

Action Statement

Flora and Fauna Guarantee Act 1988

No. 44 (revised in 2002)

Predation of native wildlife by the introduced Red Fox *Vulpes vulpes*

Description and distribution

The Red Fox *Vulpes vulpes* (hereafter referred to as the Fox) was originally introduced to Victoria (and thus Australia) from England in the 1870s. It spread rapidly and had reached Kalgoorlie in Western Australia by 1917 (Rolls 1969). This introduced predator now inhabits most of Australia, except tropical areas of the far north (above 15°S), although its presence in the northern part of its range depends on favourable rainfall (Coman 1995). It is abundant in the southern part of its range but is basically absent from Tasmania, to which State it had not, until recently (2000-01), been introduced. It is now believed to be present in some small areas of Tasmania. It occurs throughout Victoria except for some large offshore islands.



Red Fox *Vulpes vulpes*
(Illustration by John Las Gourgues)

Habitat

In Victoria, the Fox inhabits all terrestrial habitats from inner urban areas (Marks & Bloomfield 1999) to alpine heathlands, rainforest and the Mallee (NRE 2002). It is usually nocturnal and shelters during the day in places that afford good protection, such as thick riparian vegetation and infestations of blackberries *Rubus* spp. agg. In urban environments, Foxes shelter in exotic weeds and a variety of other habitats, including under buildings. Dens in urban areas are constructed beneath buildings and in earth banks (Marks & Bloomfield *in press*).



Distribution in Victoria
(from *Flora Information System*, NRE 2002)

Life history and ecology

Home ranges vary with habitat type and are a result of food availability, terrain and habitat complexity. In coastal forest and adjacent habitats, exclusive adult home ranges are 1.2-5.2 km² (Phillips & Catling 1991), while in central Victoria, in pasture/woodland habitat, home ranges range between 5 and 7 km² (Coman *et al.* 1991). Density is higher in summer than in winter and ranges from approximately one Fox per km² in arid areas to 3.9 per km² in central Victoria (Coman *et al.* 1991) and up to 16 per km² in some urban habitats (Marks & Bloomfield 1999).

Natal dens, where cubs are born and reared, are usually extensive burrows dug by the breeding pair. Alternatively, existing Rabbit (*Oryctolagus cuniculus*) and Common Wombat (*Vombatus ursinus*) burrows, or hollow logs may be used. The same natal dens are often used in consecutive breeding seasons. The Fox breeds only once a year, mating during winter. Births are not tightly synchronised and some variation, up to weeks in some instances, can be expected across Victoria. Between three and five cubs are born, but the average post-weaning litter size is approximately three cubs per natal den (Coman *et al.* 1991).

Apart from the Dingo (*Canis lupus dingo*) and wild Dog (*Canis lupus familiaris*), the Fox is the largest terrestrial mammalian predator (4.5-9 kg) on the Australian mainland. It is an opportunistic feeder and eats mammals, reptiles, birds, amphibians, insects, fruit and other vegetable matter. During winter, small mammals (especially Rabbits) and carrion are favoured. In agricultural areas, Foxes consume fewer native species than in dense forest, where native species form the major dietary component (Coman 1973). Over 50 native species have been recorded in the diet of the Fox, making it a major predator of native wildlife. The introduction of RHD, and the consequent reduction in numbers in the rabbit population, especially in arid and semi-arid districts, may increase predation on native wildlife.

Legal status

Predation by the European Red Fox is listed as a Key Threatening Process in Schedule 3 of the Commonwealth **Environment Protection and Biodiversity Conservation Act 1999**; a Threat Abatement Plan has been published (Environment Australia 1999).

Listed as a Potentially Threatening Process under Schedule 3 of the Victorian **Flora and Fauna Guarantee Act 1988**.

The Red Fox is proclaimed an Established Pest Animal under the Victorian **Catchment and Land Protection Act 1994** and must be controlled in

parcs gazetted under the Victorian **National Parks Act 1975**.

