Distribution and Abundance of Pest Animals in Western Australia

A Final Report to the Wildlife and Exotic Disease Preparedness Program (Projects 5WEDP02 & 3WEDPP04)

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1. EXECUTIVE SUMMARY

Data on the distribution and abundance of selected pest animals were obtained for the state of Western Australia. We used institutional knowledge from the Department of Agriculture (DAWA) and the Department of Conservation and Land Management (CALM) to acquire this important information.

A two-part survey process was used to capture knowledge in 104 face-to-face interviews. The first part of the survey was a questionnaire designed to capture local-area information about pest animals. The second part of the survey, a mapping exercise, was designed to capture information about the distribution and abundance of specific pest animals. The key to the mapping exercise was a set of clear abundance definitions. These nationally recognised definitions enable clear local, regional, state and national comparability of data.

The state was arbitrarily divided into two regions, the agricultural region and the pastoral region. The pest animals considered in the survey differed between the two regions, with all animals being selected on their exotic disease risk. For the agricultural region, pest animals considered included feral pigs, feral deer, feral goats and wild dogs. In the pastoral region, feral donkeys, feral camels, feral horses and feral livestock were also included, in addition to the other four. Overabundant species, such as rabbits, foxes and feral cats were not included in the mapping exercise because of their widespread distribution, particularly in the agricultural region but were included in the questionnaire. Data were collected between November 2002 and November 2003 and therefore only represent a snapshot of the distribution and abundance of pest animals during this period.

Spatial data describing the distribution and abundance of pest animals were collected on a property basis, using underlying data from the DAWA's Client Resource Information System (CRIS). In all, details on pest animal distribution and abundance were recorded for over 40,000 parcels of land across most land tenures. Land tenures included privately owned properties in the agricultural region greater than 10 ha in size, unallocated crown land, reserves managed by the CALM, other government estates and pastoral leases.

The questionnaire part of the survey captured information and experiences of staff from both agencies about pest animal management. Some key outcomes of the questionnaire included:

- Foxes were rated as having the highest triple bottom line impact in the agricultural region. In the pastoral region, DAWA respondents rated wild dogs as having the highest economic and social impacts, and feral cats as having the greatest impact on the environment. Feral cats were also ranked highest by staff from CALM for their impacts on the environment and social values.
- Feral pigs and feral cats were the key species thought to be increasing their distribution and abundance over the previous five years in the agricultural region. DAWA respondents also suggested that there were major increases in the distribution and abundance of foxes, emus and kangaroos in the agricultural

region. In the pastoral region, respondents from both agencies perceived an increase in the distribution and abundance of wild dogs over the past five years. This was matched with a perceived increase in efforts to control wild dogs.

- The key impacts of herbivorous/omnivorous pest animals were generally perceived to be damage to native vegetation, pastures and crops, which then compound issues of soil erosion and damage to watercourses. For carnivorous pests, the key impacts were perceived to be predation of livestock and native animals.
- There appeared to be differences (local, regional and between agencies) in what techniques were used to control pest animals and their perceived effectiveness. Having a list of standard operating procedures for the control pest animals may be required. However, these would need to be specific to the Western Australian conditions and legislation, and be supported with solid research evidence.
- There is scope to improve the knowledge of staff from both agencies about exotic disease preparedness, including what role staff may play in an emergency animal disease.

The mapping exercise proved to be a cost-effective means of describing the distribution and abundance of pest animals in Western Australia. Important features of the data include comparability across scales (local, region, state and national) and the ability to identify areas of high disease risk or in need of applied pest animal management. However, these data may not be suitable to determine animal abundance at the scale of an individual property, without additional ground-truthing. Furthermore, because the data relies on the existing knowledge of agency staff, there may be some temporal variability associated with that knowledge. That is, the distribution and abundance of pest animals is always changing, and therefore captured data only represent only a single point in time. Another issue that we encountered was how to report the data. Because the data were associated with property boundaries, we needed to deconstruct the data into 10 km^2 grid cells because of privacy constraints. The process of deconstruction eliminated any privacy issues while retaining the integrity of the underlying data. Despite a few minor shortcomings which may be overcome with future refinement of the technique, this approach adds significant value to the institutional knowledge of both agencies about the distribution and abundance of pest animals in Western Australia.

2. RECOMMENDATIONS

A National Approach

- We recommend the national adoption of the process outlined in this report as a system for mapping the distribution and abundance of pest animals. This system is easy to apply and simple to interpret. It also has data outputs that are spatially comparable at different scales (local, state and national). This system can also provide tools for both pest animal management and exotic disease preparedness. However, the first steps to a national adoption of this system are uptake and utilisation of the data by our agency, and recognition of this approach by similar state and national agencies.
- Examination of the data, and consequent value adding, has reinforced the proposition that pest animals potentially could play a very important role in exotic and endemic disease maintenance and transmission. Empirical data is required to support our data and speculations about the role of pest animals and disease, particularly multi-species interactions.

Data Management

- Mapping distribution and abundance of pest animals be done on a land tenure basis to add value to existing client-based corporate data sets. Reporting of distribution and abundance should be on a grid cell basis to circumvent privacy issues.

Exotic Disease Awareness

- Results from our questionnaire revealed that staff from both DAWA and CALM may benefit from endemic and exotic disease awareness training. This is not a shortcoming of any particular agency. Rather, our approach allows identification of the issue.

Refinement of methods

- The current approach can benefit from further fine tuning of this proven approach. Refinement needs to occur in two areas: the questionnaire and the mapping data. For the questionnaire, areas that could benefit from refinement include better methods to analyse and interpret data, re-wording of any ambiguous questions (e.g. disease may need to be more specifically defined as plant or animal), and the incorporation of questions on the social impacts of pest animals. In the mapping exercise, development is needed to obtain consistent results between interviewers and respondents. Refinement of the mapping data is also required to develop a system that adequately defines spatial variability in overabundant species (e.g. foxes).

Application to local pest animal managers

- Some extra investigations are required to determine how easy this approach will be to investigate local-scale pest animal problems (e.g. by Natural Resource Management (NRM) groups or local government organisations). More importantly, the technique needs to be refined so that end-users can use the data to measure the success and/or failure of control programs (i.e. be sensitive enough to detect changes in overabundant populations following control operations). For example, a community baiting program may reduce the pest animal population by 70% but the abundance, according to our definitions, may remain high. In real terms, the baiting campaign was successful, but our scale of abundance may not have the sensitivity to measure this change. This becomes important if the current approach is used for outcome reporting.

Long-term trends

- By repeating these surveys at regular intervals (e.g. every five years), temporal changes in the distribution and abundance of pest animals may be detected. Furthermore, the face-to-face interview process becomes a valuable capacity building exercise and facilitates the exchange of information, which is always encouraging.

3. INTRODUCTION

3.1 Background

The impacts created by pest animals such as feral goats, feral pigs, feral deer and foxes impose significant costs on Australia's environment and economy. These animals also potentially act as important reservoirs in the maintenance and transmission of exotic and endemic diseases (e.g. foot and mouth disease, rabies, footrot etc.). Reliable assessment of the abundance and distribution of animal pests is, therefore, a vital precursor to developing and implementing of effective pest animal management strategies.

Understanding the distribution and abundance of animal populations is important for many reasons. Perhaps two of the most important uses of these data are for risk assessments (hazard identification, risk assessment, risk management and risk communication; Black 2002, Bomford 2003, West and Saunders 2003) and triple bottom line management and accountability (social, environmental and economic values). More specific outcomes of describing the distribution and abundance of animal populations may include identifying areas where pest animals are having or could have detrimental impacts on agriculture or biodiversity, identifying areas of potential disease risk, or identifying management successes or deficiencies.

3.2 Exotic Disease Preparedness

The Management Manual for Mapping in the AUSVETPLAN (AUSVETPLAN 1999) identified the mapping capabilities of an agency, both physical and electronic maps, as a vital component of exotic disease preparedness. To be a useful decision making tool, the information needs to be current and have useful spatial information associated with it (i.e. information on ownership and property boundaries). Crucial to the mapping capabilities is having up to date information on ownership and property boundaries.

As a general tool for decision making, mapping the abundance and distribution of pest animals can assist with exotic disease preparedness. A sound map for pest animals can provide background information for preparedness strategies and risk assessments. It can also provide useful information during an outbreak by identifying what wildlife species are *likely* (since wildlife populations are stochastic) to be in the vicinity of the infected premise, and therefore deciding whether the Wild Animal Management Manual (AUSVETPLAN 2000) requires to be initiated and in what capacity.

3.3 Our Approach

3.3.1 Institutional Knowledge

One of the most cost-effective ways of describing pest animal populations is to capture local knowledge of appropriate staff from organisations such as government departments (i.e. institutional knowledge). In the past, this approach has been used successfully, at state and national scales, to describe the relative abundance and distribution of pest animals (e.g. Mitchell *et al.* 1982, Wilson *et al.* 1992, West and Saunders 2003). This project used a similar approach, with a two-part survey and mapping exercise.

Distribution and abundance data captured in this project represents the corporate knowledge of the Western Australian Department of Agriculture (DAWA) and Department of Conservation and Land Management (CALM). It represents the knowledge of operational staff and could be considered as both an asset and a resource for describing the distribution and abundance of pest animals.

3.3.2 The Spatial Framework – Client Resource Information System

As described above, the key to the success of any database/mapping tool for decision making is the currency of the information and having appropriate spatial information (e.g. property ownership and boundaries). DAWA has developed such a system to centralise, integrate and manage information collected by staff. The information system captures data with a client and a property-based component with an activity or an event variable. This client-property-event information system has been developed into the Client Resource Information System or CRIS. CRIS integrates all of the DAWA's dealings with agricultural properties and links them with specific databases. Underlying CRIS is the DAWA's spatial resource information. It is the aim of this project to utilise the DAWA's spatial resources and produce CRIS-compatible data at the end of the project.

3.4 Pest Animals of Interest

The primary aim of the project was to collect information on the distribution and abundance of key pest animals in Western Australia. In the agricultural region, the pest animals of interest were wild dogs, feral goats, feral deer and feral pigs. When the project was expanded to include the rangelands, feral camels, feral donkeys, feral horses and feral livestock were added to the list of pest animals of interest. These animals are important from perspectives of exotic disease (see Wild Animal Management Manual, AUSVETPLAN 2000), and economic, social and environmental values. Other pest animals, such as the fox and rabbit, may be considered just as important, but we have not attempted to describe their distribution and abundance because of their relative commonality. However, for completeness of our survey approach, information was also obtained during the interview process for these more common pest animals. This was extended to overabundant native species (e.g. kangaroos and emus) which are sometimes considered pests by DAWA staff.

3.4.1 Statewide Pest Animals of Interest

<u>Feral Pigs</u>

The feral pig (*Sus scrofa*) is listed by the World Conservation Union (IUCN) as being one of the worst 100 invasive species (Lowe *et al.* 2000). This list includes micro-organisms, plants (land and aquatic), invertebrates (land and aquatic), fish, amphibians, reptiles, birds and mammals. Pigs were first introduced into Australia by Captain Cook and then with the First Fleet, with feral populations subsequently becoming established (Choquenot *et al.* 1996).

Feral pigs are often singled out for their potential role in an exotic disease outbreak (e.g. Pech and Hone 1988, Pech and McIlroy 1990, AUSVETPLAN 2000, Anon 2001, Dexter 2003). They are highly susceptible hosts to a number of virulent exotic diseases, including foot-and-mouth disease, and are generally viewed as a high risk species. They are also implicated in the spread of some significant endemic diseases including leptospirosis and Murray Valley encephalitis. Ecologically, they are major environmental and agriculture pests around Australia (Choquenot *et al*. 1996). Their economic impact is estimated to be $107 million per year in losses of agriculture production and cost of control (McLeod 2004). Even though feral pigs are largely seen as a feral pest, they also have value as a commercial resource (Choquenot *et al.* 1996, Forsyth and Parkes 2004).

Feral Goats

Feral goats (*Capra hircus*) are one of 14 mammal species in the list of 100 worst invasive species (Lowe *et al.* 2000). They arrived in Australia as a stock animal with the First Fleet in 1788 (Parkes *et al.* 1996). Feral goats demonstrate remarkable flexibility in the climatic variables that they can tolerate. In Australia, feral goats are present in all states and Territories, with the exception of the Northern Territory (Parkes *et al.* 1996). Another feature of their success as a pest is their catholic food habits. They are generalist herbivores in their food preferences, eating both grass and browse depending on its nutritional quality (Dawson *et al.* 1975, Parkes *et al.* 1996). The impact of feral goats is complicated. On one hand, feral goats contribute to the damage of soils and land degradation, and through competition, they negatively impact on some native mammal species and vegetation communities (Biodiversity Group Environment Australia 1999b). On the other hand, feral goats can contribute significantly to economic viability of pastoralism through sustainable harvests (Forsyth and Parkes, 2004). In terms of exotic disease potential, feral goats are also a high risk species, particularly in relation to foot and mouth disease (Parkes *et al.* 1996, AUSVETPLAN 2000). Feral goats also pose risks for endemic diseases such as footrot.

Feral Deer

Three species of deer have established pest populations in Western Australia (Long 2003). They are fallow deer (*Cervus dama*), red deer (*Cervus elaphus*), and rusa deer (*Cervus timorensis*).

The red deer is also in the list of top 100 invasive species (Lowe *et al.* 2000). It was introduced to Australia as early as 1860 and liberated in Western Australia around 1899 (Long 2003).

Fallow deer are considered to be the most widespread and numerous of the deer species introduced to Australia (Moriaty *et al.* 2001). Fallow deer were introduced to Australia in 1829 (Tasmania) and to Western Australia in 1899 (Long 2003).

The rusa deer, a native of the Indonesian archipelago, was introduced to Australia in the second half of the nineteenth century (Long 2003). In Western Australia, they were released in 1899 and Long (2003) suggests that they failed to become established in Western Australia. However, recent evidence (Sporting Shooters Magazine, November 2003) suggests that feral populations are present in the south-west of Western Australia.

The early introductions of these three species of deer were generally unsuccessful. However, in the last decade there has been increased concern about feral populations of these three species becoming widely established in Western Australia. The main causes for concern about establishment potential are escapes from deer farms and deliberate releases for hunting (Long 2003).

For the purposes of this project, all three species have been pooled together because identifying species from tracks, signs, descriptions or brief observations may be difficult. Also, in terms of management in Western Australia, deer are generally classified generically rather than as separate species.

From an exotic disease perspective, feral deer pose significant risks for the maintenance and transmission of diseases such as foot and mouth disease (AUSVETPLAN 2000). Deer also pose risks for the maintenance and transmission of endemic diseases, including footrot. Their cryptic habits make them difficult to detect, which may be a major problem in a disease outbreak. In terms of damage, in high densities feral deer can significantly impact on vegetation communities and agricultural practices (Moriaty *et al.* 2001).

Wild Dogs

The term “wild dogs” encompasses to dingoes (*Canis lupus dingo*), feral dogs (*Canis lupus familiaris*) and their hybrids (Fleming *et al.* 2001). Our survey process attempts to separate ‘wild dogs’ from ‘dogs at large’ or ‘town dogs’ (i.e. free ranging dogs that live in and around towns). Wild dogs are found throughout much of mainland Australia, with the possible exception of areas with high value crop production where potential prey items, such as livestock, are limited. In South Australia, the distribution of wild dogs is also limited by a dog-proof fence (Fleming *et al.* 2001). Wild dogs are a pest of agriculture, particularly of agricultural enterprises involved in the production of sheep and cattle. They are estimated to cause losses of $48 million per year, with an additional $10 million spent on infrastructure to prevent wild dog attacks (e.g. dog fence; McLeod 2004). Exotic disease risks for wild dogs are similar to other canids, and they are susceptible to rabies, Aujesky’s disease (pseudorabies), screw worm fly and transmissible gastroenteritis (AUSVETPLAN 2000).

Foxes

The European red fox (*Vulpes vulpes*) is another pest listed in the top 100 worst invasive species (Lowe *et al.* 2000). Found extensively in the southern two thirds of Australia, the fox is a major pest of agriculture and is viewed as a significant threatening process for native fauna (Saunders *et al.* 1995, Biodiversity Group Environment Australia 1999a, Long 2003). In terms of economic impact, McLeod (2004) predicted that the cost of foxes was nearly $228 million per year.

The fox became established in Australia by the mid-nineteenth century, with its spread closely linked to the spread of the rabbit (Long 2003). The first reports of foxes in Western Australia were in 1911 (Long 1988). In terms of exotic disease, the fox is susceptible to rabies, Aujesky’s disease (pseudorabies), screw worm fly and transmissible gastroenteritis (AUSVETPLAN 2000).

Rabbits

The European rabbit (*Oryctolagus cuniculus*) was introduced to Australia in 1788 with the First Fleet (Long 2003). In Western Australia, rabbits may have been present on offshore islands as early as 1806 (Long 1988). Subsequent reports suggested that they had become established around the settlement of Perth by 1842 (Long 1988). However, these early reports may have been associated with domestic rabbits, with Long (2003) suggesting that the mainland population of wild rabbits largely originated from an introduction of 24 wild rabbits near Geelong in 1859, whose descendents arrived in Western Australia around 1894.

Rabbits are a low risk species, in terms of exotic disease. Their major impact is as a pest of agriculture and the environment (Williams *et al.* 1995). It is suggested that they cost the agricultural sector $113 million per year (McLeod 2004).

3.4.2 Rangeland-Specific Pest Animals of Interest

Feral Camels

One-humped camels, or dromedaries (*Camelus dromedarius*), were first introduced to Western Australia in 1839 (cited as Ogle 1839, by Long 1988) as a beast of burden. Camels played an important part in the establishment of pastoralism in Western Australia. They became established as a feral animal through escapees from captivity and deliberate liberations in the 1920s and 1930s when their role in pastoral transport was replaced by motor vehicles (McKnight 1969, Long 1988, Edwards *et al.* 2001). Feral camels are believed to cause negative impacts on native vegetation communities (Dorges and Heucke 1995, Edwards *et al.* 2001) and are known to damage pastoral infrastructure (fences, watering points etc., Short *et al.* 1988). In terms of exotic disease potential, they are susceptible to many of the diseases other ruminants, including foot and mouth disease.

Feral Donkeys

The donkey, *Equus asinus*, was introduced to Australia in 1866 as a draft animal (Long 2003) and to Western Australia in the late nineteenth century (Long 1988). As for camels, the role of donkeys in the operation of pastoral enterprises was superseded by the motor vehicle in the 1930s. Donkeys were released from captivity and subsequently established feral populations (Long 1988). By the 1950s, the feral donkey populations in Western Australia had become a significant problem to pastoralism, particularly in the Kimberley and parts of the Pilbara (Long 1988). More recently, control work by the DAWA has significantly reduced the population of feral donkeys by using the ‘Judas technique’.

The main impact of feral donkeys is pastoral degradation (Choquenot 1988). As an exotic disease risk, feral donkeys are susceptible to African horse sickness, equine influenza, rabies, screw worm fly, and vesicular stomatitis (AUSVETPLAN 2000).

Feral Horses

The horse, *Equus caballus*, was introduced to Australia with the First Fleet in 1788 and by the 1820s a horse-based industry had become established (Long 2003). Through escapees and deliberate releases, feral populations of horses became established (Wilson *et al.* 1992, Long 2003). Feral horses are considered to be both environmental and agricultural pests, with their main impacts being on the vegetation community (primarily pastures) and damage to fences and watering troughs (Dobbie *et al.* 1993). Like the feral donkey, the feral horse is susceptible to a number of exotic diseases including African horse sickness, equine influenza, rabies, screw worm fly, and vesicular stomatitis (AUSVETPLAN 2000). However, unlike the feral donkey, the feral horse is also at risk of Japanese encephalitis (AUSVETPLAN 2000). This is of concern because the highest densities of feral horses are found in northern Australia (Dobbie *et al.* 1993), the highest-risk area for this disease.

Feral Cattle

Feral cattle could equally be called ‘wild domestic cattle’ (Long 2003) or unmanaged cattle. Feral cattle are either *Bos taurus* or *B. indicus* (Brahman or Brahman crosses) and are generally only found in the pastoral areas of Australia (Long 1988, Long 2003). Mitchell *et al.* (1982) estimated that 8% of cattle in northern Queensland were probably feral.

Feral cattle can impact on native vegetation communities through grazing, browsing, trampling and camping (Long 2003). They are susceptible to all of the diseases, both endemic and exotic, that domestic cattle can contract. However, there are increased risks associated with feral cattle and disease management because they are unmanaged.

Feral Sheep

For the purpose of this study, feral sheep (*Ovis aries*) were defined as any sheep that eluded muster for more than 12 months or roamed onto conservation properties (i.e. unmanaged). The category of feral sheep included Australian merinos but was primarily aimed at gaining baseline information about exotic breeds of sheep before they potentially become a major pest of the rangelands.

There are eight exotic breeds of sheep in Western Australia (Awassi, Karakul, Damara, Dorper, Afrikaner, Namaqua, South African Meat Merino and Dohne Merino). The first of these exotic breeds were introduced to WA in the mid-1980's, however the farming of these breeds was relatively restricted until recently. The most significant introduction of an exotic sheep breed came in 1996 when the Damara was introduced to WA. Like most of the exotic sheep breeds, the Damara originated in Africa where it was developed in the harsh semi-arid and arid conditions of south-west Africa. Its advantages over other breeds of sheep include minimal animal husbandry (i.e. no shearing/crutching required), high reproductive potential, low food/nutritional requirements and low water demands. While highly profitable, the Damara has a general disregard for fences and shares many of the traits common to feral goats rather than traditional Australian merino flocks. Therefore, this exotic breed of sheep has high potential for establishing feral populations in the near future. Its disregard for fences and ability to survive without animal husbandry are characteristics that make it a high risk species in terms of pest potential, particularly disease transmission and maintenance risks. At the very least, it is a "sleeper species" in terms of being a critical vertebrate pest for the Australian rangelands.

3.5 Distribution and Abundance

It is important to acknowledge from the outset that not all descriptions of distribution and abundance are equal or necessarily describe the same information. Distributions and abundance measurements vary according to how the data were collected (e.g. subjective data versus systematic data, and structured versus unstructured) and generally only represent a snapshot in time. How the data were collected, and then used, creates a suite of issues about reliability, accuracy and sensitivity of the data. Clearly, a systematic and structured (i.e. where animals are physically counted) approach is the optimum way to describe animal distribution and abundances. However, this may often be cost- prohibitive, particularly when documenting distributions and abundances at a state level.

Our structured but subjective methodology is a cost-effective and reliable approach for exotic disease preparedness and pest animal management. The main advantage of our approach is comparability of data across regions (e.g. comparing distribution and abundance between areas within a state or even between states). However, we caution from the beginning that the approach may not be sensitive enough to address fine scale or temporal issues without additional work. Nonetheless, this approach is an extremely valuable and powerful management tool.

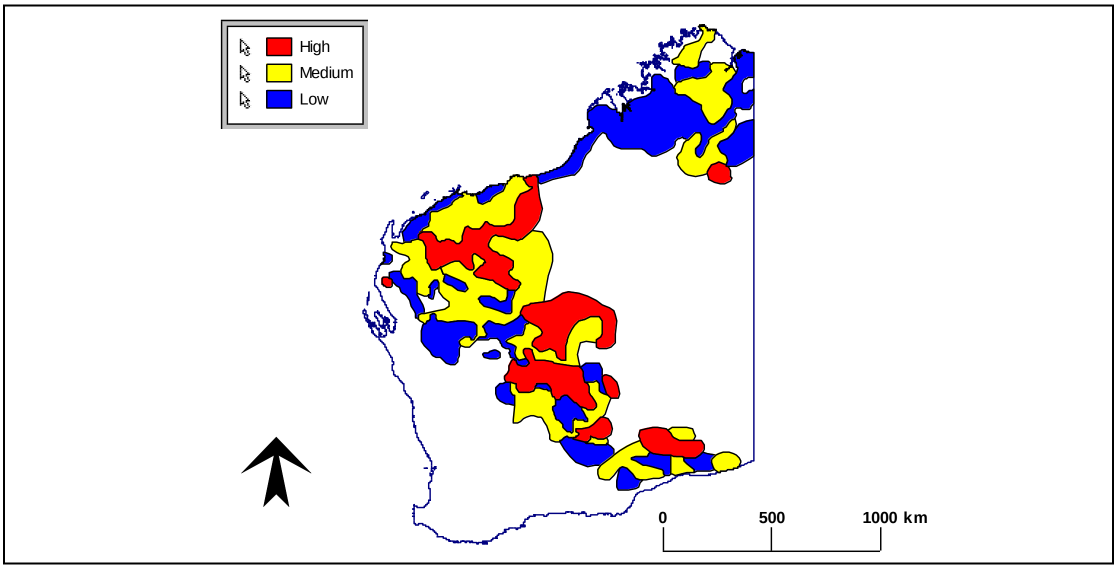
4. METHODS

4.1 Preliminary Survey and Mapping Exercise

The work described in this report was predated by a preliminary survey and mapping exercise undertaken in 2001-2002 to determine the abundance of large pest animals (wild dogs, feral pigs, emus, feral goats, feral donkeys and feral camels) in the rangelands of Western Australia (Woolnough *et al.* 2002). The primary aim of the preliminary mapping exercise was to complement long-term aerial survey data (for kangaroos, feral goats, feral donkeys, feral camels and emus) for the southern rangelands of Western Australia.

The preliminary survey succeeded in documenting the distribution and abundance of these pest animals, but it also encountered the critical problem of perception bias. Perception bias occurs when the data is weighted one way or the other based on personal interpretation or perception.

Figure 1. Perceived distribution and abundance of wild dogs in the rangelands of Western Australia, from preliminary survey data.



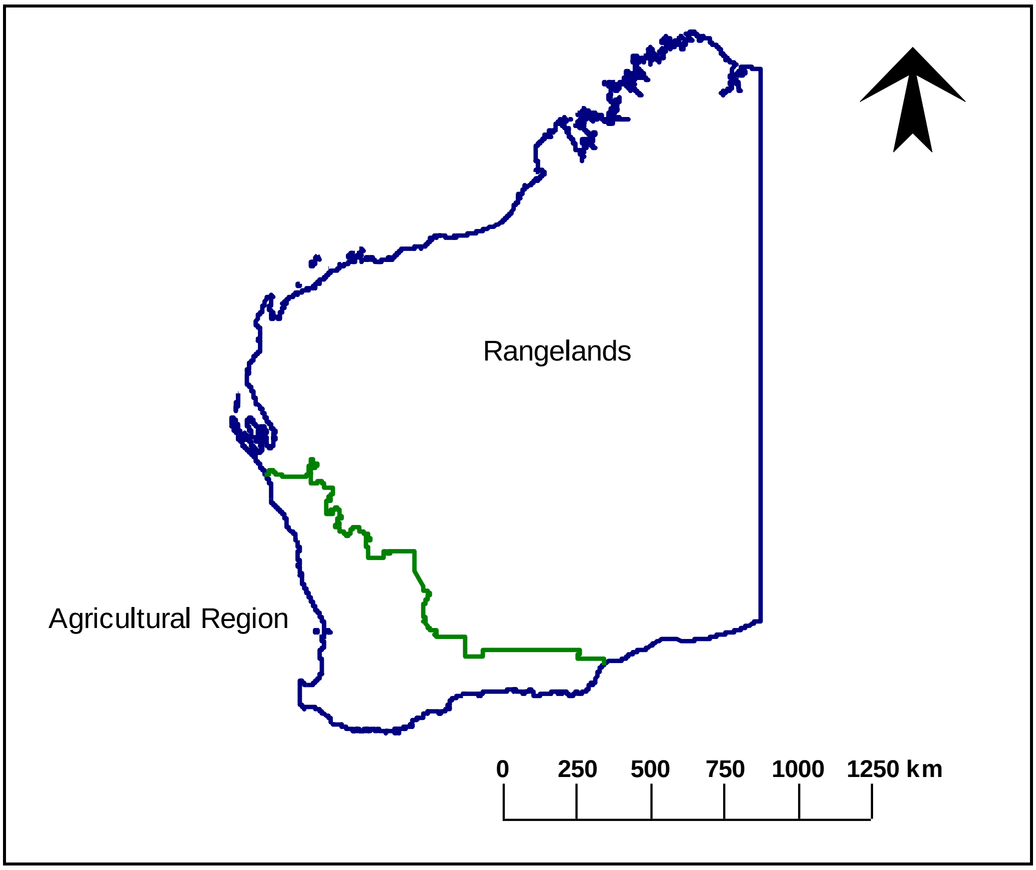
In the preliminary survey we conducted a series of mail-out interviews to biosecurity staff of the DAWA. Each staff member was asked to rate the abundance of pest animals on pastoral leases with which they were familiar. The ratings were categorised as either ‘high’, ‘medium’ or ‘low’, for each pest species. These rating categories did not have an accompanying set of definitions, so it was up to each individual to decide what each category represented. Even though this rating system successfully described the general distribution of the pest animal, the rating system suffered from perception bias when describing abundance. For example, when we examined the distribution of wild dogs in the rangelands (Figure 1), we found that the areas of ‘high’ abundance predominantly occurred in the southern rangelands. Conversely, areas such as the Kimberley generally had ‘low’ perceived abundances. This was an unexpected result, and may have been indicative of some level of perception bias. The density of wild dogs in the Kimberley is likely to be equal to or greater than the density of wild dogs in the southern rangelands. What differs between the southern rangelands and the Kimberley is the impact wild dogs have on each community, and therefore how they are perceived. A survey participant in the southern rangelands can clearly identify pastoral leases with high wild dog problems (i.e. stock losses and injury), but this may not necessarily equate to high abundance of wild dogs. Clearly, a standard set of definitions was required to define measures of abundance and reduce perception bias.

