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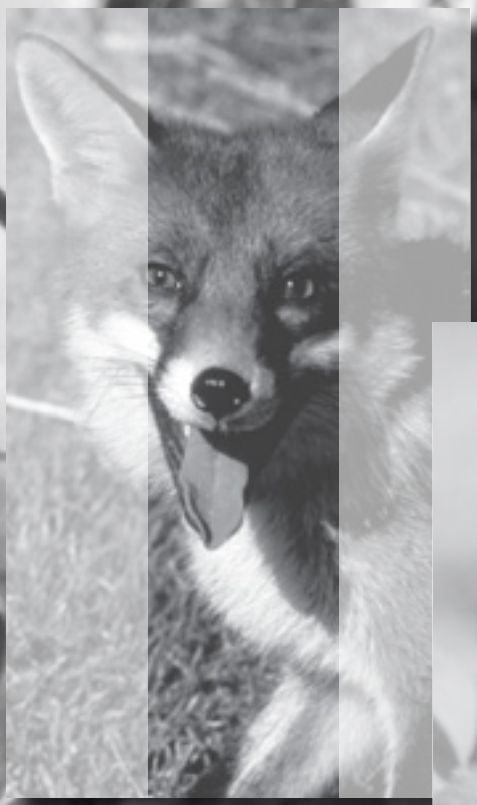

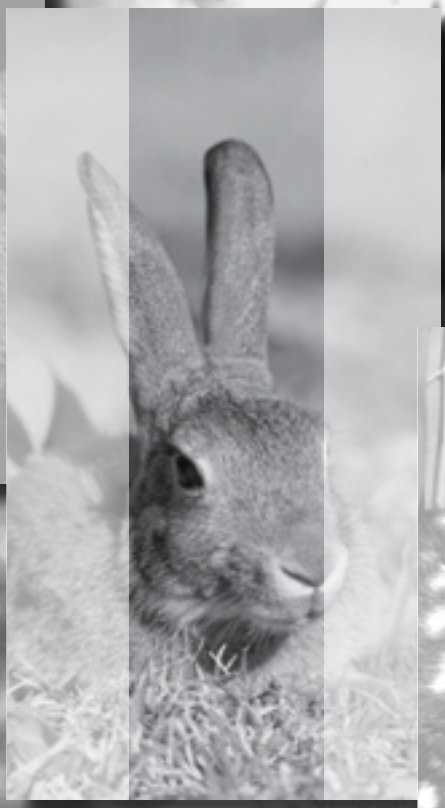

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Further information

Contact your local Department of Agriculture and Food, or telephone Freecall 1800 084 881 or email info@agric.wa.gov.au. Additional publications on the control of pest animals can be obtained by visiting the Department's website at: www.agric.wa.gov.au.

1080 – Characteristics and use

Sodium fluoroacetate (commonly known as '1080') is used extensively as a vertebrate pesticide in Australia and New Zealand. With care, and provided the directions for use are followed, 1080 can be safely used to control vertebrate pests with few potential risks to non-target animals or the environment. In many instances, 1080-baiting programs are the only viable strategies available for broad-acre control of vertebrate pests.

1080 was introduced into Australian rabbit control programs in the early 1950s. Since then, it has been shown to be highly effective against a number of pest species, particularly foxes, rabbits, wild dogs and feral pigs. Well-planned and executed 1080-baiting programs usually achieve rapid, high-level population knockdowns.

1080-baiting programs also have a long history of proven safety in Australia and New Zealand. In Western Australia, for example, there have been few reports of concerns with human safety, environmental persistence, accumulation in the food chain, or adverse impacts on non-target species.

WARNING

1080 is an extremely dangerous toxin with no effective antidote, so great care is required with its use.

Why control vertebrate pests?

Introduced vertebrates such as rabbits, foxes, wild dogs, and feral pigs have a significant and profound impact on agricultural production and biodiversity in Australia, including much of WA. These impacts include soil erosion, crop and pasture losses, the spread of weeds, degradation of on-farm bush remnants, damage to tree plantations, prevention of native plant regeneration and other habitat degradation (e.g. destroying nests and nest sites), predation of domestic and native (e.g. rock wallabies, woylies, bandicoots, numbats, quolls and possums) animals, and the maiming of livestock (e.g. calves and lambs).

