# FERAL ANIMAL MANAGEMENT GUIDELINES

## City of Melville

**June 2015**

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## Executive Summary

This guideline was prepared to accompany the Natural Areas Asset Management Plan (NAAMP) and provide a reference document detailing guidelines for the management of feral animals in the City of Melville. Feral animals are an ongoing management issue that is impacting the sustainability of the city's nature reserves. Feral animals are reducing native species populations in a number of ways: competition for food, shelter and breeding sites, predation and spreading of disease. They can also impact on the abiotic environment through soil erosion.

Research was done into reasons for feral animal invasion and the range of control methods available to reduce populations. A search of the literature and government publications provided the necessary details on current best practice in the state or nation, and was then transposed onto the City of Melville and amended for the local circumstances.

Many of the commonly-used control methods, such as baiting and shooting, were found to be unsuitable in urban areas, due to the prevalence of domestic animals and people nearby. The best methods therefore for City of Melville proved to be a combination of trapping, fumigation and fencing. The emphasis of findings was on using a combination of control methods, as no one method could necessarily manage or eradicate feral species indefinitely.

## Acronyms and Abbreviations

| | |
|---|---|
| DEWHA | Department of Environment, Water, Heritage and the Arts |
| SEWPaC | Department of Sustainability, Environment, Water, Population and Communities |
| DEC | Department of Environment and Conservation |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| EPBC Act | Environment Protection and Biodiversity Conservation Act |
| NAAMP | Natural Areas Asset Management Strategy |

# 1 INTRODUCTION

Feral animals have been identified as one of the ten most significant threats to biodiversity (NAAMP 2011). The objectives of this guideline are therefore to maintain and enhance the City of Melville's biodiversity assets through the prevention, elimination, containment and/or management of the threat of feral animals.

Feral animals are defined as "a species occurring, as a result of human activities, beyond its accepted normal distribution and which threatens valued environmental, agricultural or other social resources by the damage it causes" (SEWPaC 2011a). Many feral species were brought to Australia with the arrival of the European Settlers and either intentionally or accidentally released into the wild. Since these species are not native to this environment, they generally have few natural predators or diseases to control their populations (SEWPaC 2011b). As a result, the populations increase exponentially and they are able to spread quickly.

## 1.1 Impacts on Natural Areas

Feral animals are those species that occur, as a result of human activities, beyond their accepted normal distribution and which threaten valued environmental, agricultural or other social resources by the damage they cause. Many feral species were brought to Australia with the arrival of the European Settlers and either intentionally or accidentally released into the wild. Since these species are not native to this environment they generally have few natural predators or diseases to control their populations, and as a result the populations increase exponentially and spread widely.

Feral species have a number of key traits that make them particularly invasive:

- Fast reproductive rate
- Early reproductive maturity
- Generalist diet

Feral animals have been identified as one of the ten most significant threats to biodiversity in the City of Melville. Some of their impacts include:

- direct competition with native fauna for food, shelter and nesting sites;
- predation of native fauna;
- grazing of native flora;
- spread of weeds and diseases;
- soil erosion; and
- degradation of water courses.

The level of risk a feral animal may pose is based on their impacts and level of invasiveness. The NAAMP identifies three species of Very High Impact, which are pest species of national

significance that have key threatening process under the *Environmental Protection Act 1986*. These are the:

- Feral cat (*Felis catus*);
- European rabbit (*Oryctolagus cuniculus*); and
- European fox (*Vulpes vulpes*).

Other species of High Impact are the:

- European honeybee (*Apis mellifera*); and
- One-spot livebearer (*Phalloceros caudimaculatus*)

Feral bees have an indirect impact on native fauna, by reducing the availability of nesting hollows and consequently reducing the ability of native fauna to raise healthy young. They can also invade occupied nests and kill any young that are being reared. Research is being done into the impact of feral bees on native bee populations, as this is relatively unclear, however they may also be impacting on pollen availability. While these are rated as only High Impact, this rating may need to be reviewed in the future as this is becoming a more common issue in bushlands. It can be exacerbated by feral bee occupancy of artificial nesting boxes if these are not monitored regularly.

## 2 RISK

Feral animals are a great risk to native flora and fauna. Reserves where there is rare or threatened flora or fauna should be prioritised for control. Feral animals, particularly rabbits, may also jeopardise restoration efforts and as such, should be controlled in areas that are to be revegetated.

Feral foxes and cats tend to move around readily and have large home ranges. They can easily enter City of Melville reserves from across local government boundaries. Thought should be given to *cross-boundary control programs* with neighbouring local governments to increase the effectiveness of control. However, they tend to be located in areas such as:

- Peri-urban and urban unused land
- Remnant bushland and small reserves
- River systems and creeks with some vegetative cover
- Golf courses
- Cemeteries
- Lakes and swamps
- Refuse disposal areas (rubbish tips)

(Source: Butcher, M. 2012, personal communication)

Feral Rabbits and bees can also move through the landscape, but to a lesser extent.

Feral animals have been targeted in the following reserves in the City of Melville based on high levels of activity:

| *Known Locations of Foxes, Cats, Rabbits* | |
|---|---|
| **Reserve Name** | **Total hectares** |
| Attadale Bushland Reserve | 1.84 |
| Blackwall Reach Reserve | 12.5 |
| Blue Gum Lake Reserve | 13.45 |
| Booragoon Lake Reserve | 13.28 |
| Bull Creek Reserve | 7.55 |
| Ken Hurst Park | 51.53 |
| Piney Lakes Reserve | 30.6 |
| Point Walter Bushland Reserve | 10 |

| | |
|---|---|
| Quenda Wetland | 2.4 |
| Wireless Hill Park | 38.5 |

| *Reserves known for Invertebrate Ferals ONLY (Bees)* | |
|---|---|
| **Reserve Name** | **Total hectares** |
| Attadale Bushland Reserve | 1.84 |
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| Booragoon Lake Reserve | 13.28 |
| Bull Creek Reserve | 7.55 |
| Ken Hurst Park | 51.53 |
| Piney Lakes Reserve | 30.6 |
| Point Walter Bushland Reserve | 10 |
| Quenda Wetland | 2.4 |
| Wireless Hill Park | 38.5 |
| Bateman Reserve | 4.17 |
| Harry Sandon Reserve | 4.2 |
| Peter Ellis Park | 2.56 |
| Philip Jane Park | 4.8 |
| Richard Lewis Reserve | 5.45 |
| Robert Weir Park | 2.7 |