4.2 Survey Methods

4.2.1 A Statewide Approach

Western Australia can be arbitrarily divided into the agricultural region or the south-west, and the rangelands (interchangeably referred to as the pastoral region in this report, though it encompasses much more than pastoral leases and should technically be referred to as the rangelands; Figure 2). The regions can be distinguished by climate, land use and primary production.

Figure 2. The two survey regions, the agricultural region and the rangelands (often referred to as the pastoral region).



Our approach was to capture data from the agricultural region and the rangelands in two separately funded exercises, with data combined to produce a Statewide picture of the distribution and abundance of pest animals. To capture the data, we used a two-part interview approach (detailed below). This closely followed the approach of West and Saunders (2003).

Over a 13-month period, 104 interviews were conducted with staff from DAWA and CALM (see Appendix 1 for complete list of participants). Data from the agricultural region (71 interviews; 53 from DAWA and 18 from CALM) were collected from

November 2002 to July 2003 and data from the rangelands (33 interviews; 20 from DAWA and 13 from CALM) were collected from August 2003 to November 2003.

4.2.2 Interviews

The first part of data collection was to engage participants in a face-to-face questionnaire-based survey. The questionnaire was designed to capture information on the perceptions, attitudes and experience in pest animal management for each of the survey respondents. The structured interview was specifically based around the questionnaire survey of West and Saunders (2003). With the assistance of Peter West (NSW Department of Primary Industries), their questionnaire was slightly refined and also made specific for Western Australia and each agency. Appendix 2 details a complete questionnaire for participants from DAWA based in the rangelands. Refinement was necessary because of potential ambiguities identified by Peter West and because of differences in pest animal management practices between each of the states and each agency.

The questionnaire, taking between one and two hours to complete, focussed the attention of the respondent on pest animals in their area. The interview process also became an important capacity-building exercise between the interviewer and interviewee. It also facilitated good information transfer prior to the mapping exercise and reduced the risk of perception bias during the mapping exercise through its structured and focussed approach. Importantly, the structured approach also allowed the interviewer to collect consistent and comparable data from many interviewees.

4.2.3 Mapping Exercise

The second part of the exercise required the respondent to describe the distribution and abundance of each pest species in their region. To facilitate this process, background maps of the respondent's district or region were produced (with the GIS package Geomedia) and used as reference maps. These maps included all property information available through CRIS. The respondent was then asked to identify the distribution of pest animals and their abundance using the definitions in Table 1.

Table 1. Abundance definitions for the pest animal surveys.

Density estimate	Definition
High	Many animals seen at any time and much sign of activity, that is, animals are always observed, sightings are reliable or otherwise evidence of high abundance.
Medium	Some animals seen at almost any time and/or much sign of activity, that is, frequent but unreliable sightings of animals.
Low	Few or no sightings and/or little sign of activity, that is, rare sightings/evidence of animals.
Absent	No animals, that is, very unusual to see evidence of their presence.
Unknown	Unknown - Unsure, no data, no information.
	Unknown - Impression of low pest density.
	Unknown - Impression of medium pest density.
	Unknown - Impression of high pest density.

Central to the success of the mapping exercise and the project is the definitions in Table 1. These definitions, originally defined by the New South Wales Rural Lands Protection Board and refined by West and Saunders (2003), are an important mechanism for comparability of data across areas (local, regional, state and national). The relative simplicity of the definitions allows quick and convenient categorisation of the subjective data collected in the mapping exercise. At the same time, the definitions provide a rigid framework against which potential perception biases are minimised.

4.2.4 Data Management

Data from the questionnaire were stored and analysed in MS Access databases and MS Excel spreadsheets. Data from the mapping exercise were also stored in MS Access databases, with spatial information added in the geographic information system (GIS) package Geomedia. The construct of the spatial databases (or warehouses) conformed to those used in DAWA's CRIS.

Five spatial data sets were used to create the maps and underlying spatial databases. These data sets (Table 2) accounted for most land ownership across Western Australia, with the exception of some indigenous land-holdings. These land-holdings include freehold and leasehold properties, national parks and reserves, forestry estates and unallocated crown land. It is important to note that some properties (e.g. national parks) are made up of more than one land parcel or titled allotment. Where appropriate, all parcels within the property were given the same score.

Table 2. Number of land parcels used in the spatial databases.

Land Parcel Description	Number of Parcels	Region
Privately Owned Properties in the Agricultural Region (greater than 10 ha in size)*	19,411	Agricultural Region
Unallocated Crown Land	13,594	Statewide
CALM Reserves	8,368	Statewide
Other Government Estates	4,714	Statewide
Pastoral Leases	512	Pastoral Region

* Note that at the time of creation, this dataset was incomplete. There was more than this number of properties in the agricultural region.

4.2.5 Data Presentation – A Major Stumbling Block

Maps are clearly the most informative method of presenting the distribution and abundance data. Since our data are collected on a land parcel basis, the easiest way to present the data is as land parcels. However, we discovered during the reporting process that publicly presenting data on a property basis (through a report, presentation etc.) may have some implications regarding privacy. Instead of reporting on individual land parcels, we subsequently transformed the data to 10 x 10 kilometre grid cells, using Geomedia. This method of reporting the distribution and abundance makes comparisons between New South Wales and Western Australia easier because this is how West and Saunders (2003) presented their data. Despite the change in our presentation method (from a property basis to grid cells), the underlying data still remains on a land parcel basis, which is an extremely useful tool for DAWA.

4.2.6 Caveats

This approach is just one way of describing animal distribution and abundance. The value of the survey is in providing relatively quick, cheap, reliable information on the distribution and abundance of pest animals at the scale of a state. The capacity-building exercise of the survey process also captures the considerable skill and knowledge of pest animal management by staff from both Departments. However, the methods rely heavily on personal knowledge and consistency in interpretation of the survey questions and definitions by the respondent, which may not necessarily be guaranteed. Likewise, results and data represent only a snapshot in time of the respondent's knowledge. Animal populations can fluctuate widely and therefore may not necessarily represent current distributions and abundances. Changes in personnel and job descriptions (from largely field-based operators to office-based information providers) can also limit the currency of the information. All of these perceived limitations can be overcome with appropriate localised ground-truthing of data, using alternative survey techniques, where necessary.

5. SURVEY RESULTS AND DISCUSSION

As described above, the questionnaire and mapping exercise used essentially the same framework as the New South Wales pest animal survey (West and Saunders 2003). To aid any comparisons between the New South Wales data and our data, we have adopted the West and Saunders (2003) reporting format and have presented and discussed our results in a similar manner.

5.1 Background Survey Information

It is perhaps important to note that the questionnaires were not meant to be a 'test' of experience or knowledge. We did not view the structure of the questionnaire as a means of gauging experience or reliability of their assessment. Instead, we have viewed the questionnaire as a capacity-building exercise, which has strengthened intra and inter-department cooperation, while providing us with the means to document the distribution and abundance of pest animals in WA. We have also made the general assumption that the quality of information provided was equal between respondents and that the information was accurate at the time of collection.

5.1.1 General Information

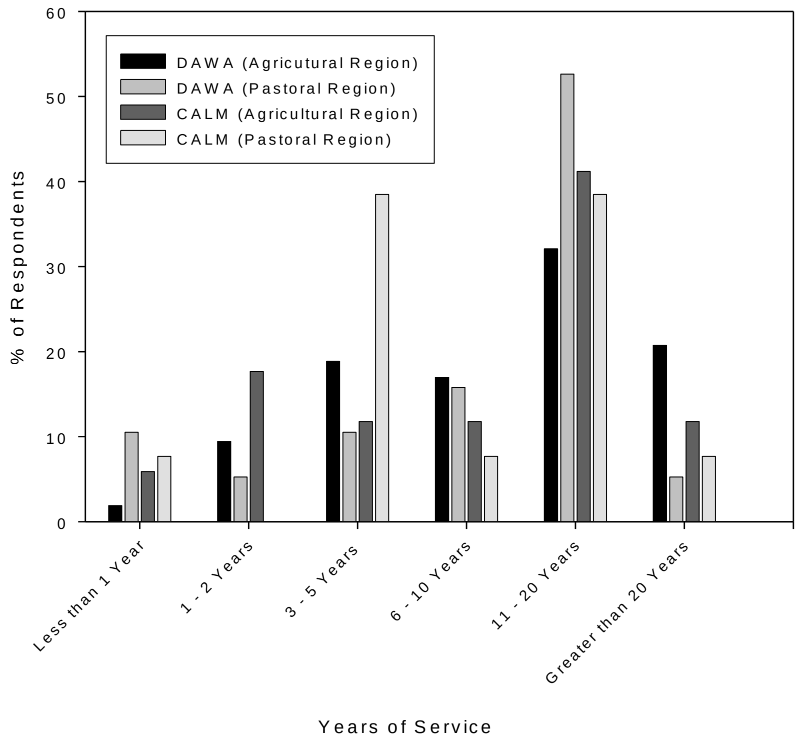
Participants

The first section of the questionnaire (Part A; Appendix 2) captures general information about the respondent. It provided us with a brief overview of general localities that the respondent was familiar with, some indication of their length of service with their respective Department, and some indication of general pest animal issues in their area.

A total of 104 interviews were conducted across the state. Staff from DAWA were the prime source of data (73 interviews; 53 in the agricultural region and 20 in the pastoral region) but significant contributions were also made by staff from CALM (31 interviews; 18 in the agricultural region and 13 in the pastoral region). Full details of participants can be found in Appendix 1. The questionnaires of all respondents (with the exception of one) were used in the analysis. The excluded questionnaire was one from a DAWA staff member in the pastoral region and it was excluded from the analyses because the interview process was viewed to be inconsistent compared to the other interviews.

More than 50% of the participants have worked in the field of pest animal management for their respective Departments for more than 6 years (Figure 3). The largest category of respondents for both DAWA and CALM was the category of 11 to 20 years. This suggests that the workforce involved in pest animal issues for both Departments is very experienced. It also could suggest that there could be potential succession planning issues in the near future because of the unevenness of the length of service structure within both Departments.

Figure 3. Length of service that the respondents have worked in the field of pest animal management for their respective Departments and regions.

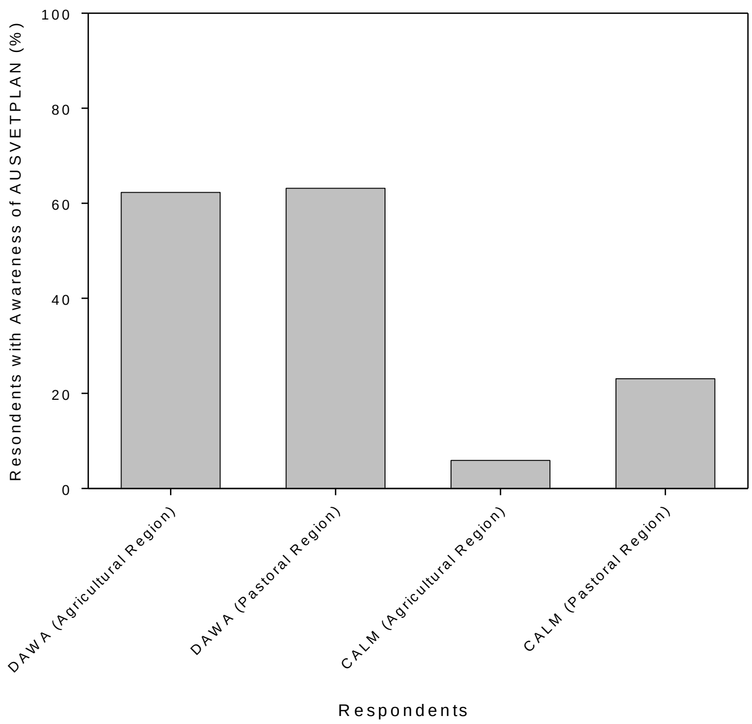


AUSVETPLAN

As this project has an exotic disease preparedness focus, we asked participants about their awareness of the AUSVETPLAN (A3; Appendix 2). As described above, the aim of the exercise was not to specifically test the knowledge of the respondent. Instead, this question was aimed at assessing whether the AUSVETPLAN was being promoted successfully by DAWA and CALM. It is important to note that this question was specifically about awareness and not about the content of the AUSVETPLAN, as these are clearly two different concepts. We believe that awareness of the AUSVETPLAN, by default, implies an awareness of exotic disease potential and preparedness, although we acknowledge that this may not be mutually inclusive. In terms of the Wildlife Animal Management module of AUSVETPLAN, many of the respondents would likely be key operational personal, and therefore some awareness of this situation should be part of their ongoing training.

Awareness of the AUSVETPLAN (Figure 4) by biosecurity staff within DAWA may be adequate, with about 60% of respondents being aware of the Plan. There is definitely scope to improve the awareness through appropriate training programs, and this should become a priority for DAWA. However, it is perhaps of some concern that the awareness of the AUSVETPLAN among CALM staff is limited (as little as 6% of CALM staff in the agricultural region). This suggests that the awareness and preparedness for exotic diseases is generally low within this agency. CALM's greatest priority for pest animal management is the protection and conservation of biodiversity. However, since feral animals occupy CALM managed land (including unallocated crown land), the risks and responsibilities associated with animal disease management perhaps should be considered in management strategies.

Figure 4. Affirmative awareness of the AUSVETPLAN by respondents.

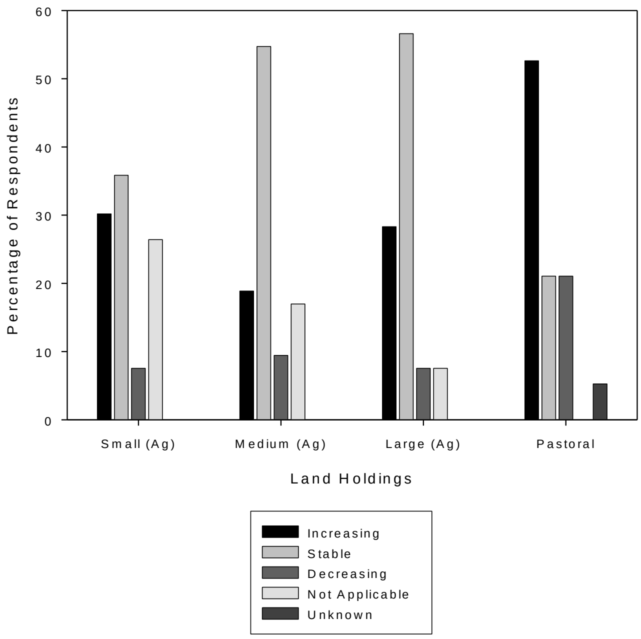


Perceptions of Pest Animal Impact

In the agricultural region, respondents from DAWA suggested that impacts of pest animal on agricultural properties were generally stable or increasing (Figure 5). It is interesting to note that in the agricultural region the increasing impact of pest animals was most often reported for small land-holdings. This could partly be attributed to a general shift in land tenure and land use from agricultural production to hobby and recreational farming. Knowledge, management and expectations of pest animal management also change with changes in land tenure, as does the ability (or lack of) to undertake meaningful control because of reasons such as regulations, non-cooperation of landholders and/or resource limitations. A similar trend of increasing impacts of pest animals on small land-holdings was identified in NSW (West and Saunders 2003). West and Saunders (2003) suggested that this was an area in need of extension of appropriate control strategies and research. A similar approach should be adopted for WA.

In the pastoral region, it is quite clear that the impact of pest animals was perceived to be increasing. This perception by respondents is likely to reflect the views and sentiments of pastoralists and the broader community of the pastoral region.

Figure 5. Perceived changes in the impacts of pest animals on properties involved with agricultural production. Small, medium and large land-holdings* refer to properties within the agricultural region and 'pastoral' refers to pastoral leases.



*Small-sized landholdings are less than 100 ha in size, medium-sized landholdings are greater than 100 ha in size but less than 1,000 ha and large-sized landholdings are greater than 1,000 ha in size.

Livestock Enterprises

Respondents were asked to describe the types of livestock enterprises that were present in their districts or neighboured CALM managed land. As expected, each district or local areas had diverse livestock enterprises. In the agricultural region, sheep, cattle (beef), pigs, poultry and horse enterprises were reported to be present by more than 80% of respondents (Figure 6). As expected, cattle were the dominant livestock enterprise reported in the pastoral region (Figure 7).

It is interesting to note that many respondents (58% DAWA; 48% CALM) reported the presence of exotic sheep enterprises (Figure 7). These respondents were largely from the southern rangelands. This suggests that there is a trend for pastoralists to rapidly take up new industries that may be profitable. From a pest animal and disease management perspective, these exotic sheep breeds may present risks to the rangelands. The role of exotic sheep breeds are discussed in Section 5.3.4.

Figure 6. Livestock enterprises identified by respondents in their districts. Responses are from both DAWA and CALM staff in the agricultural region.

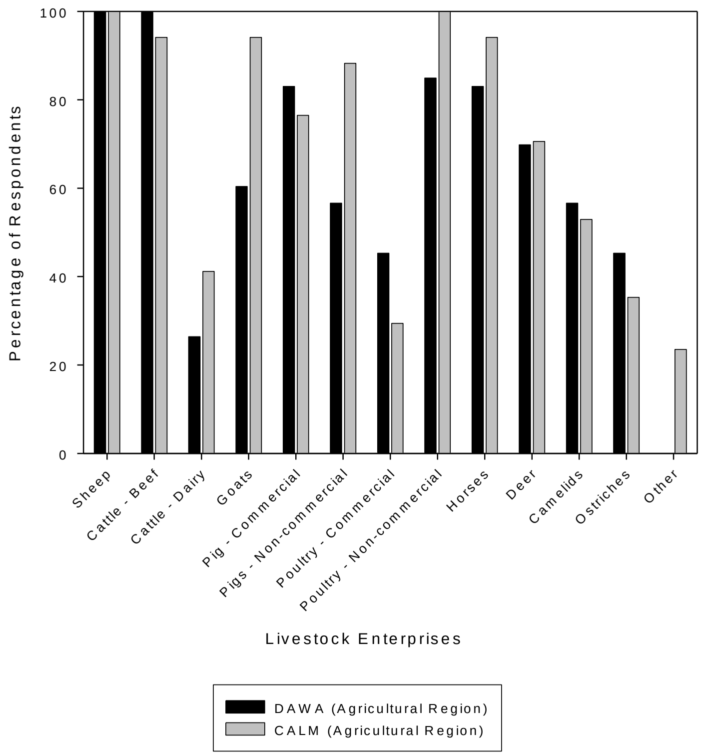
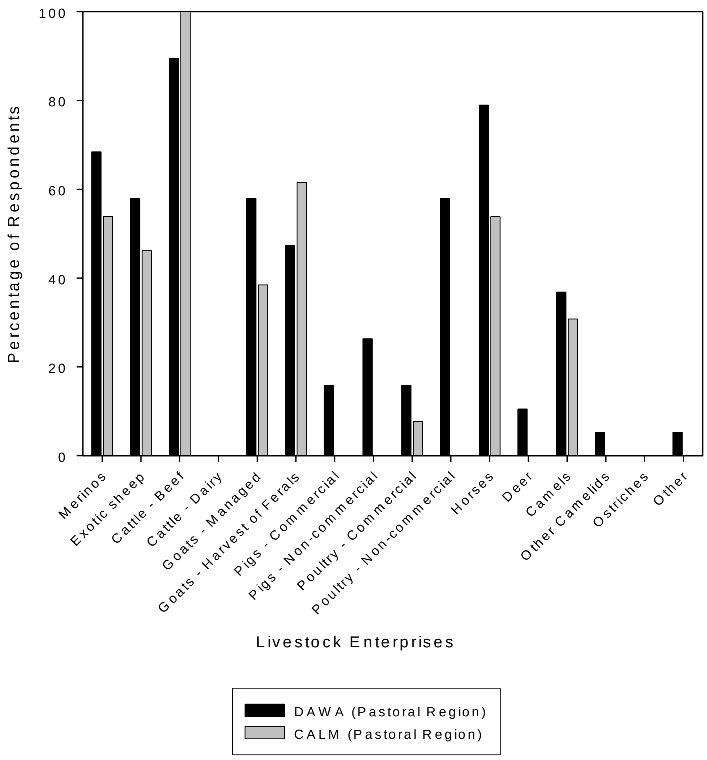


Figure 7. Livestock enterprises identified by respondents in their districts. Responses are from both DAWA and CALM staff in the Pastoral region.



Pest Animals

Pest animals present in the respondent's local areas were identified for both of the Regions and affiliations (Figure 8). It is important to note that this question identified the presence of pest animals in a local area and not what the local staff member (CALM/DAWA) thought of the pest animals.

There were clear regional differences (agricultural versus pastoral regions) in the percentage of respondents and the pest animals present, as expected (e.g. wild dogs). Likewise, there were clear differences between the two agencies (DAWA versus CALM) and their perceptions about what is defined as a pest animal. For example, staff from DAWA considered native animals such as kangaroos and emus to be pests, whereas staff from CALM generally did not. Also, CALM staff in the pastoral region clearly identified mice, rats and feral pigeons to be pest animals present in their jurisdictions (Figure 8), yet staff from DAWA did not. This suggests that the perception of what is a pest animal, and therefore how it is managed, differs between the two agencies.

In the agricultural region, rabbits and foxes were clearly the most widespread vertebrate pests identified by the respondents from both DAWA and CALM (Figure 8). Staff from CALM also identified feral pigs and feral cats to be issues in each of their jurisdictions. In the pastoral areas wild dogs were the dominant pest present in the local areas of staff from DAWA. For pastoral staff from CALM, feral cats and feral donkeys were the main pests present in areas they manage.

Familiarity with Pest Animal Distribution

Most respondents indicated that they were familiar or very familiar with the distribution of pest animal populations within their local area. Only on rare occasions did the respondents suggest that they were unfamiliar with the distribution of pest animals in their local area. These were usually for cryptic species such as feral cats, uncommon animals such as deer, or animals such as feral horses or feral cattle in large scale pastoral areas including unallocated crown land.

The question about familiarity with the distribution of pest animals could be viewed, in part, as a leading question. If the pest animal were known to be present in the local area, then general response would essentially be familiar or very familiar by default. The level of response ('familiar' versus 'very familiar') may also reflect the confidence of the respondent in answering the question. As discussed above, this was not meant to be a measured assessment of the respondent's skills or knowledge of pest animal management.

Impact on Agriculture

The impact of pest animals on agriculture production was a question posed specifically to staff from DAWA in the agricultural and pastoral regions. Foxes and rabbits were identified as having the greatest impact on agriculture production in the agricultural region (Table 3). Interestingly, native kangaroos and emus were perceived to have the next greatest impact on agriculture after foxes and rabbits. In the pastoral region, wild dogs were clearly perceived to have the greatest impact on agricultural production, followed by feral goats (Table 3). As described above, this result may need to be qualified since feral goats are absent from the northern rangelands (see distribution of feral goats below) and their regional (southern rangelands) impact may be greater than that of wild dogs.

Figure 8. Vertebrates considered as pests in the jurisdiction of each of the respondents.

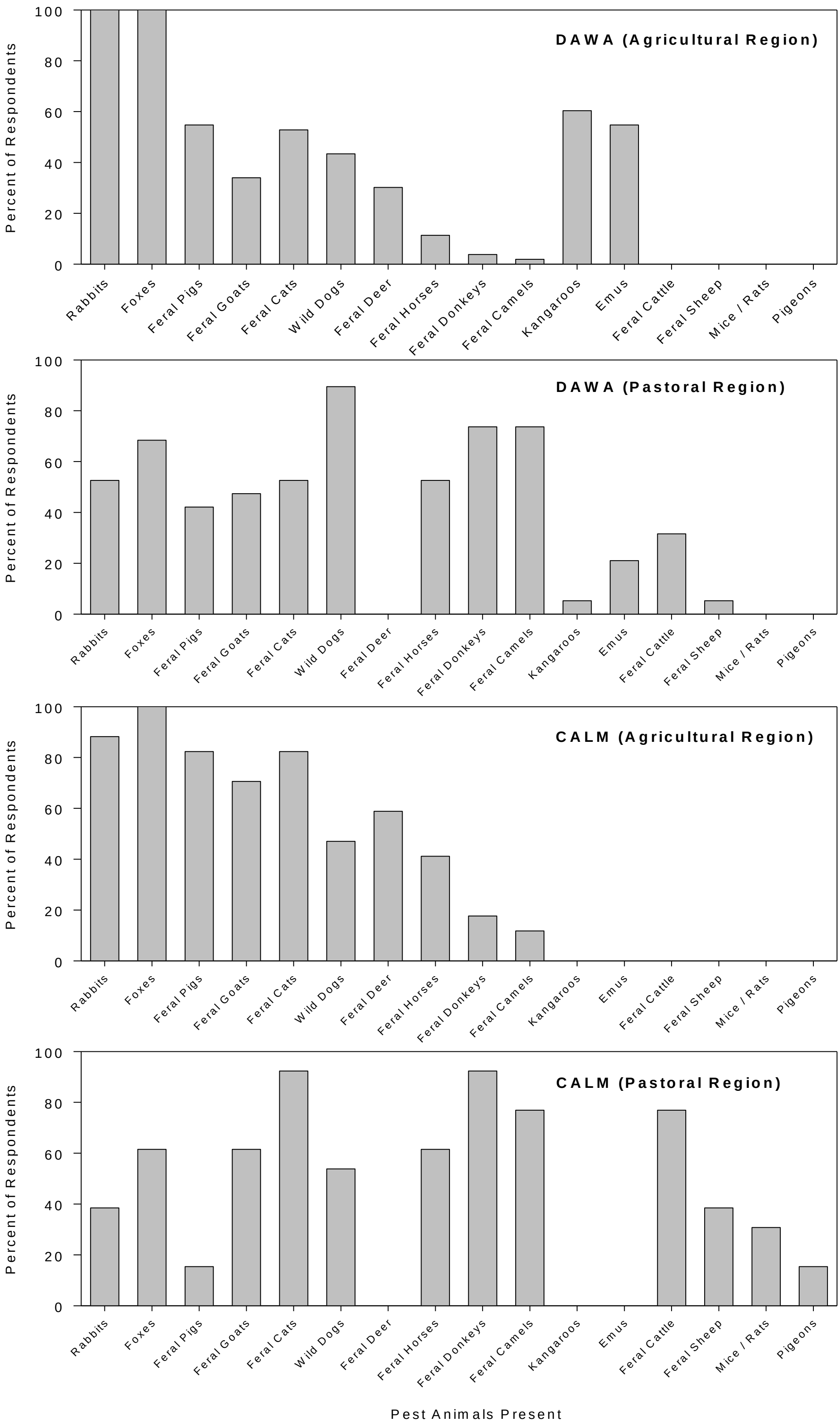


Table 3. Top five ranking guide to the responses for questions on a) pest animal impacts on agriculture (DAWA only), b) environmental impact of pest animals and c) community concern about pest animals.
Ranks were calculated from a sub-set of responses (moderate, high and very high; questions B3 to B5, Appendix 3). A rank of 1 is the highest possible rank.