Threats posed by Red Fox

Because Australian fauna did not co-evolve with the Fox, susceptible prey species have few adaptive strategies to avoid predation. The impact of the Fox has been exacerbated by habitat fragmentation and modification since European settlement. The Fox was probably a direct or contributing factor in the decline and/or extinction of many species, and was a major factor in the extinction of six mammal species in the Victorian Mallee – Western Barred Bandicoot *Perameles bougainville*; Pig-footed Bandicoot *Chaeropus ecaudatus*; Eastern Hare-wallaby *Lagorchestes leporides*; Bridled Nail-tail Wallaby *Onychogalea fraenata*; Brush-tailed Bettong *Bettongia penicillata*; and Desert Mouse *Pseudomys desertor* (Bennett *et al.* 1989).

The range and distribution of other extant native species may have been reduced to refugia as a result of Fox predation. Populations using such refugia are more at risk of local extinction due to susceptibility to environmental stresses (fire, drought, floods and disease). The often-fragmented nature of isolated refugia reduces gene flow in the population, increasing the chances of genetic bottlenecks and perhaps affecting the overall viability of the population.

Nationally, 34 species of endangered vertebrates (27 mammals, seven birds, five reptiles and one amphibian) that are listed on Schedule 1 of the **Environment Protection and Biodiversity Conservation Act 1999** are considered as at known or perceived risk from predation by Foxes (Threat Abatement Plan p. 3; Biodiversity Group, Environment Australia 1999). In Victoria, Bioregional Network analyses have identified 91 species of vertebrates for which predation by Foxes is a known or potential threat. These comprise 53 bird, 15 mammal, 19 reptile and two amphibian species (Appendix 3.2 to the draft Fox Management Strategy, Chapter 3 in the draft Victorian Pest Management Framework (NRE 2001a). These species have been allocated priorities for action – e.g. Category 1A relates to species at high conservation risk and whose occurrence in the bioregion is of highest importance. Almost 50% of species are accorded Category 1A; overall, Category 1 species comprise 81% of the total.

Recovery and reintroduction programs for threatened vertebrate species are compromised by predation by Foxes (e.g. Mala *Lagorchestes hirsutus*; Lundie-Jenkins, Corbett & Phillips 1993; Eastern Barred Bandicoot *Perameles gunnii*; Watson 2001). The diet of the Fox may overlap with that of the Spot-tailed Quoll (*Dasyurus maculatus*) where that species occurs. Thus there may be significant

competition affecting the distribution and abundance of this native carnivore, which is listed as a threatened taxon under Schedule 2 of the **Flora and Fauna Guarantee Act 1988**.

Foxes would also be a prime vector of rabies if this disease were introduced to Australia. Rabies could have a massive impact on wildlife populations, as well as stock, and pose a danger to humans (Saunders *et al.* 1995). Foxes may play a role in maintaining reservoirs of other diseases harmful to wildlife and humans, such as canine distemper, parvovirus, canine hepatitis, hydatids, toxoplasmosis, tularaemia, leptospirosis and heartworm (Saunders *et al.* 1995, Marks & Bloomfield 1997).

The Fox assists in the dispersal and colonisation of environmental and noxious weeds such as blackberries *Rubus* spp., nightshade *Solanum* spp., Boneseed *Chrysanthemoides monilifera*, Inkweed *Phytolacca octandra*, African Boxthorn *Lyceum ferocissimum*, Bridal Creeper *Asparagus asparagoides*, Hawthorn *Crataegus monogyna* and others (Brunner *et al.* 1976; Enviroweeds website via K. Blood, NRE).

The impact of the Fox on the pastoral industry is largely undetermined, but it is likely that the Fox has been overrated as a predator of otherwise viable lambs (Coman 1995). However, in some cases, large numbers of lamb deaths can be attributed to Fox predation. These effects may be significant at a local level (Applied Biotechnologies 1992). Foxes also kill and disturb chickens in commercial poultry farms and farmyard pens.

In its final recommendation, the Scientific Advisory Committee (SAC 1991) determined that predation of native wildlife by the Fox was a potentially threatening process, as in the absence of appropriate management it:

- poses a significant threat to the survival of a range of fauna;
- poses a significant threat to the survival of two or more taxa; and
- poses a significant threat to the evolutionary development of two or more taxa.