## 3 THREAT PREVENTION, ELIMINATION, CONTAINMENT AND/OR MANAGEMENT TECHNIQUES

Feral animals, due to their invasiveness, are unlikely to ever be eliminated. Steps to manage the impact of feral animals include targeted surveys, control programs

### 3.1 SURVEYS

Surveys should be conducted for feral animal species based on the following frequencies:

- Frequently (Monthly targeted surveys)- Feral rabbits, foxes, cats and bees
- Opportunistically (observations by staff and reports from public)- all other species of concern

Targeted surveys should include physical sightings, dens, scats or other indicators to predict the presence of feral animals.

### 3.2 CONTROL PROGRAM

The control works are summarised in the following table:

| Strategy | Threat Abatement Plans | | |
|---|---|---|---|
| | **Feral Cats** (DEWHA, 2008b) | **European Red Foxes** (DEWHA, 2008c) | **Competition and Land Degradation by Rabbits** (DEWHA, 2008a) |
| Shooting | X | X | X |
| Trapping | ☐ | ☐ | ☐ |
| Fencing | X | X | ☐ |
| Baiting | X | ☐ | ☐ |
| Fumigants | X | ☐ | ☐ |
| Biological control | X | X | ☐ |
| Fertility control | X | X | X |
| Commercial harvesting | X | X | X |
| Bounties | X | X | X |
| Habitat management | ☐ | ☐ | ☐ |

☐ = Likely Cost-effective and Appropriate for City to Undertake
X = Unlikely to be Cost-effective and Appropriate for City to Undertake

### 3.2.1 European Rabbit (*Oryctolagus cuniculus*)

The European Rabbit is an introduced pest that has rapidly spread across all states of Australia. Its ability to breed rapidly and colonise a range of habitats has made it so successful that it is now the most common small mammal in Australia (DEWHA 2008a). They are most abundant on deep sandy soils, such as soils of the Swan Coastal Plain, which is preferred for warren construction. They are also most successful in intermediate rainfall areas where droughts and parasites are less common (Sharp and Saunders 2005a). Rabbits cause environmental degradation and compete with native species for food and shelter, making it a top management priority for conservation areas.

Rabbits display certain traits that make them highly invasive. They reach sexual maturity as early as four months of age, have a short gestation period of one month and have an average litter size of four to five offspring (SEWPaC 2011c). Rabbits breed all year round, as long as conditions are favourable, which enables up to nine litters to be born every year (DEWHA 2008a). Their warrens also enable them to be successful by providing shelter from climatic extremes and protecting them from predators.

The impacts of rabbits have been identified in DEWHA (2008a) and include competition, grazing, soil erosion and indirect impacts on predator populations. Rabbits have a tendency to overgraze areas, out-competing native fauna and hindering natural regeneration of plant communities. Rabbits also compete for habitat and shelter, reducing the habitats available for native fauna. Rabbits also have an impact through digging, which results in soil erosion and removal of vegetation, which compounds the erosion problem. Disturbed soil can also encourage weed colonisation. Indirect impacts include increasing the food supply of feral predators such as cats and foxes, which may then also prey on native fauna.

Control of feral rabbits should involve multiple control techniques that aim to reduce populations and their impacts. Prevention and eradication strategies are generally ineffective due to rabbits being so well established, so ongoing management is required to keep populations low (DEWHA 2008a). Methods available include biological control, warren fumigation, warren destruction, poison baiting, fencing, shooting and trapping.

#### *3.2.1.1 Biological Control*

Biological control, in the form of myxomatosis and calicivirus, has been an effective method for large scale control. However in urban areas it is not that suitable as viruses can also be spread to domestic pet rabbits, so there may be a lack of public support for the method (CSIRO 2011). It is also becoming increasingly less effective; rabbits are developing genetic resistance and the viruses are evolving into less virulent strains (DEWHA 2008a). However this option may be considered every few years, rather than every year, as a cheaper alternative to other methods such as warren fumigation.

#### *3.2.1.2 Warren Fumigation*

Fumigation is a humane way of destroying rabbits in areas that aren't suitable for baiting and other methods that may affect people and pets in urban areas. It is also an effective method

for local population control, as rabbits rarely move more than 200 meters from warrens (Sharp and Saunders 2005a). It can be carried out year round, and is particularly useful during the breeding season as it can humanely dispose of offspring as well, who do not stray far from the den like the adults (Fisher and Campion 2010). Four chemicals are available for use as a fumigant: chloropicrin, magnesium or aluminium phosphide and carbon monoxide.

Chloropicrin is the least humane chemical to use, as it causes sensory and respiratory irritation and distress for several hours before death; rabbits that escape warrens before a lethal exposure is administered can take weeks to die (Sharp and Saunders 2005a). Chloropicrin vapour can also drift into the air and affect people in neighbouring areas, with concentrations of 0.3ppm shown to cause eye and respiratory irritation (Fisher and Campion 2010).

Phosphine is considered more humane than chloropicrin due to a quicker death from the time of first symptoms. It can take several hours to reach toxic concentrations, due to reliance on passive diffusion from chemical tablets and the tendency for it to pool in low spots before dispersing; thus symptoms do not develop until higher concentrations are reached, and prolonged exposure causes rapid death (Gigliotti *et al.* 2009). Symptoms include reduced respiratory and central nervous system function. Problems with this chemical include the long lag time in reaching toxic concentrations, giving time for rabbits to escape, its high flammability and tendency to ignite, and highly variable concentrations in warrens due to reliance on passive diffusion (Fisher and Campion 2010).

