



Natural  
Resources  
Commission

# Supplementary pest control trial Interim Evaluation

February 2016

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## List of acronyms

Commission – NSW Natural Resources Commission  
LLS – Local Land Services  
NPWS – National Parks and Wildlife Service  
NSW – New South Wales  
OEH – Office of Environment and Heritage  
SPC – Supplementary Pest Control  
SSAA NSW – Sporting Shooters Association of Australia NSW Branch

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Document No.D15/5551

ISBN: 978 1 925204 12 4

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## **PART I - Overview**

# 1 Executive Summary

Pest animals impose significant economic, social and environmental costs on NSW. They can affect agricultural productivity; access to export markets, public health and amenity; and the conservation of biodiversity<sup>1</sup>. Managing this complex and longstanding issue has been the subject of several reviews in the past decade in Australia.

This report is the second in a series of three reports by the Natural Resources Commission (the Commission). The series evaluates a NSW Government-led supplementary pest control (SPC) trial program (the trial), which has been designed to complement existing pest control methods. The report was formally requested by the Premier and the Minister for the Environment (the Minister), according to an agreed Terms of Reference.<sup>2</sup>

As an interim evaluation, the report aims to help the NSW Government decide whether and under what circumstances to proceed with the SPC program beyond its initial three-year trial period. Drawing on data gathered at the trial's mid-point in June 2015, the report seeks to determine the program's:

- effectiveness and efficiency
- social impacts (positive or negative)
- opportunities for improvement within the remainder of the period.

The trial's target species are all established pests (goats, pigs, foxes and rabbits). These have a range of negative impacts on natural assets such as native animal and plant species, and on agricultural resources.

A distinguishing feature of the SPC trial is its partnership between the NSW National Parks and Wildlife Service (NPWS) and volunteer shooters from the Sporting Shooters Association of Australia NSW Branch (SSAA NSW). Participants in the trial have been targeting the removal of pest animals in 12 national parks and reserves across NSW.

Pest management is considered to be most effective when it employs an integrated program of complementary tools and techniques<sup>3</sup>. The Commission has sought to evaluate whether ground shooting using volunteers can support the broad toolkit of available pest control techniques, and whether it can legitimately complement primary control techniques to increase the overall effectiveness of the NPWS broader pest management program.

In its evaluation of the trial to date, the Commission has found several positive outcomes along with some areas requiring further improvement. Key findings include:

- The trial is being implemented in line with relevant legislation and Ministerial requirements.
- The trial is meeting human safety and animal welfare requirements with no significant incidents reported to date.
- The trial is well aligned with existing pest management programs and government priorities as a supplementary control measure.

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<sup>1</sup> National Biosecurity Committee, *Modernising Australia's approach to managing established pests and diseases of national significance*, 2015.

<sup>2</sup> Available online at: <http://www.nrc.nsw.gov.au/PDF/Supplementary%20Pest%20Control/SPC%20-%20TOR.pdf> and also at Appendix 1.

<sup>3</sup> NSW Department of Primary Industries, 2008, *NSW Invasive Species Plan 2008 – 2015*, p.7

- NPWS has capably and professionally managed the voluntary program with the support of the SSAA. Both organisations have demonstrated a genuine collaborative approach, excellent team work and a willingness to share knowledge and experience.
- Although trial costs continue to decline, large fixed staffing costs continue to contribute to overall program costs.
- Significant positive relationships have been built among volunteers, land owners, community and Aboriginal groups, and NPWS staff.
- The ecological benefits of the program are difficult to measure given the lack of baseline ecological data. Some monitoring should be reviewed.
- NPWS is adaptively managing the trial activities. This has included:
  - experimenting with the timing and duration of shoots
  - refining processes for communicating and working with volunteers.

NPWS has responded to most of the Commission's previous 18 recommendations, with two areas still being addressed.

The trial has removed more than 2,800 target animals to date, raised awareness of pest animal management in National Parks and built significant goodwill between NPWS staff, program volunteers, park neighbours, community and Aboriginal groups. The positive engagement it has afforded NPWS is a testament to both NPWS staff and the selected volunteers and is a key factor in the success of the trial to date.

Ecological outcomes from the program are uncertain at this point due to monitoring design limitations, and the inability to distinguish between SPC and non-SPC pest management within the reserves.

Program costs to 30 June 2015 are \$3.63 million, including \$0.64 million in establishment costs, \$2.54 million in operational costs and \$0.22 million in evaluation costs. Operational costs have been well managed, with the average cost per field operation halved since the trial began. However, fixed office based staff costs remain significant and require further review.

Finally, this report advocates ongoing adaptive management of the trial. Using the method in combination with the right tools and techniques will be crucial to the program's success, along with the correct sequencing, timing, selection of volunteers, location selection, species targeting and coordination with other tenures.

As such, an ongoing priority of the pest control trial will be to identify the specific set of circumstances where it can be most useful to NPWS' primary pest management program.

## 2 Recommendations

For the remainder of the SPC trial the Commission recommends NPWS address the following four recommendations to improve the effectiveness and efficiency of the trial.

### 1. Review ongoing appropriateness of trialling SPC in current reserves

The Commission recommends that:

- NPWS continue to review the suitability of the current reserves and allocate resources to the sites with the most informative value for the trial.

### 2. Implement night operations

The Commission recommends that:

- NPWS pursue its proposal for night operations in 2016.

### 3. Review and reduce program costs

The Commission recommends that:

- a. NPWS improve its internal reporting systems so it can report on trial costs in more detail.
- b. NPWS review pre and post-operation costs and NPWS coordination costs to improve the efficiency of the trial. This could include rationalising central planning time to reduce associated staff costs and delegating more planning to local officers.
- c. NPWS explore options to leverage the knowledge of volunteers in planning and monitoring processes, to further reduce the ongoing marginal cost of each operation.
- d. NPWS explore possibilities for completing more operations per year.
- e. NPWS investigate whether its staff can safely participate in the shooting of pests during operations.

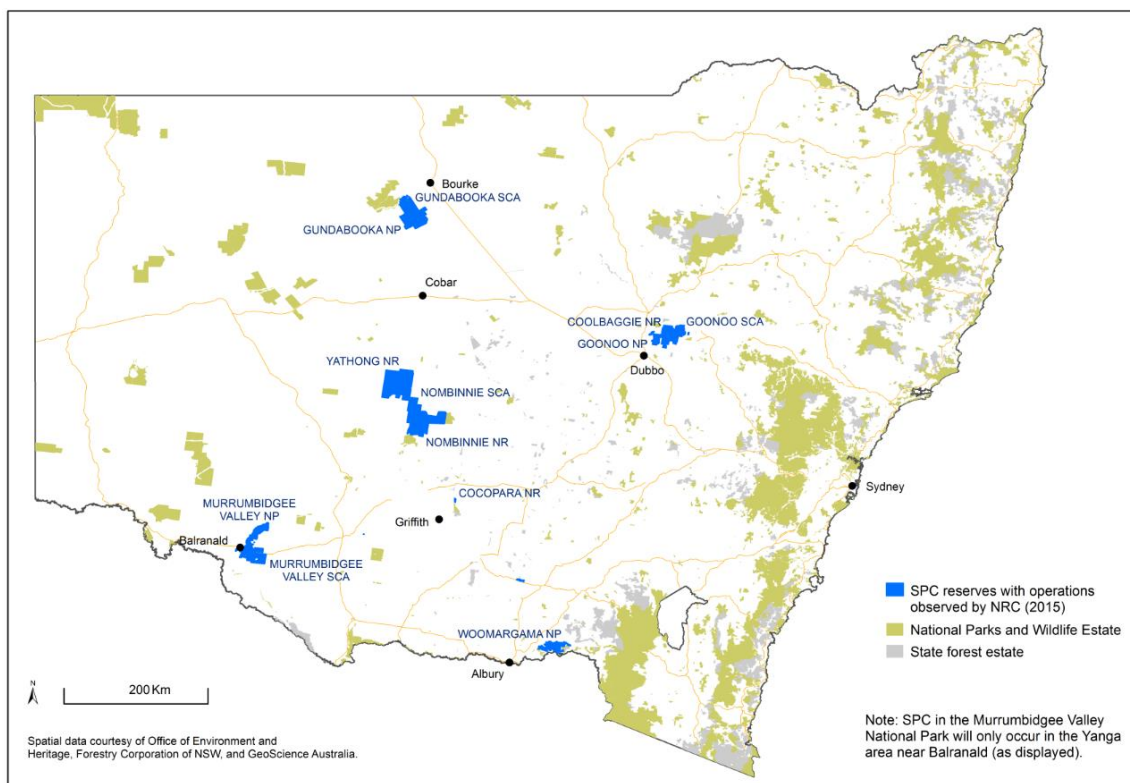
### 4. Review ongoing appropriateness of monitoring techniques

The Commission recommends that:

- NPWS assess the ecological data collected from different reserves and review the value of each monitoring activity. Specific attention should be paid to the value that current pellet count monitoring is adding to the trial.

### 3 Background

In 2013, the Minister for the Environment announced a three-year trial (the trial) of supplementary pest control (SPC) in NSW to remove pest animals including feral goats, pigs, foxes and rabbits. The trial began in early 2014 in 12 national parks and reserves, covering an area of almost 500,000 hectares. These reserves are shown in Figure 1.



**Figure 1: SPC reserves including where Commission staff have observed operations to date**

For this trial, NPWS has partnered with volunteer shooters from Sporting Shooters Association of Australia NSW Branch (SSAA NSW) to help reduce the pest animals. These SSA volunteers work under the direct supervision of NPWS staff.

The trial SPC program is designed to align strategically with existing pest management programs being undertaken through NSW, such as strategic fencing, trapping, baiting and use of biological control agents. The trial will determine whether ground shooting using volunteers could be added to this existing suite of techniques and complement ongoing NPWS pest control programs.

Through a Terms of Reference, the Premier and the Minister for the Environment requested that the Commission evaluate the trial to help the NSW Government decide whether to proceed with the proposed SPC program beyond the three-year trial period, and under what conditions.

The Terms of Reference is provided at **Appendix 1**. It requests that the Commission’s evaluation considers issues such as (but not limited to):

- the effectiveness of the trial program in contributing to the aims and objectives of existing NPWS pest control programs
- the efficiency of the trial program
- the social impacts of the trial.



## 3.1 Focus of this report

This report examines how the trial has performed to 30 June 2015 and makes recommendations for improvement. Drawing on a set of evaluation questions and methods developed specifically for the trial, the report seeks to:

- evaluate whether the trial has been effective to date
- examine whether there will be sufficient data available to inform future evaluations of efficiency and effectiveness of the trial and to inform government decisions about the future of the trial
- make recommendations that could be used to improve efficiency and effectiveness of the trial within the three-year trial period.

### 3.1.1 Evaluation questions

The Commission has worked closely with stakeholders to design a robust evaluation framework, which is provided in **Appendix 2**. An *Overview of the Evaluation Framework* was submitted to the Minister for the Environment in August 2014, and is available online.<sup>4</sup>

The framework provides a set of evaluation questions that will be used to measure success against the four trial goals (see **Appendix 2**). The questions were designed to fulfil the Terms of Reference and reflect best practice in evaluation.

### 3.1.2 Evaluation methods

Together with key stakeholders, the Commission has developed a number of methods to evaluate the design of the trial including:

- field observations
- document review
- interviews, surveys and workshops with stakeholders
- desktop research
- technical review.

The Commission attended 41 per cent of the SPC operations conducted, including at least one at each of the selected reserves. Further details regarding the evaluation methods used can be found in **Appendix 3**.

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<sup>4</sup> Available online at: <http://nrc.nsw.gov.au/content/documents/SPC%20-%20Evaluation%20framework%20-%202014%20October%202014.pdf>

## 4 Themes that govern effective pest management in NSW

The Commission has been asked to consider the effectiveness and efficiency of the SPC trial to date. This section explores the trial's core objectives in more detail, and discusses issues the Commission has taken into account for its final recommendations.

### 4.1 Creating an *effective* integrated pest management program

Supplementary pest control operations are scheduled to strategically align with existing pest management programs already being undertaken by NPWS.

Pest management is considered to be most effective when it combines an integrated set of complementary tools and techniques<sup>5</sup>. Used together, techniques such as the following address the complex factors needed to efficiently manage identified pest animals:

- matching the control techniques to the pest management outcome sought (for example eradication, containment or impact reduction)
- matching the control techniques to the target pest species characteristics
- matching the control techniques to the terrain and geography of the target area
- sequencing the control techniques effectively (for example, combining techniques that work most effectively when deployed simultaneously or one after another)
- timing and frequency of control techniques (including seasonality)
- coordinating pest control efforts to increase effectiveness, for example across land tenures (public and private) and scales (local, regional, catchment and state-wide).

The Commission has sought to evaluate whether ground shooting using volunteers can support the broad toolkit of available pest control techniques, and whether it can legitimately complement primary control techniques to increase the overall effectiveness of the NPWS broader pest management program.

#### 4.1.1 How SPC can support an integrated pest management program

The SPC trial targets several known pest species (goats, pigs, foxes and rabbits), and the pest control outcomes therefore relate to reducing their impacts on specified assets. Example assets requiring protection from pests within national parks include native animal and plant species or populations, or neighbouring crops or livestock. Example impacts on these assets from the target pest species include browse pressure, erosion, wallowing and predation.

Relevant NPWS pest control programs therefore focus on reducing existing pest populations, and maintaining pest populations at acceptably low levels to reduce the impacts. This is known as a sustained management approach for established pest species.

Within this context of protecting assets through reducing or maintaining pest species, SPC is currently being used in a variety of situations where it could increase the overall effectiveness of NPWS existing pest control programs. Examples include:

- where terrain in the target area makes other more efficient techniques less effective (for example, when dense vegetation makes aerial shooting difficult)
- where other more efficient techniques are not acceptable (for example, where nearby human or domestic animal populations mean baiting is inappropriate)
- where ground shooting used in combination with another technique can enhance total outcomes (for example, ground shooting rabbits directly after rabbit warren ripping)

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<sup>5</sup> NSW Department of Primary Industries, 2008, *NSW Invasive Species Plan 2008 – 2015*, p.7  
Document No: D15/5551  
Status: Final

- for resistant individuals in a population that is less susceptible to other techniques (for example, trap-shy or helicopter-shy goats)
- to augment another technique (for example, ground shooting foxes after a baiting program).

### Case study – Contribution of SPC activity to NPWS pest control program in Gundabooka

The Commission attended and observed a four-day SPC shoot in Gundabooka National Park and State Conservation Area, near Bourke, from 8 – 11 October 2015. Management of the area is covered by the NPWS *Gundabooka Plan of Management 2005*<sup>6</sup> and the NPWS *Regional Pest Management Strategy 2012-17: Far West Region*<sup>7</sup>.

Relevant SPC documentation developed to align SPC activity in Gundabooka with existing NPWS pest control programs, includes the *SPC Pest Management Site Plan (2014-2015): Gundabooka* (updated periodically throughout trial) and the *SPC shoot plan October 2015* (prepared for each SPC shooting activity conducted).

Alignment of SPC operations with existing NPWS pest control programs		
Program	Target of initiative	Description
Plan of Management	Introduced plants and animals (s. 4.1.3).	<b>Animal pests include the feral goat.</b> Goats impact on biodiversity by changing vegetation structure and removing ground cover. Large numbers of goats have been removed but immigration from surrounding areas remains a significant problem. <b>Ongoing pest management actions</b> is needed to control the population.
Regional Pest Management Strategy	Identified assets at risk in Gundabooka	Curly-bark Wattle Ecological Endangered Community
	Priority	<b>Critical priority – threatened species conservation.</b> Programs target pests which are significantly impacting on threatened species, populations or communities. These include highest priorities identified in threat abatement plans and priorities action statements.
	Relevant threatening processes for Curly-bark	Feral goats are a major contributor to soil erosion and compaction and have substantial impacts on vegetation structure through overgrazing.
	Target pest species causing threatening processes	<b>Feral goat</b>
	Aim of pest control	<b>Asset protection</b>
	Identified pest control actions	Mustering, trapping, water point management, fencing. These actions are conducted year-round.
SPC Site Plan (2014-2015): Gundabooka	Objective	Reduce goat activity, <b>maintain Curly-bark Wattle presence and implement Regional Pest Management Strategy objectives. Asset protection.</b>
	Pest control techniques	Passive trapping on water points throughout year.  Contracted musterer collects goats when numbers reach high levels as

<sup>6</sup> Available at: <http://www.environment.nsw.gov.au/resources/parks/pomFinalGundabooka.pdf>

<sup>7</sup> Available at: <http://www.environment.nsw.gov.au/resources/pestsweeds/20120378fwrpms.pdf>

		<p>part of a monthly mustering contract.</p> <p>Fencing to exclude access to watering points and flora assets, and divert goats away from park.</p> <p>Aerial shooting as required and as funding permits.</p> <p><b>Around four SPC ground shooting operations per year, aimed to take place following mustering and trapping activities. Will provide some focus on difficult terrain around Mt Gundabooka, providing further opportunity to reduce numbers of shy or evasive pests.</b></p>
SPC shoot plan October 2015	Situation	The Regional Pest Management Strategy identifies management of feral goats as a critical priority. <b>Ground shooting goats in specific areas of the reserve will supplement other goat control programs in the reserve.</b>
	Objective	<b>Reduce number of pest animals close to the priority assets, and remove goats from areas in the park that have been missed by the musterer.</b>

Increasingly, the Commission’s findings for Gundabooka and the other trial areas show SPC as being effective only when a specific set of factors combine. Already, trial results reveal that SPC should be used in combination with the right tools and techniques and in the right sequence, timing and geographic locations, for the right species and coordinated across tenures. A key aim during the trial’s remainder will be to identify the specific set of circumstances where SPC is of maximum use to NPWS’ pest management programs.

This evaluation report makes several recommendations that will help identify such conditions if SPC continues to be tested and refined during the trial period.

## 4.2 Creating an *efficient* integrated pest management program

This evaluation report also explores the cost effectiveness of SPC within a context of stringent risk management strategies, particularly in regards to human safety and animal welfare. Given the partnership in this program with SSAA volunteer shooters, any increases in SPC’s triple bottom line outcomes should be achieved without increasing risk to human safety and animal welfare.

An overview of some indicators of the trial’s efficiency follows below, with more detail on its alignment with other pest management strategies described in section 5.3 of this report.

### 4.2.1 What are the potential financial costs of SPC?

#### Establishment costs

As with any trial, the costs of SPC include establishing processes, procedures and protocols to implement the program. This includes staff time spent in developing training materials, establishing key relationships, and completing initial risk assessments and risk mitigation plans. Section 7 provides a detailed breakdown of the different costs.

Many of these are one-off investments that would not need to be repeated beyond the trial, should it be extended. The more SPC trial shoots conducted, the greater the value generated from the government’s initial spend. If SPC can be continued cost-effectively beyond the trial period, the value generated from this investment made well be even greater, particularly if it continues to be used as part of a package of integrated pest management tools.

As such, the Commission’s evaluation has sought to look at ways to further increase the number of effective SPC shooting activities and in turn generate greater value from the investment made to date.

## Ongoing costs

Once establishment costs are taken into account, the ongoing cost of SPC is measured by the marginal additional cost of each SPC shooting activity. These include planning individual shoots, coordinating volunteers and equipment, supervision by NPWS staff, communicating with volunteers and neighbours, and managing ongoing risks for human safety and animal welfare purposes.

Overall cost effectiveness of SPC is determined not just in terms of cost per shooting operation, but by looking at the wider social, economic and ecological benefits generated against the costs of implementing the program. The Commission will then compare these benefits and costs to alternative methods of achieving the same outcomes. For example, the Commission's final evaluation report may look to compare ground shooting using volunteers to ground shooting using professional contract shooters, or to increasing ground shooting activities by NPWS staff. The Commission may also look to assess the added social benefits that a volunteer program can bring to regional communities.

In this context, the Commission's evaluation has looked at possible ways to decrease the marginal cost of SPC shoots to improve efficiency, whilst maintaining acceptable risk levels.

It should be noted that the Commission has not sought to measure cost per pest animal killed in the trial, as this would be too simplistic a view of pest management. The purpose of SPC is not merely to maximise the number of pest animals killed, nor to compare the costs of SPC against pest culling via different methods. As noted in section 3.1 above, the purpose of SPC is to complement other more efficient pest control techniques, for example in situations where these techniques are not as effective, or where SPC can combine with them to increase the overall outcomes of the pest management program.

### 4.2.2 What are the potential social outcomes of SPC?

When looking at the benefits generated by the SPC trial, the Commission has looked beyond the ecological and financial costs to include the wider social benefits of decreasing the impacts of pests on national parks and private properties.

One key consideration has been human safety and animal welfare, which the Commission has already explored in its review of the trial's design<sup>8</sup> and more recently, in evaluating the trial's performance to date (see Section 5.2 for full details).

Another priority area has been the trial's role in fostering better community relations. Apart from being criticised for insufficient funding and poorly coordinated activities, pest management in NSW is also hampered by a lack of awareness or understanding of pest problems in parts of the community<sup>9</sup>. The design of the SPC trial has shown early signs of being able to partially address these issues.

The partnership developed with SSAA for the SPC trial has enabled NPWS to attract leveraged investment from the recreational shooting community, increasing the value delivered from the trial. The SSAA and individual volunteers have also invested their time, effort and knowledge in launching and delivering this trial. Further, the collaborative approach adopted by NPWS and SSAA has the potential to build goodwill and understanding between the two organisations.

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<sup>8</sup> Natural Resources Commission, 2014, *Evaluation of Trial Design*. Available online at: [http://www.nrc.nsw.gov.au/literature\\_196218/SPC%20Evaluation%20report](http://www.nrc.nsw.gov.au/literature_196218/SPC%20Evaluation%20report)

<sup>9</sup> From preliminary analysis of submissions to the Commission's Issues Paper for its state-wide review of NSW pest animal management. Submissions can be found at: <http://www.nrc.nsw.gov.au/pest-animal-management>

Another feature of the SPC trial is its positive impact on communication and coordination with community groups. SPC shooting activities are planned in consultation with relevant Aboriginal co-management committees and neighbours, each shoot is communicated to all park neighbours and to community groups in the area, and all SPC volunteers receive training in pest management for conservation purposes.

To date, low awareness levels have hampered effective pest management in NSW. The interactions described above can help raise awareness of the magnitude and impacts of pest problems across NSW, and the issues faced by pest managers in addressing these impacts. Adopting a collaborative approach contributes to knowledge-sharing and building informal networks that can support future pest management efforts between different pest managers. Such tenure-neutral approaches to management could increase the efficiency of pest management efforts in NSW.

These and other social costs and benefits have all informed the Commission's review of the SPC trial's effectiveness and efficiency.

#### **4.2.3 Measuring ecological outcomes of SPC**

The trial's relatively short timeframe (three years) is too short to determine permanent change in ecological factors such as pest impacts and asset condition. Further, the absence of consistent baseline pest data for all species across all SPC reserves makes ecological monitoring for SPC challenging.

The supplementary nature of SPC also makes it difficult to compare its ecological impacts against other pest management activities in national parks. Isolating the impact of SPC on pest populations in the park, as distinct from the impacts of all other pest management activities in the park and environmental factors, would require sophisticated and costly monitoring.

In response to such challenges, NPWS has adopted a monitoring approach which will provide some output data useful for evaluating the trial (for example, number of pest animals killed, number of shoots conducted). Their monitoring approach will also yield initial indications of potential changes in pest activity and asset condition in the target reserves. However, any of these potential changes will result from the collective impacts of all pest management activity in the reserve during the trial period, and will not be attributable to SPC specifically.

Further detail on NPWS' monitoring approach can be found in Section 6 of this report. The monitoring aspects of SPC comprise a large portion of the trial's overall cost, mainly in staff time.

Given these constraints and conditions, and the timing of the Commission's report (delivered at the beginning of the trial's final year), the Commission has sought to identify ways in which the monitoring approach already in place for the trial could be carried out more efficiently or effectively.

## **PART II - Detailed Analysis**

## 5 How is the supplementary pest control trial being implemented?

In its evaluation of the trial's performance to date, the Commission has found that the trial is meeting its compliance, ministerial, welfare and safety obligations. SPC operations are also well aligned with pest management plans. It is also pleasing to see that most of the Commission's recommendations from its 2014 report have been adopted or are in the process of being implemented. This section presents key evidence that illustrate these findings.

### 5.1 Compliance with legislative and Ministerial requirements

The SPC trial met a number of Ministerial requirements, including:

- the trial is to be conducted within the 12 selected reserves only
- NPWS staff are to directly supervise qualified volunteers (who must also be 18 years and over)
- operations are not to be conducted during school holidays or during the night
- volunteers are only to be permitted to use firearms that are currently approved for use by NPWS
- reserves are to be closed to visitors on the days of field operations, with signs placed at entry and exit points to the reserve prior to the commencement of operations
- operations are to be announced four weeks prior to the day of the field operation and confirmed 48 hours prior.

A review of operational planning documents, along with attendance of Commission staff at operations in all reserves, indicates that the trial currently complies with the Ministerial requirements outlined above.

Some of these requirements, such as the restriction on night operations and the long lead times for announcements, constrained the trial somewhat and are discussed further in Section 6.

### 5.2 Human safety and animal welfare

Human safety and animal welfare, two focus areas for NPWS staff when preparing and conducting operations in the field, are a strength of the SPC trial.

Incident logs suggest that no major incidents have occurred during the first 18 months of the trial. NPWS staff rated 90 per cent of SPC volunteers as good or very good for firearm safety and other health and safety procedures, with no poor ratings recorded. Some 75 per cent of SPC volunteers scored a good or very good rating for shot placement (one measure of animal welfare), with no poor ratings recorded (Figure 2).

