



**Australian Government**

**Department of the Environment**

# Threat abatement plan for predation by the European red fox (2008)

Five yearly review

2013

## **PURPOSE OF REVIEW**

Under section 279 of the *Environment Protection and Biodiversity Conservation Act 1999*, the Minister must review each threat abatement plan at intervals of not longer than five years, and consider whether a variation of the plan is necessary. The threat abatement plan for predation by the European red fox was made by the Minister in 2008.

Reviewing threat abatement plans, at least every five years, allows for an assessment of whether the threat has been abated or, if not, what progress has been made towards abating the threat. It is acknowledged that some key actions listed in threat abatement plans may take longer than five years to achieve, such as research into the development of new toxins and baiting methods. The review of a threat abatement plan assesses progress and effectiveness of progress across all actions in the threat abatement plan. It also considers progress towards threat abatement in associated ways, such as related work done through recovery plans for specific species. Finally it also considers if the threatened species are still being threatened by the subject of the threat abatement plan.

## Contents

<b>Purpose of review .....</b>	<b>2</b>
<b>Executive Summary .....</b>	<b>5</b>
<b>Introduction .....</b>	<b>7</b>
<b>Objectives of the threat abatement plan.....</b>	<b>8</b>
<b>Objective One.....</b>	<b>8</b>
Offshore islands.....	9
Case study 1.1 Middle Island, Victoria .....	9
Case study 1.2 Phillip Island, Victoria .....	10
Mainland islands.....	11
<b>Conclusion.....</b>	<b>13</b>
<b>Objective Two.....</b>	<b>15</b>
Case studies 2.1 High priority areas for threatened species management .....	16
<b>Conclusion.....</b>	<b>18</b>
<b>Objective Three .....</b>	<b>19</b>
Action 3.1 Monitoring .....	19
Action 3.2 Predator interactions - native carnivores .....	21
Action 3.3 Predator interactions - Feral cats, wild dogs and rabbits .....	23
Action 3.4 Unintended effects from fox control .....	25
Case study 3.1 Booderee National Park fox control program .....	26
Action 3.5 Estimating the environmental and other associated costs.....	27
<b>Conclusion.....</b>	<b>28</b>
<b>Objective Four .....</b>	<b>28</b>
Action 4.1 Research into effectiveness, target specificity and humaneness .....	29
Action 4.2 Further work on improvements to control techniques .....	30
Action 4.3 Information on exclusion fence designs and other control methods.....	32
Action 4.4 Investigate the feasibility of control techniques to target foxes but not dingoes.....	32
Action 4.5 Develop training programs to help land managers identify locally appropriate control methods and when to apply them. ....	33
Action 4.6 Ensure habitat rehabilitation and management of potential prey, competitors and predators of foxes are considered in fox management programs.....	33
Action 4.7 Continues to promote the adoption of model codes of practice and standard operating procedures. ....	34
<b>Conclusion.....</b>	<b>34</b>
<b>Objective Five .....</b>	<b>35</b>
Formal training for stakeholders .....	36
Cross tenure or group management programs.....	36
Other promotion .....	37
<b>Conclusion.....</b>	<b>37</b>
<b>Conclusion on the threat abatement plan .....</b>	<b>39</b>
<b>Looking forward .....</b>	<b>39</b>

<b>Works Cited .....</b>	<b>42</b>
<b>Appendices .....</b>	<b>49</b>
<b>Appendix A: Islands with foxes.....</b>	<b>49</b>
<b>Appendix B: High priority offshore islands with foxes .....</b>	<b>57</b>
<b>Appendix C: Caring for our Country projects with a fox component.....</b>	<b>58</b>
<b>Appendix D: Biodiversity Fund projects with a fox component.....</b>	<b>76</b>
<b>Appendix E: EPBC Act listed threatened species.....</b>	<b>78</b>

## EXECUTIVE SUMMARY

The threat abatement plan for predation by the European red fox has a goal of minimising the impact of foxes on biodiversity in Australia and its territories. This goal has not been met in the last five years, excepting in some small scale areas. However, significant improvements have been made in the strategic approach to fox control and improving non-target risks and welfare issues.

The first objective of the threat abatement plan focuses on high conservation value areas or 'islands' for control. This asset protection approach has been adopted across Australia. New South Wales' fox threat abatement plan prioritises areas for threatened species control. There have been a number of predator-proof fenced sanctuaries built in the last five years for threatened species protection. There are now a number of companies in both Australia and New Zealand servicing this market. This is an effective means of protecting small threatened species most at risk from predation by foxes, but it is expensive and resource intensive.

Fortunately foxes are only found on a small number of offshore islands and there are examples where eradication has been achieved or is underway. The biggest island eradication program underway is for Tasmania. This is a long-term program attempting to eradicate foxes that are established but not in high densities. The program has driven new developments in detection methods and analytical techniques such as DNA analysis of scats. At the time of this review, the program was commencing stage three which is focused on targeted surveillance. Maintaining public support for a program where there is little physical evidence is a tremendous challenge for the Tasmanian fox eradication program.

Linked with the concept of asset protection for fox control programs is the maintenance and recovery of threatened native species and ecological communities. Land managers are applying the actions set out objective 2 and are establishing cross-tenure programs for fox management, monitoring the outcomes for adaptation of the program, and using incentives. There are examples where fox control programs are specifically instigated for the protection of species such as rock wallabies, malleefowl and penguins.

The Invasive Animals Cooperative Research Centre's 2005-12 research program made important steps in improving knowledge and understanding of the foxes' ecological role in Australia. Research into monitoring techniques together with improvements in technology such as remote cameras has led to reliable monitoring techniques; studies into the interactions with other invasive predators and the effects of controlling one invasive species' impact on other species has improved knowledge (although also raised many other questions); and projects have also explored the unintended consequences of fox control. It should be noted that there are also researchers not associated with the Invasive Animals Cooperative Research Centre who have contributed to this knowledge.

We have superior tools to control foxes compared to five years ago. An improved, more humane bait will shortly be available for control. New tools are also in the product 'pipeline' from the Invasive Animals Cooperative Research Centre such as a target specific lethal control device, and a toxic spray tunnel unit.

A national training package for the control of invasive species has been registered and there are a few, although insufficient, providers for this education. Detailed educational material as well as general material have been developed by the Invasive Animals Cooperative Research Centre and are available in a variety of media from web pages, fact sheets, reports and videos.

The review has established that significant work has been done to improve our ability to control foxes. However, in the last five years, an additional 27 species have been added to the threatened species lists under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) where foxes are identified as a threat. While acknowledging that foxes may not be the major threat for some of these species, this does indicate that there is still much to be done before we can be confident that we are able to manage foxes to minimise their impact. As such, this review recommends that a threat abatement plan or alternative threat abatement strategy is still required to manage predation by the European red fox.

## INTRODUCTION

The European red fox is identified readily by many Australians as a significant predator of small native animals and also of lambs, goat kids and poultry. Foxes will take many different native animals, particularly small to medium-sized ground-dwelling and semi-arboreal mammals, ground-nesting birds and chelid tortoises (Department of the Environment, Water, Heritage and the Arts, 2008). Foxes became established in the 1870's and have now spread across most of Australia except the tropics, and are still establishing and spreading in Tasmania.

Foxes were identified in previous legislation as a threat and predation by the European fox was listed as a key threatening process on the commencement of the EPBC Act. A threat abatement plan was made in 1999. The 2008 threat abatement plan replaced this original threat abatement plan.

Foxes have a significant impact on primary production. Damage is estimated at \$227 million per year (Gong et al. 2009) and this has prompted significant investment in control methods by industry bodies, cooperative research centres and agricultural agencies. In the last five years in particular the Invasive Animals Cooperative Research Centre has invested significantly with its first phase of funding aimed at new knowledge, a new toxin and toxin delivery methods, and improved management packages to reduce the cost to Australia by \$29 million. The Invasive Animals Cooperative Research Centre has done this in partnership with most Australian governments and the Australian Wool Innovation Ltd. While this research has primarily been focused on reducing the impacts on agriculture, the outcomes have direct applicability to conservation needs, and in many cases, on-ground action for foxes such as baiting needs to be done on a nil-tenure basis so will encompass farms and conservation lands.

Governments are also investing in fox control for biodiversity through broad-scale programs (e.g. Southern Ark in Victoria and Western Shield in Western Australia), although the quantum of funding for this is unknown.

## OBJECTIVES OF THE THREAT ABATEMENT PLAN

The goal of the threat abatement plan is to minimise the impact of foxes on biodiversity in Australia and its territories by: protecting affected native species and ecological communities, and preventing further species and ecological communities from becoming threatened. This section of the review considers each of the objectives of the threat abatement plan and what work or management has occurred in each of the areas since 2008.

Each objective has subsidiary actions. In this review not all of the actions are analysed in depth as this is likely to lead to significant repetition and gaps in the review, but rather there is detail where appropriate and discussion of progress made towards each objective where the information or progress is broader.

### OBJECTIVE ONE

The objective of *prevent foxes occupying new areas in Australia and eradicate foxes from high-conservation-value 'islands'*.

#### Actions

1.1 Collate data on offshore islands and isolated mainland 'islands', assess their conservation value, the likelihood of significant biodiversity impacts from foxes and, if there are no foxes present, rank the level of risk of foxes being introduced and establishing populations.	High priority, short term
1.2 Develop management plans to prevent, monitor and, if incursions occur, contain and eradicate any fox incursion, for 'islands' with high conservation values.	High priority, medium term
1.3 Implement management plans for high-conservation-value 'islands', including prevention and monitoring actions, and containment or eradication actions if incursions occur.	Very high priority, medium term
1.4 Eradicate established populations of foxes from 'islands' with high conservation values (including Tasmania) where this is cost-effective, feasible and a conservation priority.	Very high priority, medium to long term

#### Performance indicators:

- No further establishment of foxes on offshore islands or in other fox-free areas.
- Successful eradication of isolated populations of foxes where this is attempted.
- Increased populations of affected native species in areas from which foxes, and other invasive species have been eradicated, subject to interrelated issues.

This objective is focused on the concept that foxes, and other vertebrate pests including rabbits, cats and goats, cannot be eradicated from mainland Australia. It is also not feasible from a monetary and logistical aspect to control foxes over their entire range. Therefore, it is essential for biodiversity conservation that important sites are identified where fox control can effectively be undertaken and that this will produce the desired outcomes for threatened species and other populations of native species at risk from fox predation. This concept has been encapsulated in the term 'island' which can be either a physical offshore island or a patch of mainland that has some geographical or physical feature to separate it from the surrounding country.



## ***Offshore islands***

Foxes are present on 48 islands around Australia according to the Feral Animals on Offshore Islands database (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012). The database also lists another 10 islands from which foxes have been eradicated and many of these islands are very close to the mainland with easy access for animals. The islands and details are listed at Appendix A. This is a very small portion of the total offshore islands around Australia and provides opportunities for utilisation of fox-free islands as refuges for native animals.

Ecosure (2009) undertook a desktop analysis of Australian Government offshore island databases of feral animals and threatened species. This study prioritised the islands that showed greater biodiversity value and identified where feral animals were a problem. This included foxes. Fifteen islands out of the top 100 islands greater than 200 hectares were identified with foxes present and these are listed in Appendix B. Only one of these islands (Phillip Island) was identified as having an island specific plan to manage foxes. Other islands that come under broader national park management or similar arrangements have a generic invasive species, or fox, management plan.

Most of the islands where foxes are present in Australia are accessible. This is either by causeways at low tide or by very short distances between the island and the mainland or between multiple islands. The value of undertaking control for foxes on islands is recognised by stakeholders including state and territory governments, councils, and coastal management groups. Nesting shorebirds such as shearwaters and penguins can benefit from strategically timed fox (and cat and dog) control. While foxes are able to re-invade these islands, the removal of foxes and then putting in place control measures to control movement or manage the foxes that do get back onto the islands is valuable. It is a similar concept to a fenced mainland area where ongoing fence maintenance is required along with checks to ensure breaches are not made. In the case of an accessible offshore island, the 'fence' is a causeway, channel or other natural barrier.

Two case studies below provide examples from Victoria of bird protection. The first is the use of a maremma dog to deter foxes and the second is an eradication program with control for immigration.

### ***Case study 1.1 Middle Island, Victoria***

Middle Island is an important little penguin nesting site. Foxes are able to access the island at low tide via a causeway and have also been sighted swimming across to the island. Fox predation saw the little penguin population drop from 600 birds in 1999 to four breeding pairs in 2006 when a control program for foxes and dogs commenced. The Warrnambool City Council now uses maremma guard dogs on a seasonal basis to protect the birds from foxes and other dogs, by chasing away any that attempt to come to the island. The guard dogs have stopped fox predation, which is allowing the penguins to slowly rebuild the colony (Warrnambool City Council, 2013).

Middle Island was not ranked in the top 100 islands for biodiversity value in Australia by Ecosure (2009). However, the values of the birds on the island have been sufficient for this island to be prioritised at a state level. This provides a good example of where a broad approach to evaluating biodiversity across all nationally listed threats and threatened species

may not link closely with what is considered important to protect at a regional or local level in addition to national priorities.

### **Case study 1.2 Phillip Island, Victoria**

Phillip Island in Victoria has a long-term fox control program to prevent the predation of the little penguin (*Eudyptula minor*), short-tailed shearwater (*Ardenna tenuirostris*) and hooded plover (*Thinornis rubricollis*). Foxes were first reported on the island in 1907 and have been able to access the island via a road bridge since 1947. A coordinated program has been underway since 2006 to eradicate the fox from the island with the initial knockdown to approximately 10% of the original estimated population being achieved in 2011 (Invasive Animals Cooperative Research Centre, 2012). A long-term program is now needed to remove the remainder of the population and achieve eradication.

Berry and Kirkwood (2010) used DNA from dead foxes on the island to understand the genetic and demographic information of the island foxes. They determined that there is a migration rate to the island of approximately one fox every five years and that most of the population on the island is reproducing without any external immigration (95%). The number of foxes actually breeding was very low. The breeding foxes were the dominant vixens and reynards (male foxes), so as the control program removed some of these dominant foxes the breeding population was actually 'released' and more foxes were able to breed. Berry and Kirkwood (2010) suggest that the program needs to continue to focus predominantly on reducing the number of the foxes on the island.

The challenge with eradication on a large populated island is to convince all of the community to participate in the program over a long period of time, especially once the foxes are no longer in abundance and not visible to the landholders (Invasive Animals Cooperative Research Centre, 2012). An additional challenge for Phillip Island is the enormous tourist population over the summer months as 1080 baiting cannot be undertaken while there are that many more people with pet dogs present. Further details of this case study are contained in the cited factsheet from the Invasive Animals Cooperative Research Centre's PestSmart toolkit.

As well as managing or eradicating foxes from islands where they are present in Australia, it is also important to prevent new establishments. Kangaroo Island, South Australia, is a habited island where there is a regular ferry service and other transportation between the mainland and the island. The Kangaroo Island Natural Resource Management board has a biosecurity plan which aims to keep Kangaroo Island free of foxes and other pests.

In terms of the performance indicators for this objective, the available data (e.g. Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012) does not provide information post-2008. However, the information contained in this database and with the analysis by Ecosure (2009) suggest that the foxes currently identified on offshore islands have probably accessed these islands for many years. As such the first performance indicator of no further establishments on offshore islands has probably been met.

The second performance indicator, of successful eradication of isolated populations of foxes where this is attempted, has two examples of action. The first case study – Middle Island – demonstrates a successful eradication and increased breeding of penguins is the positive

outcome. The second case study - Phillip Island – showcases a program which is headed in the right direction to eradicate the fox and is likely to show a positive outcome too if successful. As such, this performance indicator has also been met but it is noted that this is an open-ended performance indicator and more can always be done.

The third performance indicator can only be measured, for offshore islands, by the fox eradication from Middle Island. The increased breeding of penguins demonstrated how performance indicator three can be met. It would be inappropriate to indicate that this performance indicator has been met however, with foxes still present on 48 islands and predating on native fauna.

### ***Mainland islands***

There are two types of 'mainland island'. Firstly there are a number of areas around Australia that have reserves that are specifically fenced to prevent predators entering the reserve. These include Lorna Glen in Western Australia (10.8 km<sup>2</sup>); Arid Recovery in South Australia (60 km<sup>2</sup>); Nangeen Hill Nature Reserve, Western Australia (5 km long fence); Mulligans Flat Woodland Sanctuary in the Australian Capital Territory (4.5 km<sup>2</sup>); Scotia Sanctuary in New South Wales (120 km<sup>2</sup>); Yookamurra in South Australia (10 km<sup>2</sup>) and Karakamia in Western Australia (2.75 km<sup>2</sup>). All of these areas are small in comparison to the potential habitat for the species being protected and require huge resources to maintain the fence, control predators around the fence to reduce pressure from predators testing the fence, and continuously monitor for potential incursions. All of these 'islands' or fenced areas have detailed management plans that meet all the actions under objective one of developing and implementing management plans for these sites.

Secondly, there are identified areas where continuous, intensive control is undertaken for foxes and other predators to keep numbers at a sufficiently low level to allow the recovery of native species. This work must be ongoing, and hence expensive, as there will be continuous immigration from surrounding areas. These sites tend to be focused on a threatened species program (e.g. for rock wallabies, mallee fowl, southern brown bandicoot) or a community action group to protect livestock. These sites can only cater for threatened species that can cope with a degree of predation.

The objective also mentions the need to ensure that foxes remain absent from areas that they currently do not occupy, including the northern edge of their distribution. Currently there are no formal monitoring sites but the community based feralscan website ([www.feralscan.org.au](http://www.feralscan.org.au)) provides an informal monitoring tool. To date (October 2013) this database has two "very low numbers seen" sites in northern Queensland that are outside of the currently mapped range of the fox. Therefore, it is concluded that performance indicator one of no further establishment of foxes on offshore islands or in other fox-free areas has been met. It is unlikely that this is due to any human intervention but rather unsuitable habitat and/or climate.

In the paragraphs below examples from state programs are described where areas are identified as important sites for conservation and predation by foxes is a threat.

The New South Wales Threat abatement plan for predation by the red fox (NSW DECCW, 2010) has identified key threatened species at risk and then considered prime areas for conservation of these species. The plan also looks at what makes key fox habitat – such as their preference for open agricultural spaces to dense forest, and their use of tracks in forests. The plan identifies 57 sites, some of which are adjacent to each other, where fox control should be undertaken. The plan also has an additional nine sites where it is recommended

that no baiting be undertaken but monitoring of fox and native species populations be done as a control site to compare with the baited areas. The sites for control were selected because of the threatened species at the site for which targeted fox control would be an important element in their recovery. Many of these are shorebirds and the distribution of the 57 baited sites also reflects this, but the species also include the brush-tailed rock wallaby, long-nosed potoroo, the mallee fowl and the brolga. The NSW threat abatement plan has a control group who oversee the success of the site plans and make recommendations, and a technical reference group who oversee the science and provide adaptive management recommendations. These groups make it possible for the NSW Government to track the change achieved by management.

The Queensland Government has identified the bridled nail-tailed wallaby as requiring intensive fox management to maintain its populations in their restricted habitat 'islands'. This is a long-term program which commenced in 1997. It includes habitat management and a captive breeding population (Wildlife Queensland, 2013).

Western Australia has taken a larger area approach with the Western Shield animal conservation program run by the Western Australian Department of Parks and Wildlife. This program has recognised the severe decline in native species' populations in Western Australia and that this can be partially attributed to predation by foxes and cats (Department of Environment and Conservation, 2013). Western Shield's fox and feral cat baiting program covers nearly 3.9 million hectares of public and private land across the state, from Cape Arid east of Esperance to the Burrup Peninsula near Karratha. It includes the forests of the south-west, rangeland sites and numerous wheat belt reserves.

The Red Card for Rabbits and Foxes community program is a coordinated baiting and shooting program for foxes and rabbits across the south-west of Western Australia (Red Card for Rabbits and Foxes program, 2013). The largest part of the Red Card program is the community baiting programs. Each year local groups coordinate their baiting so that the maximum impact can be achieved. While this program has an agricultural focus there are benefits to biodiversity in a broad-scale baiting program.

Victoria has the regional programs of Southern Ark (Department of Environment and Primary Industries, 2013), Glenelg Ark (Department of Environment and Primary Industries, 2013) and Grampians Ark that are specifically targeting the fox. The programs are collaborative, landscape scale approaches to fox management that aim to protect small native mammals, birds and reptiles from fox attacks. The program involves two key government agencies – the Department of Environment and Primary Industries and Parks Victoria. While the focus is on protecting public land, there is also a community baiting program underway on neighbouring private land through the "good neighbour" program.

The Southern Ark program started in 2003 as a continuation of an earlier program and in 2008 started phase two which aims to bait the entire Far East Gippsland area with buried baits for foxes. Baits are buried in a six-week rotation over the entire year. The Glenelg Ark is having success with increases in long-nosed potoroos and southern brown bandicoots through fox baiting (Robley et al., 2012). The Grampians Ark program is focused on the brush-tailed rock wallaby and operates over 250,000 hectares. The fox baiting is both on public land and on private land via support for a community baiting program. The Grampians Ark program is proving the success of fox baiting through a reduction of 30-50 % in fox activity and the breeding of released wallabies in 2010. Subject to funding these programs are ongoing.

South Australia has the Bounceback program, part of which is undertaking fox control to help the yellow-footed rock wallaby. The Bounceback program (Department of Environment, Water and Natural Resources, 2013) has been running for 20 years and includes pest animal and weed control as well as other recovery actions for native flora and fauna. The trigger for the commencement of the program was the local extinction of critical weight range (less than 3 kg) species such as the brush-tailed bettong and a need for an integrated approach for management of both the threats and other recovery actions. This program is focused on the semi-arid Flinders and Olary bioregions with a focus on the Flinders Range and Gammon Range National Parks and surrounding stations. The program baits 5500 km<sup>2</sup> for foxes in winter and late summer via ground and aerial baiting. Monitoring of foxes in the baited area now shows one fox per 100 km of spotlighting transect whereas outside the baited area has approximately 10 foxes per 100 km.

In northern South Australia the Alinytjara Wilurara Natural Resource Management board is combining the use of a 100 hectare predator-proof enclosure (island) with a captive breeding program to rebuild the population of the vulnerable Warru or black-flanked rock wallaby (*Petrogale lateralis*). Foxes are considered to be the major threat to the Warru (Department of Sustainability, Environment, Water, Population and Communities, 2013). With this project, captive bred warru from Monarto Zoo are placed in the predator-proof enclosure for 'hardening off' to free living without the immediate pressure of potential fox predation.

As well as these large-scale programs, local governments and regions will also identify their own priority areas requiring protection. An example of this is case studies 1.1 and 1.2 above.