Foxes predation can cause up to 30% losses of lambs

The impacts of these pests also include the potential to spread and maintain endemic and exotic animal diseases, including their implications for human health. For example, feral pigs can act as reservoirs for a range of animal diseases, such as foot and mouth disease. Wild dogs can act as vectors for diseases that affect domestic dogs (e.g. distemper and mange). Until the disease-free status can be reconfirmed, the presence of any exotic disease in Australian livestock also has adverse implications for Australia's livestock export trade.

In Australia, production losses and the cost of control to reduce these impacts, can range for $100 to $300 million per annum for rabbits, to around $230 million p.a. for foxes, $110 million p.a. for feral pigs, and $48 million p.a. for wild dogs with a further $10 million p.a. spent on maintaining several dingo/wild dog/vermin-proof fences. Consequently, a number of management strategies have been developed Australia-wide to reduce these impacts, and this includes judicious use of 1080 products.

What is 1080?

1080 concentrate is a highly water-soluble powder which is generally odourless and tasteless to humans. It is stable under normal conditions, but starts to break down at temperatures above 110° C and completely degrades at 200° C. The active ingredient of 1080 is sodium fluoroacetate, which is a natural plant product (see below). However, the 1080 used in baits is synthetically produced.

Mode of action

The ultimate toxicity of the active ingredient of 1080, fluoroacetate, arises from its effects on the energy-producing tricarboxylic acid cycle (TCA) in the mitochondria (mitochondria are the 'powerhouse' of cells). Consequently, affected animals are not able to meet their energy needs. However, fluoroacetate itself is not toxic as it must be converted within the animal (i.e. in the mitochondria) to a second substance, fluorocitrate, to exert its toxic effects. It is the fluorocitrate thus formed which actually interferes with the TCA cycle and the production of energy.

Because 1080 (fluoroacetate) needs to be absorbed and then converted to fluorocitrate, there is lag between the ingestion of 1080 and the appearance of signs of toxicity. In mammals, this lag-phase is generally between 0.5 and 3 hours, but it can be longer than this (e.g. up to 15 h). Animals receiving small sub-lethal doses of 1080 may show only mild signs, and they metabolise and excrete the 1080 within one (most mammals) to three (reptiles) days. They then recover.

The metabolic and physiological effects of 1080-poisoning are complex. The inhibition of the TCA cycle by fluorocitrate results in a cascade of events, including elevated citrate levels in plasma and tissues. This in turn results in neurological impairment and reduced calcium levels in poisoned animals. Adequate calcium is vital for normal heart function, and for normal communication between nerves in the spinal cord. However, keep in mind, that both the role of these neurotransmitters, and the consequences of 1080-induced neurological impairment, are also very complex and beyond the scope of this Bulletin.

Signs of poisoning

Visual signs of poisoning are generally neurological in carnivores, cardiac/respiratory in herbivores, and a mixture of neurological and cardiac signs in omnivores. However, because of the varied responses which can occur with 1080-intoxication, the classification of individual species into these groupings is often arbitrary.

Prickly poison, Gastrolobium spinosum *(L Twigg)*

Natural occurrence of 1080

Fluoroacetate, the active ingredient of 1080, occurs naturally in several toxic plants in Australia, South Africa, and South America. At least 40 such species occur in Australia, with most confined to the south-west of Western Australia. All of these species are legumes but most are from the genus *Gastrolobium*, with one *Acacia*, and two species of *Nemcia*. Some of the *Gastrolobiums* can produce considerable amounts of 1080 (e.g. *G. bilobum*, *G. parviflorum*; >2500 mg per kg dry weight of leaves). Fluoroacetate also occurs at very low concentrations in tea leaves, and guar gum, a common constituent of a variety of foodstuffs.

Biodegradation

1080 is highly water soluble, and therefore readily leaches from most baits. However, mainly due to the activity of a number of fungi and bacteria (at least 24 different species) which can degrade 1080 into harmless by-products, accumulation in, or contamination of, soil or the environment does not occur. 1080 does not attain harmful levels and/or persist in waterways, even when quite high natural concentrations of fluoroacetate are present in the surrounding environment. Furthermore, as most 1080 is eliminated from living animals within three days, 1080 residues do not persist in meat, blood, the liver, or fat. (This is in contrast to the anticoagulant, brodifacoum and several other pesticides). Thus, bioaccumulation of fluoroacetate is very unlikely because biodegradation or elimination of fluoroacetate occurs at many levels in the food chain. This includes microorganisms, invertebrates, birds, mammals and reptiles.

