receiving non-lethal shocks may experience muscle weakness or loss of function for a short period but are not left with any burns or permanent injury[20]. Small non-target animals may be at risk of electrocution, but larger non-target animals are unlikely to come to any harm.

Gas traps

When mice enter the trap, the door is triggered to close, and a measured dose of carbon dioxide is released. If the gas concentration is sufficient, this causes loss of consciousness in less than 30 secs and death within around 2 min. Inhalation of carbon dioxide is likely to cause dyspnoea (breathing discomfort or 'air hunger'), anxiety and fear in rodents prior to unconsciousness. Gas traps can only be used for mice and only by authorised pest control officers.

Fumigation

The fumigation of rodents is not a common pest control practice in Australia. The fumigant methyl bromide is registered for Quarantine and Pre-Shipment (QPS) uses and Critical Use Exemptions (CUEs) only. This fumigant is an eye and skin irritant that is known to cause extreme suffering and debilitation when used as warfare gases against humans.

Phosphine is currently registered for use in NSW to manage rodents in well-sealed buildings or structures, commodity storage and stored tobacco. Other fumigants used overseas such as carbon monoxide, carbon dioxide, sulphur dioxide and cyanide gas are not registered in

Australia for use on rodents. Cyanide gas and carbon monoxide are considered to be the most humane fumigants.

Table 1: Humaneness, Efficacy, Cost-effectiveness and Target Specificity of Rodent Control Methods

Control technique	Acceptability regarding humaneness* and Relative humaneness score (Part A [1-8], Part B [A-H]**)	Efficacy regarding population reduction	Cost-effectiveness	Target Specificity	Comments
Baiting with zinc phosphide *Primary*	Only acceptable when there is no other practical alternative. Inhumane compared with other methods. Score: N/A	Effective	Cost-effective	Potential risk of poisoning non-target animals	Zinc phosphide causes significant discomfort and pain, although of a shorter duration compared with anticoagulants and cholecalciferol.
Baiting with anticoagulants *Primary*	Only acceptable when there is no other practical alternative. Inhumane compared with other methods Score: N/A	Effective	Cost-effective	High risk of poisoning non-target animals	Although widely used, anticoagulants cause discomfort and pain that can last for several days. Sub-lethally affected animals are likely to be left with internal damage.
Break-back/snap traps *Supplementary*	Acceptable Score: N/A	Limited	Cost-effective at low densities and over small areas	Risk of catching and causing severe injury and distress to non-target animals. Non-target animals cannot usually be released unharmed.	With good trap designs death can be rapid however if an animal is not killed outright and is caught by a limb, the tail or muzzle they will suffer pain and distress. Animals trapped but still alive will still need to be killed humanely. Labour intensive for large sites.

Control technique	Acceptability regarding humaneness* and Relative humaneness score (Part A [1-8], Part B [A-H]**)	Efficacy regarding population reduction	Cost-effectiveness	Target Specificity	Comments
Stretched rubber ring traps *Supplementary*	Acceptable Score: N/A	Limited	Cost-effective at low densities and over small areas	Risk of killing small non-target animals. Minimal risk to species larger than a rat or mouse.	*Nooski*™ ring traps are said to have no chance of causing suffering and maiming and are considered a more humane method than other traps. Labour intensive for large sites. Rings need to be purchased and replaced after each capture.
Electrocution traps *Supplementary*	Acceptable Score: N/A	Limited	Relatively expensive and only cost-effective at low densities and over small areas	Non-target animals that are small enough to enter the trap may be electrocuted. Low risk to animals larger than a rat.	These devices will be more humane when the amount of current that runs through them is sufficient to cause immediate loss of consciousness followed by death without a return to consciousness. They are known to have a high failure rate.
Gas traps (with CO_2) *Supplementary*	Acceptable Score: N/A	Limited	Relatively expensive and only cost-effective at low densities and over small areas.	Risk of trapping and killing small non-target species. Low risk to animals larger than a rat.	Only available for use by ACOs.

Control technique	Acceptability regarding humaneness* and Relative humaneness score (Part A [1-8], Part B [A-H]**)	Efficacy regarding population reduction	Cost-effectiveness	Target Specificity	Comments
Live box traps followed by prompt and humane euthanasia *Supplementary*	Acceptable Score: N/A	Limited	Relatively expensive and only cost-effective at low densities and over small areas.	Risk of catching non-target animals although they can usually be released unharmed.	Disadvantages of this method include: live caught animals still need to be killed humanely; trapped animals could injure themselves when trying to escape; risk of predation if more than one animal is trapped; and traps need to be checked regularly to prevent suffering from hunger, thirst or exposure.
Deterrents (e.g., predators, chemicals, (naphthalene, aluminium ammonium sulphate), exclusion by rodent-proofing and habitat modification *Supplementary*	Acceptable Score: N/A	Variable and depends on method used	Unknown	Can be in certain situations	Eliminating nest sites, refuge areas and eliminating access to buildings is effective. Reducing food availability may cause infant rodent mortality, predators may cause fear and chemical deterrents may cause irritation but these effects are minor compared with other control methods.

Control technique	Acceptability regarding humaneness* and Relative humaneness score (Part A [1-8], Part B [A-H]**)	Efficacy regarding population reduction	Cost-effectiveness	Target Specificity	Comments
Fumigation *Supplementary*	Depends on fumigant, for example: Cyanide gas is the most humane. Phosphine gas causes pain and discomfort for a maximum of a few hours but causes no long-term harm in animals that survive sub-lethal doses. Methyl bromide causes significant suffering. Score: N/A	Effective	Cost-effective	Secondary poisoning risks are negligible since affected animals are not dangerous to predators. Other animals in the burrow system are susceptible to fumigation.	Methyl bromide and phosphine are the only fumigants registered for use in Australia and are not widely available. Cyanide gas is considered humane but is not used in Australia
Fertility control *Not available*	Acceptable Score: N/A	Unknown	Unknown	Depends on agent used	No products currently available
Baiting with 1080 *Not available*	Acceptable Score: N/A	Effective	Cost-effective	Potential risk of poisoning non-target animals.	Not registered for rodents in NSW Rats are more sensitive to 1080 compared with mice