Tasmania has an eradication program to remove foxes from the island/state (Department of Primary Industries, Parks, Water and the Environment, 2013). The second stage of the four stage program involved strategic baiting of highly suitable fox habitat between 2010 and 2013. Following a review of the Fox Eradication Program in late 2012 (Kitchell et al. 2013), the Tasmanian Department of Primary Industries, Parks, Water and Environment undertook a change in focus. Since June 2013 the focus has shifted to strategic landscape monitoring and surveillance activity predominantly using detector dogs, and responding to any detection of fox activity.

These state examples demonstrate how mainland areas or "islands" can be identified and fox management put in place. The fenced 'island' reserves demonstrate the achievement of performance indicators two and three in successfully eradicating foxes from the area and increasing numbers of threatened species within the reserves. The other identified mainland areas experience continual immigration of foxes from outside the site meaning performance indicator two cannot be met but ongoing monitoring is demonstrating it is possible to meet performance indicator three of increased populations of affected native species.

## **Conclusion**

We know well where foxes are in Australia. There has been some slow northwards expansion of their range in the Northern Territory and possibly also in Queensland and Western Australia compared to the distribution map presented in the background document to the 2008 threat abatement plan (reference NLWRA, 2007). It is not possible to control foxes across their entire range, especially in remote areas. Therefore it is not practical to prevent any northwards range expansion other than at key identified sites.

The identification of assets – 'islands' – of high biodiversity value where fox management should be undertaken has been done at a national, state and local government level. The

Australian Government has produced two reports respectively identifying offshore and mainland islands of high value; state and territory governments have identified and implemented programs for areas identified through threat abatement plans or regional programs; and some local governments have identified the assets they wish to protect in their jurisdiction.

The review has identified that, where fox management is being undertaken in fenced mainland reserves ('islands') or identified areas, the performance indicator has been met for increasing populations of affected native species.

All the programs highlighted in this objective have management plans that include monitoring to determine the reduction in fox numbers and/or impact. The NSW threat abatement plan and the Victorian Glenelg Ark have taken this concept a further step to put in place control sites to measure changes that might be occurring regardless of the fox baiting program. The South Australian Bounceback program also measures the reduction in fox numbers through spotlighting inside and outside the baited area. This will provide an immediate indication of the potential for biodiversity outcomes even if the species that is being protected (e.g. the yellow-footed rock wallaby) is slow to recover. The other government programs also have an emphasis on monitoring outcomes for their targeted threatened species.

So, in conclusion, we know where the priorities for fox control are and implementation of management plans is occurring. However, the other element of objective one – that is to eradicate foxes from high conservation value islands – has not been achieved and is only likely to occur in small isolated locations where there are fences or effective means to prevent immigration in the long term. Therefore, it is suggested that this objective needs to be amended.

## OBJECTIVE TWO

The objective of *promote maintenance and recovery of threatened species and ecological communities that are affected by fox predation.*

### Actions

2.1 Identify priority areas for fox control based on: <ul style="list-style-type: none"> <li>the significance of the population of the affected native species or of the ecological community</li> <li>the degree of threat posed by foxes to species and ecological communities relative to other threats</li> <li>the cost-effectiveness of maintaining fox populations below an identified 'damage threshold' in the region, and</li> <li>the feasibility of effective remedial action.</li> </ul>	High priority, medium term
2.2 Conduct and monitor regional fox control, through new or existing programs, in priority areas identified in Action 2.1.	High priority, long term
2.3 Apply incentives (other than bounties), partnerships and negotiated agreements to promote and maintain on-ground fox control on private or leasehold lands within or adjacent to priority sites identified in Action 2.1.	Medium priority, medium term

### Performance indicators:

- Priority areas, where fox control is required to protect important affected fauna, have been identified and are a focus of fox control programs.
- Fox control work involves pre and post-control monitoring of fox populations and key native species targeted for protection, according to national protocols, to measure the outcomes of control operations.
- Reliable native species population indicators are used to measure the outcome of reduced pest populations.

The threat abatement plan outlines the need for the maintenance and recovery of threatened species and ecological communities to occur in the identified priority areas – as per objective one – because it is not possible to control foxes across all of Australia.

In identifying priority species – and hence priority areas – at a national level, the EPBC Act listing of threatened species and ecological communities identifies key threats. Since 2008, predation by foxes has been identified as a threat for an additional 27 species, bringing the total to 103 species.

Table 1: Number of threatened species that may be affected by predation by foxes.

	<b>TAP threatened species that may be affected</b>	<b>Non-listed species that may be affected (in TAP)</b>	<b>Additional SPRAT* database threatened species</b>
Birds	14	35 ( <i>Botaurus poiciloptilus</i> now listed as endangered)	9
Mammals	48	2	8
Reptiles	12	0	7
Amphibians	2	0	3
<b>Total</b>	<b>76</b>	<b>37</b>	<b>27</b>

\*Species Profiles and Threats database (Department of Sustainability, Environment, Water, Population and Communities, 2012).

It should be noted that some of these newly identified species threatened by foxes are those that *may* be adversely affected rather than definitely identified in all cases. Of the threatened species listed, there are recovery plans for 31 species and 12 of these identify predation by

foxes as a major threat. Four plans indicate predation by foxes is secondary to another key threat. It is noted that none of the newly identified species have recovery plans. The updated list of threatened species and associated information is in Appendix E.

It can be difficult to measure changes occurring against the outcomes of recovery plans for threatened species between updates of plans. As such it has not been possible to make any assessment as to whether any of the recovery plan actions have changed the degree of threat to any particular species. However, specific projects such as Wheeler and Priddle's (2009) work with the malleefowl provide the best indication of progress where close monitoring of both ground and aerial baiting outcomes has occurred since the start of the program in 1996. Monitoring determined that thrice-yearly aerial baiting for foxes was more effective than intensive ground baiting, and they were also able to demonstrate the increased pressure on the malleefowl from feral cats following suppression of foxes.

Case study one gives six examples of areas identified at a state or regional level where foxes need to be controlled for threatened species protection.

#### ***Case studies 2.1 High priority areas for threatened species management***

South Australia, under its natural resources management legislation, has funded Conservation Volunteers Australia to reduce fox populations in and around the Brookfield Conservation Park to protect malleefowl (Natural Resources South Australia, 2013).

South Australia has also funded the Anangu Pitjantjatjara Yankunytjatjara for ecological management that includes control and monitoring of feral animals (Natural Resources South Australia, 2013).

Western Australia uses a mix of predator control in open spaces to maintain threatened species' populations, and small fenced islands for specific breeding programs. The black flanked rock wallaby is now restricted to the central wheat belt and is vulnerable to predation by foxes and cats, and competition from rabbits. The Wheatbelt NRM group has been supported to implement coordinated pest animal control activities (WA State NRM Office, 2013).

Wadderin Sanctuary is a 430 hectare predator-free island in the central wheat belt, Western Australia where three threatened mammals (red-tailed phascogale, woylie, quenda), one threatened bird (malleefowl) and three other species (brushtail possum, western brush wallaby and bush stone curlew) have been introduced. Funding from the Western Australian Government provides for regular inspection and maintenance of the fence as well as baiting for foxes and cats as required (WA State NRM Office, 2013), (Wildlife Research Management, 2011).

Karakamia Wildlife Sanctuary is a 275 hectare predator-free island in a Jarrah forest close to Perth, Western Australia. The Australian Wildlife Conservancy is maintaining the 2.4 metre high barrier and electric fence for foxes and cats. They have introduced woylie, quenda, tammar wallaby, western ringtail possum, quokka and numbat (WA State NRM Office, 2013), (Australian Wildlife Conservancy, no date).

A 400 hectare predator-free island has been established in the Perup Nature Reserve near Manjimup, Western Australia specifically for the woylie.



The examples from state and territory programs indicate that local and regional groups are identifying threatened species which require intervention to protect them from fox predation and undertaking control programs – either on-ground suppression or, in the case of at least three sites in Western Australia, building fenced reserves into which the threatened species can be safely released. Community groups such as the Wheatbelt NRM group in the central wheat belt have developed ways to coordinate action across land tenures for biodiversity outcomes.

The other important aspect identified in the plan is the need to control foxes beyond the boundary of the identified priority area to slow the immigration of foxes following a period of fox control.

The first performance indicator (relating to identifying and managing priority areas for fox control programs) has been met as demonstrated from the examples above. However, this is not a one-off exercise and this action of identifying priority areas and making the associated assessments of threat, effectiveness and feasibility is ongoing.

Monitoring, as is identified as part of action 2.2, is essential to understand the success of the control program and to maintain the benefits gained from the control.

The Australian Government Caring for our Country program (Australian Government, 2013) included a call for proposals, in all funding rounds, for projects that incorporate invasive species management for vertebrate pests. Foxes are included in this broader category. Appendix C lists all the projects funded that either target foxes or have a component of fox management within a broader project. While it is not possible to quantify exactly the Caring for our Country investment in fox management, these projects total a significant investment of \$23 million from 2008-2013.

The Australian Government Biodiversity Fund (Department of Sustainability, Environment, Water, Population and Communities, 2013) also recognises that in helping land managers store carbon, enhance biodiversity and build greater environmental resilience across the Australian landscape, pest animal control is an important element. Seven large, multi-year projects have been funded that have an element of fox control. Appendix D lists these projects. As with the Caring for our Country projects, the fox management element is not listed separately so is a component of the \$5.34 million invested in projects since 2011-12.

Both of these funding programs require proponents to undertake monitoring and evaluation as a key component of project management (Australian Government, 2013). As such, this meets the second performance indicator for objective two. The monitoring may comprise a before and after fox abundance measurement or, the preferable but more difficult, monitoring of native species' population response. A challenge for the proponents and for the program is in the dissemination of monitoring information. Only a few of the projects have publicly accessible reports.

State and territory governments have incentive programs to promote the recovery of threatened species and ecological communities as well as providing funding programs for local groups undertaking specific work targeted at protecting species. Objective one provides some of the broad-scale programs and below are examples of specific species programs. These examples are by no means exhaustive.

There are two examples from South Australia where fox control programs are being implemented. The first – Operation Bounceback – has significant state government

investment that has allowed the implementation of best practice monitoring that has demonstrated good biodiversity outcomes from the program. The second – Eyre Peninsula fox project – is a private landholder driven program with much less capacity for monitoring. Some monitoring of fox populations through spotlight counts has shown a decline in fox numbers but there has been little evaluation of baiting practices of private landowners and whether baiting is contributing to a landscape scale biodiversity improvement (pers. Comm. Mark Williams, Primary Industries and Research South Australia. 16 September 2013).

While Action 2.3 explicitly excludes bounties as an incentive for fox control, it is noted that the Victorian government has introduced a bounty to promote the control of foxes and wild dogs (Premier of Victoria, 2013).

While all these programs are important for fox control, it is not clear that they have been identified from a state or national prioritisation process or driven by a locally or regionally recognised need. Having willing people to implement programs is essential so this recognition of need is important – but it may also be necessary, as has been done for the NSW threat abatement plan for predation by the red fox, to overlay a regional/state/national sense of priority.

As such, at a national level the performance indicators for this objective have been met. However, the need to continue to promote the maintenance and recovery of native species and ecological communities is ongoing as will be the refinement of priority areas and incentives provided to landholders and community groups.

## **Conclusion**

The actions under objective two of identifying the priority areas where fox control is possible, monitoring fox control and applying incentives to work across tenures are now actions that are well embedded into control programs for foxes. As such, the performance indicators are being met as well. Areas prioritised for fox control include many for the recovery of native species and ecological communities as well as for primary production reasons. All of the funding programs require a degree of monitoring to determine if the programs are meeting their goals.

Where there is government funding assisting with fox control programs for the recovery of threatened species, the degree or quality of monitoring depends on the funding available and the willingness of the recipients to undertake monitoring. Monitoring may not be implemented ideally for community driven programs where there is significant in-kind action or less monetary outlay. In addition, capacity or knowledge of monitoring may be lesser in these groups so they tend to rely on more rudimentary measures of success. As will be discussed later in the review, the Invasive Animals Cooperative Research Centre has identified this knowledge gap and has developed some information products on monitoring.

The maintenance and recovery of native species and ecological communities that are affected by fox predation will be a task that is never-ending given that foxes will not be eradicated from Australia. Therefore the actual objective of promoting this is also a never-ending task.

## OBJECTIVE THREE

The objective of *improve knowledge and understanding of fox impacts and interactions with other species and ecological processes.*

### Actions

3.1 Develop simple and cost-effective methods for monitoring populations of foxes and the impacts of foxes, including reliable methods for monitoring foxes and key native species at different densities, including very low densities.	Medium priority, short term
3.2 Investigate interactions between foxes and native carnivores to identify the significance of competition and predation by foxes to these native species.	Medium priority, long term
3.3 Determine the nature of interactions between foxes, feral cats, wild dogs and rabbits to effectively integrate fox control activities for all four species.	Medium priority, long term
3.4 Identify any unintended effects that fox control may have if conducted in isolation from other management activities.	Medium priority, long term
3.5 Develop means for estimating the environmental and other associated costs of impacts arising from foxes.	Medium priority, short term

### Performance indicators:

- Reliable fox monitoring techniques have been developed.
- Integration of control methods for pest species.
- The unintended effects of fox control are minimised.

Each action in this objective is discussed and a commentary about progress in meeting the performance indicators follows. This format is used as there has been a significant amount of research undertaken to improve our knowledge and understanding of fox impacts and interactions in the last five years. The review attempts to capture the breadth of this work.

### **Action 3.1 Monitoring**

The affordability, availability, and ease of use of remote cameras has changed for the better with many more people undertaking monitoring of all animals. Remote cameras are now being used for many applications – both in wildlife monitoring and other areas outside of conservation management – and have reduced significantly in price. Remote cameras are typically set up for monitoring either on sites such as fire trails and other places which foxes regularly utilise, or in front of baits or other lures. These sites are valuable for monitoring any change in fox occupancy before and after control programs, or to see what species are attracted to the baits or lures. However, the interpretation of results from remote cameras is not always statistically robust. It is anticipated that in the next few years, technology and accessibility will improve further. Remote cameras are predominantly used in control programs where specific funding has been allocated for the purchase of cameras. However, as they can be used multiple times the use of cameras will increase.

Diment (2010) undertook a PhD study into monitoring tools for foxes in the forests of East Gippsland, Victoria. In particular he compared the efficiency of camera traps versus sand pads to monitor bait uptake for a buried bait program. In a relatively wet area where the bait stations are not accessed daily, footprints are regularly destroyed and where the prints are registered it is not always possible to determine multiple visits. Diment (2010) determined for

his site that it was 28 times more efficient to use camera traps for monitoring compared to sand pads.

An example of camera use is by Towerton et al. (2011) in the Goonoo region, central New South Wales. Two studies measured occupancy before and after baiting and they were able to demonstrate greater levels of fox activity on vehicular tracks than off them, with this difference being more marked in forest than in cleared agricultural land. Subsequent monitoring (Bergsen, pers. comm.) from the same area showed a decline in occupancy and activity within Goonoo National Park after 2011, but inconsistent results in the surrounding agricultural country. Studies such as these allow better design of baiting programs for land managers. For example, foxes' preference for tracks can be built into program design for forested areas.

Meek et al. (2013) have published a design for a security box so that remote cameras can be used for monitoring in areas where there is a high risk of theft or damage to the camera.

Another monitoring technique that has improved significantly in the last five years is the monitoring of individual animals through tracking collars. GPS loggers are now inbuilt into many collars and can give accurate positional fixes of the animals at regular intervals. This is particularly valuable for improving our understanding of how foxes use the landscape – both in a spatial sense and a temporal sense. In turn, this information will allow refinement of techniques such as bait placement or trap location.

Berry et al. (2012) used a non-invasive DNA technique to measure the change in fox density after baiting. Fox hairs were collected from hair snares three times pre-baiting and once after baiting. Analysis of the DNA from the fox hairs allowed for an accurate count of the number of foxes visiting the hair snare sites. This provided an average of 0.73 foxes per square kilometre prior to baiting and 0.004 foxes per square kilometre after baiting. Berry et al. (2012) conclude that this is significantly more effective in determining abundance than conducting a trapping program with 28 % of trap nights yielding suitable samples.

The fox eradication program in Tasmania is using DNA analysis of fox scats to determine the number and location of individual foxes. The DNA analysis has been able to confirm there are at least 16 individuals out of the 61 scats containing fox DNA (Invasive Animals Cooperative Research Centre, 2013) showing that, together with the other monitoring tools being used, there is a viable population in the state. The Invasive Animals Cooperative Research Centre has this project as an ongoing research project in the 2012-17 extension of the cooperative research centre. The Land Pest Products and Strategies program has under outcome 1 (no new vertebrate pests established in Australia) the project of 'Technologies and strategies for long-term Tasmanian fox incursion response' (Invasive Animals Cooperative Research Centre, 2010). The project includes: next generation invasive carnivore detection tools, techniques and strategies including DNA and other detection techniques; detection thresholds through telemetry and detection probability analysis; risk and long term strategic planning.

The Tasmanian Fox Eradication Program is using odor detection dogs to search for sign of foxes, such as scats, in the current landscape scale strategic monitoring phase.

Diment (2010) determined that scat density counts were useful in Far East Gippsland, Victoria for determining fox abundance, and that DNA analysis of the scats provided another level of information on individual fox ranges.

Land managers are also still reliant on the use of sand pads to indicate the presence or absence of foxes, and often deploy them on management trails where a sandy substrate exists. It should be noted that sand pads require the right conditions (e.g. three-four days of consecutive data, and no vehicles, rain or wind on the sand pads) to get robust information. Informal monitoring such as the visual sighting of foxes and road-kill foxes are also an indicator of presence for land managers.

The Invasive Animals Cooperative Research Centre (McLeod L. 2013) has released a glovebox guide for managing foxes that provides land managers with information about how to identify fox prints and how to work out whether predated animal carcasses (e.g. lambs) have been attacked by foxes or another animal. This new publication is based on the more detailed Monitoring techniques for vertebrate pests: foxes (Mitchell & Balogh, 2007), which provides land managers with detailed information about how to undertake spotlighting, bait station monitoring, track counts, scat counts, den counts, capture-recapture, trapping and telemetry, and genetic sampling.

Vine et al. (2009) undertook a study in 2003-04 on the southern tablelands of New South Wales to compare sampling effort and detection methods for foxes. While some of the specific findings about camera traps and hair traps have been superseded (see Towerton et al. (2011) and Berry et al. (2012)) they found significant differences between the four methods used over the seasons. Spotlighting efficiency peaked in autumn and was least efficient in winter whereas genetic sampling of scats is least effective in summer due to the breakdown of the scats.

It is concluded that this performance indicator has been met as reliable fox monitoring techniques are available for land managers to use, even at low densities, and that the technology is likely to improve in the future. The examples provided in this review are of best-practice, peer-reviewed use of the techniques. It will be important to ensure that all users of new techniques and technology, such as remote cameras, understand how to correctly interpret data. For example, whether your camera is measuring a change in occupancy based on actual fox abundance, or the detectability of foxes. A change in season may move foxes away or towards a set of cameras.

As such, while it is concluded that performance indicator one of reliable fox monitoring is met, this is an open-ended performance indicator and more could, and needs to, be done.

### **Action 3.2 Predator interactions - native carnivores**

Limited studies have been undertaken on the interaction between foxes and quolls, the main native predator that is in competition for prey with the fox. Glen and Dickman (2008) undertook a study of diets and spatial overlap of spotted-tailed quolls (*Dasyurus maculatus*), foxes and dogs in north-eastern New South Wales. While only one fox was collared so no meaningful spatial data was obtainable, sample sizes of scats were adequate to do a dietary comparison. There was extensive overlap in diet between the three species with medium sized mammals (rabbits, red-necked pademelons and bandicoots) dominating all diets. Foxes took proportionally more small mammals than quolls (antechinus, rats etc) and fewer insects. Glen and Dickman (2008) conclude that control of foxes and dogs would benefit the spotted-tailed quoll through greater food resource availability. Further modelling by Glen and Dickman (2013) suggested that high densities of predators competing could drive some quoll populations to extinction. Experimental evidence is required for this hypothesis.

Control programs for foxes and wild dogs, especially ones where the bait is surface laid (e.g. aerial baiting), may put individual quolls at risk by consuming baits. Claridge et al. (2006) undertook a non-toxic study of surface bait consumption and determined 47% of spotted-tailed quolls (*Dasyurus maculatus*) took one or more surface baits. It should be noted that the baits were delivered at a higher density in this study than is normal for a control program for foxes or wild dogs. An earlier study by Körtner and Watson (2005) radiotracked 36 spotted-tailed quolls (*Dasyurus maculatus*) after aerial baiting with nine mortalities – only one of which could be confirmed as due to the 1080 toxin. Five quolls consumed baits and survived. Körtner and Watson (2005) propose that there may also be a developed or innate avoidance of 1080.

*The following paragraph has been added post-Ministerial noting of the review to incorporate key research missed during the review and clarify current knowledge regarding the potential risk to spotted-tailed quolls from aerial baiting with 1080.*

Further research by Körtner (2007) in the New England Tablelands, NSW and by Claridge and Mills (2007) in Kosciuszko National Park, NSW radiotracked the fate of spotted-tailed quolls after aerial baiting with the 1080 toxin. Both studies used a tracking dye, rhodamine-B, to determine which quolls consumed baits and survived when they were re-trapped 5+ weeks after baiting. The results showed that spotted-tailed quolls are more resilient to the toxin in a bait in the field than sensitivity tests have suggested. Körtner (2007) measured 19 quolls post-baiting and determined 68% had eaten baits and survived, with multiple bait takes being common. Claridge and Mills (2007) measured 19 quolls post-baiting and determined 33% had eaten baits and survived. Of the mortalities during the two trials, post-mortems showed no deaths due to the 1080 toxin. It is concluded from these three studies that quolls are likely to consume baits during aerial baiting but that they may be more tolerant to the doses required in these baits for foxes and wild dogs and not be poisoned.

These studies of the interaction of foxes, spotted-tailed quolls and control programs highlight the dietary overlap. Baiting control programs for foxes may assist quolls but they need to be carefully designed so as to ensure no ill effects on quoll populations, especially where they are small or fragmented.

Sutherland et al. (2010) considered dietary overlap of varanid species and mammalian carnivores, including foxes. The overlap is considerable and Sutherland et al. (2010) highlight the need for this to be considered when managing predators for fauna conservation.

Byrant (2012) studied the south-west carpet python (*Morelia spilota imbricata*) as a native mesopredator that may be affected by foxes. Two study sites, one in a fox baited and one in a non-baited area were used and the pythons were monitored for three years. These pythons and foxes share similar prey resources. Byrant (2012) did not find any temporal segregation by pythons to avoid foxes but microhabitat use was different between the sites with higher and longer use of tree hollows in the unbaited site. Byrant (2012) suggests the pythons are retreating to the tree hollows when they are most vulnerable to direct fox predation (i.e. when they are less capable of quick movement).