Carbon monoxide (CO) is the most humane chemical to use, as it replaces oxygen attached to haemoglobin and causes rapid unconsciousness and then death without pain (DEWHA 2008a). CO is a lighter gas than the other chemicals, and this allows quicker dispersion through the warren and produces more consistent results (Gigliotti *et al.* 2009). Pure CO should be used as opposed to combusted car exhaust fumes, which can cause other symptoms due to the presence of nitrogen oxide, hydrocarbons and other contaminants, and it is also extremely hot (Gigliotti *et al.* 2009).

#### *3.2.1.3 Warren Destruction*

Warrens are a key factor in rabbit survival, as they are protected from the climate and predators, and it gives them a safe place to nest and breed (DEWHA 2008a). Warren destruction eliminates this protective place, done through explosives or ripping of the soil and causing warrens to collapse. Deep ripping is seen as a more humane method, as it minimizes the chance of rabbits becoming trapped and suffocating in tunnels that are no completely destroyed (DEWHA 2008a).

Warren ripping does not need to be conducted as regularly as other methods, if done thoroughly (Sharp and Saunders 2005a). It can also be used effectively to stop re-colonisation of rabbits that have been treated with other methods (DEWHA 2008a). Warren ripping may not be appropriate in areas of natural bushland that are of high conservation value because of the soil disturbance and destruction it can cause. The other issue with this method is that in areas of natural bushland, rabbits can also find refuge in shrubs and logs,

and removal of these may not be appropriate when they are used as habitat by native species (DEWHA 2008a). Thus destruction of warrens alone may not control rabbit populations, and would best be done along with other methods of control.

#### *3.2.1.4 Poison Baiting*

Poison baiting constitutes a large part of rabbit control. Sodium fluoroacetate (1080) is most commonly used as it is considered to be more humane than the alternative, pindone (Sharp and Saunders 2005a). 1080 is also found in some native plants of Western Australia and as such many native herbivores have evolved a tolerance for it, while feral introduced species like the rabbit have not (DEWHA 2008a). This can make it a problem in urban areas where domestic pets are also at risk of poisoning (Sharp and Saunders 2005a). Pindone does have an advantage over 1080 in urban areas because there is an antidote that can be administered to domestic animals as an injection or tablet if they are poisoned (Department of Agriculture and Food 2007). 1080 is the favoured baiting methods used in City of Melville control programs.

Poison baiting is a cheap method, and rapidly breaks down in the environment so minimises the time that native species and domestic pets are at risk from poisoning (DEWHA 2008a). It is also highly effective, with a mortality rate of approximately 90% (SEWPaC 2011c). Baiting should be carried out in late summer or autumn when less food alternatives are available and rainfall is low to minimise leaching of the chemicals into the soil (DEWHA 2008a). Baits for rabbits can include carrots, oats or bran pellets (DEWHA 2008a).

Due to the risks involved for domestic animals with the use of 1080, baiting should only be carried out in areas with low public use and access. The only reserve approved for baiting in the City of Melville currently is Ken Hurst Park.

#### *3.2.1.5 Fencing*

Fencing can exclude rabbits from areas and act as a barrier between nesting and feeding areas as is appropriate for areas of conservation value (DEWHA 2008a). Wire netting fences or electric fences are favoured for feral animal control (Long and Robley 2004). In order for fences to be effective, a 30cm piece of mesh (a foot apron) should be buried underneath the fence to prevent rabbits digging (Moseby and Read 2006). Fences should also be higher than 0.5m, as rabbits can jump to this height (DEWHA 2008a). Gates are weak points in fences, and thus should be constructed to the same specifications as the rest of the fence; gates used for public access should also include a spring-hinge so that gates automatically close without relying on people to close it (Long and Robley 2004).

Fencing is expensive to erect and maintain; therefore it should only be implemented in relatively small areas, such as urban reserves, otherwise it may not be cost effective (Moseby and Read 2006). Fencing can be more cost effective however in areas trying to control other feral species, as it is also an effective control method for foxes and cats. Fencing can interrupt movement of native species, so thought about fence placement and the ecology of high priority native species may minimise these effects (DEWHA 2008a).

#### *3.2.1.6 Shooting*

Shooting is a humane method of destruction; however, rabbits are small and difficult targets, particularly in dense vegetation (Sharp and Saunders 2005a). It can be effectively used to remove survivors after other control treatments have been used, such as warren fumigation (DEWHA 2008a).

#### *3.2.1.7 Trapping*

Trapping is not commonly used for rabbit control, as it cannot produce large reductions in populations like other methods (DEWHA 2008a). It is also labour intensive and has the potential to cause injury to both target and non-target species (Sharp and Saunders 2005a). However, it may be used to complement other control methods. Cage traps are the most humane, as the animal is generally caught unharmed, however leg hold traps can also be used; if leg hold traps are used, the jaws should be padded with rubber to reduce injury and discomfort for the rabbit (Sharp and Saunders, 2005a). Traps should be checked regularly, as native animals can also be caught in them and must be released as soon as possible (DEWHA 2008a).

### 3.2.2 European Red Fox (*Vulpes vulpes*)

Foxes pose a significant threat to the biodiversity of Australia. Originally introduced for hunting in the 1800's, they are now wide spread throughout the south and middle regions of the mainland as well as in Tasmania (DEWHA 2008b). They can inhabit a wide variety of habitats with few specific requirements. Habitat can include urban areas where they can reach high densities of up to 12 adults per km² (Sharp and Saunders 2005b). Undisturbed sites with some degree of cover and that do not have high human activity are prime urban locations for foxes (Saunders *et al.* 1995).

Foxes are able to invade very effectively due to a lack of natural predators and disease to control population numbers. Dingoes are the only real predator of the fox, and they do not generally occur in urban areas where fox populations are having their greatest impacts (Sharp and Saunders 2005b). Foxes are able to reproduce quickly and young have a high survival rate. They also have a very generalist diet, feeding on mammals, reptiles, birds and amphibians, as well as insects and fruit, and are known to be scavengers (SEWPaC 2011d). Foxes are strongly correlated with rabbit populations, as rabbits make up a large portion of their diet (Saunders *et al.* 1995).