Control technique	Acceptability regarding humaneness* and Relative humaneness score (Part A [1-8], Part B [A-H]**)	Efficacy regarding population reduction	Cost-effectiveness	Target Specificity	Comments
Baiting with cholecalciferol *Supplementary*	Only acceptable when there is no other practical alternative. Inhumane compared with other methods Score: N/A	Effective	Relatively cost-effective	Potential risk of poisoning non-target animals, but considered low as rodents only ingest small amounts and this is quickly metabolised in the body. Reduced risk to birds due to high cholecalciferol tolerance. The active metabolites of cholecalciferol are less persistent in poisoned animals compared with second generation anticoagulants.	Cholecalciferol causes discomfort and pain that can last for several days. Sub lethally affected animals are likely to be left with long-term damage.
Glueboard traps *Supplementary*	Not acceptable Score: N/A	Limited	Not cost-effective	Risk of catching and causing severe injury and distress to non-target animals. Non-target animals cannot usually be released unharmed.	Unless animals are promptly killed after becoming stuck on a glueboard there is an unacceptably high risk of pain and suffering. They are also at risk of suffering from hunger, thirst or exposure and predation. This method is considered to be inhumane and should not be used. Alternatives are available for most situations.

Footnotes for Table 1

* *Acceptable* methods are those that are relatively humane when used correctly in accordance with the applicable Standard Operating Procedure. Conditionally acceptable methods are those that, by the nature of the technique, may not be consistently humane. There may be a period of poor welfare before death.

Methods that are not acceptable and are considered to be inhumane – the welfare of the animal is very poor before death, often for a prolonged period

** From assessments conducted using a model to assess the relative humaneness of pest animal control methods (Sharp and Saunders 2011)15. Humaneness score (AB) consists of Part A - welfare impact prior to death, scale of 1 – 8, less suffering to more suffering and Part B - mode of death, scale of A – H, less suffering to more suffering. For assessment worksheets and matrix of relative humaneness scores see: Sharp, T. & Saunders, G. (2011). Appendix 12: Relative humaneness of rodent control methods (pp. 122). In A model for assessing the relative humaneness of pest animal control methods (Second edition). Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, ACT.

N/A = Humaneness scores not yet available.

Control techniques are classified as primary (maximum effect), supplementary (follow-up) or 'not available'. In some situations, techniques can alternate between primary and supplementary.

Relevant legislation

All those involved in vertebrate pest control should familiarise themselves with relevant aspects of the appropriate federal and state legislation. The table below lists relevant legislation. This list is by no means exhaustive and was current at the time of writing.

Commonwealth	*Agricultural and Veterinary Chemicals Code Act 1994* *Environment Protection and Biodiversity Conservation Act 1999*
New South Wales	*Biodiversity Conservation Act 2016* *Biosecurity Act 2015* *Game and Feral Animal Control Act 2002* *Local Government Act 1993* *Local Land Services Act 2013* *National Parks and Wildlife Act 1974* *Pesticides Act 1999* *Prevention of Cruelty to Animals Act 1979*
Other relevant legislation	*Civil Aviation Act 1988* *Civil Aviation (Carriers' Liability)* *Dangerous Goods (Road and Rail Transport) Act 2008* *Work Health and Safety Act 2011*

Note: copies of the above legislation and relevant regulations may be obtained from federal and state publishing services.

Further information

Local Land Services	https://www.lls.nsw.gov.au/biosecurity/pestplan
NSW National Parks and Wildlife Service	https://www.environment.nsw.gov.au/topics/animals-and-plants/pest-animals-and-weeds/pest-animals
NSW Department of Primary Industries	https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests
NSW Environment Protection Authority	https://www.epa.nsw.gov.au/your-environment/pesticides/pesticides-nsw-overview/pesticide-control-orders
PestSmart Connect	https://www.pestsmart.org.au/

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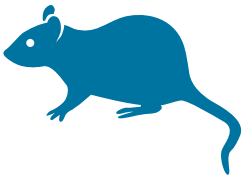
Standard Operating Procedures:

- Ground baiting of rodents with anticoagulants (NSWROD SOP1)
- Baiting of rodents with zinc phosphide in crops (NSWROD SOP2)
- Trapping of rodents (NSWROD SOP3)



NSWROD SOP1 Ground baiting of rodents with anticoagulants

Background

Baiting with anticoagulants is used to minimise the impact of the introduced house mouse (*Mus musculus*), brown rat (*Rattus norvegicus*), black rat (*Rattus rattus*) and Oriental house rat (*Rattus tanezumi*). These are usually targeted in commercial and domestic premises, and for the protection of agricultural production, for conservation outcomes, and for eradication on islands.

Baiting with anticoagulants is one of the most common and effective methods of quickly reducing small populations of rodents and their impacts around buildings and storage facilities. However, once rodents begin to reach high numbers (i.e. during plagues), baiting with anticoagulants has little or no effect. Anticoagulants are generally restricted to use in and around structures and are not typically used for broad-scale application across the landscape or in crops. However, exceptions exist where certain anticoagulants have been registered for off-label use on some islands for conservation purposes where eradication of rodent populations is the aim (check with the APVMA or local state authorities i.e., EPA, LLS and NSW DPIE, for current permits).

Rodents are highly susceptible to the effects of anticoagulants; however, other species, especially some native animals and birds, and domestic pets and livestock, are also vulnerable to poisoning. Good baiting technique and safe storage helps to minimise the risk to non-target species and maximise the effect on targeted rodent populations.

This standard operating procedure (SOP) is a guide only; it does not replace or override the relevant NSW or federal legislation. The SOP should only be used subject to the applicable legal requirements (including WHS) operating in the relevant jurisdiction.

Individual SOPs should be read in conjunction with the overarching Code of Practice for that species to help ensure that the most appropriate control techniques are selected and that they are deployed in a strategic way, usually in combination with other control techniques, to achieve rapid and sustained reduction of pest animal populations and impacts.

Application

- Baiting with anticoagulants should only be used in a strategic manner as part of a co-ordinated program designed to achieve sustained effective control.
- Poisoning with anticoagulants is used as part of an early intervention strategy to quickly reduce small populations of pest rodents, and prevent a build-up in numbers. Rodent-proofing, habitat modification and good hygiene (e.g., keeping grass cut, stubble management, weed control and keeping rubbish around buildings to a minimum) can

then be used to reduce the potential or maximum population density and slow re-colonisation.