The establishment of foxes in Tasmania, be it currently at a low population density, means that the impact of predation by foxes on native wildlife will need to be managed in the future. Hughes et al. (2011) undertook a preliminary study on the palatability and possible effects of fox baiting on the Tasmanian devil. The field study determined that devils will consume

surface laid baits and dig up accessible baits (5 cm burial depth). Deep burial (15 cm) posed a lower but still significant bait take. The study used non-toxic Foxoff® baits, but a calculated toxic dose is 1.4 baits for a median sized devil. Hughes et al. (2011) suggest further work needs to be done on burial depths that remain attractive for foxes and whether there is a depth for burial at which devils are not attracted.

It is concluded that there is a good understanding of the need to have knowledge of the interactions between foxes and native carnivores, and the way that these interactions then cascade through ecosystems. In particular, there has been an emphasis on the spotted-tailed quoll, although there is still a lot to understand for designing effective fox control programs where quolls exist. There has been less work done on other species so at this point in time it would be difficult to conclude the performance indicators two and three (integration of control methods for pest species and the unintended effects of fox control are minimised) have been met with respect to native carnivores.

### ***Action 3.3 Predator interactions - Feral cats, wild dogs and rabbits***

Note that, for the purposes of this review, wild dogs, dingoes and their hybrids are considered to be the same.

Buckmaster (2011), as part of his PhD research considered the way that feral cats used their home range. GPS tracking of feral cats provided point data on the parts of the home range being utilised. Trapping of small mammals indicated sufficient food resources were available across the entire range. Buckmaster (2011) hypothesised that avoidance of foxes and wild dogs (intraguild predators) may be suppressing the use of part of the home range while food resources are sufficient. There were both wild dogs and foxes in the area at the time as the capture of 10 wild dogs and 9 foxes, as well as the predation of one radio-collared cat, indicated.

The development of fox and wild dog specific control devices such as the mechanical ejector (Invasive Animals Cooperative Research Centre, 2012) have the potential to release feral cats from predation and competition pressure. Land managers will need to ensure the potential impacts of this are considered. Objective four provides more detail on these devices.

The threat abatement plan notes the use of exclusion fences to exclude foxes will also exclude cats and wild dogs, which may also be desirable for species threatened by predation. To date, where exclusion fences have been erected there has been a dire need to protect one or more species from predation – and often from all three predators. However, there may be some species contained within the fence that are successful in breeding to high populations that then create their own imbalance with no predation other than raptors. For example, the Arid Recovery reserve in South Australia has recently relocated a number of burrowing bettongs (*Bettongia lesuer*) because they were overpopulating the fenced reserve (Elliott, 2013).

Cupples et al. (2011) looked at dietary overlap between dingoes and foxes in three arid sites (c.f. Glen and Dickman (2008) above) through scat analysis. There was at least 85% overlap in diet at all the sites although, not surprisingly, dingoes consumed more large (>999g) and less small (<100g) mammals than foxes. Cupples et al. (2011) suggest that the dietary overlap could contribute to a suppressive effect of dingoes on fox abundances, as well as direct predation of the foxes. The results showed that rabbits were an important food item for both the dingoes and foxes and where rabbits were scarce in the Simpson Desert they consumed a greater portion of reptiles, invertebrates and rodents. Pavey et al. (2008) also noted the overlap in predation of rodents by the fox and dingo in central Australia. Overlap

was highest during a rodent irruption and Pavey et al. (2008) estimated that dingoes, foxes and cats together consumed 11 times the number of rodents as letter-winged kites (*Elanus scriptus*).

Johnston and VanDerWal (2009) analysed published data on fox and wild dog abundances in eastern Australian forests. They concluded that these data demonstrated a suppression of foxes by wild dogs such that: when wild dogs are abundant, foxes are consistently rare, while when wild dogs are rare, foxes may be abundant but not always so.

This is in contrast to the work of Mitchell and Banks (2005) in the Blue Mountains of New South Wales which found different responses to landscape use but no support for landscape-scale exclusion of foxes by wild dogs.

Letnic et al. (2009a) looked at the relationship between a rodent, *Notomys fuscus* or dusky hopping mouse, in the arid zone and dingoes, foxes, rainfall and other factors. The study considered abundances of the different animals on either side of the dog fence in the Strzelecki Desert. Long-term rainfall was an important relationship as was the presence of dingoes. There was a negative relationship with foxes and Letnic et al. (2009a) propose that the dingo as the top order predator is suppressing foxes (and cats) in a way that benefited the *N. fuscus*.

These examples from Johnston and VanDerWal (2009) and Letnic et al. (2009a) are studies that show suppression of foxes by wild dogs in these two situations, but whether this is widespread in the Australian landscape is highly contested. Allen et al. (2013) put forward the reminder that wild dogs (dingoes) also predate on native animals and given the high dietary overlap (Glen & Dickman, 2008) it is not surprising that they are also listed under the EPBC Act as a known or potential threat to 54 threatened species (Department of Sustainability, Environment, Water, Population and Communities, 2013). Further understanding of the complex interactions between the various carnivores (non-native and native) and their prey is needed in different environments to be able to accurately guide land managers in threatened species recovery.

A workshop of experts was held in October 2012 to have a facilitated discussion of predator and prey responses to lethal control of wild dogs, foxes and feral cats (Fleming, Ballard, & Allen, 2013). It concentrated on determining the expected trophic responses to lethal predator control. There was a focus on World Heritage Areas but the discussions were broader to encompass the ideas of control across tenures and the real constraints on some management techniques in World Heritage Areas. The experts agreed on a number of points including:

- It is more likely that there is an overlap in control techniques between foxes and wild dogs than other combinations (e.g. cats and foxes);
- The key factors in achieving control of predators were: controlling immigration; having a program on a sufficient scale to affect both individuals and the population; guild composition (especially the changes in Tasmania with the introduction of foxes and loss of Tasmanian devils); resource availability for the predators; topography and vegetation; temporal scale of the management program; and linking the management strategy with knowledge of the ecology of the affected species.
- There was debate about the control of dogs resulting in the release of foxes or the control of foxes. Some argued that foxes have a higher population growth and can recover from control programs quicker than dogs but others argued (from observation in north-east New



South Wales) that control programs can disproportionately affect foxes. A hypothesis was put forward that bait spread is an important factor in whether dogs or foxes are affected to a greater degree.

- It was suggested that dog control may allow foxes and cats greater access to optimal hunting areas, meaning that the post-dog-control impact from foxes on biodiversity is greater. This is in response to the direct dog-fox-cat agonistic behaviour.
- Tables were developed for single and multiple control programs suggesting the responses of both the predators and also non-target species (e.g. quolls, goannas and corvids). For foxes, a single event short term control is expected to control foxes, decrease wild dogs, keep cat populations the same, and have no impact on non-target species. For multiple events in the long term foxes and wild dogs will decrease, cats will be the same or increase, and non-target populations will increase with the exception of corvids which are expected to be unaffected.
- It was noted that for critical weight range species it is almost impossible to reduce predator densities (especially foxes and cats) low enough to benefit native fauna in the arid zone. This depends on the particular environment and whether refuges are available for the native species. It was noted that in areas where foxes are functionally or literally absent, the critical weight range animals are more abundant.

Climate change and the density of foxes has been modelled for NSW by Caley et al. (2011). They used four climate models to forecast density of foxes in 2050 and concluded that there will be some changes to the way foxes spatially utilise the landscape where they occur, although little or no reduced overall distribution is predicted. Increasing wild dog distribution and abundance is likely to have an impact on fox populations.

These studies demonstrate the work that is being done to understand the various predator interactions and the important effect that rabbits also have as a food resource to all the predators. Cupples et al. (2011) reinforces the concept of prey switching from rabbits to native animals. Land managers need to be cognisant of this when planning rabbit control programs, especially if the rabbit control is aimed at releasing small native rodents and invertebrates from competition.

In conclusion, there is some understanding of the interactions of foxes with cats and dogs but the hypotheses are highly contested. The role of dogs as top order predators and whether they should be controlled or not for conservation is driving the research. It is likely that a better understanding will come in future years. The challenge will be to integrate this knowledge into fox management programs. The interaction with cats and rabbits is also only partially known. As such, the two performance indicators (integration of control methods for pest species, and the unintended effects of fox control are minimised) have only partially been met and much more work is still required.

### ***Action 3.4 Unintended effects from fox control***

Unintended effects from undertaking fox control can range from the release of other invasive species including the mesopredator release of feral cats and the release of rabbits from predation pressure, to changes in other species interactions. The case study below provides an example of the latter.

There is lots of information available for land managers outlining the need to consider the release of rabbits from fox control programs. The Invasive Animals Cooperative Research Centre's (McLeod L. 2013) glovebox guide for managing foxes discusses the need for an integrated approach: "*Rabbits are a major food source for foxes. When rabbit numbers are low, fox numbers are also generally low. Controlling foxes without also controlling rabbits can lead to an increase in rabbit numbers, which can then allow a more speedy recovery for the fox population. By decreasing the amount of alternative food available, rabbit control can also increase the effectiveness of fox control programs.*"

### **Case study 3.1 Booderee National Park fox control program**

Booderee National Park, south coast of NSW, has undertaken fox control since 1999. As the park is on a peninsula it has provided a site where it is possible to reduce fox abundances to a very low level and control immigration through strategic placement of baits. Baiting occurred twice yearly at Booderee from 1999 to 2003, and since then at monthly intervals.

Monitoring of species occurs with the measurement of bait take being used as an index for fox numbers. Spotlight transect counts are used for other species. The bait take by foxes is now at a consistently low 1% of baits and the spotlight transects have shown a tenfold increase in the abundance of swamp wallabies (*Wallabia bicolor*), a prey item for foxes (Dexter, Ramsey, MacGregor, & Lindenmeyer, 2012).

There have been two unintended consequences of the fox control program on the ecosystem at Booderee. The first is the increase in abundance of the swamp wallaby which has led to heavy browsing of a wide range of plants, causing a change in the understory community from one dominated by a diverse community of angiosperms to one dominated by the unpalatable bracken fern (*Pteridium excultum*).

Dexter et al. (2012) speculate that the second unintended consequence is the decline and virtual disappearance of the greater glider (*Petauroides volans*). Spotlight transects did not detect greater gliders in 2007 to 2009 (Dexter, Ramsey, MacGregor, & Lindenmeyer, 2012). There are two hypotheses put forward.

The first is an increase in common ringtail possums (*Pseudocheirus peregrineus*) as they were released from fox predation pressure subsequently causing an increase in the powerful owl (*Ninox strenua*) population as the owls benefitted from an increase in their food resources. However, powerful owls forage by depleting arboreal marsupial populations from different parts of their very large home ranges in a systematic manner. The powerful owls would be taking greater gliders as well as the common ringtail possum causing the decline.

The second hypothesis is that there is competition from the common brushtail possum (*Trichosurus vulpecular*) for nest hollows. The common brushtail possum has also increased in abundance since fox baiting commenced.

Bushfires since the time when baiting for foxes commenced will have complicated the analysis of the data on animal abundances with Lindenmayer et al. (2008) finding the complication of feral animal control while studying the mammal responses to a large wildfire in 2003.

Dexter et al. (2012) undertook some fuzzy cognitive modelling to consider potential management solutions to the problem of these unintended consequences of the fox baiting

program, and specifically how to improve the understorey vegetation. They modelled responses of vegetation and various animal species to five management options: status quo with continued high levels of fox control; ceasing fox control; culling swamp wallabies and maintaining high levels of fox control; introducing dingoes and ceasing fox control; and introducing dingoes and maintaining fox control. The modelling was limited by a poor understanding of the interactions between the modelled taxa, despite Booderee being well studied. Only two of the options, culling swamp wallabies and introducing dingoes to predate on the swamp wallabies predicted an improvement in the vegetation. Dexter et al. (2012) note that ceasing fox control would also cause long-nosed bandicoots, common brushtailed possums, and diamond pythons to decline from increased predation pressure and/or competition. It needs to be noted that culling wallabies or introducing dingoes may not be considered acceptable management techniques for Booderee National Park.

In conclusion, most people consider changes to other predators and prey items as “unintended effects”. However, the Booderee National Park example shows the ecological systems in which fox control is being conducted is much more complex. At this point in time, managers conducting fox control programs are unlikely to be meeting the performance indicator of minimising unintended effects out of pure ignorance of what those effects may be.

### ***Action 3.5 Estimating the environmental and other associated costs***

Estimating the environmental costs of invasive species is a problem that has attracted many studies, and is also tied into the different methods used to value the environment. However, there has been little specific work undertaken to estimate the environmental costs of foxes in Australia.

The economic cost of foxes is most easily calculated for agricultural enterprises, especially lamb production. For example, Jones et al. (2006) undertook an evaluation of a coordinated fox baiting program in rural New South Wales. This established a mean benefit-cost ratio for lamb production of 13:1 with a very low probability of the program providing a negative economic return.

The Invasive Animals Cooperative Research Centre invested in a report by Gong et al. (2009) on the economic impacts of vertebrate pests in Australia. As with the Jones et al. (2006) report, this is mostly restricted to the direct economic impacts on agriculture and the expenditure by governments and landholders on pest management, administration and research. The New South Wales and Western Australian governments’ expenditure on conservation estate has been provided for 2007-08. For foxes this is \$1.27 million cost of direct management and fox threat abatement planning in New South Wales, and \$2.2 million in Western Australia. Overall losses to agriculture across of Australia are estimated at \$21.1 million from foxes.

The social impact of foxes in the Upper Hunter, New South Wales was considered by Fitzgerald and Wilkinson (2009). Foxes were considered to be the second most important problem animal, after wild dogs. The main issues were predation on sheep and poultry undermining the sustainability of sheep farming, and the recognised predation on native animals. Reduced farm income, financial and psychological stress were the main social impacts created by the fox problem.

In conclusion, there has been some work done considering primary production and social costs of foxes but there are no readily applied proxies to compare with environmental costs.

Further work is required in the broader environmental valuation space before this action can be completed.

## Conclusion

There has been considerable work undertaken to improve knowledge and understanding of fox impacts and interactions with other species and other ecological processes. In particular, the ways in which foxes can be monitored have improved with the use of remote cameras and GPS logging. The need to understand the interactions between various predators, both native and non-native, is driving many studies. It is anticipated that this momentum will see more published research in the next few years. In particular, the role of dingoes as an apex mesopredator and the possible suppression of foxes (and other predators) is still being extensively debated.

There is less published information on unintended effects of fox management but the examples that are available highlight the complexities of managing foxes where they have been long established in an ecosystem.

The only area where there has been little change in the level of knowledge is on the specific environmental and other associated costs of impacts arising from foxes.

The performance indicators for this objective have been partially met (mainly with the development of reliable monitoring methods), however, these are open-ended performance indicators and they could very easily be retained and be valid in the future. This conclusion also applied to the objective, with the acknowledgement that we do not have a comprehensive knowledge of foxes in the Australian landscape and further research is required.

## OBJECTIVE FOUR

The objective of *improve the effectiveness, target specificity, integration and humaneness of control options for foxes.*

### Actions

4.1 Conduct research and extension to improve the effectiveness, target specificity and humaneness of existing toxin-bait media and baiting methods.	High priority, long term
4.2 Conduct further work on the development of new, or improvements to existing, control techniques.	High priority, long term
4.3 Test and disseminate information on exclusion fence designs and other control methods regarding their cost-effectiveness for particular habitats or topography.	Low priority, medium term
4.4 Investigate the feasibility of control techniques to target foxes, but not dingoes, in some areas.	Low priority, long term
4.5 Develop training programs to help land managers identify locally appropriate control method(s) and when (i.e. circumstances and times) to apply them in controlling foxes.	High priority, short term
4.6 Ensure that habitat rehabilitation and management of potential prey, competitors and predators of foxes are considered in fox control programs.	Medium priority, long term
4.7 Continue to promote the adoption and adaptation of the model codes of practice and standard operating procedures for humane management of foxes.	High priority, long term

#### Performance indicators:

- Increased range of registered control techniques available for fox control.
- Widespread use of the most appropriate, cost-effective control methods, according to local conditions.
- Increased adoption and adaptation of the model codes of practice and standard operating procedures for the humane management of foxes, including their recognition as a reference under the National Competency Standards for Vertebrate Pest Management.

As with objective three, each action is discussed and a commentary about progress in meeting the performance indicators follows.

There has been considerable research undertaken since 2008 that meets this objective. The Invasive Animals Cooperative Research Centre has, in phase one (2005-2012): led the development of an additional new toxin for fox and wild dog control; researched fox ecology in response to lethal control; and developed new DNA monitoring techniques, which are being applied in the search for foxes in Tasmania. The second phase (2012-2017) is finalising the new toxin and furthering the technologies and strategies for the long-term Tasmanian fox incursion response. State governments are also working on control techniques with regional NRM groups, conservation agencies and land management groups.

#### ***Action 4.1 Research into effectiveness, target specificity and humaneness***

The Invasive Animals Cooperative Research Centre has been developing a new baiting product based on the toxin para-aminopropiophenone (PAPP) (Invasive Animals Cooperative Research Centre, 2012). The toxin is highly toxic to foxes, dogs and cats due to the unique way that they metabolise PAPP. Few native species show this degree of vulnerability to the toxin, however there are some (such as goannas) which are susceptible and some which could consume a toxic dose, especially for the higher dose dog baits, if enough of the bait was eaten. The animals in this secondary group, such as quolls, are more tolerant to the toxin on a milligrams of toxin per kilogram of body weight basis but are much smaller animals (e.g. an eastern quoll weighs between 0.9 and 1.3 kg, and a spotted tailed quoll is up to 4 kg while foxes range between 3 and 14 kg). In places where fox or dog control is being undertaken for conservation the new bait may still need to be buried, as is the case for 1080 baits, to prevent consumption by non-target species such as quolls.

The new toxin and bait both require registration through the Australian Government's Australian Pesticides and Veterinary Medicines Authority. An application to register the PAPP toxin active was submitted in March 2012 and the Foxecute® bait product registration application was submitted in June 2012.

As part of the development of the PAPP-based baits for foxes and wild dogs, an antidote has also been developed that can reverse the effects of the toxin. This provides a tool for farmers to use on their working dogs if they consume a bait.

The New South Wales National Parks and Wildlife Service has been trialling a mechanical ejector for a target specific alternative to buried baits. The mechanical ejectors are a metal tube buried into the ground, with a bait or attractant attached to the head. A dose of toxin is administered to the back of the mouth of the animal when it pulls on the head to remove the bait. The device is target specific to foxes and dogs through a spring loading that requires a pull that only these animals can apply. Non-target species such as quolls are unable to trigger

the device. At present the New South Wales National Parks and Wildlife Service has been trialling these devices using the toxin 1080 (NSW National Parks and Wildlife Service, 2010). But the mechanical ejector can be loaded with other toxins and PAPP and cyanide are being considered. Both of these toxins will need to be registered for use prior to them being made available to land managers. The NSW National Parks and Wildlife Service (2010) suggest the most benefit from ejectors will be gained in areas where foxes avoid or continually cache regular buried baits; long-term fox and wild dog control sites where resources do not allow continuous baiting or trapping; and to expand current programs to include areas where difficult or remote access restricts regular visits to bait stations.

There is significant concern about the humaneness of the toxin 1080 (Australian Pesticides and Veterinary Medicines Authority, 2007) and also of the non-target secondary poisoning potential. Poisoned animals collapse and convulse as the central nervous system is disrupted prior to death which has the appearance that the animal is suffering. However the animals are unresponsive to external stimuli, making an assessment of the humaneness difficult. Marks et al. (2009) undertook a study to see if analgesic or anxiolytic drugs are able to alter the possible suffering. Carprofen, copper indomethacin and buspirone were tested and carprofen and copper indomethacin reduced retching from the foxes and did not appear to affect the lethality. Copper indomethacin reduces the time to the onset of poisoning symptoms and death while carprofen reduces the overall intensity of the convulsions. Marks et al. (2009) suggest that copper indomethacin shows immediate potential to be used. However, at present these drugs are not available for addition to 1080 baits due to manufacturers' concerns in being associated with toxic baiting (pers. comm. Frank Gigliotti, 2012).

Diment (2010) monitored a fox baiting program in Far East Gippsland using remote cameras. In this study the baits were buried 10-15 cm deep in prepared plots. An analysis of the photographs taken of species that exhumed and consumed baits indicated in this forested environment that native rats, in particular *Rattus fuscipes* and *R. lutreolus*, took baits. While the baits were lethal to the rats on an individual level, the relative abundances of the rats mean there was no long-term impact on the populations.

In conclusion, the development of a bait containing PAPP is a large step forward in humaneness, although it is noted that this cannot replace 1080 in all situations. Other tools have been developed to improve target specificity. As such, this provides tools to help meet performance indicator two of the appropriate and cost-effective control method use.

#### **Action 4.2 Further work on improvements to control techniques**

The focus of the Invasive Animals Cooperative Research Centre has been on the development of the Foxecute® PAPP bait (Research program 2005-12 goal 1) described above.

Another line of recent research has been the development of devices, such as tunnels, with sensors at different heights to detect the passing of an animal. The intention is to be able to distinguish between dogs, foxes, cats and quolls based on animal height and leg height. If the sensors determine the animal to be the target species (e.g. fox) a toxic liquid will be sprayed on the animal to trigger a grooming reflex and cause ingestion of the toxin. This research is still underway by the Invasive Animals Cooperative Research Centre.

Padded leg-hold traps are a commonly used trapping device for foxes. These traps are generally considered to be humane if used in the appropriate way, which includes regular checking of traps. The Invasive Animals Cooperative Research Centre (2012) is developing a

lethal trap device to be fitted to the padded leg-hold traps to provide a rapid means of death. A lethal trap device consists of a tube of toxin (potentially cyanide) that will rupture on chewing by the trapped animal and deliver a toxic dose. This will improve the humaneness of the padded leg-hold traps as they will provide a rapid time to death.

Moseby and Hill (2011) looked at baiting design to control both feral cats and foxes around the predator exclosure at Roxby Downs, South Australia. Over four years it was determined that quarterly aerial baiting was required to suppress fox numbers as less frequently than this (e.g. annual baiting) allowed reinvasion of the area within four months. This study should assist land managers in planning of baiting programs.

Diment's (2010) study in Far East Gippsland of baiting design was able to confirm the efficacy of the Southern Ark program's 1 km spacing for buried bait stations. This was concluded by looking at the timing of fox visits to bait stations through remote camera photographs. Multiple baits were taken on about 50 % of the bait removals. Diment (2010) recommended a study into whether a 2 km spacing of bait stations in this environment may keep the same level of effectiveness of fox kill while being cheaper (fewer baits) and minimising the number of baits potentially cached by foxes that are then available to non-target species. The bait station spacing is also contingent on the shape of the track networks in an area to provide an overall density of baiting for an area (pers. comm. Alan Robley 2013).