In addition, evidence from Commission field observations indicates that human safety protocols have been strictly adhered to, with lengthy discussions and demonstrations at pre-operation briefings. Pre-briefings also included detailed presentations on gun handling and storage, animal welfare and shot placement.

SPC volunteers, through post operation surveys, have also expressed positive feedback about the human safety aspects of the program. As some volunteers noted:

"I particularly enjoyed the team work ... Done safely but also effectively." – SPC volunteer



“The program is excellently run and very professional.” – SPC volunteer

A similar comment was made about firearm safety and animal welfare:

“All NPWS staff were very knowledgeable, educational and kept firearms safety standards high. Animal welfare protocol always followed.” – SPC volunteer

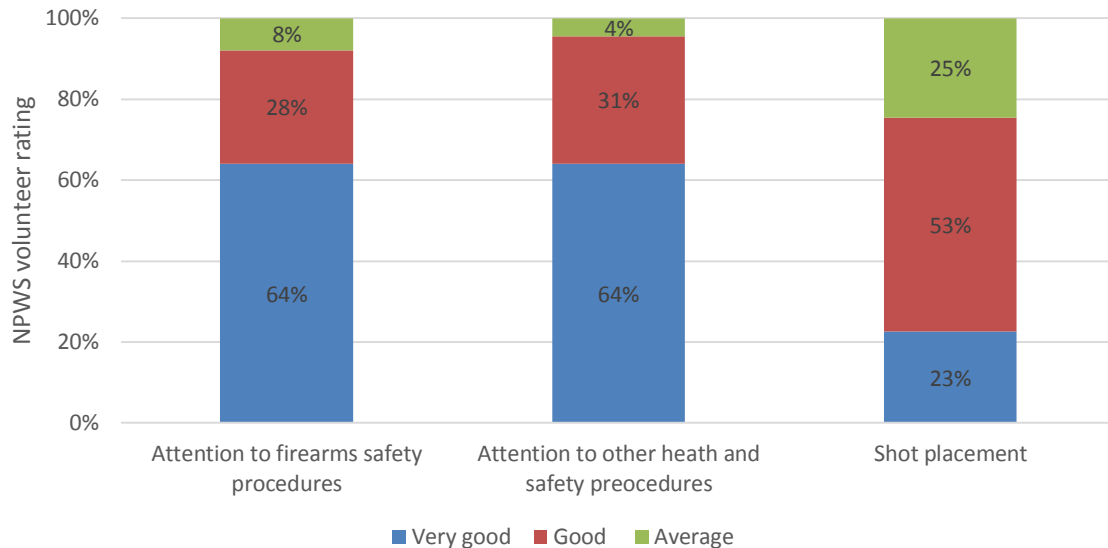


Figure 2: NPWS appraisals of SPC volunteers

### 5.3 Integration and alignment with existing pest management activities

The Commission has also reviewed documents relevant to the integration and alignment of the SPC Trial. These documents included:

- SPC Shoot Plans for six SPC Trial sites
- Annual Pest Management Site Plans for each SPC Trial site
- Regional Pest Management Strategies for all four SPC Regions in which SPC activities occur.

The documentation covers the 12 reserves across six Management Sections in which SPC operations occur. Two SPC management reserves, Cocopara and Woomargama, were used as case studies of strategy and planning documentation for the *Preliminary evaluation report* delivered by the Commission in late 2014. This has provided the opportunity to compare between the previous and current year’s planning documentation for those sites.

**Table 1 : SPC sites reserves and relevant regions.**

SPC Trial sites	Reserves within the site	Region
Central Mallee	Yathong Nature Reserve Nombinnie Nature Reserve & State Conservation Area	Western Rivers
Cocopara	Cocopara Nature Reserve	Western Rivers
Yanga	Murrumbidgee Valley National Park & State Conservation Area	Western Rivers
Goonoo	Goonoo National Park & State Conservation Area Coolbaggie Nature Reserve	Northern Plains
Gundabooka	Gundabooka National Park & State Conservation Area	Far West
Woomargama	Woomargama National Park	Southern Ranges

### 5.3.1 Alignment of SPC operations to contribute to other actions regarding threatened species

Regional Pest Management Strategies identify priority pest species for each site targeted by the SPC trial. SPC shooting activities in each reserve target these priority species, as documented in the Pest Management Site Plans for each reserve (see Appendix 5). In particular, the shooting activities openly target species ranked as critical in the regional priority for management, because of their impacts on threatened species. Key documents indicate that these shooting activities are strategically aligned with other actions regarding threatened species. Importantly, the Regional Pest Management Strategies clearly note that protecting these threatened species requires the effective control of the priority pest species for each site.

Across the documentation reviewed, the Commission found that:

- all sites list priority species in their Pest Management Site Plans that are consistent with Regional Pest Management Strategy priorities
- all SPC Shoot Plans identify targets for SPC activities that are identified as priority species in the Pest Management Site Plan.

### 5.3.2 Identification of the highest priority pests for each SPC reserve

The Pest Management Site Plans for each site identify and document the highest priority pests for each SPC reserve, directly referencing these species from the respective Regional Pest Management Strategy. The Commission noted strong consistency between the pests identified in each strategy and those targeted in each plan.

A range of vertebrate pest species are endemic across the regions examined. A subset of these pests are of priority importance within the SPC trial sites, making them the target species. These pest animals have both direct and indirect impacts within these regions.

From its document reviews, the Commission finds that the pest species being targeted through SPC shoots are well aligned with pest management priorities for the sites. In general:

- pest species targeted through SPC shoots are priority species for the site and for the region
- most SPC Shoot Plans reviewed identified target species that aligned with the relevant Regional Pest Management Strategy and Pest Management Site Plans for that site.

There was one exception, where the Cocopara March 2015 Shoot Plan<sup>10</sup> targeted pigs, which are not listed as a management priority for the site in the Regional Pest Management Strategy for the Western Rivers<sup>11</sup>. However, they are listed as a priority species for the region overall and in the Cocopara 2015 Pest Management Site Plan, indicating a possible change in conditions for the site since the Regional Pest Management Strategy was developed in 2012.

### 5.3.3 Alignment between aims and objectives

Aims and objectives are aligned throughout the SPC Shoot Plans, Pest Management Site Plans and Regional Pest Management Strategy, according to the documentation reviewed. Shoot Plans and Pest Management Site Plans consistently document how their objectives are informed by overarching plans and strategies, including their Regional Pest Management Strategy (See **Appendix 4**).

For example, a comparison between the 2014 and 2015 annual Pest Management Site Plans for Cocopara and Woomargama indicates that:

- the aims and objectives in the annual Pest Management Site Plans and SPC Shoot Plans for Cocopara and Woomargama remained consistent between 2014 and 2015
- individual SPC Shoot Plans target different species but remain consistent in terms of the priority species identified in the Pest Management Site Plans.

### 5.3.4 Alignment of SPC operations with other pest control activities by NPWS or neighbours

Key documents reveal that shooting activities in SPC reserves are strategically aligned with other pest control activities done by NPWS and neighbours. Pest Management Site Plans detail how SPC shooting activities are coordinated with other NPWS activities, and describe wider involvement with neighbouring properties and community groups as well as coordination with other agencies in pest management activities.

Work by the NPWS is complemented by work conducted by Local Land Services (LLS), and in some areas by the pest control activities of park neighbours. For example:

- Adjoining landholders conduct property-scale pest control with LLS support in the Central Mallee. LLS and NPWS interact directly to undertake a landscape approach to pest management. NPWS keeps adjacent landholders notified of results.<sup>12</sup>
- At Yanga, LLS and NPWS interact directly to undertake a landscape approach to pest management. NPWS keeps adjacent landholders notified of results.<sup>13</sup>
- Cross-tenure fox control program is in place at Goonoo, with baiting occurring across the reserve complex, in state forest and on neighbouring land, coordinated by the LLS. NPWS

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<sup>10</sup> Cocopara NR SPC 07-03-15 to 08-03-15 Shooting Operations Plan.

<sup>11</sup> Office of Environment and Heritage, 2012, *Regional Pest Management Strategy 2012-2017: Western Rivers Region*.

<sup>12</sup> NSW National Parks and Wildlife Service, 2015, *Central Mallee Pest Management Site Plan*, p.1

<sup>13</sup> NSW National Parks and Wildlife Service, 2015, *Central Mallee Pest Management Site Plan*, p.1

also involves local community groups and the general public in monitoring and reporting activities.<sup>14</sup>

- Gundabooka have local Indigenous involvement in management through a Joint Management Advisory Committee. NPWS conducts coordinated dog baiting with neighbouring properties and a local community group, prompted by consultation with landholders. Fencing agreements are being negotiated with a number of neighbours, to reduce movement of goats and stock.<sup>15</sup>
- Neighbours of Woomargama NP monitor and report regularly to park staff on pest management issues as they arise. They also contribute to wild dog control under the Hume Wild Dog Management Plan.<sup>16</sup>

More broadly, landholders were consulted during the formulation of Regional Pest Management Strategies for all regions.

SPC operations replicate this approach to alignment and coordination. Existing programs being run by NPWS, neighbours, LLS and others are recognised in Pest Management Site Plans and taken into account in the planning of individual shoots.

For example, one neighbour contributes to a passive trapping program at Cocopara by maintaining fodder and watering points so as to attract goats through one-way gates. This program has been in place for five years and has removed on average 600 goats per year. SPC operations in Cocopara coordinate with this program by ground shooting in locations that encourage goats to move towards the neighbour's one-way gate. In this way, the number of goats taken off the park is increased by combining ground shooting and trapping techniques.

## 5.4 Progress against the Commission's previous recommendations

The Commission's 2014 *Evaluation of Trial Design*<sup>17</sup> report contained a number of recommendations to improve the trial (**Appendix 5**).

NPWS has reviewed these recommendations and implemented or made a definitive response to 16 of the 18 recommendations made (see **Appendix 6**). The two recommendations still being implemented relate to:

- the appropriateness of site selection for individual operations
- night operations.

These recommendations remain relevant and the Commission encourages NPWS to continue the work it has begun in addressing these recommendations.

Few nocturnal target animals have been removed by the SPC trial to date due to the fact that such operation are currently not permitted. This is discussed further in section 6.1.1, and the Commission's *Evaluation of Trial Design*<sup>18</sup> report also discusses the potential benefits of night shooting.

Ecologically, pigs, rabbits and deer are known to forage through the night while goats tend to rest in secure campsites. Foxes are generally nocturnal. Conducting operations at night would significantly increase the number of targets reached during the operational period and may result in increased numbers of pests removed. Conducting SPC operations at night may have

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<sup>14</sup> NSW National Parks and Wildlife Service, 2015, *Goonoo Pest Management Site Plan*, p.1

<sup>15</sup> NSW National Parks and Wildlife Service, 2015, *Gundabooka NP & SCA Pest Management Site Plan*, p.1

<sup>16</sup> NSW National Parks and Wildlife Service, 2015, *Woomargama Pest Management Site Plan*, p.1.

<sup>17</sup> Available online at: [http://www.nrc.nsw.gov.au/literature\\_196218/SPC%20Evaluation%20report](http://www.nrc.nsw.gov.au/literature_196218/SPC%20Evaluation%20report)

<sup>18</sup> Available online at: [http://www.nrc.nsw.gov.au/literature\\_196218/SPC%20Evaluation%20report](http://www.nrc.nsw.gov.au/literature_196218/SPC%20Evaluation%20report)

other benefits, such as shortening operation time-frames (for example, eight hours rather than 14 hours), and reduce the risk of fatigue and dehydration for staff and volunteers.

To maximise the opportunities of the trial and fully explore the potential effectiveness and efficiency of SPC, night operations with appropriate safety and monitoring protocols would be a useful addition to the program.

A table summarising the recommendations and NPWS implementation can be found at **Appendix 6**.

- The Commission recommends that:
  - NPWS continue to review the appropriateness of the current reserves, and allocate resources to the most appropriate sites so to be as informative for the trial as possible.

- The Commission recommends that:
  - NPWS pursue their proposal for night operations in 2016.

## 6 What is the supplementary pest control trial delivering?

The SPC trial to date has delivered a range of results and some unexpectedly high community relations outcomes. On the pest control front, it appears to be generating some positive achievements as a supplementary mechanism when used in combination with other methods. In ecological terms the impacts of SPC have been difficult to assess in isolation from other methods, due to limitations in baseline data. Methodologies for sampling are still being refined, with camera trap data appearing to be the most detail-rich method, and other techniques still being monitored. This section presents key data that illustrate these findings.

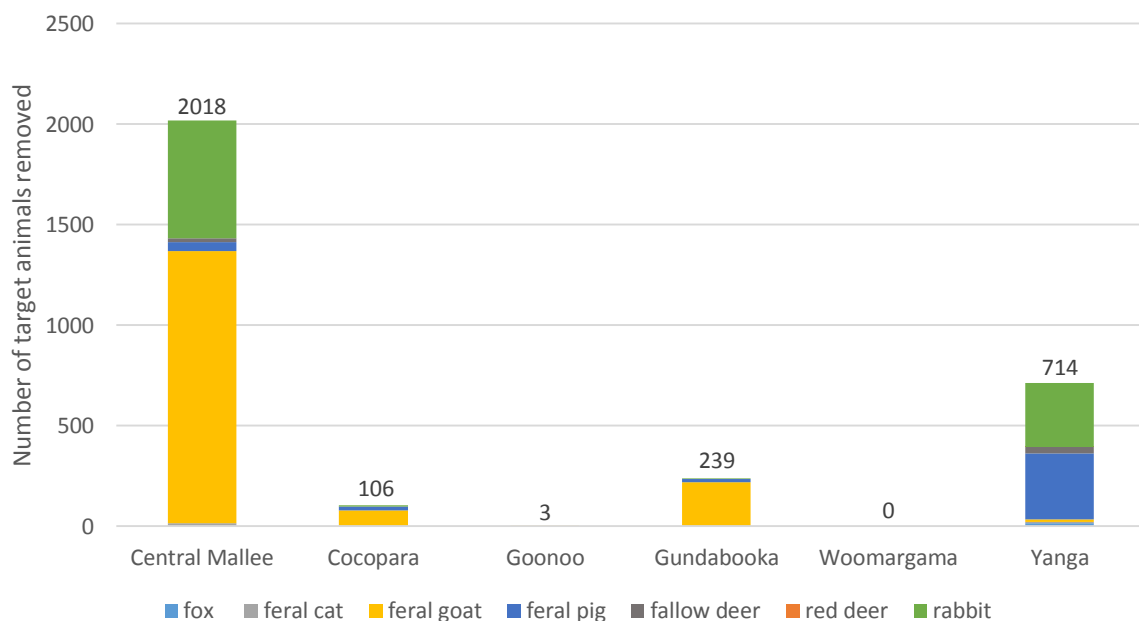
### 6.1 Pest control outcomes

Between February 2014 and June 2015, SPC volunteers removed 2,846 target animals from the 12 target reserves. The largest number of removals were feral goats (55 per cent), rabbits (31 per cent) and pigs (11 per cent), accounting for 97 per cent of the total over this period (Figure 3). Central Mallee followed by Yanga and Gundabooka reserves accounted for the majority of pest removals.

Cocopara, the smallest of the reserves, represented the highest number of animals removed relative to reserve size, with one pest animal removed every 45 hectares on average. This is in contrast to the largest reserve, Central Mallee, where one pest animal was removed every 117 hectares on average.

Given that night operations are not currently permitted as part of the SPC trial, not many primarily nocturnal target animals (namely feral cats, deer and foxes) were removed during operations. This constraint is having a significant impact on both the effectiveness and efficiency of the SPC trial.

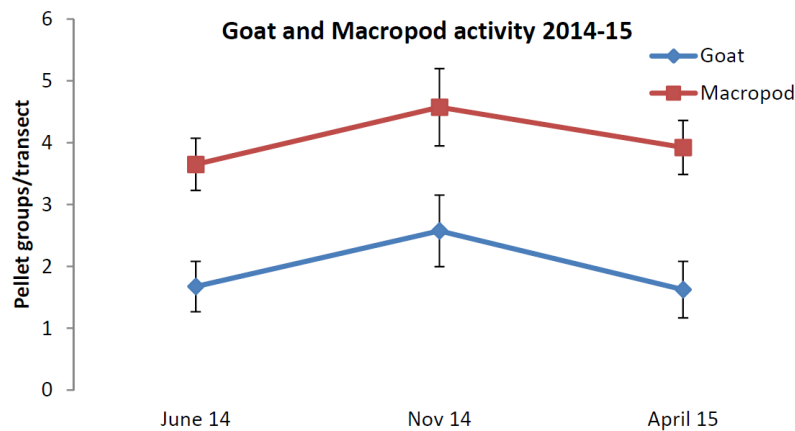
Other factors, including geography and complementary management practises, are also influencing the target animal removals and it is important to not view SPC pest removals in isolation.



**Figure 3: Target animals removed from SPC reserves – February 2014 to June 2015**

For example, goat herd activity in Gundabooka indicates that numbers have remained relatively stable between June 2014 and April 2015 despite an SPC operation being conducted

there in August 2014 (Figure 4). There are three main reasons for this which include the lack of a goat musterer on the reserve for a period, the practice of leaving goat traps open and the poor quality of boundary fences. In response NPWS has since engaged a new contract musterer, reviewed water point management and commenced the installation of new boundary fencing.



**Figure 4: Mean pellet groups per transect. The Index of goat and macropod activity in Gundabooka NP and Gundabooka SCA show small seasonal variation**

Similarly, external factors continue to play a major role in managing pigs within the Yanga complex. For example, environmental water flows through the reserve's northern section have hampered operational and monitoring access to certain pig habitats. While beneficial to the environment, these water flows have also facilitated breeding and led to the need for large numbers of pigs to be removed from this reserve.

Central Mallee, the largest of the SPC reserves, has a long history of fox baiting due to its significant Malleefowl numbers. As a result, goat management in the reserve has not been as proactively addressed, which has led to an increase in the numbers of goats. Since 2014, however, a comprehensive and coordinated goat management strategy including mustering, trapping and SPC operations has been implemented, which is showing signs of reducing goat populations.

Although it would be premature to make conclusions on the effectiveness of ground-based operations, achievements of the SPC trial so far suggest that the most positive results have been achieved when combined with other pest management activities such as mustering. Analysis also indicates that approaches to pest management must vary between reserves. This makes it difficult to assess the ecological outcomes achieved from individual programs such as SPC.

## 6.2 Ecological outcomes

The NPWS ecological and operation monitoring document (**Appendix 9**) presents methods that are intended to measure pest species abundance and threatened species condition and status, both before and after the management actions by NPWS staff and SPC volunteers.

The document includes analysis of raw data on faecal pellet-count indices, spotlight transect counts and camera trap counts, and browse indices on indicator plants. Data on when, where and how various pest species were controlled in the six study reserves were also reviewed.

No experimental controls (areas with no pest control) were available, so the design provides weak evidence of the efficacy of the pest control without a before-and-after data set. A detailed discussion of this design limitation was included in the Commission's *Evaluation of trial design report* released in 2014.

In general, the absence of random locations of some of the monitoring devices and systems means care must be taken in extrapolating results to the whole site, or to making inferences about the trial. In addition, it is unlikely that the monitoring methods will be sensitive enough to discriminate between effects from NPWS control and any additional control achieved by the SPC trial.

Evidence from the ecological monitoring to date has been useful in establishing baseline data for the various reserves, although this was not the original intention of the monitoring. In some instances, it does suggest that target animal populations have been effected by controls in the reserves. However, due to the lack of control sites, the data cannot differentiate between SPC and other park control activities. It should also be noted that the sample period of 18 months is not sufficient to draw strong conclusions about the ecological benefits of the program at this time.

### **6.2.1 Is the monitoring appropriate?**

The methodologies are, in general, appropriate although each has its strengths and weaknesses in terms of detecting any real change in animal density and attributing that to the management imposed. The lack of baseline data and control sites makes it difficult to conclude that the SPC program is having a direct impact on the protection of key threatened species.

The ideal monitoring method should be able to detect significant changes in animal abundance due to the NPWS control (the major treatment), along with the additional reductions due to the SPC volunteers (the minor treatment). To do this the method must give precise estimates and needs to be timed to capture both types of treatment.

Independent analysis suggest that the camera trap data appears to be the most robust method, at least for goats and foxes. Camera traps are deployed at four of the six study complexes with only cameras at Woomargama located randomly. Placement of the Goonoo cameras offered particularly rich detail, given their dispersal on a 5 km grid, 40 within the park and 60 on adjacent land to cover the whole study site. The other sites have cameras at particular locations (for example, near malleefowl sites) and are thus not sampling the whole complex. The cameras run for 14 consecutive nights in late autumn (generally before any 1080 baiting is conducted for fox control) and in spring. Introduced pests trigger the cameras as well as native species, so all are counted.

Camera trap data shows significant differences between the indices of goats and foxes over the two sampling periods in 2014 for the Central Mallee site but no significant differences at the Gundabooka site. In Central Mallee, the total number of foxes recorded fell over the period, supporting a real decline in numbers, but this is likely to be attributable mostly to baiting activities as SPC volunteers did not remove any foxes during this time. Goats, however, increased in number, possibly suggesting a change in group size rather than total numbers. Goats at Gundabooka decreased over this period, which could be explained by the removal of 112 goats by SPC volunteers in August 2014. However, it is unlikely the SPC operation was the sole contributor to the decline. Comparisons might be best made between the same seasons once all data has been collected. However, this preliminary screening of the data from two reserves does suggest that camera traps are useful in measuring changes.



**Table 2: Changes in numbers of goats and foxes recorded on 80 camera traps set in early winter and late spring at two sites (Yathong and Roundhill) in Central Mallee.**

Parameter	Goat		Fox	
	Winter 2014	Spring 2014	Winter 2014	Spring 2014
Mean number animals/trigger event	1.97	1.12	0.46	0.26
Standard error	0.51	0.23	0.11	0.1
Paired t test	P = 0.0026		P = 0.002	
Total animals counted	615	823	116	22

Parameter	Goat		Fox		
	Winter 2014	Spring 2014	Winter 2014	Spring 2014	Summer 2015
Mean number animals/trigger event	1.44	1.15	0.2	0.23	0.29
Standard error	0.65	0.74	0.58	0.59	.97
Paired t test	P = 0.079		P = 0.67 (winter v. summer)		
Total animals counted	661	283	7	8	10

The spotlight and day-count transects (samples) may not be capable of detecting changes in animal populations given the small number of transects and the low densities of pests. Results from the Yanga complex rely on the value of count transects only, which is risky if they prove inadequate in measuring changes in pest densities. Day and night counts along transects are a standard assessment method and while they have no lag effect, they do assume no change in animal behaviour or observability between monitoring periods.

The number of transects appears to be too low to allow much sensitivity in detecting changes in pest abundances. For example, if we compare the means of the average daily counts on the four transects in the Central Mallee for goats (daytime counts) and rabbits (night-time counts), no significant changes over the three sampling periods are detected. This is largely because of the amount of variability in the means among the four transects.

Pellet counts alone are unlikely to help staff detect any significant changes in animal abundance as a result of the NPWS control and SPC operations. Each transect is the sample unit and not enough can be deployed to achieve any precision around the estimates. The lag effect of decomposing pellets deposited across the treatment periods also confounds any measurement

of treatment effect. Clearing pellets from the plots or transects at each measurement overcomes this problem, by moving the focus to pellet recruitment rather than standing crop.

**Table 3: Changes in daytime and night-time counts of goats and rabbits, respectively, along four transects measured between June 2014 and March 2015 in the Central Mallee site**

Parameter	Daytime counts of goats			Night-time counts of rabbits		
	Jun 2014	Nov 2014	Mar 2015	Jun 2014	Nov 2014	Mar 2015
Mean	3.37	7.13	2.1	5.66	5.55	7.22
SE	4.04	7.6	1.84	3.37	4.56	6.7

The limited data from the trial to date suggests that changes in the index are difficult to detect, even when large numbers of animals are removed. Nonetheless this may improve as more data is collected.

### 6.3 Review ongoing appropriateness of monitoring techniques

As discussed in Sections 6.2, a range of monitoring techniques has been used to measure the effectiveness of the trial in reducing pest animals and protecting identified threatened species.

Given the lack of baseline data at the control sites, it is difficult to deduce from the monitoring data collected to date whether the SPC trial is effective in protecting key assets and reducing pest numbers.

Nonetheless, some of the monitoring techniques, namely the day and night transects and camera monitoring, are showing signs of producing statistically significant data outputs. The design and outputs from other elements of the monitoring, such as pellet counts, appear to be less useful. To further improve monitoring techniques, maintain efficiency and maximise the usefulness of the data collected, a review of current monitoring practices would be valuable.

- The Commission recommends that:
  - NPWS assess the ecological data collected from different reserves and review the value of each monitoring activity. Specific attention should be paid to the value of pellet count monitoring for this trial.

### 6.4 Volunteer outcomes

From evidence collected in the field, post-operational surveys and various workshops, the relationships developed between NPWS staff and SPC volunteers is extremely positive. This a key success area of the program to date.

Since the trial began, volunteers have also consistently been pleased with the quality of planning and execution, team work, safety, NPWS knowledge and expertise, communication and animal welfare. Post-operation volunteer surveys indicate that around 30 per cent of volunteers felt their SPC experience was extremely positive, with no recommendations for improvement. This is up from around 10 per cent in 2014, a testament to NPWS' proactive management and program improvements.

As one volunteer noted:

“All NPWS staff (are) very knowledgeable, educational and kept firearms safety standards high. Animal welfare protocol always followed.”

Other volunteers made similar comments about the professionalism of the program and the positive experiences they had:

“Personally appreciated the opportunity to help with ferals and felt privileged to have the access.”

“I particularly enjoyed the teamwork when stalking animals and from vehicles. Done safely but also effectively.”

