



NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Pest Animal Survey May 2007 - Reader's note

This document is part of a larger publication. The remaining parts and full version of the publication can be found at:

<http://www.dpi.nsw.gov.au/aboutus/resources/majorpubs/reports/pest-animal-survey>

Updated versions of this document can also be found at the above web address.

This document is subject to the disclaimers and copyright of the full version from which it is extracted. These disclaimers and copyright statements are available in the appropriate document at the above web address.

1 INTRODUCTION

1.1 Background

The total costs of pest animals in Australia have been estimated at over \$700 million annually (McLeod 2004). These costs are considered conservative due to lack of information about the cumulative impacts of pest species such as land degradation. In NSW, there are many species that are considered pests because of their adverse affects on our environmental, agricultural and social values. Pest animals include introduced species (such as feral goats) and over abundant native species (such as kangaroos). The suitability and variety of habitats, modified landscapes, lack of natural predators, and absence of zoonotic diseases are some of the reasons why many introduced species have become well-established in this country. The management of pest animals is rarely simple, as some species may cause significant impacts but are simultaneously valued as a resource or are protected for their conservation value. As a result, managing these competing priorities is a challenge currently faced by land managers throughout Australia.

In the agricultural regions of NSW, the primary pest species of concern are feral pigs, feral goats, wild deer, foxes, rabbits and wild dogs/dingoes (West and Saunders 2003). Less than 0.3% of NSW can claim freedom from these species. Other pests of concern include feral cats, European starlings, introduced carp, and cane toads. The management of these species relies on having detailed information about their distribution and abundance, biology, breeding behaviour, movement, and the suitability of various control and monitoring techniques to allow populations to be adequately managed. It is equally important to understand or monitor the impacts of pest animals particularly in response to control. However, impact monitoring and reporting is generally difficult without rigorous field data collection and sufficient resources.

While pest animals have many direct impacts, there are also many associated, and often substantial, costs incurred by land managers, such as the ongoing costs of control. As a result, it is critical to design, coordinate and implement control programs with care to reduce the costs of control while ensuring management objectives are achieved. Identifying and targeting areas where pest animals are most problematic, and/or focusing on areas where the affects of control are likely to generate the greatest rewards, are ways to reduce the overall long-term costs of control and sustain maximum benefits to the environment and agricultural production. To evaluate control programs, meaningful information is required on the effects of control interventions. This report presents the outcomes of a state-wide survey using agreed monitoring techniques to collect regional information on pest animals and to address many of these on-going management requirements.

In the years preceding this survey, widespread drought conditions was reported to have altered the distribution and abundance of many pest species, and the way they were managed. This report identifies changes in the pest animal populations and presents recommendations for pest species management.

1.2 Importance for pest animal planning and disease preparedness

The development of effective pest animal plans requires the adoption of best-practice management principles that involves defining the scope of a pest animal problem, the species of concern, their geographic range, appropriate management strategies, and the monitoring of control outcomes (Braysher and Saunders 2007). Management authorities and land managers are currently being urged to adopt best-practice guidelines through assigning pest animal priorities, and by developing management plans through PESTPLAN (Braysher and Saunders 2003). The PESTPLAN framework aims to improve pest animal management and to achieve tangible management outcomes. The survey and mapping of pest animal populations throughout NSW is complementary to this process, enabling land managers to monitor progress, target pest animal populations and measure responses to management practices.

The outcomes of previous state-wide mapping surveys have been used to develop cooperative management programs, disseminate operational funding, prioritise regional pest control activities, and in monitoring the performance of large control programs. This current report builds on previous survey information to deliver improved mapping of pest animals to address these on-going needs, and to identify emerging populations of pest species throughout NSW.

The potential for large-scale exotic disease emergencies involving wild animals remains a concern for wildlife health authorities throughout Australia. The exact roles that wild animals may play in an exotic disease outbreak are uncertain. However, many species (e.g. feral pigs) may potentially act as reservoirs in the maintenance and transmission of exotic disease. Pre-emptive control of wildlife populations in response to perceived exotic disease risks is impractical (Saunders 2001). According to AUSVETPLAN, upon detection of a notifiable disease in Australia, authorities would be required to promptly collate information on the distribution and abundance of susceptible animal hosts and to develop and coordinate an appropriate disease response plan. Previous NSW state-wide mapping surveys address this requirement at a regional and state-wide scale, and this report value-adds to these previous surveys by updating disease-host abundance information.