Some agricultural studies have been conducted to maximise the effectiveness of fox control programs on lamb predation. The conclusions of these studies would also be applicable to fox control programs for biodiversity outcomes. Carter et al. (2011) looked at spatial coverage of baiting for foxes and how well this overlapped with fox home ranges. As with any baiting program there was a limited uptake by land holders so not all properties were baited. Six foxes were tracked with radio-tracking collars and these had on average about one third of their home range being baited and only two of the foxes consumed baits. The study concluded that alternative baiting strategies such as using roadside baiting may need to be considered to improve fox control in an agricultural landscape. This study by Carter et al. (2011) was part of research to improve fox management in agricultural landscapes inhabited by bush-stone curlews.

The use in agriculture of guardian dogs such as the Maremma breed to protect livestock from predation has moved into the area of threatened species protection. If a guardian dog can be bonded with a species that groups it may be an option to reduce predation. An example is from the Middle Island Maremma Project in Warrnambool in Victoria to protect little penguins (case study 1.1).

McLeod et al. (2010) looked at group participation in fox control programs in New South Wales. They found that the development of a high level of group participation in control programs improved both the spatial and temporal success of the program. Properties that had near neighbours (<2.5 km) participating in the program had a higher survival rate of lambs, and twice yearly baiting had higher lamb survival rates.

The findings from both Carter et al. (2011) and McLeod et al. (2010) would apply to the survival rates of threatened species where there are appropriate habitats across multiple land holders.

In conclusion, there is an increased range of fox control techniques either under development or close to registration in Australia. Most of these will not replace existing techniques but provide an additional tool. As such performance indicator one (increased range of registered

control techniques available for fox control) has been met and the challenge will be to ensure uptake. There will be an ongoing need for new tools and techniques to improve control of foxes.

#### ***Action 4.3 Information on exclusion fence designs and other control methods***

Exclusion fence designs have essentially standardised on models that are most effective in different situations. All of these designs have some sort of floppy or rolled top to prevent climbing over, and some sort of apron at the base to prevent digging under. The design of corners is particularly important as these provide more climbing opportunities. Some designs also incorporate electric wires to prevent the challenging of the fence itself.

Both Australian and New Zealand companies have designs that work for a variety of species including foxes. Western Australia has built a number of predator exclosures in the south-west to protect a number of their threatened species. Case study 2.1 provides some more detail on these projects. The Australian Wildlife Conservancy and other groups also use exclosures. Predominantly the use of exclusion fences has been to provide a predator-free area for animals to live where the threatened species are under sufficient pressure such that control programs in the open are insufficient, although in South Australia the exclosure is used as a hardening-off area prior to full release (see objective one).

The Department of Parks and Wildlife in Western Australia is embarking on a multi-species eradication on Dirk Hartog Island. While this does not include foxes (not present on the island), they will be using a fence across the middle of the island to break the area for eradication at one time in half. Assuming this works – and there are significant challenges including the design at the water's edge – the fence will provide another step forward in how to predator-proof areas. The fence building is scheduled to commence in 2014 (Department of Parks and Wildlife, 2009).

No specific work has been done on the cost-effectiveness of exclosure fences versus other control methods or in relation to particular habitats.

Alex Diment (2010) looked at fox ecology in response to lethal control in Far East Gippsland, Victoria. This project provides some insights into how and when foxes reinvade areas that have been subject to a control program and also considered native species' densities in both areas of control and outside these areas.

In conclusion, exclusion fence designs are now good and provide an effective barrier to foxes. There has been widespread adoption of the use of exclusion fences to create mainland 'islands'. As such, performance indicator two (widespread use of the most appropriate, cost-effective control methods, according to local conditions) has been met for this action. Fence designs now need to be extended to more challenging situations.

#### ***Action 4.4 Investigate the feasibility of control techniques to target foxes but not dingoes.***

In 2007 some work was commenced by Strive et al. (2007) considering immunocontraceptive responses in foxes. A valuable knowledge base was established on the reproductive biology, husbandry, biology and basic immunology of viral vectors in the fox. However, no further work has been conducted since this time.

Robley et al. (2011) have undertaken some research into scent marking by dingoes and how this provides a territorial boundary. Should this research lead to an understanding of what



chemical markers prevent the movement of dingoes, and possibly other carnivores such as foxes, it may provide an option as a control technique.

No other research has been identified on control techniques attempting to target foxes but not dingoes.

In conclusion, there has been very little research in this area and it has not contributed to meeting the performance indicators.

***Action 4.5 Develop training programs to help land managers identify locally appropriate control methods and when to apply them.***

Information is also provided against objective five in relation to formal pest management training programs and cooperative groups undertaking control programs.

The Invasive Animals Cooperative Research Centre has released a DVD on undertaking leg hold trapping for foxes (Invasive Animals Cooperative Research Centre, 2011). This aims to provide land managers with information about how to confidently incorporate trapping into a fox management program.

Specific programs controlling foxes for a particular threatened species use monitoring of foxes to tailor their programs. An example of this is from the Yathong Nature Reserve in western New South Wales (Wheeler & Priddel, 2009) where the authors released malleefowl (*Leipoa ocellata*) and brush-tailed bettongs (*Bettongia penicillata*). They found that intensive ground baiting of foxes was ineffective in mitigating the threat of predation by foxes but that broad-scale aerial baiting three times a year substantially enhanced malleefowl survival, at least during the first few years. Unfortunately the fox baiting has not concurrently controlled feral cats that also pose a threat to the malleefowl.

It is known that fox densities are often related to rabbit densities where rabbits are their predominant prey item. However, there is little direct information available for land managers on how rabbit control programs may affect fox numbers or densities.

Fox baiting in Australia is done using baits containing the toxin 1080. Being a toxin that is highly toxic to many species it is tightly regulated, both at the Australian Government level and also at the state/territory government level. Because of different circumstances in different states/territories (e.g. landscape type and use) there are necessarily differences in the regulation of the 1080 licences and application of baits. This can be confusing for stakeholders, particularly those who are trying to run cross-border, cross-tenure control programs.

In conclusion, there is lots of information available but it is difficult to know whether the performance indicator of widespread use of the most appropriate, cost-effective control methods, according to local conditions, has been met due to very little reporting on many control programs. Those receiving government grants may specify in grant applications which techniques are to be used but the onus tends to be on the proponent to ensure they are the most appropriate and cost-effective method.

***Action 4.6 Ensure habitat rehabilitation and management of potential prey, competitors and predators of foxes are considered in fox management programs.***

There are a number of examples (e.g. Byrant (2012), Cupples et al. (2011), Dexter et al. (2012), Fleming et al. (2013), Hughes et al. (2011), and Pavey et al. (2008)) from objective

three where the management of potential prey, competitors or predators of foxes has been included in studies. Current research and management practices consider this to be an essential element of any fox control program.

The Caring for our Country grants program of the Australian Government (Australian Government, 2013) has a compulsory monitoring, evaluation, reporting and improvement framework that is applied to all grants to ensure that there is a process of continual improvement. The monitoring that is required, tailored for each project, ensures that consideration is given to habitat rehabilitation and management of other potential consequences of a fox management program.

This action needs to be considered in tandem with objective three for the management of other species. That objective concluded, as is also concluded here, that the interactions with other species is complex and only partially understood. However, there are some guides for fox management programs to follow.

***Action 4.7 Continue to promote the adoption of model codes of practice and standard operating procedures.***

The model codes of practice and standard operating procedures were updated in 2012 and these are readily available for managers to use (Sharp & Saunders, Model code of practice for the humane control of foxes), (Sharp, Standard operating procedures: foxes, 2012-2013). Australian, state and territory governments continue to promote the model codes of practice and standard operating procedures. There is a process underway to seek endorsement of the various codes through the committees servicing the Primary Industries Standing Council.

The Australian Animal Welfare Strategy was developed in 2004 and continues to provide a broad standard for appropriate management of pest animals including foxes.

In conclusion, the performance indicator – of increased adoption and adaptation of the model codes of practice and standard operating procedures for the humane management of foxes, including their recognition as a reference under the National Competency Standards for Vertebrate Pest Management – has been met or is close to being met with updated procedures that the Vertebrate Pests Committee (representing all governments) is recommending to the Primary Industries Standing Council. Governments are committed to promoting the procedures and this will assist in their uptake by all fox control managers.

## **Conclusion**

It is concluded that there has been significant work, driven by the Invasive Animals Cooperative Research Centre's main goals in both the 2005-12 and 2012-17 research programs. This will deliver a more humane bait for broad-scale control of foxes and potentially other novel control methods. Leg-hold trapping humaneness may be improved with the use of lethal trap devices.

The use of exclusion fencing for the protection of threatened species is increasing with reserves across Australia. There are companies in both New Zealand and Australia who sell well-designed exclusion fences for a range of species including foxes.

There has been very little research conducted into the specific control of foxes while excluding dingoes, although as the evidence in objective three shows there is considerable research and

debate to understand the roles of wild dogs/dingoes, foxes and other species in the environment. It is expected that if appropriate when more knowledge is available the question of how to control of foxes without also negatively impacting on dingoes will be explored.

Actions 4.5 and 4.6 (regarding developing training programs to help land managers, and ensuring habitat rehabilitation and management of potential prey, competitors and predators of foxes are considered) overlap with objectives three and five, and much of the information found has been documented there. However, it should be noted that there is now lots of good information about how to develop and implement an effective fox control program and lots of people undertaking management who would be able to assist with advice on the establishment of new programs. Formal training is also available, although the delivery of this may still have some limitations with regard to location and skills of the trainers. See objective five for more detail.

Finally, the model codes of practice and standard operating procedures are current and governments are working towards ensuring these are used as appropriate in their own jurisdictions.

As such, the performance indicators have been met for this objective. That is, shortly, there will be an increased range of fox control products on the market, there has been promotion of best practice control methods for land managers to adopt, and the model codes of practice and standard operating procedures are current with a requirement to use in some form in all states and territories (noting this may vary by state or territory).

The specific actions under this objective could be updated to reflect the considerable progress made in this area and focus attention on the next step of improving the effectiveness, target specificity, integration and humaneness of control options as this will always be an objective of fox management.

## OBJECTIVE FIVE

The objective of *increase awareness of all stakeholders of the objectives and actions of the TAP, and of the need to control and manage foxes.*

### Actions

5.1 Promote: <ul style="list-style-type: none"> <li>• broad understanding of the threat to biodiversity posed by foxes and support for their control</li> <li>• support for the actions to be undertaken under this plan</li> <li>• the use of humane and cost-effective fox control methods</li> <li>• best-practice effective fox control in all tenures, and</li> <li>• understanding of predation by foxes as a key threatening process.</li> </ul>	High priority, long term
---	--------------------------

### Performance indicators:

- Increased proportion of fox control programs that use current best-practice techniques in fox control.
- Increased awareness of the threat posed by foxes.
- Increased awareness of the TAP actions and objectives.

### ***Formal training for stakeholders***

Formal training structures are an essential basis to increase awareness of best-practice management of foxes. These provide the foundation for broader education on the problem, and for gaining public and hence financial support for management programs.

In 2010 Brown and Munckton (2010) undertook a scoping study of vertebrate pest management training in response to a perceived reduction in appropriate management training over the last decade. The main finding of the study was a significant variation in the content and delivery of training, and disturbingly a large drop in the fieldwork component with training packages requiring none to only 50 contact hours on vertebrate pest management. Brown and Munckton (2010) found some increased demand for courses from Natural Resource Management boards in South Australia, but a greater need for participation by Indigenous land managers. Courses, such as 1080 licensing, can be prohibitive for some Indigenous land managers because of a high English literacy requirement. The strong link to weed management was identified as essential to be included in future courses in pest management.

There was a national curriculum course (AHC31810) Certificate III in vertebrate pest management developed in 2011, and updated in March 2013 that covers the requirements of someone seeking to work in vertebrate pest management. Twelve providers are registered to provide some units or all of the course, although these providers do not cover all states and territories (e.g. none registered in Tasmania). This is likely to limit the ability of some vertebrate pest managers to easily access formal training.

Brown and Munckton (2010) recognise the PestSmart education tools that the Invasive Animals Cooperative Research Centre has been developing for primary school (Pestales, Invasive Animals Cooperative Research Centre, no date) and secondary school (Feral Focus, Invasive Animals Cooperative Research Centre, no date) children as well as pest managers and other interested people. These websites provide resources for teachers linked directly to the national schools curriculum, and include fox information. For example there is a unit considering why foxes cannot be eradicated if thylacines were exterminated from Tasmania so quickly.

In conclusion, the performance indicator of an increased proportion of fox control programs that use current best-practice techniques in fox control is likely to have been met because there are many more resources available. However, there is very little information about what techniques are being used for most programs so it is not possible to accurately measure.

### ***Cross tenure or group management programs***

Management programs that involve groups, be it a cross-tenure land management program or a community group, raise general awareness of problems and can undertake appropriate management. Examples of cross tenure land management include Carter et al (2011) who looked at spatial coverage of baiting in south-east Australia in a management program involving a coordinated approach by 37.5% of the landholders in an area and used radio-collared foxes to demonstrate the effectiveness of their baiting program; McLeod et al. (2010) who demonstrated lamb survival rates related to spatial coverage of the fox control program in New South Wales; a program of urban, peri-urban and rural holdings across the Milton/Ulladulla region of New South Wales where the aim was to educate landholders about the impact of foxes on their business and establish a fox shooting control program (Invasive Animals Cooperative Research Centre, 2011); and an urban program in northern Sydney to reduce the number of foxes impacting on native species in local bush reserves which raised

community awareness of the problem but at the same time raised unrealistic expectations of the degree of control that was possible (Invasive Animals Cooperative Research Centre, 2012).

It is possible to assess these best-practice examples that are published and conclude that the performance indicators for objective five are being met. However, these are only a very small proportion of the fox control programs being undertaken and there is insufficient information about other programs to make an accurate assessment of performance.

### ***Other promotion***

The Invasive Animals Cooperative Research Centre has two videos on foxes, one on how to set foot-hold traps and the second on the development of the PAPP toxin bait for foxes (Lapidge, Braysher, & Sarre, 2004-present). There are also videos that cover techniques for both foxes and wild dogs including setting traps, lethal trap devices, and mechanical ejectors. The Invasive Animals Cooperative Research Centre also ran a series of workshops or road shows around all of Australia on best practice pest animal management in 2012.

The Australian Pest Animal Strategy (Natural Resources Management Ministerial Council, 2008) covers foxes and was promoted by the National Facilitator, Dr David Dall, from 2010-2013. This national strategy has the same principles for promotion of fox management as this objective. Caring for our Country program proponents were able to contact Dr Dall for advice on ensuring their fox management project was being undertaken in an appropriate manner during the grant application process.

There are codes of practice and standard operating procedures for foxes. The model code of practice (Sharp & Saunders, Model code of practice for the humane control of foxes, 2012) provides information about the appropriate and humane methods to manage foxes and the standard operating procedures (Sharp, 2012-2013) cover generic trapping using soft net traps and methods of euthanasia; and fox-specific trapping using padded-jaw traps, fumigation of fox dens using carbon monoxide, trapping of foxes using cage traps, ground shooting of foxes, ground baiting of foxes using 1080, and aerial baiting of foxes using 1080.

### **Conclusion**

There has been an increase in awareness raising materials since 2008 through the Invasive Animals Cooperative Research Centre's development of website and training materials. There is also better, standardised training more widely available for vertebrate pest management linked to the standard national curriculum. It is yet to be seen if this flows through to an increase in levels of fox control undertaken in a more effective and humane way. The PestSmart roadshows were very effective in reaching rural communities and promoting vertebrate pest management.

It is hoped that fox control programs will apply better practice due to the promotion of the model code of practice through the Invasive Animals Cooperative Research Centre, the Australian Pest Animal Strategy Facilitator and through a requirement of all Australian Government Caring for our Country applicants to use the code.

Evidence has not been found of any measurement of the degree of awareness of the threat posed by foxes or the threat abatement plan actions and objectives. However, it should be noted that this is difficult to measure in any meaningful way.

It can be concluded, as with all the other objectives, that some work has been undertaken to increase the awareness of all stakeholders of the threat abatement plan and the need to control and manage foxes. However, this work must be ongoing to ensure that stakeholders who have direct control of land understand the need so they actually participate in control programs, and those who don't have direct control have the understanding to drive a community expectation that foxes will be managed for biodiversity outcomes.

## CONCLUSIONS

This review has identified that since 2008 a lot of work has been put into fox threat abatement: research has been undertaken into foxes, priority threat abatement actions undertaken for threatened species, new control products developed, and education materials developed to train land managers and other stakeholders. Much of this work and subsequent positive outcomes would not have occurred without the investment in, and focus on fox management, by the Invasive Animals Cooperative Research Centre.

Specific conclusions against each objective have been outlined in each section. The actions occurring are appropriate to current thinking on how to undertake threat abatement for a species that cannot be eradicated. However, in terms of abating the threat to listed threatened species, a further 27 species have been added to the lists where foxes are considered to be a threat and none removed. Therefore it is concluded that the threat from the European red fox has not been abated and a threat abatement plan or alternative threat abatement strategy is still required.

## LOOKING FORWARD

While undertaking the review, a number of possible future actions for threat abatement were identified. These have been captured below. It is suggested that these concepts should be considered in a future strategy for threat abatement – be that a revised threat abatement plan, a strategy for threat abatement for predation by the fox or another document.

- The concept of identifying high priority sites at a state or regional level for threatened species, as has been done in NSW with their threat abatement plan, is useful. If other jurisdictions have not done this systematically, it may be helpful for their state planning and prioritisation of threatened species protection. It is acknowledged that most other jurisdictions have structured programs for the protection of native species from fox predation. While state-based processes have the potential to overlook nationally threatened species or sites, this is considered unlikely. It is also noted that the Australian Government is reliant on actions undertaken at a state or regional level to assist in abating the threat.
- Any systematic analysis of priority sites on a state or local level needs to be overlaid with management options – what is actually feasible in these areas, and then a dose of pragmatism about what can realistically be funded. It may be that not all sites should have the same level of control – what can be managed and is sufficient to abate the threat to a level that improves biodiversity outcomes. Effective monitoring is essential to understanding the level of management required.
- In the natural resource management and agricultural arena, it is important to understand some of the unintended consequences of management activities. For example, improving a patch of remnant bush or establishing a new planting may improve habitat for foxes as well as for native flora and fauna. There is potential that fox predation may undo the benefits of the improved flora.

- The concept of how agricultural landholders, especially those linked to natural resource management groups, are able to create landscape scale synergies in fox control programs that benefit both agriculture and biodiversity, should be captured. Consideration will need to be given to the threatened species being protected and their habitats in relation to agricultural lands.
- The concept of eradication of foxes from mainland islands is flawed (unless fenced). Instead the focus should remain on strategic eradication from offshore islands and the prevention of new incursions and establishments on other islands. Any island that is accessible needs to have robust measures in place to prevent reinvasion. Where necessary for threatened species protection, the further creation of fenced islands.
- It is noted that conservation management plans for islands normally have biosecurity contingency plans as part of the management strategy. However, this concept is still very important.
- There remains a need to apply incentives for fox management to promote cross tenure control. The challenge is how to best integrate the 'bottom-up' identification of the need for fox control by local land owners or conservation groups, with the 'top-down' national or state level identification of need for fox control, which is driven by protection of key threatened species. Both methods of identification are essential for a well-managed fox control system.
- A nationally or state coordinated standard or set of guidelines for fox control monitoring would benefit groups running fox control programs. The standards would need to include the monitoring of foxes as well as the monitoring of the threatened species being protected.
- In conjunction with the development of monitoring standards, is the need to provide stakeholders with the tools to understand monitoring results. In particular the use of remote cameras for monitoring needs to be combined with a statistically robust method for understanding the resulting data.
- The development of DNA techniques for use on scats has allowed researchers to refine population data for foxes. Continued use of this tool will improve understanding of foxes in the landscape and allow refinements to control programs.
- The Tasmanian fox eradication program has developed or refined techniques to detect foxes in very low densities. The findings from this program have the potential to be applied elsewhere in Australia, especially where it is necessary to control foxes to very low numbers to benefit a particular threatened species.
- Research into the interactions of foxes and other species, especially the role of wild dogs/dingoes, is at the stage of drawing out more questions than providing answers on control methods. Further research is required into the interactions of the various invasive carnivores (including dogs and cats), their interaction with native carnivores and also their interaction with other species. While the role of rabbits in providing a food source for foxes is known, more detail on the implications of the control of rabbits on fox populations and their alternative prey would be helpful for land managers.
- As with most of our invasive species, there has been little research into quantifying the environmental costs of foxes and translating this into a metric (e.g. dollars). This concept



is captured in the current plan and it should remain as a need for the future, but with the acknowledgement that broader environmental valuation techniques need to be developed and accepted before they can be applied to the benefits to biodiversity of fox control.

- While significant and important steps have been made in producing a new bait that is much more target specific and humane, these baits will still need to be buried in situations where there are native carnivores who may consume the bait. For efficiencies in human resources it would be desirable if the next step in research and development of baits allowed for broad-scale surface or aerial deployment.
- The concept that we need research into a biocontrol or fertility control for foxes remains. However, a future plan or strategy should not emphasise this at the expense of directing funding for improvements to other control methods.
- The delivery of training and materials for best practice methods for fox control now needs improvement.
- The Invasive Animals Cooperative Research Centre is funded until 2017. A legacy plan is already being considered by the CRC but this needs to be planned by all stakeholders including the Australian Government. In particular, research into control methods, and education have been areas where the CRC has made particular gains that should be built upon.

## WORKS CITED

Allen, B. L., Fleming, P. J., Allen, L. R., Engeman, R. M., Ballard, G., & Leung, L. K.-P. (2013). As clear as mud: A critical review of evidence for the ecological roles of Australian dingoes. *Biological Conservation*, 159, 158-174.

Australian Government. (2013, August 23). Retrieved 29 August 2013, from Caring for our Country: [www.nrm.gov.au](http://www.nrm.gov.au)

Australian Government Department of Sustainability, Environment, Water, Population and Communities. (2012, November 07). *Feral Animals on Offshore Islands database*. Retrieved 07 February 2013 from Australian Government Department of Sustainability, Environment, Water, Population and Communities: <http://www.environment.gov.au/biodiversity/invasive/ferals/islands/index.html>

Australian Government. (2013, August 23). *Monitoring, evaluation, reporting and improvement*. Retrieved 29 August 2013 from Caring for our Country: <http://www.nrm.gov.au/funding/meri/index.html>

Australian Pesticides and Veterinary Medicines Authority. (2007). *The reconsideration of registrations of products containing sodium fluoroacetate and approvals of their associated labels*. Canberra: Australian Pesticides and Veterinary Medicines Authority.