“The rangers are highly experienced with good communication and relationship skills that are commendable.”

“Thoroughly enjoyed the experience and appreciated the opportunity to see a lot of Yathong Nature Reserve.”

“Thank you to the NPWS staff involved for a safe and extremely well executed program.”

SPC volunteers also made suggestions for improvement, with reviews of the reserves included in the trial and consistent recommendations to introduce night operations into the trial.

## 6.5 Other stakeholder outcomes

In July 2015, the Commission engaged Roberts Consulting Pty Ltd to conduct surveys with SPC reserve neighbours, community and Aboriginal groups. A total of 282 surveys took place using different methods, including telephone interviews, online questionnaires and mail-out surveys. A total of 82 neighbours responded to the survey representing a 29 per cent response rate (Figure 5). Individual contact details were provided to the Commission by NPWS. The list of survey questions can be found at **Appendix 7**.

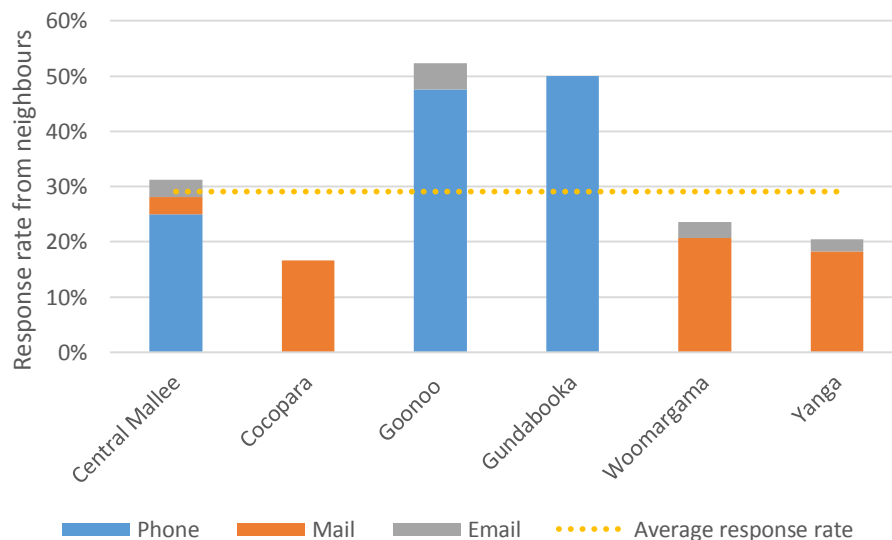
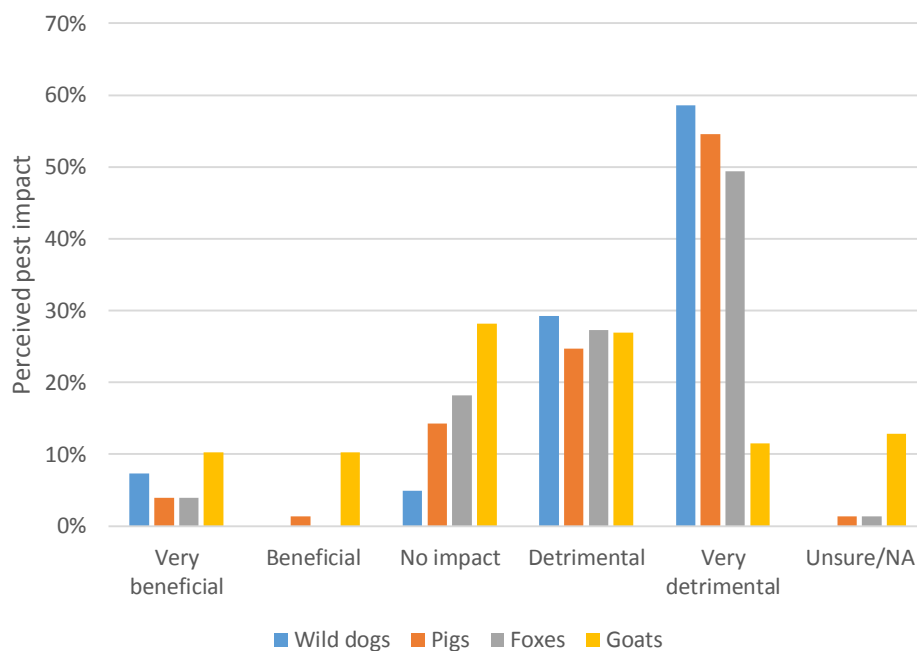


Figure 5: Responses by neighbours to SPC survey

### 6.5.1 Perceived pest impacts and changes to pest animals

The perceived impacts of different pest animals on neighbours varied among respondents. Wild dogs, feral pigs and foxes appeared to have the most negative impacts on neighbours, who described their impacts as very detrimental (Figure 6). In contrast, feral goats had a split response from neighbours, rated as beneficial or having no impact by almost 50 per cent of respondents while almost 40 per cent reported that they were detrimental or very detrimental.

In addition to introduced pest species, reserve neighbours also cited a range of native species that negatively impact on them, such as the 22 per cent mentioning kangaroos.



**Figure 6: Perceived impact of wild dogs, pigs, foxes, goats**

Some respondents perceived changes in the impacts of some species since the trial began. Thirty-five per cent of Gundabooka and Goonoo reserve neighbours reported that the impacts from foxes had reduced, with nine respondents praising the NPWS' baiting program as a key factor.

Across most reserves, neighbours reported increased impacts of feral pigs since January 2014. Trends were strongest among the neighbours of Goonoo, where 47 per cent of respondents indicated impacts had worsened.

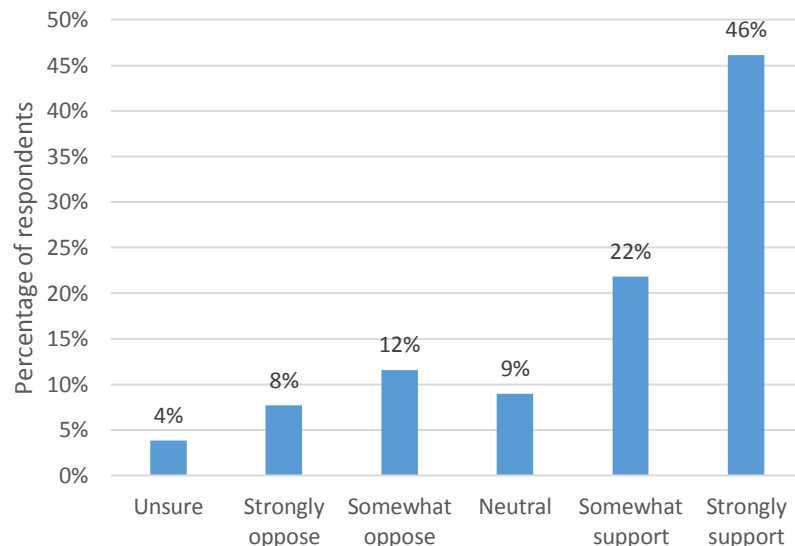
No clear trends were apparent in the impacts from goats across most reserves. The exception was Woomargama, where 36 per cent of respondents noted that the impacts of goats was somewhat less. In Woomargama, 43 per cent of neighbours also noted that the impacts from wild dogs had become somewhat or much worse since January 2014.

### 6.5.2 Support for and impacts of pest control programs and SPC

Almost all (92 per cent) respondents to the survey consider the control of pest animals in NSW to be extremely or very important. In addition, 94 per cent noted that they somewhat or strongly support pest animal control programs in NSW parks and reserves.

Around two-thirds (68 per cent) indicated support for the use of qualified volunteers in the control of pest animals (Figure 7). A number of survey respondents said they felt that the SPC trial was a good idea and should continue.

Around one-fifth (20 per cent) of survey respondents were opposed to the SPC trial, with 8 per cent strongly opposed to the use of qualified volunteers (Figure 7).



**Figure 7: Extent of support for volunteers controlling pest animals through shooting**

Key concerns specifically related to volunteers' experience and the efficiency and effectiveness of the approach. As one respondent noted:

"It would be good if you had experienced people but I don't think they are. I've been a hunter all my life, and I think it is impossible that they are hunting on foot. It's not very resourceful." - Reserve neighbour, Goonoo region

Another made a similar point about cost-effectiveness:

"The money could be spent better in other control methods, such as baiting and trapping. I don't believe shooting is a viable way to control pest animals." - Reserve neighbour, Woomargama NP

Concerns about the efficacy of pest control methods were not limited to the SPC trial alone. One raised issues around NPWS using bomb baits that could have injured their dogs, while three respondents suggested that aerial shooting, as with SPC, was ineffective and inefficient. Two other respondents, in contrast, stated their explicit support for aerial shooting. This demonstrates the variety of perspectives in the target areas, the complexity of the issue and the potential for misinformation to spread.

Others (eight respondents) noted in-principle support for the program, but highlighted concerns that:

- the program remains part of an integrated and strategic approach to pest management
- the trial uses appropriately experienced and qualified volunteers.

Some comments included:

"I hope it goes well, I hope they can eradicate all the pests. I think it is okay if they have qualified and experienced volunteers doing the shooting, but I do not support the program if there are blokes who've hardly shot anything, roaming around the parks shooting anything on legs." - Reserve neighbour, Yathong NR

"I feel most confident in Parks management when it is clear these activities are part of a diverse and flexible strategy to manage the parks. For example, baiting, trapping, monitoring and communicating about pest management. Which seems to be working well in Woomargama NP. The local ranger is a key trusted person and I feel less confidence in teams coming in from other places with less local knowledge and relationships." - Reserve neighbour, Woomargama NP.

Sentiments about the experience of volunteers questioned the efficacy of the approach (discussed above), as well as safety standards for neighbours and other animals (seven

comments). Two respondents clarified that their concerns were less about the SPC operations and more about their concern that SPC had encouraged other shooters to hunt in the area:

“There were a group doing a goat cull... there were bullets flying around everywhere and they weren't very far from our house. It was unsafe. I found out they weren't involved with the National Parks but they must have seen the information in the paper and thought that they could get involved and have a shoot.” - Reserve neighbour, Yathong NR

Another concern (voiced by seven respondents) was that by targeting goats, the SPC trial could impact on landholders' trappings and the sale of goats as part of their income. No comments indicated that this had actually occurred, only that it was a potential impact of the trial. The final noted impacts or concern about the trial were that it:

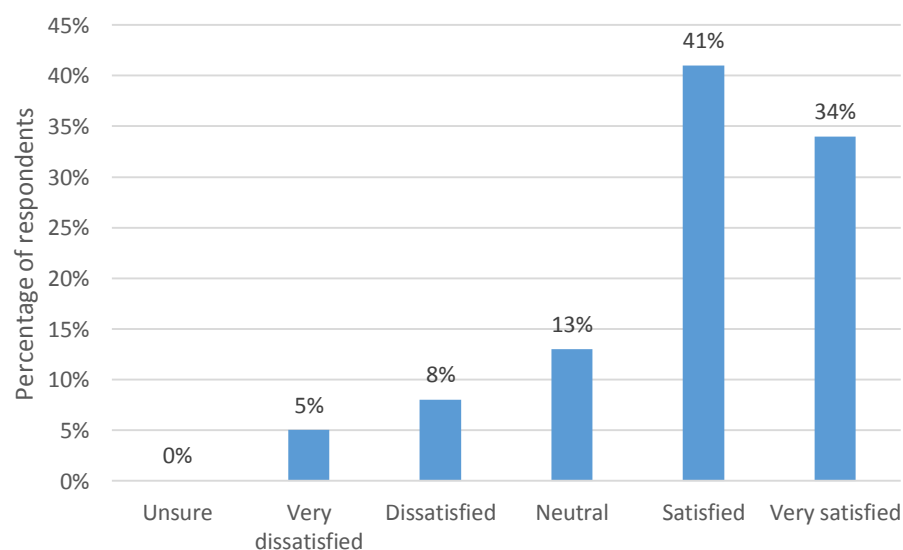
- had hindered access to roads and parks (two comments)
- was driving pest species onto neighbours' properties (two comments)

“I saw a large collection of goats gathered in front of my farm because they had been scared away by the volunteers making lots of noise and moving with their guns. When I saw the people from National Parks and Wildlife, I asked them how they had gone and they said they hadn't found any goats. I told them it was because they had scared them off and sent them to my property!” - Reserve neighbour, Goonoo SCA

### 6.5.3 NPWS communication with neighbours

Overall, three-quarters of respondents (75 per cent) were satisfied or very satisfied with the information provided by NPWS about the SPC trial (Figure 8). Typifying comments by this group of respondents, one neighbour noted:

“I am pretty happy with it. They let me know what's going on. They send me a letter and usually there is a courtesy phone call a few days before anything goes on.” - Reserve neighbour, Goonoo SCA



**Figure 8: Level of satisfaction with information provided by NPWS**

Despite most respondents' positive views of NPWS' communications, 13 per cent were dissatisfied in some way, including 5 per cent who were very dissatisfied. These individuals typically indicated that they simply had not been informed about the SPC trial. As one respondent noted:

“They do a lot of things without telling us, they need to send more letters out, we never get the mail even when they promise they are contacting us.” - Reserve neighbour, Yathong NR

Given most respondents noted that they had been kept informed through letters or phone calls, cases where neighbours were insufficiently informed appear to be due to:

- instances where a neighbour was unavailable for phone calls, was missed in mail deliveries or overlooked letters
- instances where a neighbour is already dissatisfied with NPWS' communications and the information provided on the SPC trial has been insufficient to sway these broader views – a position evident in at least one respondent's answers.

Those respondents who noted concerns about the SPC trial were asked if they had raised their concerns with NPWS. Of the respondents who had, three were satisfied with NPWS' response to their concern, one noting:

"I talked to them and explained the culling situation and it turns out it wasn't the Parks boys, it was another group not associated with anyone. They were very receptive." – Reserve neighbour, Yathong NR

Two were dissatisfied with their response, with these respondents appearing to have more general concerns about land management and pest control, one noting:

"They do whatever they want with no regard for the rules that apply to farmers out here. They do nothing to support sustainable land. They do not cull roos or do anything to help with that issue." – Reserve neighbour, Gundabooka NP

Respondents also suggested potential improvements to NPWS' communications around the SPC Trial:

"I would rather see and hear that they are getting on top of it, maybe some feedback. I get a little folder/newsletter once in a blue moon. We also go to the fox baiting and community meetings (land management) and they are very informative and helpful." – Reserve neighbour, Goonoo SCA

#### 6.5.4 Indigenous groups

Interviews were conducted with two members of the Gundabooka Joint Management Committee. Key topics included the level of involvement and interaction with the NPWS, extent to which they felt cultural heritage sites were protected and their level of satisfaction in working with NPWS. Key insights from these stakeholders were that:

- NPWS engaged with the Aboriginal groups in a range of ways including holding meetings, discussing how the trial would be run and offering the opportunity to provide feedback. One interviewee noted they went and met the shooters during an operation and that they received a report after a shooting trial indicating the results (such as how many pigs were shot).
- As part of the engagement process cultural heritage sites were mapped out, with emphasis on the places volunteers could and could not go. One group member noted that they were given a say about whether or not the shoot went ahead.
- The general sentiment was that there is a good level of communication to ensure safety for the community (for example, shoots are advertised in the papers and radio, and the gate to the park is locked).
- Both group members were very satisfied in how NPWS were working with them, noting that they keep in touch very well:
  - "They've kept us informed about what's happening, and the changes they've made; they took our concerns on board." – Joint Management Committee Interviewee
  - "We have meetings – they can ring us if they want to find out something, but generally we all get together and they explain it to us together. They keep in touch with us very well." – Joint Management Committee Interviewee)
- One interviewee noted that they reported their concerns about the SPC Trial in a letter and all of them were addressed sufficiently. These concerns included the health risks of

carcasses being left behind, something that was addressed through reassurance that carcasses would be removed.

- There were no suggestions for how NPWS could improve the SPC trial:

“They’ve got another one coming up, and from the last one I don’t think there’s much they need to change.”  
– Joint Management Committee Interviewee

- In their final comments, both interviewees indicated that they felt NPWS was doing a good job and stated their approval around the measures to address pest animals:

“It’s helped manage the pests – to get the nuisance animals out of the way. And that’s our country and it’s very important to try and preserve it as much as we can. And they mess up the water holes, dig up artefacts. And the trails we’ve got for people to walk on to see the rock paintings, it’s all helping a lot to stop all that damage.” – Joint Management Committee Interviewee

### 6.5.5 User groups and other community members

There were three respondents from community group representatives (out of nine valid contacts). The small size of this sample of stakeholders should be taken into consideration when interpreting the results below.

All three groups were aware that NPWS conducts pest animal control programs and that they were using volunteer shooters to control pest animals on NSW reserves and parks. Newspaper and radio were the main means by which the groups heard about the SPC trial. They reported that there had been no direct communication to them from NPWS. One community group was satisfied with the NPWS communications about the trial; another indicated it was not applicable and the third did not respond.

Two of the three respondents noted concerns about the trial. Both concerns related to non-NPWS people doing pest control, with one noting that it would be more cost-effective for NPWS to use the resources on their own programs. Another noted that park staff should be euthanizing animals rather than allowing non-park staff to use firearms in national parks. One respondent elaborated on the issues involved in pest control in national parks and how ground-shooting by volunteers is not an appropriate response:

“Federal and state funding for pest control in national parks and adjacent land is insufficient for an effective control measure. I’ve seen numerous parks across NSW struggling with pest animals and having been getting much worse over the past three years, and opening the park up to non-park staff handling firearms is not the way to solve that.” – Community group respondent

## 6.6 Improve communication with neighbours and community

As noted in Section 4.4 and as discussed through section 5.3, a number of positive relationships have stemmed from the SPC trial to date. The data collected reveal an overwhelming majority of key stakeholder groups to be pleased with how the program has been conducted and communicated.

Feedback from some stakeholders (Section 6.4) and SPC volunteers suggests that communication, albeit sound, could be improved. Specifically, developing and using a stakeholder engagement strategy would significantly boost the positive messages stemming from the SPC trial. Evidence from surveys suggests that, without clear communication with neighbours about how the program is being run and what outcomes are being achieved, some misconceptions about the program are developing within some segments of the community.

In addition, improving communication with neighbours and key regional stakeholders about SPC operations has the potential to improve the management of pest animals across the landscape, and also on NPWS reserves.



The Commission encourages NPWS to implement a stakeholder engagement strategy and use it to guide future program communications. NPWS should consider providing regular updates to neighbours, community and Aboriginal groups on the progress of the trial to share successes and promote positive pest outcomes.

From its review so far, the Commission believes that adopting a strategic approach to communications and engagement could also assist in better coordination of pest management activities across all tenures.

## 7 What is the cost of the supplementary pest control trial?

From looking at expenses incurred so far, the SPC trial appears to have invested the greatest funds in establishment costs including program design and the purchase of equipment. While these represent one-off investments, the program also maintains a high level of ongoing operational and staffing costs. Meanwhile, significant improvements made in the first 18 months have halved costs to around \$9,400 per operation. Since total program costs will be well within the budgeted \$11 million, the Commission proposes that NPWS invest effort into capturing accurate information of program costs during the balance of the trial period. This will provide some of the key data needed to ultimately determine whether SPC can be an efficient and effective supplement to primary pest control methods in NSW.

### 7.1 Total program costs

The total cost of the trial to date is well within the initial \$11 million allocation for the trial. Further, it is highly unlikely that NPWS will spend the whole allocation by the completion of the trial. To date around \$3.6 million has been spent by NPWS on the SPC trial, including:

- \$0.64 million (18 per cent) on program design and establishment costs
- \$0.32 million (9 per cent) on equipment
- \$0.25 million (7 per cent) has been spent on operational costs.
- Pre and post operations, NPWS Coordination staff, in-field monitoring and pre and post in-field monitoring costs represent \$1.78 million (around 50 per cent) of total expenditure to date (Figure 9 and **Appendix 8**).

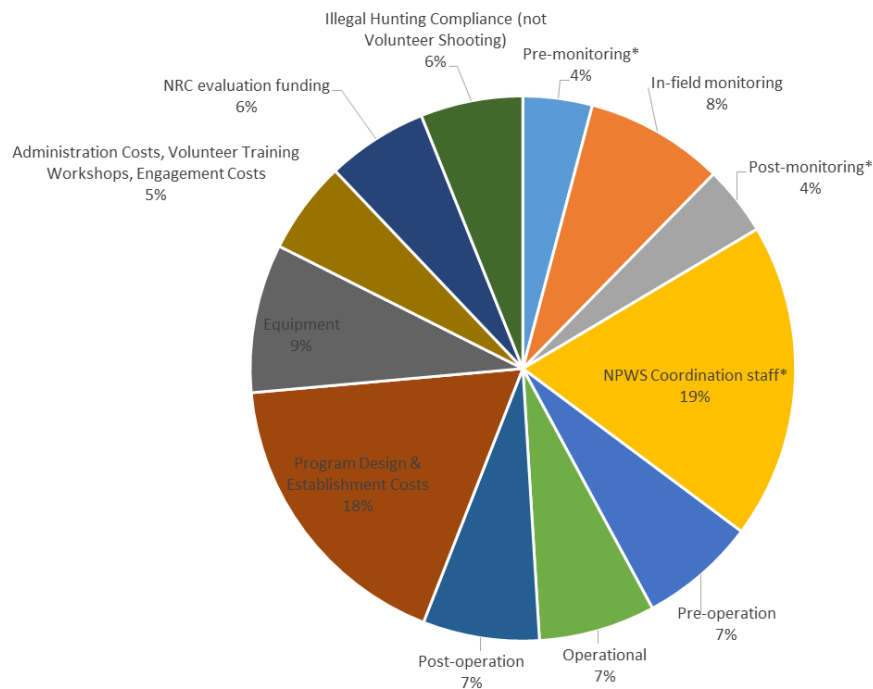


Figure 9: SPC expenditure 2012/13 - 14/15

\* Indicates estimates. All other figures are actuals.

## 7.2 Establishment and design costs

Establishment and program design costs totalled \$0.64 million in 2012-13 and 2013-14, or around one-quarter of total costs. In addition, a significant amount of equipment, including GPS trackers, was purchased to meet the program’s safety requirements. The initial cost of this equipment was \$0.26 million in 2013-14 with around \$0.06 million spent in 2014-15 (Figure 10).

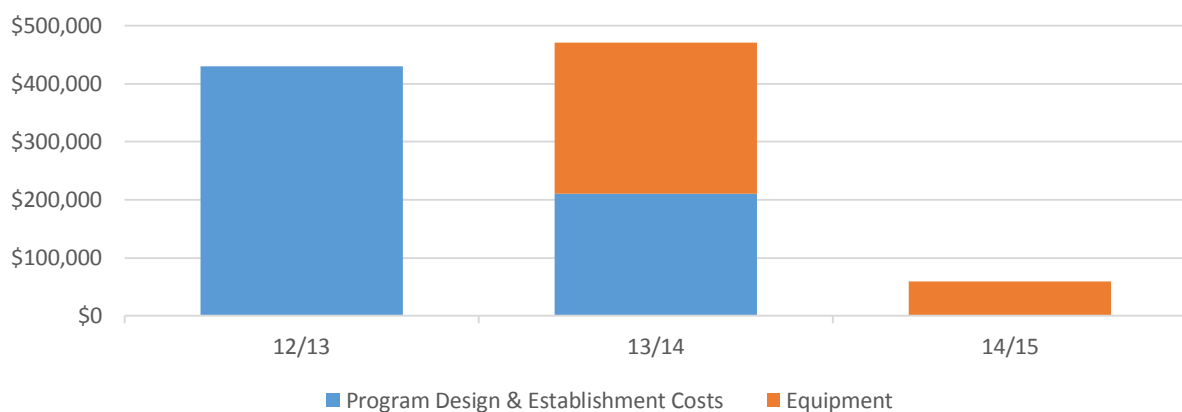


Figure 10: Establishment costs - program design and equipment

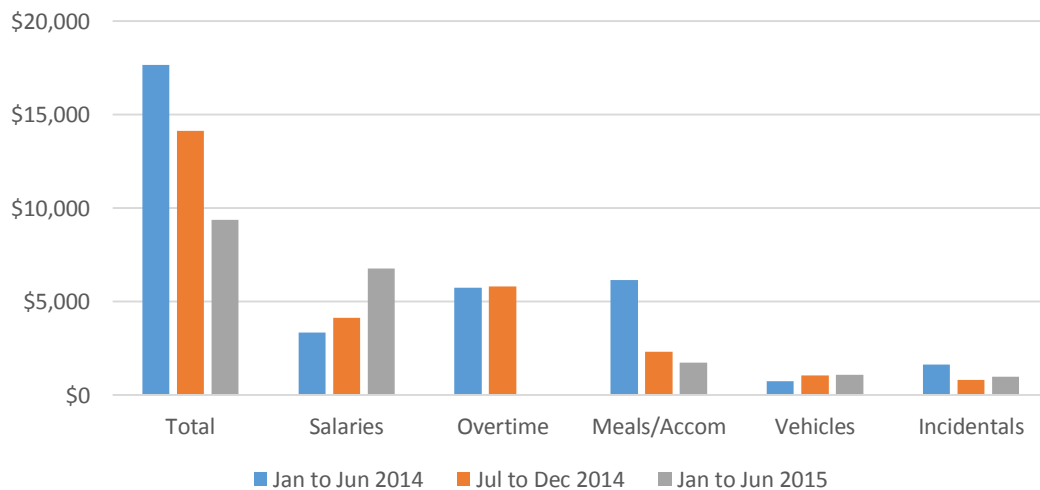
## 7.3 Operational costs

The costs of field operations and monitoring have almost halved in the period since the program began. Over the period January 2014 to June 2015:

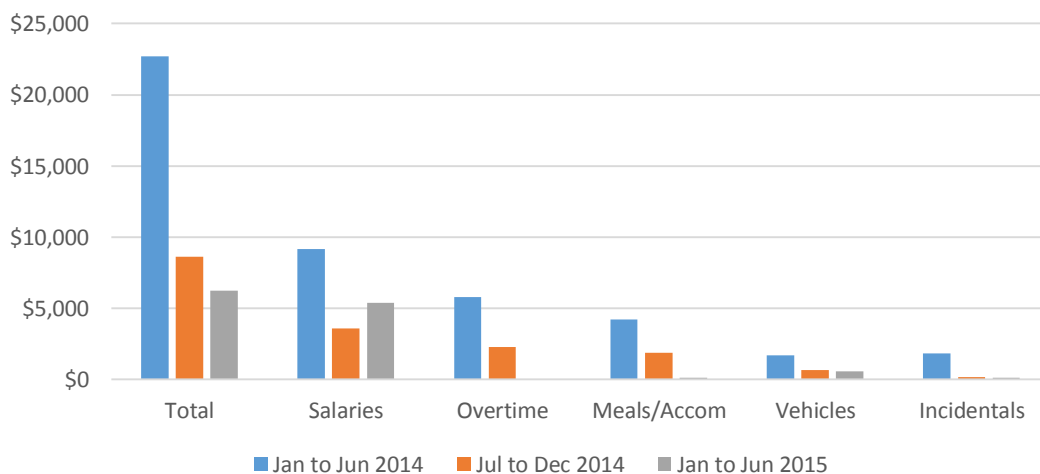
- average operational costs have declined by almost 50 per cent from around \$17,600 per operation down to around \$9,400 per operation (Figure 11)
- average monitoring costs have also declined by around 75 per cent, falling from around \$22,000 to around \$6,200 (Figure 12).