1.3 Previous surveys and trends in abundance

There have been several state-wide surveys of major pest animals in NSW: 1979, 1985, 1996 and 2002. These surveys have been used to highlight variation in pest animal populations and have produced a generalised assessment of the geographic range of pest species. Foxes and rabbits have been found to be widespread throughout most of the state, while feral pigs and feral goats were mainly concentrated throughout the tablelands and far-western NSW. Wild deer and wild dogs were localised along the coastal and tablelands divisions, but abundant within their range. Populations of wild deer also appeared to be increasing. This report presents additional information to identify trends in the abundance of these species throughout NSW.

1.4 Capturing knowledge through consultation

The most robust methods for measuring the abundance of pest animals involve direct counting of animals using rigorous field sampling techniques, such as spotlight counts and aerial surveys. Although field sampling provides informative and detailed data about the distribution and abundance of wild animal populations, in most cases it is prohibitively expensive and labour intensive, particularly if required for large areas. As a result, alternative (or supplementary) strategies have been developed for broad-scale assessment of wild animal populations, to address information needs and facilitate appropriate planning activities.

This report describes generalised trends in the distribution and abundance of pest animals throughout NSW and the ACT using an innovative and reliable knowledge-based technique. It captures two types of information: information contained within formalised datasets and records wherever available and referred to by land managers, and perception-based information from land managers based on their experiences and observations. This method has been applied in previous NSW surveys (e.g. Hone and Waithman 1979; Croft unpublished 1979; Bryant unpublished 1985; West and Saunders 2003), in Queensland through the Annual Pest Distribution Survey (Qld. DNRW), in Western Australia (Woolnough *et al.* 2005), and very recently in South Australia (Williams, DWLBC, pers. comm. 2006) to report state-wide trends in animal populations. Landholder or land manager knowledge, also referred to as institutional knowledge represents an under-utilised resource for addressing broad-scale management goals (Woolnough *et al.* 2004).

1.5 Climate history and control initiatives

During the previous 5 years, much of eastern Australia has experienced widespread drought conditions. In mid-2004, drought affected areas accounted for approximately 87% of the NSW (source: NSW DPI). These conditions impacted heavily on agricultural enterprises and many rural communities. In response to widespread drought, both the Federal and NSW Governments committed drought relief funds of approximately \$2million to increase the control of feral pigs and foxes in drought afflicted regions (mainly the Western Division). These funds were provided to purchase essential resources to increase control efforts using aerial and ground-based control techniques; to reduce the immediate impacts of these pests on livestock producers; and to take tactical advantage of the drought and reduced and contracted densities of these pests, particularly around permanent water sources. Anecdotal reports indicated that there were substantial declines in these pest animals and their impacts within the areas where control had been conducted. Establishing the scale of reductions was not considered a priority at the time, but was apparent throughout this survey.

2 PROJECT INFORMATION

2.1 Project Title

Pest animal survey: A review of the distribution, impacts and control of invasive animals throughout NSW and the ACT, 2004-2006.

2.2 Collaborating organisations

Rural Lands Protection Boards, NSW Department of Environment and Conservation (National Parks and Wildlife Service), Environment ACT, Game Council of NSW, and Birds Australia.

2.3 Project Aims

Below average rainfall throughout much of NSW in recent years has resulted in the decline in landholder resources available for controlling pest animals. It is important to identify how pest animal populations respond to periods of dry, and to concerted control initiatives which may take advantage of these conditions. It is also important to maintain current information on the distribution and abundance of invasive animals to plan and evaluate specific control activities, and for the allocation of management resources to priority areas. Previous surveys have revealed considerable expansions in the range of some species in NSW, such as wild deer which raises concern that there are emerging pest species throughout the State.

The key aims of this project were to:

1. Identify and highlight any changes in the distribution, abundance, control and impacts of invasive pest animals throughout NSW and the ACT since the previous survey in 2002;
2. Update generalised distribution and abundance maps of invasive pest animals throughout NSW to provide management agencies with a reliable tool to prioritise control programs; and
3. Survey and report on the distribution and abundance of additional pest species of significance in NSW.