- Anticoagulants must only be used in and around commercial, agricultural, industrial and domestic premises. Agricultural buildings include grain stores, animal housing and farm machinery buildings. This poison must not be used near exposed human or animal food, food preparation or food storage areas.
- Anticoagulants must not be used for broad-scale application across the landscape or in crops, with the exception of some islands where eradication of rodent populations is the aim.
- Anticoagulant baits become less efficient when wet so should be placed in sheltered areas. Consumption of sub-lethal doses can lead to the development of bait aversion, although this is less likely to occur with anticoagulants than other poisons as the animals generally do not associate bait consumption with the developing symptoms owing to the delayed action.
- Because of the high risk of poisoning non-target animals, baits should be placed in areas that are inaccessible to domestic animals, livestock and wildlife, including birds. Baits should not be placed where they can contaminate streams, rivers or waterways. Where possible, baits should be applied in the late afternoon as rodents mostly feed at night, therefore, bait laid in the evening will be mostly consumed overnight before diurnal non-target species such as birds will have access
- Anticoagulants are not registered for the control of any of the native species of rodents in NSW.
- Alternate food sources should be eliminated as far as possible to improve the effectiveness of baiting.
- Containers which have held bait material should not be used for any other purpose, and should be disposed of correctly. Bromadiolone and coumatetralyl are emulsifiable in water so all equipment should be thoroughly rinsed with water and allowed to drain. When washing down in the field, waste water, bait and other waste should be buried in a pit or collected in a container marked 'Poison' and returned to the pesticide facility for appropriate disposal.
- Anticoagulants are listed as a Schedule 6 Poison under the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP). These substances have a potential for causing harm and must be packaged distinctively with strong warnings and safety directions on the label.
- A person taking possession of coumatetralyl rodent bait prepared by an ACO must be given a copy of the pesticide label and the current APVMA permit and be aware of their instructions.

Animal welfare implications

Target animals

- All anticoagulants act by interfering with the Vitamin K-1 metabolism which affects blood clotting and the daily repair of blood vessels which in turn leads to internal

haemorrhaging. First-generation compounds are considered 'short acting', often requiring multiple doses to exert their lethal effects, whereas second generation compounds are more toxic with a more prolonged effect, and are lethal after a single dose.

- The effects of anticoagulants are gradual, developing over several days with poisoned rodents showing clinical effects of external bleeding, pale extremities, bloody diarrhoea and internal haemorrhaging at multiple sites throughout the body.
- The degree and duration of any suffering of animals depends on the site and severity of this haemorrhaging, which is influenced by the dose received, the compound used and the individual animal's genetic predisposition. Bleeding *per se* is not painful but the accumulation of blood in enclosed spaces is capable of producing moderate to severe pain.
- Symptomatic periods can range from a few hours to, more commonly, 1-3 days, with time to death ranging between 1-8 days, depending on the dose received, the compound used and the individual animal's genetic predisposition.
- Animals receiving sub-lethal doses can be ill and disabled for a considerable period, suffering damage to organs from internal haemorrhaging, blood loss and anaemia. Clotting times also often remain sub-optimal for weeks or even months. During this period they are vulnerable to other illnesses, starvation and predators.

Non-target animals

- Anticoagulants are toxic to a wide range of species including fish, mammals and birds.
- Poisoning of non-target species can occur either directly by eating baits intended for rodents (primary poisoning), or through scavenging the carcasses of poisoned animals or the consumption of live animals that have consumed baits but not succumbed to toxic effects (secondary poisoning).
- Primary poisoning of non-target, domestic animals is considered to be unlikely since repeated doses are usually required, although for many second generation anticoagulants this may not be the case. There is a lag period of several days after ingestion of the baits before onset of clinical symptoms, during which veterinary intervention should be given.
- Primary poisoning of non-target wild animals is also considered to be low since repeated doses are usually required, however the required veterinary treatment of these animals can be difficult, and usually does not occur.
- Anticoagulants, particularly second generation compounds, pose an increased risk of secondary poisoning due to the prolonged persistence in the tissues of the dead rodents and the ability of these compounds to progressively accumulate in the liver of other prey species, predators and scavengers over time. The transfer of this toxin through the food chain can also lead to tertiary poisoning where animals which consume carcasses or baits are then themselves consumed by a top order predator.
- The susceptibility of non-target species to primary poisoning is determined by many factors, including diet, the type of anticoagulant and bait carrier used, the sensitivity to the poison, body weight, concentration of anticoagulant in the bait, bait placement and palatability, timing of baiting and level of exposure to poison baits. In addition, factors

affecting secondary poisoning include the number of dead animals available for scavenging, the time period over which carcasses are available and the concentration of poison in the carcasses.

- Non-target animals affected by anticoagulants experience similar symptoms as target rodents; however, the onset of symptoms, the duration of action, the sites of haemorrhage and the time to death tend to vary. Some species, e.g., possums have been reported to experience symptoms for up to three times longer than rodents. This species variation may be due to differences in doses received compared to bodyweight, biochemical responses (such as poison absorption, distribution, metabolism and excretion), physiological responses (e.g., levels of clotting factors in liver or presence of alternate blood clotting factors) or behaviour (which can affect the location and severity of haemorrhaging).
- The type of anticoagulant compound (i.e. first or second generation) can affect the response of a non-target animal to therapy. In a dog, for example, a first generation compound such as warfarin, has a half-life of approximately 14 hours, and its clinical effects last up to one week, whereas second generation compounds have much longer half-lives (4-6 days), and their clinical effects can last anywhere between 12-30 days.
- To minimise the risks to non-target animals, the following monitoring and baiting strategies are recommended to either reduce the amount of toxic bait dispensed or minimise the broad distribution of baits in areas where rodent populations are low:
    - Monitoring – can be used to estimate the rodent population and its distribution and can provide a guide for the amount of bait required and effective bait placement. Monitoring can involve damage assessments, trapping or the use of bait cards which are squares of grid paper soaked in linseed or canola oil.
    - Pre-feeding with non-poisoned bait – allows an assessment of what animals are eating the bait and the quantities of poisoned bait needed for the control program.
    - Placement of bait – bait should not be spread out thinly but concentrated in known locations (bait stations). Bait stations should be located in sheltered areas, inaccessible to non-targets, particularly children and domestic animals, in areas where activity is obvious, such as active nests, along runs, under rubbish or where droppings are observed. Secure baits or container with wire or nails if possible. In the case of perimeter baiting, adhere to all stipulated directions and distance restrictions.
    - Timing of baiting – rodents mostly feed at night, therefore bait laid in the late afternoon / evening will be mostly consumed overnight before diurnal non-target species such as birds will have access.
    - Check bait stations regularly – bait stations should be checked at least twice a week in the first week of a baiting program, and at least weekly intervals after that. Bait stations that show no signs of activity should be removed or relocated to a new location.
    - Collection of uneaten bait – any uneaten bait at the end of a program should be collected and destroyed by either incineration or burial to depth of 50 cm.
    - Collection of rodent carcasses – where possible, any rodent carcasses should be located and collected daily and either destroyed by incineration or buried, to prevent secondary poisoning.