These reductions have been made through:

- improved planning, which has reduced the need for overtime
- changes in staffing ratios
- reduced use of access control staff at some complexes during operations, and
- improved meal and accommodation arrangements.



**Figure 11: Average costs per operation**



**Figure 12: Average monitoring costs**

## 7.4 Review and improve program costs

The reductions in operational and monitoring costs have been significant over the first 18 months of the trial and should be commended. However, fixed coordination staff costs continue to account for a significant proportion of trial expenditure at a level which would not be sustainable in a non-trial environment. Pre and post-operational costs account for 14 per cent of total expenditure to date, and should also be reviewed for potential efficiency improvements.

Internal NPWS challenges around measuring non-operational staff time and costs appear to hamper the ability of NPWS management to clearly assess and report on this aspect of the trial. Greater transparency would help NPWS management better assess and manage non-operational expenditure.

Another clear theme in the feedback received from SPC volunteers related to the ability of volunteers to improve their capability, target efficiency and increase knowledge as they continue to work with NPWS and learn about SPC. NPWS should consider what value experienced volunteers could add to future SPC operations beyond shooting pests; for example, by participating in planning or monitoring processes.

- The Commission recommends that:
  - NPWS improve its internal reporting systems so it can report on all aspects of trial costs in detail.
  - NPWS review pre and post-operation costs and NPWS coordination costs to improve the efficiency of the trial. This could include rationalising central planning time to reduce staff costs.
  - NPWS explore options to involve volunteers in planning and monitoring processes to leverage their knowledge and expertise, and decrease the ongoing marginal cost of each operation.

The NSW Government could gain more value from its investment in the SPC trial via a number of efficiency improvements at NPWS.

For example, many of the establishment costs associated with SPC do not need to be repeated and could be considered sunk. Establishment costs represent 18 per cent of the total trial costs to date. The greater the number of SPC shoots conducted, the greater the value generated from the government's investment. NPWS should explore possibilities to increase the number of operations that can be efficiently conducted in the remaining trial period.

Another way to further recoup investment from the SPC trial is to decrease the marginal cost of conducting each additional operation. At present, managing human safety and animal welfare risks means that volunteers must be supervised by NPWS staff during an operation. These staff do not participate in shooting during operations (except in a small number of very specific instances relating to animal welfare). NPWS should consider allowing its supervising staff to participate in the shooting of pest animals. All NPWS staff involved in the trial are qualified and very experienced in the use of firearms for pest control, and could add considerably to the number of animals despatched during an operation.

- The Commission recommends that:
  - NPWS explore possibilities for completing more operations per year.
  - NPWS investigate whether NPWS staff can safely participate in the shooting of pests during operations.

Finally, the Commission strongly encourages NPWS to make full use of the remainder of the trial period to test different techniques and ideas. These will provide valuable information on the efficiency and effectiveness of SPC as a potential future tool within the NPWS pest management toolkit.

## **Part III - Appendices**

# Appendix 1: Terms of Reference

## TERMS OF REFERENCE FOR THE EVALUATION OF THE SUPPLEMENTARY PEST CONTROL TRIAL PROGRAM

### Background

The NSW Government has decided to:

- implement a program of Supplementary Pest Control (SPC) in national parks and other reserves using volunteer shooters who will be regulated, scheduled and carefully managed by the National Parks and Wildlife Service (NPWS); the purpose of this program is to assist in controlling pest animals by complementing ongoing NPWS pest control programs;
- commence the program, initially as a trial, in 12 reserves;
- independently evaluate the trial before any further rollout of the program.

These Terms of Reference outline how this evaluation will be conducted.

### Evaluation of the SPC trial

The Premier and the Minister for the Environment requests that the Natural Resources Commission (the Commission) evaluate the SPC trial program to assist the NSW Government in deciding whether, and how, to proceed with the proposed SPC program (beyond the trial period).

The Commission will independently evaluate the effectiveness and efficiency of the SPC trial program based on robust, evidence-based exploration of key issues. In developing its advice the Commission should consider issues such as (but not limited to):

1. the effectiveness of the SPC trial program in contributing to the aims and objectives of existing NPWS pest control programs, including
  - a) evidence that relevant native species populations have been additionally protected by the SPC trial
  - b) evidence that impacts of pest animals on neighbouring landholders and on the environment have been reduced
  - c) evidence that the number of pest animals taken by volunteers contributes to the existing NPWS pest animal programs (giving consideration to relative timing of control activities)
  - d) evidence that good animal welfare standards have been maintained
  - e) evidence that the SPC trial has been successfully aligned with and integrated into existing NPWS pest control programs, including evidence of any impacts on NPWS park operations
  - f) evidence that the SPC trial has been conducted in a manner consistent with the program approved by Government, that appropriately manages risk, that complies with relevant legislation and aligns with Government priorities (such as the NSW Biosecurity Strategy and NSW2021).

2. the efficiency of the SPC trial program, including
  - a) the costs and benefits of the trial to the NSW Government and to regional communities
  - b) how the SPC trial program compares to alternative uses of the available resources that may achieve similar outcomes
3. the social impacts of the SPC trial.

Any recommendations from the Commission should include potential improvements to the SPC program to enhance effectiveness and efficiency, if the program is to continue after the trial.

The Commission should also have regard to the following in undertaking the evaluation:

- any broader research carried out by the Department of Primary Industries on hunting as a pest control technique
- best practice in pest control programs and their evaluation in other jurisdictions.

The Commission should consult with relevant stakeholders in conducting their evaluation and in developing recommendations, including park neighbours, Aboriginal communities, Local Land Services, NPWS staff, volunteers and shooting organisations involved in the trial, other members of the hunting community, conservation and animal welfare groups, recreational users of parks and reserves, and tourism providers.

The Commission should also consult technical experts with pest management expertise and ecological, economic and social science skills including the Office of Environment and Heritage (OEH), Department of Primary Industries and universities conducting relevant research.

The Commission should work closely with the Office of Environment and Heritage (OEH) in designing and conducting the evaluation.

Evaluation outcomes and recommendations rely heavily on the design of the trial, the availability of existing data (including baselines) and information on existing NPWS pest control programs, as well as any additional data that can be collected during the three year trial. OEH will be responsible for the collection and quality of data from existing NPWS pest control programs and from the SPC trial, as required by the evaluation.

For some elements of the evaluation, conclusive, scientifically reliable evidence at all sites may not be achievable within the timeframe of the trial (three years). In this instance the best available alternative sources of evidence will be sought.

The Commission is to provide:

- interim evaluation reports, including draft findings
- a final evaluation report, including outcomes of the evaluation and recommendations to Government, by 31 May 2017.

### **Amendments**

Any changes to these Terms of Reference may be made by the Minister for Environment and the Premier and will be published on the website of the Office of Environment and Heritage and the Natural Resources Commission.

## Appendix 2: Evaluation framework and logic

Evaluation framework questions	Questions on trial design addressed in this report	Interim report	Final report
<b>K1: Should SPC proceed beyond the trial period, and if so, how?</b>			
KS1: To what extent could SPC improve outcomes and/or reduce the cost of existing NPWS pest programs?			✓
KS2: Under what circumstances is SPC (as a technique) most useful?			✓
KS3: What improvements could be made so that SPC works better and costs less in the future?		✓	✓
<b>K2: How effective was the SPC trial?</b>			
KS4: To what extent has the SPC trial contributed to existing NPWS pest programs (including alignment and integration)?	<b>K2(iii):</b> Is it designed to be aligned with existing pest management programs? <b>K2(iv):</b> Are governance arrangements, roles and responsibilities appropriate?	✓	✓
KS5: To what extent have negative impacts of pest animals on neighbours been reduced?			✓
KS6: To what extent have relevant native species populations been additionally protected?	<b>K2(ii):</b> Is it designed to be aligned with government priorities, particularly pest management and threatened species priorities?	✓	✓
KS7: To what extent was the SPC trial implemented in compliance with relevant legislation and Government priorities?	<b>K2(i):</b> Is it designed to be compliant with legislation? <b>K2(ii):</b> Is it designed to be aligned with government priorities, particularly pest management and threatened species priorities? <b>K2(iv):</b> Are governance arrangements, roles and responsibilities appropriate?		✓
KS8: To what extent were human safety risks appropriately managed?	<b>K2(i):</b> Is it designed to be compliant with legislation? Are SPC staff and volunteers appropriately qualified and trained? <b>K2(vi):</b> Are appropriate risk management plans and processes in place for human safety and animal welfare risks?		✓
KS9: To what extent were animal welfare risks appropriately managed?	<b>K2(i):</b> Is the trial designed to be compliant with legislation? <b>K2(v):</b> Are SPC staff and volunteers appropriately qualified and trained? <b>K2(vi):</b> Are appropriate risk management plans and processes in place for human safety and animal welfare risks? <b>K2(vii):</b> Is the ecological monitoring framework designed to report on trial outputs and inform the evaluation?		✓
<b>K3: How efficient was the SPC trial?</b>			
KS10: What were the costs and benefits of the SPC trial to Government?		✓	✓
KS11: How does the SPC trial compare to alternative uses of the available NPWS resources that may achieve similar outcomes?			✓
KS12: Has the efficiency of the SPC trial improved over the period of the trial?		✓	✓
<b>K4: What were the social impacts (intended or unintended) of the SPC trial?</b>			
KS13: What were the impacts on volunteers and associated organisations?		✓	✓
KS14: What were the impacts on park neighbours and Aboriginal communities involved in joint management?	<b>K4(i):</b> Are park neighbours being effectively engaged in order to identify any unintended (positive or negative) impacts?	✓	✓
KS15: What were the impacts on regional communities including park users, local Aboriginal communities etc.?		✓	✓



## Appendix 3: Summary of evaluation methods

Method	Details																					
<b>Mid-trial feedback workshop</b>	A mid-trial feedback workshop was held to collect feedback on the trial from volunteers and NPWs staff. This workshop was attended by NPWS SPC staff, NPWS staff, SSAA NSW staff and SPC volunteers.																					
<b>Field observations</b>	Commission staff attended eleven of the twenty-seven field operations conducted in 2014-15. This included at least one operation in each of the sites sampled in the document review (described below). <table border="1" data-bbox="395 533 1348 925"> <thead> <tr> <th>SPC complex</th> <th>No. operation days (2014 -2015)</th> <th>Commission observation (2014 - 2015)</th> </tr> </thead> <tbody> <tr> <td>Cocopara NR</td> <td>14</td> <td>15-16 Feb '14, 1-4 Nov '14, 7-8 Mar '15</td> </tr> <tr> <td>Goonoo Complex</td> <td>9</td> <td>28 Apr - 1 May '15</td> </tr> <tr> <td>Gundabooka Complex</td> <td>7</td> <td>8-11 Oct '15</td> </tr> <tr> <td>Murrumbidgee Valley NP (Yanga)</td> <td>13</td> <td>10-11 May '14, 24-27 Oct '14, 15-17 Sept '15</td> </tr> <tr> <td>Woomargama NP</td> <td>12</td> <td>15-16 Nov '14, 7-8 May '15</td> </tr> <tr> <td>Yathong NR</td> <td>10</td> <td>28-30 Apr '15</td> </tr> </tbody> </table> <p>Commission staff recorded the following information of relevance to this report:</p> <ul style="list-style-type: none"> <li>▪ issues or concerns raised by staff and volunteers</li> <li>▪ operational issues and how they were dealt with observations of safety or animal welfare issues.</li> </ul>	SPC complex	No. operation days (2014 -2015)	Commission observation (2014 - 2015)	Cocopara NR	14	15-16 Feb '14, 1-4 Nov '14, 7-8 Mar '15	Goonoo Complex	9	28 Apr - 1 May '15	Gundabooka Complex	7	8-11 Oct '15	Murrumbidgee Valley NP (Yanga)	13	10-11 May '14, 24-27 Oct '14, 15-17 Sept '15	Woomargama NP	12	15-16 Nov '14, 7-8 May '15	Yathong NR	10	28-30 Apr '15
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Yathong NR	10	28-30 Apr '15																				
<b>Interviews with stakeholders</b>	The Commission engaged Roberts Evaluation Pty Ltd. to conduct survey interviews with park neighbours, relevant community and Aboriginal groups. These interviews sought stakeholder's views on the social impacts of the trial to date.																					
<b>Technical review<sup>19</sup> - ecology</b>	The NPWS ecological and operational monitoring document ( <b>Appendix 9</b> ) and SPC ecological data was reviewed and analysed by a vertebrate pest expert. The reviewer looked at: <ul style="list-style-type: none"> <li>• Whether the current ecological and operational monitoring framework was appropriate for the SPC program.</li> <li>• Identified missing elements and recommended opportunities for improvement.</li> <li>• Assessed monitoring data and provide analysis of the effectiveness and efficiency of the program from an ecological perspective.</li> </ul>																					

<sup>19</sup> The Terms of Reference for the evaluation requires the Commission to consult with technical experts with pest management expertise and ecological, economic and social science skills.

Method	Details
<b>Technical review - alignment and integration</b>	<p>The Commission engaged First Person Consulting Pty Ltd. to review the strategic alignment of SPC activities. The reviewer assessed:</p> <ul style="list-style-type: none"><li>• The alignment of SPC activities and relevant legislation/policies under Activity 7 of the SPC evaluation Implementation plan, including a review of all six management sections.</li><li>• The alignment between a sample of pest management shooting operation plans and relevant policy and legislation</li></ul>
<b>Technical review - economic data</b>	<p>The Commission has conducted an analysis of total SPC program and individual park costs.</p>
<b>Incident logs</b>	<p>The Commission has reviewed all incidents logged</p>
<b>NPWS staff questionnaire and survey</b>	<p>The Commission has reviewed all responses to the post operation surveys completed by NPWS staff</p>
<b>SPC volunteer survey</b>	<p>The Commission has reviewed all responses to the post operation surveys completed by SPC volunteers. The Commission has also review responses to the SSAA NSW SPC volunteer survey.</p>

## Appendix 4: Objectives of pest control programs and key species in SPC management sections

SPC Management Section	What are the regional and national priorities for pest management for the site?	What are the aims and objectives of site level pest/threatened species management?	How does the PMSP/SPC Shoot Plan identify and document the highest priority pests?	What are the threatened species?
Central Mallee	<p>The RPMS outlines as a critical priority the protection of declining and threatened mallee woodland fauna through predation by foxes, and the protection of woodlands ecological communities through vegetation degradation and erosion through goats, rabbits and pigs.<sup>20</sup></p> <p>Central Mallee is listed as a priority site for management under the NSW Fox Threat Abatement Plan (TAP) for the protection of malleefowl, chestnut quail thrush, and southern scrub robin.<sup>21</sup></p> <p>Browsing by goats are a threat to the malleefowl listed in its National Recovery Plan.<sup>22</sup></p>	<p>The PMSP for Central Mallee identifies feral goats, foxes and rabbits as priority species, and pigs as a secondary species when conditions cause an increase in population. These species are targeted for their impacts on:</p> <ul style="list-style-type: none"> <li>• Vegetation recovery, attributed to feral goats and rabbits</li> <li>• Reduction in native species including mammals and reptiles, in particular the SPRAT listed Malleefowl, as a result of predation by introduced foxes and native predator species.<sup>23</sup></li> </ul> <p>The Central Mallee PMSP also</p>	<p>The PMSP for Central Mallee identifies feral goats, foxes and rabbits as priority species, and pigs as a secondary species when conditions cause an increase in population. The reduction of the numbers of these species in the Central Mallee reserve system is the main objective of the site plan. SPC shooting activities targets foxes and goats.</p> <p>The Central Mallee PMSP refers to RMPS priority programs relating to target species.</p> <p>The Shoot Plan identifies compliance with the Central Mallee POM, and with RMPS priorities, and states:</p> <p>“Goats, pigs, rabbits &amp; foxes [...] have a very large impact causing damage to natural habitats and impact heavily on native flora and fauna within these reserves. Curly Bark Wattle is an endangered species known to exist in two small locations in Yathong &amp; Nombinnie. The latest information from Biodiversity &amp; Wildlife Team would suggest these populations are struggling to survive due to heavy browsing, primarily by goats.”<sup>25</sup></p>	<p>Malleefowl</p> <p>Southern Scrub Robin</p> <p>Chestnut Quail Thrush</p> <p>Redlored Whistler</p> <p>Gilbert’s Whistler</p> <p>Greycrowned Babbler</p> <p>Brown tree Creeper</p> <p>Speckled warbler</p> <p>Varied sittella</p> <p>Hooded robin</p> <p>Shy heathwren</p> <p>Curly Bark Wattle (<i>Acacia curranii</i>)</p> <p><i>Ningauai yvonneae</i> (Marsupialia):</p>

<sup>20</sup> Office of Environment and Heritage, 2012, *Regional Pest Management Strategy 2012-2017: Western Rivers Region*.

<sup>21</sup> Office of Environment and Heritage (OEH), Dec 2010, *NSW Fox Threat Abatement Plan – Predation by the Red Fox (*vulpes vulpes*)*, OEH, Sydney.

<sup>22</sup> Benshemesh, J. 2007. *National Recovery Plan for Malleefowl*. Department for Environment and Heritage, South Australia.

<sup>23</sup> NSW National Parks and Wildlife Service, 2015, *Central Mallee Pest Management Site Plan*.

<sup>25</sup> Central Mallee SPC 28-04-15 to 30-04-15 Shooting Operations Plan.

		states: "Strategic pest animal control programs are one tool to maintain acceptable species protection to allow species richness and abundance to be maintained." <sup>24</sup>		Dasyuridae) Semi-arid woodlands <sup>26</sup>
Cocopara	<p>The RPMS outlines as critical priorities for Cocopara the protection of <i>Pomaderris cocoparrana</i> (ROTAP) and Inland Grey Box Woodland EEC through strategic goat and rabbit control.<sup>27</sup></p> <p>Feral goats were listed as the main threat to <i>Pomaderris cocoparrana</i> in the scientific determination of its listing as a Threatened species in NSW.<sup>28</sup></p>	<p>Cocopara PMSP objectives include:</p> <ul style="list-style-type: none"> <li>• Reduce feral goat numbers within Cocopara Nature Reserve</li> <li>• Maintain feral pig numbers at current low densities</li> <li>• Alleviate browsing pressure on <i>Pomaderris cocoparrana</i> and Inland Grey Box Woodland, and reduce land degradation</li> <li>• Reduce the impacts of pests to neighbouring properties<sup>29</sup></li> </ul>	<p>The PMSP identifies feral goats and pigs as priority species. Rabbits, foxes and cats are secondary priorities. SPC shooting activities target both priority species.</p> <p>The Cocopara PMSP references the RPMS feral pig, goat and rabbit priority programs for Cocopara and also notes, "Feral pigs are currently declared noxious pests under the Local Land Services Act 2013 which requires the land manager (NPWS) to continuously suppress and destroy them to minimise the risk of damage to the land."<sup>30</sup></p> <p>The SPC Shoot Plan describes the economic and biodiversity impact of pigs and their reinvasion from neighbouring land:</p> <p>"Feral pigs are a small intermittent problem in Cocopara NP/NR which, if left unchecked, have the potential to become a landscape issue. Pigs seem to mostly come from agricultural enterprise, although it is believed that some</p>	<p><i>Pomaderris cocoparrana</i></p> <p>Superb Parrot</p> <p>Turquoise Parrot</p> <p>Glossy Black Cockatoo</p> <p>Major Mitchell Cockatoo</p> <p>Painted Honeyeater</p> <p>Gilbert's Whistler</p> <p>Shy Hyacola</p> <p>Chestnut Quail Thrush</p> <p>Common Wombats</p> <p>Grey Box</p>

<sup>24</sup> NSW National Parks and Wildlife Service, 2015, *Central Mallee Pest Management Site Plan*, p.1.

<sup>26</sup> NSW National Parks and Wildlife Service, 2015, *Central Mallee Pest Management Site Plan*, p.1; Western Rivers Regional Pest Management Strategy, p.11.

<sup>27</sup> Office of Environment and Heritage, 2012, *Regional Pest Management Strategy 2012-2017: Western Rivers Region*.

<sup>28</sup> Office of Environment and Heritage (OEH), *NSW Scientific Committee Preliminary Determination: Pomaderris cocoparrana*. <<http://www.environment.nsw.gov.au/resources/threatenedspecies/determinations/PDPomacocoES.pdf>>.

<sup>29</sup> NSW National Parks and Wildlife Service, 2015, *Cocopara Nature Reserve Pest Management Site Plan*, p. 1.

			illegal seeding has occurred in neighbouring forests.” <sup>31</sup>	Woodland EEC <sup>32</sup>
Yanga	The RPMS priorities for management of Yanga are to reduce threats to threatened species including the southern bell frog and migratory wetland birds through deer and pig control, and the protection of the Sandhill Pine Woodland EEC through rabbit control. Pest management at Yanga is also a priority for the protection of cultural and historic heritage. Strategic, continuous pig control program at Murrumbidgee NP is a flagship program under the Regional Plan. <sup>33</sup>	The Yanga PMSP identifies pigs, deer and rabbits as priority pest species and its stated objectives are to reduce the impacts of vertebrate pests on: <ul style="list-style-type: none"> <li>• Migratory wetland birds</li> <li>• Southern bell frogs</li> <li>• Identified EECs</li> <li>• Neighbouring properties<sup>34</sup></li> </ul>	Feral pigs, deer and rabbits are identified as the priority species in the Yanga PMSP, and the primary target of SCP shooting activities.  The Yanga PMSP describes the widespread impacts of rabbits and pigs, and references RPMS priority programs for pigs, deer and rabbits relating to Yanga and aligning with its planned pest control activities. <sup>35</sup>  The Shoot Plan identifies compliance with the Yanga Plan of Management (POM), and identifies compliance with the RPMS relating to pig, deer and rabbit programs, and also states its alignment with the PMSP. It describes the impacts of pigs on the reserve:  “[Pigs] have a very large impact, causing damage to natural habitats, native flora and fauna within these reserves.” <sup>36</sup>	Southern bell frog ( <i>Litoria raniformis</i> )  Migratory wetland birds  Blue-billed and Freckled Ducks  Spotted-tailed Quoll  Australian Painted Snipe  Major Mitchell Cockatoo  Painted Honeyeater  Sandhill Pine Woodland EEC  <i>Acacia melvillei</i> Yarran Shrubland and Myall Woodland in the Darling Riverine Plains EECs

<sup>30</sup> NSW National Parks and Wildlife Service, 2015, *Cocopara Nature Reserve Pest Management Site Plan*, p. 1.

<sup>31</sup> Cocopara NR SPC 07-03-15 to 08-03-15 Shooting Operations Plan, p.1.

<sup>32</sup> NSW National Parks and Wildlife Service, 2015, *Cocopara Nature Reserve Pest Management Site Plan*, p. 1; *Cocopara NR SPC 07-03-15 to 08-03-15 Shooting Operations Plan*, p. 3.

<sup>33</sup> Office of Environment and Heritage, 2012, *Regional Pest Management Strategy 2012-2017: Western Rivers Region*.

<sup>34</sup> NSW National Parks and Wildlife Service, 2015, *Yanga Pest Management Site Plan*.

<sup>35</sup> *Ibid.*, p. 1.

<sup>36</sup> Murrumbidgee Valley National Park & State Conservation Area (Yanga NP & SCA) SPC 15-07-15 to 17-07-15 Shooting Operations Plan.