Existing control measures

- Poisoning with Sodium Monofluoroacetate (Compound 1080) in various carriers is the most commonly used control technique. The development of the commercially available dry bait Foxoff[®] by Applied Biotechnologies Pty Ltd has enabled the wider and safer use of poisoning. Foxoff[®], however, has been found to have lower palatability than liver baits, and hence acceptance by Foxes may be reduced. This observation, together with bait caching, prompted a review of the system. Liver baits

were found to be less likely to be cached (van Polanen Petel, Marks & Morgan 2001), so baiting programs often now use these two baits in alternation. This practice provides some degree of flexibility and variation and may assist in attracting Foxes to the bait. Concerns about the humaneness of 1080 have prompted experiments using analgesic, anxiolytic/sedative or analgesic/sedative additives to the bait. Diazepam, an anxiolytic/sedative agent was found to be effective in minimising anxiety experienced by Foxes, especially during the first symptoms of 1080 toxicosis (Marks, Hackman, Busana & Gigliotti 2000). Poison may only be applied in buried baits, under NRA guidelines.

- Shooting is carried out either by day with dogs to put up Foxes or by night with the aid of a spotlight. Daylight shooting is usually carried out by volunteer shooting organisations, and night shooting by specialist contractors.
- Den fumigation has been the subject of some concern by animal welfare agencies. Carbon monoxide (CO) is the preferred toxic gas (Marks 1996). CO has been shown to be effective in natal dens, using Den-Co-Fume[®] Carbon Monoxide Cartridges to generate CO (Hart, Marks & Staples 1996)
- Den destruction is carried out as the opportunity presents itself.
- Trapping, using cage or appropriate, soft-jaw leg-hold traps is used at specific target sites.
- Experimental use of M-44 ejectors, loaded with 1080, has been undertaken at several sites (Marks, Busana & Gigliotti 1999).
- Experimental use of abortifacients such as cabergoline has demonstrated the potential for use in local situations and appears to be highly target-specific, but its widespread use has still to be evaluated (Marks, Nijk, Gigliotti, Busana & Short 1996, Marks 2001).
- Passive control measures – habitat management – are effective in some local situations.
- A Fox bounty scheme has recently been announced (May 2002). A three-month trial across Victoria will offer \$10 per tail during July, August and September 2002.
- Most existing control programs are small scale and thus need to be maintained rigorously for them to be effective.

Conservation objectives

Long term objective

- To reduce the threat posed to native fauna by the introduced Red Fox so as to allow the native fauna to survive, flourish and retain their

potential for evolutionary development in the wild.

Objectives of this Action Statement

To define, plan and implement appropriate actions that will result in improved management of issues concerning the control of the Red Fox in Victoria.

Overall approach

Consistent with the aims and outcomes of the draft Victorian Pest Management Framework (VPMF) (NRE 2001a), the specific goal for the State's Fox management programs is to minimise the impact of Foxes on environmental, economic and community values through the implementation of a strategic approach to Fox management that is supported by the community and meets the desired conservation and/or production outcomes of the land.

The long-term environmental objective is to reverse the decline in the conservation status of Victorian native species subject to predation by the Fox. In particular, the protection and promotion of viable populations of threatened wildlife on both public and private land, based on statewide management priorities and agreed action plans.

There is a need for a strategic approach to Fox control in Victoria and adjoining States. The complexity of land ownership and landscape fragmentation mean that control will involve close integration of research, management and monitoring by all land managers. A continual process of evaluation and revision of policy and legislation will provide an adaptive framework for responsible and pro-active Fox management. The effective coordination of strategic and sustained Fox management across all land tenures is the key to achieving the conservation objectives.

The strategy is composed of seven elements:

Priorities:

The determination of priorities for Fox control should follow the criteria laid out in Determining Priorities for Fox Control (NRE 2001b), consistent with the Victorian Biodiversity Strategy (NRE 1999). These criteria are:

- Species' risk attributes, based on importance in a bioregion, conservation status and vulnerability to Fox predation.
- The ability to coordinate management effort (group vs individual).
- Opportunities for multiple benefits where priority species are co-located and/or adjacent to agricultural priority areas.
- Opportunities for preventative programs.
- Opportunities to complement and value-add to other ecological programs, particularly those

addressing other pests and other threatening processes.

- Feasibility of reducing damage within a reasonable timeframe and preventing re-invasion.
- Logistics of control and the physical area involved.
- Availability of appropriate management techniques.
- Availability of funds, time, labour and equipment both for immediate action and for future sustained control.
- The level of commitment for effective reduction in the potential impact from Foxes.
- Braysher and Saunders (*in prep.*) provide a detailed methodology for establishing priorities.