Workplace health and safety considerations

- Operators using anticoagulants must strictly follow the directions on the approved label when using, storing or disposing of the rodenticide.
- Anticoagulants are toxic to humans and should be handled with care. Exposure can occur from ingestion, inhalation of generated dust or skin contact. Toxic effects are produced after exposure to a high dose or repeated low doses over a period of time.
- Appropriate personal protective equipment including overalls, impervious footwear, face mask or safety glasses and elbow length rubber or PVC gloves must be worn when handling poisoned baits. A scoop or measure should be used if required.
- If the poisoned bait gets on the skin, immediately wash area with soap and water.
- After use and before eating, drinking or smoking, wash hands, arms and face with soap and water.
- After use, wash contaminated clothing, footwear and gloves.
- If poisoning occurs, go straight to a hospital or doctor or contact the Poison's Information Centre (Ph 13 11 26).
- Vitamin K-1 is an effective antidote and is readily available from hospitals and veterinary practices.
- For further information refer to the label and the Material Safety Data Sheet (MSDS), available from the supplier.

Equipment required

Poison baits

- Anticoagulant baits are commercially available from retail merchants such as supermarkets, hardware stores and agricultural suppliers.
- Anticoagulant baits intended for rodent consumption are available in either grain, pellet, paste or wax block form. Anticoagulants are also available in a tracking powder which adheres to the animal's feet and is consumed through grooming. Liquid formulations are also available which are added to water to make a toxic drink for rat control.
- Most anticoagulant baits are supplied in ready-to-use sachets or containers, however some bulk products may require the user to supply their own containers for bait distribution.
- It is recommended to concentrate baits at particular locations (bait stations).

Procedures

Assessment of site and estimation of rodent numbers

- It is recommended to conduct some form of monitoring of the population before conducting rodent control. This allows an estimation of the amount of bait required and effective bait placement to ensure all animals receive a sufficient dose.

- Monitoring can also assist in identifying any non-target impacts.
- Monitoring can involve trapping, damage assessments, or observation of droppings.

Laying of bait

Always read and follow all directions on the pesticide label.

- Anticoagulants can only be used in and around (within 2m) commercial, agricultural, industrial and domestic premises. Agricultural buildings include grain stores, animal housing and farm machinery buildings. This poison should not be used near exposed human or animal food, food preparation or food storage areas.
- The placement of baits is critical to achieve maximum effectiveness. Baits should be placed in areas where rodent activity is obvious, such as active nests, along runs, under rubbish or where droppings are observed. The bait container should be secured with wire or nails if possible. Most manufacturers recommend that the spacing of bait stations should not exceed 3 m for mice and 9 m for rats. The rate of application is 50-500 grams of bait per bait station.
- Baits should be placed in sheltered areas, inaccessible to non-target animals, particularly children and domestic animals, and protected from the weather.
- Rodents mostly feed at night, therefore bait should be laid in the late afternoon/evening to reduce access to diurnal non-target species such as birds.
- Bait should be checked at least twice a week in the first week of a baiting program, and at least weekly intervals after that. Baits that show no signs of activity should be removed or moved to a new location.
- Consumed bait should be replaced until all visible signs of rodent activity have ceased.

Collection of uneaten baits and rodent carcasses

- It is recommended that at the end of any control program all uneaten bait should be collected and destroyed either through a local authority landfill, or by incineration or burial to depth of 50cm. Consult the label for specific disposal requirements.
- Containers which have held bait material should not be used for any other purpose. Disposal of these containers should be through a local authority landfill, or if not available, buried below 50cm in a disposal pit.
- Rodent carcasses should be located and collected daily if possible, and either destroyed by incineration or buried.

Procedural notes

Users of anticoagulants must always refer to the relevant Commonwealth and State legislation for more detailed and up-to-date information on conditions of use including distance restrictions and bait distribution, storage, transportation and disposal.

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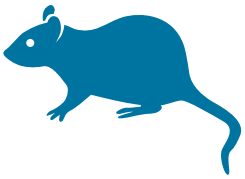

NSWROD SOP2 Baiting of rodents with zinc phosphide in crops

Background

Zinc phosphide is the most commonly used rodenticide after anticoagulants. It is an acute poison, killing after a single dose and is used when a rapid reduction in the rodent population is required. For mice it can be deployed for broadacre, in-crop protection as well as in commercial and industrial premises. Pre-prepared bait, either in grain or pellet form, is available for mouse control, which can be applied using ground or aerial techniques (as specified on the label and APVMA permit). Baits for Australian native climbing rats and Australian native ground rats are supplied in cellulose-based sachets which are distributed throughout sugar-cane crops by hand from vehicles or tractors while other operations are being conducted in the crop (e.g., weed spraying).

Zinc phosphide is an extremely toxic compound. Rodents, like most vertebrates, are highly susceptible to the effects of zinc phosphide, which is a non-specific pesticide. Native animals and birds, and domestic pets and livestock are also vulnerable to this type of poisoning. Good baiting technique helps to minimise the risk to non-target species and maximise the effect on targeted rodent populations.

This standard operating procedure (SOP) is a guide only; it does not replace or override the relevant NSW or federal legislation. The SOP should only be used subject to the applicable legal requirements (including WHS) operating in the relevant jurisdiction.

Individual SOPs should be read in conjunction with the overarching Code of Practice for that species to help ensure that the most appropriate control techniques are selected and that they are deployed in a strategic way, usually in combination with other control techniques, to achieve rapid and sustained reduction of pest animal populations and impacts.