Foxes have an impact on the native fauna through predation. Small mammals weighing between 35 and 5500grams are most at risk, as well as ground-nesting birds (DEWHA 2008b). Two City of Melville mammals, the Western Brush Wallaby and the Southern Brown Bandicoot, are greatly affected by fox predation (DEC 2002). The Western Brush Wallaby is listed as being at great risk of local or regional extinction in City of Melville.

Fox control in urban areas can be difficult due to the most effective treatments such as baiting not being appropriate for use close to residents and domestic animals (Lamond 2009). Complete eradication is not achievable in the short term, and thus ongoing control is needed. Rabbits are one of the common food sources for foxes, so control of feral rabbits can also aid in management of the fox. There is also concern that reducing rabbit populations may prompt foxes to increase their predation of native fauna; therefore control of both pests should be simultaneous (NSW Office of Environment and Heritage 1999).

#### *3.2.2.1 Poison Baiting*

Sodium fluoroacetate (1080) is commonly used as a control method for foxes in Western Australia, because the local wildlife has evolved a higher tolerance to the chemical which originates from Western Australian plants. It is highly effective for fox control, and is a more humane chemical to use that the alternative, strychnine (Sharp and Saunders 2005b).

Baiting can pose a risk to both native wildlife and domestic pets in urban areas; however, this risk can be reduced if baits are buried at least 10cm below the surface, as foxes can still smell and dig up baits, while native species generally do not dig to significant depths (Department of Agriculture and Food 2003; NSW Office of Environment and Heritage 2011). Buried baits were found to have a lower uptake than surface baits in fox trials, but the decrease in non-target species uptake was much greater, making burying worthwhile

(Moseby *et al.* 2011). Buried baits can still pose a problem for domestic dogs and cats however, as they may still smell and dig for baits (SEWPaC 2011d).

Due to the risks involved for domestic animals with the use of 1080, baiting should only be carried out in areas with low public use and access. The only reserve approved for baiting in the City of Melville currently is Ken Hurst Park.

If baiting is to be used, products to conceal the bait may include injected eggs or egg products and dried or fresh meat baits (DEWHA 2008b). Baiting should be carried out in late winter and spring, as this coincides with the major reproductive season and thus food demand is high (Department of Agriculture 2003). The commonly used density of baiting in Western Australia is 5 baits/km² and baits should be placed at least 200m away from another bait to minimise the chance of multiple baits being taken by the same fox (Thompson *et al.* 2000; Department of Agriculture 2003).

Foxes have a tendency to become bait-shy, but this can be overcome by replacing baits regularly so that a lethal dose is administered to every fox (NSW Office of Environment and Heritage 2011). If foxes ingest a sub-lethal dose that causes sickness but not death, they are less likely to consume baits a second time (NSW Office of Environment and Heritage 2011).

#### *3.2.2.2 Den Fumigation*

Fumigation of fox dens appears to be the most humane method of destruction, with carbon monoxide used to bring about unconsciousness and death quickly (Sharp and Saunders 2005b). This method is the same as that used for the European rabbit, and can be conducted at the same time to minimise costs and labour. Den fumigation should be undertaken during the day when foxes are most likely to be residing in the dens (SEWPaC 2011d).

#### *3.2.2.3 Trapping*

Trapping is a useful control method in urban areas where poison baiting and other methods are unsuitable. Although traps are generally not target specific, any non-target species caught in them can be released (Sharp and Saunders 2005b). Cage traps are preferable over leg hold traps, as they require less training to use and generally do not cause injuries as the whole animal is enclosed (Sharp and Saunders 2005b). Padded-jaw traps are the most humane of the leg hold traps, but they still have the potential to cause injury as the animal is more likely to struggle if just its foot is caught (Sharp and Saunders 2005c).

An effective technique described by Butcher (2007) prior to setting cage traps is to “pre-feed” in the weeks before trapping; this involves placing baits at the entrance of the trap and gradually moving it closer until it is inside the trap before setting the trap to close. This allows foxes time to get used to taking bait from in and around the trap before it traps them. Suitable bait for traps includes chicken, rabbit, lamb or kangaroo meat (Butcher 2007).

Trapping should be carried out overnight when foxes are active, and unset during the day when non-target species are more likely to be caught than foxes (Butcher 2007).Traps should be placed in an area not exposed to extreme weather conditions (e.g. direct sunshine,

wind and rain), and should be checked daily to ensure any animals caught in the trap do not suffer thirst, starvation, shock or injury (Sharp and Saunders 2005c). If non-target species are caught, they should be released quickly, while foxes caught in traps should be disposed of humanely on site if possible, or as soon as appropriate (Butcher 2007).

#### *3.2.2.4 Shooting*

Shooting is an effective method of localised control, especially in conjunction with other control methods, and if done correctly, it is one of the most humane (Sharp and Saunders 2005d). Shooting should aim to dispose of the fox in one shot, not to injure or cause prolonged suffering (Sharp and Saunders 2005d). Shooting is best conducted at night, when foxes are active, with a spotlight, and before the main breeding season (August and September) to maximise effectiveness, as female foxes will reside in dens with their young in late spring and may be more difficult to eradicate (NSW Office of Environment and Heritage 2011; SEWPaC 2011d).

Shooting may not be suitable in areas where vegetation is dense and there are many places for foxes to hide, or in areas where people are present, unless they are notified and excluded at the time of control (Sharp and Saunders 2005d).

#### *3.2.2.5 Fencing*

Fencing can be used effectively in conjunction with other control methods when fox movements need to be limited. Foxes can jump to approximately 1.8m, so fences should be higher than this, ensuring there are no solid parts of the fence for the fox to brace on (Long and Robley 2004). However fencing may not be appropriate if there are other native wildlife around that may be impeded, particularly on small reserves that are not large enough to sustain a population.