Australian Wildlife Conservancy. (no date). *Karakamia Sanctuary*. Retrieved 5 August 2013, from Australian Wildlife Conservancy: <http://www.australianwildlife.org/AWC-Sanctuaries/Karakamia-Sanctuary.aspx>

Berry, O., & Kirkwood, R. (2010). Measuring recruitment in an invasive species to determine eradication potential. *Journal of Wildlife Management*, 74 (8), 1661-1670.

Berry, O., Algar, D., Angus, J., Hamilton, N., Hilmer, S., & Sutherland, D. (2012). Genetic tagging reveals a significant impact of poison baiting on an invasive species. *The Journal of Wildlife Management*, 76 (4), 729-739.

Brown, M., & Munckton, C. (2010). *Scoping study: Training and capacity building in vertebrate pest management*. Canberra: Invasive Animals Cooperative Research Centre.

Buckmaster, A. J. (2011). *Ecology of the feral cat (Felis catus) in the tall forests of Far East Gippsland*. Sydney: PhD Thesis, University of Sydney.

Byrant, G. L. (2012). *Biology of the south-west carpet python (Morelia spilota imbricata): is there evidence for mesopredator release in response to fox baiting?* Perth: PhD Thesis, Murdoch University.

Caley, P., Tennant, P., & Hood, G. (2011). *Modelling the distribution of vertebrate pests in New South Wales under climate change*. PestSmart. Canberra: Invasive Animals Cooperative Research Centre.

Carter, A., Luck, G. W., & McDonald, S. P. (2011). Fox-baiting in agricultural landscapes in south-eastern Australia: a case-study appraisal and suggestions for improvement. *Ecological Management and Restoration*, 12 (3), 214-223.

Claridge, A. W., Murray, A. J., Dawson, J., Poore, R., Mifsud, G., & Saxon, M. J. (2006). The propensity of spotted-tailed quolls (*Dasyurus maculatus*) to encounter and consume non-toxic meat baits in a simulated canid-control program. *Wildlife Research*, 33, 85-91.

Claridge, A. W., & Mills, D. J. (2007). Aerial baiting for wild dogs has no observable impact on spotted-tailed quolls (*Dasyurus maculatus*) in a rainshadow woodland. *Wildlife Research*, 34, 116-124.

Cupples, J. B., Crowther, M. S., Story, G., & Letnic, M. (2011). Dietary overlap and prey selectivity among sympatric carnivores: could dingoes suppress foxes through competition for prey? *Journal of Mammalogy*, 92 (3), 590-600.

Department of Environment and Primary Industries. (2013, May 10). *Glenelg Ark*. Retrieved July 2013 from Victorian Government Department of Environment and Primary Industries: <http://www.dse.vic.gov.au/plants-and-animals/invasive-species/weeds-and-pests-projects/glenelg-ark>

Department of Environment and Primary Industries. (2013, May 10). *Southern Ark*. Retrieved July 2013 from Victorian Government Department of Environment and Primary Industries: <http://www.dse.vic.gov.au/plants-and-animals/invasive-species/weeds-and-pests-projects/southern-ark>

Department of Environment, Water and Natural Resources. (2013, July 23). *Bounceback*. Retrieved July 2013 from South Australian Department of Environment, Water and Natural Resources: [http://www.environment.sa.gov.au/managing-natural-resources/Ecosystem\\_conservation/Bounceback](http://www.environment.sa.gov.au/managing-natural-resources/Ecosystem_conservation/Bounceback)

Department of Environment and Conservation. (2013, July 1). *Western Shield*. Retrieved July 2013 from Western Australian Government Department of Environment and Conservation: [http://www.dec.wa.gov.au/management-and-protection/animals/index.php?option=com\\_content&view=category&id=299&Itemid=1631](http://www.dec.wa.gov.au/management-and-protection/animals/index.php?option=com_content&view=category&id=299&Itemid=1631)

Department of Parks and Wildlife. (2009). *Dirk Hartog Island Ecological Restoration Project*. Retrieved 28 August 2013 from Project Eden: <http://www.sharkbay.org/DHIERP.aspx>

Department of Primary Industries, Parks, Water and the Environment. (2013, June 26). *Tasmania's fox eradication program*. Retrieved 29 August 2013, from Invasive Species: <http://www.dpiw.tas.gov.au/inter.nsf/ThemeNodes/LBUN-96T3US?open>

Department of Sustainability, Environment, Water, Population and Communities. (2013, August 13). *Biodiversity Fund*. Retrieved 29 August 2013, from Department of Sustainability, Environment, Water, Population and Communities: <http://www.environment.gov.au/cleanenergyfuture/biodiversity-fund/index.html>

Department of Sustainability, Environment, Water, Population and Communities. (2013, July 16). *Species Profile and Threats Database - Petrogale lateralis lateralis - black-flanked rock wallaby*. Retrieved 2 August 2013 from Australian Government Department of Sustainability, Environment, Water, Population and Communities: [http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon\\_id=66647](http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66647)

Department of Sustainability, Environment, Water, Population and Communities. (2012, January 30). *Species Profiles and Threats Database*. Retrieved 29 August 2013, from

Department of Sustainability, Environment, Water, Population and Communities:  
<http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>

Department of Sustainability, Environment, Water, Population and Communities. (2013, January 25). *Species Profile and Threats Database*. Retrieved 13 August 2013 from Australian Government Department of Sustainability, Environment, Water, Population and Communities: [http://www.environment.gov.au/cgi-bin/sprat/public/publicspeciessearch.pl?new\\_facet=f%5Fthreat%5Fclass%3AInvasive+and+Other+Problematic+Species+and+Genes%3AInvasive+Non%2DNative%2FAlien+Species%3ACompetition+and%2For+predation%3ACanis+lupus+familiaris](http://www.environment.gov.au/cgi-bin/sprat/public/publicspeciessearch.pl?new_facet=f%5Fthreat%5Fclass%3AInvasive+and+Other+Problematic+Species+and+Genes%3AInvasive+Non%2DNative%2FAlien+Species%3ACompetition+and%2For+predation%3ACanis+lupus+familiaris)

Department of the Environment, Water, Heritage and the Arts. (2008). *Threat abatement plan for predation by the European red fox*. Canberra: DEWHA.

Dexter, N., Ramsey, D. S., MacGregor, C., & Lindenmeyer, D. (2012). Predicting ecosystem wide impacts of wallaby management using a fuzzy cognitive map. *Ecosystems*, 1-17.

Diment, A. N. (2010). *Monitoring the ecological impacts of invasive predator control*. Sydney: PhD Thesis, University of Sydney.

Ecosure. (2009). *Prioritisation of high conservation status of offshore islands*. Cairns, Queensland: Ecosure.

Elliott, S. (2013, August 08). *Winter bettong trapping at Arid Recovery*. Retrieved 12 August 2013 from Arid Recovery :  
[http://www.aridrecovery.org.au/\\_blog/Arid\\_Recovery\\_News/post/winter-bettong-trapping-at-arid-recovery/](http://www.aridrecovery.org.au/_blog/Arid_Recovery_News/post/winter-bettong-trapping-at-arid-recovery/)

Fitzgerald, G., & Wilkinson, R. (2009). *Assessing the social impact of invasive animals in Australia*. Canberra: Invasive Animals Cooperative Research Centre.

Fleming, P. J., Ballard, G., & Allen, B. (2013). *Interim report on: Predator-prey interaction review and workshop proceedings*. NSW Department of Primary Industries. Canberra: Invasive Animals Cooperative Research Centre.

Glen, A. S., & Dickman, C. R. (2008). Niche overlap between marsupial and eutherian carnivores: does competition threaten the endangered spotted-tailed quoll? *Journal of Applied Ecology*, 45, 700-707.

Glen, A.S., & Dickman, C.R. (2013). Population viability analysis shows spotted-tailed quolls may be vulnerable to competition. *Australian Mammalogy*, 35, 180-183.

Gong, W., Sinden, J., Braysher, M., & Jones, R. (2009). *The economic impacts of vertebrate pests in Australia*. Canberra: Invasive Animals Cooperative Research Centre.

Hughes, C., Gaffney, R., & Dickman, C. R. (2011). A preliminary study assessing risk to Tasmanian devils from poisoning for red foxes. *Journal of Wildlife Management*, 75 (2), 385-392.

Hunt, R. J., Dall, D. J., & Lapidge, S. J. (2007). Effect of a syntehtic lure on site visitation and bait uptake by foxes (*Vulpes vulpes*) and wild dogs (*Canis lupus dingo*, *Canis lupus familiaris*). *Wildlife Research*, 34, 461-466.

Invasive Animals Cooperative Research Centre. (2011, September). *Case study: Coordinated fox shooting program*. Retrieved 23 August 2012 from PestSmart: [www.feral.org.au/pestmart](http://www.feral.org.au/pestmart)

Invasive Animals Cooperative Research Centre. (2012, May). *Case study: foxes on Phillip Island*. Retrieved July 2013 from [www.feral.org.au/pestmart/foxes](http://www.feral.org.au/pestmart/foxes).

Invasive Animals Cooperative Research Centre. (2012, August). *Case Study: Northern Sydney regional fox baiting program*. Retrieved 23 August 2013 from PestSmart: [www.feral.org.au](http://www.feral.org.au)

Invasive Animals Cooperative Research Centre. (no date). *Feral Focus*. Retrieved 23 August 2013 from Feral Focus: <http://www.feralfocus.org.au/>

Invasive Animals Cooperative Research Centre. (2011, May). *Fox bounties*. Retrieved 5 August 2013 from Pest Smart: foxes: <http://www.feral.org.au/pestmart/foxes/>

Invasive Animals Cooperative Research Centre. (2012). *IA CRC Product Pipeline*. Retrieved 15 August 2013 from PestSmart: <http://www.feral.org.au/pestmart/foxes/>

Invasive Animals Cooperative Research Centre. (2010). *Land Pest Products and Strategies*. Retrieved 28 August 2013 from Invasive Animals Cooperative Research Centre: <http://www.invasiveanimals.com/research/phase2/land-pests/>

Invasive Animals Cooperative Research Centre. (no date). *Pestales*. Retrieved 23 August 2013 from Pestales: <http://www.pestales.org.au/>

Invasive Animals Cooperative Research Centre. (2011). *PestSmart DVD: Introduction to using foot hold traps for the capture of wild dogs and foxes*. Retrieved 29 August 2013 from PestSmart: <http://www.feral.org.au/ifoot-hold-traps-for-wild-dogs-and-foxes-dvd/>

Invasive Animals Cooperative Research Centre. (2013, May). *Pestsmart Foxes in Tasmania*. Retrieved 9 August 2013 from Pestsmart: <http://www.feral.org.au/pestsmart-foxes-in-tasmania/>

Johnston, C. N., & VanDerWal, J. (2009). Evidence that dingoes limit abundance of a mesopredator in eastern Australian forests. *Journal of Applied Ecology*, 46, 641-646.

Jones, R., Saunders, G., & Balogh, S. (2006). *An economic evaluation of a pest management control program: 'Outfox the fox'*. Orange: NSW Department of Primary Industries.

Kitchell, M., Braysher, M., Woolnough, A., & Cameron, E. (2013) *Fox Eradication Program review panel report*. Report for the Tasmanian Department of Primary Industries, Parks, Water and Environment.

Kortner, G., & Watson, P. (2005). The immediate impact of 1080 aerial baiting to control wild dogs on a spotted-tailed quoll population. *Wildlife Research*, 32, 673-680.

Kortner, G. (2007). 1080 aerial baiting for the control of wild dogs and its impact on spotted-tailed quoll (*Dasyurus maculatus*) populations in eastern Australia. *Wildlife Research*, 34, 48-53.

Lapidge, K., Braysher, M., & Sarre, S. (2004-present). *PestSmart: Foxes website*. (Invasive Animals Cooperative Research Centre) Retrieved 23 August 2013 from [feral.org.au: http://www.feral.org.au/pestmart/foxes/](http://www.feral.org.au/pestmart/foxes/)

- Letnic, M., Crowther, M. S., & Koch, F. (2009a). Does a top-predator provide an endangered rodent with refuge from an invasive mesopredator? *Animal Conservation*, 12, 302-312.
- Letnic, M., Koch, F., Gordon, C., Crowther, M. S., & Dickman, C. R. (2009b). Keystone effects of an alien top-predator stem extinctions of native mammals. *Proceedings of the Royal Society Biological Sciences*, 276, 3249-3256.
- Lindenmayer, D. B., MacGregor, C., Welsh, A., Donnelly, C., Crane, M., Michael, D., et al. (2008). Contrasting mammal responses to vegetation type and fire. *Wildlife Research*, 35, 395-408.
- Marks, C. A., Gigliotti, F., & Busana, F. (2009). Assuring that 1080 toxicosis in the red fox (*Vulpes vulpes*) is humane. II Analgesis drugs product better welfare outcomes. *Wildlife Research*, 36, 98-105.
- McLeod, L. (2013). *Glovebox guide for managing foxes*. Canberra, ACT: Invasive Animals Cooperative Research Centre.
- McLeod, L. J., Saunders, G. R., McLeod, S. R., Dawson, M., & van de Ven, R. (2010). The potential for participatory landscape management to reduce the impact of the red fox (*Vulpes vulpes*) on lamb production. *Wildlife Research*, 37, 695-701.
- Meek, P. D., Ballard, G.A., & Fleming, P. J. (2013). A permanent security post for camera trapping. *Australian Mammalogy*, 35, 123-127.
- Mitchell, B., & Balogh, S. (2007). *Monitoring techniques for vertebrate pests: foxes*. Orange, NSW: NSW Department of Primary Industries.
- Moseby, K. E., & Hill, B. M. (2011). The use of poison baits to control feral cats and red foxes in arid South Australia I. Aerial baiting trials. *Wildlife Research*, 38, 338-349.
- Mitchell, B. D., & Banks, P. B. (2005). Do wild dogs exclude foxes? Evidence for competition from dietary and spatial overlaps. *Austral Ecology* (30), 581-591.
- Natural Resources Management Ministerial Council. (2008). *Australian Pest Animal Strategy*. Canberra: Australian Government.
- Natural Resources South Australia. (2013). *NRM Community Grants*. Retrieved 5 August 2013, from Natural Resources South Australia: <http://www.nrm.sa.gov.au/Funding/CommunityGrants.aspx>
- NSW DECCW. (2010). *Draft Threat Abatement Plan for Predation by the Red Fox (Vulpes vulpes)*. Hurstville: New South Wales Department of Environment, Climate Change and Water.
- NSW National Parks and Wildlife Service. (2010, June). *Ejector field trial update No.4*. Retrieved 20 August 2013 from feral.org.au: [http://www.feral.org.au/wp-content/uploads/2011/07/M44newsletter4\\_June10.pdf](http://www.feral.org.au/wp-content/uploads/2011/07/M44newsletter4_June10.pdf)
- Pavey, C. R., Eldridge, S. R., & Heywood, M. (2008). Population dynamics and prey selection of native and introduced predators during a rodent outbreak in arid Australia. *Journal of Mammalogy*, 89, 674-683.

Premier of Victoria. (2013, January 13). *Media releases*. Retrieved 5 August 2013 from Coalition doubles bounty on wild dogs: <http://www.premier.vic.gov.au/media-centre/media-releases/5812-coalition-doubles-bounty-on-wild-dogs.html>

Red Card for Rabbits and Foxes program. (2013). *Red Card for rabbits and foxes*. Retrieved July 2013 from Red Card for Rabbits and Foxes program: <http://www.redcard.net.au/index.html>

Robley, A., Gormley, A., Albert, R., Bowd, M., Hatfield, C., McDonald, R., Scroggie, M., Smith, A., Thorp, A., & Warton, F. (2012). *Glenelg Ark 2005-2011: Evidence of sustained control of foxes and benefits for native mammals*. Arthur Rylah Institute for Environmental Research Technical Report Series No. 240. Department of Sustainability and Environment, Heidelberg, Victoria.

Robley, A., Lindeman, M., Dam, D., Cook, I. (2011). *Identification of semiochemical markers in dingo urine: Method development and qualitative comparisons*. Arthur Rylah Institute for Environmental Research Project Update Report. Department of Sustainability and Environment, Heidelberg, Victoria.

Sharp, T. (2012-2013). *Standard operating procedures: foxes*. Canberra: Invasive Animals Cooperative Research Centre.

Sharp, T., & Saunders, G. *Model code of practice for the humane control of foxes*. Orange: Department of Primary Industries, NSW.

Sharp, T., & Saunders, G. (2012). *Model code of practice for the humane control of foxes*. Department of Sustainability, Environment, Water, Population and Communities. Canberra: Invasive Animals Cooperative Research Centre.

Strive, T., Hardy, C. M., & Reubel, G. H. (2007). Prospects for immunocontraception in the European red fox (*Vulpes vulpes*). *Wildlife Research*, 34, 523-529.

Sutherland, D. R., Glen, A. S., & de Tores, P. J. (2010). Could controlling mammalian carnivores lead to mesopredator release of carnivorous reptiles? *Proceedings of the Royal Society Biological Sciences*, 1-9.

Towerton, A. L., Penman, T. D., Kavanagh, R. P., & Dickman, C. R. (2011). Detecting pest and prey responses to fox control across the landscape using remote cameras. *Wildlife Research*, 38, 208-220.

Vine, S. J., Crowther, M. S., Lapidge, S. J., Dickman, C. R., Mooney, N., Piggott, M. P., et al. (2009). Comparison of methods to detect rare and cryptic species: a case study using the red fox (*Vulpes vulpes*). *Wildlife Research*, 36, 436-446.

WA State NRM Office. (2013, February 03). *Grants page*. Retrieved 5 August 2013 from Natural Resource Management in Western Australia: <http://www.nrm.wa.gov.au/projects.aspx>

Warrnambool City Council. (2013). *Middle Island Mareema Project*. Retrieved 29 August 2013, from Warrnambool City Council: <http://www.warrnambool.vic.gov.au/index.php?q=node/943>

Wheeler, R., & Priddel, D. (2009). The impact of introduced predators on two threatened prey species: a case study from western New South Wales. *Ecological Management and Restoration*, 10 (S1), S117-123.

Wildlife Queensland. (2013). *Bridled Nailtailed Wallaby*. Retrieved July 2013 from Wildlife Queensland:

[http://www.wildlife.org.au/wildlife/speciesprofile/mammals/bridled\\_nailtail\\_wallaby.html](http://www.wildlife.org.au/wildlife/speciesprofile/mammals/bridled_nailtail_wallaby.html)

Wildlife Research Management. (2011, May 18). *Reconstructing the fauna of the central wheatbelt – reintroductions to Wadderin Sanctuary*. Retrieved 5 August 2013 from Wildlife Research Management: <http://www.wildliferesearchmanagement.com.au/wadderin.htm>



## APPENDICES

### Appendix A: Islands with foxes

ISLAND NAME	ALTERNATE NAME	ISLAND GROUP	STATE	PRESENCE	PRESENCE COMMENT	REFERENCE	COMMENT	DIST FROM MAINLAND (km)	LONG	LAT	ISLAND AREA (ha)
ANGEL ISLAND		DAMPIER ARCHIPELAGO	WA	ERADICATED	natural spread, eradicated 1989/90			1.61	116.805069	-20.493102	916.24
BAIRD ISLAND	UNNAMED ISLAND BAIRD BAY		SA	OCCASIONAL	May not be resident, accessing occasionally, only at low tide	SA Dept for Environment and Heritage, Introduced Animals on South Australia's Islands: Improving Australia's ability to protect its island habitats from feral animals, 2008	updated May 2010	0.63	134.283938	-33.081596	15.60
BENNISON ISLAND			VIC	ERADICATED		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		1.82	146.369386	-38.842375	5.74
BIG DOG ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		0.47	146.547659	-38.696694	134.52
BRIBIE ISLAND			QLD	PRESENT		Bell S, Le Grand J, Calvert M, Paping P, Bryant M (2008). Introduced animals on Queensland islands. Queensland Department of Primary Industries and Fisheries.		0.26	153.135368	-26.986692	14756.97
BROULEE ISLAND			NSW	PRESENT		NSW National Parks and Wildlife Service (2008). Broulee Island Nature Reserve Plan of Management. NSW National Parks and Wildlife Service.	updated November 2009. This island connected to the mainland.	0.28	150.187946	-35.857761	27.10

ISLAND NAME	ALTERNATE NAME	ISLAND GROUP	STATE	PRESENCE	PRESENCE COMMENT	REFERENCE	COMMENT	DIST FROM MAINLAND (km)	LONG	LAT	ISLAND AREA (ha)
BURNSIDE ISLAND			WA	PRESENT				0.46	114.510821	-22.102670	76.73
CAREY ISLAND		DAMPIER ARCHIPELAGO	WA	PRESENT	tracks			0.69	116.176323	-20.948129	71.57
CHINAMAN ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.	updated January 2010	0.26	145.311615	-38.238536	47.84
CHURCHILL ISLAND			VIC	ERADICATED		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		1.97	145.338998	-38.500787	58.69
COHEN ISLAND		DAMPIER ARCHIPELAGO	WA	PRESENT		Department of Conservation and Land Management (1990). Dampier Archipelago Nature Reserves Management Plan 1990-2000.	updated December 2009	15.09	116.805042	-20.386437	12.50
CURTIS ISLAND			QLD	PRESENT	eradication planned for 2006, presence to be confirmed	<a href="http://www.gbrmpa.gov.au/corp_site/info_services/publications/sotr/latest_updates/seabirds/response">http://www.gbrmpa.gov.au/corp_site/info_services/publications/sotr/latest_updates/seabirds/response</a>	updated February 2010	0.13	151.151976	-23.612381	57646.00
DEPUCH ISLAND		FORESTIER ISLANDS	WA	PRESENT	natural spread from mainland			2.71	117.725480	-20.632267	1136.56
DOG ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		0.16	146.718493	-38.677963	443.20
DOLPHIN ISLAND		DAMPIER ARCHIPELAGO	WA	ERADICATED	natural spread, eradicated 1980-85			0.38	116.853664	-20.484326	3306.03
DOWNES ISLAND			WA	PRESENT	tracks observed			0.11	118.512401	-20.315977	306.68