2.4 Acknowledgments

We would like to acknowledge the support of the following organisations and individuals for assisting with the collection, collation and reporting of information for this review: 86 Rangers from the Rural Lands Protection Boards; 39 Pest Management Officers and operational staff from NSW Department of Environment and Conservation (National Parks and Wildlife Service); Paul Meek and Robert Madden (State Forests of NSW); Bill Woodruff and Graham Blinksell (Environment ACT); and Brian Boyle (Game Council of NSW). Dean Gilligan (NSW DPI Fisheries) contributed significant information, data and expert knowledge of NSW rivers to assist in European carp mapping. Birds Australia kindly provided detailed records of Starling sightings; and NSW National Parks and Wildlife Service and Arthur White (Frog Rescue Service) provided advice on established cane toad populations throughout NSW. Jo McKiernan and Jessica Gibson (NSW DPI) assisted with mapping, survey coordination and data delivery. This project was funded through NSW Department of Primary Industries and the Invasive Animals CRC.

3 PROJECT DESCRIPTION

The purpose of this report is to provide a synopsis of the distribution, abundance, control and impacts of the major invasive pest animals throughout NSW and the ACT during 2004-06. Results should be considered in combination with the findings of a comparable survey conducted during 2002 (West and Saunders 2003) to elucidate trends in the management of pest animals. This report also provides baseline information from multiple land management agencies which can be used as a guide to prioritising the control and long-term management of invasive animals and their impacts.

3.1 Survey species

There are many established pest animals in NSW and Australia, and many other emerging pests that have potential to cause significant impacts to the environment, economy (particularly primary production) and society. This survey focussed on species of significance in terms of 'triple bottom line' impacts in NSW, and has included both established and emerging pests. The key species that were selected for this survey were: feral pigs (*Sus scrofa*), feral goats (*Capra hircus*), wild deer (consisting of 6 species), foxes (*Vulpes vulpes*), rabbits (*Oryctolagus cuniculus*), wild dogs/dingoes (*Canis lupus familiaris*, *Canis lupus dingo*, and hybrids), feral cats (*Felis catus*), cane toads (*Bufo marinus*), European carp (*Cyprinus carpio*) and European Starlings (*Sturnus vulgaris*).

Many of these pests pose a risk for endemic and exotic disease transmission and some have also been listed as key threatening processes in NSW by the NSW Scientific Committee under the Threatened Species Conservation Act 1995 at the time of report production (Table 1).

Table 1. Listed Key Threatening Processes in NSW under the Threatened Species Conservation Act (1995) (source: NSW Department of Environment and Conservation)

Species	Description of threatening process
Feral Pigs	Predation, habitat degradation, competition and disease transmission
Feral Goats	Competition and habitat degradation
Deer	Herbivory and environmental degradation
Red Fox	Predation
European Rabbit	Competition and grazing
Feral Cat	Predation
Cane Toad	Predation and ingestion of toxin by predators

3.2 Methods

Detailed information about the distribution, abundance, impacts and control of pest animals throughout NSW and the ACT was captured through a two-part survey involving multiple land management agencies. Survey methods applied throughout the survey relied on consultation with Government and non-Government land management agencies in NSW.

3.2.1 Survey Group 1

Survey Group 1 involved a survey during 2004/05 consisting of a questionnaire on the impacts, control and management of invasive animal populations, and a complementary mapping exercise for reporting spatial trends in abundance. This Group contained feral pigs, feral goats, wild deer (consisting of 6 species), foxes, rabbits, and wild dogs /dingoes.

Questionnaire:

During 2004/05 a short mail-out questionnaire was distributed to Rural Lands Protection Boards to obtain information on the impacts, control and management of the above-mentioned pest species in the agricultural region of the state (see appendix 1). The questionnaire was designed to capture knowledge and experience of pest managers, gather information with relative simplicity, and re-address many issues and questions raised during the former survey of 2002. It also contained some outcomes from the 2002 survey to assist participants to make quick comparisons between years. In total, 48 questionnaires were received from experienced pest management staff within the Rural Lands Protection Board Districts, and responses were collated in a centralised database.

Mapping:

Pest animal managers and key representatives from Government and non-Government Agencies responsible for the control of pest animals throughout NSW and the ACT were also approached to assist in mapping the distribution and abundance of invasive animals across the state. The agencies involved in the mapping survey included the Rural Lands Protection Board Districts, NSW Department of Environment and Conservation (National Parks and Wildlife Service), NSW Department of Primary Industries (State Forests of NSW), Environment ACT, and Game Council of NSW.

The Survey was conducted during late 2004 and early 2005. Agencies received local-scale maps (via mail-out) depicting pest animal distribution and abundance (as collated during the 2002 survey), whereby changes in animal abundance, and any new populations of pest animals could be reported. It was considered highly beneficial to provide previous survey results to stream-line the reporting process with participants, particularly where there had been little or no change in pest populations. Where new populations had been detected in recent years, or where changes in populations had been determined, participants reported these changes on the maps provided.