Catchment Management Authority Fox Action Plans:

Development, implementation and communication of the actions and outcomes of these plans will follow pre-determined criteria, which are listed in 1 above.

Partnerships:

Established partnerships with Government organisations, industry, CMAs and the general community will be maintained and enhanced to ensure that Fox management is focused at a landscape level and on minimising damage.

Best Practice:

Adaptive Fox management will be based on appropriate application of research findings, monitoring and review, and will emphasise the reduction of damage rather than Fox eradication.

Research:

A strategic research plan on Fox predation has been developed (Soderquist 2000). Six key objectives are given in this plan. They are:

- Improving research by streamlining and amalgamation of research paths.
- Enhancing design and implementation of existing control programs.
- Ensuring that data collection is appropriate for critical interpretation and adaptive adjustment of research and management programs.
- Examining issues specifically needed for Fox management in Victoria.
- Initiating broadscale control programs that focus on population increases in vulnerable prey species and the reintroduction of locally extinct species.
- Educating the community about Fox management programs now and in the future.

Monitoring, evaluation and reporting:

Mechanisms to integrate communication about Fox management will follow established processes such as Bioregional Planning and Environmental Management Planning in Parks Victoria, and through a statewide evaluation process that will be allied to the Good Neighbour Program.

Traditionally, monitoring of Fox baiting programs has used indirect measures of success, such as bait take, and the underpinning philosophy has been to reduce Fox numbers. Outcome-based monitoring is essential if we are to be confident that conservation targets are being met. With Fox management programs, monitoring should assess not just body counts of dead Foxes or how many programs are underway, but measure changes in survival, reproduction, movement and abundance of both target species and other native mammals. Measures of abundance of Foxes, feral Cats and wild Dogs should be made if practical, particularly to know whether or not predator interaction effects are occurring. These measures may be direct (e.g. animals seen during standard surveys) or indirect (scats per length of track; footprints on sand-pads). Changes in vegetation should be assessed in all cases. This will be particularly relevant where native herbivorous mammals increase as a consequence of Fox control, or where such mammals are introduced to new locations.

Incentives:

Incentives will be extended to cover the protection of significant conservation values on private land.

Intended management actions

The intended management actions listed below are further elaborated in DSE's Actions for Biodiversity Conservation Database. Detailed information about the actions and locations, including priorities, is held in this system and will be provided annually to land managers and other authorities.

Planning and Management

1. Finalise and accept the draft Fox Management Strategy as outlined in the draft Victorian Pest Management Framework.

Responsibility: DSE Divisions and Parks Victoria

2. Establish a cross-tenure Fox Management Steering Group for Fox management, aimed at developing a more strategic and co-ordinated approach to controlling and monitoring the impacts of Foxes on public land throughout Victoria.

Responsibility: DSE Divisions and Parks Victoria

3. Develop, promote and implement a set of Guidelines and Principles for effective and co-ordinated control of Foxes to achieve

biodiversity and economic benefits across Victoria

Responsibility: DSE Divisions and Parks Victoria

4. Support and extend Fox management on private land by continuing implementation of existing State and Commonwealth initiatives, and extension of such schemes as is deemed necessary, especially at sites where it augments Fox management on high priority public land. Increase community ownership of Fox control projects

Responsibility: DSE Divisions, DSE Regions, Victorian Farmers Federation

5. Carry out a statewide assessment of Fox control in relation to wildlife enhancement, which will detail priority areas, techniques, frequency and performance measures, and evaluate use of current resources.

Responsibility: DSE Divisions and Arthur Rylah Institute, Parks Victoria

6. Accept and adopt the Strategic Research Plan on Fox Predation in Victoria 2000-2003.

Responsibility: DSE (Biodiversity and Natural Resources Division, Agriculture Division), Catchment Management Authorities and Parks Victoria

7. Maintain active links with interstate agencies involved in Fox research and management.

Responsibility: DSE (Biodiversity and Natural Resources Division)

8. Continue training for Regional staff in Fox control.

Responsibility: DSE Regions, Parks Victoria

Research and Monitoring

9. Implement the key objectives of the predator research initiative to support existing and proposed management approaches: threatened species management, fortress sites, broadscale experiments, reintroductions and livestock protection.