ISLAND NAME	ALTERNATE NAME	ISLAND GROUP	STATE	PRESENCE	PRESENCE COMMENT	REFERENCE	COMMENT	DIST FROM MAINLAND (km)	LONG	LAT	ISLAND AREA (ha)
					1995						
DREAM ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		0.55	146.853889	-38.653310	368.01
EAST BIRD ISLAND		BIRD ISLANDS	SA	OCCASIONAL	May not be resident, accessing occasionally, only at low tide	SA Dept for Environment and Heritage, Introduced Animals on South Australia's Islands: Improving Australia's ability to protect its island habitats from feral animals, 2008	updated May 2010	0.27	137.546914	-33.987175	1.63
EAST INTERCOURSE ISLAND		DAMPIER ARCHIPELAGO	WA	PRESENT	causeway to mainland 1963			1.36	116.683488	-20.653544	233.10
EAST SCRUBBY ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		0.72	146.805571	-38.662131	292.99
EBA ISLAND			SA	OCCASIONAL	May not be resident, accessing occasionally, only at low tide	Department for Environment and Heritage (2006). Island Parks of Western Eyre Peninsula Management Plan. Department for Environment and Heritage. Adelaide, South Australia.	updated May 2010	0.50	134.269705	-32.678351	99.67
FRANKLIN ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		0.05	146.274970	-38.698968	260.29
GARDEN ISLAND			WA	UNKNOWN	reported on causeway, but not established on island			2.09	115.676724	-32.201833	1209.45

ISLAND NAME	ALTERNATE NAME	ISLAND GROUP	STATE	PRESENCE	PRESENCE COMMENT	REFERENCE	COMMENT	DIST FROM MAINLAND (km)	LONG	LAT	ISLAND AREA (ha)
GERMEIN ISLAND			SA	OCCASIONAL	May not be resident, accessing occasionally, only at low tide	SA Dept for Environment and Heritage, Introduced Animals on South Australia's Islands: Improving Australia's ability to protect its island habitats from feral animals, 2008	updated May 2010	0.58	134.674519	-33.209208	197.15
GIDLEY ISLAND		DAMPIER ARCHIPELAGO	WA	ERADICATED	natural spread, eradicated 1980, reinvaded? baited 1989, now absent			6.12	116.818135	-20.450485	848.21
GRANITE ISLAND			SA	PRESENT		SA Dept for Environment and Heritage, Introduced Animals on South Australia's Islands: Improving Australia's ability to protect its island habitats from feral animals, 2008		0.52	138.630164	-35.564364	27.87
GRIFFITH ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.	May be considered as mainland - connected by a land bridge	0.00	142.246532	-38.393878	61.98
HAUY ISLAND		DAMPIER ARCHIPELAGO	WA	ERADICATED	eradicated 1980s			14.09	116.967278	-20.434214	103.05
HINCHINBROOK ISLAND			QLD	PRESENT		<a href="http://www.derm.qld.gov.au/wildlife-ecosystems/wildlife/wildlife_online/generate_a_species_list_for_a_selected_area.php#selected_area">http://www.derm.qld.gov.au/wildlife-ecosystems/wildlife/wildlife_online/generate_a_species_list_for_a_selected_area.php#selected_area</a>	Updated February 2010	0.72	146.235736	-18.355248	39613.40
HOPE ISLAND			WA	PRESENT			May be considered as mainland	0.00	114.474783	-22.170485	690.72

ISLAND NAME	ALTERNATE NAME	ISLAND GROUP	STATE	PRESENCE	PRESENCE COMMENT	REFERENCE	COMMENT	DIST FROM MAINLAND (km)	LONG	LAT	ISLAND AREA (ha)
HUNTER ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.	May be considered as mainland	0.00	146.770129	-38.656051	196.66
ISLAND POINT			SA	PRESENT	one recently sighted	Department for Environment and Heritage (2009). Althorpes Islands, Goose Island and Troubridge Island Conservation Parks Management Plan. Department for Environment and Heritage.	updated November 2009	0.07	137.413249	-34.443828	3.71
KANGAROO ISLAND	BOONNAHBAH		QLD	PRESENT		Point location data held by DEWHA	updated January 2010	0.28	153.382465	-27.770602	644.19
KEAST ISLAND		DAMPIER ARCHIPELAGO	WA	ERADICATED	natural spread, eradicated			13.85	116.830969	-20.389694	40.60
LEGENDRE ISLAND		DAMPIER ARCHIPELAGO	WA	ERADICATED	natural spread, eradicated 1980			13.34	116.879671	-20.386310	1320.15
LITTLE DOG ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		0.35	146.562307	-38.689298	75.72
LITTLE SNAKE ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		0.94	146.466234	-38.718617	532.22
MACKENZIE ISLAND			QLD	PRESENT		Point location data held by DEWHA	updated January 2010	0.40	150.862491	-23.511165	170.88
MANGROVE ROOT ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		2.34	146.730781	-38.684777	9.33

ISLAND NAME	ALTERNATE NAME	ISLAND GROUP	STATE	PRESENCE	PRESENCE COMMENT	REFERENCE	COMMENT	DIST FROM MAINLAND (km)	LONG	LAT	ISLAND AREA (ha)
MERRI ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		0.05	142.470866	-38.402246	0.11
MIDDLE GIDLEY ISLAND		DAMPIER ARCHIPELAGO	WA	ERADICATED	natural spread, eradicated ca 1989, now absent			9.23	116.822604	-20.424189	230.82
MIDDLE ISLAND			VIC	PRESENT	absent since introduction of maremma guard dogs	Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		0.16	142.471921	-38.403534	1.15
MUTTONBIRD ISLAND			NSW	ERADICATED			This island connected to the mainland	0.00	153.151584	-30.305132	11.74
NORTH STRADBROKE ISLAND			QLD	PRESENT		Bell S, Le Grand J, Calvert M, Paping P, Bryant M (2008). Introduced animals on Queensland islands. Queensland Department of Primary Industries and Fisheries.		3.56	153.454366	-27.545639	26948.97
PHILLIP ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		0.44	145.240868	-38.490601	10129.07
PIGFACE ISLAND			SA	PRESENT		SA Dept for Environment and Heritage, Introduced Animals on South Australia's Islands: Improving Australia's ability to protect its island habitats from feral animals, 2008		0.56	134.278017	-32.695284	7.13
QUAIL ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		0.26	145.292385	-38.233605	533.28

ISLAND NAME	ALTERNATE NAME	ISLAND GROUP	STATE	PRESENCE	PRESENCE COMMENT	REFERENCE	COMMENT	DIST FROM MAINLAND (km)	LONG	LAT	ISLAND AREA (ha)
REEF ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		0.30	145.407799	-38.469470	10.32
SLOPE ISLAND			WA	PRESENT				2.06	113.414328	-26.090609	1.93
SNAKE ISLAND	LA TROBE ISLAND		VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		2.35	146.536051	-38.756499	4461.49
SOUTH STRADBROKE ISLAND			QLD	PRESENT		<a href="http://www.goldcoast.qld.gov.au/attachment/environment/south_stradbroke_management_flora.pdf">http://www.goldcoast.qld.gov.au/attachment/environment/south_stradbroke_management_flora.pdf</a>	Updated February 2010	0.22	153.424613	-27.838412	2022.52
ST MARGARET ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		0.09	146.832056	-38.629191	1888.99
SUNDAY ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		1.32	146.631351	-38.710538	1192.36
SWAN ISLAND			VIC	PRESENT		Johnston, M, (2008), Introduced animals on Victorian islands: improving Australia's ability to protect its island habitats from feral animals. Department of Sustainability and Environment.		0.61	144.680645	-38.248059	289.26
TENT ISLAND			WA	PRESENT				0.30	114.524980	-22.024407	1911.98
TORRENS ISLAND			SA	PRESENT	Problem to bird breeding on nearby sand bar: Greg Johnson 2007.	Peter Canty (SA DEH) pers comm. May 2010		0.36	138.528183	-34.789935	747.85

ISLAND NAME	ALTERNATE NAME	ISLAND GROUP	STATE	PRESENCE	PRESENCE COMMENT	REFERENCE	COMMENT	DIST FROM MAINLAND (km)	LONG	LAT	ISLAND AREA (ha)
WEDGE ISLAND			WA	PRESENT	natural spread			0.27	115.188903	-30.828494	5.91
WEST BIRD ISLAND		BIRD ISLANDS	SA	PRESENT		SA Dept for Environment and Heritage, Introduced Animals on South Australia's Islands: Improving Australia's ability to protect its island habitats from feral animals, 2008		0.21	137.537684	-33.984855	63.96



## **Appendix B: High priority offshore islands with foxes**

Bribie Island, Queensland  
Curtis Island, Queensland  
Dream Island, Victoria  
East Intercourse Island, Dampier Archipelago, Western Australia (top 100, lower 50)  
East Scrubby Island, Victoria  
Franklin Island, Victoria (top 100, lower 50)  
Hinchinbrook Island, Queensland (top 100)  
Little Snake Island, Victoria (top 100, lower 50)  
North Stradbroke Island, Queensland (top 100)  
Phillip Island, Victoria (top 100)  
Quail Island, Victoria (top 100)  
Snake Island, Victoria (top 100, lower 50)  
St Margaret Island, Victoria (top 100, lower 50)  
Sunday Island, Victoria (top 100, lower 50)  
Swan Island, Victoria (top 100)

Data from the Prioritisation of high conservation status offshore islands (Ecosure, 2009).

## Appendix C: Caring for our Country projects with a fox component

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2008-09	.	NSW	Central West Catchment Management Authority		Activities include protecting native vegetation and fauna on private and public land and controlling foxes and other pests. Priorities also include identifying fragile groundwater dependent ecosystems for conservation and supporting farmers in their adoption of sustainable practices including improving soil health and controlling weeds.	3,240,000
2008-09	.	NSW	Western Catchment Management Authority		A significant priority is improving native pasture and groundcover on grazing land and mitigating the spread of invasive scrub. Other activities include controlling pig, fox and wild dog populations and implementing voluntary conservation management plans along 32 kms of priority river corridors.	2,400,000
2008-09	.	QLD	QMDC Inc	.	Activities include controlling feral pigs, cats, foxes and aquatic pests such as mosquito fish and European carp. Other priorities include improving ecosystem connectivity, increasing the extent of remnant vegetation, improving wetland health and treating erosion on agricultural land.	2,640,000
2008-09	.	SA	SA Arid Lands NRM Board		Activities to assist Indigenous and non-Indigenous land managers to improve their management of pest animals and plants (such as Opuntia) in the rangelands to reduce their impact and spread. This will be supported by development of cross-regional strategies to manage large vertebrate pests (camels, donkeys and horses) and feral cats and foxes. The effect of dingo management on stock losses will be investigated and land managers will be supported to improve protection of threatened species (such as the yellow-footed rock wallaby), remnant vegetation and biodiversity. The Arid Recovery program at Roxby Downs will be supported in partnership with industry and the community.	1,800,000
2008-09	.	SA	South East NRM Board		This project focuses on restoring several wetlands, investigating salt water intrusion into aquifers, improving the health of Lake George, encouraging sustainable water use and assist protecting Blue Lake. It will investigate changes to soils resulting from the Upper South East drainage system and the best pastures to grow, and will improve management of soil salinity for wine quality at Padthaway. The project will develop an information system on fire history and an invasive species biosecurity strategy, assist recovery of threatened species, and will undertake control of deer, foxes and Weeds of National Significance.	2,612,000

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2008-09	CC083625	NSW	Randwick City Council	Bumborah Point bushland restoration project	The project will improve the flora and fauna habitat of Bumborah Point by removing weeds, including primarily Bitou bush, installing soil erosion control measures and revegetating. Standard bush regeneration techniques will be applied. Bumborah Point is located on the northern shores of Botany Bay just east of Sydney Ports. It is the last section of the Botany Bay foreshore under Randwick Council's (RCC) care, to be restored. Botany Bay is an identified State biodiversity hot spot. Bumborah Point is also a significant section Randwick City's Coastal Fauna Corridor, linking Yarra Beach dunes to the east to the weedy, but useful fauna habitat, on Sydney Electricity and Crown land to the North West. This project will build on Bitou bush control work commenced in 2007 by RCC with Dept Primary Industry funding. It will include primary and secondary weeding in remnant soils and revegetation in areas without a seed bank. Fox and stray cat control will also be continued.	37,018
2008-09	CC082627	NSW	Mates Of The Manning	Endangered shorebird program	This project will minimise disturbance to shorebird nesting sites and dovetails with the current management of endangered shorebirds such as the Little Tern, Pied Oystercatcher, and Beach-stone Curlew in the Manning River estuaries. Signage will be erected that better illustrates this issue and educates the public on correct behaviour when using these areas recreationally. The project also entails increased fox control measures in the form of year-round baiting. Educational resources will be developed for handout at school talks and various market days, as well as mass mailing to the surrounding townships. Further fencing will be undertaken to assist in minimising human and vehicular access and subsequent disturbance to nesting sites. Removal of Bitou bush from sites, with vegetation manipulation as required, will improve habitat for the three endangered shorebird species.	22,127
2008-09	CC085052	NSW	Southern Rivers Catchment Management Authority	Long-nosed potoroo and threatened shorebird recovery at Tanja (Please read 'Potoroo and shorebirds at Tanja1.pdf' before this one)	This project will significantly augment the Threatened Shorebird Recovery Program in the Wapengo area and in doing so expand and protect a population of the Nationally Threatened Long-nosed Potoroo occupying adjacent sand forest and coastal heath habitats. The project will communicate to National Resource Management agencies and landholders 'best practice' in fox control for the protection of ground dwelling native animals. The Long-nosed Potoroo is endemic to the coastal vegetation of the south-east corner of Australia and is preyed upon by the Red Fox. The latest Fox Threat Abatement Plan review on the Shorebird program indicates that wider fox control is required. There are many examples across the country of ongoing fox control efforts that have little or no benefit to biodiversity. The project will define for the local community, local government and state NRM agencies best practice fox control for the purposes terrestrial biodiversity protection.	25,127

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2008-09	CC085361	SA	Back Beach (Sa) Pty Ltd Atf Back Beach Property Trust	Feral flora and fauna control at Back Beach, Streaky Bay	The purpose of this project is the control of African Boxthorn infestations and feral foxes and cats around Hawley Farm in the Back Beach area of Streaky Bay. The project will increase the opportunity for native flora and fauna to recolonise this property and the adjacent coastal Conservation lease area. It will combat the effects of habitat degradation caused by Boxthorn infestation and feral species predation and competition, exacerbated by the drought. The anticipated outcomes of this project include a contribution to existing feral flora and fauna programs within the Cape Bauer and greater Eyre Peninsula region, such as The Cape Bauer Group Project; and the Eyre Peninsula. Integrated Pest Management Program increased habitat availability for native flora and fauna species through the removal of large stands of African Boxthorn. Reduction in predation by foxes and cats on native species of birds, kangaroos and wallabies and other small mammals, as well as reduced predation on production lambs and reduction in food supply and habitat for invasive species.	20,205
2008-09	CC083683	SA	South East Natural Resources Management Board	Threat abatement for key habitat of migratory and threatened shorebirds in south east of South Australia	This project will abate the threat of feral animals, particularly foxes and cats, to migratory shorebirds and their nesting habitat through an intensive and collaborative management program spanning the coastal reserves and adjoining agricultural land.	151,341
2008-09	CC082135	VIC	Phillip Island Nature Park Board Of Management Inc	Phillip Island fox eradication project	This project will eradicate foxes from Phillip Island for the long term protection of native species. Funding will assist in the application of baiting into targeted hot-spots and assist in the application and assessment of a number of monitoring methods for Phillip Island's low density fox population. At risk native species will be monitored to determine the success of the program. The data collected during this project will be compared with data collated from over twenty years of fox control and the last ten years of monitoring at risk native species. The project outcomes include confirmation of a reduction in fox numbers and monitoring the effect reduced fox numbers has on at risk native species.	29,250

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2008-09	CC081727	VIC	Harmers Haven Residents & Ratepayers Group; The Friends Of Harmers Haven	Looking after our Hoodies and waterways: community action and education around weeds, foxes, unleashed dogs, and revegetation.	This project involves local communities adjacent to the Harmers Haven Coastal Reserve and Bunurong Marine Park and Coastal Reserve combining to implement an action and education program. We aim to improve water quality, undertake weed control and revegetation works, track rationalisation, feral animal control, protect fauna, and enhance awareness of responsible pet ownership. Water quality and biodiversity will be improved by restoring three coastal waterways, all infested with invasive weed species. Part of the project will form the second stage of works at Cape Paterson, Pea Creek and Cassia Street Reserve, including weed eradication and revegetation of the upper end of the creek. Foxes and unleashed dogs remain a major threat, and soft-jaw fox trapping will be introduced. The project will develop strategies to increase compliance with Parks Victoria (2006) Management Plan dog regulations. Outcomes will include community engagement and education around weed identification, revegetation, responsible pet ownership, track rationalisation and board walk construction.	49,500
2008-09	CC083476	VIC	South Gippsland Landcare Network	Supporting coastal pest animal management along the Cape Liptrap coast	Nationally threatened species such as the Southern Brown Bandicoot, migratory shorebirds and the Orange-bellied parrot and many others are threatened via predation by the European fox found in the Cape Liptrap Coastal Park and its hinterlands. This project will focus on training, empowering and supporting private landholders to increase and improve their fox management practices. This will align with a landscape-scale fox eradication program initiated by the Friends of Venus Bay Peninsula and Parks Victoria. Venus Bay residents and Parks Victoria have committed to improving fox management by initiating a more intense fox baiting program. This commitment provides the strong basis to engage the managers of the large properties comprising the remaining areas within the landscape in order to improve their fox management activity. The project will encourage private landholders to change or add to their fox management activity by the establishment of permanent control points (comprising regular baiting, trapping or shooting) on their properties.	45,455

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2008-09	CC083432	WA	Department of Environment and Conservation and The trustee for The Gnarlaloo Station Trust	Fox control to support the Gnarlaloo Community monitoring program of endangered and vulnerable marine turtles	Ningaloo Marine Park in Western Australia has been identified as having significant beaches for turtle nesting, in particular the Loggerhead, Green, and Hawksbill Turtles. Fox predation of turtle nests has been identified as a key threat to the recovery of turtle populations and research has found that on some beaches foxes destroy as many as 70% of turtle nests. Studies on the population dynamics of marine turtles indicate that continued losses of more than a few percent above the natural mortality level are likely to lead to further significant population declines. Five per cent has been identified as a sustainable fox predation level for the Ningaloo Region. The project will conduct 1080 fox baitings in these newly identified areas in support of the Gnarlaloo Marine Turtle Survival Program. The anticipated outcomes of this project include the protection of turtle nesting sites, community engagement in turtle conservation management, and increased public awareness of turtle conservation issues.	117,555
2009-10	.	SA	Middleback Alliance (Ecological Horizons Pty. Ltd.)	The Middleback Alliance: A landholder partnership achieving landscape scale restoration in remote South Australia	The Middleback Alliance is a joint initiative between local landholders, the S.A. Dept for Environment and Heritage and OneSteel Mining Operation. The aim of the program is to jointly manage more than 100,000 hectares of semi-arid rangelands in remote Australia to improve land management, reduce threatening processes such as goats, foxes and rabbits and enhance threatened species habitat. Activities include community engagement and education, regional threat abatement programs coordinated by local landholders, fire management, waterhole management, and surveys and monitoring for threatened species (including nationally threatened chalky wattle (Acacia cretacea), Malleefowl and Sandhill Dunnart)	247,500
2009-10	CAG09-00053	VIC	FARM TREES AND LAND ASSOCIATION INC UPPER OVENS VALLEY LANDCARE GROUP	Improving River Health and Water Quality (Upper Ovens River, NE Victoria) - Stage 4	The iconic Upper Ovens River and its riparian zone has been degraded by widespread infestations of willow (seeding Grey Sallow and vegetative Crack Willow) and blackberry which are all listed as Weeds of National Significance. The degradation is occurring through collapsing trees that are causing issues including bank erosion; seasonal leaf-drop is causing anoxic conditions for macroinvertebrates and fish; and extensive brambles are providing harbour for rabbits and foxes. This community-based project aims to clear these noxious weeds and revegetate with indigenous species, with steering advice from a number of public land management agencies and specialists. To date, 12 km of the river have been rehabilitated.	19,940
2009-10	CAG09-00324	WA	Lake McDermott Catchment Group (INC)	1080 Fox and Rabbit Baiting in the Shire of Mt Marshall	The funding will be used to purchase 1080 baits to bait for foxes and rabbits within the Shire of Mt Marshall. Local landholders will be able to express their interest to gain baits through this project. Rabbit and fox populations are an ongoing environmental problem for the Shire of Mt Marshall and the region as they are causing detrimental impacts to the local sheep and cropping industries as well as local flora and fauna. Reducing the populations and impact of the fox and rabbit populations will help of the populations of vulnerable species recovery including local populations of Western Spiny-tailed Skinks and Malleefowls.	9,091

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2009-10	CAG09-00504	NSW	Friends of The Brush-Tailed Rock-Wallaby Incorporated	Census and control of pest animals for the protection of Brush-tailed Rock-wallabies	A questionnaire on the presence, abundance, and frequency of a number of key feral animal species observed on private properties will be developed and mailed out to local landholders in the vicinity of brush-tailed rock-wallaby colonies in the Kangaroo Valley, Illaroo and Bugong areas. Pest species of particular interest are foxes, wild dogs, goats and deer. Ten remote cameras will be loaned out to interested landholders to assist them with pest animal identification. Following the identification of pest species locations a contract trapper/shooter will be employed to control the threatening pest species on private properties in the vicinity of local Brush-tailed rock wallaby colonies.	9,000
2009-10	CAG09-00226	VIC	Mornington Peninsula And Western Port Biosphere Reserve Foundation Ltd	Community contribution to Western Port Ramsar and endangered icon Southern Brown Bandicoot	This project focuses on the habitat of the Southern Brown Bandicoot in and around the Western Port Ramsar site and adjacent Nature Conservation Reserves in its effort to raise community awareness about managing pest species and other threats to critical habitats. Information booklets and educational material will be produced for website publication and face to face educational activities, while the project will engage the local community in a series of workshops and educational activities to improve local understanding of issues such as native vegetation management and the risks and benefits of fox and rabbit control methods for the broader landscape.	19,836
2009-10	CAG09-00658	WA	Blackwood Basin Group Incorporated	Controlling feral vertebrates to protect biodiversity assets in the Blackwood Basin.	This project will link with established programs to reduce rabbit and fox numbers. Land managers within a 30 kilometre buffer area will be engaged in protecting high biodiversity assets and offered an incentive to help cover the financial costs of baiting, fumigating and ripping burrows. Media publicity to raise awareness of the damage caused by rabbits, knowledge of control options and project outcomes will be widespread. Awareness and capacity of land managers to undertake meaningful pest control will increase through training and technical advice in control methods.	19,636
2009-10	CAG09-00335	NSW	Mates of the Manning (MoM)	Endangered Shorebird Program	This project aims to minimise disturbance to shorebird nesting sites, extending the current management of endangered shorebirds in the Manning River estuaries, Manning Entrance State Park. The project aims to increase pest management activities, particularly fox control, on both the surrounding private properties and public lands, improve and create suitable habitat for the endangered shorebirds and further enhance public knowledge of the threats to the endangered shorebirds in the Manning estuaries.	20,000
2010-11	OC11-01168	SA	The Barossa Council	Managing Habitat at Landscape Scale in the Upper Torrens Catchment	This project will help landholders near the Cromer Conservation Park develop a conservation cluster. Private, corporate and Government landholders will be encouraged to work with the Upper River Torrens Landcare Group to ensure that the region's biodiversity and landscape is protected from threats such as foxes and overgrazing by kangaroos and domestic stock.	75,000