<p>Goonoo</p>	<p>According to the Northern Plains RPMS, Goonoo is considered a regional priority for fox control, and the Goonoo multi-stakeholder coordinated fox control program is a key regional program.</p> <p>The RPMS lists fox control is a critical priority for the site, aimed at protecting malleefowl and livestock from fox predation. Rabbits are a low priority target due to impact on native flora.<sup>38</sup></p> <p>Goonoo is listed as a priority site for management under the NSW Fox Threat Abatement Plan (TAP) for the protection of malleefowl.<sup>39</sup> A Site Plan exists for the park and fox baiting activities have been conducted since 2001.</p> <p>Browsing by goats are a threat to the malleefowl listed in its National</p>	<p>Goonoo PMSP objectives are to:</p> <ul style="list-style-type: none"> <li>• Reduce impacts of vertebrate pests on Malleefowl</li> <li>• Limit the impacts of pests to neighbouring properties</li> <li>• Maintain pests at low numbers</li> <li>• Reduce Goat numbers – thereby reducing habitat degradation/modification through goat browsing</li> <li>• Limit the spread of existing and/or emergent weeds</li> </ul>	<p>Foxes and feral goats specified targets of the PMSP and the SPC shooting activities.</p> <p>The PMSP refers to RPMS priorities for Goonoo Reserve Complex to reduce and maintain fox activity at low level and maintain malleefowl presence<sup>41</sup>, and the Management Section’s ongoing fox abatement work under the Fox Threat Abatement Plan (Fox TAP) since 2001.</p> <p>The Shoot Plan identifies compliance with the Goonoo Plan of Management (POM), and the RPMS priorities for pest management in the Goonoo NP and SCA, and states:</p> <p>“European red fox and other pest animal species have the ability to impact upon threatened species in Goonoo NP and SCA and Coolbaggie NR. Ground shooting is a supplementary method of controlling pest animals in identified areas of the reserve [...] The Regional Pest Management Strategy identifies management of fox as a critical priority for the protection of malleefowl. The program will assist in keeping pest densities at low levels thus preventing significant impacts. Goat, feral pig and deer are an emerging issues in the Goonoo complex. Rabbits, cats and dogs have been recorded on FoxTAP cameras. These species are included in</p>	<p>Bush stone-curlew<sup>37</sup></p> <p>Malleefowl</p>
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<sup>37</sup> Office of Environment and Heritage, 2012, *Regional Pest Management Strategy 2012-2017: Northern Plains Region*; NSW National Parks and Wildlife Service, 2015, *Yanga Pest Management Site Plan*; Murrumbidgee Valley National Park & State Conservation Area (Yanga NP & SCA) SPC 15-07-15 to 17-07-15 Shooting Operations Plan.

<sup>38</sup> Office of Environment and Heritage, 2012, *Regional Pest Management Strategy 2012-2017: Northern Plains Region*, p.3

<sup>39</sup> Office of Environment and Heritage (OEH), Dec 2010, *NSW Fox Threat Abatement Plan – Predation by the Red Fox (vulpes vulpes)*, OEH, Sydney.

	Recovery Plan. <sup>40</sup>		this plan and will be targeted opportunistically.” <sup>42</sup>	
Gundabooka	<p>The Far West RPMS identifies the following critical priorities for Gundabooka:</p> <ul style="list-style-type: none"> <li>• Feral goat control for the protection of Curly-bark wattle</li> <li>• Feral pig control to reduce impacts on neighbouring agriculture</li> <li>• Wild dog control to reduce predation on neighbouring stock</li> </ul> <p>The RPMS also lists fox control as a medium priority for the Park to reduce impacts on neighbouring stock and biodiversity.</p> <p>The Feral Goat TAP lists curly-bark wattle as species affected by competition and land degradation from unmanaged goats.<sup>43</sup></p>	<p>Gundabooka PMSP objectives are to:</p> <ul style="list-style-type: none"> <li>• Reduce goat activity within Gundabooka NP &amp; SCA</li> <li>• Maintain curly-bark wattle presence within the Gundabooka site</li> <li>• Maintain Oldenlandia galioides, Rusty desert Phebalium and Mount vincent mintbush presence within the Gundabooka site</li> <li>• Implement Regional Pest Management Strategy objectives.</li> <li>• Monitor and implement control of new and emerging pest species (deer)</li> <li>• Maintain exclusion of goats from rock art</li> </ul>	<p>Feral goats, pigs, foxes and wild dogs are priorities in the Gundabooka PMSP. Goats are targeted by the SPC shoot activities.</p> <p>The PMSP notes RPMS priorities for Gundabooka regarding feral goats and protection of Curly-bark wattle EEC, as well as identification of other emergent threats by staff on-park.<sup>45</sup></p> <p>The Shoot Plan identifies compliance with the Gundabooka POM, and the RPMS priorities for fox, pig and goat control for the Reserve. It also states:</p> <p>“Feral goats in Gundabooka National Park (NP) and State Conservation area (SCA) impact upon natural habitats, native flora and fauna, and Aboriginal and European Heritage sites. The Regional Pest Management Strategy identifies management of feral goats as a critical priority for the protection of curly-bark wattle, rusty desert Phebalium, Mount Vincent mintbush and Oldenlandia galioides.”<sup>46</sup></p>	<p>Curly-bark wattle (<i>Acacia curranii</i>)</p> <p><i>Oldenlandia galioides</i></p> <p>Rusty desert Phebalium (<i>Phebalium glandulosum</i>)</p> <p>Mount vincent mintbush <i>Prostranthera stricta</i></p> <p>12 fauna species listed under the TSC Act 1995. (PMSP)</p>

<sup>41</sup> NSW National Parks and Wildlife Service, 2015, *Goonoo Pest Management Site Plan*, p. 1.

<sup>40</sup> Benshemesh, J. 2007. National Recovery Plan for Malleefowl. Department for Environment and Heritage, South Australia.

<sup>42</sup> Goonoo SPC 29-04-15 to 01-05-15 *Shooting Operations Plan*.

<sup>43</sup> Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008). *Threat abatement plan for competition and land degradation by unmanaged goats*, DEWHA, Canberra.

	sites <sup>44</sup>			
Woomargama	<p>The Southern Ranges RPMS describes the critical priorities for pest management at Woomargama:</p> <ul style="list-style-type: none"><li>• Pigs and rabbits for protection of Phantom Wattle and Small Snake Orchid</li><li>• Wild dogs and foxes for their predation on stock.</li></ul> <p>Pigs are a medium level priority for the site to reduce impact on neighbours' agriculture.<sup>47</sup></p> <p>The Woomargama National Park PoM notes that controlling pig populations is "a matter of priority" due to their impacts upon threatened native species.<sup>48</sup></p> <p>The National Recovery Plan for Phantom Wattle lists</p>	<p>The Woomargama PMSP objectives include:</p> <ul style="list-style-type: none"><li>• Reduce feral animal numbers within the reserve and prevent potential population increases across tenures.</li><li>• Reduce the potential browsing impacts from feral animals.</li><li>• Reduce the potential ground disturbance associated with feral animals in known locations of threatened species.</li></ul> <p>Management of the target species is also a high priority for protection of the site's cultural heritage assets.<sup>50</sup></p>	<p>Feral goats, pigs and rabbits are the target species identified in the PMSP, and goats and pigs are listed as primary targets of the SPC shooting activities in the PMSP, while rabbits are the primary target of the March 2015 SPC shoot.</p> <p>The PMSP further notes the Southern Ranges RPMS priorities for goats, pigs and rabbits for the protection of Phantom Wattle and Small Snake Orchid, and states:</p> <p>"Phantom wattle (<i>Acacia phasmoides</i>) is listed as Vulnerable, Threatened Species Conservation Act 1995 (TSC), where the only known population recorded in NSW exists near the southern boundary of Woomargama NP. Grazing, browsing and trampling are listed as a key threat to the population survival. Goats, pigs and rabbits have the potential to impact on this threatened species if populations are not controlled.</p> <p>The Small Snake Orchid, listed in the TSC as Endangered, has been recorded within the reserve, however was not identified prior to or during the development of the POM. Current threats to this species are similar to Phantom Wattle, however additional concerns exist where</p>	<p>Phantom Wattle (<i>Acacia phasmoides</i>)</p> <p>Small Snake Orchid (<i>Diuris pedunculata</i>).<sup>53</sup></p>

<sup>45</sup> NSW National Parks and Wildlife Service, 2015, *Gundabooka NP & SCA Pest Management Site Plan*, p. 1.

<sup>46</sup> Gundabooka NP & SCA SPC 26-07-15 to 29-07-15 *Shooting Operations Plan.*, p.3.

<sup>44</sup> NSW National Parks and Wildlife Service, 2015, *Gundabooka NP & SCA Pest Management Site Plan*, p. 1.

<sup>47</sup> Office of Environment and Heritage, 2012, *Regional Pest Management Strategy 2012-2017: Southern Ranges Region*.

<sup>48</sup> NSW National Parks and Wildlife Service, 2009, *Woomargama National Park, Woomargama State Conservation Area, Mullengandra Nature Reserve and Mullengandra State Conservation Area Plan of Management*, p. 22.

<sup>50</sup> NSW National Parks and Wildlife Service, 2015, *Woomargama Pest Management Site Plan*, p. 1.



browsing by goats, pigs, rabbits and deer as a key threat, and lists management of these impacts as a recovery objective.<sup>49</sup>

feral pigs may disturb or eat orchid tubers.”<sup>51</sup>

The Shoot Plan identifies compliance with the Woomargama POM, and the Southern Ranges RPMS priorities for pig, goat and rabbit control for the Reserve, in particular as a critical priority for the protection of Phantom Wattle and Small Snake Orchid. It states:

“Due to the current low abundance of these pest species they may not be impacting on the identified threatened species however the program will assist in keeping pest densities at low levels thus preventing significant impacts.”<sup>52</sup>

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<sup>53</sup> *Ibid.*

<sup>49</sup> Sutter, G. 2010. *National Recovery Plan for Phantom Wattle Acacia phasmoides*. Department of Sustainability and Environment, East Melbourne

<sup>51</sup> NSW National Parks and Wildlife Service, 2015, *Woomargama National Park Pest Management Site Plan*, p. 1.

<sup>52</sup> Woomargama National Park SPC 07-05-15 to 10-05-15 *Shooting Operations Plan*, p.2

## Appendix 5: Evaluation of trial design - Recommendations

**In its 2014 report the Commission identified a number of opportunities for improvement during the trial period**

### 1. Clarify and strengthen governance arrangements

The Commission recommends that:

- a. NPWS develop procedures for the SPC Project Control Group to outline the roles and responsibilities of the group, standing agenda items and reporting obligations
- b. NPWS consider appointing an independent member to the SPC Project Control Group to provide objectivity and diversity of experience
- c. NPWS ensure that the Group is active (meeting at least quarterly) and provides appropriate trial oversight, particularly in relation to any changes in the risk profile of the trial
- d. NPWS consider establishing a technical reference group to provide expert input to adaptive management decisions.

### 2. Review ongoing appropriateness of trialling SPC in current reserves

The Commission recommends that:

- a. NPWS assess the results of operations in different reserves and reflect the findings in future operational planning, to appropriately focus trial resources
- b. NPWS document emerging knowledge on what the appropriate criteria should be for identifying suitable supplementary pest control locations.

### 3. Improve flexibility and responsiveness in design of individual operations

The Commission recommends that:

- a. NPWS continue to trial varying lengths and intensities of shooting operations, to match local conditions
- b. NPWS continue to apply greater flexibility and responsiveness in regional-scale planning so that:
  - i. operations can be cancelled if they are unlikely to yield desired outcomes (giving due consideration to impacts on volunteers)
  - ii. operations can be planned at short notice if an opportunity arises (note that NPWS needs to provide neighbours with written notice at least four weeks prior to the commencement of any operations).

### 4. Build local relationships and volunteer capacity

The Commission recommends that:

- a. Sporting Shooters Association of Australia NSW Branch (SSAA NSW) and NPWS continue to focus on attracting and retaining local volunteers who are interested in participating in ongoing pest management activities
- b. SSAA NSW and NPWS hold more induction and training sessions in regional centres closer to the trial reserves where there is a higher likelihood that regional volunteers may participate
- c. SSAA NSW and NPWS support future devolution of appropriate supplementary pest control activities by fostering engagement and increasing trust between regional supplementary pest control staff and local branches of the SSAA
- d. NPWS consider involving volunteer groups in other stages of the pest management process. For example, in planning and monitoring, which allows for closer alignment of pest management needs and volunteer capabilities and capacity. It may also contribute to developing ongoing collaborative relationships between volunteers and NPWS staff at the local level.

## 5. Trial different supervisor to volunteer ratios

The Commission recommends that:

- a. NPWS continue to trial various supervision scenarios to identify optimum operating ratios
- b. NPWS continue to encourage and support long-term involvement of individual volunteers to build capacity, enhance trust and strengthen teamwork.

## 6. Assess the potential for night operations

The Commission recommends that:

NPWS undertake a risk assessment of night shooting that could inform a business case for the SPC Project Control Group to consider. If risks can be appropriately managed, it is recommended that NPWS pilot a number of night-shooting operations during the trial and assess whether night-shooting is feasible.

## 7. Improve documentation for greater transparency and accountability

The Commission recommends that:

NPWS develop documentation, and make documents publicly available, for the following aspects of the trial:

- i. engagement strategy, including Aboriginal stakeholders
- ii. ecological monitoring design.

## Appendix 6: Progress against 2014 recommendations

Commission 2014 Recommendation	NPWS response
<b>1. Clarify and strengthen governance arrangements</b>	
The Commission recommends that:	
a. NPWS develop procedures for the SPC Project Control Group to outline the roles and responsibilities of the group, standing agenda items and reporting obligations	The project control group has been formalised with a standing agenda and is meeting regularly. Roles and responsibilities have been incorporated into the project plan.
b. NPWS consider appointing an independent member to the SPC Project Control Group to provide objectivity and diversity of experience	NPWS considered this recommendation and has chosen not to take it up. Given the involvement of senior NPWS managers in the program, NPWS has determined that there is a need for control group members to understand its internal structure. Other mechanisms such as the Joint Consultative Committee of Trade Unions and SSAA NSW have been engaged as required.
c. NPWS ensure that the Group is active (meeting at least quarterly) and provides appropriate trial oversight, particularly in relation to any changes in the risk profile of the trial	The Project Control Group currently meets quarterly and as necessary.
d. NPWS consider establishing a technical reference group to provide expert input to adaptive management decisions.	A specific technical reference group has not been established, but an SPC coordination group and working group is in place. The working group meets fortnightly. Within each region there is a technical working group.
<b>2. Review ongoing appropriateness of trialling SPC in current reserves</b>	
The Commission recommends that:	
a. NPWS assess the results of operations in different reserves and reflect the findings in future operational planning, to appropriately focus trial resources	<p>NPWS staff have worked hard to trial various approaches to on-ground operations across different reserves. Hides, attractants, in-vehicle and on-foot techniques have all been used and incorporated into planning.</p> <p>NPWS has been keen to ensure they do not continue to repeat approaches in each operation – they have made an effort to explore different techniques and maximise the opportunities of the trial environment. This is reflected in operational plans.</p>
b. NPWS document emerging knowledge on what the appropriate criteria should be for identifying suitable supplementary pest control locations.	<p>To assist with identifying the criteria for the most suitable SPC locations, NPWS could:</p> <ul style="list-style-type: none"> <li>- review the appropriateness of the current reserves</li> <li>- consider the value of continuing SPC operations in all 12 reserves, and</li> <li>- allocate program resources to the most</li> </ul>

	appropriate sites.
<b>3. Improve flexibility and responsiveness in design of individual operations</b>	
<p>The Commission recommends that:</p> <p>a. NPWS continue to trial varying lengths and intensities of shooting operations, to match local conditions</p>	<p>Operations of between one and four days have been trialled.</p> <p>The four-week ministerial requirements for notification restricts flexibility to some degree. However, flexibility has been built into plans so that slight variations can be made during operations (Ministerial requirement).</p>
<p>b. NPWS continue to apply greater flexibility and responsiveness in regional-scale planning so that:</p> <p>i. operations can be cancelled if they are unlikely to yield desired outcomes (giving due consideration to impacts on volunteers)</p> <p>ii. operations can be planned at short notice if an opportunity arises (note that NPWS needs to provide neighbours with written notice at least four weeks prior to the commencement of any operations).</p>	<p>Flexibility is built into all aspects of the operations, but it remains difficult to mobilise volunteers at short notice (under four weeks), notwithstanding the Ministerial constraints.</p>
<b>4. Build local relationships and volunteer capacity</b>	
<p>The Commission recommends that:</p> <p>a. Sporting Shooters Association of Australia NSW Branch (SSAA NSW) and NPWS continue to focus on attracting and retaining local volunteers who are interested in participating in ongoing pest management activities</p>	<p>Volunteers are generally split around 50/50 between regional and city origins. NPWS staff, in conjunction with SSAA, have conducted a number of induction programs over the past 18 months in regional areas including Hay, Cobar, Griffith, Casino, Batemans Bay, Newcastle and Lismore.</p>
<p>b. SSAA NSW and NPWS hold more induction and training sessions in regional centres closer to the trial reserves where there is a higher likelihood that regional volunteers may participate</p>	<p>Local branches of SSAA do not have capacity, hence the involvement of SSAA at the state level.</p>
<p>c. SSAA NSW and NPWS support future devolution of appropriate supplementary pest control activities by fostering engagement and increasing trust between regional supplementary pest control staff and local branches of the SSAA</p>	<p>NPWS believes that volunteers require supervision. There is a range of capacity amongst volunteers and not all are suitable for all types of activities.</p>
<p>d. NPWS consider involving volunteer groups in other stages of the pest management process. For example, in planning and monitoring, which allows for closer alignment of pest management needs and volunteer capabilities and capacity. It may also contribute to developing ongoing collaborative relationships between volunteers and NPWS staff at the local level.</p>	<p>NPWS have not done this yet. They have focused on operational aspects of the program and ensuring its success. At present NPWS has little capacity to manage volunteer involvement but this may be possible further down the line.</p> <p>NPWS believes that, at present, using current adopted approaches, volunteers require almost as much resources to manage as what they actually provide. NPWS considers that volunteers are not</p>

	<p>cheaper than NPWS staff.</p> <p>NPWS does see a role for more community engagement and will look to develop this over the rest of the trial.</p> <p>At information and induction sessions, NPWS provides volunteers with the opportunity to engage in other aspects of the program. There is often little support for its take-up.</p>
<p><b>5. Trial different supervisor to volunteer ratios</b></p>	
<p>The Commission recommends that:</p> <p>a. NPWS continue to trial various supervision scenarios to identify optimum operating ratios</p>	<p>NPWS continue to trial ratios in different areas. Ratios in Yanga and Central Mallee in particular can increase and decrease depending on the type of operation.</p> <p>The ability to change ratios in Woomargama, Goonoo and Cocopara is more limited.</p>
<p>b. NPWS continue to encourage and support long-term involvement of individual volunteers to build capacity, enhance trust and strengthen teamwork.</p>	<p>SPC volunteers continue to be very supportive of the program and NPWS will look to improve communications in 2016.</p>
<p><b>6. Assess the potential for night operations</b></p>	
<p>The Commission recommends that:</p> <p>NPWS undertake a risk assessment of night shooting that could inform a business case for the SPC Project Control Group to consider. If risks can be appropriately managed, it is recommended that NPWS pilot a number of night-shooting operations during the trial and assess whether night-shooting is feasible.</p>	<p>NPWS has undertaken a risk assessment and simulated a trial night operation with NPWS staff.</p> <p>A report of the simulation and a proposal for night operations has been completed but not submitted for approval. NPWS hopes to have night operations running in 2016.</p>
<p><b>7. Improve documentation for greater transparency and accountability</b></p>	
<p>The Commission recommends that:</p> <p>NPWS develops documentation, and make documents publicly available, for the following aspects of the trial:</p> <p>i. engagement strategy, including Aboriginal stakeholders</p>	<p>NPWS is looking at developing a communication strategy and sharing the positive outcomes of the program to date. There has been strong engagement with Aboriginal stakeholders at Gundabooka. Other areas do not have same strength of connection to land.</p>
<p>ii. ecological monitoring design.</p>	<p>The ecological monitoring design has been submitted for approval and for publication, but is yet to be signed off. The document has been provided to the Commission for evaluation.</p>

**Key:**

Recommendation implemented

Alternative approach taken by NPWS

Recommendation in the process of being addressed

## Appendix 7: Survey questionnaire – reserve neighbours

Thank you for following the web address through to this survey.

The National Parks and Wildlife Service (NPWS) is partnering with experienced and skilled volunteer shooters to help reduce pests in 12 national parks and reserves. The program is called the [Supplementary Pest Control trial](#) (SPC trial).

The Natural Resources Commission (NRC) is independently evaluating the trial.

As a neighbour of one of the parks/reserves in the SPC trial, we are interested in your feedback.

The survey should take under 10 minutes, depending on the level of detail you provide.

Data will be analysed by independent firm [Roberts Evaluation](#) and your name will not be linked to your responses or used in any report from this survey.

The NRC's Privacy Policy is available at [www.nrc.nsw.gov.au/information#plans](http://www.nrc.nsw.gov.au/information#plans).

Please click "next" below to proceed or simply close this browser window to exit.

1. Which of the following reserves or parks do you live the closest to (e.g. share a boundary with)?

*Please select all that apply*

- Cocopara Nature Reserve
- Coolbaggie Nature Reserve
- Goonoo National Park
- Goonoo State Conservation Area
- Gundabooka National Park
- Gundabooka State Conservation Area
- Murrumbidgee Valley National Park (Yanga Precinct)
- Murrumbidgee Valley State Conservation Area
- Nombinnie Nature Reserve
- Nombinnie State Conservation Area
- Woomargama National Park
- Yathong Nature Reserve

2. How important to you is the control of pest animals in NSW parks and reserves?

- Not at all important
- Slightly important
- Moderately important
- Very important
- Extremely important

3. Overall, how would you describe the impact of the following pest animals on you:

	Very beneficial	Beneficial	No impact	Detrimental	Very detrimental	Unsure	Not applicable
Foxes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feral deer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feral pigs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feral goats	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rabbits	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wild dogs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other <i>please describe below</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other animal

4. Overall, how has the impact of the following pest animals changed since January 2014:

	Much better	Somewhat better	About the same	Somewhat worse	Much worse	Unsure	Not applicable
Foxes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feral Deer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feral Pigs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feral goats	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rabbits	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wild dogs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other <i>please describe below</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other animal



5. Can you provide any examples of how the impacts of pest animals on you have changed in the last 18 months?

6. Overall, to what extent do you support or oppose pest animal control programs in NSW parks and reserves?

- Strongly oppose
- Somewhat oppose
- Neutral
- Somewhat support
- Strongly support
- Unsure

7. Overall, to what extent do you support or oppose the use of qualified volunteers to control pest animals through ground shooting in NSW parks and reserves?

- Strongly oppose
- Somewhat oppose
- Neutral
- Somewhat support
- Strongly support
- Unsure

8. Overall, how satisfied have you been with the information provided to you by the National Parks and Wildlife Service about the SPC trial?

- Very dissatisfied
- Dissatisfied
- Neutral
- Satisfied
- Very satisfied
- Unsure
- Not applicable

9. Are there any ways in which the National Parks and Wildlife Service could improve their communication with you around the SPC trial?

10. So far during the SPC trial, have you had any concerns about any aspects of the trial?

11. What were your concerns?

12. If you raised your concern with the National Parks and Wildlife Service, how satisfied were you with their response?

- Very dissatisfied
- Dissatisfied
- Neutral
- Satisfied
- Very satisfied
- Unsure
- Not applicable

Please feel free to elaborate

13. Has anything unexpected (positive or negative) happened to you as a result of the SPC trial?

14. Are there any final comments you would like to make about the SPC trial?

## Appendix 8: SPC expenditure 2012/13 - 2014/15

	12/13	13/14	14/15	TOTAL
<b>Pre in-field monitoring*</b>		\$68,153	\$81,007	\$149,160
<b>In-field monitoring</b>		\$136,306	\$162,014	\$298,320
<b>Post in-field monitoring*</b>		\$68,153	\$81,007	\$149,160
<b>NPWS Coordination staff*</b>		\$177,669	\$502,132	\$679,801
<b>Pre-operation</b>		\$52,997	\$197,670	\$250,667
<b>Operational</b>		\$52,997	\$197,670	\$250,667
<b>Post-operation</b>		\$52,997	\$197,670	\$250,667
<b>Program Design &amp; Establishment</b>	\$429,806	\$210,134	\$0	\$639,940
<b>Equipment</b>		\$260,829	\$59,206	\$320,035
<b>Administration Costs, Volunteer Training Workshops, Engagement</b>		\$121,603	\$78,082	\$199,685
<b>Commission evaluation funding</b>		\$124,758	\$93,152	\$217,910
<b>Illegal Hunting Compliance (not Volunteer Shooting)</b>		\$89,611	\$130,617	\$220,228
<b>TOTAL</b>	<b>\$429,806</b>	<b>\$1,416,208</b>	<b>\$1,780,225</b>	<b>\$3,626,239</b>

\* Indicates estimates. All other figures are actuals.

## **Appendix 9: NPWS SPC 2014-2016 Ecological and Operational Monitoring**



Office of  
Environment & Heritage  
NSW National Parks & Wildlife Service



# **Supplementary Pest Control Trial 2014-2016 Ecological and Operational Monitoring**

Version 1.3

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## **Abbreviations**

The following abbreviations are used throughout this document:

AMS	Asset Maintenance System
DPI	Department of Primary Industries
EEC	Endangered Ecological Community
FAAST	Feral Animal Aerial Shooting Team
Fox TAP	NSW Fox Threat Abatement Plan
LLS	Local Land Services
NP	National Park
NPWS	National Parks and Wildlife Service
NR	Nature Reserve
OEH	Office of Environment and Heritage
PWIS	Pest and Weed Information System
RPMS	Regional Pest Management Strategy
SAP	Systems Applications and Products
SCA	State Conservation Area
SF	State Forest
SOS	Saving Our Species Program
SPC	Supplementary Pest Control
TAP	Threat Abatement Plan
WHS	Work Health and Safety





# 1 Introduction

## 1.1 Background

In mid-2013, the NSW Government decided to:

- Implement a program of Supplementary Pest Control (SPC) in selected national parks and other reserves, using volunteer licensed shooters under direction and supervision of National Parks and Wildlife Service (NPWS) staff;
- Commence the program initially as a 3-year trial in 12 reserves (see Figure 1 and sec 4); and
- Undertake an evaluation of the 3-year trial to assess and report on its effectiveness before any further rollout of the program.