Agricultural Region					
	DAWA Respondents			CALM Respondents	
Pest Animal	Agricultural Impact	Environmental Impact	Community Concern	Environmental Impact	Community Concern
Feral Pigs		4		4	4
Feral Goats					5
Foxes	1	1	1	1	1
Rabbits	2	3	2	2	2
Wild Dogs	5				5
Feral Cats		2	3	3	2
Emus	4		5		
Feral Horses				5	
Kangaroos	3	5	3		
Pastoral Region					
	DAWA Respondents			CALM Respondents	
Pest Animal	Agricultural Impact	Environmental Impact	Community Concern	Environmental Impact	Community Concern
Feral Goats	2	3		4	2
Foxes		2		4	2
Rabbits		5			
Wild Dogs	1	4	1		2
Feral Cats		1	2	1	1
Emus	5		5	3	
Kangaroos	3	5	3		
Feral Donkeys			4	2	5
Feral Camels	5				
Feral Cattle					5
Feral Sheep	3	5			

Impact on the Environment and Community Concerns

All respondents were asked to rate the environmental impact of each of the major pest animals in their local areas or jurisdictions (Table 3). In the agricultural region, the fox, feral cat and rabbit were identified as the pest animals causing the most environmental impact and causing the most concern to the community. In the pastoral region, the feral cat was identified by respondents as having the greatest impact on the environment and, along with wild dogs, of most concern to the community.

Triple Bottom Line Impact of Pest Animals

In the agricultural region, the fox is clearly identified as the most critical or threatening pest animal within a triple bottom line framework (economic, environmental and social values; Table 3). Both agencies identified the fox as the pest animal impacting most on agricultural production and the environment, as well as being the prime pest animal of concern for community members of the agricultural region. This is not surprising, as the impacts of foxes have clearly been identified by many others (e.g. Saunders *et al.* 1995, Biodiversity Group Environment Australia 1999) and the Western Australian Government has implemented successful strategies (e.g. CALM's Western Shield http://www.naturebase.net/projects/west_shield.html, DAWA community baiting) to mitigate their impact.

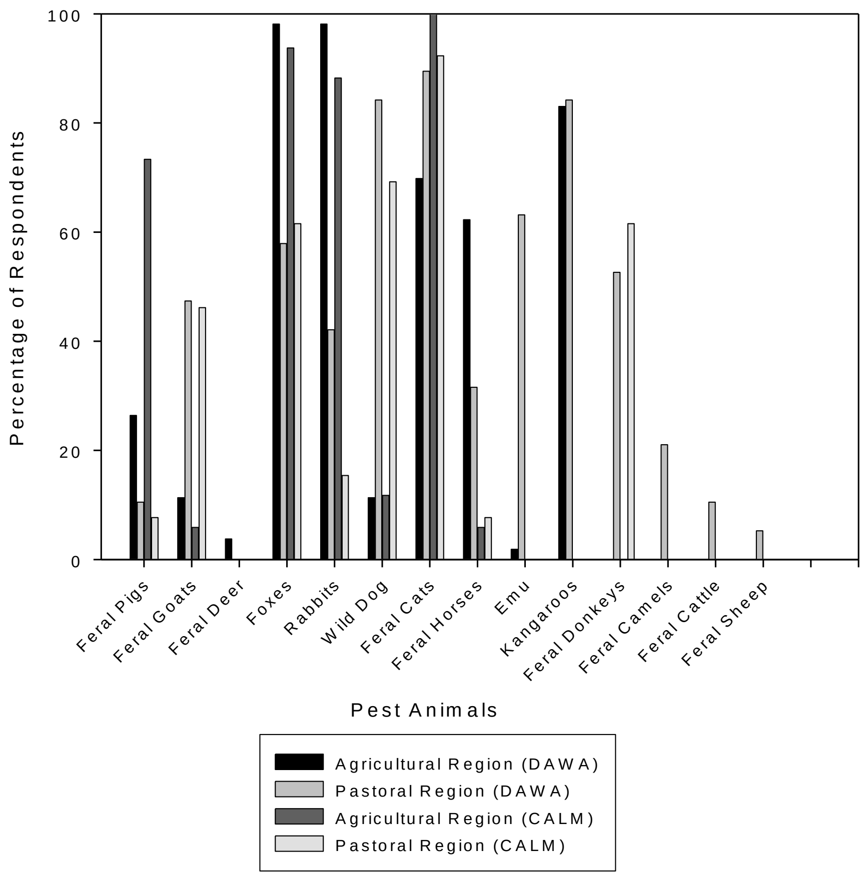
The survey results are a snap-shot of respondents' thoughts and views at the time of the survey. It is likely that there could have been some variation in these results if circumstances were different. For example, if the survey was conducted in the agricultural region prior to the release of rabbit haemorrhagic disease, then rabbits may have appeared to have been a greater triple bottom line threat than foxes.

The situation in the pastoral region is slightly different. Feral cats were identified as having the highest triple bottom line threat, but this does not necessarily reflect the way feral cats are managed or perceived by Government and landholders. The reality is that some triple bottom line effects carry more weight than others, in terms of motivation for pest animal management. Since feral cats do not impact significantly on agricultural production or cause economic hardship they do not rate highly in terms of allocating precious resources for pest animal management at a landscape level. However, CALM allocates resources to controlling feral cats where achievable conservation goals and objectives can be met (i.e. in local areas of high conservation value). The management of feral cats in the extensive pastoral region by land-holders, DAWA and CALM is minor or non-existent. Conversely, the high impacts on agricultural production and high level of community concern caused by wild dogs has meant that wild dogs far surpass feral cats in terms of political impact (i.e. community outrage). The agri-politics associated with wild dogs dictates that time and resources from DAWA and land-holders are spent on the management of wild dogs. This may distract the triple bottom line threats posed to the pastoral region by feral cats. It also suggests that realistic triple bottom line comparisons of pest animals will always be clouded by other factors (e.g. conflicts between economic and environmental agendas) and differing points of view of staff from both agencies.

Abundance of Pest Animals

In the agricultural region, foxes, rabbits and feral cats were identified as the most commonly abundant pest animal (Figure 9). In the pastoral region the most commonly abundant pest animals were feral cats, wild dogs and kangaroos (the latter for DAWA staff only). As described above, some pest animals may be abundant in one area but not another (e.g. feral goats are present in the southern rangelands but not the northern rangelands). Because these data represents the whole region (agricultural or pastoral region; Figure 2) some pest animals of significance may inadvertently appear to be under-represented.

Figure 9. Pest animals identified as having *very common* or *common* abundance by survey respondents.



*Emu and Kangaroos are not viewed as pests by staff from CALM.
** Questions about the abundance of feral cattle and sheep were only asked of respondents in the rangelands.

One of the interesting results of this question was the apparent abundance of feral pigs reported by staff from CALM in the agricultural region. Only 17% of staff from DAWA reported feral pigs to be common or very common in their local jurisdiction, whereas 73% of staff from CALM reported feral pigs to be commonly or very commonly abundant. This could suggest that feral pigs may be more abundant on CALM managed land than agricultural land. Alternatively, it could suggest that the way the perception of the abundance of feral pigs differed between staff of the two agencies. The issues of feral pigs are discussed in more detail in section 5.2.1.

Trends in the Distribution, Abundance and Control of Pest Animals

A series of questions were asked to define trends in pest animal populations and the effectiveness of control techniques for these populations over the past five years. These questions were designed to establish if the following factors were increasing or decreasing: the distribution of pest animals (i.e. the area where pest animals were found); the abundance of pest animals (i.e. the number of pest animals); the control effort (i.e. time, resources and effort used to control pest animals); and the effectiveness of control (i.e. if techniques and strategies used to control pest animals have changed in their effectiveness).

Staff from DAWA suggested that both the distribution and abundance of most pest animals increased in the agricultural region over the past five years (Table 4). There were some exceptions, these being rabbits and feral deer. In terms of control efforts, the main contrasts were the fox and rabbit. Generally the effectiveness of control was constant.

Feral deer were perceived to be relatively stable in terms of distribution and abundance. The control efforts and success of these control efforts were also constant (Table 4). These responses are perhaps typical of a pest animal in the infancy of its pest potential. Pest animal populations typically go through a period of exponential growth. Control is most effective before the period of rapid exponential population growth (Long 2003). It is more than likely that feral deer populations are currently at the early establishment period, prior to the period of exponential growth. However, because populations are seen to be constant in terms of distribution and abundance, an element of complacency or lack of perceived risk currently hampers the removal of the small populations. Consequently, it is more than likely that feral deer will become a major pest of the agricultural region if current management strategies overlook this possibility.

Foxes were generally perceived to be increasing in distribution and abundance on private land in the agricultural region (Table 4, DAWA). This was generally viewed by respondents to be a consequence of the decline over the past five years of efforts to control foxes. Respondents were quite clear in reporting that the role of a Biosecurity Officer have changed such that they now facilitate fox control rather than actively undertake fox control. The change from service provider to information provider, combined with landholder apathy, could have resulted in the perceived increase in fox populations. In contrast, CALM staff perceived that the fox population has declined in parts of the agricultural region due to the success and effectiveness of Western Shield.

Rabbits were perceived to have decreased in their general distribution and abundance. From a pest animal management perspective, the strategic approach to rabbit management would be to increase efforts to control the reduced population.

Control Efforts

In terms of control efforts, control of some species has increased over the last five years and for others the control effort has decreased (Table 4). In the agricultural region, there has been a major decline in the effort to control rabbits and foxes in agricultural properties and a decline in rabbit control on conservation estates. DAWA respondents in the agricultural region suggest that control efforts for feral pigs and emus have had the largest increase. CALM respondents in the agricultural region also indicated that there had been increases in control efforts for feral pigs, as well as for foxes (e.g. Western Shield) and feral cats. In the pastoral region, all respondents suggest that control of pest animals has increased or remained steady over the past five years. DAWA respondents suggest the key increases in control efforts in the rangelands have been for wild dogs, feral goats and kangaroos. CALM respondents from the pastoral region suggested that there were greater increases in control of feral goats, feral camels and feral donkeys in this period.

Table 4. Trends in pest animal issues for each region and each agency.
Numbers represent a net percentage difference between the number of respondents reporting 'increases' in each category and the number of respondents reporting 'declines' in each category. A positive number indicates that the issue is increasing and the number is representative of the magnitude of that issue. A negative number is the inverse while zero represents no change. Categories represent changes over the past five years in the respondents' local area for the following issues: trends in the distribution of pest animals; trends in the abundance of pest animals; trends in the control effort for managing pest animals and; trends in the effectiveness of control efforts to manage pest animals.

Region	Agency	Selected Animals	Distribution	Abundance	Control Effort	Effectiveness of Control
Agricultural Region	DAWA	Feral Pigs	21.2	21.2	17.3	0.0
		Feral Goats	9.6	5.8	7.7	0.0
		Feral Deer	0.0	-1.9	0.0	0.0
		Foxes	21.2	26.9	-41.5	-1.9
		Rabbits	-5.8	-25.0	-63.5	1.9
		Wild Dogs	15.4	13.5	1.9	-7.5
		Feral Cats	19.2	25.0	9.6	-1.9
		Emus	30.8	46.2	22.6	0.0
		Kangaroos	25.0	38.5	3.8	-1.9
Agricultural Region	CALM	Feral Pigs	47.1	41.2	29.4	23.5
		Feral Goats	11.8	23.5	5.9	0.0
		Feral Deer	23.5	23.5	11.8	0.0
		Foxes	-23.5	-29.4	23.5	5.9
		Rabbits	0.0	11.8	-11.8	0.0
		Wild Dogs	-5.9	0.0	5.9	0.0
		Feral Cats	23.5	41.2	17.6	17.6
Pastoral Region	DAWA	Feral Pigs	5.3	-10.5	10.5	5.3
		Feral Goats	36.8	31.6	36.8	36.8
		Foxes	0.0	-5.3	15.8	10.5
		Rabbits	-15.8	-15.8	0.0	5.3
		Wild Dogs	57.9	57.9	52.6	0.0
		Feral Cats	10.5	10.5	10.5	0.0
		Emus	15.8	5.3	10.5	5.3
		Kangaroos	31.6	21.1	21.1	5.3
		Feral Donkeys	-26.3	-26.3	15.8	15.8
		Feral Camels	26.3	31.6	10.5	0.0
Pastoral Region	CALM	Feral Pigs	15.4	23.1	0.0	0.0
		Feral Goats	0.0	-7.7	38.5	7.7
		Foxes	7.7	15.4	23.1	23.1
		Rabbits	7.7	0.0	0.0	7.7
		Wild Dogs	30.8	23.1	23.1	0.0
		Feral Cats	15.4	23.1	15.4	23.1
		Feral Horses	-15.4	-7.7	7.7	7.7
		Feral Donkeys	-23.1	-15.4	30.8	46.2
		Feral Camels	38.5	38.5	38.5	23.1

Effectiveness of Current Control Techniques

This question which related to the effectiveness of the control was designed to establish whether current control techniques were still performing today as well (or as poorly) as they did five years ago. In the agricultural region, DAWA respondents generally reported only very slight decreases in the effectiveness of control efforts over the past five years (Table 4), suggesting that, when applied, control efforts were consistent from one year to the next. CALM respondents in the agricultural region suggested that the effectiveness of control efforts for feral pigs and feral cats had increased over the past five years. For feral pigs, this could be attributed to CALM's pro-active volunteer program to trap feral pigs. The perceived increase for feral cats may be attributed to the development of a feral cat-specific bait under development by Dr D. Algar from CALM.

In the pastoral region, respondents from DAWA suggested there has been a major increase in the effectiveness of control efforts for both feral goats and feral donkeys over the past five years (Table 4). For feral goats, this change may be associated with the change in declaration (see Forsyth and Parkes 2004) and increase in the use of total grazing management systems and traps on waters (i.e. increase in commercialism of the feral goat industry). For feral donkeys, the adoption of the Judas technique and the expansion of the Judas program into the Pilbara may be responsible for the perceived increase in effectiveness of control. This explanation for feral donkeys may also explain the observed increase in effectiveness of control by CALM respondents from the pastoral region (Table 4). Other species that CALM staff perceived there to be an increase in effectiveness of control measures over the last five years included foxes, feral cats and feral camels. For feral camels, opportunistic by-catch through the Judas program may offer one explanation for the increase in effectiveness. For foxes and feral cats, the observed increase may be associated with better coordinated baiting strategies as well as the development of new baits.

Exotic Disease Risks

Respondents were asked to rate the risk of an exotic disease, such as foot and mouth disease, becoming established in a pest animal population, with mixed results (Table 5). Generally, it could be argued that while the risks of an exotic disease are very low, the consequences are extremely high. This suggests that there may be opportunities for training staff from both agencies about what the risks are and what their role in an EAD (emergency animal disease) outbreak could be. This may be incorporated into any AUSVETPLAN awareness training as described above (see Figure 4).

Table 5. Perceived risk of exotic disease (e.g. foot and mouth disease) establishment by each of the respondent groups.

Respondent	No Risk	Very Low	Low	Moderate	High	Very High
DAWA - Agricultural	0	22.6	24.5	18.9	24.5	9.5
DAWA – Pastoral	5.2	21.1	21.1	31.5	5.3	15.8
CALM – Agricultural*	0	5.9	35.3	17.6	23.5	11.8
CALM - Pastoral	0	46.1	38.5	7.7	0	7.7
All Respondents*	1.0	22.5	27.5	19.6	17.6	10.8

*Note that some respondents did not complete this question.

5.2 Pest Animals – Statewide Responses

5.2.1 Feral Pigs

Distribution and Abundance of Feral Pigs

Feral pigs were reported across WA, but their distribution is relatively sparse compared to other areas of Australia (Figure 10). The highest abundance of feral pigs is in the Kimberley, in northern WA. In this area, patches of high abundance are generally associated with major drainage systems, with the key catchment being the Fitzroy River. Other areas identified as having significant infestations of feral pigs include the De Grey River catchment in the Pilbara and the Northampton/Kalbarri area at the north-western boundary of the agricultural-pastoral region. In the south-west of the state, feral pigs are widespread, with their distribution and abundance being patchy. The distribution and abundance of feral pigs, particularly in the south-west of the state, is influenced by illegal movements by hunters (Spencer and Hampton 2005), which must be considered simultaneously with our data.

Corporate understanding of feral pigs

In the agricultural region, 56% of DAWA staff and 88% of CALM staff reported feral pigs to be present in the areas that they managed (Figure 11A). CALM staff also reported that, in the agricultural region, they were generally familiar (65%) or very familiar (17%) with the distribution of feral pigs on CALM estate, and that feral pigs were generally common (47%) or very common (27%) in abundance (Figure 11B). DAWA staff were generally less familiar with the distribution of feral pigs and generally report a lower abundance of feral pigs than CALM staff.

The difference in responses between the two Departments in the agricultural region may indicate a more common occurrence of feral pigs on CALM managed reserves. Likely contributing factors include the availability of undisturbed refuge and reported illegal releases of pigs into reserves for recreational hunting (see Spencer and Hampton 2005). Moreover, CALM staff are perhaps more likely to see signs of feral pig than DAWA staff because of differences in operational objectives between the two agencies.

In the pastoral region, a higher number of DAWA respondents (42%) than CALM respondents (15%) reported feral pigs to be present (Figure 11A). When feral pigs were present, both agency respondents were confident that they were familiar with their distribution. The abundance of feral pigs, as shown in Figures 10 and 11C, is concentrated in a few key regions, such as the De Grey and Fitzroy River catchments, and in these areas abundance can be common or even very common.

The perceived impacts of feral pigs contrast between the two agencies (Figure 12). From an agricultural production perspective, pasture damage, soil erosion and watercourse damage rated as the three highest impacts in the agricultural area. In the pastoral area, these were soil erosion and watercourse damage, as well as damage to native vegetation. From a conservation perspective, damage to native vegetation, soil erosion and watercourse damage were perceived to be the greatest impacts. It is interesting to note that disease spread was ranked low compared to other impacts. This may be because it has been interpreted as a (future) threat rather than an (present) impact. There was also confusion as to what disease meant; plant disease such as dieback (caused by the fungus *Phytophthora cinnamomi*) or animal disease.

Figure 10. Reported distribution and abundance of feral pigs in Western Australia.

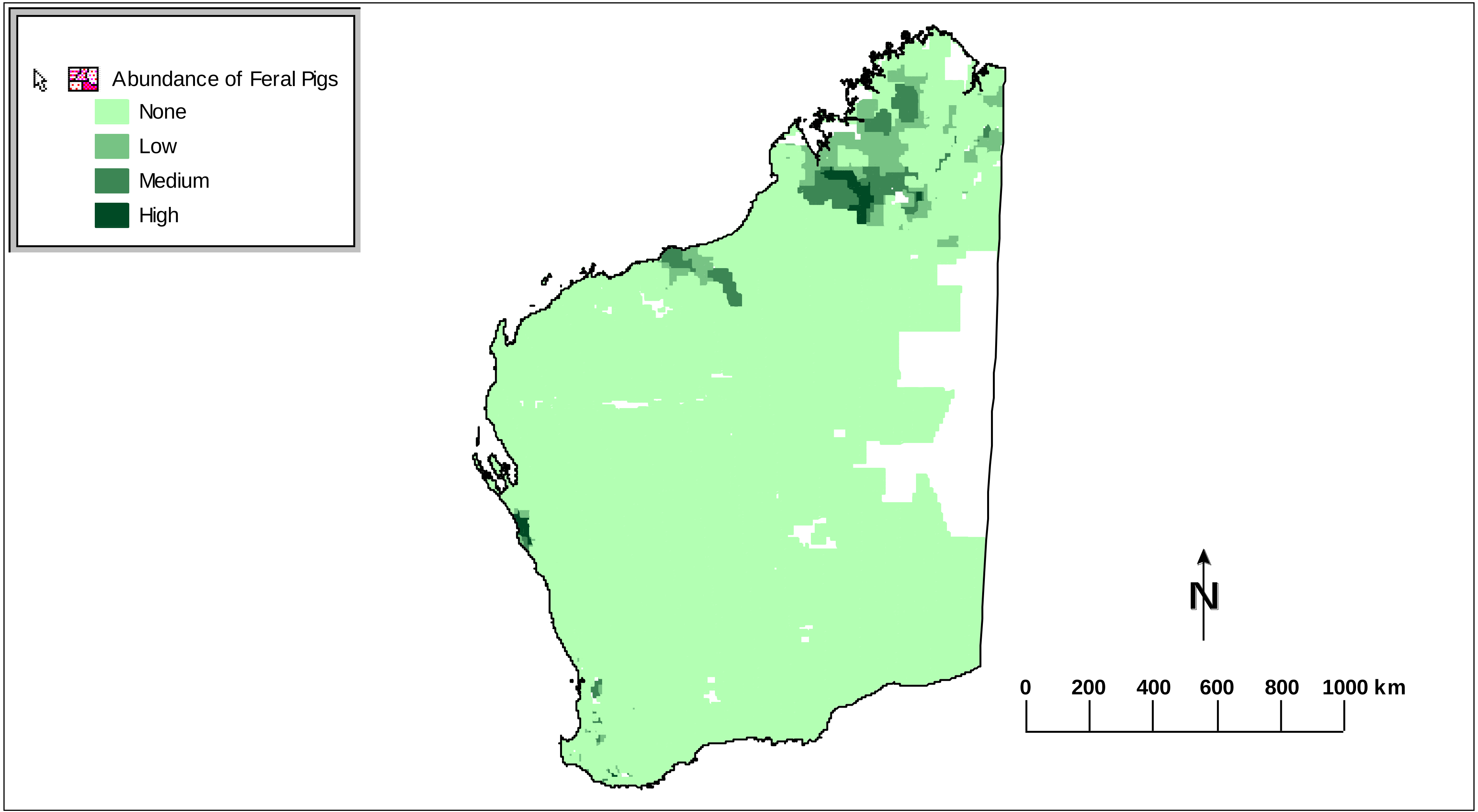


Figure 11. Presence (A), familiarity (B) and abundance (C) of feral pigs for Western Australia described by all respondent groups.

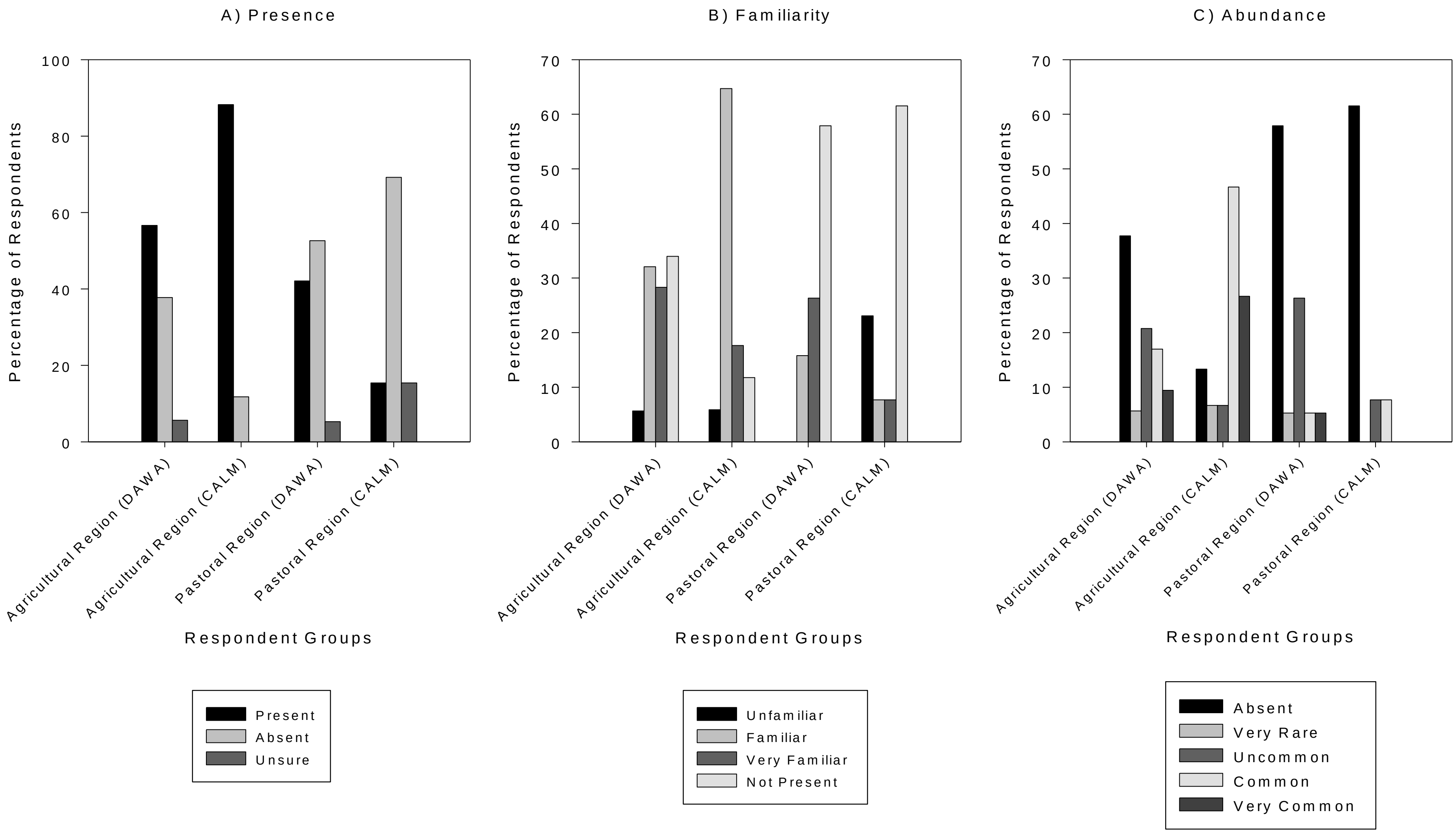
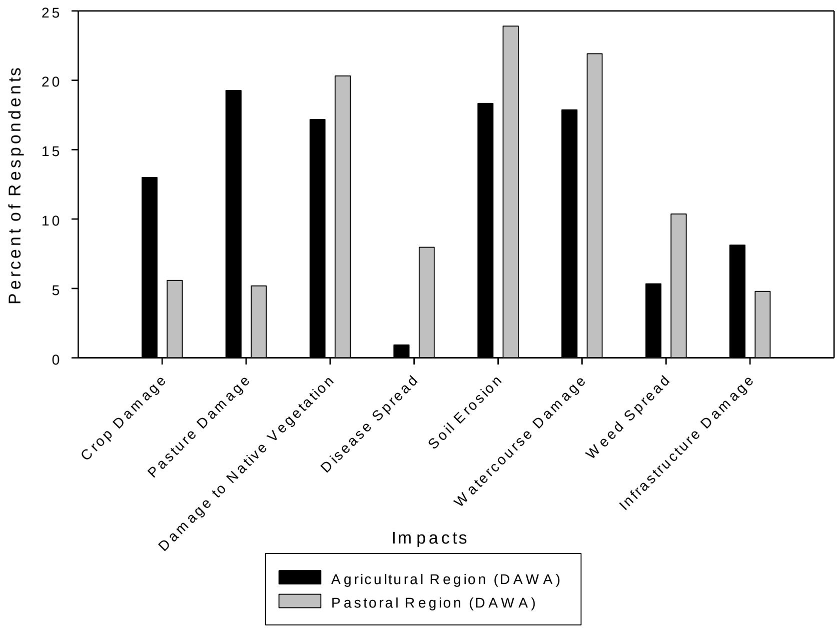
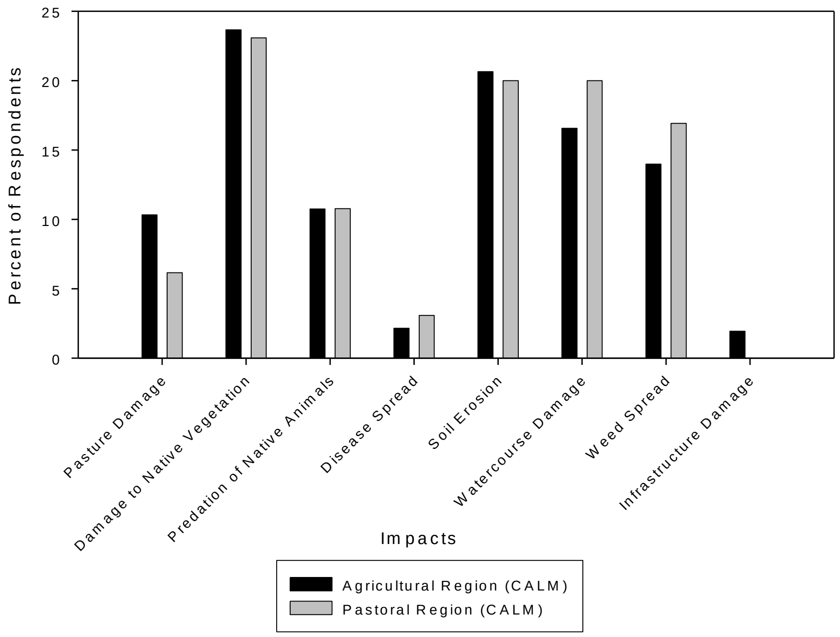