### 3.2.3 Feral Cat (*Felis catus*)

Cats were brought to Australia with the English settlers and intentionally released to control rats, mice and rabbits (SEWPaC 2011e). They have since become a nationally recognised pest, spreading to most habitats across mainland Australia and Tasmania, with the exception of rainforests areas (DEWHA 2008c).

Feral cats are particularly invasive because they have few natural predators. The predators they do have, dingoes and eagles, are not common in urban areas, so feral cat populations are able to increase without limitation (SEWPaC 2011e). Cats are able to reproduce from one year of age, and although there is a low rate of kitten survivability, they can breed all year round and build up their population (SEWPaC 2011e). They can also survive with very little water, as they obtain most of their water needs from their prey (Quinn *et al.* 2010).

Feral cats have a generalist diet and prey upon many of the native species that are present in the City of Melville. Species most at risk from predation are mammals less than 220g and birds less than 200g, although prey up to 3kg in weight can be consumed (Quinn *et al.* 2010). Feral cats have been identified as a threat to 35 species of bird, 36 species of mammals, 7 reptiles and 3 amphibian species, all of which are listed on the threatened species list of the EPBC Act (DEWHA 2008c). Cats can also spread infectious diseases such as toxoplasmosis and sarcosporidiosis to native animals and humans (SEWPaC 2011e).

Feral cats are not easily controlled, as they are highly mobile, avoid human contact and are naturally wary (DEWHA 2008c). However, because they are usually found at low densities, eradication from an area is possible. The control methods employed vary depending on the type of cat, whether feral or domesticated. As both have impacts on wildlife, some level of management is required for all cats (DEWHA 2008c). Domesticated cats require methods targeted towards responsible ownership rather than eradication, while feral or stray cat populations are more strictly controlled. Feral cats, defined in SEWPaC (2011e) as “cats that survive and reproduce in the wild without human intervention or assistance”, should be the focus of control.

#### *3.2.3.1 Fencing*

Fencing can be used with other methods to successfully manage feral cat populations in smaller areas. Cats can jump to 1.8m high, so fences must be higher than this with no solid parts for cats to use as a leverage point (Long and Robley 2004; DEWHA 2008c). Due to the high cost of fencing, it is only suitable for small areas of high conservation value; fencing serving a dual purpose to control multiple feral species may make this method more cost effective (DEWHA 2008c).

#### *3.2.3.2 Trapping*

Trapping is a commonly used method of local control for feral cats, and when combined with fencing, can lead to eradication from an area. Leg hold traps are the most effective, as feral cats are often trap shy and not easily lured into cage traps (SEWPaC 2011e). Soft catch

padded jaw traps are the most humane of leg hold traps, but still has the potential to cause injuries to the restrained leg (Sharp and Saunders 2005e).

Trapping should be conducted in a similar manner to fox trapping, at night, with the traps checked daily to prevent prolonged suffering of captured animals (Sharp and Saunders 2005e). Trapping may take time, therefore increasing costs, as feral cats are usually in low densities and are not easily attracted to baits and traps. Lures are often more effective than baits to lead cats to traps, as their hunting skills rely on audio and visual stimuli and less on smell (DEWHA 2008c). Lures may include flagging tape, lights and any moving object, as well as recorded sounds of a cat (Molsher 2001; Moseby *et al.* 2011). Molsher's study (2001) found that capture efficiency for cats was highest in autumn and early winter.

#### *3.2.3.3 Shooting*

Shooting of feral cats may be difficult as they avoid human contact and are in low densities with large territories. However it is a humane method that can be used opportunistically to complement other control methods (DEWHA 2008c).

#### *3.2.3.4 Poison Baiting*

Poison baiting is not readily used as a control method for feral cats, as cats do not take baits easily (DEWHA 2008c). This is likely due to a an aversion to unfamiliar foods, a preference for live prey, which is softer and more palatable than dried meat, and the fact that cats only eat when hungry, not opportunistically like foxes do (Moseby *et al.* 2011). Baits known to be taken by cats include kangaroo, chicken, fish or rabbit baits, or specially formulated baits such as 'Eradicat' used by the DEC in Western Australia (Moseby *et al.* 2011). Rabbit baits are particularly useful as rabbits comprise a large portion of their diet (Moseby *et al.* 2011).

Baiting is most effective in the drier seasons as damp weather causes the baits to spoil quickly; this is the reason behind DEC trialing cat baiting during summer to autumn (DEC 2011). This also coincides with periods of food shortage and a lack of young prey (Quinn *et al.* 2010). 1080 is the toxin commonly used, due to native animal tolerance and it causing the most humane death (SEWPaC 2011e). Baiting density is recommended at 50 baits per km² for the most effective control (Quinn *et al.* 2010). Surface baits generally have higher visitation by feral cats, as they do not seem to smell and dig up buried baits (Moseby *et al.* 2011). Using surface baits increases the risk to non-target species, and therefore baiting for feral cats may not be suitable in urban or conservation areas that contain domestic and native animals.

#### *3.2.3.5 Fumigation*

Feral cats often utilise rabbit warrens for shelter, making them vulnerable to fumigation (DEWHA 2008c). Fumigation using carbon monoxide can be carried out simultaneously to fox and rabbit fumigation, minimising costs and time. As with foxes, fumigation should be done during the day, as cats are a nocturnal species (SEWPaC 2011e).

#### *3.2.3.6 Habitat Destruction*

Feral cats use a wide variety of habitats and have a large territory, reducing the effectiveness of habitat destruction. It is also not suitable to carry out in areas of conservation value where native fauna also rely on such habitat. Dense vegetation may also help to protect native wildlife from feral cat predation, so removing it may be increasing risks to wildlife (DEWHA 2008c).