## 1.2 SPC Program Goal

To assist the control of pest animals by supplementing NPWS pest control programs through appropriately qualified volunteer shooters.

## 1.3 Desired Outcomes of SPC Trial

- A. Safe implementation of SPC operations.
- B. Pest animals controlled in trial reserves in a way that enhances other NPWS pest programs in reducing impacts on the environment and neighbouring landholders.
- C. Respectful relationships between NPWS and volunteer shooters and associated organisations, who find their participation rewarding.
- D. Community informed of and appropriately engaged in the SPC trial.
- E. Robust evidence-based measures of effectiveness, benefits and costs of the trial program, sufficient to inform decisions about proceeding with the program.

### 1.3.1 SPC Effectiveness, Benefits and Costs

This document presents the SPC methodology aimed at measuring effectiveness of the trial and its integration into existing pest management (point 1.3E). Data collected will help answer key questions about the merits of the SPC trial program. The primary high-level questions are:

- Did the trial work?
  - Has the SPC trial assisted the effectiveness of existing NPWS pest control programs in minimising the impact of pest animals on the environment and neighbouring landholders? If yes, to what extent and what are the key success factors?
  - What is the evidence that relevant native species populations have been additionally protected by the SPC trial? This will partly rely on existing NPWS monitoring in the 12 reserves, already used for reporting for *NSW 2021 A Plan to Make NSW Number One*.

- What is the evidence that impacts on neighbouring landholders from pest animals have been reduced?
- How many pest animals did volunteers remove and what contribution has this made in complementing numbers of animals controlled through existing NPWS pest control activities? (This includes consideration of relative timing of control activities).
- Has the SPC trial been operationally integrated into existing NPWS pest animal programs? If yes, what are the key success factors in achieving this? Have there been any negative impacts of the trial on other NPWS park operations? What improvements should be made to operating procedures?
- Have good animal welfare standards been maintained?
- Has the SPC trial been conducted in a manner that minimises identified risk and is compliant with relevant legislation?
- Was the trial worth it?
  - What have been the overall costs and benefits of this trial to the NSW Government and to the relevant regional economies?
- Social impacts
  - What have been the (positive or negative) social impacts of the trial, taking into account the views of park neighbours, relevant Aboriginal communities, Local Land Services, shooters involved in the trial, other members of the hunting community, conservation and animal welfare groups, and tourism providers?
- How could the SPC program be improved to be more efficient and effective?
  - What has been learnt during the course of the trial?
  - Which elements should continue, which elements should be modified and which elements should be discontinued if the program is rolled out after the trial has finished?

As much reliable evidence as possible will be gathered to answer each of these questions. For some questions (e.g. recovery of native species populations) conclusive, scientifically reliable evidence at all sites may not be achievable within the trial timeframe.

## **2 Governance**

OEH will conduct the trial, utilising its established adaptive management framework, which is being applied to similar evaluations of new park management techniques such as ecological thinning and grazing.

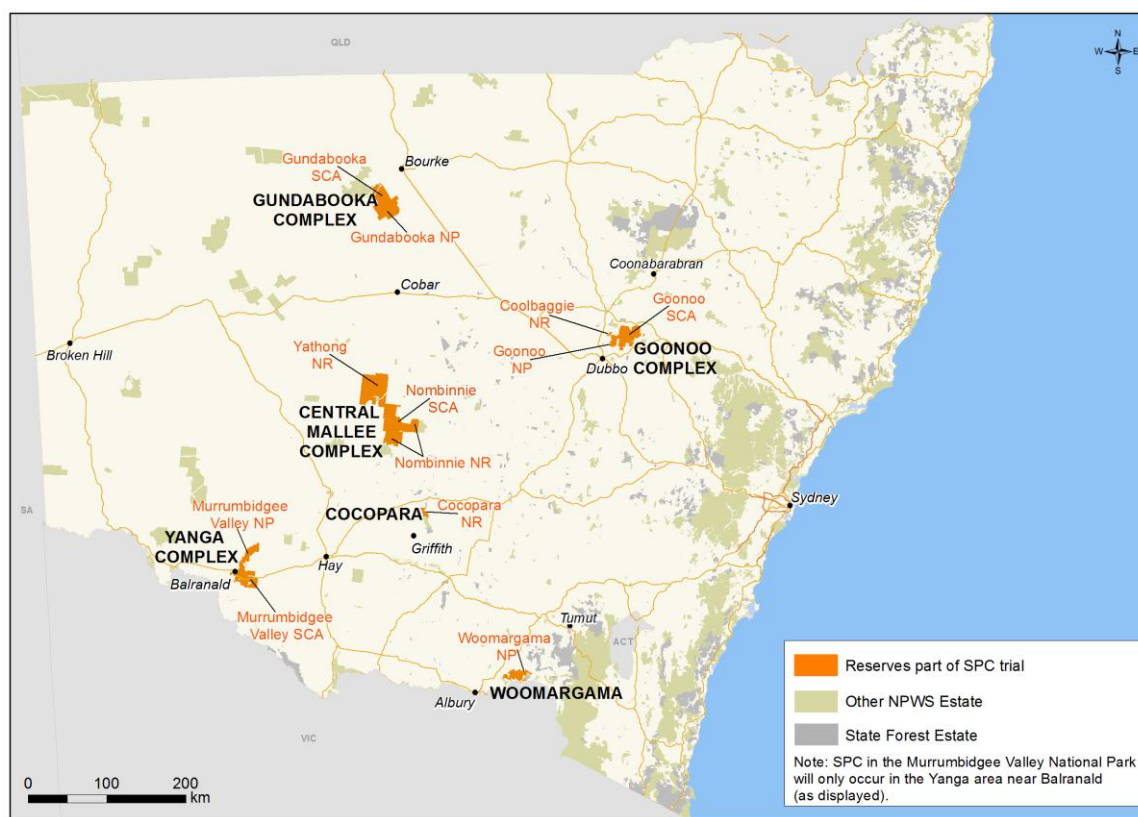
Any scientific papers produced as part of the trial will be peer reviewed, and appropriate scientific rigour will be managed in accordance with the OEH Scientific Rigour Position Statement.

### 3 Timeframe

The trial commenced in January 2014 and will proceed for three years. The Natural Resources Commission (NRC) are conducting the evaluation of the trial program. The data collected as per this document will be provided to the NRC as part of their evaluation. The NRC will provide an evaluation report to the NSW Minister for the Environment at the conclusion of the trial.

### 4 The SPC Trial Reserves

The SPC trial is being conducted in 12 reserves predominantly in western NSW (Figure 1). Where reserves are adjacent or in close proximity to each other they have been considered as a single complex for the purpose of the evaluation. This resulted in complexes (see Figure 1 and Table 1 ).



**Figure 1** SPC Trial Complexes and the reserves that are contained within them.

**Table 1** SPC Trial Reserves

<b>Complex Name</b>	<b>Reserves</b>	<b>NPWS Area</b>	<b>NPWS Region</b>
Gundabooka	Gundabooka NP Gundabooka SCA	Bourke	Far West
Goonoo	Goonoo NP Goonoo SCA Coolbaggie NR	Coonabarabran	Northern Plains
Central Mallee	Yathong NR Nombinnie NR Nombinnie SCA	Mid West	Western Rivers
Cocopara	Cocopara NR	Mid West	Western Rivers
Yanga	Murrumbidgee Valley NP Murrumbidgee Valley SCA	South West	Western Rivers
Woomargama	Woomargama NP	Riverina Highlands	Southern Ranges

## 5 Ecological Monitoring of SPC

### 5.1 Limitations of vertebrate pest monitoring

The primary function of monitoring vertebrate pest management programs is to indicate whether the program is achieving its objectives (Hone 1994). The information gathered is then used to determine if there is a need to adapt the methodology used for both the management program and the monitoring system. The objectives of the management program are therefore imperative in determining what type of monitoring will be undertaken.

The ecological objective of SPC is to assist with the effectiveness of existing NPWS vertebrate pest control programs in minimising the impact of pest animals on identified threatened species and ecological communities. In order to determine if this is being achieved two things need to be monitored:

- Threatened species recovery
- Vertebrate pest abundance

Each reserve that has been selected for the SPC trial has threatened species or endangered ecological communities which are being protected by ongoing vertebrate pest control programs. Ideally, measuring the responses of threatened species recovery to these pest control programs involves monitoring at treatment and nil-treatment sites (Quinn and Keough 2002; Underwood 1997). However, there is a lack of suitable nil-treatment sites for the SPC trial complexes due to a range of factors. There are two main factors that preclude suitable nil-treatment sites: 1) Lack of comparable reserves due to the small amount of areas of land under conservation in Western NSW (where the 6 SPC complexes are located) - the selection of areas for conservation somewhat compounds this issue as uniqueness is often a key reason for conservation status thereby making the reserve intrinsically different; 2) The large differences in pest animal population and pest control techniques. This means the baseline pest population as well as pressures from pest control vary greatly between reserves making these populations unfit for comparison. One or both of these factors exist for each of the SPC complexes preventing the use of nil-treatment sites in the SPC evaluation.

There are also limitations to measuring threatened species recovery: 1) generally low abundance/distribution of the threatened species, difficulty in differentiating the impact of other species, and the slow recovery time of the threatened species. Due to these limitations, it was deemed impractical to empirically survey threatened species recovery and to adopt other measures. However in two of the SPC complexes (Cocopara and Central Mallee), the impacts on threatened species will be monitored either directly (such as monitoring activity at malleefowl mounds) or with surrogate measures (such as browsing of abundant plants as a surrogate of browsing on *Cocoparra pomaderris*).

Estimates of the absolute abundance of wild animals are costly, and not practical for some species (such as foxes) and are largely unnecessary for measuring changes in population abundance (Caughley 1980). Indices of abundance of the vertebrate pest

itself will be used as an indication of pest impacts, with a relationship between population size, population indices, and impact (where it isn't being measured directly) assumed (Edwards *et al.* 2004; Mitchell and Balogh 2007a). Sample counts will be used to provide indices to infer trends in vertebrate pest abundance, details of count methodologies for each SPC complex are provided in following sections.

Since nil-treatment sites are not being used in the SPC evaluation, effects of factors such as rainfall, climatic variation, other exotic species, and other management actions will need to be considered by other means. Data from other sources such as the Bureau of Meteorology and existing NPWS pest data bases will be used to add context to abundance indices. In the SPC complexes where goats are the target pest species, the macropod activity will be recorded concurrently to help tease out the effectiveness of goat management practices. For example, a decline in goat activity while macropod activity remains stable or increases likely indicates that goat management in that area is being effective. .

Given the consideration above, the species monitored and the techniques used for the SPC trial will vary between locations. Indices of abundance and/or activity will be used rather than absolute counts. In reserves that already have existing monitoring programs (e.g. for Fox TAP or SOS purposes) those programs will be utilised.

After 12 months of monitoring has been completed for the SPC trial the data will be reviewed and any changes required to the methodology will be implemented.

## 5.2 Gundabooka Complex

### 5.2.1 Brief Description of the Reserves and Threatened Species

The Gundabooka Complex is made up of Gundabooka NP and Gundabooka SCA and is located in the semi-arid environment of north western NSW. It is approximately 50 km south-west of Bourke and 110 km north-west of Cobar. The climate is characterised by hot summers and mild winters with annual average rainfall of 350 mm, although this is highly variable.

Gundabooka Complex contains Mount Gunderbooka, the Gunderbooka Range and surrounding slopes and plains to the north, east and west, and the Darling River to the north. The park is located at the northern end of the Cobar Peneplain biogeographic region. The area of land dedicated to the maintenance of biodiversity within this biogeographic region is small. The complex is isolated from other protected areas and surrounded by pastoral lands. In this context it provides valuable habitat for native flora and fauna.

The vegetation is dominated by open woodland, and there are populations of four threatened plant species. Two of these plants, the desert phebalium (*Phebalium glandulosum*) and Mount Vincent mint bush (*Prostanthera stricta*), are small/medium shrubs that are restricted to small areas of the range. Both have been heavily grazed by introduced herbivores. Sweet false gallium (*Hedyotis galioides*) is a rare annual herb that has only been recorded in the Gunderbooka range. The curly-bark wattle (*Acacia curranii*) is a small tree with a very limited and disjunct distribution. A population of approximately 150 trees has been recorded on Mount Gunderbooka. Surveys for this species within the park indicate that it only occurs on two small areas on Mount Gunderbooka. Goat control has been listed as critical for curly-bark wattle conservation in the Regional Pest Management Strategy for Far West Region (OEH 2012a).

Three threatened mammal species have been recorded in the complex: the little pied bat (*Chalinolobus picatus*), yellow-bellied sheath-tail-bat (*Saccolaimus flaviventris*) and the kultarr (*Antechinomys langier*). The little pied bat is distributed across western NSW and roosts in caves, rock outcrops and tree hollows. The yellow-bellied sheath-tail-bat has been recently recorded at several sites in western NSW. It roosts in large tree hollows and forages for airborne insects above the canopy of wooded habitats. The main threats to populations of both these species are thought to be clearing and predation at roost sites by cats. The kultarr has always been rare in western NSW, and is found in ground and log hollows in a wide variety of vegetation types. The main threats to this species are fire, land degradation, flooding, predation and cultivation.

Three threatened bird species have been recorded; the pink cockatoo (*Cacatua leadbeateri*), pied honeyeater (*Certhionyx variegatus*) and painted honeyeater (*Grantiella picta*). Pink cockatoos are found sporadically in woodland and tree-lined watercourses over a wide area of western NSW and beyond. They depend on fresh surface water and tree hollows. The main threats to their populations are clearing, grazing (which inhibits regeneration of future nesting trees) and illegal trapping. Pied honeyeaters, although widespread across arid and semi-arid woodlands, are rarely

seen. They follow rain and flowering shrubs, predominantly various species of *Eremophila*. They are threatened by a reduction of food supplies through the clearing of shrubland/woodland. Painted honeyeaters are distributed across western NSW, mainly throughout forested drainage lines and are dependent on the fruiting patterns of mistletoe (*Amyema* spp.) infestations. The threats to this species are largely unknown, however competition with other species, clearing and selective thinning of infected trees may all be factors (DEC 2005).

### **5.2.2 SPC Target species**

Goats are the primary target for SPC in the Gundabooka complex. They are listed in the current Far West Regional Pest Management Strategy (RPMS) as a critical threat to the survival of the curly-bark Endangered Ecological Community (EEC) (OEH 2012a). Secondary targets most likely to be encountered are pigs, wild dogs, foxes, cats and rabbits.

### **5.2.3 Vertebrate Pest Monitoring**

Goats will be the primary vertebrate pest species monitored as part of the ecological monitoring of the SPC trial in the Gundabooka Complex. Records of other pest species shot will be kept as part of the operational monitoring (see sec. 6).

Monitoring of goats across large spatial areas in Australia is often undertaken using aerial surveys (Mitchell and Balogh 2007d; Pople and Froese 2012). In NSW, goats have been counted in the western rangelands as part of OEH's Kangaroo Management Program (KMP) annual and ongoing aerial surveys since 1993 (Ballard et al. 2011). Transects for these surveys are approximately 50 km apart based on latitude (ie 2 transects per degree of latitude). However, this type of operation is expensive and must be carried out by trained observers. Untrained observers have been known to see only 10% - 30% of the number of animals of trained observers (Lethbridge et al. 2013b). Consequently, it was decided to use alternative monitoring methods for goats in Gundabooka to facilitate the continuation of this monitoring program regardless of the outcome of the SPC trial.

Goats leave conspicuous sign of their presence, namely dung, and counting this can be an alternative to estimating their actual abundance (Triggs 2004). Pellet count transects are a well-established method for monitoring goat activity (Lethbridge *et al.* 2013b, 2013a; Mitchell and Balogh 2007d; Russell *et al.* 2011) and can also indicate if other pest species are becoming a problem. Therefore pellet count transects will be used to monitor changes in goat activity in the Gundabooka Complex. Macropod dung will also be recorded to help determine the effects of factors not being measured such as climatic influences.

Motion-triggered cameras will also be used in grid formations on Mt Gunderbooka, partly due to the ruggedness of the terrain and difficulties of conducting pellet counts here, but also to gain a different insight to goat activity in this part of the reserve. Mt Gunderbooka has strong cultural values and numerous art sites. Some of these art sites have been protected from goats entering overhangs and rubbing up on the rockwalls, however not all sites have been protected and it is also assumed that not all sites have been recorded. After consultation with the Gundabooka Joint



Management Committee, one grid was established in close proximity to known art sites, one around the curly-bark wattle population and a third which includes a gorge of cultural significance.

#### *Pellet Counts*

- Transects are located across the reserve with the exception of Mt Gunderbooka. These transects target known and reliable waterpoints, but are not within 200m of the waterpoint in order to alleviate bias due to goats temporal persistence at these locations.
- Transects are 100m long and 2m wide and marked with pegs at the start and end point to allow accurate re-sampling. The direction of transects was determined using randomly generated compass bearings. Start and end point coordinates were recorded with unique identifiers.
- All fresh dung 1m either side of transects will be counted and recorded by species according to Triggs *et al.* (2004). Macropod dung in the Gundabooka Complex cannot be accurately differentiated and as a result data for these animals are pooled. Data is recorded using a Trimble Juno handheld computer with CyberTracker software installed.
- Counts are conducted in autumn and spring each year.

#### *Motion-Triggered Cameras*

- Cameras are located in 3 grids of 12 on Mt Gunderbooka. One grid is around art sites, with the other two grids around curly-bark wattle locations and a culturally significant gorge. The cameras are approximately 750m apart.
- One Reconyx PC800 Hyperfire camera is permanently attached to a suitable tree using a cablelock at each of the sampling points. The set up is such that the camera is not facing the rising or setting sun, at a height of approximately 1m and with a very slight downwards angle.
- Fresh batteries and SD cards are put in each camera for a minimum of 14 consecutive nights in autumn and spring each year coinciding with the pellet counts.
- Cameras are passive set (ie no bait or other attractants will be used) and are programmed to take 5 images per trigger event with a 5 second delay between each image. There is a 60 second delay between trigger events. These settings have been designed with goats in mind as they have a propensity to camp in front of cameras compared to other pest species such as foxes which move rapidly through their home range (B. Mitchell and A. McSorley, personal observations).
- After the completion of the minimum deployment time SD cards are retrieved and the images downloaded.
- Images are tagged using ExifPro software for analysis



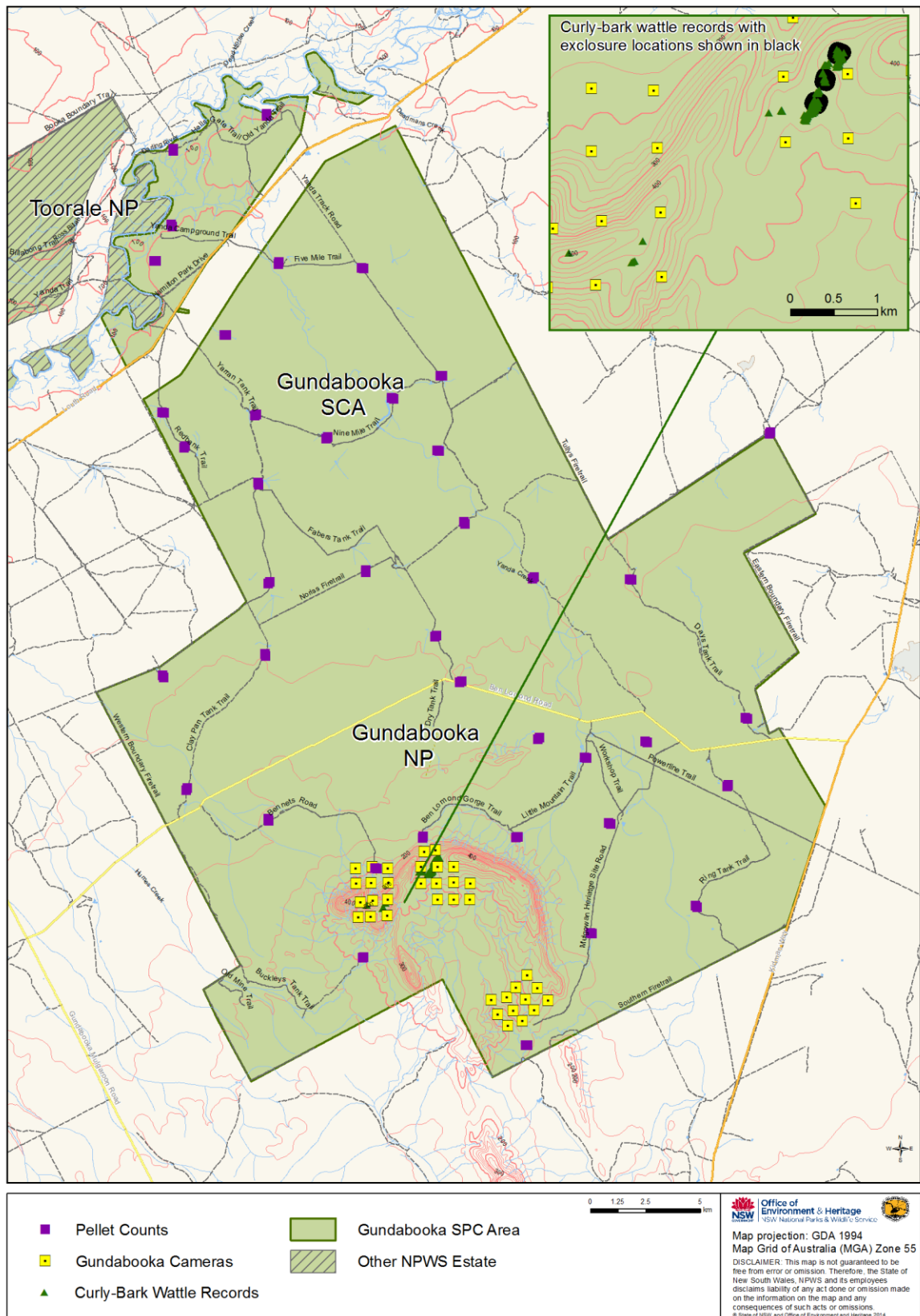
**Figure 2** Goats walking in front of a motion-triggered camera on Mt Gunderbooka (SPC)

#### 5.2.4 Threatened Species Monitoring

Curly-bark wattle monitoring is being undertaken as part of the OEH Saving Our Species Program. 3 large exclosures have been constructed to keep goats away from the majority of curly-bark wattles. Monitoring of resilience and recruitment of the wattle, both inside and outside the exclosures, occurs once per year.



**Figure 3** Mature curly-bark wattle within one of the exclosures on Mt Gunderbooka (S.Thornton)



**Figure 4** Gundabooka Complex showing monitoring locations and curly-bark wattle records

## 5.3 Goonoo Complex

### 5.3.1 Brief Description of the Reserves and Threatened Species

The Goonoo Complex is made up of three reserves: Goonoo NP, Goonoo SCA and Coolbaggie NR, and encompasses 65 000 ha of the southern end of the Brigalow Belt South Bioregion. The climate is characterised by hot summers and cool winters, with an average annual rainfall of 600 mm.

The land surrounding the Goonoo complex is a mix of grazing and intensive farming agricultural land. Dubbo is located 30 km to south-west, Gilgandra 40 km north-west and Dunedoo 40 km east of the complex.

The Goonoo Complex supports communities of narrow leafed ironbark and white cypress on poor sandy soils and black cypress on silt stones. Congoo mallee and green mallee predominate in the mallee areas. White mallee also exists in small stands at its eastern most extent. One EEC is found within the complex, the Inland Grey Box Woodland.

There have been five threatened plant species recorded within the Goonoo Complex: *Tylophora linearis*, Keith's Zieria (*Zieria ingramii*), *Rulingia procumbens*, scant pomaderris (*Pomaderris queenslandica*) and *Homoranthus darwinioides*. These species are threatened by habitat degradation, track maintenance activities and grazing by rabbits and goats (OEH 2013a).

Seventy-seven bird species have been recorded with the Goonoo Complex with twenty-two of them listed as threatened. These include malleefowl (*Leipoa ocellata*), glossy black-cockatoo (*Calyptorhynchus lathami*), speckled warbler (*Chthonicola sagittata*) and Gilbert's whistler (*Pachycephala inornata*). The malleefowl population in the Goonoo Complex is the eastern-most population in NSW and is spatially isolated from other malleefowl populations. It is particularly vulnerable to local extinction due to the small local population size, threats to nesting and forage habitat and its isolation. The Goonoo forests have been a priority site for the Fox TAP since 2001 and a comprehensive fox control and malleefowl monitoring program is in place to reduce malleefowl predation by foxes and monitor the breeding success of the local malleefowl population (DECCW 2010).

### 5.3.2 SPC Target species

Foxes are the primary target for SPC in the Goonoo Complex. They are listed in the Northern Plains Regional Pest Management Strategy (RPMS) as a critical threat to the survival of malleefowl (OEH 2012b). Secondary targets are, but not limited to, goats, rabbits, pigs, deer, wild dogs and cats. Goats are an emerging threat in the Goonoo complex and pose a significant risk to malleefowl due to habitat degradation.

### 5.3.3 Vertebrate Pest Monitoring

Foxes and goats will be monitored as part of the SPC trial in the Goonoo Complex. Records of other pest species shot will be kept as part of the operational monitoring (see sec. 6).