Responsibility: DSE Divisions and Parks Victoria, through Arthur Rylah Institute and Victorian Institute of Animal Science

10. Continue to support research on the improvement of baiting practices for Foxes, including risks to non-target species, bait markers, mechanical delivery of toxins and anti-fertility drugs, target-specific delivery of toxicants and humane aspects of baiting programs.

Responsibility: DSE (Divisions, Victorian Institute of Animal Science, Arthur Rylah Institute)

11. Investigate the best way to safeguard the Spot-tailed Quoll *Dasyurus maculatus* from Fox (and Dog) baiting.

Responsibility: DSE (Regions, Arthur Rylah Institute, Victorian Institute of Animal Science) in collaboration with NSW and ACT

12. Initiate and support post-graduate studies on the risks of Fox baiting (especially to quolls) and the effects of habitat disturbance on Fox management programs. An objective will be to translate ecological information about Red Fox/Spot-tailed Quoll interactions into management actions.

Responsibility: DSE (Biodiversity and Natural Resources Division, Arthur Rylah Institute, Victorian Institute of Animal Science) in collaboration with other research institutes e.g. CSIRO

13. Investigate improved methods of monitoring Fox control programs. Monitor the use of FOXOFF® baits and their effectiveness. Monitor and assess the effectiveness of burying baits and their potential for access by non-target species.

Responsibility: DSE (Regions, Victorian Institute of Animal Science, Arthur Rylah Institute)

14. Monitor effectiveness of bounty trials in reducing Fox populations in key areas.

Responsibility: DSE (Catchment and Water Division)

15. Support Commonwealth initiatives into biological and other control measures, and establish subsidiary and/or complementary research and management programs.

Responsibility: DSE (Biodiversity and Natural Resources Division, Victorian Institute of Animal Science) in collaboration with other research institutes e.g. CSIRO

Control

16. Continue to support and expand Project Deliverance in Gippsland.

Responsibility: DSE (Biodiversity and Natural Resources Division, Gippsland Region, Arthur Rylah Institute)

17. Establish co-ordinated and intensive Fox control measures to protect specific populations of threatened fauna: Eastern Barred Bandicoot (all release sites), Malleefowl, Long-footed Potoroo (Bellbird), Brush-tailed Rock-wallaby (Upper Snowy River), Mountain Pygmy-possum (Mt Hotham and surrounds), Little Tern (Gippsland Lakes area). Populations will be monitored by Regional staff to evaluate the effectiveness of the Fox control efforts. This will be coordinated with Rabbit and/or wild Dog control programs.

Responsibility: DSE Regions, Parks Victoria

18. Ensure that Fox control in National Parks, conservation reserves and other public lands is both strategic and effective for the protection of threatened wildlife populations. Co-ordinate complementary control on adjacent public and private land

Responsibility: Parks Victoria

19. Through the development of Fox Action Plans by CMAs, initiate programs to gradually create Fox-free zones in defined areas, for wildlife protection and/or livestock protection. Maintain all areas that are currently Fox free in that condition.

Responsibility: Catchment Management Authorities, DSE Regions, Parks Victoria

20. Attempt, in conjunction with organised shooters, to eliminate resident Foxes on Phillip Island. Develop techniques to make Phillip Island permanently Fox free.

Responsibility: Phillip Island Nature Park, DSE (Victorian Institute of Animal Science)

Community Interaction

21. Promote group control schemes by landholders, particularly in relation to Land for Wildlife properties, Landcare groups and areas adjacent to significant wildlife populations, and/or existing control programs on public land.

Responsibility: DSE Regions

22. Promote the use of the buried bait and other safe and efficient techniques by land managers.

Responsibility: DSE Regions

23. Promote the use of hunting in managing Fox populations in specific areas, especially for the conservation of threatened species, through cooperation with hunting and sporting shooter organisations such as Sporting Shooters Association and the Victorian Field and Game Association.

Responsibility: DSE (Divisions and Regions)

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Further information can be obtained from
Department of Sustainability and Environment
Customer Service Centre on 136 186.

Flora and Fauna Guarantee Action Statements are
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Environment website: <http://www.dse.vic.gov.au>

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