The longevity of 1080 in baits, or of the baits themselves, depends upon the prevailing weather conditions. In the presence of rain, baits may only remain toxic for a matter of days, particularly with the grain-based baits. In contrast, some baits used to control pest canids can remain toxic for several months under dry conditions. The loss and degradation of 1080 from baits and carcasses is mainly dependent upon leaching, and the activity of microorganisms. However, it is not only the longevity of baits and their active ingredient (i.e. 1080) which determines a potential risk profile. How quickly baits are taken, the rate of lay, and where baits are located all influence these assessments.

For safety reasons (e.g. restocking paddocks), however, it is best to assume that baits will remain toxic for at least 4 weeks, and end-users must make their own decisions based on the local conditions regarding restocking of baited paddocks. Some bait trails can be covered with soil to reduce any potential hazard.

Sensitivity of animals to 1080

Each major animal group (e.g. reptiles, mammals and birds) have differences in their metabolic rates which means that they also vary in their ability to convert fluoroacetate (1080) to fluorocitrate. Similar differences can also occur between the various

Families within these groups. Consequently, there is often wide variation in the sensitivity of the different animal groups to 1080, and this is summarised below.

Canids (dogs and foxes) are among the most sensitive species to fluoroacetate. Herbivores and birds are less sensitive, and reptiles and amphibians are relatively insensitive to 1080.

Fish and other aquatic fauna (including many invertebrates) are relatively resistant to 1080, and lethal concentrations would not be achieved even under intensive, operational baiting programs. There is no evidence of detrimental impacts of 1080-baiting programs on individual invertebrates or their populations at the level of exposure that is likely to result from properly conducted baiting programs.

The acute toxicity of 1080 has been determined for over 240 species/populations of animals, including birds, mammals, reptiles and insects. However, the relative toxicity of 1080 can increase when some warm-blooded animals are exposed to temperature extremes outside of their normal body temperature range. 1080 can also have a chronic effect on animals, such as a temporary reduction in their fertility.

Sensitivity of introduced animals

Vertebrate pests such as wild dogs, foxes, rabbits, feral pigs and feral cats are introduced species and, consequently, are highly sensitive to 1080 (Table 1).

Table 1: LD50* of 1080 (mg/kg) for some introduced vertebrates

Species	LD50 (mg/kg)*
Dog	0.11
Fox	0.14
Rabbit	0.42
Pig	1-2
Cat	0.40
Sheep	0.49
Cow	0.39
Horse	0.41
Chicken	7.70
Human	~2

* The LD50 is the amount of toxin, on a body weight basis, required to kill 50 per cent of the test animals. Amounts are for pure 1080.

Most pets and domestic livestock are similarly quite sensitive to fluoroacetate (1080). Hence, they are also susceptible to 1080 baits. Domestic, and other dogs, are at risk both from eating 1080-baits, and through secondary poisoning. Secondary poisoning occurs when a dog feeds on the carcasses of animals (e.g. rabbits) killed by 1080 baits. These carcasses may remain toxic to introduced species (but not the more tolerant native species – see below) until they decompose within 2-8 days. Secondary poisoning in this way also provides an added advantage in that some foxes will be killed by feeding on carcasses containing 1080. Livestock can also be killed if they are allowed to feed on 1080-poisoned grain baits used to control rabbits and/or feral pigs.

Sensitivity of native animals

Many native animals in Western Australia have co-evolved with fluoroacetate-bearing plants, and as a consequence, are often quite tolerant to 1080. That is, they can generally eat some of the toxic plants or animals containing 1080 (fluoroacetate) with little risk of being poisoned. However, in contrast, the same genus/species of animals in south-eastern Australia, where the toxic plants do not occur, are generally much more sensitive to 1080 (Table 2).

A bait layer being loaded for rabbit control

Thus, the enhanced tolerance of our native animals makes 1080 a particularly useful and target specific toxin in WA. However, provided that best practice procedures are followed, enhanced tolerance to 1080 is not a prerequisite for safe and effective baiting programs.

Target specificity

The target specificity of 1080 baits is enhanced by the increased tolerance to 1080 of many of WA's native fauna. However, the specificity of any poison bait, including 1080 products, is determined by a number factors including the sensitivity of target and non-target species to the active ingredient, the body

mass of non-target animals relative to that of the target-species, the bait medium used, the hardness of the bait and where the toxin is located, whether non-target animals are exposed to the toxic baits or poisoned animals and, if so, whether these are acceptable food items, and the timing of baiting programs.