### 3.2.4 European Honey Bee (*Apis mellifera)*

The European Honey Bee was brought to Australia in the 1800s for honey farming, and escaped from managed hives to form their own feral colonies (Oldroyd 1998). They are now unevenly distributed throughout the mainland and Tasmania, with the highest densities occurring in woodland or coastal areas near a water body (Paton 1996). The European Honey Bee is able in invade such a wide range of habitats due to its generalist diet, visiting flowers from up to 200 Australian plant genera (Paton 1996).

Honey Bees are recognised as a high impact introduced species under the City's NAAMP due to their increasing threat to hollow-dependent fauna. Many Australian marsupials and birds are dependent on tree hollows for reproduction and shelter, such as the endangered Carnaby's Black Cockatoo; thus these animals are in direct competition with feral bees that also use nesting hollows (Cale 2003). Nest hollows take many years to develop, and are already in short supply due to land clearing and logging, particularly in urban areas (Whitford 2002). Once occupied, hollows can be used by Bees for between 20 and 50 years (NSW National Parks and Wildlife Service 2002). Other impacts of feral bees include competition for floral resources, inadequate pollination of native flora and undesirable pollination of exotic flora, as well as presenting a risk to the public because of their swarming and aggressive behaviour (Paton 1996; Oldroyd 1998; Paini 2004). Feral bees may also have a positive outcome by increasing pollination of some plants with limited native pollinators, although the negative outcomes likely outweigh the positives (Paton 1996).

Bee control must be carried out opportunistically when feral hives are built in the area. Care must be taken with control methods, as there is no way to distinguish between feral and managed bees which may be using the same area (Paton 1996). This may limit the use of bee control methods in areas where managed hives are present. The Local Law relating to the Keeping of Bees under the Local Government Act 1960 states that written permission is required from the City to keep bees and there is a limit of two hives at any residential property. There are currently no registered bee keepers within the City of Melville. Any bee hives being kept illegally should be reported to the Environmental Officer and/or Environmental Health department for investigation.

#### *3.2.4.1 Direct Application of Insecticide*

Control of feral bees can be done by locating the hives and directly destroying them using insecticide (Oldroyd 1998). Pyrethrum is generally used because it is a non-persistent, naturally occurring chemical that has a low toxicity to mammals (Johnson *et al.* 2006). A variation of this method is to attract swarms to nesting boxes using pheromone lures, and then also applying insecticide to remove them. Pheromones are only effective over a short range (approximately 100m), so nest boxes need to be located in a grid system close to existing hives for this method to be effective (Oldroyd 1998).

#### *3.2.4.2 Bait Stations*

Another method of delivering poison to a colony being trailed by DEC uses baiting stations. Stations are set up close to an existing hive, and attract bees using a sucrose solution. Once

many bees are visiting the station regularly, a poison is added to the solution to be taken back to the hive by the bees, where the chemical can then destroy the entire hive (Oldroyd 1998). Foliage around the bait stations can also be sprayed with honey or sugar solution to increase the attractiveness of bait stations to bees (Taylor and Goodwin 2001). There is potential for non-target species to be affected by baiting, such as other insects or birds, but this can be minimised by the types of containers used and the position of baiting stations: useful containers include plastic bottles or containers with small access holes (Taylor and Goodwin 2001). Bees generally forage within 2km of their hive, so stations should be placed within this range and the closer the better (Paton 1996). Baiting is thus only effective if the location of the hive is known (Oldroyd 1998).

#### *3.2.4.3 Bee Protection in Nest Boxes*

Artificial nest boxes installed by the City of Melville as nesting habitat for native wildlife also seem to attract feral bees to form hives. In particular parrot-sized nest boxes are most at risk from invasion by feral bees. Bees should be treated using insecticide as per 3.2.4.1, and the honeycomb destroyed and removed from the inside of the nest box. This enables the nest boxes to be made available for their purpose, as many animals will be deterred if there are remains of a feral bee hive. For natural tree hollows found with feral bee hives, the same process will apply as for nest boxes. Nest boxes should be monitored annually for invasion by feral bees.

### 3.2.5 Other Species of Concern

Other species of concern should be controlled if and when observations (either from staff or members of the public) are made and if they are deemed to be of high risk to the environment.

#### *3.2.5.1 Rainbow Lorikeets*

Rainbow lorikeets are now a declared pest in Western Australia, having established a feral population of up to 20,000 birds in the Perth metropolitan area alone (Chapman and Massam 2007). Rainbow lorikeets compete with native birds for resources and aggressively defend their feeding and nesting areas, often excluding other birds. A risk assessment carried out by the Department of Agriculture and Food suggested that they are a threat to Western Australia and are “highly likely to establish further, more widespread free-living populations” (Chapman and Massam 2007).

#### *3.2.5.2 European Wasp*

The European Wasp is yet to establish a feral population in Western Australia; however isolated nests have been found (Davis 2004). They are prolific in the eastern states, and if able to establish, will likely have the same impacts; these include predation of native insects and competition with native fauna, such as birds, for food resources (Davis 2004).

#### *3.2.5.3 Cane Toad*

The Cane Toad is particularly invasive and has expanded its distribution to the Kimberley in Northern Western Australia. If it is able to establish a Western Australian feral population in the future, its impacts may include poisoning and predation of native wildlife, competition with native frogs for food and breeding sites and spreading of diseases to native frogs (Gray *et al.* 2009).

#### *3.2.5.4 Sulphur-crested Cockatoo*

Sulphur-crested Cockatoos do not have very large populations in the Perth metropolitan area but they are still a declared pest in WA. Their impacts include competition for food and nesting hollows with endangered species such as the Western Long-billed Corella and White-tailed and Red-tailed Black Cockatoos (Massam 2001).

#### *3.2.5.5 Little Corella*

The Little Corella (*Cacatua sanguinea*) is a small white cockatoo native to the northern part of Western Australia. It has expanded its distribution south to the Wheatbelt and Perth metropolitan area, where it is recognised as a pest of agriculture (DEC 2009). The Little Corella also has impacts on native bird species (particularly the endemic Cockatoo species) through competition for food resources and nesting hollows, and tend to aggregate in large flocks that may displace native birds (DEC 2009).