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2010-11	CAG10-122	NSW	Mates of the Manning	Endangered shorebird Program in the Manning River estuaries	This project will further previous successes in the increased breeding of the endangered shorebirds in the Manning river estuaries. The project will improve on and create additional suitable breeding habitats for endangered species. This will be achieved through, increased pest (fox) management on local and surrounding land and the control of invasive vegetation such as bitou bush. Community educational activities such as workshops and field days will be undertaken to enhance public knowledge and awareness of the threats to endangered species.	20,000
2010-11	CAG10-1176	NSW	Condobolin and District Landcare		The project will control infestations of African boxthorn that threaten riparian zones and biodiversity in the riverine waterways of the Condobolin area. Project activities include mapping infestations, developing treatment schedules, weed control, fox baiting, monitoring and assessment. A field day will demonstrate coordinated approaches to improving biodiversity. Project outcomes include establishment of native grasses and shrubs, improved resilience of native habitat, removal of feral animal habitat, and productivity improvements.	20,000
2010-11	CAG10-439	NSW	TM Vella and RJ Waters	Eradication of feral animals in the NSW highlands and national parks	The project aims to reduce feral pests in the New South Wales highlands and national parks such as Abercombie River National Park and Reserve. There are 56 introduced invasive vertebrate animals such as foxes, pigs and dogs damaging the environment, the economy and Indigenous culture in these areas, costing more than \$720 million annually. The project will control and eradicate pest species using Indigenous knowledge of tracking and the land as well as mainstream techniques such as trained tracking dogs, trapping and some baiting. The project will record the impact of System the pests on the environment, Aboriginal sites and property to demonstrate the effects of pest populations breeding in nature reserves and parks on adjoining properties.	20,000
2010-11	CAG10-1252	NSW	Southern Rivers Wapengo Watershed Community Group	Enhancing coastal ecosystems through protection of the threatened Potoroo	This project will enhance the ecosystem of the New South Wales far south coast to assist in the protection work of the survival of the long-nosed potoroo - a small marsupial listed as both a state and nationally threatened species. Habitat rehabilitation is essential due to the fungal foraging role of the potoroo. Predator control, fauna monitoring and habitat management will be undertaken by landholders coupled with training and skill development to expand conservation efforts. A workshop for wild dog and fox baiting including bait handling will be held with the help of local experts along with training for potoroo and predator population monitoring, habitat management, Indigenous culture connection and heritage significance. The project will increase the number of community members undertaking potoroo conservation work, and further develop their understanding and awareness of this work.	18,420



Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2010-11	CAG10-757	QLD	Coolum District Coastcare Group	Turtles in trouble: Monitoring and working to protect nesting female turtles and turtle nests in the Coolum district	Nesting female turtles and turtle nests in the Coolum District of the Sunshine Coast from Mooloolah River to Sunshine Beach are under serious threat from foxes, dogs, human activities, artificial lighting, boat strike, and debris. The Coolum District Coast Care Group will undertake an extensive turtle protection project that will include locating, monitoring and protecting nests, turtle tagging and data collection, reducing predators such as foxes, and increasing community involvement in turtle conservation. In addition, the group will undertake rehabilitation of coastal dune habitats to ensure long term nesting site availability. An officer will be appointed to manage activities, and volunteers dealing directly with turtles will be accredited in accordance with legal requirements.	18,410
2010-11	AG10-971	QLD	Lower Nebine best practice group	Exploring and trialling options for pest management of wild dogs, foxes, cats and pigs in the Nebine catchment.	This project will host a workshop comprising land managers, regional partners (SW National Resource, Paroo Shire Council and Agforce), state agencies, regional partners (SW Natural Resource Management, Paroo Shire Council and Agforce), state agencies and local industry to explore best practice management options for the control of feral pest species within the Nebine region. Targeted species include wild dogs, cats, pigs and foxes which disturb sensitive wetlands and prey on a myriad of native species. The feral species also impact grazing businesses through predation on domesticated animals. Training is a key component of the project with training of motivated local operators in control operations thereby ensuring project sustainability. Workshop topics will include baiting, trapping, repelling of feral species and use of guardian species such as donkeys, alpacas and maremma dogs. Current legislative responsibilities and issues will be explored. After gathering best practice methodologies the group will establish networks of control teams and implement actions through on ground works across their properties. Commercial impacts caused by the feral pest species will also be documented using a "before and after" the project survey. The group will establish simple monitoring and evaluation systems to record numbers. Distribution of each pest species controlled and a biodiversity audit will be conducted to show the results of the project.	19,900

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2010-11	CAG10-1371	QLD	Murweh Shire South West Feral Animal Control Syndicate	Feral animal management in the Murweh Shire South West syndicate	Feral species, including dogs, cats, pigs and foxes, disturb sensitive wetlands, and prey on both native species and domesticated animals. A workshop hosted in conjunction with peer groups, regional partners, state agencies and industry specialists will explore best practice management options for feral species management. Control options will be discussed, including baiting, trapping, repelling and use of guardian species such as donkeys, alpacas and Maremma dogs. Legislative issues will be explored. Networks of control teams will be established to reduce feral populations and allow for regeneration of native animals and plants. The impact of feral species on commercial activity will be documented by a survey conducted before and after project activity. Numbers and distribution of each pest species will be documented, and a biodiversity audit will show project results. Training of local operators in control options will ensure project sustainability. The project will link to other projects in the region investigating the impact of feral species on native wildlife.	20,000
2010-11	CAG10-62	SA	Loxton to Bookpurnong Local Action Planning Committee	Reduce the impact of invasive species to aid protection of native wildlife in the Pyap to Kingston on Murray land and water management	This project will reduce fox numbers in the Pyap to Kingston area on the Murray river. Fox baits will be provided to participating landholders who will monitor and replace baits over a period of weeks. At the completion of the baiting period landholders will remove remaining baits. The program is scheduled to coordinate with an existing fox baiting program in the nearby Bakara Group Conservation Park. Reducing fox numbers will have positive impact on native fauna, and the program will also increase participation rates of local regional communities in natural resource management and environmental protection.	14,400
2010-11	CAG10-01397	VIC	Corio Shire Landcare	Hovells Creek Restoration project- an integrated approach to rabbit and weed control to enable the restoration of native habitat	This project will restore an eight kilometre stretch of the Hovell Creek riparian zone, increase biodiversity and create a habitat corridor linking to the You Yangs Regional Park. This will be achieved through an integrated approach to the elimination of invasive animal species such as rabbits and foxes, and the removal of noxious weeds, including weeds of national significance such as boneseed, bridal creeper and serrated tussock. These non-native species erode river banks (causing downstream siltation and water quality problems) and destroy the native habitat of indigenous wildlife. A qualified contractor will be engaged to undertake a program of warren fumigation and poison baiting. Volunteers and contractors will remove invasive vegetation or treat it with herbicides. After the control programs are complete, native grasses and trees will be planted to restore the native habitat. Land managers and the Corio Landcare Group will maintain the area.	18,200

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2010-11	CAG10-01144	VIC	Panyyabyr Landcare Group	Grampians to the Plains Grasslands - conservation, collaboration, buffering public and private grassy woodland fauna from fox predation	This project will implement a best practice pulse fox-baiting program to protect threatened species of the volcanic plains grassy communities in a target area of grassy woodland and wetland habitat adjoining the Grampians National Park. The project will be timed to coincide with the Grampians Ark fox baiting project. Following the model established by Grampians Ark and with support from the group the project will map significant habitat areas on public and private land and fox hides. Monitoring and research will be undertaken using digital cameras. Two community engagement and biodiversity education field days will be held for public and private landholders to raise the profile of the area's ecology and demonstrate effective pulse baiting techniques. Extensive mapping of the area and establishing permanent bait stations will make it easier to continue baiting in the future. Landholders will be encouraged to develop their own monitoring regimes.	20,000
2010-11	CAG10-00861	VIC	Blampied-Kooroocheang Land Care Group	South Central Cairn Curran Water Conservation Project (STAGE TWO)	The project involves a series of educational and community awareness activities to address the threat posed to the local seed growing industry by invasive weeds, which could pollute crops and destroy income. The project will address the need to control invasive pests and noxious weeds in the area. Pest animals such as foxes and rabbits find harbour in these weeds. A demonstration day will show correct procedures in ripping warrens, spraying weeds, correct handling of chemicals and protection of operators. Areas to be treated will be mapped. Regenerated areas will be fenced and a co-ordinated fox and rabbit eradication program will be undertaken. Farm walks will be organised on selected properties to demonstrate the benefits of efficient programs. Community groups will meet to publish newsletters and press releases and there is an ongoing commitment from participants to continue the program.	20,000
2010-11	CAG10-00252	VIC	Campaspe River and Land Management Group Friends of the Campaspe River	Hand clearing of Poplar Suckers from river bed and native plant revegetation of steep river bank - Campaspe River Kyneton - Apex Weir to Racecourse	Building on a seven year community project that has seen four kilometres of the Campaspe River returned to environmental health from previous use as a town rubbish tip, the Friends of the Campaspe River will clear and revegetate upstream areas of the river bank where suckers of elm, poplar and willow choke the river banks. This weed infested environment provides a refuge for feral animals such as foxes and rabbits. Working closely with the North Central Catchment Management Authority and the Macedon Ranges Shire Council, a qualified contractor will spray weeds, volunteers will cut down dead weeds for mulch, and suitable native species will be planted out on the cleared riverbanks. It is anticipated that the project will greatly enhance river flows and lead to the return of native flora and fauna to the area including black swans and platypus.	19,500

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2010-11	CAG10-01077	VIC	North East Wild Dog Management Group	Wild dog and fox control using best practice baiting techniques	Wild dogs and foxes are a significant threat to native wildlife within the Gippsland region. These pest populations have been targeted on public lands by the Department of Primary Industry, Department of Sustainability and Environment and Parks Victoria. However, there is a need to control these animals on private lands. The North East Wild Dog Management Group will build community capacity to play a role in cross tenure pest predator control by offering 50 free places on 1080 agricultural chemical users permit endorsement courses. The courses will be made available in local areas of significant biodiversity values and those with established conservation programs such as the North East biolinks incentive program. As an inducement for landowners to synchronise their baiting programs with public programs, a one-off supply of free 1080 baits will be made available to participants. This project will achieve significant biodiversity benefits through reduction in native species predation by wild dogs and foxes.	20,000
2010-11	CAG10-01401	VIC	Wandiligong Preservation Society Incorporated	The Wandiligong Community's Determination to Restore Biodiversity to Significantly Degraded Public Land	This project aims to enhance biodiversity and improve degraded public land, accessibility, public education and community safety in Wandiligong. Invasive plants within the project area include blackberries, pussy willows, hawthorn, caper spurge, St Johns wort, easter oil plants and robinia. These have created an impenetrable barrier for humans and also provide safety and habitat for feral animals such as cats, foxes and rabbits. The area presently is a bushfire hazard. These weeds will be removed by excavator, chainsaw, grubbing and poisoning. Once weeds have been removed planting of species indigenous to the area will occur which will create wildlife corridors and significantly enhance biodiversity. Fauna control will largely be based on habitat removal, involving the destruction of rabbit warrens and fox lairs. Vegetative cover will also be removed. Erosion restoration will be conducted by a contractor, which will include earth works for bank stabilisation. Community members will assist with voluntary labour.	13,075
2010-11	CAG10-01358	WA	Shire of West Arthur	Protection and enhancement of the Dardadine Block for the preservation of rare native flora and fauna	The Dardadine Block in the Shire of West Arthur is being encroached upon by winter and summer weeds, preventing endemic species including rare and endangered flora from regenerating. In addition, predation and environmental damage are being caused by feral animals such as foxes and rabbits. The Land for Wildlife Site 8 group will implement an environmental management plan in conjunction with expert advisors, community volunteers and local schools to control weeds, encourage regeneration of native species, control feral animals, survey nesting sites and collect seeds for propagation and replanting. The outcome from these activities will enable native vegetation to outcompete and suppress weeds, and will reduce erosion. Local students and community volunteers will learn skills in seed collection and propagation as well as constructing native fauna nesting sites. Ongoing maintenance of the area will be continued by landholders and community volunteers.	10,699

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2011-12	OC12-00922	NSW	MANNING ENTRANCE STATE PARK TRUST	On-ground works to manage ecological values of Manning Entrance State Park - NSW	This project will consolidate management of the endangered ecological community littoral rainforest and coastal vine thickets and 'buffer' high conservation value ecosystems in the Manning Entrance State Park NSW. Agencies, volunteers and Indigenous people will partner to control Weeds of National Significance in 50ha of littoral rainforest along 10km of coastline, reduce the impact of foxes to protect threatened fauna, and enhance skills and knowledge in weed and pest management.	335,000
2011-12	OC12-00403	NSW	NEW ENGLAND NORTH WEST LANDCARE NETWORK CHAIRS INC	Pest Animal Management and Landholder Engagement in New England NSW	This project will reduce the threats to endangered ecological communities and threatened species in the NSW New England region. The project will raise awareness about the impact of pest animals such as pigs, foxes, wild dogs and rabbits on natural assets and agricultural production. Landholders will be engaged in cooperative programs to control and manage these pests.	173,000
2011-12	OC12-00496	NSW	SHOALHAVEN CITY COUNCIL	Predator Control for Shoalhaven Endangered Species	This collaborative project will implement a strategic predator control program over two years to reduce key threats to endangered fauna in the Shoalhaven. A wide range of both conventional and new control techniques will be deployed in 12 zones to reduce impact on seven EPBC listed, two NSW listed endangered and 37 migratory EPBC species. It builds upon the existing Fox TAP program. The project aims to mobilise additional landowners and volunteers, reduce threats through community education and map key predator habitat.	111,801
2011-12	OC12-00255	SA	DEPARTMENT FOR ENVIRONMENT AND NATURAL RESOURCES	Landscape-scale aerial fox control for the nationally threatened Andu wallaby	This project expands the successful Bounceback Program for the threatened Andu (yellow-footed rock-wallaby), to include privately managed reserves, Aboriginal land and key pastoral properties. It addresses a gap by further developing partnerships, engaging landholders across the region and aerial baiting over a large proportion of known wallaby colonies in the semi-arid rangeland environments of SA.	195,000
2011-12	OC12-00244	SA	ROYAL ZOOLOGICAL SOCIETY OF SOUTH AUSTRALIA INC	Increasing biodiversity and habitat health through vertebrate pest removal	Perimeter fencing around a 1000ha property will be upgraded to be feral-proof, allowing for staged eradication to remove rabbits, cats and foxes. This will allow regeneration in remnant vegetation, including protected peppermint box and lomandra grasslands and threatened species including the monarto mintbush.	179,400
2011-12	OC12-00952		BELLARINE LANDCARE GROUP INC	Bellarine Ark 2 - Predator Control for Bellarine Peninsula Ramsar Sites	Priority locations within Ramsar sites on the Bellarine Peninsula will be protected from predators notably foxes. A range of control approaches will be used to suit different landscapes, monitoring and reporting of predator activity will be undertaken, and community and organisational capacity and engagement will be increased.	240,000
2011-12	OC12-00448	VIC	PROJECT PLATYPUS ASSOCIATION INC	Controlling fox predation on Southern Brown Bandicoot populations Upper Wimmera	The project will focus on reducing the impact of fox predation on southern brown bandicoot populations in the Upper Wimmera as part of a local southern brown bandicoot recovery plan. A comprehensive and ongoing fox control program, demonstration sites for bandicoot-friendly rabbit and weed control, and trials of complementary revegetation methods will be established.	43,000

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2011-12	.	NT	Territory NRM	.	Territory NRM Territory NRM will work with Indigenous and community groups and all four of the key pastoral landcare associations across the region covering all of the Northern	6,636,600
2011-12	CAG-728888-856	VIC	Australian Freshwater Turtle Conservation & Research Association Incorporated	Kerang and Gunbower Wetlands Turtle Nest Protection and Field Survey 2011/12	It is estimated that over 90% of turtle nests are predated, predominantly by foxes. Locate areas where turtles nest within the Kerang and Gunbower Wetlands during the nesting season. Protect any nests that have not been predated to prevent predation. Collect data from predated nests i.e. number of eggs on ground, photograph site, GPS location, species etc. Collect additional data from nesting turtles i.e. time, date of nesting, duration of nesting, place temperature recording device in nest. Record sighting of any turtle. Discuss with landholders management issues that relate to turtle nests, i.e. ploughing, seeding, weed control, fox control etc. and assist with the protection of these nesting sites.	5,350
2011-12	CAG-727870-825	VIC	Ballarat Environment Network Inc	BEN Biodiversity Reserves Enhancement - Stage 2	Most of the Network's 50 biodiversity reserves are adversely impacted by woody and herbaceous weeds, rabbits and foxes. Over the past eight years, utilising a range of funding, these impacts have been greatly reduced. Continuation of control measures is required but attention can now be given to greater involvement of volunteers, especially local residents, in managing and caring for the reserves.	20,000
2011-12	CAG-722648-547	VIC	Bunyip Landcare Group Inc.	Integrated pest control to build resilient Southern Brown Bandicoot habitat	The Bunyip River is a major waterway leading to the RAMSAR listed Western Port. This project aims to begin an on-going invasive pest plant and animal program to protect native wildlife and plant communities around the Bunyip River catchment. A community monitoring group began recently to map the southern brown bandicoot (SBB) - a nationally threatened species, found in this catchment. SBB are threatened by the removal of habitat but also by predators such as foxes, cats and wild dogs. This project would see an integrated approach to pest plant and animal control by encouraging the community to be involved in the monitoring group and using experts, volunteer labour and contractor labour.	20,000
2011-12	CAG-727922-845	QLD	Lake Macdonald Catchment Care group	Feral Fauna Forum - managing invasive pests	In south east Queensland and the Wide Bay region, feral animals including foxes, cats, pigs and deer are causing widespread destruction to farming areas and loss of biodiversity. Deer out-compete native wildlife. Foxes, cats and wild dogs prey on domestic and native animals as well as turtle eggs. Feral pigs are one of the most destructive of all, causing widespread damage to crops and vegetation, as well as spreading diseases and parasites. Indian mynas out-compete many hollow dependant native fauna. This project aims to improve awareness and facilitate coordinated actions to address these issues with land managers throughout the region	8,800

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2011-12	CAG-727924-846	VIC	Mornington Peninsula & Western Port Biosphere Reserve Foundation Ltd	Reconnecting landscape in Western Port Biosphere Reserve for endangered wildlife	The southern brown bandicoot is a nationally threatened Environment Protection and Biodiversity Conservation listed species. It and other species protected under RAMSAR and international treaties are endangered due to urban growth, habitat loss and fragmentation and climate change in our Biosphere. Implementing on ground action for the eight management plans and an imminent Environment Protection and Biodiversity Conservation Strategic Assessment is an issue. We initiated fox control, now maintained by Commonwealth and state projects; ensuring all-stakeholder ownership is needed. We contribute professional evaluation using remote cameras. It is imperative the community contributes an independent voice. The community asked the Biosphere to create a Regional Recovery Group with all stakeholders, now to being implemented.	20,000
2011-12	CAG-716327-165	QLD	Pullen Pullen Catchment Group Inc	Protecting and Restoring Marsupial Habitat in Pullen Pullen Catchment	This project aims to protect and restore critical remnant habitat of five iconic marsupial species known to inhabit key bushland areas in the Pullen Pullen Catchment - the sugar glider, squirrel glider, yellow-footed antechinus, brush-tailed phascogale and long-nosed bandicoot. Habitat loss and predation by domestic and feral animals (cats and foxes) are the key threats to their survival. Weed removal and revegetation works at two strategic project sites, engaging community, corporate volunteer groups and contractors, will enhance critical habitat areas. Four community tree planting and wildlife spotlighting events and a media education strategy will be delivered to engage and educate the community. 400-450 people are expected to participate.	13,820
2011-12	CAG-718206-244	VIC	Trustee for the Cape Otway Centre for Conservation Ecology	Reducing impacts of pest species on endangered Tiger Quolls across the landscape	This project will help to mitigate a key threat to the persistence of the endangered tiger quoll in the Otway Ranges, one of its last stronghold areas in Victoria. Utilising the tiger quoll as a flagship species, the project will undertake control efforts on vertebrate pest species (foxes and feral cats) which compete with tiger quolls. These activities will in turn benefit broader biodiversity, particularly small mammals. Edge habitats on private land are likely to harbour source populations of these introduced predators which then impact protected areas. By undertaking control efforts on private land the project activities will complement efforts by Parks Victoria and Department of Sustainability and Environment and significantly contribute to landscape conservation.	19,980

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2011-12	CAG-719441-294	VIC	Upper Ovens Valley Landcare Group	Improving River Health and Water Quality Stage 5	The iconic Upper Ovens River and its riparian zone has been degraded by widespread infestations of willow (seeding pussy willow and vegetative crack willow) and blackberry - all Weeds of National Significance (WONS). Collapsing trees are causing braiding of the river stem and bank erosion, seasonal leaf-drop is causing anoxic conditions for macro invertebrates and fish, and extensive brambles are providing harbour for rabbits and foxes. A six-year multi-staged community-based project to clear WONS and re-vegetate with indigenous species is being led by our Landcare Group, with steering advice from public land management agencies and specialists. This funding would support joining two previous project areas creating over 20km of repaired riparian land.	19,990
2011-12	CAG-718479-251	WA	Wagin Woodanilling Landcare Zone Inc	A Phascogale Friendly Community - Nest boxes and Predator control program	Threats facing the endangered species red tailed phascogale (RTP) include a lack of natural hollows in existing habitat and an ever increasing threat of two invasive species, the red fox and feral cat. The community wishes to address these threats to support past monitoring and on ground works under the Recovery Action Plan. Wagin Woodanilling Landcare Zone (WWLZ) will engage with and enable community and private landholders through coordination of four main activities; community nest box building workshops, fox baiting and cat trapping program, community nest box survey, camera trapping and monitoring. Wildlife Research and Management (WRM) will be contracted to create a thorough monitoring system, placement of nest boxes with camera set up.	20,000
2011-12	CAG-729658-965	WA	Wildlife Australia Incorporated	Jarrah Forest in Decline: Controlling Ferals and Restoring Damaged Jarrah Forest	Wildlife Australia Incorporated (WAI) operates from the Kaarakin Black Cockatoo Rehabilitation Centre (BCRC) and is situated on the outskirts of Perth. It is surrounded by the Jarrah/Marri/Wandoo forest of Banywola Regional Park (BRP). The 18 hectare site is heavily impacted upon by feral foxes and cats that kill endemic fauna on site and in the surrounding BRP. WAI has an ongoing revegetation program to rehabilitate a severely degraded former wildlife park and eradicate feral animals. Both programs aim to reduce the impact of invasive flora and fauna species and promote and protect native fauna and flora in this biologically sensitive important area. This is in line with Caring for Our Country's five year plan in biodiversity and conservation.	19,810
2012-13	OC13-00543	NSW	MURRAY CATCHMENT MANAGEMENT AUTHORITY	Increase Indigenous participation in NRM for the proposed Werai IPA.	This project will support traditional owners, the Indigenous community, and NSW and Australian Governments to declare Werai Forest an Indigenous Protected Area. The project will further develop Indigenous capacity to undertake natural resource management in the Werai Ramsar area, support the use of traditional ecological knowledge, develop capacity to manage the forest, foster partnerships with stakeholders, develop onground programs such as cross tenure fox control, and build community support for Indigenous Protected Areas.	150,000



Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2012-13	OC13-00096	SA	ALINYTJARA WILURARA NATURAL RESOURCE MANAGEMENT BOARD	Innovative management of invasive species in the Maralinga Tjarutja Lands,	The Alinytjara Wilurara Natural Resource Management Board will partner with Indigenous landowners to assist in the management of invasive species across the remote Maralinga Tjarutja Lands. By using animal track data and an invasive species management tool, the project will manage cats and foxes around threatened species sites.	139,192
2012-13	OC13-00050	SA	COORONG DISTRICT COUNCIL	Enhancing priority remnant native vegetation in the Upper South East	This project will increase native habitat and reduce the impact of vertebrate pests and Weeds of National Significance on endangered species within the Coorong and Tatiara Districts of South Australia. This will be achieved through fencing to protect listed communities and endangered species, controlling weeds, foxes and rabbits, providing technical support for onground works, and enhancing partnerships between stakeholders.	178,000
2012-13	OC13-00339	SA	ECOLOGICAL HORIZONS PTY LTD	Threat abatement for nationally threatened Middleback mallee species	Feral foxes, cats and goats present a serious threat to nationally threatened Malleefowl, Sandhill Dunnart, Chalky Wattle and Yellow Swainsona Pea, in the Middleback Alliance region of Eyre Peninsula. This project will refine optimal techniques for controlling pests over 500,000 ha of private, public and Natural Reserve System land, through the use of radiotracking and automated poisoning devices.	78,000
2012-13	OC13-00270	SA	ROYAL ZOOLOGICAL SOCIETY OF SOUTH AUSTRALIA	Reducing the impact of vertebrate pests on a 1000 ha property at Monarto	This project will reduce the impact of rabbits, cats and foxes on 1000 ha of property in Monarto. The outcomes of this work will be increased regeneration of habitat, revegetation and protection of EPBC Act 1999 listed plant communities and species, and building skills and knowledge within the local community.	169,920
2012-13	OC13-00100	WA	DEPARTMENT OF ENVIRONMENT AND CONSERVATION	Saving EPBC listed species by controlling introduced predators	This project will continue aerial baiting trials to reduce predation by feral cats and foxes in key conservation reserves on the south coast of WA. This will reduce critical threats to over 300,000 ha of key habitat for EPBC listed fauna species, including the critically endangered Gilbert's Potoroo and the endangered Western Ground Parrot.	92,000
2012-13	CAG-1034516-1046	NSW	MCGLASHAN & CRISP PTY LIMITED	Endangered Shorebird Program	This project will minimise disturbance to shorebird nesting sites extending the current management of endangered shorebirds in the Manning River estuaries (Manning Entrance State Park). The project will increase pest management activities particularly fox control on both the surrounding private properties and public lands, improve and create suitable habitat for the endangered shorebirds, and further enhance public knowledge of the threats to the endangered shorebirds.	19,990

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2012-13	CAG-1071343-1153	NSW	TWEED LANDCARE INC	Protection and restoration of significant coastal habitat at Cabarita Beach, NSW	The project involves bush regeneration and community engagement to protect and restore important coastal habitats at Cabarita Beach on the Tweed Coast of NSW. The site provides important habitat for the threatened Glossy Black Cockatoo, Common Blossom Bat, Grey-headed Flying Fox and contains Coastal Cypress Pine Endangered Ecological Community, regenerating littoral rainforest plants and the threatened pink nodding orchid. Invasive plant species, including Weeds of National Significance, threaten the ongoing viability of threatened flora and fauna habitat. High levels of human visitation also have the potential to degrade the site. The project will manage and reduce the impact of these threats, through bush regeneration and increasing community awareness and knowledge.	8,800
2012-13	CAG-1078633-1316	NSW	CENTRAL WEST LIVESTOCK HEALTH AND PEST AUTHORITY	Goonoo Fox Control Program, a fox control project to protect Malleefowls	This project will minimise fox predation on Malleefowl to maintain its presence in the area centring on the Goonoo Conservation area and surrounding private land north east of Dubbo NSW. The program has been run for the last 20 years, and involves up to 200 local farmers and three NSW government agencies coordinating fox control activities across 200,000 ha to protect Malleefowl from fox predation. Monitoring has shown that the program has been successful in keeping the fox population continuously around 80-85% lower than non baiting areas. This project will provide fox baits to private landholders.	10,000
2012-13	CAG-1087520-1712	NSW	CONDOBOLIN AND DISTRICT LANDCARE MANAGEMENT COMMITTEE	Weed and Pest management stage 2	Local Landcare have identified the African Boxthorn as a major priority in environmental weed and pest control along our sensitive riverine waterways. It is a problem because it severely restricts the growth of native vegetation, effects water quality reduces the resilience of native fauna and provides harbour for the feral fox, cat and wild pig. This project will treat 1200 ha of African Boxthorn as a second stage of a larger project. Coordinating on this issue has led to a cohesive motivated Landcare group benefiting the people farms and native biodiversity.	19,990
2012-13	CAG-1079246-1355	VIC	WARRNAMBOOL COASTCARE LANDCARE GROUP INC	Thunder Point Coastal Reserve Restoration	This project will protect and enhance the natural values of the Thunder Point Coastal Reserve and the Merri Marine Sanctuary by addressing the threat of invasive species (foxes and environmental weeds), restoring indigenous vegetation, and engaging the community in conservation science. The reserve adjoins the sanctuary and incorporates Middle Island. The island is home to several seabird species, including a rare urban Little Penguin colony. Due to its proximity to the mainland, the island's seabirds have been decimated by fox predation in recent years.	9,100
2012-13	CAG-1079654-1402	VIC	VFF FARM TREE AND LANDCARE ASSOCIATION INCORPORATED	Murrayville and Districts Fox and Rabbit Baiting Program 2013	The group is located between the Murray Sunset National Park and Big Desert National Park which is an important bio-link for the Mallee region. Large pest populations are affecting local biodiversity through foraging and building warrens, and are known to be present in the priority woodland areas. Implementing an integrated pest management plan is paramount to optimising activities and value for money, and this project will be a valuable support to primary control methods.	18,000

Year	Grant #	State	Proponent	Title	Description	Funding (GST Excl)
2013-14	.	QLD	Inglewood and Texas Landcare Association Inc	Improved pig; dog and fox management in the Inglewood/Texas region		49,200
2013-14	.	QLD	Beardmore Dam Pest Management Group (sponsored by Dirranbandi Landcare Group Inc)	Addressing Feral pig ,Wild dogs & foxes in Beardmore Dam catchment	.	50,000
2013-14	.	QLD	Dirranbandi Landcare Group Inc	Addressing Feral pig ,Wild dogs & foxes in Lower Balonne & Narran river catchment	.	50,000
2013-14	.	SA	Loxton to Bookpurnong Local Action Planning Committee Inc	Protecting River Corridor and Mallee Farmlands From Foxes or Rabbits	.	9,000

## Appendix D: Biodiversity Fund projects with a fox component

Proponent	Title	Project description	Funding	Time frame
Invasive Animals Ltd, NSW	Protecting the endangered malleefowl from introduced predators near Mount Hope	A recent aerial survey undertaken by the Lachlan CMA revealed a breeding population of endangered Malleefowl on "Kilparney Station" near Mt. Hope NSW, and 40km south of Kilparney are the Nombinnie and Round Hill Nature Reserves where Malleefowl also exist. Two of the largest threats to the survival of the Malleefowl in the region are habitat fragmentation and predation by introduced predators. Although a large area of intact remnant vegetation still connects the two areas, predators such as feral pigs and foxes are abundant. The predator management programme championed by this project will protect existing Malleefowl populations and permit their expansion via the creation of a predator free land bridge between the two areas.	870,000	4 yrs
S.V Proust & P West, NSW	Restoration of littoral rainforest and wading bird habitat	A habitat restoration project, targeting invasive weeds on an island in the Hastings River. Invasive weeds threaten the littoral rainforest (critically endangered - EPBC Act) on the northern part of the island. Many of these weeds, especially vines, threaten the survival of the tree layer and the rainforest itself and have the potential to spread to nearby natural areas. The high tide roost for the wading birds that migrate from the Northern Hemisphere in summer is threatened by the invasion of exotic weeds. Removal of these weeds will maintain the health of the rainforest and suitability of the high tide roost. • Feral predator control, fox and rat, will reduce the predation of JAMBA/CAMBA listed waders	55,200	3 yrs
Southern Rivers Catchment Management Authority, NSW	Potoroo & koala habitat restoration & cultural connections	Broad-scale private landholder engagement to strengthen other NSW government agency initiatives & rebuild a resilient landscape with strong biodiversity & indigenous cultural outcomes. Focus to conserve, connect & rehabilitate habitat of iconic threatened fauna species: koala & long-nosed potoroo. Priorities are habitat conservation & rehabilitation in fertile riparian zones & enhanced connectivity to patches of endemic vegetation (> 5ha). Successful pilot landholder engagement in broad scale coordinated fox control, fauna monitoring & containment of the southward spread of lantana will be extended across this landscape. Landholder engagement by local Aboriginal people around the cultural importance of these species will also be extended.	2,646,500	6 yrs
Earlside Pty Ltd, SA	Earlside remnant scrub protection and corridor linkage project	We will protect our area of remnant native scrub (approx) 45 ha by controlling invasive species and developing an ongoing plan that will address weed control, fire control and risk management. We will contract assistance and advice where necessary to make sure that the work is completed in a competent and timely manner. We will continue our program of fox control. We will continue to plant biodiverse corridors of local native species using locally sourced seeds to link existing corridors and areas of established scrub on our private land and nearby reserves.	82,800	5 yrs
Cardinia Environment Coalition Inc. Vic.	Increasing the resilience of Bandicoot Corner to pest species incursions	Bandicoot Corner is a small reserve that has been established for the preservation of the Southern Brown Bandicoot, ( <i>Isodon obesulus obesulus</i> ). It is a relatively intact area of remnant vegetation with significant biodiversity within a highly modified rural landscape. Although the reserve is protected by predator fence; incursions by invasive species such as Red Fox, feral Cat, and European Rabbit still occur. Foxes and feral Cats prey on Southern Brown Bandicoots; Rabbits are identified as a threat via habitat degradation. This project will strengthen the perimeter fence as a barrier to pest incursions; monitor and remove reduce pest animal populations within the reserve.	10,000	1 yr

FTLA – Northern Yarra Landcare Network, Vic.	Protecting fire affected biodiversity from invasive blackberry in the Northern Yarra	Invasive blackberry is now thriving in the northern Yarra Ranges region following the Black Saturday bushfires, benefitting from this major disturbance. The weed now threatens the regenerating native vegetation by smothering bushland and waterways. It also provides harbour for rabbits and foxes, further exacerbating the threat to recovering biodiversity. The Northern Yarra Blackberry Action Group (part of the Northern Yarra Landcare Network) runs a small program to assist landowners with their obligations to control blackberry on private land. This project will add a biodiversity focus to the existing program to more effectively address the harmful impacts of invasive blackberry on the region's biodiversity.	230,000	5 yrs
Department of Environment and Conservation, WA	South coast integrated biodiversity management project	This project will address the impact of introduced predators on native fauna in the south coast region of Western Australia by developing appropriate methods for control of feral cats and integrating these with fox control in key conservation reserves within the South Coast Macro Corridor coastal corridor. Developing suitable methods of control for these predators throughout the landscape will provide direct benefits for land managers and communities in surrounding landscapes by reducing the threat of predation on native species within reserves, wildlife corridors and neighbouring patches of remnant vegetation. Knowledge gained through this project will be applied throughout the landscape.	1,450,000	5 yrs

## Appendix E: EPBC Act listed threatened species

Updated list of threatened species where predation by foxes is identified as a threat. Noted is where a recovery plan exists and any noted degree of threat by foxes in either the recovery plan or the listing information.

Scientific Name	Common Name	Threat Status	Recovery plan	Degree of threat
<i>Amytornis barbatus barbatus</i>	Grey Grasswren (Bulloo)	Vulnerable	no	
<i>Amytornis modestus</i>	Thick-billed Grasswren	Vulnerable	no	
<i>Anomalopus mackayi</i>	Five-clawed Worm-skink, Long-legged Worm-skink	Vulnerable	no	a threat
<i>Bettongia lesueur lesueur</i>	Burrowing Bettong (Shark Bay), Boodie	Vulnerable	yes	major
<i>Bettongia penicillata ogilbyi</i>	Woylie	Endangered	no	a threat
<i>Bettongia tropica</i>	Northern Bettong	Endangered	yes	a threat
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Endangered	no	secondary
<i>Burramys parvus</i>	Mountain Pygmy-possum	Endangered	no	
<i>Caretta caretta</i>	Loggerhead Turtle	Endangered	yes	a threat
<i>Chelonia mydas</i>	Green Turtle	Vulnerable	yes	a threat
<i>Cinclosoma punctatum anachoreta</i>	Spotted Quail-thrush (Mt Lofty Ranges)	Critically Endangered	no	
<i>Cyclodomorphus praealtus</i>	Alpine She-oak Skink	Endangered	no	a threat
<i>Dasycercus cristicauda</i>	Crest-tailed Mulgara	Vulnerable	no	
<i>Dasycercus hilleri</i>	Ampurta	Endangered	no	
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	Endangered	no	
<i>Dasyuroides byrnei</i>	Kowari	Vulnerable	no	
<i>Dasyurus geoffroii</i>	Chuditch, Western Quoll	Vulnerable	no	
<i>Dasyurus hallucatus</i>	Northern Quoll	Endangered	no	secondary
<i>Dasyurus maculatus gracilis</i>	spotted tailed quoll, or yarri (north Queensland subspecies)	Endangered	no	
<i>Dasyurus maculatus maculatus</i> (SE mainland population)	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	Endangered	no	
<i>Delma impar</i>	Striped Legless Lizard	Vulnerable	yes	secondary
<i>Dermochelys coriacea</i>	Leatherback Turtle, Leathery Turtle, Luth	Endangered	yes	a threat
<i>Egernia kintorei</i>	Great desert skink, tjakura, warrarna, mulyamiji	Vulnerable	yes	a threat
<i>Elusor macrurus</i>	Mary River Turtle, Mary River Tortoise	Endangered	no	
<i>Emydura macquarii signata</i> (Bellinger River, NSW)	Bellinger River Emydura	Vulnerable	yes	major
<i>Eulamprus tympanum marnieae</i>	Corangamite Water Skink	Endangered	yes	a threat
<i>Geophaps scripta scripta</i>	Squatter Pigeon (southern)	Vulnerable	no	
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	Vulnerable	no	
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	Vulnerable	no	
<i>Hylacola pyrrhopygia</i>	Chestnut-rumped Heathwren	Endangered	no	secondary

Scientific Name	Common Name	Threat Status	Recovery plan	Degree of threat
<i>parkeri</i>	(Mt Lofty Ranges)			
<i>Isoodon obesulus nauticus</i>	Southern Brown Bandicoot (Nuyts Archipelago)	Vulnerable	no	a threat
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot (Eastern)	Endangered	no	
<i>Lagorchestes hirsutus</i> unnamed subsp.	Mala, Rufous Hare-Wallaby (central mainland form)	Endangered	yes	major
<i>Lagostrophus fasciatus fasciatus</i>	Banded Hare-wallaby, Marnine, Munning	Vulnerable	yes	major
<i>Leipoa ocellata</i>	Malleefowl	Vulnerable	yes	major
<i>Leporillus conditor</i>	Wopilkara, Greater Stick-nest Rat	Vulnerable	no	
<i>Liasis olivaceus barroni</i>	Olive Python (Pilbara subspecies)	Vulnerable	no	a threat
<i>Lichenostomus melanops cassidix</i>	Helmeted Honeyeater	Endangered	no	secondary
<i>Liopholis guthega</i>	Guthega Skink	Endangered	no	major
<i>Liopholis kintorei</i>	Great Desert Skink, Tjakura, Warrarna, Mulyamiji	Vulnerable	no	a threat
<i>Litoria aurea</i>	Green and Golden Bell Frog	Vulnerable	no	
<i>Litoria castanea</i>	Yellow-spotted Tree Frog, Yellow-spotted Bell Frog	Endangered	no	secondary
<i>Macrotis lagotis</i>	Greater Bilby	Vulnerable	yes	major
<i>Myrmecobius fasciatus</i>	Numbat	Vulnerable	no	
<i>Natator depressus</i>	Flatback Turtle	Vulnerable	yes	a threat
<i>Neochmia ruficauda ruficauda</i>	Star Finch (eastern), Star Finch (southern)	Endangered	no	
<i>Neophema chrysogaster</i>	Orange-bellied Parrot	Critically Endangered	yes	secondary
<i>Notomys fuscus</i>	Dusky Hopping-mouse, Wilkiniti	Vulnerable	no	
<i>Notoryctes caurinus</i>	Karkarratul, Northern Marsupial Mole	Endangered	yes	unknown
<i>Notoryctes typhlops</i>	Itjaritjari, Southern Marsupial Mole, Yitjarritjarri	Endangered	yes	unknown
<i>Onychogalea fraenata</i>	Bridled Nail-tail Wallaby	Endangered	yes	major
<i>Pachycephala rufogularis</i>	Red-lored Whistler	Vulnerable	no	secondary
<i>Parantechinus apicalis</i>	Dibbler	Endangered	no	
<i>Pedionomus torquatus</i>	Plains-wanderer	Vulnerable	no	
<i>Perameles bougainville bougainville</i>	Western Barred Bandicoot (Shark Bay)	Endangered	no	
<i>Perameles gunnii gunnii</i>	Eastern Barred Bandicoot (Tasmania)	Vulnerable	no	
<i>Perameles gunnii</i> unnamed subsp.	Eastern Barred Bandicoot (Mainland)	Endangered	no	
<i>Petrogale lateralis lateralis</i>	Black-flanked Rock-wallaby	Vulnerable	no	
<i>Petrogale lateralis MacDonnell Ranges race</i>	Warru, Black-footed Rock-wallaby (MacDonnell Ranges race)	Vulnerable	no	major
<i>Petrogale lateralis West Kimberley race</i>	Black-footed Rock-wallaby (West Kimberley race)	Vulnerable	no	
<i>Petrogale lateralis pearsoni</i>	Pearson Island rock-wallaby	Vulnerable	no	

Scientific Name	Common Name	Threat Status	Recovery plan	Degree of threat
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	Vulnerable	yes	major
<i>Petrogale xanthopus xanthopus</i>	Yellow-footed Rock-wallaby (SA and NSW)	Vulnerable	no	
<i>Pezoporus flaviventris</i>	Western Ground Parrot	Critically Endangered	no	
<i>Pezoporus occidentalis</i>	Night Parrot	Endangered	no	
<i>Phascogale calura</i>	Red-tailed Phascogale	Endangered	no	
<i>Phyllorhiza fowleri</i>	Baw Baw Frog	Endangered	no	possible
<i>Potorous gilbertii</i>	Gilbert's Potoroo	Critically Endangered	yes	a threat
<i>Potorous longipes</i>	Long-footed Potoroo	Endangered	yes	a threat
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (SE mainland)	Vulnerable	no	
<i>Pseudemydura umbrina</i>	Western Swamp Tortoise	Critically Endangered	yes	a threat
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	Vulnerable	no	
<i>Pseudomys australis</i>	Plains Rat, Palyoora	Vulnerable	yes	major
<i>Pseudomys fieldi</i>	Shark Bay Mouse, Djoongari, Alice Springs Mouse	Vulnerable	no	
<i>Pseudomys fumeus</i>	Koonoom, Smoky Mouse	Endangered	yes	major
<i>Pseudomys novaehollandiae</i>	New Holland Mouse, Pookila	Vulnerable	no	a threat
<i>Pseudomys oralis</i>	Hastings River Mouse, Koontoo	Endangered	yes	major
<i>Pseudomys pilligaensis</i>	Pilliga Mouse, Poolkoo	Vulnerable	no	
<i>Pseudomys shortridgei</i>	Dayang, Heath Rat	Vulnerable	no	
<i>Rheodytes leukops</i>	Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle, White-eyed River Diver	Vulnerable	no	
<i>Rostratula australis</i>	Australian Painted Snipe	Endangered	no	secondary
<i>Sarcophilus harrisii</i>	Tasmanian Devil	Endangered	no	
<i>Setonix brachyurus</i>	Quokka	Vulnerable	no	
<i>Sminthopsis douglasi</i>	Julia Creek Dunnart	Endangered	yes	a threat
<i>Sminthopsis psammophila</i>	Sandhill Dunnart	Endangered	no	
<i>Sternula nereis nereis</i>	Australian Fairy Tern	Vulnerable	yes	major
<i>Stipiturus malachurus intermedius</i>	Southern Emu-wren (Fleurieu Peninsula), Mount Lofty Southern Emu-wren	Endangered	yes	secondary
<i>Stipiturus malachurus parimeda</i>	Southern emu-wren (Eyre Peninsula)	Vulnerable	no	
<i>Stipiturus mallee</i>	Mallee Emu-wren	Endangered	no	secondary
<i>Turnix melanogaster</i>	Black-breasted Button-quail	Vulnerable	yes	secondary
<i>Tympanocryptis pinguicollis</i>	Grassland Earless Dragon	Endangered	no	secondary
<i>Uvidicolus sphyrurus</i>	Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko	Vulnerable	no	
<i>Wollumbinia bellii</i>	Bell's Turtle, Western Sawshelled Turtle, Namoi River Turtle, Bell's Saw-shelled Turtle	Vulnerable	no	
<i>Xeromys myoides</i>	Water Mouse, False Water Rat, Yirrkoo	Vulnerable	yes	a threat
<i>Zyzomys pedunculatus</i>	Central Rock-rat, Antina	Endangered	yes	possible