The density/abundance of pest animals was estimated using consistent criteria with that used during previous surveys in NSW (Table 2; and West and Saunders 2003), and also successfully applied in Western Australia (Woolnough *et al.* 2004). The method was developed for field appraisal of pest animal relative abundance, and relies on effective communication of pest animal information from landholders to those involved in the assessment process. Seasonal variations in pest animal populations were not considered in the abundance estimates. It was important to ensure this survey replicated the methodology of the 2002 survey to facilitate comparability of outcomes. Where feasible, this survey involved the same agency staff involved in the 2002 survey. Maps were returned from the various agencies and the data was projected within ArcView GIS (ESRI v.3.2).

In total, 125 land managers assisted in the mapping of survey group 1 species, consisting of 86 operational staff (Rangers) from the 48 Rural Lands Protection Board (RLPB) Districts and, 39 pest management staff from NSW National Parks and Wildlife Service (NPWS), State Forests of NSW, Game Council of NSW, and Environment ACT.

Table 2. Density/abundance criteria for pest animals applied to survey group 1.

Density	Definition
High	<i>Many animals seen at any time and much sign of activity i.e. animals always observed, reliable sightings or otherwise evidence of high abundance. Best described as observing significant evidence of many animals on greater than 80% of occasions.</i>
Medium	<i>Some animals seen at almost any time and/or much active sign i.e. frequent but unreliable sightings of animals. Best described as observing significant evidence of some animals on 50-80% of occasions.</i>
Low	<i>Few or no sightings and/or little active sign i.e. rare sightings / evidence. Best described as observing very little evidence of animals on 1-50% of occasions.</i>
Absent	<i>No animals i.e. very unusual to see evidence of animals. Best described as seeing either no evidence or very little evidence of extremely low numbers of animals on less than 1% of occasions.</i>

3.2.2 Survey Group 2

Survey Group 2 involved a mapping exercise conducted during 2006 to capture spatial information to address emerging pest animal management priorities for four additional species, namely: feral cats; cane toads; European carp; and European starlings. Methods applied to capture and report information on these species varied from survey group 1 (described above). In total, mapping of survey group 2 species involved consultation with 64 operational staff and ecologists, as well as records from a number of spatial databases comprised of records from many field surveys and field observations. Fifty-eight RLPB Rangers contributed to the mapping of feral cats in NSW, and advice was provided by several NPWS staff for selected areas of the State. Starling data was obtained from the Birds Australia database (from records between 1998 and 2006) compiled from the surveys and research of many field biologists/naturalists. Carp data was supplied by Dean Gilligan (NSW DPI Research Scientist) from a database of records obtained during electro-fishing surveys conducted throughout the State by many Fisheries Officers and researchers. Cane toad data was provided by 6 operational staff and ecologists within NSW DEC and independent authorities.

Species specific information for group '2' species was obtained as follows:

Feral Cats

Distribution and abundance information for feral cats was obtained through consultation with the Rural Lands Protection Boards (RLPB's), with guidance from the NSW Department of Environment and Conservation (National Parks and Wildlife Service). Key representatives from these Agencies reporting information regarding the distribution and abundance of feral cats on maps of their respective jurisdiction; a process they were familiar with from involvement in previous surveys. Regional maps showing landscape features and land tenure were produced and distributed to key representatives from the RLPB Districts. Instructions were provided containing criteria for estimating feral cat

abundance using a 5x5 km grid array (see appendix 2). These criteria were modified slightly from other species (Table 2) to account for their elusive behaviour. Maps were returned and data collated within an ArcView GIS database. Representatives from the NSW Department of Environment and Conservation were consulted from various regions to provide additional information. There were no questionnaires used to gather information on feral cats, and this species was not mapped in the ACT.

Starlings

Information on the European starling was obtained from sighting records provided by Birds Australia (between 1998 and 2006) and reported as presence/absence, and an index for density (derived from the reporting rate) was calculated. Birds Australia retains the most accurate database currently available on wild birds throughout NSW (Birds Australia, Atlas of Australian Birds, 1998-2006). They have surveyed many areas of NSW using various field survey techniques, whereby the presence of species has been recorded. The Birds Australia data used for this project was obtained from 4 survey types (from which the outcomes were pooled):

- 2ha searches for 20 minutes;
- Area searches for at least 20 minutes within 500 metres of a central point;
- Area searches for at least 20 minutes within 5km of a central point; and
- Incidental observations.