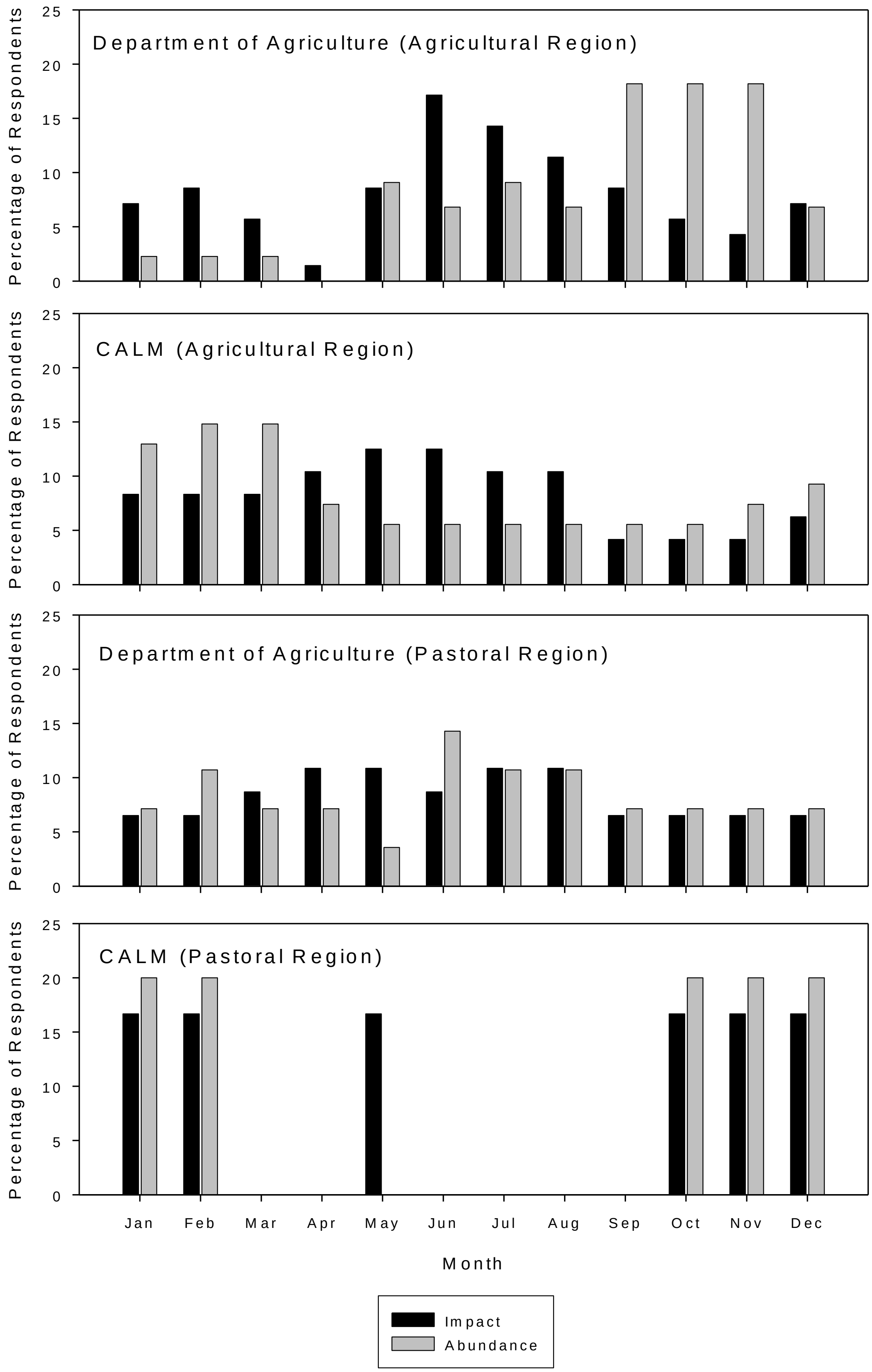
Figure 12. Impacts of feral pigs in the agricultural region and rangelands assessed by Department of Agriculture staff (top, agricultural focus) and Department of Conservation and Land Management (below, conservation focus).





The timing of impacts caused by feral pigs provides a profile of key activities (Figure 13). Generally, the perceived impact was greatest during the winter months due to the presence of germinating and growing crops and native pastures, and softer soils. In the summer months, the perceived impact was less but it was perhaps greatest on watercourses. The perceived highest abundance of feral pigs was generally in the summer months. This is the time when numbers are concentrated around water sources, and hence sightability is greatest. The actual peak in abundance of pig populations was reportedly in winter, possibly due to breeding activity.

Figure 13. Timing of the maximum impacts (black) and abundances (grey) of feral pigs for each of the respondent groups.



Hunting or shooting are the most commonly used technique to control feral pigs, particularly in the pastoral region (Figure 14). In the agricultural region, trapping is also a method that is used. Both hunting and/or shooting and trapping are also perceived to be the most effective forms of control (Table 6), far more so than 1080 poisoning. It is interesting to note that a small amount of opportunistic or secondary control in the form of aerial shooting (as a by-catch of other control) and baiting for wild dogs were also reported to impact on feral pig populations.

Figure 14. Use of techniques for the control of feral pigs reported by each of the respondent groups.

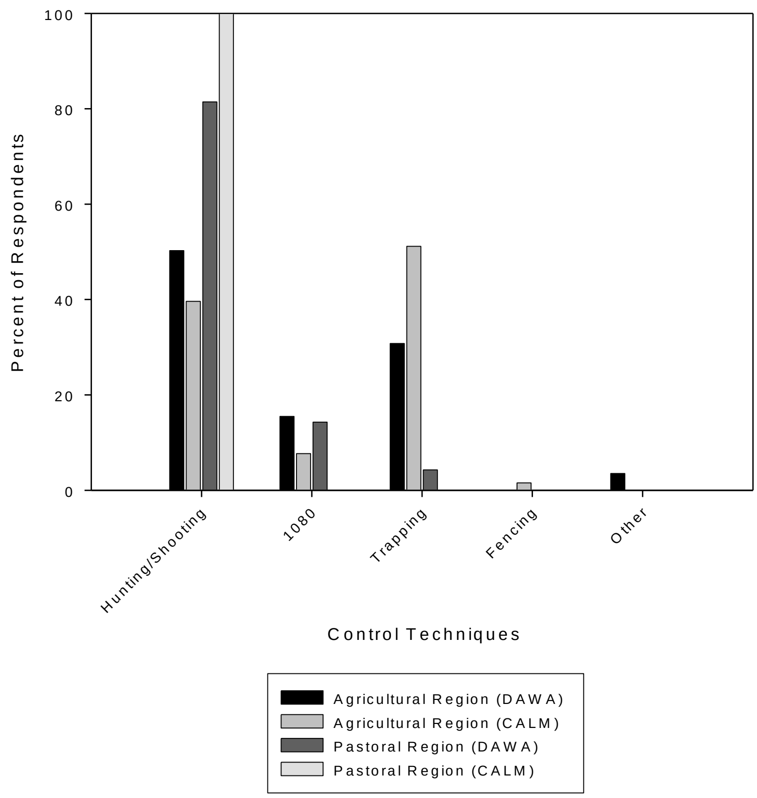


Table 6. Control techniques for feral pigs ranked according to their perceived effectiveness for each of the respondent groups.

Control Techniques	DAWA Agricultural	CALM Agricultural	DAWA Pastoral	CALM Pastoral
Hunting and/or Shooting	1	2	1	1
Judas Techniques	not rated	not rated	not rated	not rated
1080 Poisoning	3	4	4	not rated
Exclusion Fencing	4	3	not rated	not rated
Commercial Harvesting	5	not rated	5	not rated
Trapping	2	1	3	not rated
Aerial Shooting	not rated	not rated	2	not rated

Where feral pigs occur, with the exception of DAWA respondents from the pastoral region, between 86% and 100% or respondents indicated that feral pigs continue to cause problems (Figure 15). Furthermore, many respondents suggested that feral pigs had potential to have close contact with domestic stock (Figure 16). In the agricultural region, 83% of DAWA respondents suggested that feral pig-livestock interactions were possible. This could potentially present some major problems for disease management, particularly EADs.

Feral pigs play an important role in the recreational hunting community. Using genetics, Spencer and Hampton (2005) have demonstrated that illegal dumping of feral pigs from one area to another is a major problem. The most avid recreational hunters usually carry out these illegal movements, either to seed a new area or to have a constant supply of feral pigs to hunt. In the agricultural region, over 66% of CALM staff and 73% of DAWA staff responded that feral pigs were being deliberately introduced from outside the local area (Figure 17). Local accidental or deliberate releases were also reported as sources for feral pig populations (Figure 18). In contrast to the agricultural region, fewer respondents from the pastoral region reported illegal movements and local introductions, with many unsure that it was occurring. This suggests that, compared to the agricultural region, illegal movements of feral pigs in the pastoral region are currently not a major issue. Nonetheless, the whole concept of illegal movements of feral pigs has some major implications for EAD planning.

Figure 15. Recurrence of feral pig problems after control efforts for each of the respondent groups.

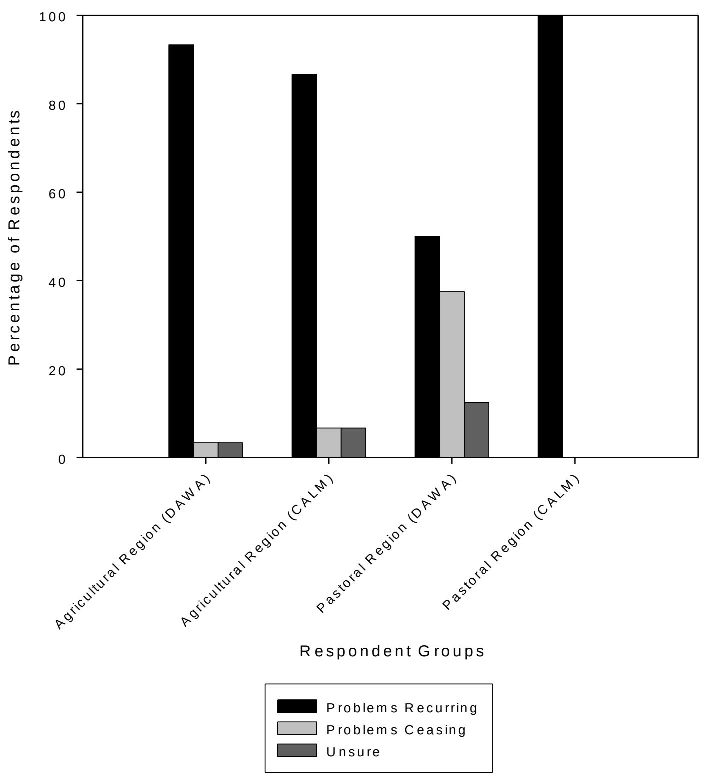


Figure 16. Potential for close contact between feral pigs and domestic stock for each of the respondent groups.

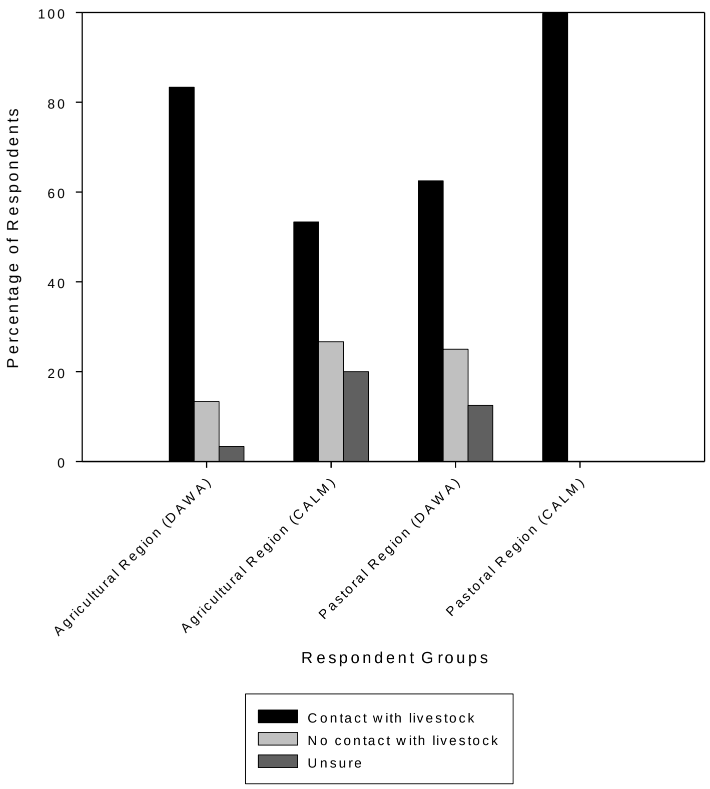


Figure 17. Deliberate movements or introductions of feral pigs from outside the local area for each of the respondent groups.

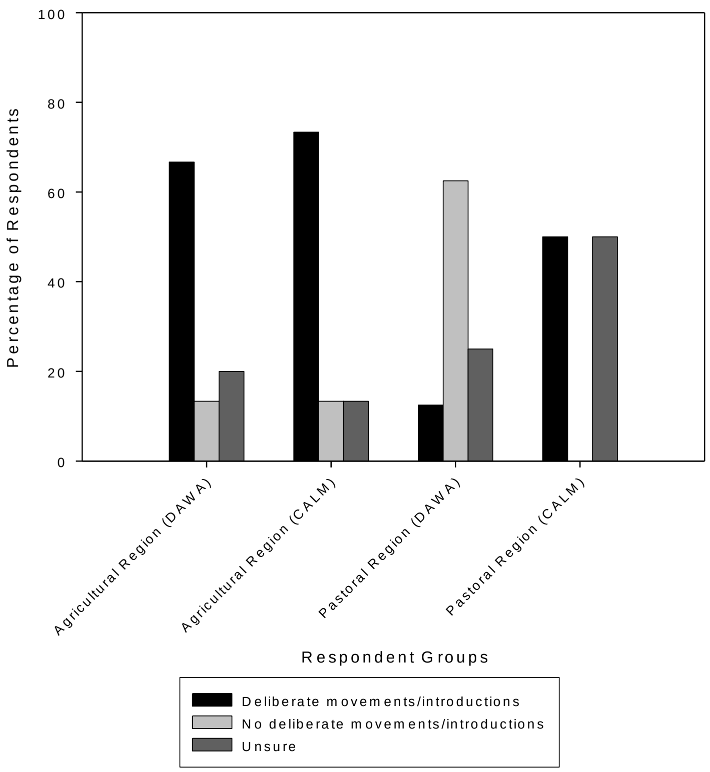
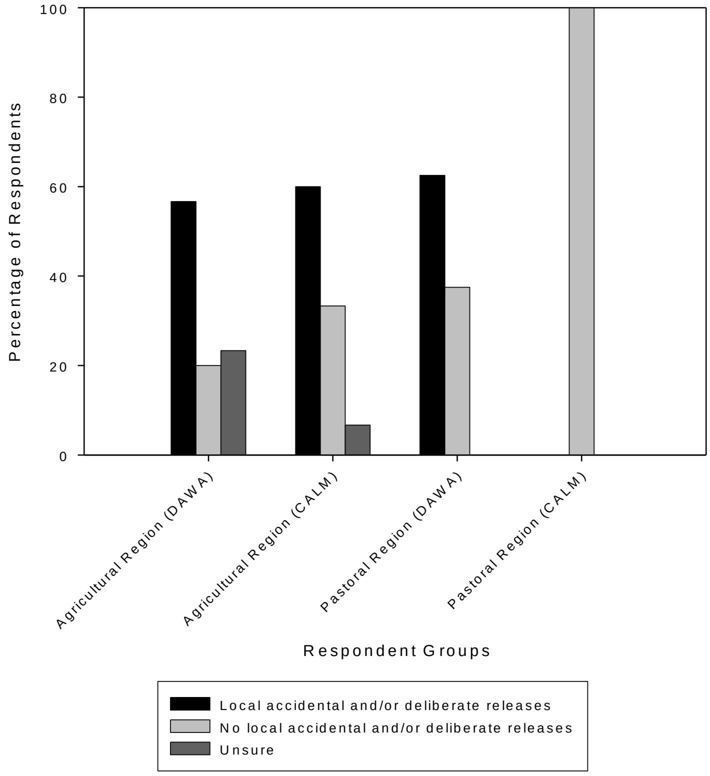


Figure 18. Accidental or deliberate releases from captivity of pigs for each of the respondent groups.



5.2.2 Feral Goats

Distribution and abundance of feral goats

In WA, feral goats were most commonly reported in the southern rangelands (Figure 19). This band of distribution extends from Exmouth in the north-west to Norseman in the south-east. Abundance within the southern rangelands is generally medium to high. Feral goats are also present in the south-west of the state but are generally restricted to conservation estates rather than farming properties. Consequently, their distribution in the south-west is patchy, with low abundance.

Corporate understanding of feral goats

In the agricultural region, feral goats were more commonly reported to be present by CALM staff (82%) than DAWA staff (35%) (Figure 20A). This may suggest that CALM managed reserves are a more likely source of refuge for feral goats in the agricultural area. In the pastoral areas, a similar percentage of respondents from both agencies reported feral goats to be present. This generally represents the ubiquitous nature of feral goats in the southern rangelands (Figure 19). However, it may also represent the distribution of agency staff across the rangelands.

When feral goats were present, most respondents were either familiar or very familiar with their distribution (Figure 20B). In terms of abundance (Figure 20C), the majority of DAWA staff in the agricultural area reported feral goats to be absent, which supports the observed distribution of feral goats in the region (Figure 19). Similarly, CALM staff in the agricultural region reported the abundance of feral goats to be either very rare or uncommon, when goats were present. In contrast, the pastoral area responses reflected the distribution and abundance of feral goats in the southern rangelands (Figure 19). Over 30% of staff from both agencies indicated that the abundance of feral goats in the rangelands was very common (Figure 20C).

The impacts of feral goats were perceived by both agencies to be similar across regions and land use (Figure 21). Generally, all respondents suggest that the main impacts of feral goats are damage to native vegetation, damage to pastures and soil erosion. Interestingly, CALM respondents in the agricultural region also perceive goats to be a source of weed spread. In the pastoral region, DAWA respondents report that feral goats impact on infrastructure (Figure 21). Interestingly, only pastoral respondents suggested that disease spread was a possible impact (Figure 21).

The abundance and timing of the maximum impacts caused by feral goats can be viewed as seasonal (Figure 22). In the agricultural region, the abundance and impact of feral goats is generally greatest in the summer, though this perception is higher for DAWA than CALM respondents. In the pastoral region, both agencies also reported that the impacts and abundances were perceived to be greatest in the spring and summer months. Respondents offered the possible explanation that feral goats have maximum impact on pasture and native vegetation at this time because the availability and quality of food has declined. Feral goats may also leave refuges, such as conservation estates, in search of food and water. Furthermore, during the summer months water is often a limiting factor. In the pastoral region, this restriction in water availability is used to trap feral goats. However, it may also lead to the perception that there is an increase in abundance of feral goats at this time, as they congregate at waters.

Figure 19. Reported distribution and abundance of feral goats in Western Australia.

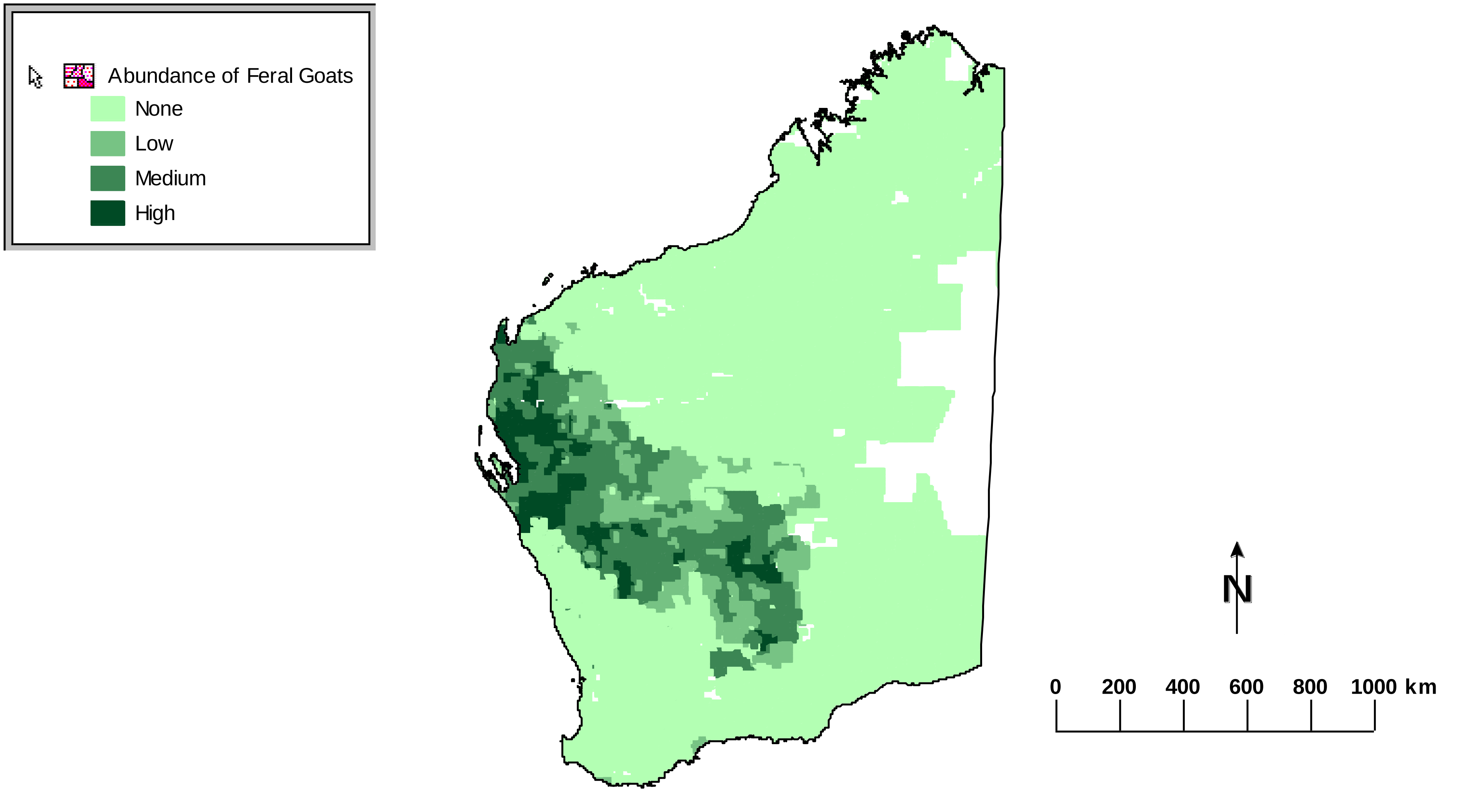


Figure 20. Presence (A), familiarity (B) and abundance (C) of feral goats for Western Australia described by all respondent groups.

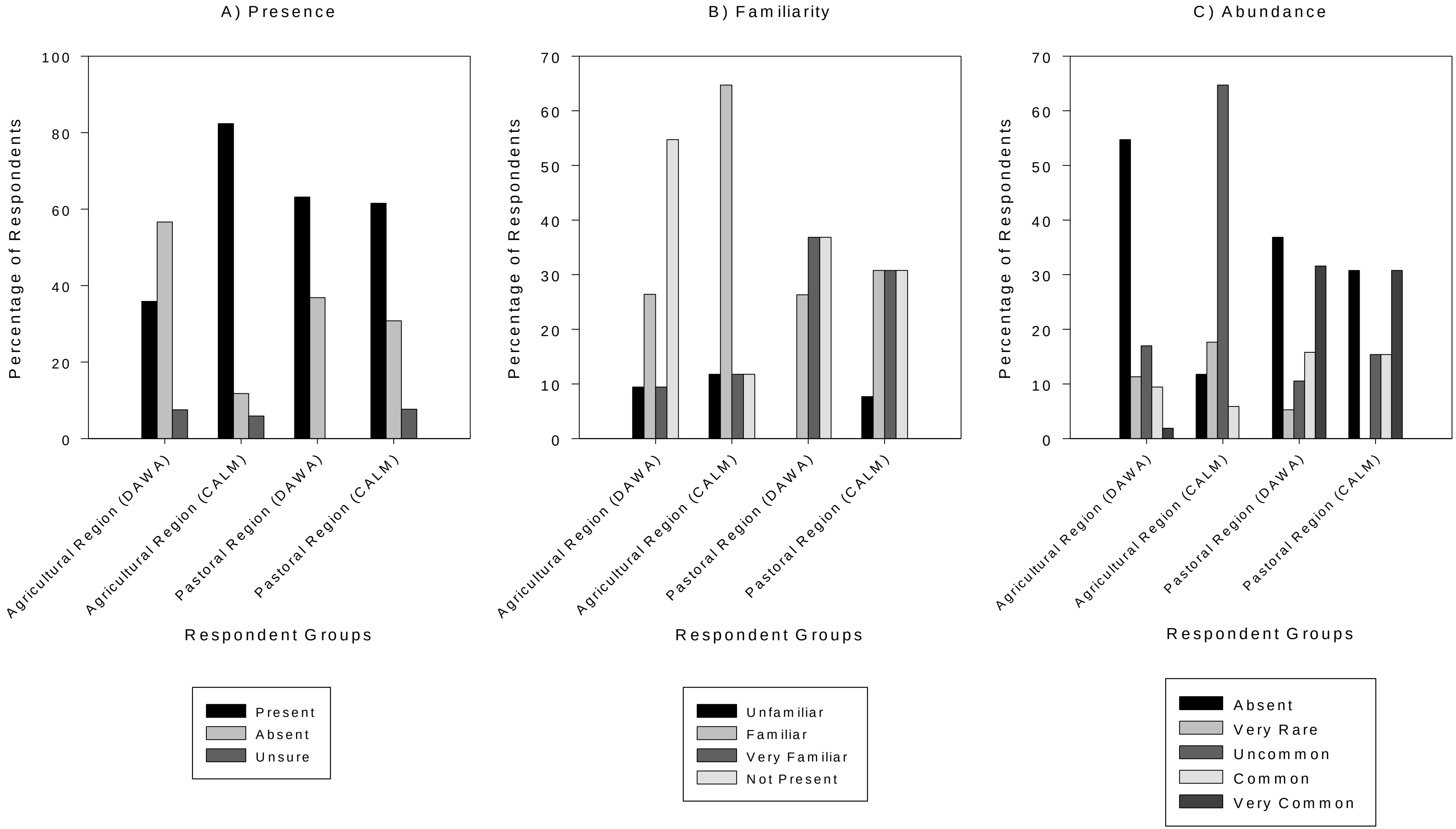
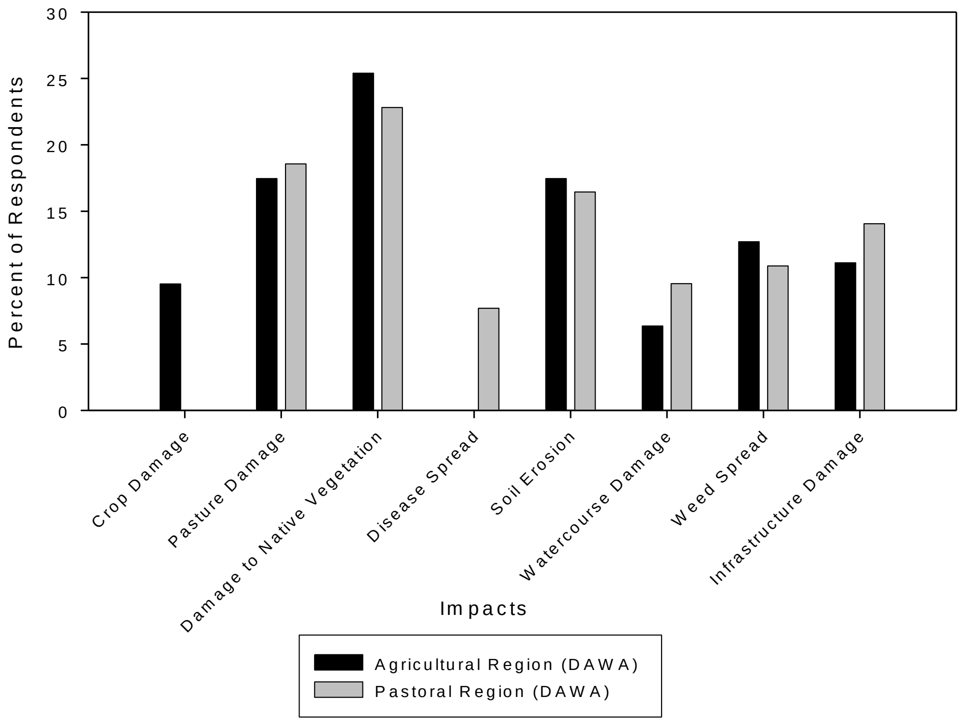


Figure 21. Impacts of feral goats in the agricultural region and rangelands assessed by Department of Agriculture staff (top, agricultural focus) and Department of Conservation and Land Management (below, conservation focus).