Application

- Baiting with zinc phosphide should only be used in a strategic manner as part of a co-ordinated program designed to achieve sustained effective control, and is commonly used for plague control (once-off crises).
- Crops can only be baited after they have been assessed as at a reasonably high risk from rodent damage, the potential for crop damage will be of economic significance and there are no native mouse species present (Users should check the specific requirements in NSW, see EPA for more information).
- For in-crop mouse protection baits must not be placed within the outer 50 m of crop or within 50 m of native vegetation. It can be deployed for broadacre, in-crop protection,

using aerial application or accurately calibrated ground application equipment delivering 2-3 grains/m^2.

- For commercial and industrial premises, individual site risk assessments must be completed before any baiting to ensure there is a suitable buffer between area to be baited and stored grain to avoid inadvertent contamination of stored grain stocks.
- In facilities where food production occurs, the use of baits should be integrated with current rodent control policies and practices to prevent any contamination of food production areas.
- Because of the high risk of poisoning non-target animals, particularly birds, baits should be placed in areas of sufficient vegetation cover or in active burrows (see relevant APVMA permit for specific details).
- Sachets for rat control can be applied at 100 sachets per hectare or the equivalent of 1kg of bait material per hectare.
- Sachets should not be visible from the surface, and if they cannot be concealed, then bait stations must be used. If possible, baits should be applied in the late afternoon. Baits should not be placed in locations accessible to livestock and domestic animals. Baits should not be placed where they can contaminate streams, rivers or waterways.
- Containers which have held bait material should not be used for any other purpose. Disposal of used containers involves crushing and burying below one metre in a disposal pit specifically marked and set up for this purpose, clear of waterways, vegetation and roots. Excess or unused baits must also be buried below one metre. Used containers and baits must never be burnt.
- Zinc phosphide is listed as a Schedule 7 - Poison under the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP). This compound has a high potential for causing harm at low exposure and requires special precautions during manufacture, handling, storage and use. Zinc phosphide is only available to licensed or authorised users who have the skills to handle it safely. Special regulations are in place restricting the availability, possession, storage or use of this poison. In NSW, contact Local Land Services (LLS) for information on where to purchase zinc phosphide rodenticide products.
- Persons using this product may be required to hold a fumigators license in NSW (*NSW Pesticides Regulation 2017*). It is the responsibility of permit users to ensure they are compliant with NSW requirements.

Animal welfare implications

Target animals

- Zinc phosphide is an extremely toxic compound. When it comes into contact with moisture under acidic conditions (e.g., in a stomach), it reduces to phosphine gas which upon absorption causes chemical corrosion and congestion to the liver and other organs, damage to the liver and respiratory distress, depression of the central nervous system and diarrhoea.
- Clinical signs of poisoning generally appear rapidly, with animals showing reduced activity within one hour. Poisoned animals may kick at their abdomens with their hind

feet and show postural changes indicative of severe abdominal pain. The symptomatic period can last for several hours, with final symptoms including convulsions and paralysis. Time to death can be either rapid (8–24 hrs) or prolonged (24–72 hrs), with death usually occurring as a result of cardiac and respiratory failure or pulmonary oedema.

Non-target animals

- Zinc phosphide is toxic to a wide range of vertebrate species and there is no antidote for zinc phosphide poisoning. Non-target animals can be at risk during a baiting campaign.
- Poisoning of non-target species can occur either directly by eating baits intended for rodents (primary poisoning) or through scavenging carcasses from poisoned animals (secondary poisoning).
- There is some potential for secondary poisoning as the compound persists in the poisoned rodents' stomach for several days, however it does not accumulate in the muscle or other tissue, nor within the predators themselves. So as long as the single dose eaten is not too great, predators will experience no ill long-term effects. Many scavengers can detect phosphine odour in carcasses and discard the gut contents of poisoned mice.
- The susceptibility of non-target species to primary poisoning is determined by many factors, including sensitivity to the poison, body weight, concentration of zinc phosphide in the bait, bait placement, bait type and palatability, timing of baiting and level of exposure to poison baits. Additional factors affecting secondary poisoning include number of dead rodents available for scavenging, the time period over which carcasses are available and the concentration of poison in the carcasses.
- To minimise the risks to non-target animals, the following monitoring and baiting strategies are recommended to either reduce the amount of toxic bait dispensed or minimise the broad distribution of baits in areas where rodent populations are:
    - Monitoring – can be used to estimate the rodent population and its distribution, and can provide a guide for the amount of bait required and effective bait placement. Monitoring can involve damage assessments, trapping or the use of bait cards which are squares of grid paper soaked in linseed or canola oil.
    - Pre-feeding with non-poisoned bait – allows an assessment of what animals are eating the bait and the quantities of poisoned bait needed for the control program.
    - Placement of baits – place bait in areas with sufficient vegetation cover to hide from birds. Do not apply to bare ground (including fallow where there is no vegetative cover). In the case of mouse baits, apply bait as evenly as possible across the crop, and do not apply in a trail. Sachets for rat control must be placed in bait stations, and can be covered with leaf trash or placed under the crop canopy. Particular care should be taken when baits are applied near native vegetation using aircraft as high bait concentrations may occur on the ground beneath aircraft that need to climb steeply. Adhere to all stipulated directions and distance restrictions in the relevant permit and label.
    - Timing of baiting – rodents mostly feed at night; therefore, bait laid in the late afternoon will be mostly consumed overnight before diurnal non-target species such as birds will have access.

- Check bait stations regularly – bait stations used for rat control should be checked at no less than 72-hour intervals.
- Withholding period – livestock should not be allowed to graze baited areas for 14 days after application, or after all bait sachets have been recovered or have completely degraded.

Workplace health and safety considerations

- Operators using zinc phosphide must strictly follow the directions on the approved label when using, storing or disposing of this rodenticide.
- Zinc phosphide is toxic to humans and should be handled with care. Exposure can occur from ingestion, skin contact or inhalation of vapours. This poison must be kept away from acids, water and liquids, as dangerous phosphine gas is released slowly in moist air and immediately if wet. It must be kept away from naked flames, or any sources of heat or ignition.
- Adequate ventilation must be maintained during use.
- Appropriate personal protective equipment including overalls, impervious footwear, full-face respirator with combined dust and gas cartridge or supplied air respirator and elbow-length PVC gloves must be worn when opening the container and handling poisoned baits. Gloves and respirator should be washed after each day's use.
- If the poisoned bait gets on the skin, immediately wash area with soap and water.
- After use and before eating, drinking or smoking, wash hands, arms and face with soap and water.
- After use, wash contaminated clothing, footwear and gloves.
- If poisoning occurs, go straight to a hospital or doctor or contact the Poison's Information Centre (Ph 13 11 26). Remove from contaminated area. Apply artificial respiration if not breathing.
- For further information refer to the Material Safety Data Sheet (MSDS) available from the supplier.