For more information on field survey design and procedures see the Birds Australia Website: <http://www.birdsaustralia.com.au/>

Data obtained from Birds Australia, was interpolated using ArcView GIS to devise three separate map products:

1) Starling Presence/ Absence map – showing the areas (where surveys had been undertaken) where starlings had been observed in NSW.

2) Starling Density map – showing the abundance of starlings based on the reporting rate (number of observations/ number of independent surveys) for 10' areas (approximately 15km x 18km) of NSW. Abundance was ranked into three categories of high, medium and low based on a reporting rate of 1-33%, 34-66% and 67-100% respectively. In addition, 'absent' was assigned to areas where no Starlings had been observed, irrespective of survey effort. Areas where surveys had not been undertaken in NSW were recorded as unmarked cells on the density map.

3) Survey Effort map – showing 10' areas (approximately 15km x 18km) of survey effort in six categories: 1-20, 21-40, 41-60, 61-80, 81-100% and greater than 100 surveys in a 10' area.

These maps have been produced to represent available information in the most meaningful/interpretable manner.

- Map 1 (Presence/ Absence) was produced to show where starlings were present.
- Maps 2 and 3 need simultaneous examination for accurate interpretation. Starling density has been calculated from reporting rate (which may not always reflect the true abundance of starling numbers in any area given survey effort varies throughout their range). The more surveys or the greater the survey effort, the more reliable the data becomes.
- All maps provide 'snapshots' of the available data on Starlings in NSW.

European Carp

Distribution and abundance of carp were derived from a database of electro-fishing survey records (reported as catch-per-unit-effort) from over 600 stratified sampling sites located throughout the rivers of NSW provided by Dean Gilligan, Research Scientist, NSW DPI. These included many main rivers of the Murray-Darling Basin, rivers throughout the tablelands and slopes regions, coastal rivers and some large lakes/water bodies. These sites were sampled during routine Fisheries surveys between July 2000 and June 2006. Additional information on carp abundance (particularly between sampling localities) were obtained from knowledge of NSW DPI Fisheries staff. The abundance of carp was estimated using an alternative technique to that of terrestrial species, i.e., abundance estimates were based on six years electro-fishing catch-per-unit values (carp caught per hour of electro-fishing) at sample sites (defined as a 1km reach of river).

The following method was used to translate catch-per-unit-effort (CPUE) sampling information to categories for abundance (selected to account for the range and median of CPUE values):

Absent = CPUE less than 1.

Low = CPUE 1-5.

Medium = CPUE 5-50.

High = CPUE 50-500.

All sample point data were courtesy of NSW DPI Fisheries. Data were reported for the main rivers of NSW using 5x5km grid array and projected in ArcView GIS. Where sampling sites were not sufficient to provide a continuous dataset along rivers, the experience and knowledge of NSW DPI Fisheries staff (expert advice) was used to interpolate information (estimate density) between sample points. Ephemeral water bodies and rivers that flow only during infrequent flood events were reported as containing 'no carp' due to widespread drought conditions throughout NSW.

Cane toads

Detailed mapping information on the distribution and abundance of established cane toads was captured through a process similar to survey group 1 species and feral cats. Key representatives from the NSW Department of Environment and Conservation (DEC) (National Parks and Wildlife Service) were consulted to report the distribution and abundance of established cane toad populations using a 5x5km grid array. Abundance categories as described in table 2 were used to estimate the distribution and abundance of cane toads in northern NSW. ArcView GIS was used to record data with background landscape features, land tenure and townships to familiarise survey participants with regions for reporting. Expert advice was also sought from relevant independent authorities throughout NSW, including staff from NSW DPI and the Frog Rescue Service.

3.3 Interpretation of mapping outcomes.

These surveys were based on the best available information at the time of data collection. Certain assumptions have been made in the process, as estimates largely represent the judgement of experts within wildlife management Agencies in NSW in the absence of detailed field survey data. Animal populations also naturally fluctuate with seasonal or reproductive cycles, and are regulated by the availability of localised resources. Many species move large distances, migrate or disperse in response to climatic conditions and

stochastic events. Herein, abundance estimates attempt to capture and accurately represent spatial variation in populations, presenting a 'snap-shot' of the perceived average population abundance throughout NSW.

This survey utilised a 5x5 km grid array (equating to 25km²) to record and collate pest animal information. This reporting resolution size accommodates for the spatial distribution and territorial size of most species, as well as variation in habitats, and units appropriate to the allocation of resources for most control programs. Data for starlings has been presented in a slightly larger size (approximately 15x17 km² grid) due to the origin and collection process of the data.