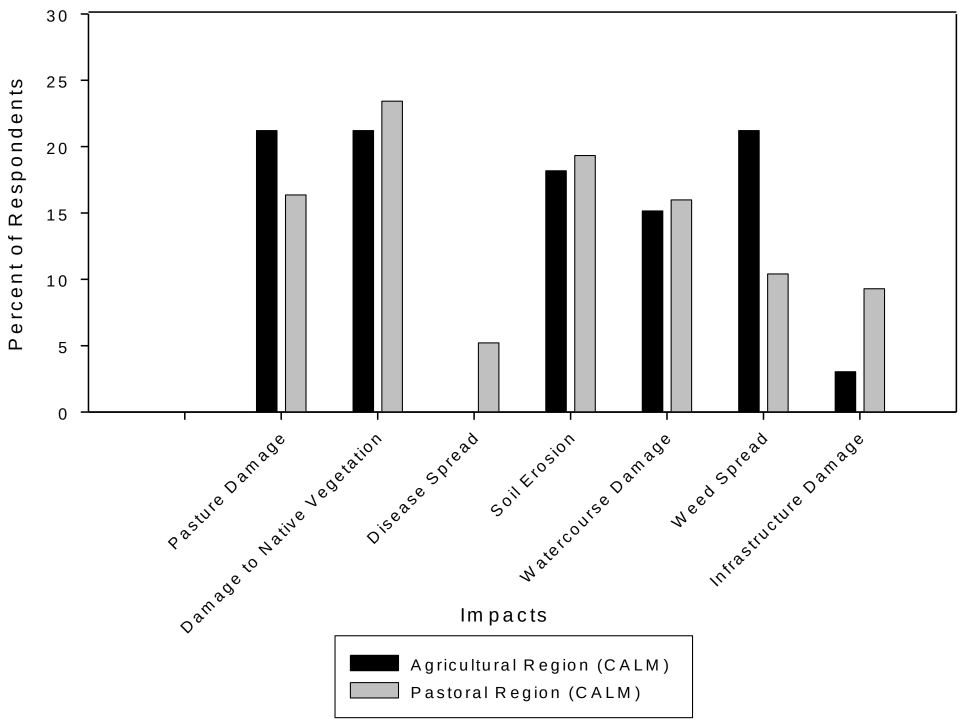
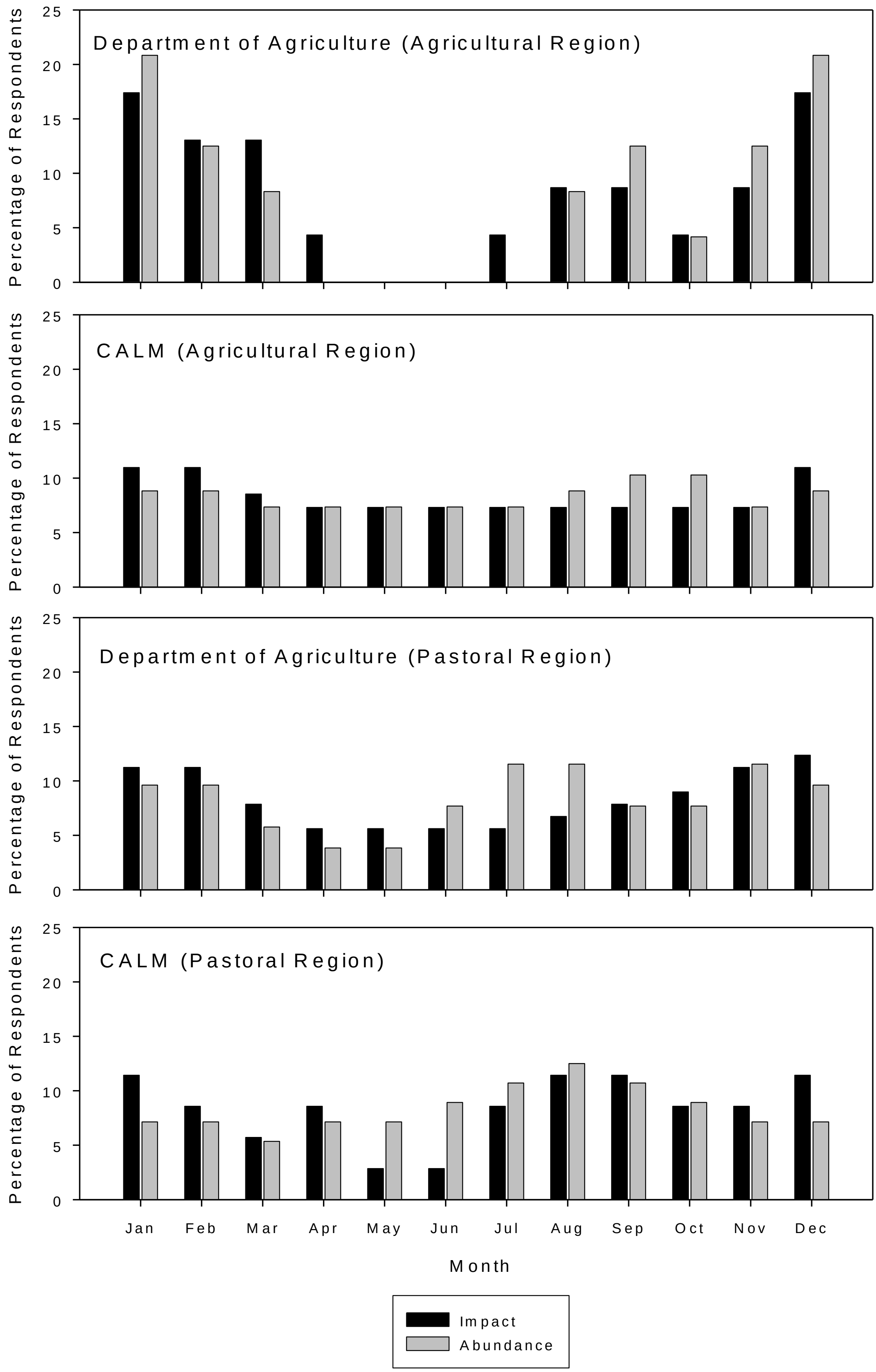


Figure 22. Timing of the maximum impacts (black) and abundances (grey) of feral goats for each of the respondent groups.



There are regional differences in the methods used to control feral goats (Figure 23). In the agricultural region, the most common technique used is hunting or shooting. In contrast, the control technique most used in the pastoral region is trapping or mustering (with the exception of shooting reported by CALM respondents, Figure 23). In terms of the effectiveness of the control techniques, most respondents suggested that shooting was the most appropriate (Table 7). However, DAWA respondents from the pastoral region suggested commercial harvest was the most effective form of control. In reality, control in the agricultural region is generally undertaken on low density isolated populations, for which shooting may be the most appropriate control technique. However, commercial harvesting, trapping and mustering may be the most effective control techniques for feral goats in the high abundance area of the southern rangelands. These techniques are very good at removing large numbers very quickly and cost effectively. Hunting and shooting may be more effective techniques to ‘mop up’ remaining animals from an area. It is important to remember that these results are perceptions of effectiveness rather than endorsements of control techniques.

Figure 23. Use of techniques for the control of feral goats reported by each of the respondent groups.

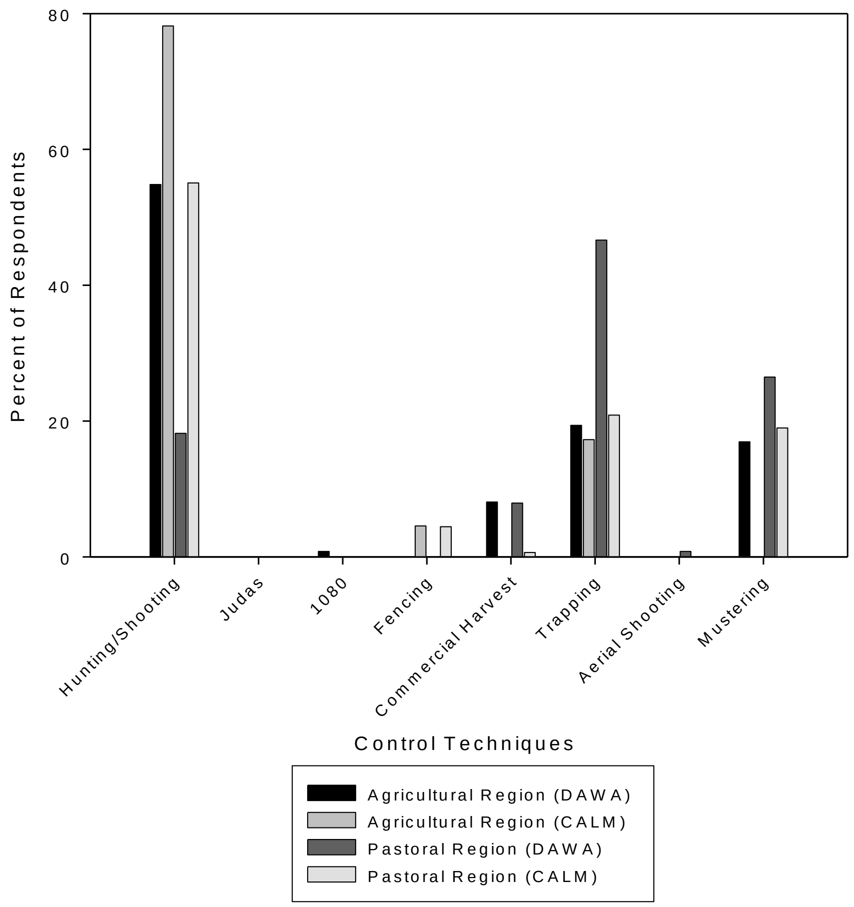


Table 7. Control techniques for feral goats ranked according to their perceived effectiveness for each of the respondent groups.

Control Techniques	DAWA Agricultural	CALM Agricultural	DAWA Pastoral	CALM Pastoral
Hunting and/or Shooting	1	1	2	1
Judas Techniques	not rated	not rated	not rated	6
1080 Poisoning	7	not rated	not rated	not rated
Exclusion Fencing	not rated	5	5	3
Commercial Harvesting	4	4	1	2
Trapping	2	2	3	5
Aerial Shooting	5	4	6	7
Mustering	3	not rated	4	4
Other	6	not rated	not rated	not rated

In the pastoral region, over 90% of DAWA and 100% of CALM respondents reported that problems caused by feral goats continued after control efforts (Figure 24). A similar response was gained from CALM respondents in the agricultural region. This may reflect the difficulties in managing feral goats on CALM estates in the agricultural region (e.g. limited resources, conflicting priorities, terrain issues etc.) In contrast, less than 50% of DAWA respondents in the agricultural region felt that feral goat problems continued to occur after control. That is, over 40% of respondents reported that control operations on non-CALM estate in the agricultural region effectively stopped feral goat problems.

The chances of feral goats coming into contact with domestic stock were perceived by CALM and DAWA rangeland respondents to be over 87% (Figure 25). In the agricultural area, both agency respondents reported that the potential was well over 50%. This suggests that feral goats may be a high risk species in terms of EADs. In the southern rangelands, this risk may be considerable because of the potential for close contact with sheep.

Figure 24. Recurrence of feral goat problems after control efforts for each of the respondent groups.

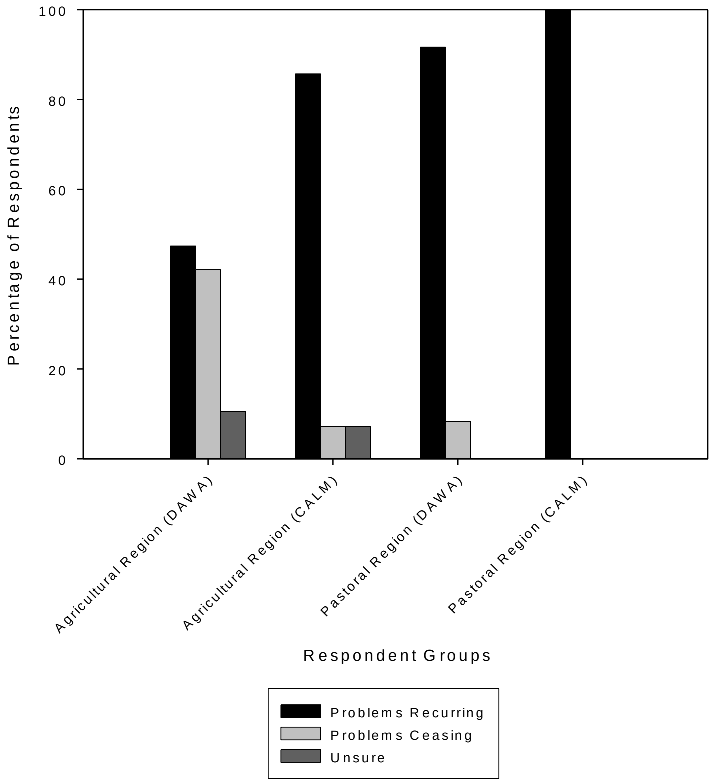
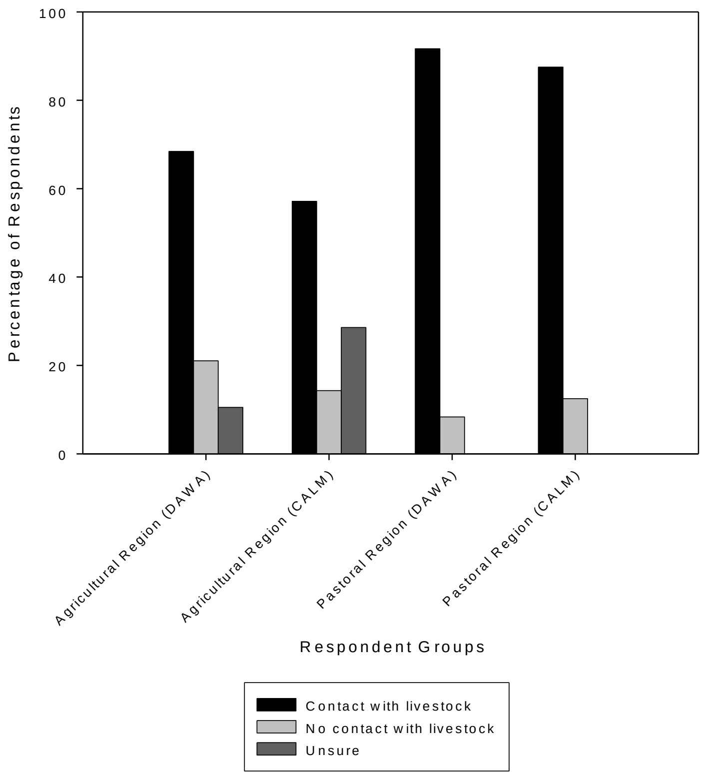


Figure 25. Potential for close contact between feral goats and domestic stock for each of the respondent groups.

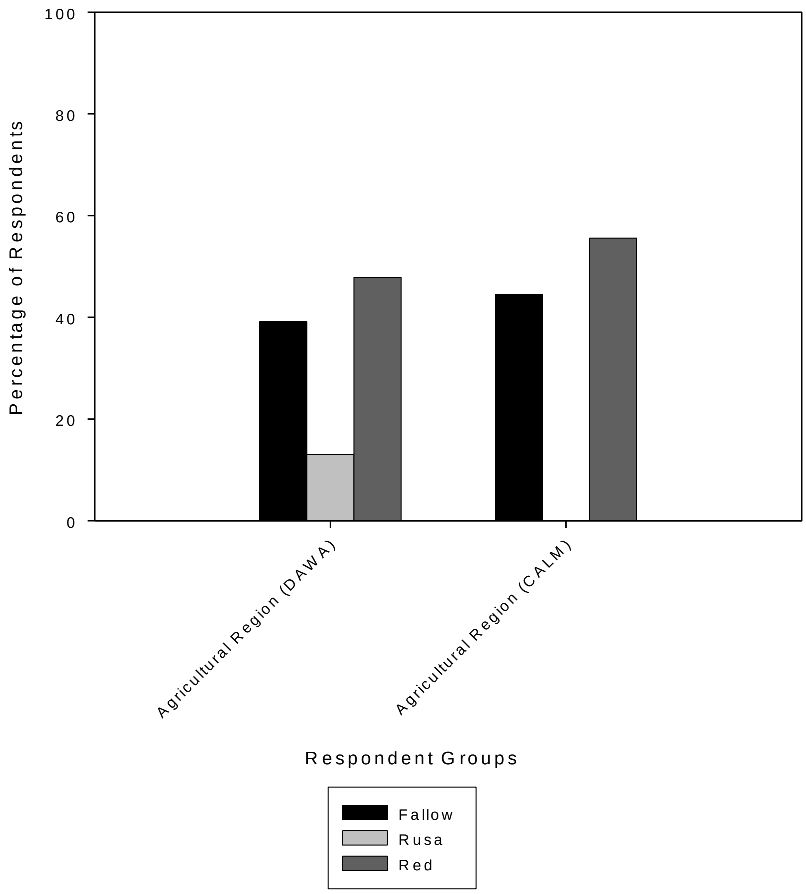


5.2.3 Feral Deer

Distribution and abundance of feral deer

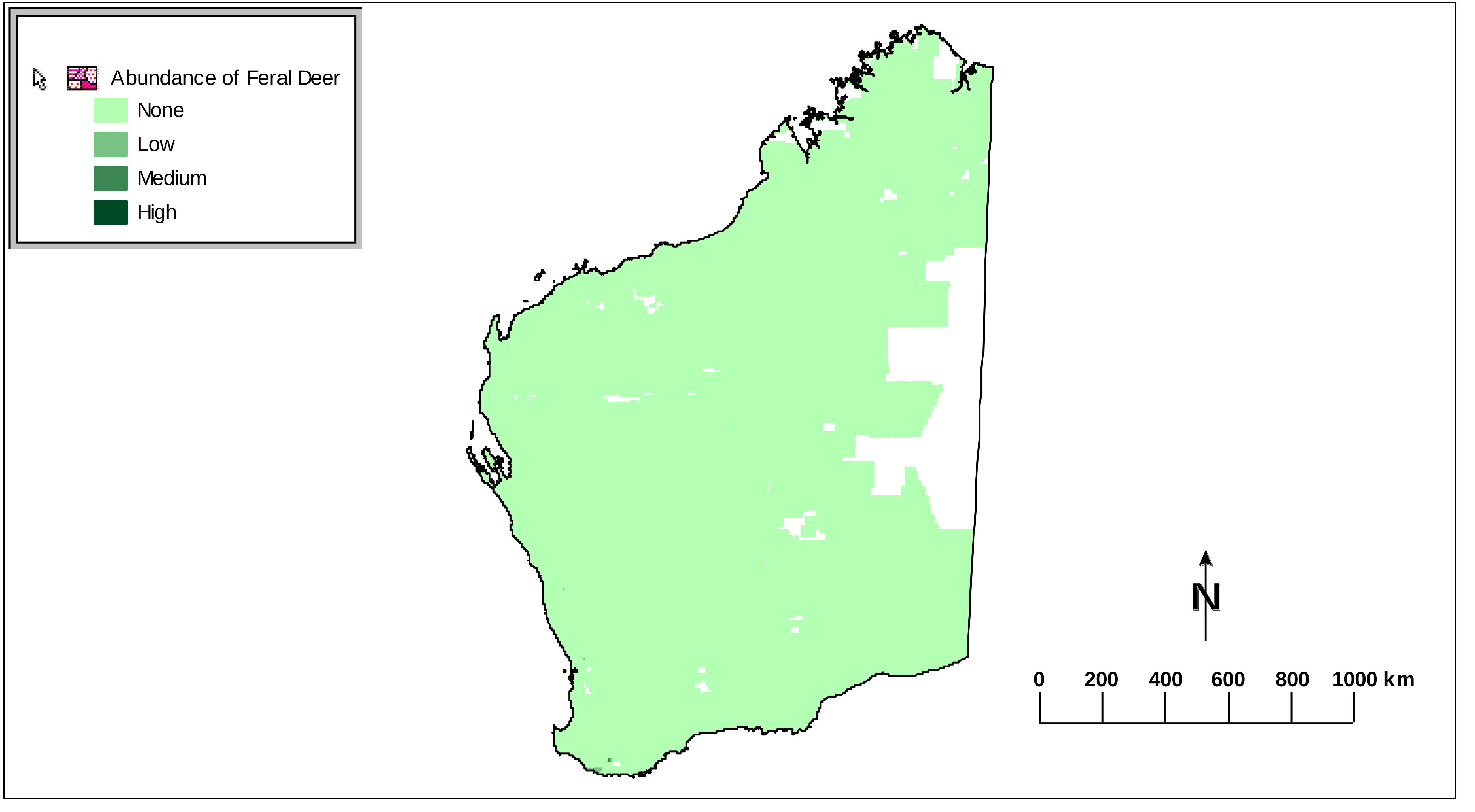
Three species make up the feral deer population in WA: fallow, red and rusa deer. Staff from both agencies have reported red deer to be the most common species of feral deer, followed by fallow deer (Figure 26). Feral populations of rusa deer are less common and have only recently come to the attention of DAWA staff. As described above (see Section 3.4), for the purpose of reporting the three deer species have been pooled together and are referred to as 'feral deer'.

Figure 26. Feral deer present in the agricultural region.



In terms of distribution and abundance, feral deer can be considered an emerging pest in WA and as such there are no areas of high abundance. Small areas of low and medium abundance are restricted to the south-west of the state (Figure 27). Some key areas where deer are found include the Mount Frankland National Park, Fitzgerald River National Park, the Perth hills and the Northampton district. Red and fallow deer are the more common species of deer in these areas.

Figure 27. Reported distribution and abundance of feral deer in Western Australia.



Corporate understanding of feral deer

Based on the information provided, feral deer were only reported in the agricultural region, with one exception from the pastoral region. Most respondents indicated that feral deer were absent from their area (Figure 28A). In the agricultural area, 30% of DAWA respondents and 43% of CALM respondents indicated that feral deer were present. When feral deer were present, most respondents were familiar with their distribution (Figure 28B). In the pastoral area, a single respondent from DAWA indicated that feral deer were present in the Murchison area (Figure 28A), but the respondent was unfamiliar with their distribution (Figure 28B).

The abundance of feral deer in the agricultural region is generally very rare or uncommon (Figure 28C). However, this is a characteristic of an emerging pest. Furthermore, feral deer are notoriously difficult to detect and quantify. Therefore, these reports may not be detailed enough for informed decision making without additional ground-truthing. That is, these results should form the building blocks for further investigations.

The key impacts of feral deer were reportedly damage to native vegetation, spread of weeds and, for CALM respondents, soil erosion (Figure 29). Interestingly, the role that feral deer may play in the spread of disease was considered to be low. The timing of the maximum impact was perceived to be in late spring and summer, when deer may be more visible because of food and water limitations (Figure 30). However, information about the timing of impacts was low because of the lack of familiarity of respondents with this pest animal.

Reported methods used to control feral deer were almost exclusively shooting based (Figure 31). Exclusion fencing was also listed as a technique that was used to control feral deer, but it was perceived to be less effective than shooting to control the impacts of feral deer (Table 8). Other techniques such as poisoning or trapping were also perceived to be less effective than shooting. However, like many emerging pest species, having good information about control options and their effectiveness in a specific environment takes time to develop. Consequently, feral deer problems generally tend to recur after control efforts (Figure 32).

Each of the three species of feral deer are disease risk species. Both DAWA and CALM respondents considered that feral deer have potential to have close contact with domestic stock (Figure 33). The mobile yet cryptic nature of feral deer, combined with their propensity to inhabit farmland/bush-edge habitats adds to the risk of disease transmission of endemic diseases and EADs. Also, because feral deer are so cryptic, detection of disease within a population is likely to be very difficult.

Unlike feral pigs, feral deer are unlikely to be introduced to an area deliberately for recreational hunting purposes (Figure 34). However, they are species that are likely to escape from captivity or be liberated from a managed deer farm (Figure 35). These accidental and deliberate releases of managed deer are likely to form the basis of feral populations in the agricultural region of WA.

Figure 28. Presence (A), familiarity (B) and abundance (C) of feral deer for Western Australia described by all respondent groups.