Equipment required

Poison baits

- Zinc phosphide baits are available from rural suppliers and are strictly controlled by the requirements of the AVPMA for Schedule 7 poisons.
- Zinc phosphide used for mouse control is available in pre-prepared bait, either in grain or pellet form.
- Zinc phosphide used for rat control is available in pre-prepared grain bait, distributed in 10g individual sachets. These sachets should not be opened.

Other equipment

- Equipment for ground or aerial baiting.
- Personal protective equipment.
- First Aid kit.

Procedures

Always read relevant permit for conditions and directions for use.

Assessment of site and estimation of rodent numbers

- Apart from seeing rodents, some form of monitoring is required to identify the species present, gauge the population, the possible level of damage and the potential impact on non-target species. This monitoring is a legal requirement for using zinc phosphide bait.
- Monitoring of mice can be carried out using active hole counts, bait cards (which are squares of gridded paper soaked in linseed or canola oil and placed at suitable intervals), baits stations or traps. Methods for monitoring of rats include assessment of fresh chewing damage and rat movement tracks, use of break-back traps or active burrow counts.
- Visual monitoring for any effects on non-target species must be undertaken and recorded in the days immediately following baiting.

Laying of ground bait for mouse control

- The even placement of bait is critical to achieve maximum effectiveness and minimise risks to non-target species.
- Ground application of zinc phosphide must be done using accurately calibrated ground application equipment to apply the bait at a rate of 1 kg/ha to achieve an even coverage of 2-3 grains (pellets)/m^2.
- Zinc phosphide can only be used for in-crop protection. This poison must not be used around commercial, agricultural, industrial and domestic premises, or within towns or residential areas. Baits must not be placed within native vegetation or within 50m of crop boundaries.
- Baits should be placed in areas with sufficient vegetation cover. Baits should not be placed in locations accessible to livestock and domestic animals. Baits should not be placed where they can contaminate streams, rivers or waterways.
- Rodents mostly feed at night; therefore bait should be laid in the late afternoon to reduce access to diurnal non-target species such as birds.
- Baits should not be applied if heavy rain is imminent. Zinc phosphide baits will tolerate some light rain and dew and remain active for several days; however, it is recommended that at least two nights are free from rain after baits are applied to ensure maximum performance.
- A withholding period of 14 days applies within which crops may not be harvested, or livestock allowed to graze in baited areas.

- Retreatment may be required in line with manufacturer recommendations and relevant permit in areas of extremely high mouse densities.

Aerial baiting for mouse control

- Baits can only be applied from an aircraft if the pilot holds a NSW EPA Aerial Applicator Pilot Licence, has an agricultural rating and the aircraft has an air operator's certificate endorsed for pesticide application and is employed or is the holder of an EPA Aerial Applicator Business licence.
- Pilots must be given a property map showing the paddocks to be baited and a signed indemnity form from the landholder before commencing baiting application.
- A pesticide application record applicable to the bait line must be completed by the aerial contractor and supplied to the landholder.
- The even placement of bait is critical to achieve maximum effectiveness and minimise risks to non-target species. Bait should be applied at a rate of 1 kg/ha to achieve an even coverage of 2-3 grains (or pellets)/m^2.
- Baits should be placed in areas with sufficient vegetation cover. Baits should not be placed in locations accessible to livestock and domestic animals. Baits should not be placed where they can contaminate streams, rivers or waterways.
- Rodents mostly feed at night; therefore, it is preferable for bait to be laid in the late afternoon to reduce access to diurnal non-target species such as birds. However, this may reduce available aerial operator time and may not be practical in high-demand situations.
- Baits should not be applied if heavy rain is imminent. Zinc phosphide baits will tolerate some light rain or dew and remain active for several days; however, it is recommended that at least two nights are free from rain after baits are applied to ensure maximum performance.
- A withholding period of 14 days applies within which crops may not be harvested, or livestock allowed to graze in baited areas.
- Retreatment may be required in line with manufacturer recommendations in areas of extreme high mouse densities or areas with significant alternative feed.

Laying of ground baits for rat control

- The placement of bait is critical to achieve maximum effectiveness and minimise risks to non-target species.
- Zinc phosphide used for rat control is available in pre-prepared grain bait, distributed in 10g individual sachets. These sachets should not be opened, but placed at bait stations spaced no less than 10m apart within the crop to achieve a rate of 100 sachets (1kg) per hectare. These baits cannot be applied by aerial application methods.
- Zinc phosphide can only be used for in-crop protection. This poison must not be used around commercial, agricultural, industrial and domestic premises, or within towns or residential areas. Sachets must not be placed within native vegetation or within 5m of crop boundaries.

- Bait stations should be in areas where rats are active and there is potential for damage to the crop. There should be sufficient vegetation cover, such as under crop canopy to prevent access by birds and keep bait dry during rain. Sachets can be covered with leaf trash. Baits should not be placed in locations accessible to livestock and domestic animals.
- Bait stations should be designed to prevent the bait from spilling out onto the ground. Sachets must not be attached or wired to trees. Bait must not be placed in direct contact with the ground. Baits should not be placed where they can contaminate streams, rivers or waterways.
- Bait stations should be checked at no less than 72-hour intervals.
- Rodents mostly feed at night; therefore, bait should be laid in the late afternoon to reduce access to diurnal non-target species such as birds.
- Bait may retain activity for several weeks or months if sachets are unopened by rats, even in wet conditions. The cellulose-based sachets and enclosed bait are designed to eventually degrade due to the effects of soil moisture and sunlight.
- A withholding period of 14 days applies within which crops may not be harvested, vegetative matter cut for stock feed, or livestock allowed to graze in baited areas. Livestock or domestic pets should not be allowed access to the baited area unless all bait sachets have been recovered or completely degraded.
- Re-baiting of crops may be required in areas of extreme high rat densities or areas with significant alternative feed. The minimum retreatment interval is 14 days, although one month is recommended in some circumstances.