#### *3.2.5.6 Pacific Black Rat*

Rats are common throughout the urban area.

## 4 RESOURCE OPTIMISATION

Reserves are divided into four categories based on their conservation value in the NAAMP, and Category 1 reserves with feral animals should be controlled first.

Given limited resources, regular targeted surveying and control programs should be implemented for:

- European Fox
- European Rabbit
- Feral Cat
- European Honey Bee

All other species of concern should be targeted opportunistically following observations by staff and reports from public. If future programs are implemented in surrounding local governments or by State Government, these guidelines should be reviewed in line with best practice.

## 5 KEY PERFORMANCE INDICATORS

The key performance indicators to be used for evaluating the success of Feral Animal management in the field include:

- Scheduled surveys for feral animals to be carried out within one month of targeted time; and
- A control program is to be implemented within one week of reported or observed feral animals.

## 6 Conclusion

Feral animals are a threat to the biodiversity assets within City of Melville, and thus their populations should be managed and controlled. Many commonly-used control methods are unsuitable to be applied in the City of Melville, due to the close proximity of reserves to people and domestic animals. The most appropriate methods for the City of Melville were found to be fencing, trapping and fumigation for rabbits, foxes and cats, and direct application of insecticide for feral honeybees. These methods were found to be most successful at management and eradication when combined, rather than relying on one sole method. Control methods that are similar between species (such as rabbit and fox control) should also be used simultaneously to minimize the costs, labour and time associated with control. The focus of Melville's control will be primarily on the high impacting species rabbits, foxes, feral cats and honeybees; however there are other species that are impacting native species or may have impacts in the future, and feral animal controls may then need to be revised. Given the mobility of many of these feral animals, complete eradication may not be possible, so ongoing management and eradication where observed is the goal, however it is likely that this will be an ongoing management issue for the City of Melville.

# References


Butcher, M. (2007) *Fox trapping using cage traps.* URL: http://www.amrshire.wa.gov.au/library/file/4Environment/Landcare/FoxTrappingFlyer.pdf (accessed 30/9/11)

Cale, B. (2003) *Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris) *Recovery Plan 2002-2012.* URL: www.dec.wa.gov.au (accessed 13/10/11)

Chapman, T., and Massam, M. (2007) *Pest Note: Rainbow lorikeet*. URL: http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/vp/bird/pn2006_rainbow_mmassam.pdf (accessed 13/10/11)

City of Melville (2011) *Natural Areas Asset Management Plan 2011*. City of Melville, Perth.

CSIRO (2011) *Fact Sheet: Myxomatosis and rabbits in Australia Today*. URL: http://www.csiro.au/resources/Myxomatosis.html (accessed 25/8/11)

Davis, P. (2004) *Farmnote: European Wasps*. URL: http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/ins/hp/euwasp.pdf (accessed 13/10/11)

DEC(2002) *Fauna species profiles*. URL: http://www.dec.wa.gov.au/content/view/3432/1999/1/2/ (accessed 1/9/11)

DEC (2009) *Fauna Notes: No. 20 Little Corella*. URL: http://www.dec.wa.gov.au/component/option,com_docman/Itemid,708/task,doc_download/gid,1136/ (accessed 21/10/11)

DEC (2011) *Feral cats taking the bait*. URL: http://www.dec.wa.gov.au/content/view/6567/1560/ (accessed 7/10/11)

Department of Agriculture and Food (2003) *Farmnote: Fox Baiting.* URL: http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/vp/ddf/fn061_2003.pdf (accessed 29/9/11)

DEWHA (2008a) *Background Document for the Threat Abatement Plan for Competition and Land Degradation by Rabbits*. URL: http://www.environment.gov.au/biodiversity/threatened/publications/tap/pubs/tap-rabbit-background.pdf (accessed 18/8/11)

DEWHA (2008b) *Background Document for the Threat Abatement Plan for Predation by the European red fox.* URL: http://www.environment.gov.au/biodiversity/threatened/publications/tap/foxes08.html (accessed 18/8/11)

DEWHA (2008c) *Background Document for the Threat Abatement Plan for Predation by feral cats.* URL: http://www.environment.gov.au/biodiversity/threatened/publications/tap/cats08.html (accessed 18/8/11)

Fisher, P., and Campion, M. (2010) *How humane are our pest control tools?* URL: http://www.biosecurity.govt.nz/files/pests/salt-freshwater/102010-how-humane-are-our-pest-control-tools.pdf (accessed 2/9/11)

Gigliotti, F., Marks, C., and Busana, F. (2009) Performance and humaneness of chloropicrin, phosphine and carbon monoxide as rabbit-warren fumigants. *Wildlife Research* **36**(4): 333-341

Gray, G., Massam, M., Pearson, D., and Kruger, E. (2009) *Pestnote: Cane Toad.* URL: http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/vp/toad/canetoadpestnote2009.pdf. (accessed 14/10/11)

Hopper, S., and Gioia, P. (2004) The Southwest Australian Floristic Region: Evolution and Conservation of a global hotspot of biodiversity. *Annual Review of ecology, evolution, and systematics* **35**(1): 623-650

Johnson, R., Wen, Z., Schuler, M., Berenbaum, M. (2006) Mediation of Pyrethroid Insecticide Toxicity to Honey Bees (Hymenoptera: Apidae) by Cytochrome P450 Monooxygenases. *Journal of Economic Entomology* **99**(4): 1046-1050

Lamond, S. (2009) *Local Government Guidelines for Bushland Management in the Perth and Coastal South-West Natural Resource Management Regions Western Australia*. URL: http://pbp.walga.asn.au/publications/bushland_management/1_title_page_acknowledgements.pdf (accessed 25/8/11)

Long, K., and Robley, A. (2004) *Cost Effective Feral Animal Exclusion Fencing for Areas of High Conservation Value in Australia*. URL: http://www.environment.gov.au/biodiversity/invasive/publications/pubs/fencing.pdf (accessed 9/2/11)