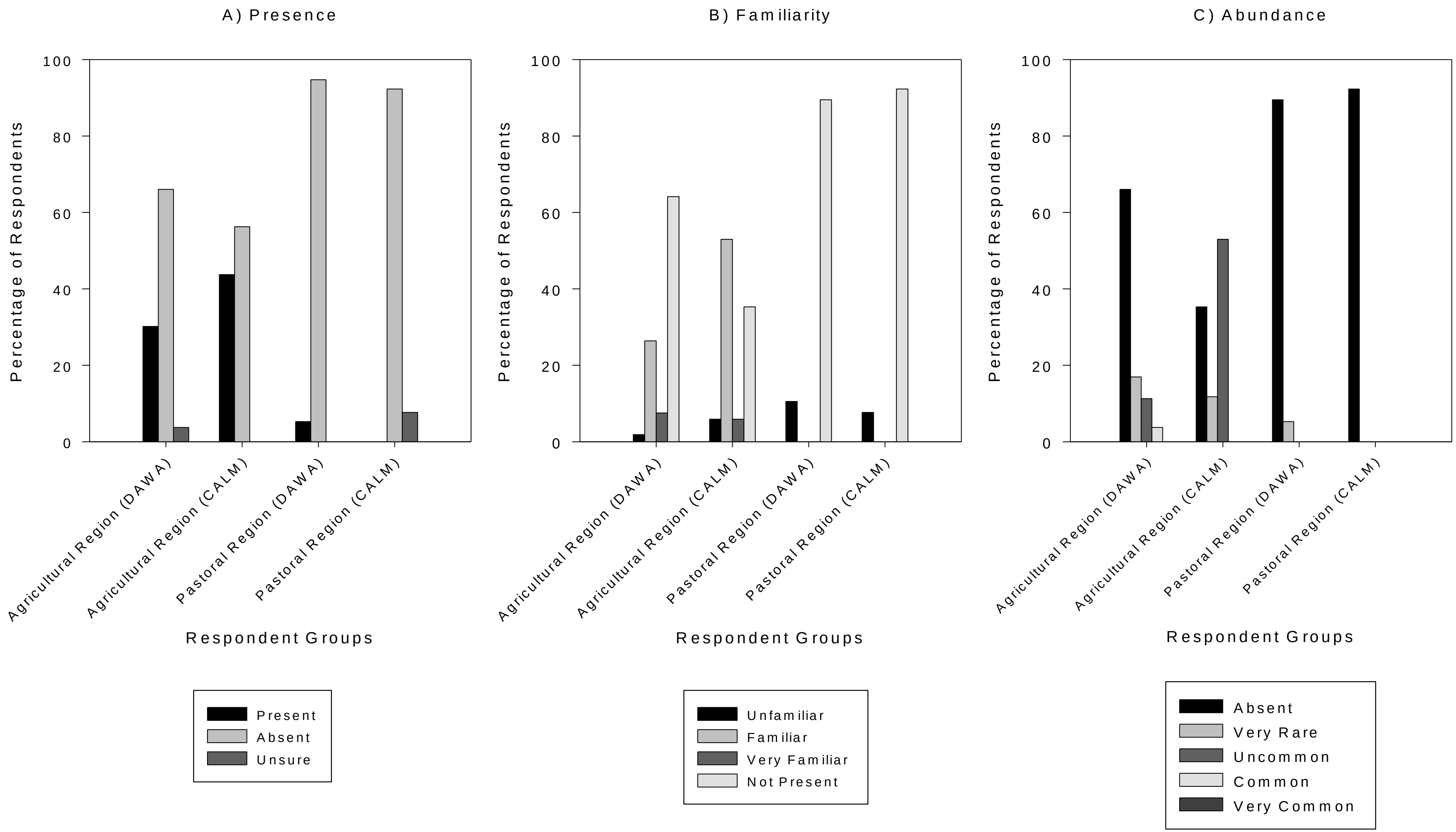


Figure 29. Impacts of feral deer in the agricultural region.

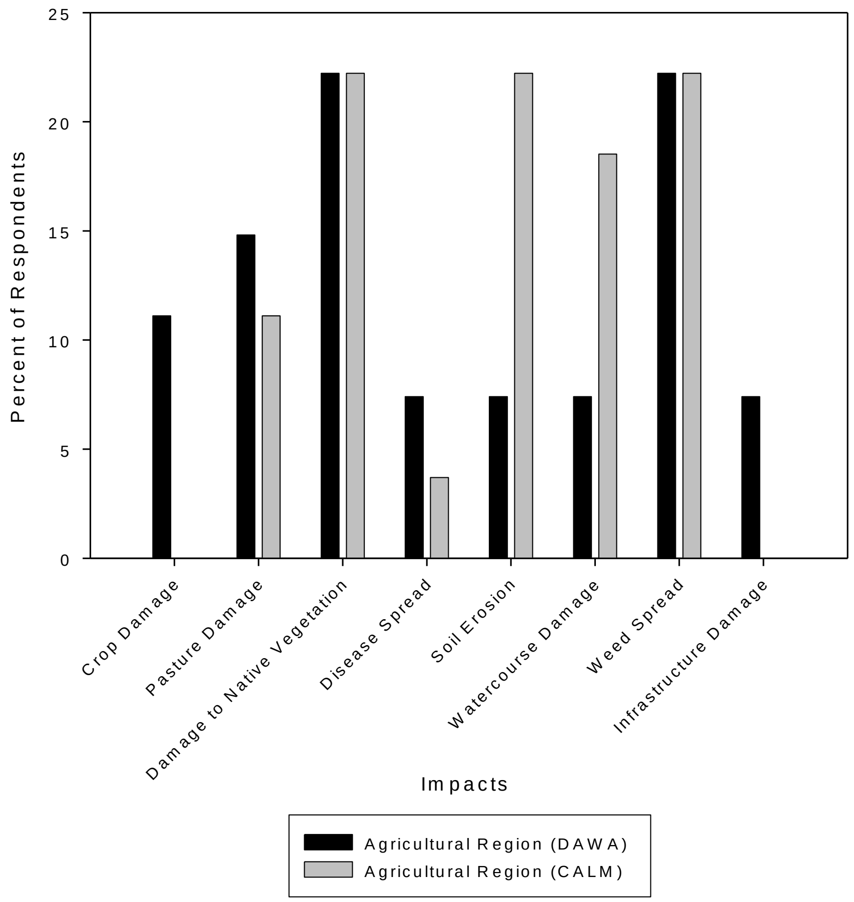


Figure 30. Timing of the maximum impacts (black) and abundances (grey) of feral deer for respondents from the Department of Agriculture in the agricultural region. Note, there was insufficient data for the other respondent groups.

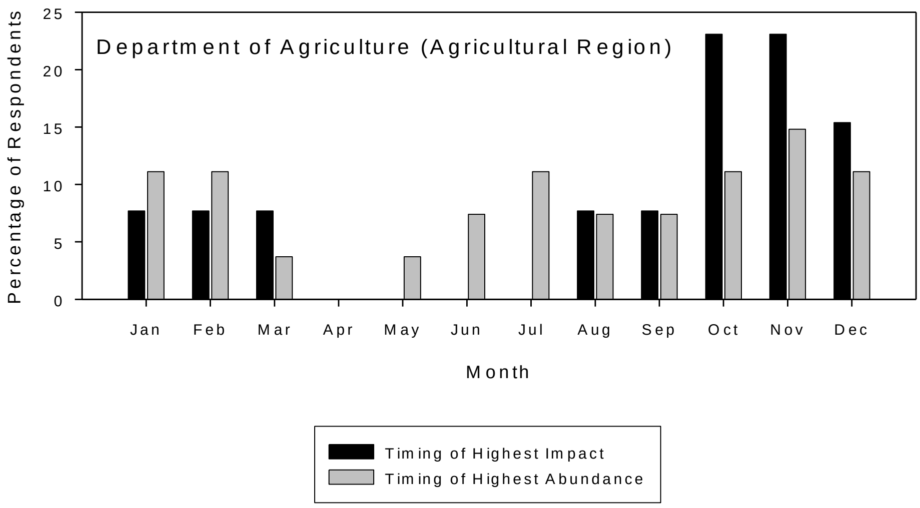


Figure 31. Use of techniques for the control of feral deer reported by each respondent group in the agricultural region.

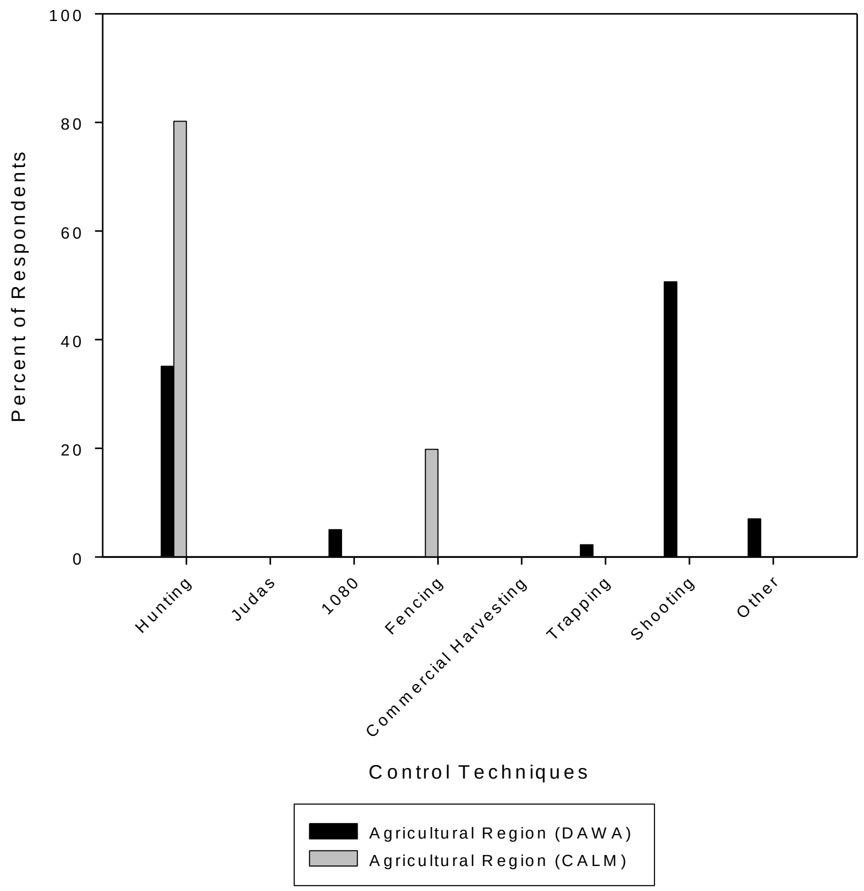


Table 8. Control techniques for feral deer ranked according to their perceived effectiveness for each of the respondent groups.

Control Techniques	DAWA Agricultural	CALM Agricultural	DAWA Pastoral	CALM Pastoral
Hunting and/or Shooting	2	1	N/A	N/A
Judas Techniques	not rated	not rated	N/A	N/A
1080 Poisoning	4	not rated	N/A	N/A
Exclusion Fencing	5	2	N/A	N/A
Commercial Harvesting	not rated	not rated	N/A	N/A
Trapping	3	not rated	N/A	N/A
Shooting	1	not rated	N/A	N/A

Figure 32. Recurrence of feral deer problems after control efforts in the agricultural region.

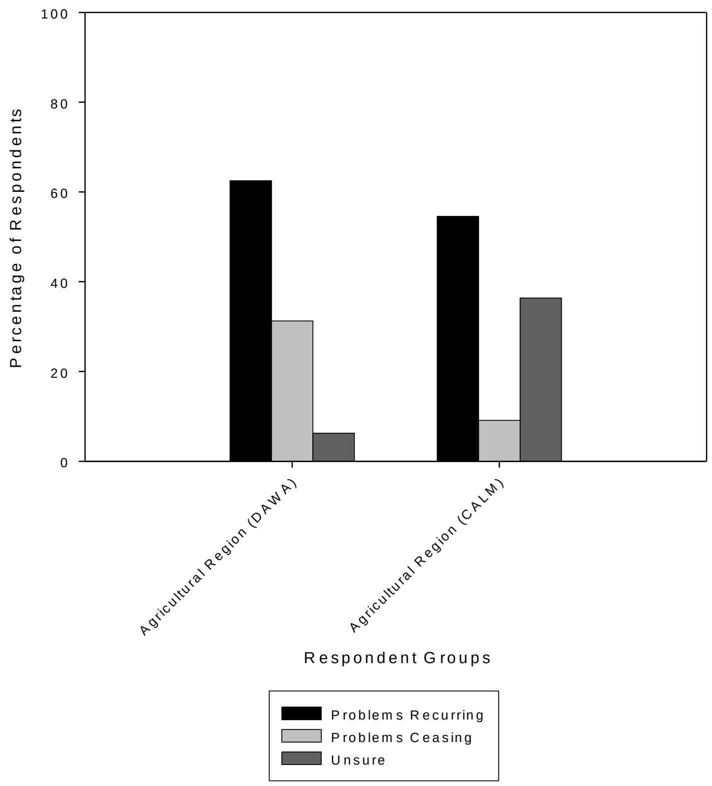


Figure 33. Potential for close contact between feral deer and domestic stock in the agricultural region.

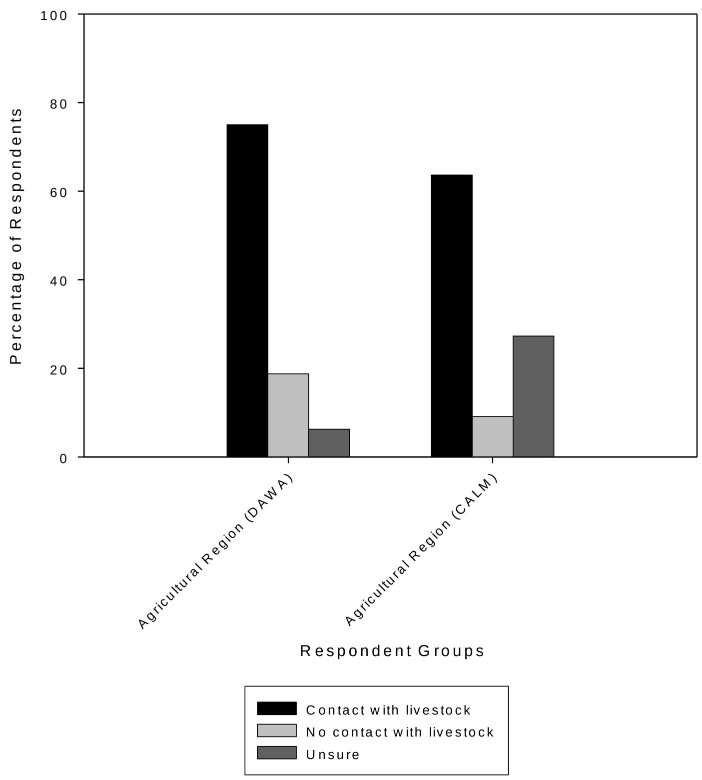


Figure 34. Deliberate movements or introductions of feral deer from outside the local area in the agricultural region.

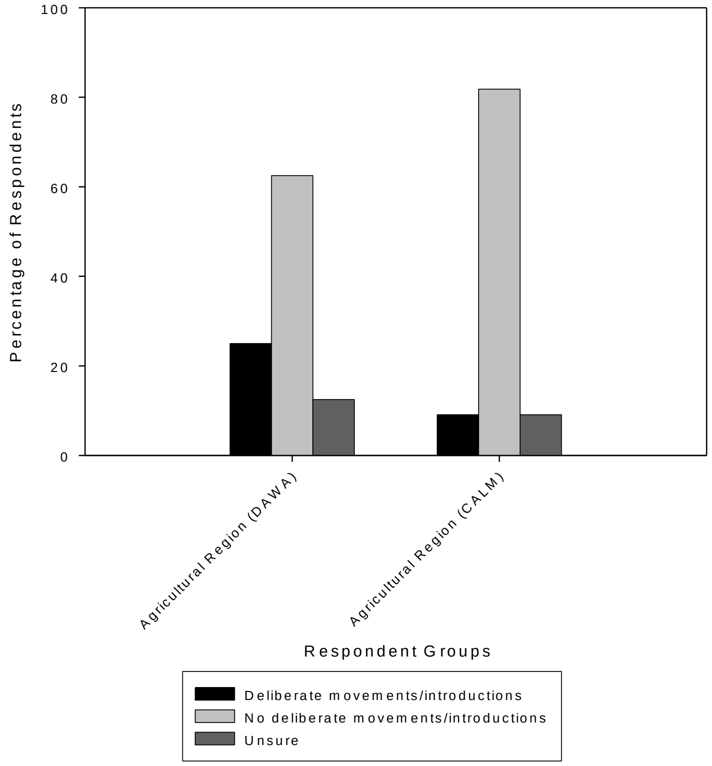
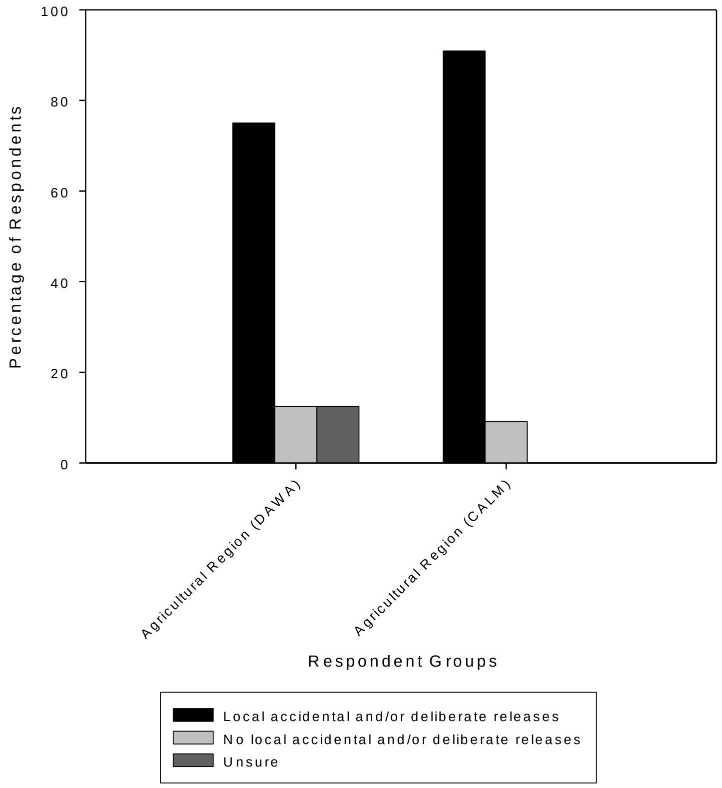


Figure 35. Accidental or deliberate releases from captivity of deer in the agricultural region.



5.2.4 Foxes

Distribution and abundance of foxes

This study did not examine the distribution and abundance of very common species, such as the fox (see Section 3.4). This information can be obtained from sources such as Long (1988), Saunders *et al*. (1995) or Long (2003).

Corporate understanding of foxes

Foxes are widespread in Western Australia, particularly in the agricultural region and the southern rangelands. All respondents in the agricultural region reported foxes to be present in the areas they managed (Figure 36A). Furthermore, respondents were either familiar or very familiar with their distribution (Figure 36B). In the pastoral region, over 75% of respondents reported the presence of foxes (Figure 36A). Most of the rangeland respondents without foxes in their districts were located in the north of the state. Like the agricultural region, most pastoral region respondents were familiar or very familiar with the distribution of foxes, when they were present (Figure 36B). In the agricultural region foxes were considered to be common or very common, regardless of land tenure (Figure 36C). In the pastoral region foxes were generally considered common in abundance when present.

Both agencies reported that predation was the biggest impact caused by foxes (Figure 37). For the conservation-oriented CALM, predation of native animals was the main impact. Similarly, DAWA staff reported predation of native animals as the biggest impact, closely followed by predation of livestock (Figure 37). CALM respondents also suggested that foxes were important in the spread of weeds and disease. Again, we can not be certain if the spread of disease is specifically animal disease, or if it includes plant diseases such as dieback.

Because foxes are abundant and subjected to continual control, all respondents had good knowledge about the timing of the impacts caused by foxes and when numbers were reportedly at their peak (Figure 38). These factors coincide with variables such as lambing (maximum agricultural impact) and the fox breeding season (maximum fox abundance). Saunders *et al.* (1995) describe much of the timing issues in detail.

Baiting with 1080 poisoning is the most commonly used technique to control foxes (Figure 39), and is regarded as the most effective control technique for foxes (Table 9). Shooting and hunting is frequently used in the agricultural region to control foxes (Figure 39) and is perceived to be the next most effective control technique after 1080 (Table 9). Other techniques are generally not used or they are perceived to be less effective than 1080 or shooting.

Most respondents reported that fox problems continue despite control efforts (Figure 40). This result is a little surprising, especially for CALM respondents. We expected that at least some CALM respondents would have suggested that baiting campaigns, as part of Western Shield, may have had success in preventing recurrence of problems caused by foxes.

Figure 36. Presence (A), familiarity (B) and abundance (C) of foxes for Western Australia described by all respondent groups.

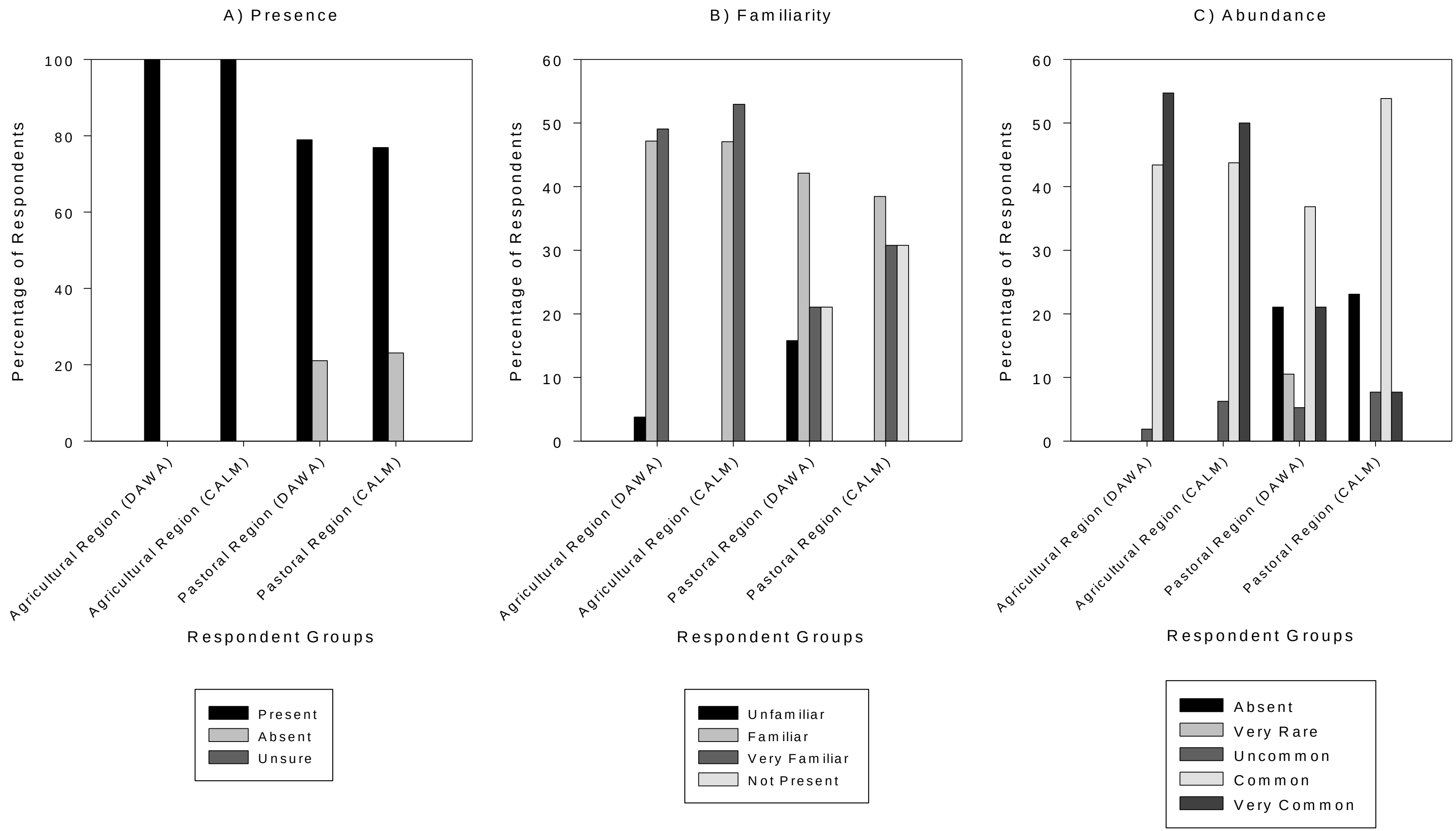
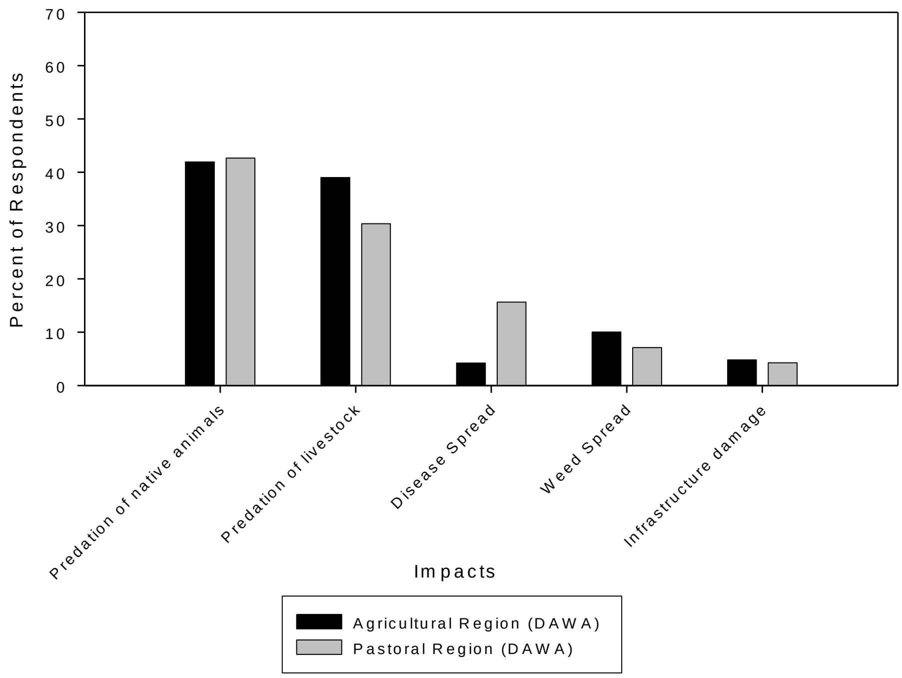


Figure 37. Impacts of foxes in the agricultural region and rangelands assessed by Department of Agriculture staff (top, agricultural focus) and Department of Conservation and Land Management (below, conservation focus).



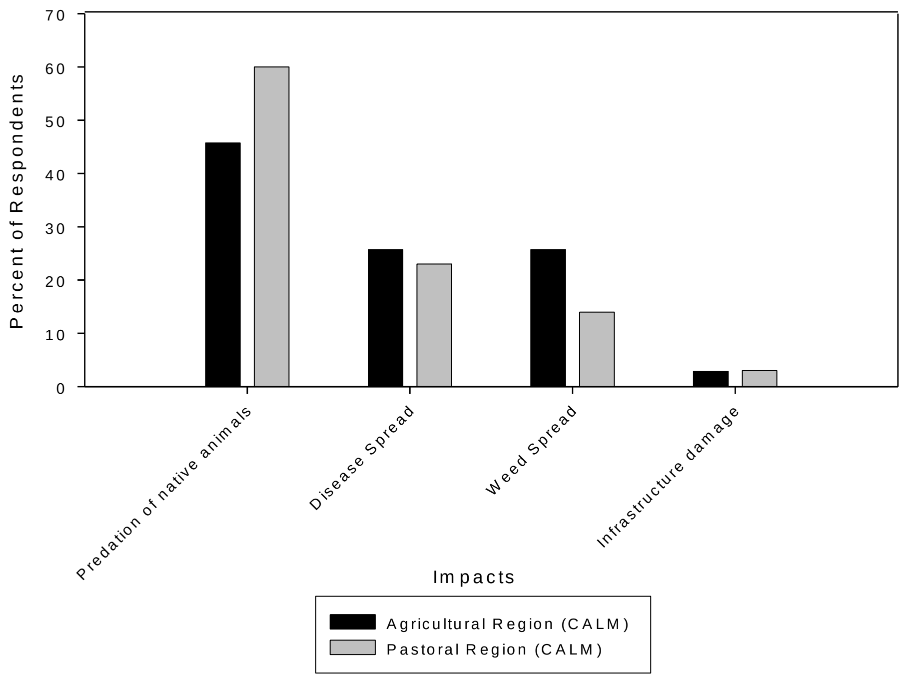


Figure 38. Timing of the maximum impacts (black) and abundances (grey) of foxes for each of the respondent groups.