Collection of uneaten baits and rodent carcasses

- Where possible, any uneaten bait at the end of a program should be collected and buried to depth of one metre.
- Where possible, rodent carcasses should be located and collected daily, and buried.

Procedural notes

Users of zinc phosphide must always refer to the relevant Commonwealth and State legislation and current APVMA permit for more detailed and up-to-date information on conditions of use including distance restrictions and bait distribution, storage, transportation and disposal.

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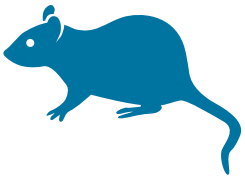

NSWROD SOP3
Trapping of rodents

Background

Trapping is used to minimise the impact of the introduced house mouse (*Mus musculus*), brown rat (*Rattus norvegicus*), black rat (*Rattus rattus*), and Oriental rat (*R. tanezumi*) in commercial and domestic premises and on agricultural production. Because of the low efficacy and high labour cost of trapping rats and mice for broad-scale population reduction, the use of traps is generally limited to small-scale infestations rather than rodent plagues.

All traps have the potential to cause injury and some degree of suffering and distress. Traps that contain an animal (live traps) cause fewer injuries than traps that restrain an animal. Traps that are designed to kill extremely rapidly (break-back/snap traps, electrocution traps) are considered to be among the most humane methods of rodent control if they are well-designed and set and monitored appropriately.

This standard operating procedure (SOP) is a guide only; it does not replace or override the relevant legislation that applies in NSW. The SOP should only be used subject to the applicable legal requirements (including WHS) operating in the relevant jurisdiction.

Individual SOPs should be read in conjunction with the overarching Code of Practice for that species to help ensure that the most appropriate control techniques are selected and that they are deployed in a strategic way, usually in combination with other control techniques, to achieve rapid and sustained reduction of pest animal populations and impacts.

Individual SOPs should be read in conjunction with the overarching Code of Practice for that species to help ensure that the most appropriate control techniques are selected and that they are deployed in a strategic way, usually in combination with other control techniques, to achieve rapid and sustained reduction of pest animal populations and impacts.

Application

- Trapping is labour intensive and is an inefficient method for large-scale rodent control. It has little impact when population numbers are high or in a plague situation.
- Trapping is used as part of an early intervention strategy to quickly reduce small populations of rodents, and prevent a build-up in numbers. Rodent-proofing, habitat modification and good hygiene (e.g., keeping grass cut, stubble management, keeping rubbish around buildings to a minimum) can then be used to reduce the potential population capacity and slow re-colonisation.
- There are a variety of trap types available. Some types of traps are designed to kill extremely rapidly (break-back/snap traps, electrocution traps), whereas others are designed to contain or restrain (live traps).

- Traps have the potential to cause significant injuries, suffering and distress; some designs more so than others. Selection of appropriate traps and trap sites will maximise the chance of capture and minimise the distress caused to target and non-target animals.
- Every effort must be made to avoid target and non-target deaths from factors such as exposure, shock, dehydration, starvation, exhaustion and predation.
- Traps must be used in accordance with the *Prevention of Cruelty to Animals Act 1979*.
- Traps can only be used for the control of native rodents under special permits (Users should refer to NPWS for information on licenses to harm native animals in NSW).
- Rodents that are not killed instantly by the trap should be euthanased by manually applied blunt force trauma to the head.

Animal welfare implications

Target animals

- All traps have the potential to cause injury and some degree of suffering and distress. The humaneness of any trap depends on the length of time the animal remains trapped and on the manner of death.

Break-back/snap traps

- Are designed to kill rapidly using a descending bar to hit the animal either on the back of the head or in the upper cervical area, usually causing irreversible loss of consciousness within one minute.
- If badly designed, not set properly or poorly baited can result in animals being injured rather than killed thus causing prolonged pain and distress.
- Traps with spikes or serrations on the jaws should not be used.
- Should be checked at least daily to minimise the suffering of any injured animals.

Stretched rubber ring traps

- Utilise a stretched rubber ring which is released onto the rodent when it enters the baited tunnel trap to cause crushing and suffocation.
- Are designed to kill instantly with 100% efficacy.
- Can potentially trap and kill small non-target animals.

Electrocution traps

- Are designed to kill quickly, with the time to death being less than 2 minutes.
- Usually consist of a box structure with an opening for entry. The rodent is enticed to stand on two plates, which act as terminals, to receive an electric shock transmitted via the feet.
- May or may not cause unconsciousness in the animal due to shock before it experiences the pain of severe muscle constriction, ventricular fibrillation and respiratory distress caused by this type of death.

- Can potentially cause non-lethal shocks which cause animals to experience muscle weakness or loss of function for a short-period but they are not left with any permanent injury or burns.

Gas traps

- Enclose the mouse when it enters the trap and releases a measured dose of carbon dioxide.
- Cause loss of consciousness in less than 30 secs and death within around 2 min when gas concentration is sufficient.
- Are likely to cause dyspnoea (breathing discomfort or 'air hunger'), anxiety and fear in rodents prior to unconsciousness.

Glueboard traps

- Make use of a highly adhesive glue to restrain any rodents that come in contact.
- Cause trapped animals to become stuck by the feet and fur and suffer from instant and prolonged pain and distress.
- Cause suffering and trauma depending on the period of entrapment, including dehydration, hunger, forceful hair removal, torn skin, and broken limbs, and sometimes self-mutilation.
- Are considered unacceptable and inhumane due to the length of time the animal remains trapped and the manner of death, and as such will not be discussed further in this SOP.

Live traps using box or cage traps

- Should be placed in a suitable area protected from extremes of weather.
- Should be set in the evening and checked in the morning.
- Can cause animals to be at risk of exposure, thirst, starvation, shock, capture myopathy and predation, although they are not likely to experience significant injuries unless they make frantic attempts to escape.
- Should be approached carefully to minimise panic, further stress and risk of injury of the trapped animal.
- Introduced species of rodents that are live trapped should be euthanased promptly by manually applied blunt force trauma to the head. Other methods of euthanasia in domestic situations may include euthanasia at a veterinary premise. Translocation to an unfamiliar area can raise potential welfare issues and is not permitted under NSW environmental legislation.
- There are welfare implications of trapping while females have dependent young as they will be left to starve to death. If lactating females are trapped, reasonable efforts should be made to find and humanely kill dependent young; otherwise they will die a slow death from starvation.