Properly conducted baiting programs (i.e. in accordance with the label directions) provide safe and effective control options. Shallow burial of baits under ground litter, or the tethering of baits, can further reduce potential risks to non-target species.

Table 2: LD50 of 1080 (mg/kg) for some native Australian animals

Species	LD50 (mg/kg)
Bobtail skink	
Western Australia	>800
South Australia	201
Rosenberg's goanna	
Western Australia	235
South Australia	38
Brushtail possum	
Western Australia	118
South Australia	0.64-0.84
Western grey kangaroo	47
Eastern grey kangaroo	0.29
Banded hare-wallaby	106
Chuditch/Western quoll	7.1
Red-tail phascogale	16.5
Emu	96
Malleefowl	106
Bronzewing pigeon	38
Western rosella	71
Brown falcon	~30
Barn owl	~22

Amounts of 1080 used in New Zealand and Australia

New Zealand is the greatest user of 1080 concentrate, using up to four tonnes of powder per year. In contrast, only around 200 kg of 1080 powder are used in Australian pest control programs each year. 1080 baits have been used in New Zealand since the 1950s, primarily for aerial baiting of possums introduced from eastern Australia, and for the control of rabbits. Possum control is aimed at protecting biodiversity and helps to reduce the spread of bovine Tb. New Zealand sowing rates for aerial operations are 3–5 kg/ha, which equates to 4.5–7.5 g 1080/ha. This compares to around 0.00015 g 1080/ha for many fox baiting programs in Western Australia. Interestingly, areas with fluoroacetate-bearing plants can have up to 550 g of fluoroacetate per ha and yet, due to its degradation by microbes, fluoroacetate does not persist in these environments.

Injecting and drying field-prepared wild dog baits

How does 1080 compare to alternatives?

As yet there are no alternative broad-scale methods for effectively and efficiently reducing the numbers and impact of vertebrate pests across Australia. Some of the possible additional options considered are discussed below.

Immunosterility

Fertility control of pest species is an attractive option as it focuses on decreasing birth rate rather than increasing death rate as do lethal control options. The possibility of developing target-specific, naturally disseminated, anti-fertility, genetically-modified agents has been considered for rabbits, house mice, foxes, and introduced (New Zealand) brushtail possums. However, despite a conservatively estimated $80AUD million research effort spanning three Cooperative Research Centres over approximately 15 years, the technical challenges have proven too great with current technology, and disseminating or bait delivered fertility control could not be practically developed for any pest species.

Strychnine

Strychnine is not target-specific as most animals are equally highly sensitive to this toxin. Strychnine also has a high environmental persistence. Strychnine is not registered for use in predator baits in Western Australia, but it can be used on trap-jaws to help ensure a humane death when trapping wild dogs.

It is also used on grain to control emus because of their high tolerance to 1080 (Table 2).

Trapping can be an useful option for wild dog control

Shooting, trapping, fumigation and warren destruction

These are all viable techniques when pest control needs to be undertaken at a localised level, although they too can have potential risks associated with their use (e.g. fumigation can kill native animals, warren ripping may destroy native vegetation). Because of the associated cost, and/or the logistics involved, these methods are generally impractical and unsuitable for broad-acre pest control programs.

Use of 1080 in other countries

A few other countries also use 1080. These include New Zealand, Mexico, Japan, Korea, Israel, and very restricted use in the United States (sheep-coyote collars). 1080 is not approved in many other countries because of concerns regarding potential human, and other off-target, poisoning.

Safe use of 1080 through regulation

1080 use in Australia is closely regulated by Commonwealth (Australian Pesticides and Veterinary Medicines Authority) and State (Department of Health) government agencies. Supply of 1080 products is strictly regulated, and clear guidelines are provided to govern its use in all States.

In Western Australia, additional State regulations also apply via the *Poisons Act 1964*, the *Poisons Regulations 1965*, the *Health (Pesticides) Regulations 1956*, and the Code of Practice for the Safe Use and Management of 1080 in Western Australia. The *Dangerous Goods Safety Act 2004* provides general regulation for the storage, handling and transportation of 1080, and 1080 products.

These restrictions mean that:

- 1080 is not readily available to the general public.
- Authorisation is required before anyone can obtain 1080 baits.
- A Risk Assessment is undertaken before any authorisation is given.
- Training requirements are stipulated, and must be met.
- Reporting of incidents is mandatory.

This process is overseen by the Western Australian Department of Health.

Further reading

Department of Health, Western Australia, Code of Practice for the Safe Use and Management of 1080 in Western Australia.

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