#### Foxes

The Goonoo Complex is within the Goonoo Fox TAP site, which has an established monitoring program for foxes. Therefore, this existing program is being utilised for the SPC trial at these reserves. Motion-triggered cameras are being used to monitor the presence of foxes at sampling points throughout the Goonoo Complex. There are 100 monitoring sites located on a 5km grid pattern across the TAP site with 40 of these sites located on NPWS estate and managed by NPWS staff. The other 60 sites are on private property surrounding the reserves and will be managed by the Central West Local Land Services (LLS).

Monitoring on NPWS reserves is being implemented in June/July & December each year. The June/July monitoring is undertaken prior to a cooperative baiting program in July. One camera is positioned at each monitoring site and set up according to the methods set out in the Goonoo Fox TAP Site Plan. Cameras are used to record activity for 14 nights at each site.

The cameras are a mix of Reconyx RC60 and Reconyx HC500 and have the same settings and setup to ensure consistency in data collection. All NPWS images taken are being catalogued using Portfolio (software program) to allow for analysis. Central West LLS are providing the raw data from their cameras to NPWS for analysis.

#### Goats

Pellet count transects will be used to monitor changes in goat activity in the Goonoo Complex. Goats are in very low numbers (David Wurst, Northern Plains Pest Management Officer personal communication, 2014) and as such aerial surveys would be unsuitable. The most conspicuous sign of goat presence may not always be the animals themselves but rather their dung, especially when they are at low densities (Triggs 2004). Pellet count transects are a well-established method for monitoring goat activity (Lethbridge *et al.* 2013b, 2013a; Mitchell and Balogh 2007d; Russell *et al.* 2011) and can also indicate if other pest species are becoming abundant. Macropod dung will also be recorded to help determine the effects of factors not being measured such as climatic influences.

Data from the first survey of goats in the Goonoo Complex confirmed the low abundance of these animals in the reserve. In order to increase the sensitivity of the count to detect change additional pellet count transects were established around reliable waterpoints within the complex.

#### *Pellet Counts*

- Transects are located in two ways in the Goonoo Complex: 40 transects are randomly allocated (but within 500m from a vehicular access point to allow timely sampling) and 44 transects are located around 11 reliable waterpoints creating a square formation.

- Transects are 100m long and 2m wide and marked with pegs at the start and end point to allow accurate re-sampling. Start and end point coordinates were recorded with unique identifiers.
- All fresh dung 1m either side of transects will be counted and recorded by species according to Triggs *et al.* (2004). Macropod dung in the Goonoo Complex cannot be accurately differentiated and as a result data for these are pooled. Data is recorded using a Trimble Juno handheld computer with CyberTracker software installed.
- Counts are conducted in autumn and spring each year



**Figure 5** Pellet count set up, Goonoo Complex (B.Mitchell)

### **5.3.4 Threatened Species Monitoring**

As part of the Goonoo Fox TAP site, the Goonoo Complex has an established monitoring program for malleefowl. Therefore, this existing program will be utilised for the SPC trial at these reserves.

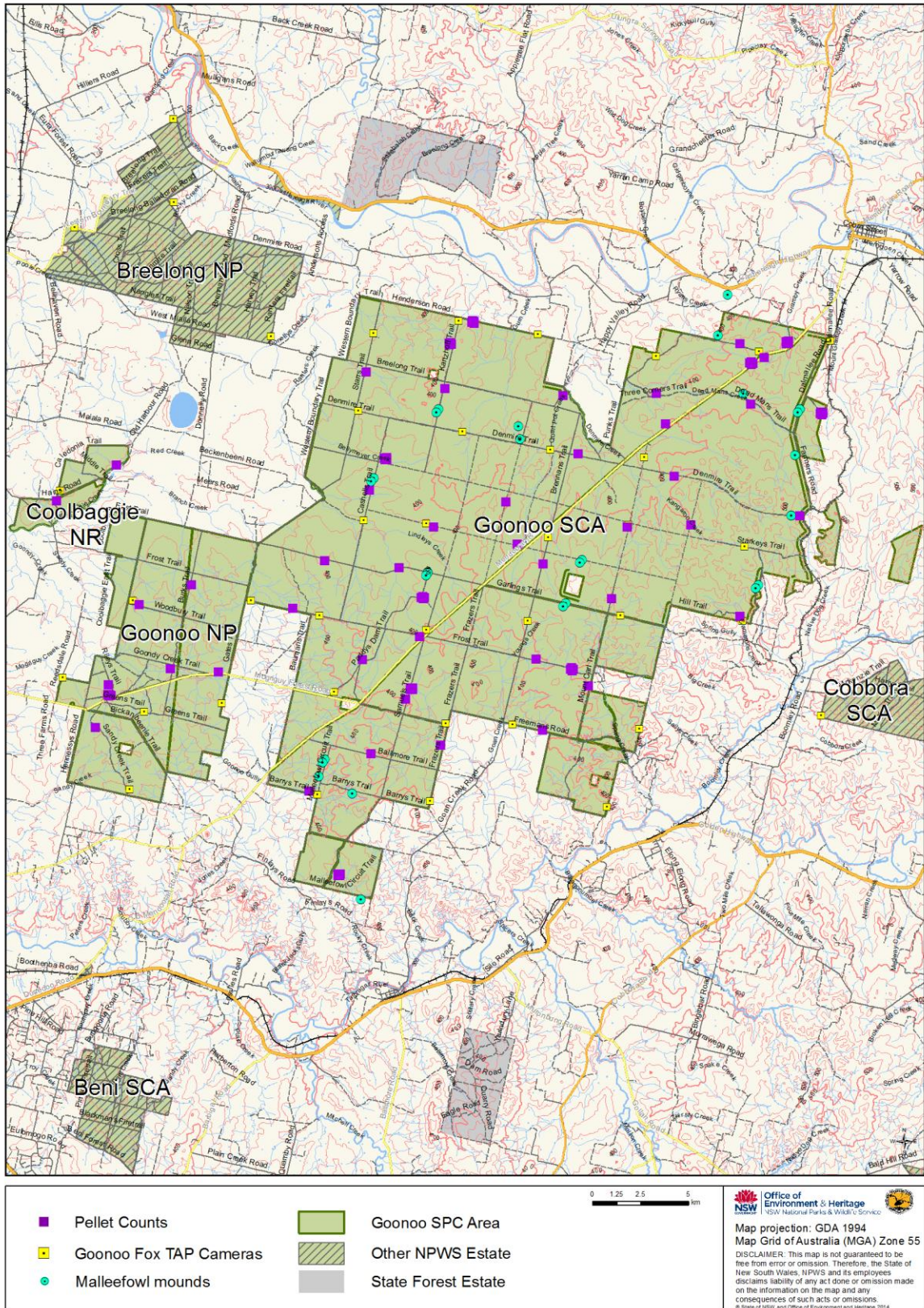
#### *Motion-Triggered Camera Monitoring*

Prior to the breeding season each year, cameras will be set up at each known mound to capture any malleefowl activity. Once active mounds for the season have been identified, cameras will then be set up on the active mounds to monitor breeding behaviour and (potentially) reproductive success i.e. egg laying and chicks hatching, as well as visitation to the mounds by other species. Cameras will be attached to a steel post or tree within 5 metres of the mound at a height of 1-2 metres and programmed to take still and/or video footage of activities around mounds. Cameras will be revisited every 4-6 weeks to change batteries and memory cards.

#### *Bi-annual Monitoring for inclusion into the National Malleefowl Monitoring Database*

All known mounds on NPWS estate within the site will be monitored bi-annually using the National Malleefowl Monitoring Database (NMMD). NPWS will liaise with LLS and landholders to undertake monitoring on private land using NMMD. The database aims to record the details (including the location, size, age and activity status) of mounds across Australia.

The data collected via the above methods will be used locally to provide an indication of Malleefowl presence / absence within the site and to monitor the persistence of breeding pairs at mounds. This work is currently being undertaken with assistance from staff in the Biodiversity Conservation Unit in Dubbo.



**Figure 6** Goonoo Complex showing malleefowl mounds



## 5.4 Central Mallee Complex

### 5.4.1 Brief Description of the Reserves and Threatened Species

The Central Mallee Complex is a large contiguous area (230 000 ha) comprising three reserves located in central NSW: Yathong NR, Nombinnie NR and Nombinnie SCA. The complex is on the boundaries between three major biophysical regions; the Cobar Penneplain, the Darling Depression and the Southern Riverine Plain. The resulting geography of ranges, hills, rolling downs and lowlands, plains and dunefields gives the area great diversity of landscape and habitat. The major landscape feature of the complex is the Merrimerrriwa Range, which rises to 200m above the plains. The climate is characterised by hot summers and mild winters with an average annual rainfall of 400 mm.

The surrounding district is used for grazing (mainly sheep) and dryland wheat farming. The nearest village is Mount Hope (20 km east), with the complex remote from any large towns. Cobar (north), Condobolin (east) and Griffith (south) are all approximately 150 km away.

The Central Mallee Complex protects the largest remaining stand of mallee in NSW, a vegetation community which has been subject to large scale clearing for grain cropping and has been severely diminished in NSW. Mallee communities contain a variety of plant species, many of which show preference for specific soils, from sandy dunes to plains and old clayey drainage depressions. The large and varied area of the Central Mallee Complex therefore protects a wide range of species and habitats. In addition, the complex contains areas of woodland habitats typical of central NSW such as white cypress pine (*Callitris glaucophylla*), bimble box (*Eucalyptus populnea*), black box (*E. largiflorens*) and belah (*Casuarina cristata*). These communities have also been widely cleared for grazing and cropping in the region (NPWS 1996b).

Rare and endangered plant species occurring in the complex include the threatened curly-bark wattle (*Acacia curranii*), wild lime (*Eremocitrus glauca*), common sour-bush (*Choretrum glomeratum*), western wedding-bush (*Ricinocarpus bowmanii*), iron-grass (*Lomandra patens*), yellow darling pea (*Swainsona laxa*) and *Phebalium obcordatum*. A number of species are near the limit of their range, for example brigalow (*Acacia harpophylla*), which is near its southern limit and azure daisy-bush (*Olearia rudis*) which is at its easterly limit. The survival of the curly-bark wattle in particular is threatened by grazing from goats (Genevieve Wright, NPWS Flora Ecologist personal communication, 2014; (OEH 2014).

The Central Mallee Complex is a major area of habitat for two threatened native mammals: the southern Ningauai (*Ningauai yvonneae*) a mouse sized carnivore and kultarr (*Antechinomys laniger*). Threats to these animals are predation by foxes and cats and heavy grazing and trampling of habitat and food resources by goats and rabbits (NPWS 1996b).

Six threatened bird species have been recorded in the Central Mallee Complex: malleefowl (*Leipoa ocellata*), striated grass wren (*Amytornis striatus*), red-lored whistler (*Pachycephala rufogularis*), Gilbert's whistler (*Pachycephala inomata*), southern scrub robin (*Drymodes brunneopygia*) and chestnut quail thrush

(*Cincoloma castanotum*). Threats to the survival of these species include habitat loss and predation by foxes and cats. Central Mallee Complex is also a Fox TAP site for the protection of these species (NPWS 2001; OEH 2011).

#### **5.4.2 SPC Target species**

Foxes and goats are the primary target for SPC in the Central Mallee Complex. They are both listed in the Western Rivers RPMS as a critical threat to the survival of malleefowl and other mallee birds (OEH 2012d). Goats are also a critical threat to the curly-bark wattle (OEH 2012d). Secondary targets are, but not limited to, cats, rabbits, pigs, deer and wild dogs.

#### **5.4.3 Vertebrate Pest Monitoring**

Foxes and goats are the vertebrate pest species monitored as part of the ecological monitoring of the SPC trial in the Goonoo Complex. Records of other pest species shot will be kept as part of the operational monitoring (see sec. 6).

##### **Foxes**

The Central Mallee Complex is within the Central Mallee Fox TAP site which has an established monitoring program. However, parts of this monitoring program were planned but unfunded. Therefore, SPC will assist with this shortfall and carry out two different programs aimed at foxes. Spotlighting will be used in areas where mallee vegetation is absent or sparse. This technique has been used for many years to survey foxes, can cover large areas in a short amount of time and is relatively simple to do (Mitchell and Balogh 2007b; Saunders *et al.* 1995; Sharp *et al.* 2001; Vine *et al.* 2009). Spotlighting was also chosen as it can be done concurrently with the goat monitoring (see below). Motion-triggered cameras will also be used to monitor the presence of foxes, and other fauna, at sampling points established on vehicular tracks in areas of known malleefowl activity.

##### *Spotlight Counts*

- There will be 4 spotlight count transects along suitable trails in Central Valley (Yathong NR) and Nombinnie NR & SCA (see Figure 9).
- Transect lengths are a minimum of 20km in length.
- Spotlight count must start approximately 30 minutes after sunset from an established start point.
- One person drives a 4WD vehicle at a constant slow speed (10-15 kmh) while the observer, positioned in the front passenger seat) scans a 90° arc ahead of the vehicle with a window mounted spotlight and counts pest animals and macropods seen. The vehicle may be paused in order to obtain a positive identification.
- Data is to be recorded using a Juno Trimble handheld computer with CyberTracker software installed.
- Repeat the count on three consecutive nights of similar weather (not in high wind or rain).

- Subsequent counts must start at the same time as the first count, follow the same route (direction and distance) and use the same equipment and observers.

#### Cameras

- There will be 80 monitoring sites in two separate areas (40 cameras in each area) of known malleefowl activity along vehicular tracks. The cameras are approximately 1.5km apart (see Figure 9).
- One Reconyx PC800 Hyperfire camera is securely attached to a star post driven into the ground at each of the sampling points. The set up is such that the camera is not facing the rising or setting sun, at a height of approximately 1m and with a very slight downwards angle.
- Each camera is set for a minimum of 14 consecutive nights. Timing of deployment is pre-fox baiting in February/March and in Spring.
- Cameras are passive set (ie no bait or other attractants will be used) and are programmed to take 3 rapidfire images per trigger event. These settings have been designed to maximise the chance of capturing species which may move rapidly past a camera.
- After the completion of the minimum deployment time the cameras are retrieved and the images downloaded.
- Images are tagged using ExifPro software for analysis



**Figure 7** Fox and malleefowl walking past passive set cameras set in the Central Mallee SPC Complex (SPC)

#### Goats

Goat monitoring in the Central Mallee complex will consist of vehicular based daylight counts. Macropod numbers will also be recorded to help determine the effects of factors not being measured such as climatic influences. This method was chosen as (similarly to spotlighting) it can cover large areas in a short amount of time, is relatively simple to do, and it can be done concurrently with other monitoring in the complex (Mitchell and Balogh 2007d; Parkes *et al.* 1996). This method is also relatively easy to maintain over many years. Aerial surveys were

considered but not undertaken due to costs and the uncertainty of future funding for ongoing monitoring.

- There will be 4 daylight count transects that overlap with the spotlight count routes
- Transect lengths are a minimum 40km in length
- Daylight counts occur on the same days as the spotlight counts and must start from an established start point between 0800-1000 so that they are completed such that they do not influence the spotlight counts.
- One person drives a 4WD vehicle at a constant slow speed (20-40 kmh) while the observer, positioned in the front passenger seat scans ahead of the vehicle and counts pest animals and macropods seen. The vehicle may be paused in order to obtain an accurate number of animals when seen in large groups.
- Data is to be recorded using a Juno Trimble
- Repeat the count on the three consecutive mornings of the spotlight counts
- Subsequent counts must start at the same time as the first count, follow the same route (direction and distance) and use the same equipment and observers.

#### **5.4.4 Threatened Species Monitoring**

##### **Malleefowl**

###### *Central Mallee Aerial Survey*

Aerial surveys will be conducted by NPWS Ecosystems and Threatened Species Team and will be limited to locating known and new malleefowl mounds in the Central Mallee with resources primarily to go to surveying Yathong NR. Yathong has the most data available from past aerial surveys to help in identifying population trends in response to management. Surveys in Round Hill NR will be a second priority if resources allow, as this reserve is also part of the Central Mallee Fox TAP site and may provide valuable data on malleefowl breeding.

###### *Central Mallee mound monitoring – Motion-triggered Cameras*

The camera trap project, run by NPWS Ecosystems and Threatened Species Team, aims to capture image data from a representative sample of the malleefowl population on Yathong NR. From historical knowledge there may be up to 12 or 15 mounds active during a good breeding season. Currently the project aims to capture data from an entire breeding season, with data analysis expected to provide guidance on the longer term value of continuing monitoring beyond the first year period (including recommendations for cost efficiency measures).

##### **Red-lored whistler**

Point surveys are undertaken across the Central Mallee complex targeted towards red-lored whistler as part of the SOS program run by NPWS Ecosystems and Threatened Species Team. Information on non-target species, including chestnut

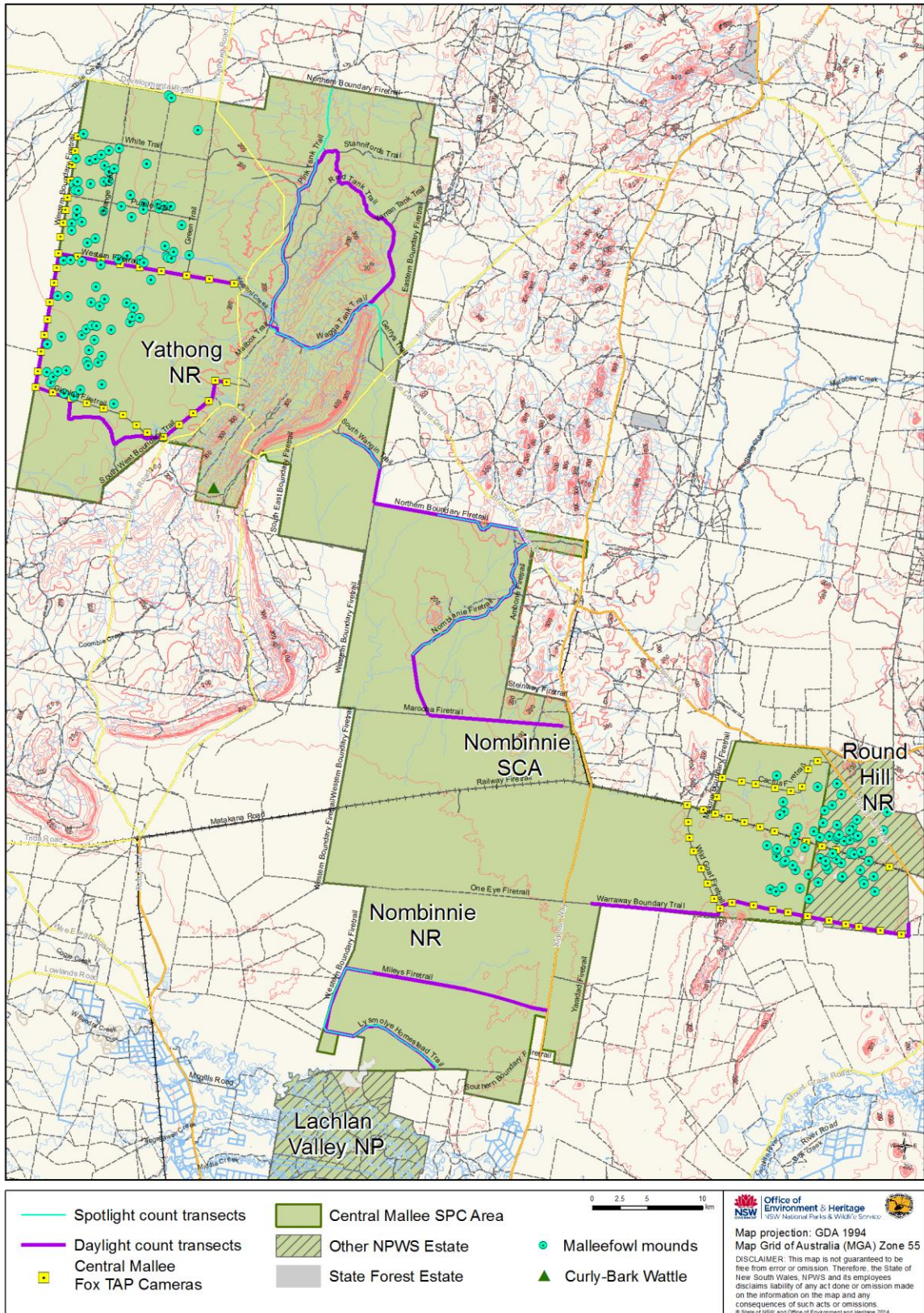
quail thrush, southern scrub robin and Gilbert's whistler are also recorded. 15 minutes are spent at each point; with 3 minutes of listening to get some data on how many birds are calling voluntarily; 4 minutes playing red-lored whistler calls; and 8 minutes listening for a response.

### **Curly-bark wattle**

Curly-bark wattle is known to occur in a small area in the south of Yathong Nature Reserve. A recent survey by the NPWS Biodiversity and Wildlife Team has found that goats are browsing on these plants. Follow up surveys by the Biodiversity and Wildlife Team are planned for 2015 and will look at resilience and recruitment of this curly-bark population.



**Figure 8** Curly-bark wattle browsed, stripped and broken by goats in Yathong NR (G.Wright)



**Figure 9** Central Mallee Complex showing monitoring locations and threatened species information.

## 5.5 Cocopara Nature Reserve

### 5.5.1 Brief Description of the Reserves and Threatened Species

Cocopara Nature Reserve is located about 25 km northeast of Griffith in the Riverina District of southern NSW. The climate is characterised by warm summers and cool winters with annual average rainfall of 420 mm. This small reserve encompasses almost 5 000 hectares and is bounded at the northern and southern ends by Conapaira South State Forest and Cocoparra National Park respectively.

Cocopara NR is made up of the high, dry broken landscape of the Cocoparra Range and is almost surrounded by cleared agricultural land, including the intensively developed irrigation area to the south. The principal vegetation communities include black cypress, currawang, dwyer's gum and red stringy bark with box woodlands on lower and more fertile slopes. The plains were previously covered in mallee or an acacia or pine/box woodland and the patches of vegetation on the valley floors of the range are scarce remnants of this formerly extensive woodland of the plains.

Cocopara NR provides refuge for a number of plant and animal communities that are typical of the semi-arid ranges of this part of NSW. The Cocoparra Range is close to the most westerly limit of distribution for a large number of plant and animal species which occur more commonly on the southern tablelands or in cypress pine woodlands of the western slopes and ranges. It is also the easterly limit of species which occur on the western plains (NPWS 1996a).

Threatened plant species or communities occurring in the reserve include the Cocoparra pomaderris (*Pomaderris cocoparrana*), a medium-sized shrub found in sensitive rock outcrop environments, and Inland Grey Box Woodland EEC. Threats to these plants and communities are primarily grazing by goats and rabbits.

There have been eight vulnerable bird species recorded in Cocopara NR: the painted honeyeater (*Grantiella picta*), superb parrot (*Polytelis swainsonii*), turquoise parrot (*Neophema pulchella*), glossy black cockatoo (*Calyptorhynchus lathami*), chestnut quail-thrush (*Cinlosoma castanotum*), Gilbert's whistler (*Pachycephala inornata*), shy hylacola (*Sericornis cautus*) and pink cockatoo (*Cacatua leadbeateri*). The glossy black cockatoos found within the reserve are at the southern extent of the endangered glossy black-cockatoo, Riverina Population.

### 5.5.2 SPC Target species

Goats are the primary target for SPC in Cocopara NR. They are listed in the Western Rivers RPMS as a critical threat to the survival of the Cocoparra pomaderris and Inland Grey Box Woodland EEC (OEH 2012d). Secondary targets are, but not limited to, rabbits, pigs, deer, wild dogs, foxes and cats.

### 5.5.3 Vertebrate Pest Monitoring

Goats will be monitored as part of the ecological monitoring of the SPC trial in Cocopara NR. Records of other pest species shot will be kept as part of the operational monitoring (see sec. 6).

Aerial surveys in Cocopara NR were not considered due to the reserve's small size and steep relief. Therefore pellet count transects will be used to monitor changes in goat activity in this area. Macropod dung will also be recorded to help determine the effects of factors not being measured such as climatic influences.

#### *Pellet counts*

- 40 transects randomly located across the reserve. Reserve stratified into two areas by topography: gullies and other. Transects are within a ½ hr walk from the nearest vehicle access point to allow timely sampling.
- Transects are 100m long and 2m wide and marked with pegs at the start and end point to allow accurate re-sampling. Start and end point coordinates were recorded with unique identifiers.
- All fresh dung 1m either side of transects will be counted and recorded by species according to Triggs *et al.* (2004). Macropod dung in the Cocopara cannot be accurately differentiated and as a result data for these are pooled. Data is recorded using a Trimble Juno handheld computer with CyberTracker software installed.
- Counts are conducted in autumn and spring each year

#### **5.5.4 Vertebrate Pest Impact Monitoring**

The Cocoparra pomaderris, *Pomaderris cocoparrana*, is threatened by grazing from goats however its distribution in the Cocopara NR is poorly recorded. Therefore, browsing of indicator plants will be used to monitor goat impact (Lethbridge *et al.*, 2013). A minimum of four indicator plant species that are palatable to goats, well distributed and common within the reserve, easy to identify, long-lived and woody will be selected to monitor over time. The condition of individual plants will be used to generate an index of browsing pressure. Plants with height >2m will be avoided for monitoring purposes as they have effectively 'escaped' the browse zone of goats. Indicator plants should also have a mixture of life stage (e.g. seedling, juvenile, and adult). A minimum of 40 of each indicator species will be required (Lethbridge *et al.*, 2013).

#### *Browse class and Growth form monitoring*

In order to ease re-location indicator plants will be used as close to pellet count transects as possible.