Non-target animals

- Traps are not always target specific, so a wide range of non-target species may be caught.
- Small non-target animals will suffer similar distress, injuries or death as the targeted rodents.
- Larger non-target animals are unlikely to come to any harm; however, slight suffering and injury may occur if they trigger a break back/snap trap.
- Live non-target animals caught in traps must be examined for injuries and signs of illness or distress (or taken to a veterinarian if there is a lack in competency) and dealt with as follows:
    - Animals which are unharmed or have only minimal injuries should be immediately released at the site of capture only, as translocation to an unfamiliar area can raise potential welfare issues.
    - Animals which have more severe injuries but may respond to veterinary treatment, should receive appropriate attention from a qualified carer or veterinarian.
    - Severely injured non-target animals which are untreatable should be destroyed humanely, using a technique that is suitable for the species. For more information on euthanasia techniques refer to *GEN001 Methods of euthanasia*.
- To minimise the risks to non-target animals, the following strategies are recommended:
    - Use of live traps – allows an assessment of what non-target animals are in the area.
    - Placement of traps – place traps in sheltered areas, inaccessible to non-targets and potential predators (e.g., in tunnels), in areas where rodent activity is obvious, such as active nests, along runs, under rubbish or where droppings are observed.
    - Timing of trapping – rodents are mostly active at night; therefore, set traps in the late afternoon / evening and check in the morning.
    - Check traps regularly – traps should be checked at least once a day, preferably twice, to minimise suffering of trapped live animals.

Workplace health and safety considerations

- Care must be taken when handling rodents as they may carry diseases such as leptospirosis, toxoplasmosis and salmonellosis that can affect humans and other animals. Routinely wash hand and other skin surfaces contaminated with faeces, blood and other body fluids.
- Operators must be protected by tetanus immunisation in case of infection of scratches and bites when handling trapped or injured animals.
- Operators should also be wary of the risks of injury when placing and setting traps, and handling wild animals. Protective clothes may help prevent the operator from being scratched and bitten. Leather gloves may help prevent finger injuries from live and break-back/snap traps.

Equipment required

Traps

- Traps are commercially available from retail merchants such as supermarkets, hardware stores and specialised suppliers.
- Traps should be supplied with instructions for use (including any limitations on the operation of the trap), maintenance, service and safety operation. These instructions should be adhered to by the operator.
- Traps should be mechanically robust, free from imperfections and defects. The design should incorporate adequate strength and rigidity to prevent breakages or permanent deformation which would reduce their effectiveness, humaneness and safety. Trap material, as well as bonding or welding, should comply with applicable international, or national standards. Replacement parts should meet the same specifications as the original parts.
- Traps should incorporate a means of securing them to prevent displacement before or after capture. Pegs should be used to tether traps when used outdoors.
- Characteristics of a good break-back/snap trap include a strong bar and spring, and a large trigger platform. The point of impact should be in the head or upper neck area.
- Kill traps should effectively kill the target animal quickly. Break-back/snap traps are considered to have an *acceptable* welfare impact if they cause irreversible unconsciousness in at least 80% of animals (minimum of 12 animals tested) in ≤60 seconds for mice and ≤90 seconds for rats. Traps with better welfare will be quicker (≤30s for mice and ≤45s for rats) – refer to Schlötelburg et al. (2021) NoCheRo-Guidance for the Evaluation of Rodent Traps for further details.
- Live-trapping is conducted using box/cage traps which are usually rectangular and constructed from wire mesh. They have a mesh or sheet metal trap door which is held open until the trap is triggered either by a rodent standing on a treadle or taking bait from a trigger inside the trap. When the trap is triggered, the door is closed (usually by a spring) and the animal is retained in the trap.
- Restraining traps should effectively hold the animal without causing excessive trauma. NAWAC humane guidelines recommend that trapped animals should not suffer with trauma more severe than mild at least 70% of the time, and trauma more severe than moderate at least 80% of the time. Traps that result in moderately severe to severe trauma are not acceptable.

Other equipment

- Heavy metal or wooden blunt implement for killing live rodents.
- Pegs for tethering outdoor traps.
- Tunnels for protecting non-target animals from injury (where suitable).
- Personal protective equipment (including waterproof gloves).

Procedures

Laying of traps

- The placement of traps is critical to achieve maximum effectiveness. Traps should be placed in areas were rodent activity is obvious, such as active nests, along runs, under rubbish or where droppings are observed.
- Before setting each trap, ensure that it is functioning properly.
- If a bait is required to lure the rodent in the trap, use a food which is more tempting (at least a different smell) to the animal than other food-stuffs which may be available.
- Set the trap according to the manufacturer's instructions and place in its final position. When placed outdoors, live box traps and break-back/snap traps should be firmly anchored in the treatment area.
- Keep records of when and where traps are set.

Checking of traps

- Traps should be checked at least once a day, between sunrise and sunset. To minimise the suffering of trapped animals that are still alive, it is preferable to check traps twice per day in the morning or evening and whenever the trap is thought to be sprung.
- Remove dead rodents and humanely kill any trapped rodents that are still alive.
- Re-set the trap and continue trapping until rodent activity ceases. Traps may need to be moved to different locations.

Euthanasia of live rodents

- Live-trapped rodents and rodents that have not been successfully killed in break-back/snap traps or other types of trap must be euthanased as soon as possible after capture. The most appropriate technique is manually applied blunt force trauma to the head to destroy the brain.
- Animals caught in live traps should be gently transferred from the box/cage trap to a bag or hessian sack prior to euthanasia. Encourage the rodent into a corner of the sack and prevent it from moving. Locate the head and strike it accurately and strongly with a suitable heavy and blunt instrument.
- Death of the animal should always be confirmed by observing a combination of the following:
    - no heartbeat
    - no breathing
    - no corneal reflex (no blinking when the eyeball is touched)
    - no response to a toe pinch (a firm squeeze of the pad on the large toe)
- If there is any doubt that the animal is dead then repeat the method.

Disposal of dead rodents

Rodent carcasses must be disposed of carefully and hygienically.

Procedural notes

Users of traps must always refer to the relevant Commonwealth and State legislation for more detailed and up-to-date information on conditions of use.

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