Lowe, T., and Twigg, L. (2007) *Pestnote: Rabbit control in urban and semi-urban areas.* URL: http://www.agric.wa.gov.au/PC_90009.html (accessed 14/10/11)

Massam, M. (2001) *Farmnote: Sulphur-crested Cockatoo.* URL: www.agric.wa.gov.au/content/pw/vp/bird/F08601.pdf (accessed 14/10/11)

Molsher, R. (2001) Trapping and demographics of feral cats (*Felis catus)* in central New South Wales. *Wildlife Research* **28**(6): 631-636

Moseby, K., and Read, J. (2006) The efficacy of feral cat, fox and rabbit exclusion fence designs for threatened species protection. *Biological Conservation* **127**(4): 429-437

Moseby, K., Read, J., Galbraith, B., Munroe, N., Newporte, J., and Hill, B. (2011) The use of poison baits to control feral cats and red foxes in arid South Australia II. Bait type, placement, lures and non-target uptake. *Wildlife Research* **38**(4): 350-358

NSW National Parks and Wildlife Service (2002) *Competition from Feral Honeybees as a Key Threatening Process – an overview*. URL: http://www.environment.nsw.gov.au/resources/pestsweeds/feralHoneybeesFactsheet.pdf (accessed 23/9/11)

NSW Office of Environment and Heritage (1999) *Voluntary conservation on Public and Private land: Fox Control in Wildlife Habitat* URL: http://www.environment.nsw.gov.au/resources/pestsweeds/factsheet4foxcontrol.pdf (accessed 29/9/11)

NSW Office of Environment and Heritage (2011) *New South Wales best practice guidelines for fox control for the conservation of native fauna*. URL: http://www.environment.nsw.gov.au/pestsweeds/FoxControlBpg.htm (accessed 29/9/11)

Oldroyd, B (1998) Controlling feral honey bee, *Apis mellifera* L. (Hymenoptera: Apidae), populations in Australia: Methodologies and costs. *Australian Journal of Entomology* **38**(2): 97-100

Paini, D. (2004) Impact of the introduced honey bee (*Apis mellifera*) (Hymenoptera: Apidae) on native bees: A review. *Austral Ecology* **29**(4): 399-407

Paton, D. (1996) *Overview of Feral and Managed Honeybees in Australia: Distribution, Abundance, Extent of interactions with native biota, evidence of impacts and future research.* URL: http://www.environment.gov.au/biodiversity/invasive/publications/bees/index.html (accessed 18/8/11)

Quinn, J., Robley, A., Johnston, M., and Algar, D. (2010) Chapter 13 "Feral Cats: monitoring and control" In Jambrecina, M. (ed) *Kakadu National Park Landscape Symposia Series 2007–2009*. Symposium 5: Feral animal management, 3–4 December 2008. URL: http://www.environment.gov.au/ssd/publications/ir/568.html (accessed 22/9/11)

SEWPaC (2011a) *Invasive Species*. URL: http://www.environment.gov.au/biodiversity/invasive/index.html (accessed 14/10/11).

SEWPaC (2011b) *Feral Animals in Australia*. URL: http://www.environment.gov.au/biodiversity/invasive/ferals/index.html (accessed 14/10/11)

SEWPaC (2011c) *Feral European Rabbit (*Oryctolagus cuniculus*)*. URL: http://www.environment.gov.au/biodiversity/invasive/publications/pubs/rabbit.pdf (accessed 18/8/11)

SEWPaC (2011d) *European Red Fox* (Vulpes vulpes). URL: http://www.environment.gov.au/biodiversity/invasive/publications/european-red-fox.html (accessed 18/8/11)

SEWPaC (2011e) *The Feral Cat (*Felis catus). URL: http://www.environment.gov.au/biodiversity/invasive/publications/cat-factsheet.html (accessed 22/9/11)

Sharp, T., and Saunders, G. (2005a) *Model Code of Practice for the Humane Control of Rabbits*. URL: http://www.environment.gov.au/biodiversity/invasive/publications/pubs/cop-rabbits.pdf (accessed 18/8/11)

Sharp, T., and Saunders, G. (2005b) *Model Code of Practice for the Humane Control of Foxes*. URL: http://www.environment.gov.au/biodiversity/invasive/publications/pubs/cop-foxes.pdf (accessed 25/8/11)

Sharp, T., and Saunders, G. (2005c) *FOX005: Trapping of Foxes using padded-jaw traps*. URL: http://www.environment.gov.au/biodiversity/invasive/publications/pubs/fox005-trapping-foxes-padded-jaw-traps.pdf (accessed 30/9/11)

Sharp, T., and Saunders, G. (2005d) *FOX003: Ground Shooting of Foxes.* URL: http://www.environment.gov.au/biodiversity/invasive/publications/pubs/fox003-ground-shooting-foxes.pdf (accessed 29/9/11)

Sharp, T., and Saunders, G. (2005e) *Model Code of Practice for the Humane Control of Feral cats*. URL: http://www.environment.gov.au/biodiversity/invasive/publications/pubs/cop-feral-cats.pdf (accessed 25/8/11)

Taylor, M., and Goodwin, R. (2001) *Destruction of managed and feral honey bee (*Apis mellifera*) colonies*. URL: http://hawaii.gov/hdoa/pi/pifiles/pifiles/Destruction%20of%20feral%20colonies-Taylor%20Goodwin.pdf (accessed 13/10/11)

Thompson, P., Marlow, N., Rose, K., and Kok, N. (2000) The effectiveness of a large-scale baiting campaign and an evaluation of a buffer zone strategy for fox control. *Wildlife Research* **27**(5): 465-472

Western Australian Museum (2010) *Feral Bees*. URL: http://www.museum.wa.gov.au/explore/online-exhibitions/cockatoo-care/feral-bees (accessed 13/10/11)

Whitford, K. (2002) Hollows in Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) trees: I. Hollow sizes, tree attributes and ages. *Forest Ecology and Management* **160**(1-3): 201-214