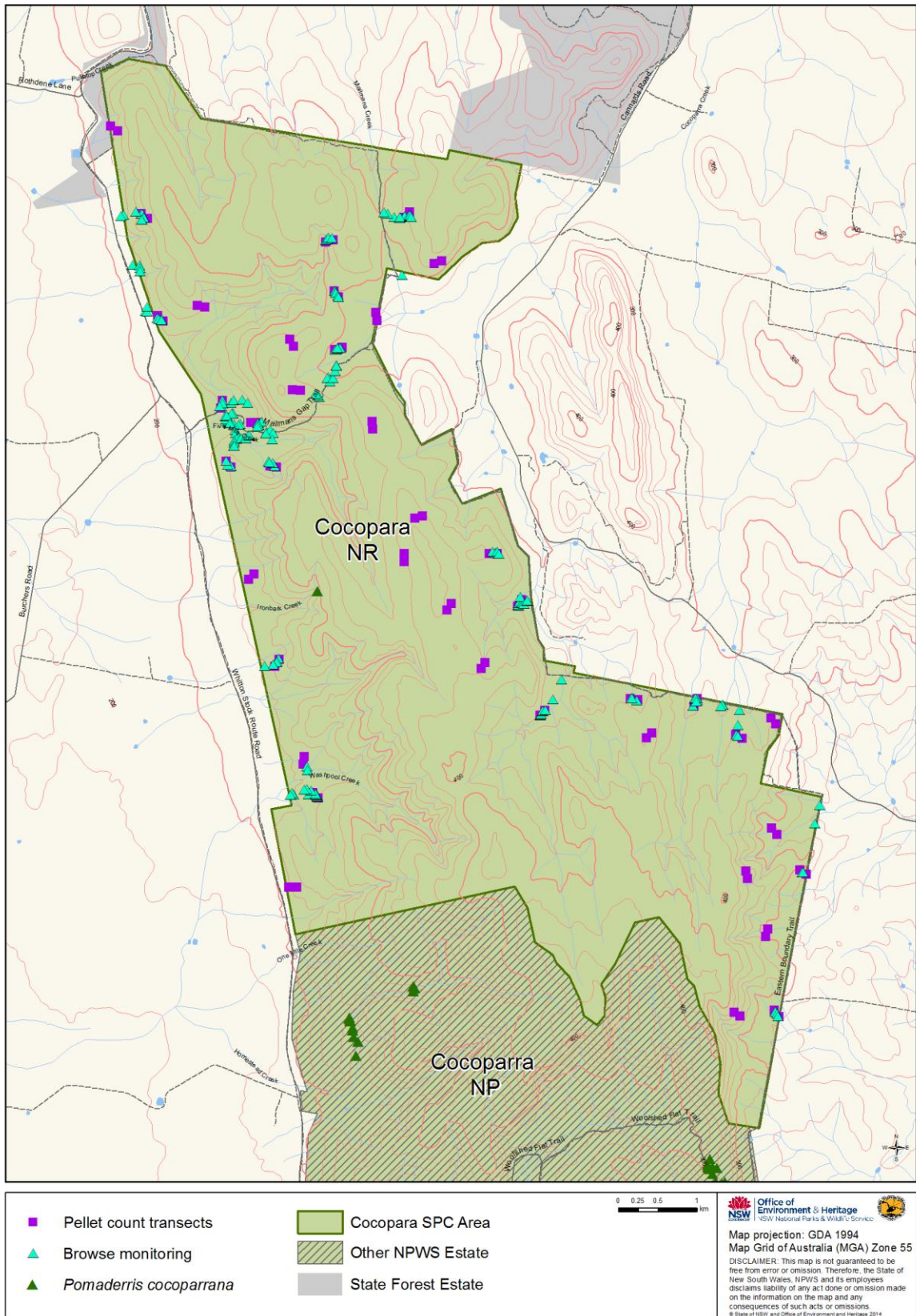
- Indicator plants will be permanently marked using steel land markers with white caps
- Each plant will be examined for browsing and the following data recorded:
  - Growth form of the plant:
    - Unaffected (no or very little browsing (ie just tips missing))
    - Recovering (new shoots emerging from browsed stock but are not browsed)



- Affected (hedged form, new shoots from browsed stock are browsed)
- Heavily affected (death of all stems previously browsed and new growth emerging from lower stem)
- Browse class of the plant (the average diameter of all previously browsed stem tips):
  - Intact (no browsing)
  - Toothpick (< 1.5mm)
  - Matchstick (1.5-3 mm)
  - Drink straw (3.1mm-5mm)
  - Pencil (6-9mm)
  - Little finger (10-15mm)
  - Thumb (15-25mm)



**Figure 10** *Cocoparra pomaderris* with significant browsing (A. McSorley)



**Figure 11** Cocopara Nature Reserve showing SPC monitoring and Cocoparra pomaderris records

## 5.6 Yanga Complex

### 5.6.1 Brief Description of the Reserves and Threatened Species

The Yanga Complex is located in south-western NSW at the western edge of the Riverina agricultural region, approximately 50 kilometres from the Victorian border. The nearest towns are Balranald (8 kilometres to the west), Hay (134 kilometres to the east) and Swan Hill (114 kilometres to the south in Victoria). The complex is made up of the Murrumbidgee Valley SCA and the Yanga Precinct of the Murrumbidgee Valley NP. This area encompasses approximately 70 000 hectares and has hot summers and mild winters, with an average rainfall of 300 mm.

Land use surrounding the Yanga complex includes dry-land and irrigated cropping (cereal crops, rice, cotton, lupins, faber beans, corn, sorghum), grazing of natural and improved pastures, and private forestry harvesting.

The Yanga Complex has a diverse assemblage of vegetation including river redgum forests and woodlands, wetlands, chenopod shrublands, Acacia shrublands, arid woodlands and Mallee environments. Three EECs occur within the complex: Sandhill Pine Woodland; *Acacia melvillei* Yarran Shrubland; and, Myall Woodland. Two endangered plant species occur within the complex: winged peppergrass (*Lepidium monoplocoides*) and Austral pipewort (*Eriocaulon australasicum*). Threats to these plants survival include habitat degradation and grazing by rabbits.

Sixteen threatened bird species have been recorded in the Yanga Complex including the bush stone-curlew (*Burhinus grallarius*), the eastern subspecies of the regent parrot (*Polytelis anthopeplus monarchoides*), and the painted snipe (*Rostratula benghalensis australis*) (Wen *et al.* 2011). The wetlands found within the complex also host 12 bird species listed on international migratory bird agreements and two threatened amphibians: the southern bell frog (*Litoria raniformis*) and Sloane's froglet (*Crinia sloanei*) (OEH 2013b). Threats to the survival of these species include habitat degradation or loss and predation by pigs and foxes.

### 5.6.2 SPC Target species

Pigs, deer and rabbits are the primary targets for SPC in the Yanga Complex. Pigs and deer are listed in the Western Rivers RPMS as a critical threat to migratory wetland birds and the southern bell frog, while rabbits are a critical threat to the Sandhill Pine EEC (OEH 2012d). Secondary targets are, but not limited to, goats, wild dogs and foxes.

### 5.6.3 Vertebrate Pest Monitoring

Pigs, deer and rabbits are being monitored as part of the ecological monitoring of the SPC trial in the Yanga Complex. Records of other pest species shot will be kept as part of the operational monitoring (see sec. 6).

Spotlighting is being used to monitor all primary pest species. This technique has been used for many years for these animals, can cover large areas in a short amount of time and is relatively simple to do (Choquenot *et al.* 1993; Cruz *et al.* 2013; Engeman *et al.* 2013; Fletcher *et al.* 1999; Mitchell and Balogh 2007c, 2007a; Twigg

*et al.* 1998). This method is also relatively easy to maintain over many years. Aerial surveys were considered but not undertaken due to costs and the uncertainty of future funding for ongoing monitoring.

### *Spotlight Counts*

- There are 5 spotlight count transects along suitable trails in the Yanga Complex (see Figure 12).
- Transect lengths are a minimum of 15km in length.
- Spotlight counts must start approximately 30 minutes after sunset from an established start point.
- One person drives a 4WD vehicle at a constant slow speed (10-15 kmh) while the observer, positioned in the front passenger seat) scans a 90° arc ahead of the vehicle with a window mounted spotlight and counts pest animals and macropods seen. The vehicle may be paused in order to obtain a positive identification.
- Data is being recorded using a Juno Trimble handheld computer with CyberTracker software installed.
- Count is repeated on three consecutive nights of similar weather (not in high wind or rain).
- Subsequent counts must start at the same time as the first count, follow the same route (direction and distance) and use the same equipment and observers.

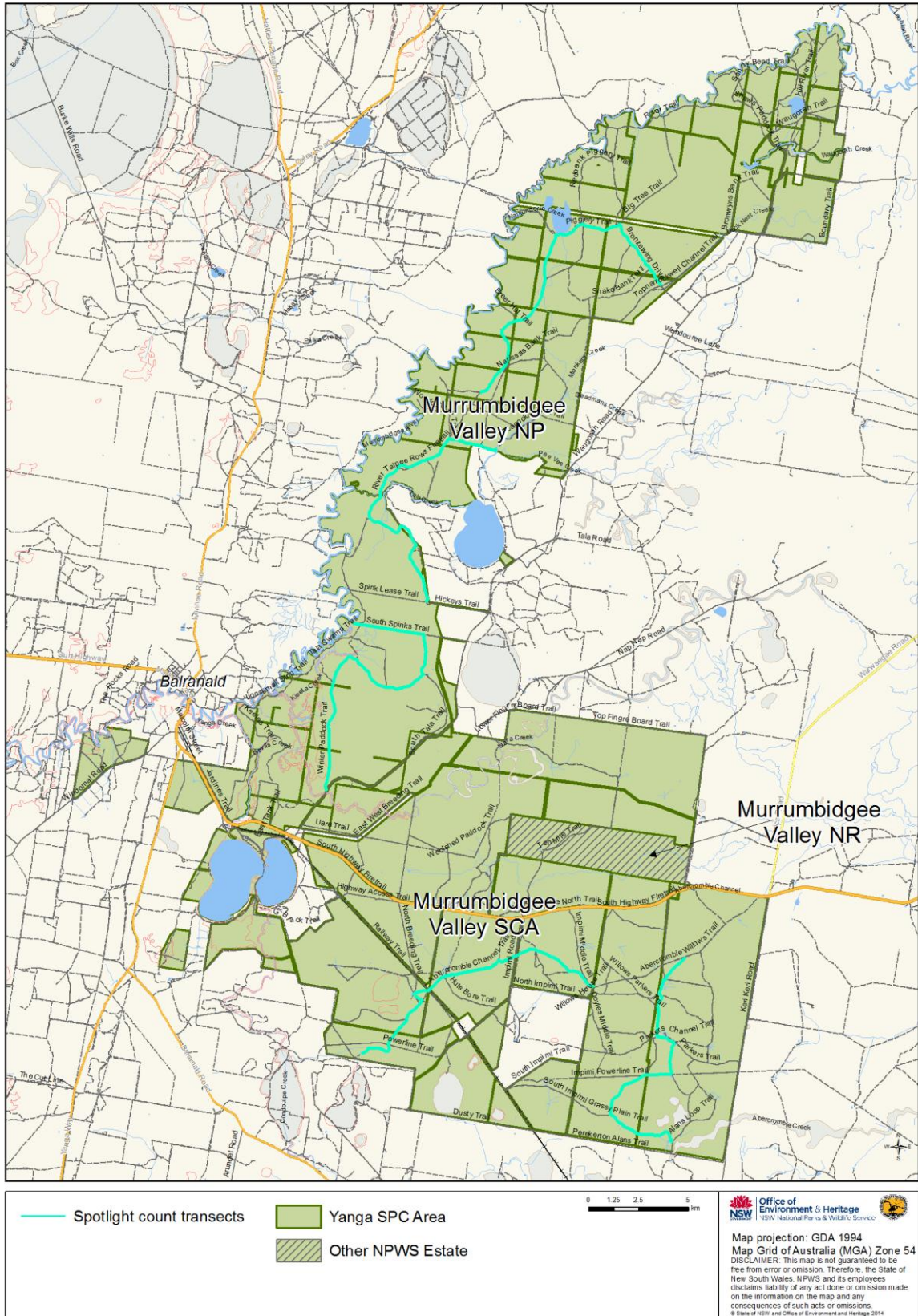
## **5.6.4 Threatened Species and Impact Monitoring**

### *Waterbirds*

Waterbird ground surveys are conducted bi-monthly as part of environmental flow monitoring conducted by OEH and Charles Sturt University and also coincide with the annual Eastern Australia Waterbird Survey run by the University of NSW.

### ***Southern bell frog***

Broad-scale surveys for tadpoles and adult frogs, along with assessments of aquatic and terrestrial habitat, and water quality are conducted throughout the year by OEH in conjunction with Charles Sturt University.



**Figure 12** Yanga Complex showing SPC monitoring

## 5.7 Woomargama National Park

### 5.7.1 Brief Description of the Reserves and Threatened Species

Woomargama National Park is located immediately north of the Murray River, which forms the NSW/Victorian border and is approximately 20 kilometres south-east of Holbrook and 30 kilometres north-east of Albury on the South West Slopes of NSW. Woomargama National Park is comprised of just over 24 000 hectares, with warm summers and cool winters and an average annual rainfall of 700 mm.

The main land use in the area is agriculture, including cropping and grazing, and pine forestry. Privately owned pine plantations border the east and west boundaries of Woomargama NP. The reserve protects an area of highly diverse forest and woodland communities on the northern and western extent of an almost continuous belt of vegetation between south-east NSW and northern Victoria. The forests support a suite of native fauna, some of which are at the limit of their western distribution. The reserves are situated in the transition zone between the mountainous NSW South West Slopes and the broader plains of the Riverina.

Significant occurrences of old growth Yellow Box (*Eucalyptus melliodora*), and Blakely's Red Gum (*Eucalyptus blakelyi*) occur in the central western sections of Woomargama NP. These are regarded as a component of the White Box/Yellow Box/Blakely's Red Gum woodland that is listed as an EEC. Other threatened flora include the phantom wattle (*Acacia phasmoides*), a small to medium sized shrub, which is found in the south of the reserve in one specific watercourse where Broad-leaved Peppermint/Norton's Box grassy forest dominates. This is the only known population of this species in NSW and one of only five populations in Australia. Out of a total known number of 405 plants in the wild, the Woomargama population accounts for 320 individuals, or 80% of the known distribution of this species. The small snake orchid (*Diuris pedunculata*) is also found in moist grassy areas in sclerophyll forest within the reserve. Threats to the survival of these species include grazing by goats, pigs and deer and high frequency, high intensity fire (DECCW 2009).

Four threatened mammals are found in Woomargama NP: the koala (*Phascolarctos cinereus*); the yellow-bellied sheath-tail bat (*Saccolaimus flaviventris*); the greater long-eared bat (*Nyctophilus timoriensis*); and, the eastern false pipistrelle (*Falsistrellus tasmaniensis*).

Eighteen threatened birds have been recorded in this reserve including the regent honeyeater (*Xanthomyza phrygia*) and painted snipe (*Rostratula benghalensis australis*). Threats to threatened birds include clearing and fragmentation of forest habitat and loss of hollow bearing trees, predation and grazing or disturbance of wetlands.

### 5.7.2 SPC Target species

Goats, pigs and rabbits will be the primary targets for SPC in Woomargama NP. These species are listed in the Southern Ranges RPMS as critical threats to the

survival of the phantom wattle and small snake orchid (OEH 2012c). Secondary targets are, but not limited to, deer, wild dogs, foxes and cats.

### **5.7.3 Vertebrate Pest Monitoring**

Vertebrate pests are in very low abundance in Woomargama NP (David Pearce, NPWS Ranger, Riverina-Highlands Area and Peter Scobie, SPC Operations Supervisor, personal communication, 2014) and as such aerial surveys would be unsuitable. Spotlight counts were not considered due to the nature of the reserve (steep and heavily wooded). Sign counts would normally be an appropriate alternative and was trialled (see below). Consequently motion-triggered cameras were selected to monitor pest animal activity throughout the reserve to increase the likelihood of capturing elusive species (Tobler *et al.* 2008). Use of cameras in wildlife management is increasing rapidly and globally and is a very convenient tool for determining site occupancy (Meek *et al.* 2014). Changes in a species activity at camera sites during the trial period will point towards a change in the occupancy of said species (note that only change in occupancy will be indicated by this method). It will be inferred that a reduction in pest animal activity indicates a reduction in occupancy and pest animal population size.

40 cameras will be placed throughout Woomargama NP. 32 will be placed on game trails (located near road ways for practicality). Cameras will be spaced at approximately 1.5km intervals. The remaining 8 cameras will be placed in close proximity to phantom wattle sites. Unlike other camera monitoring for SPC, the camera set up in Woomargama will be active in that a salt block will be used as an attractant. This attractant will increase the chance of obtaining identifiable images of animals that would otherwise be potentially moving swiftly past a camera.

Changes in pest species activity recorded at cameras sites located near phantom wattle will be used to infer a reduction in the impact of pest species on the phantom wattle. It will be assumed that a decrease in the activity of pest species at the phantom wattle location will mean a reduction in browsing/damage and therefore a reduction in the impact of pest species.

Transects recording vertebrate pest sign (e.g. pellets, rubbings, wallows, etc.) were initially trialled as a secondary measure of animal activity. This technique is used in other SPC trial reserves and may have allowed a comparison of pest animal activity between Woomargama NP and these reserves. The continuation of this method was ceased after the trial garnered low confidence data (misinterpretation of some sign and dung). A revised strategy of using cameras in clusters at sites previously identified as having pest animal activity will be used in addition to the active cameras. Clusters will be 4 cameras set in a 100m grid.

### Active Cameras

- There will be 40 monitoring sites: 32 spaced approximately 1.5km apart on game trails close to management trails, 8 placed around known phantom wattle sites.
- One Reconyx PC800 Hyperfire camera is securely attached to a suitable tree at each of the sampling points. The set up is such that the camera is not facing the rising or setting sun, at a height of approximately 1m and with a very slight downwards angle.
- Each camera is set for a minimum of 14 consecutive nights. Timing of deployment is autumn and spring each year.
- Cameras are active set: a urea-free salt block is placed in front of the camera to encourage animals to pause. Cameras are programmed to take 3 images per trigger event with a 60 second delay between trigger events.
- After the completion of the minimum deployment time the cameras are retrieved and the images downloaded.
- Images are tagged using ExifPro software for analysis

### Passive Cameras

- There will be 10 monitoring sites with 4 cameras placed in a grid formation approximately 100m apart (ie 40 cameras in total). The ten sites were chosen after evaluating the first round of active camera monitoring
- One Reconyx PC800 Hyperfire camera is securely attached to a suitable tree next to a game trail at each of the sampling points. The set up is such that the camera is not facing the rising or setting sun, at a height of approximately 1m and with a very slight downwards angle.
- Each camera is set for a minimum of 14 consecutive nights. Timing of deployment is after the active camera monitoring has been completed each autumn and spring.
- Cameras are passive set: no attractant is used. Cameras are programmed to take 3 images per trigger event with a 60 second delay between trigger events.
- After the completion of the minimum deployment time the cameras are retrieved and the images downloaded.
- Images are tagged using ExifPro software for analysis



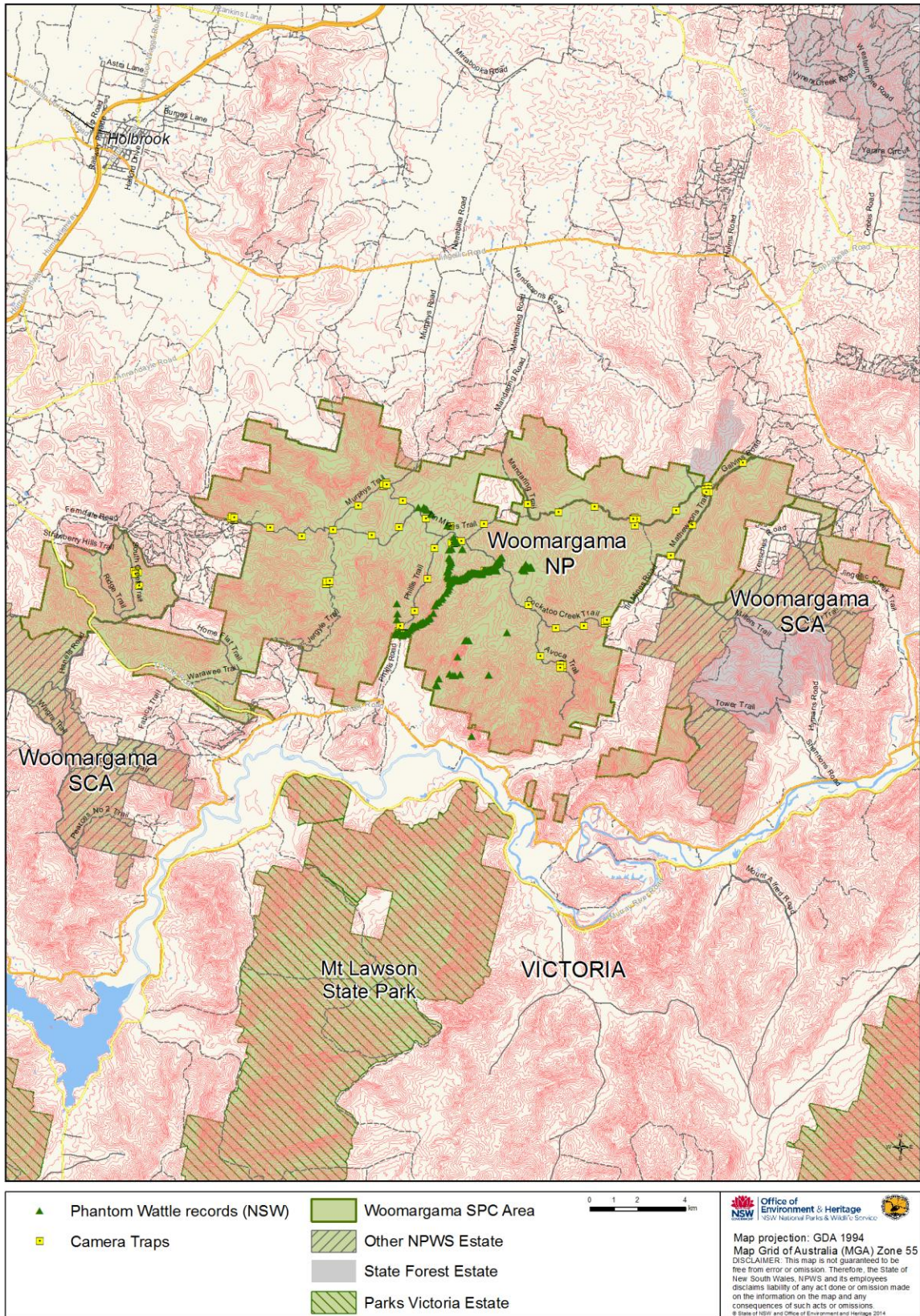


**Figure 13** Sambar deer captured by motion-triggered cameras in Woomargama NP (SPC).

#### **5.7.4 Threatened Species Monitoring**

The phantom wattle has been part of an ongoing volunteer program for the protection and revegetation of the species within Woomargama National Park. This has involved propagation, replanting monitoring and maintenance of this threatened species. Thirty volunteers form the membership of the Woomargama Volunteer Group responsible for the conservation of the phantom wattle, which has been operating since at least 2011. SPC pest animal monitoring activities have discovered a small, new population and a recent survey by the NPWS Biodiversity and Wildlife Team found a new and large population of phantom wattle at the head of Basin Creek (see Figure 14).

Impacts of vertebrate pest on the snake orchid will not be measured. This species is small and difficult to find making direct monitoring unrealistic. Instead changes in impact on the snake orchid will be inferred from changes in vertebrate pest animal activity measured on cameras and transect.



**Figure 14** Woomargama National Park showing threatened flora records

## **6 Operational Monitoring of SPC**

### **6.1 Cost**

The amount of effort expended directly for SPC will be evaluated using the existing OEH Asset Maintenance System (AMS). A non-spatial Systems Applications and Products (SAP) System will capture time and cost effectiveness.

Information collated will include: salary (non-overtime), overtime, accommodation and catering, motor vehicles, incidental cost, and work hours.

### **6.2 Species and number of animals removed**

An Environmental Systems Research Institute (ESRI) geodatabase has been developed to accommodate spatial requirements of the SPC trial and will include operational areas and point locations and numbers of animals destroyed. This data will be incorporated into the NPWS Pest and Weed Information System (PWIS).

### **6.3 Volunteers**

The number of volunteers and volunteer hours will be recorded in total and per operation.

As part of the evaluation process the skill and abilities of SPC volunteers will also be recorded in a Volunteer Appraisal form by NPWS Operation Supervisors at the conclusion of each SPC Operation.

The information collected will be used to identify any training requirements, track the skill development of volunteers, and help improve and adapt the program over the course of the trial.

### **6.4 Safety**

Safety is of paramount importance to the SPC trial and will be monitored by the use of two reporting systems.

WorkSafeOnline is OEH's web based WHS system which allows the capture and management of incidents, hazards and workplace audits. This reporting tool will be used for all SPC related accidents and near misses.

SPC Online was developed specifically for the SPC trial and is OEH's web based recording system which allows the capture and management of SPC issues and operation debriefs. This reporting tool collects all complaints and animal welfare, safety and communication issues. These may be reported by the general public, NPWS staff and contractors among others. Operational debriefs are also recorded in SPC online to allow constant improvement of the trial.

### **6.5 Animal Welfare**

NPWS is dedicated to the humane destruction of pest animals in all shooting operations. Animal welfare protocols have been established and every effort is made to adhere to them. Any breaches of these protocols will be recorded in SPC online

via operational debriefs. Members of the general public have the opportunity to report animal welfare incidents or concerns, which may or may not have any connection to SPC, by contacting local NPWS office's or OEH's Environment Line. Information reported this way will be entered into SPC Online.

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