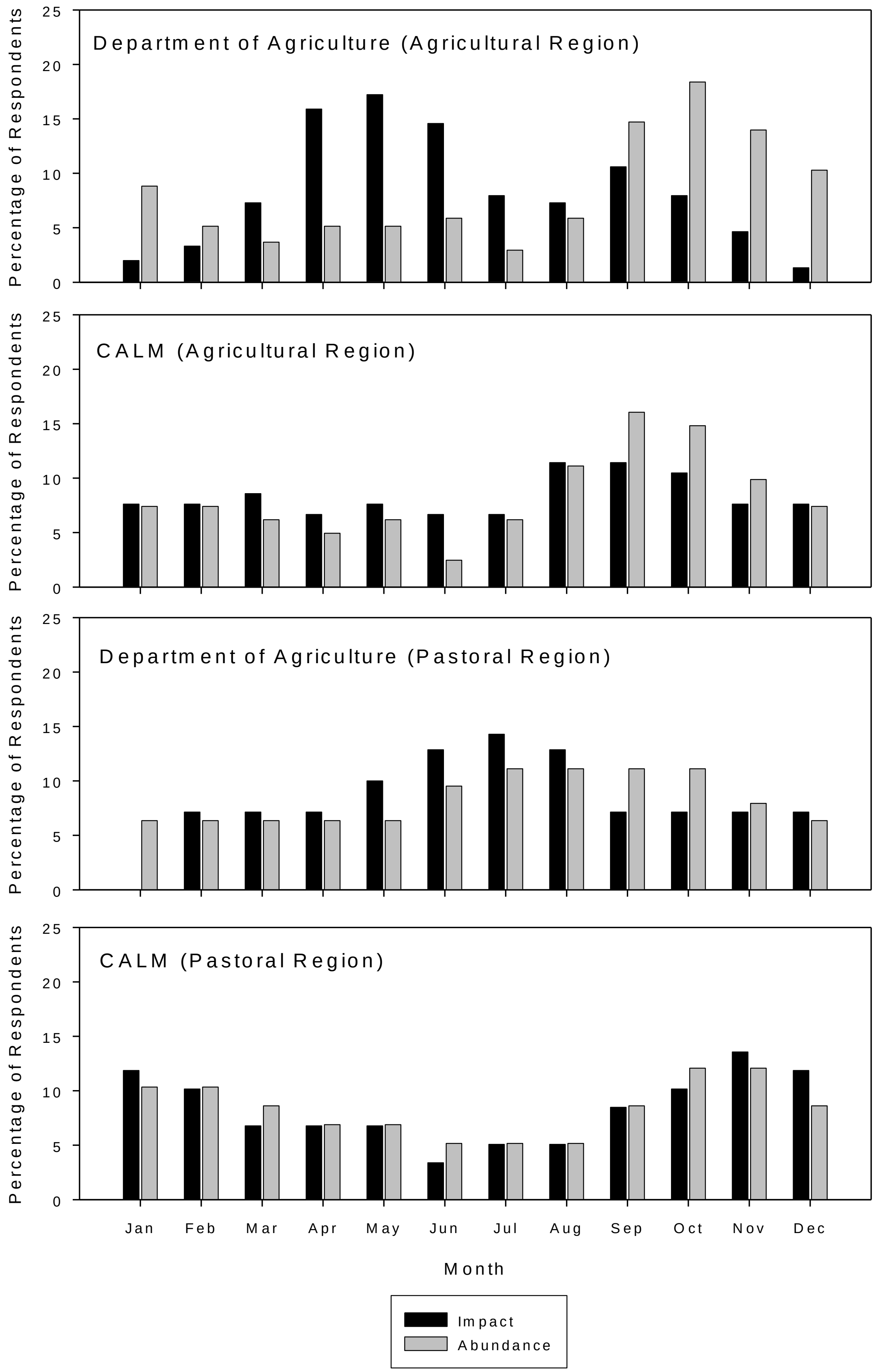


Figure 39. Use of techniques for the control of foxes reported by each of the respondent groups.

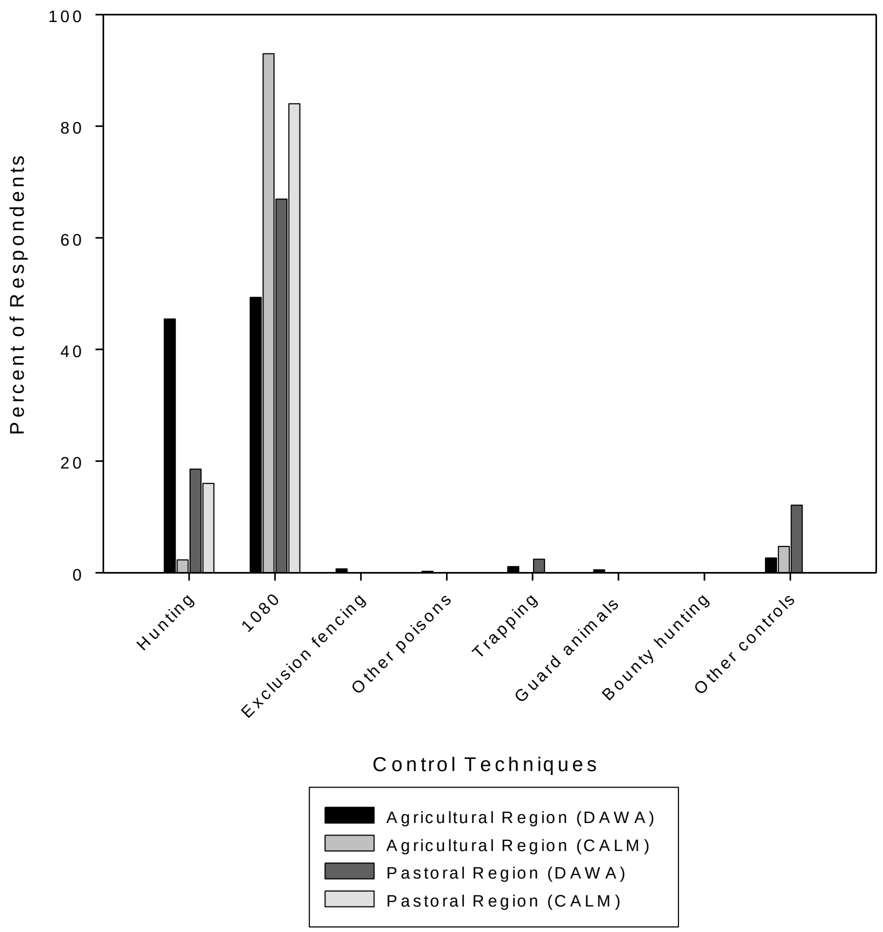
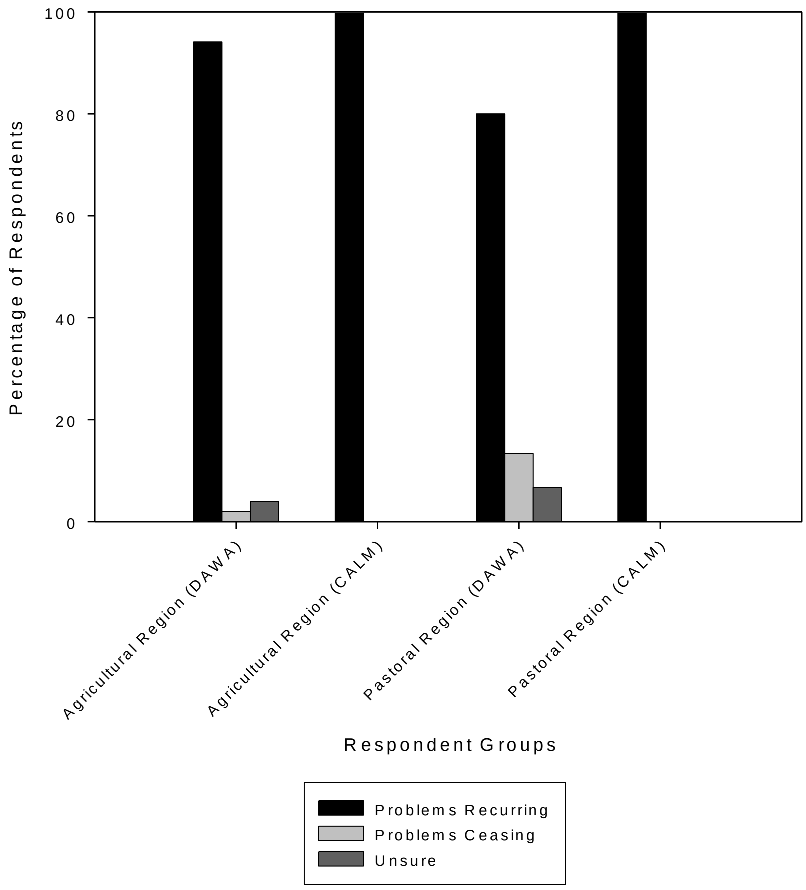


Table 9. Control techniques for foxes ranked according to their perceived effectiveness for each of the respondent groups.

Control Techniques	DAWA Agricultural	CALM Agricultural	DAWA Pastoral	CALM Pastoral
Hunting and/or Shooting	2	2	2	2
1080 Poisoning	1	1	1	1
Exclusion Fencing	3	3	not rated	not rated
Other Poisons	6	not rated	not rated	3
Trapping	4	not rated	3	4
Guard Animals	5	not rated	not rated	not rated
Bounty Hunting	7	not rated	not rated	not rated
Other	not rated	not rated	not rated	not rated

Figure 40. Recurrence of fox problems after control efforts for each of the respondent groups.



5.2.5 Wild Dogs

Distribution and abundance of wild dogs

Wild dogs were reported in high abundance in the Pilbara, Kimberley and Nullarbor regions of the state (Figure 41). Their distribution and abundance generally correlates with the majority of control activities and the type of pastoral enterprise (i.e. sheep versus cattle). The southern rangelands, for example, are generally associated with sheep production and have historically been subjected to high levels of control, more so than the cattle-based enterprises of the northern rangelands.

One surprising feature of the distribution and abundance map for wild dogs is the perceived high abundance of wild dogs in the eastern wheat belt. Despite cross-validation of data, high values within the Yilgarn/Westonia Shires were likely to reflect public concern over wild dogs, at the time of the survey, rather than actual abundance (P. Thomson, pers. comm.). This is expanded on in the discussion (see section 6.2.2).

Corporate understanding of wild dogs

As described above (see Section 3.4), we used the definition of Fleming *et al.* (2001) to define wild dogs. Dogs responsible for livestock incidents included town dogs, feral dogs and dingoes or dingo-hybrids (Figure 42). The distribution and abundance of the three dog groupings outlined in Figure 42 is likely to be a function of settlements and urbanisation. For example, town dogs are unlikely to be found large distances from a settlement and hence their impact on livestock is likely to be associated with enterprises close to these settlements. Consequently, the impact of town dogs on livestock is possibly greater in the agricultural region than the less settled rangelands, with these trends indicated by regional difference in the compositional structure of wild dogs (Figure 42).

Wild dogs are synonymous with the pastoral region. This is reflected in Figure 43A where 100% of DAWA staff and 92% of CALM staff in the pastoral region indicated that wild dogs were present in the areas they managed. In the agricultural regions, the number of respondents with feral dogs present was less. Those respondents from the agricultural region that did report feral dogs being present were often from the shires at the edge of the pastoral region or had overlap with the pastoral region (e.g. Shire of Esperance). However, wild dogs were also present in other areas of the agricultural region (see Figure 41), particularly in some CALM reserves which acted as refuges.

Pastoral region respondents from DAWA were generally familiar or very familiar with the distribution of wild dogs (Figure 43B). This is primarily because of the role of DAWA staff in the coordination of baiting campaigns in the pastoral region. Similarly, CALM respondents in the pastoral region were also generally familiar with the distribution of wild dogs, but they have not generally played such an important role in wild dog management. In the agricultural region, when wild dogs were present DAWA respondents were generally familiar or very familiar with distributions. This reflects the fact that impacts on sheep are generally reported to DAWA offices. Some CALM respondents were unfamiliar with the distribution of wild dogs when they were present, whereas others were familiar. Again, this may represent regional differences in the management of wild dogs by CALM respondents across the agricultural region. For example, CALM respondents working in the eastern wheat belt are probably familiar with the distribution of wild dogs on CALM estates and unallocated crown land because of community engagement. In contrast, CALM respondents working in other reserves may not be familiar with the distribution of wild dogs because there are other management issues with higher priority.

Figure 41. Reported distribution and abundance of wild dogs in Western Australia.

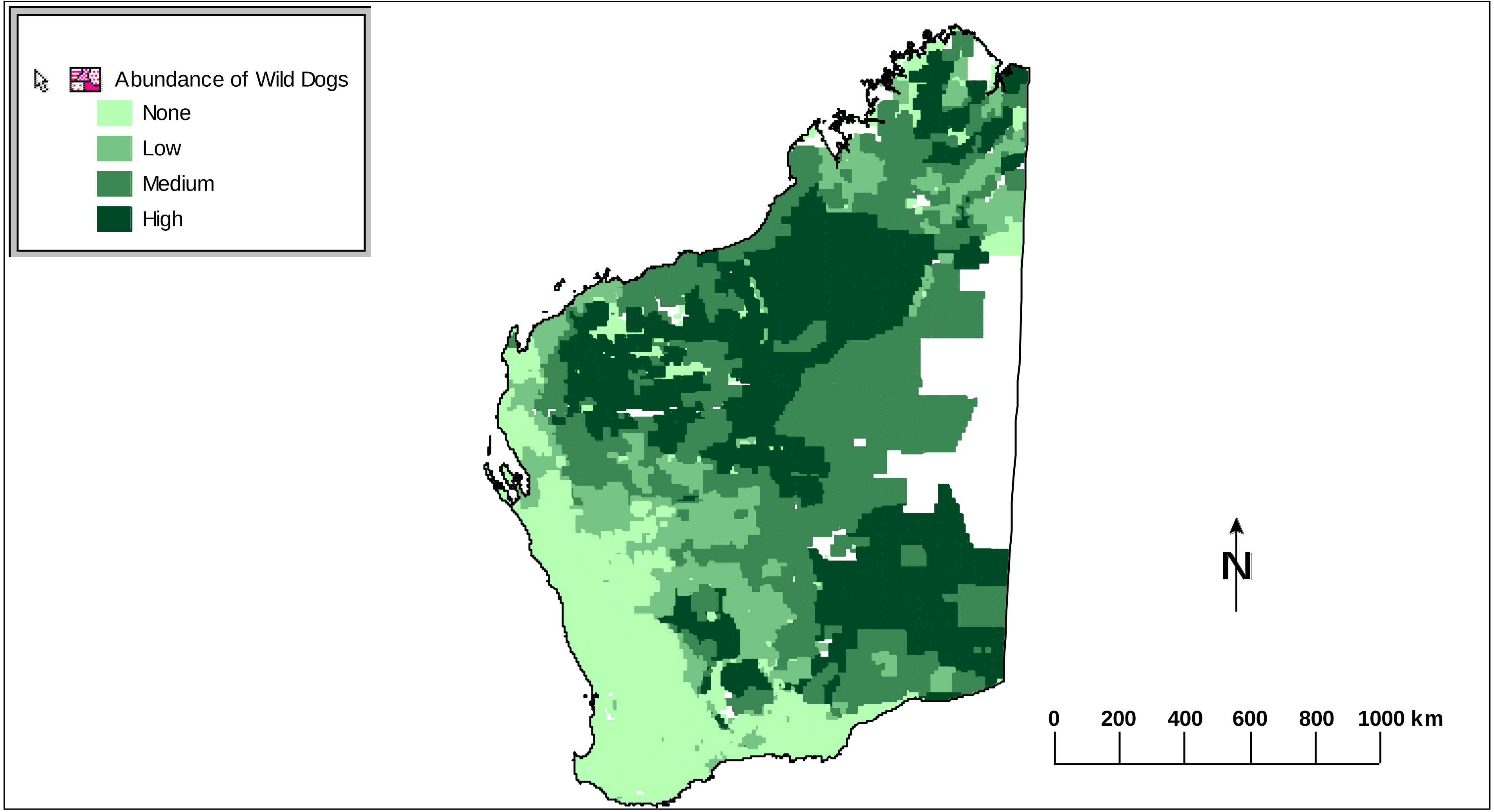
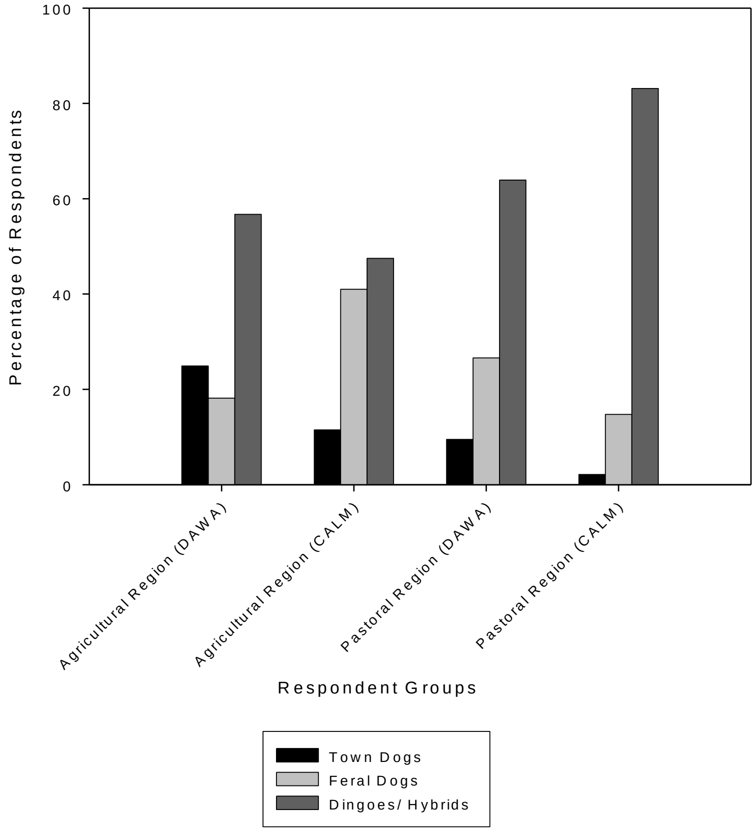


Figure 42. Make up of wild dog population implicated in incidents with livestock.



The abundance of wild dogs is also skewed towards the pastoral region (Figure 43C). Over 84% of DAWA respondents in the pastoral region reported wild dogs to be common or very common in the areas they managed. Likewise, 69% of CALM respondents in the pastoral region reported wild dogs to be common in abundance. In the agricultural region, the abundance of wild dogs could be regarded as absent to uncommon. However, as described above, there is generally a gradient of abundance of wild dogs in the agricultural region, with wild dogs becoming more abundant towards the interface of the agricultural and pastoral regions (Figure 41).

From the perspective of DAWA respondents, the key impacts of wild dogs were reported to be the predation of livestock and native animals (Figure 44). This holds true for both the agricultural region and the pastoral region. Although a similar result was provided by all CALM respondents, the responses were weighted towards predation of native animals rather than livestock. From an animal disease perspective, wild dogs were generally not perceived to be a problem, although they may be implicated with Neosporosis in cattle.

With the exception of DAWA respondents from the agricultural region, it was generally perceived that there was limited variability in the timing of maximum impacts and abundances of wild dogs throughout the year (Figure 45). DAWA respondents in the agricultural region suggested that the maximum impacts caused by wild dogs and the abundance of wild dogs were generally highest in summer, with a second peak of maximum impact associated with the autumn lambing season. In the pastoral region, DAWA respondents also suggest that the abundance of wild dogs is highest in August and September when juvenile animals are present.

Figure 43. Presence (A), familiarity (B) and abundance (C) of wild dogs for Western Australia described by all respondent groups.

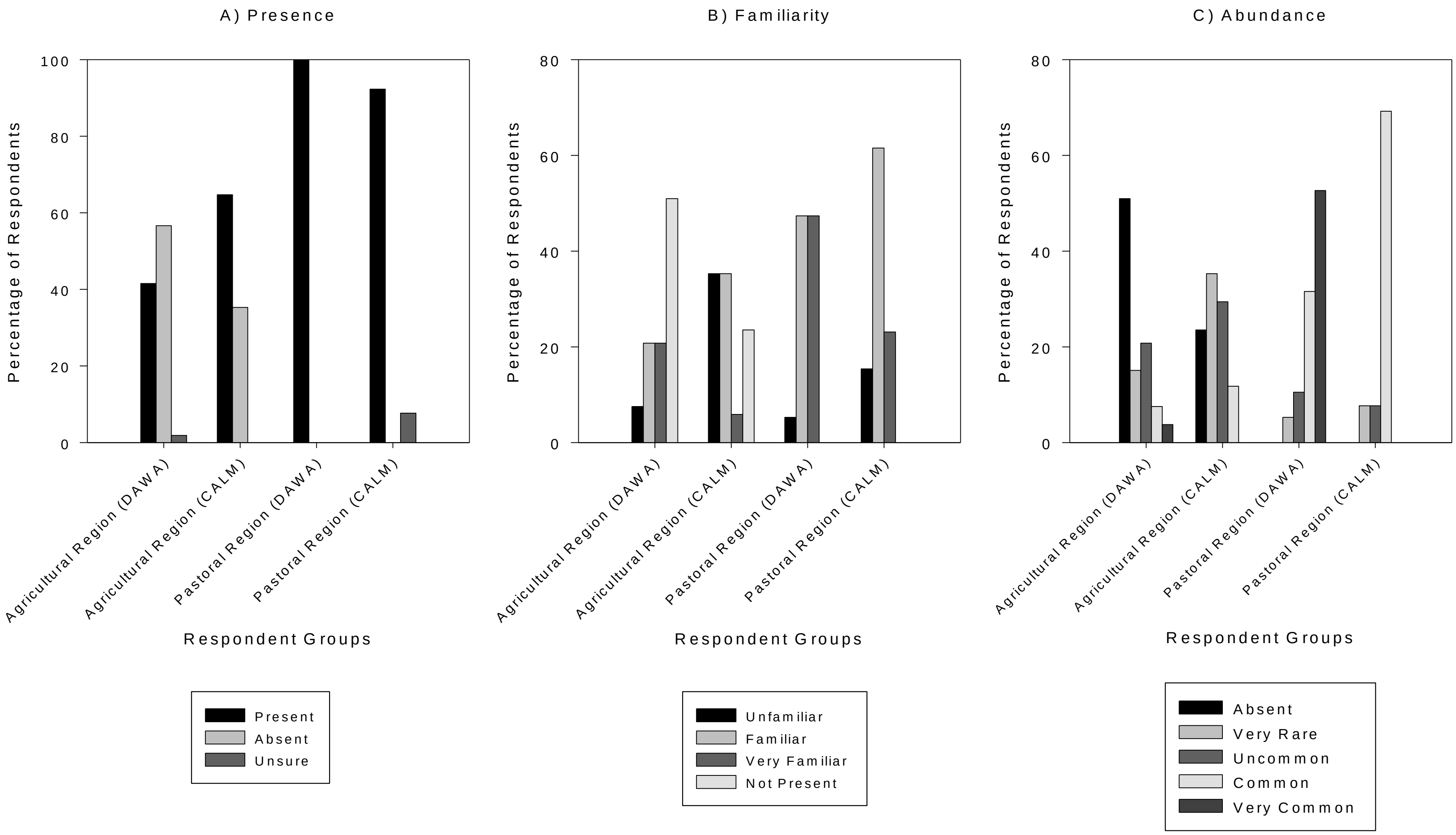
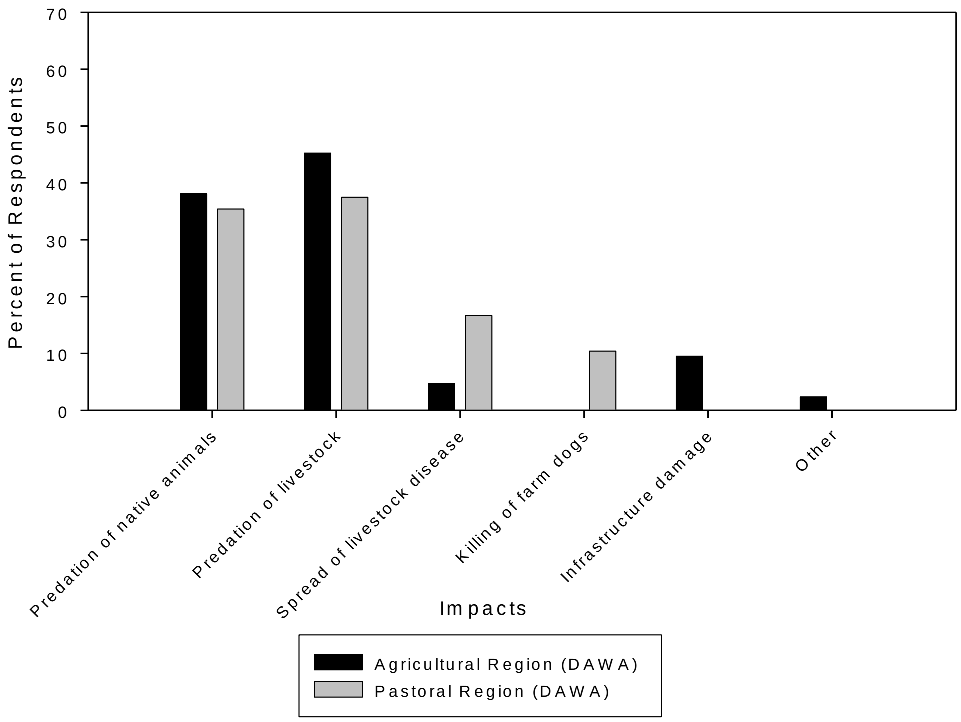


Figure 44. Impacts of wild dogs in the agricultural region and rangelands assessed by Department of Agriculture staff (top, agricultural focus) and Department of Conservation and Land Management (below, conservation focus).



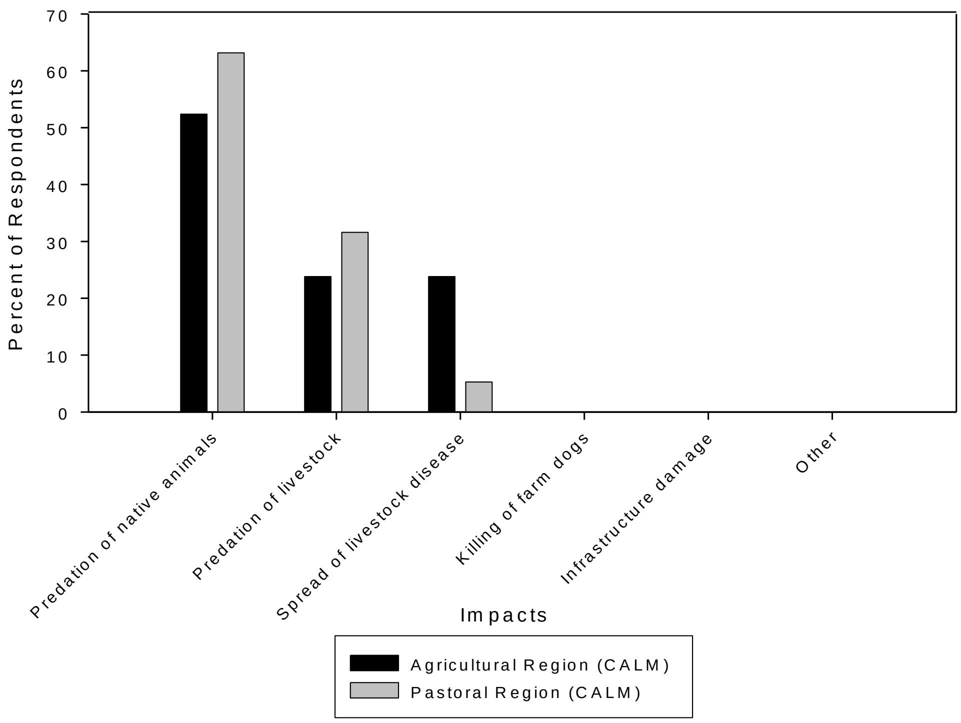


Figure 45. Timing of the maximum impacts (black) and abundances (grey) of wild dogs for each of the respondent groups.

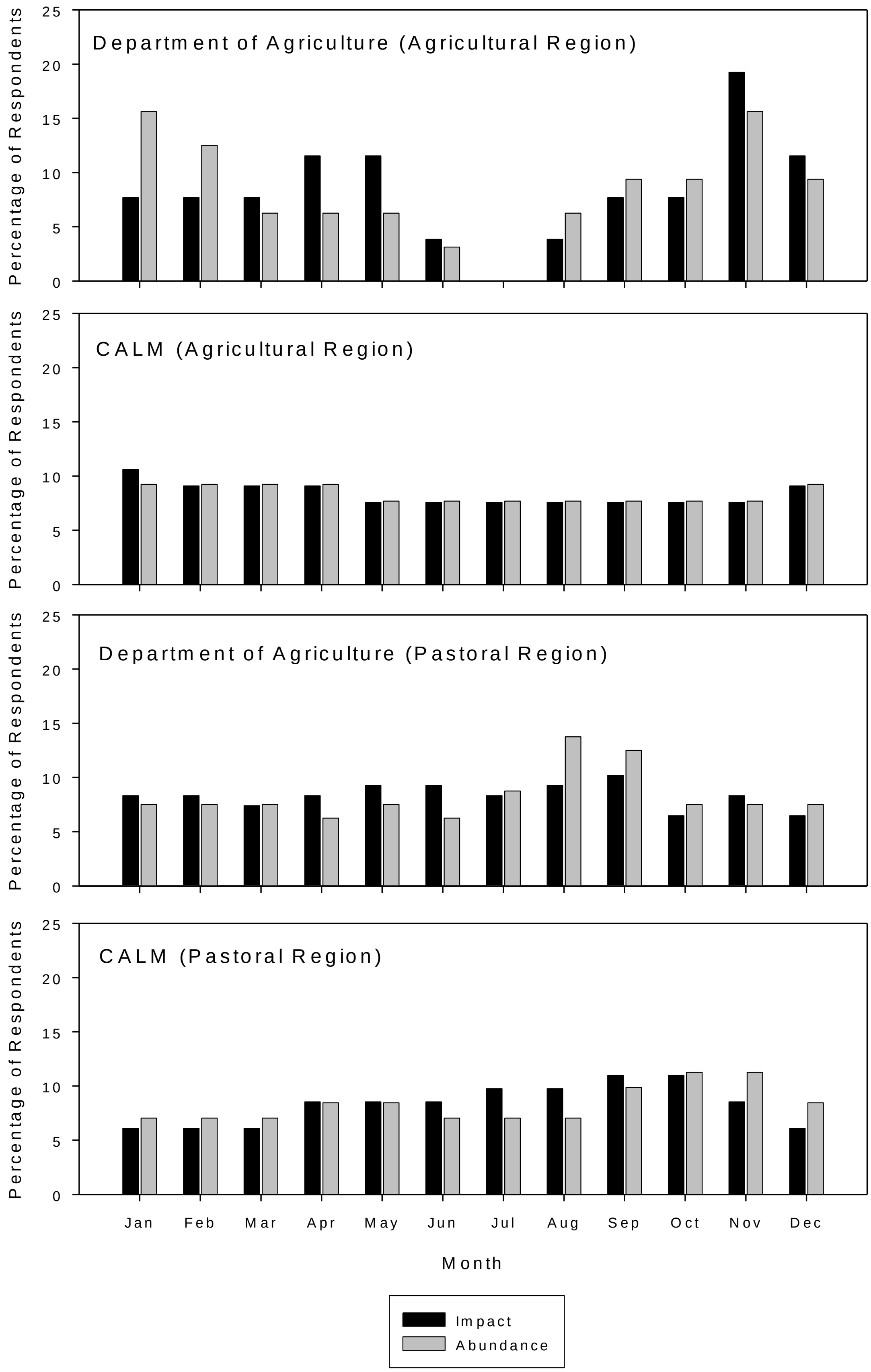


Figure 46. Use of techniques for the control of wild dogs reported by each of the respondent groups.

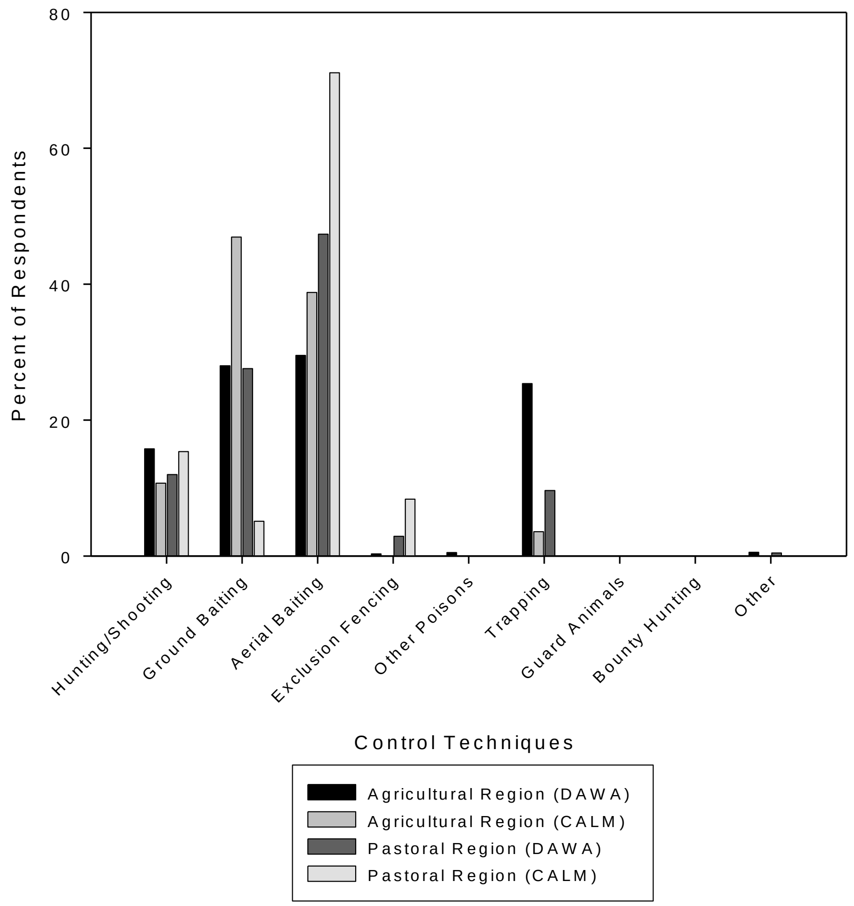


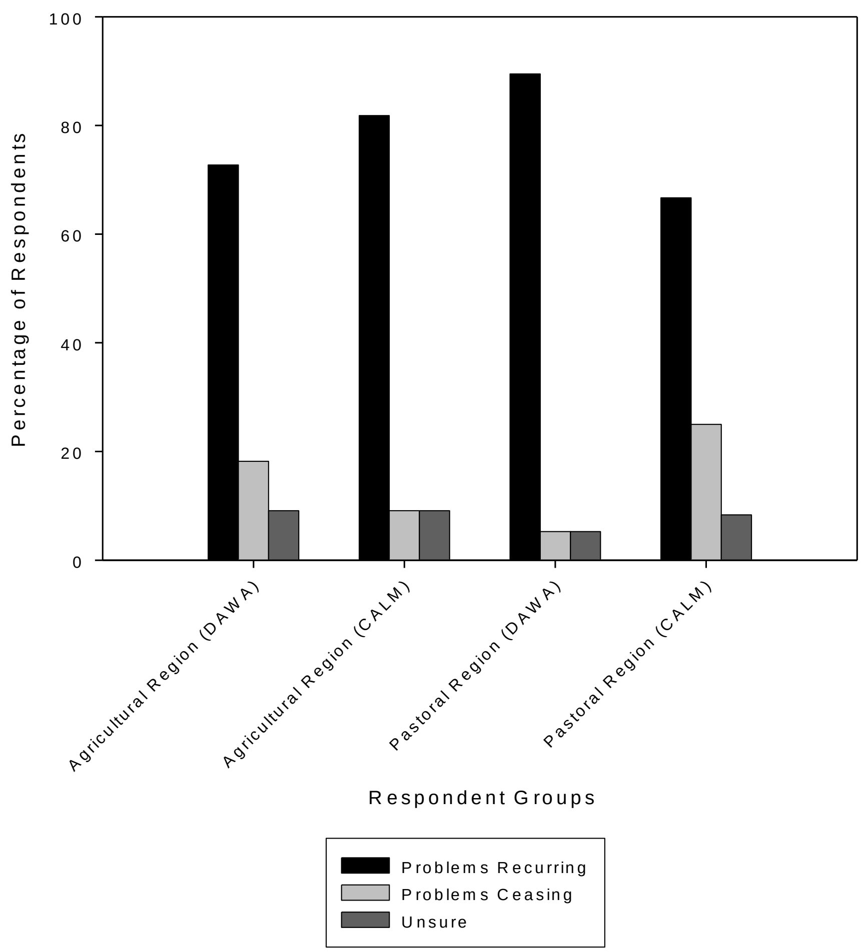
Table 10. Control techniques for wild dogs ranked according to their perceived effectiveness for each of the respondent groups.

Control Techniques	**DAWA Agricultural**	**CALM Agricultural**	**DAWA Pastoral**	**CALM Pastoral**
Hunting and/or Shooting	3	3	3	3
Ground Baiting	1	2	1	2
Aerial Baiting	4	1	2	1
Exclusion Fencing	6	4	5	not rated
Other Poisons	5	not rated	7	not rated
Trapping	2	not rated	4	4
Guard Animals	7	not rated	not rated	not rated
Bounty Hunting	8	not rated	6	5

Baiting is the most commonly used control technique for wild dogs (Figure 46). With the exception of DAWA respondents in the agricultural region (57%), over 75% of respondents suggested that baiting (both ground and aerial) was the method most used to control wild dogs. Of the two baiting methods, most respondents suggested that aerial baiting was used more than ground baiting. Shooting or hunting and trapping were the only other control techniques generally used to control wild dogs. Ground baiting was thought by DAWA respondents to be the most effective control technique (Table 10). CALM respondents perceived aerial baiting to be the most effective control technique, followed by ground baiting.

Most respondents believed that wild dog problems continue to occur after control has been undertaken (Figure 47). This is particularly the case for respondents from DAWA in the pastoral area, with 89% of respondents suggesting that wild dog problems continue. Generally, this perception is shared by pastoralists and they exert significant political pressure to redress the situation.

Figure 47. Recurrence of wild dog problems after control efforts for each of the respondent groups.



5.2.6 Rabbits

Distribution and abundance of rabbits

As with the fox, the project did not examine the distribution and abundance of the rabbit. This is because they can be generally regarded as widespread and common in the agricultural region and southern rangelands, and our methods may not be appropriate to obtain detailed information for such a common species. However, good descriptions of the distribution and abundance of the rabbit can be obtained from sources such as Long (1988), Williams *et al*. (1995) or Long (2003).

Corporate understanding of rabbits

As described above, rabbits are found throughout the agricultural region. All DAWA respondents and 94% of CALM respondents in the agricultural region reported rabbits to be present (Figure 48A). In the pastoral region, 68% of DAWA respondents and 69% of CALM respondents reported rabbits to be present. These figures are reflective of the distribution of rabbits in the rangelands and the distribution of staff from both agencies. Those respondents that reported rabbits to be absent were most likely located in the northern rangelands, or beyond the northern range of rabbits.

When rabbits were present, respondents were generally familiar or very familiar with the distribution of rabbits (Figure 48B). This was more apparent for the agricultural region, where over 90% of respondents from both agencies were either familiar or very familiar with the distribution of rabbits.

Despite the considerable effects of rabbit haemorrhagic disease (RHD) and myxomatosis in recent years, respondents reported the abundance of rabbits in the agricultural region to be common or very common (Figure 48C). In contrast, the reported abundance of rabbits in the pastoral region differed widely between respondents, but rabbits were not generally very common in the pastoral region.

Respondents from DAWA in the agricultural region reported crop damage, pasture damage, damage to native vegetation and soil erosion to be the major impacts caused by rabbits (Figure 49). In the pastoral region, where cropping is not a major agricultural practice, DAWA respondents reported damage to pasture, native vegetation and soil erosion. These three impacts are also consistent with CALM respondents from both regions. In addition, respondents from CALM in the agricultural region suggested that the spread of weeds by rabbits was also a major impact (Figure 49).

The timing of the impacts of rabbits (Figure 50) is well understood, particularly in the agricultural region and for impacts on agriculture. DAWA respondents in the agricultural region reported that the impacts of rabbits were greatest during the crop growing season, when crops are at their most vulnerable to grazing pressure. Abundance of rabbits coincides with their breeding season (see Williams *et al*. 1995). CALM respondents in the agricultural region suggest that the impacts and abundance of rabbits are not as clearly defined within a conservation system. That is, the impact of rabbits is consistent throughout the year. In contrast, CALM respondents from the pastoral region clearly identify that the impact of rabbits is greatest in spring. In the southern rangelands, this timing coincides with maximum pasture growth and production. However, there are differences between agencies in the reporting of the timing of peak abundance of rabbits in the same environment. Hence, this information should only be used as a rough guide.

Figure 48. Presence (A), familiarity (B) and abundance (C) of rabbits for Western Australia described by all respondent groups.

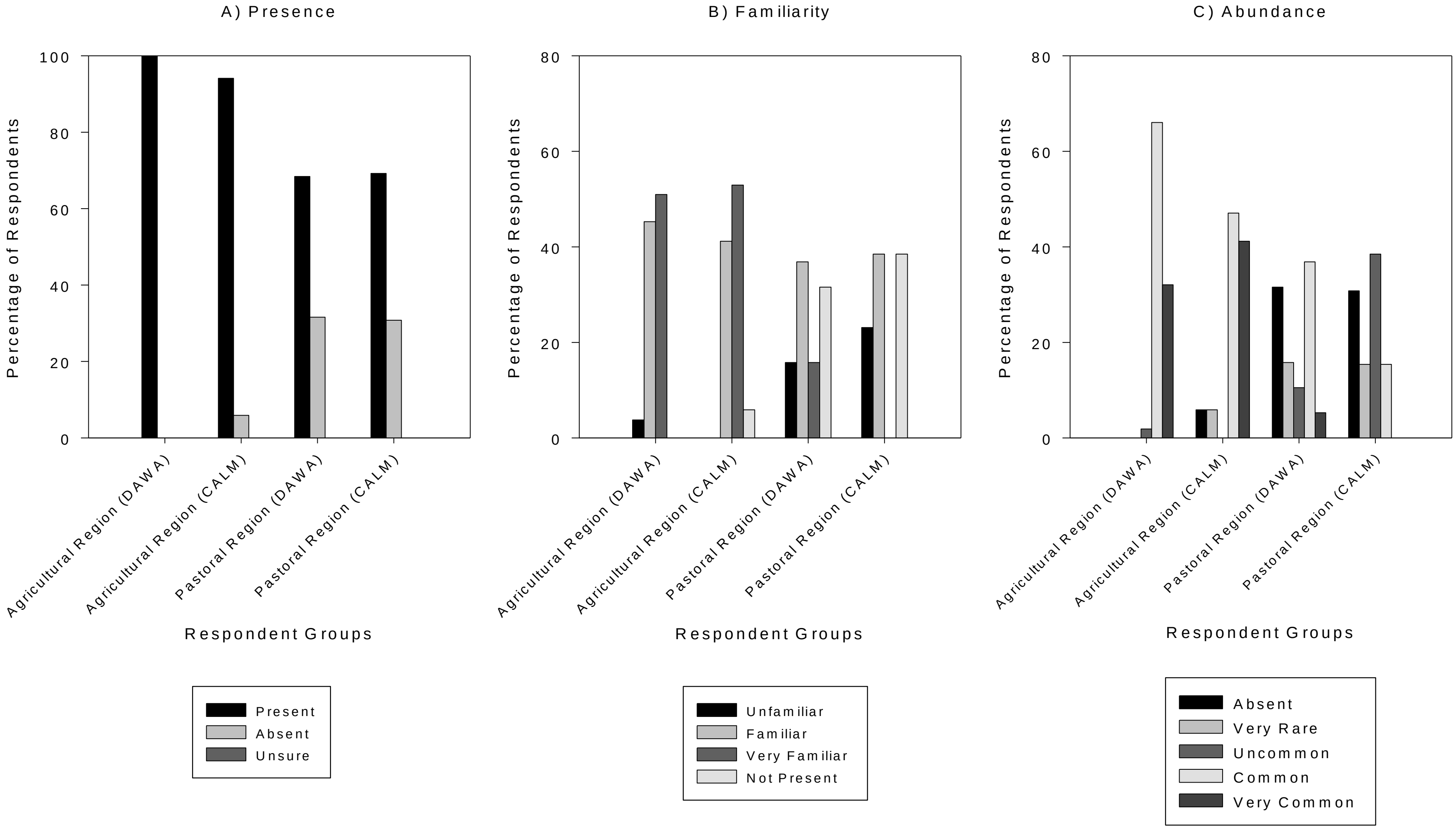
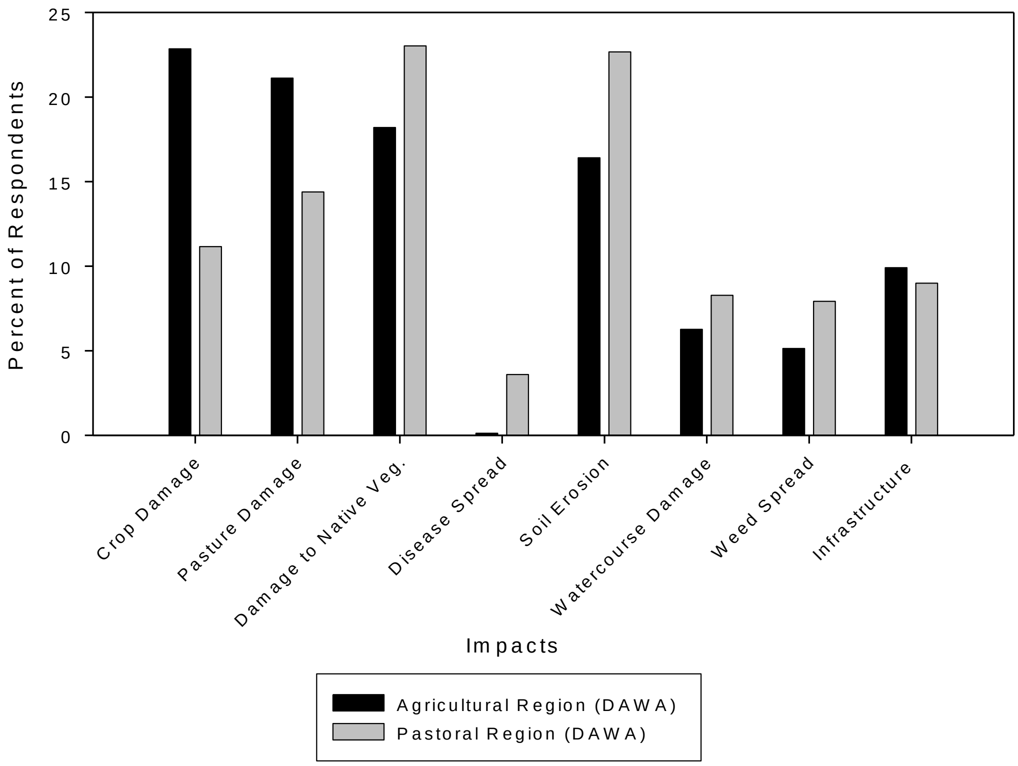


Figure 49. Impacts of rabbits in the agricultural region and rangelands assessed by Department of Agriculture staff (top, agricultural focus) and Department of Conservation and Land Management (below, conservation focus).



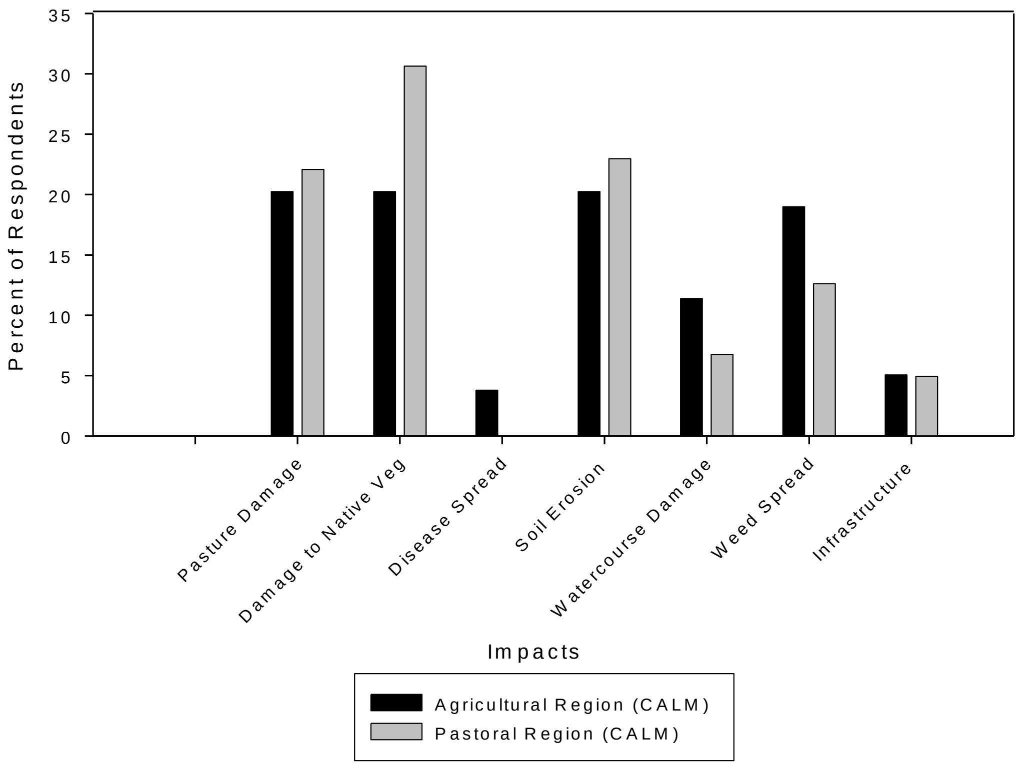


Figure 50. Timing of the maximum impacts (black) and abundances (grey) of rabbits for each of the respondent groups.

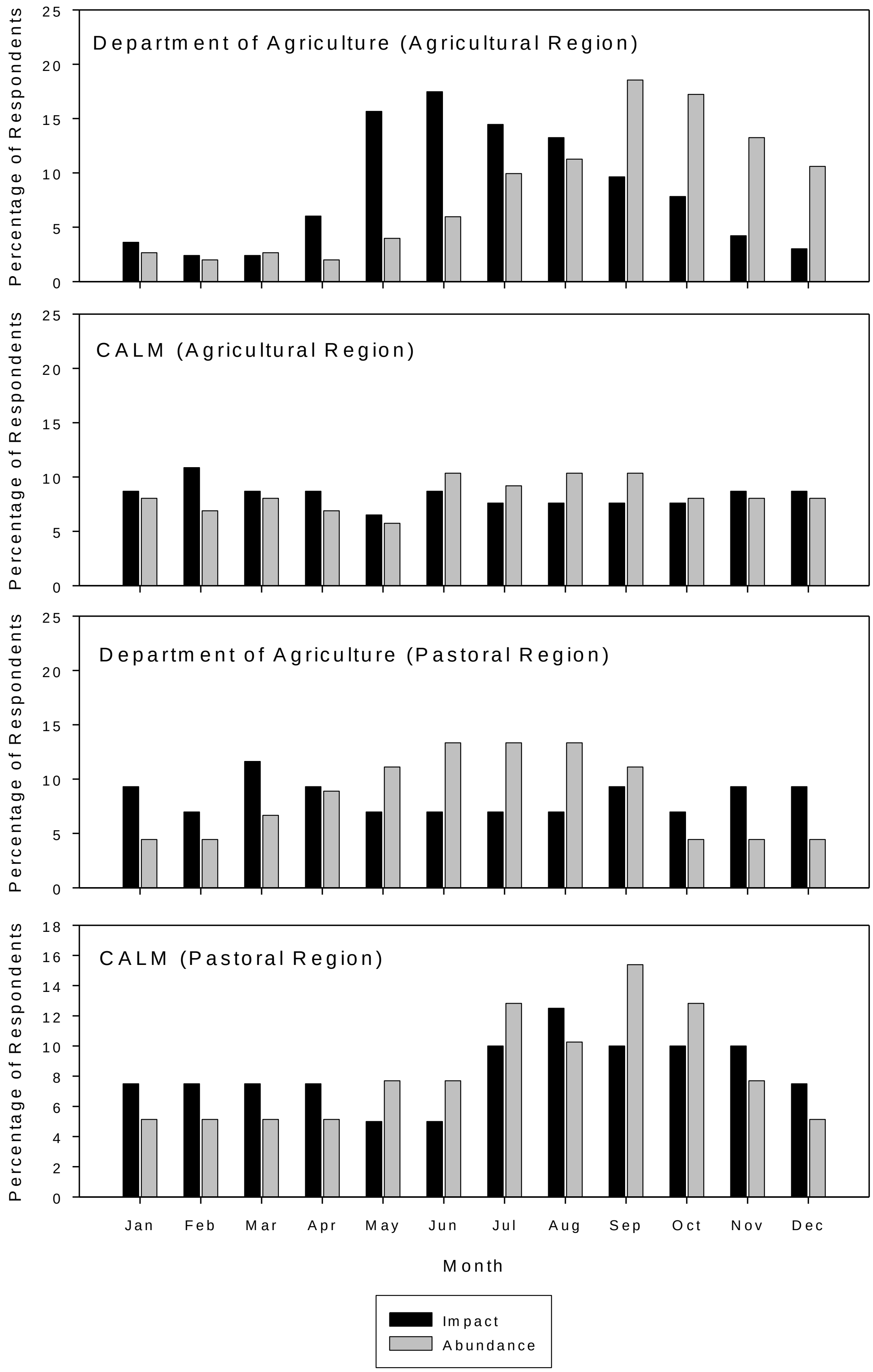
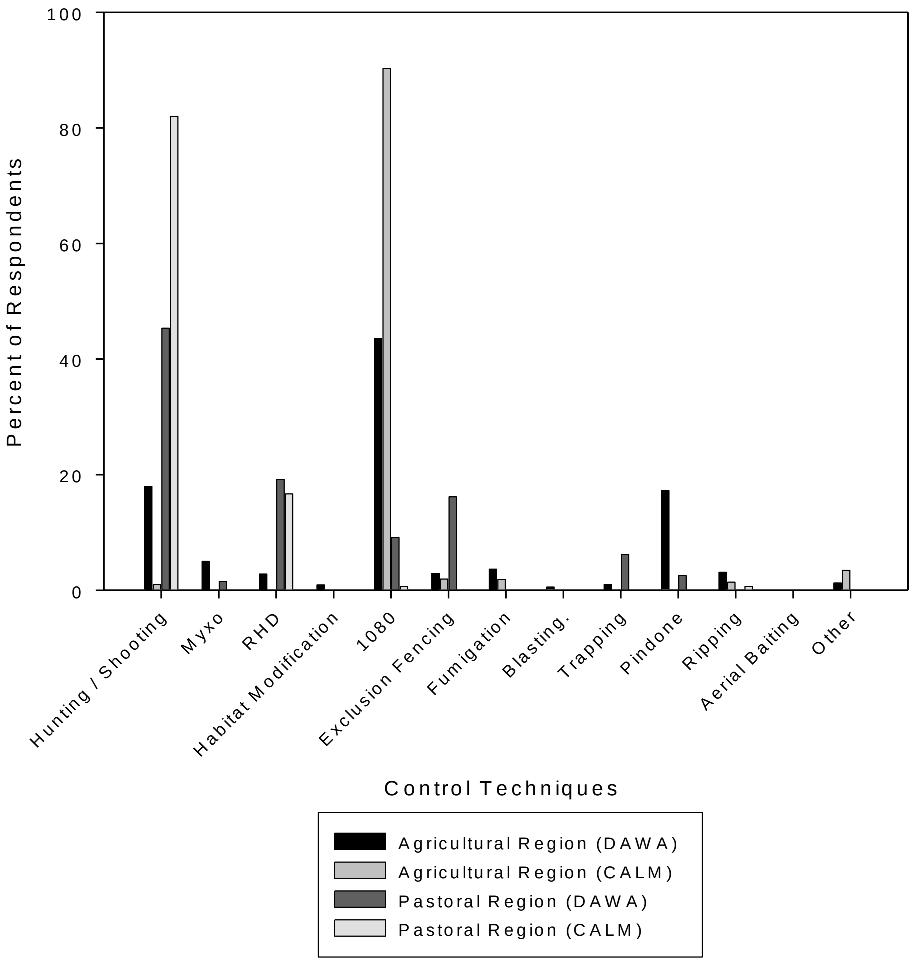


Figure 51. Use of techniques for the control of rabbits reported by each of the respondent groups.



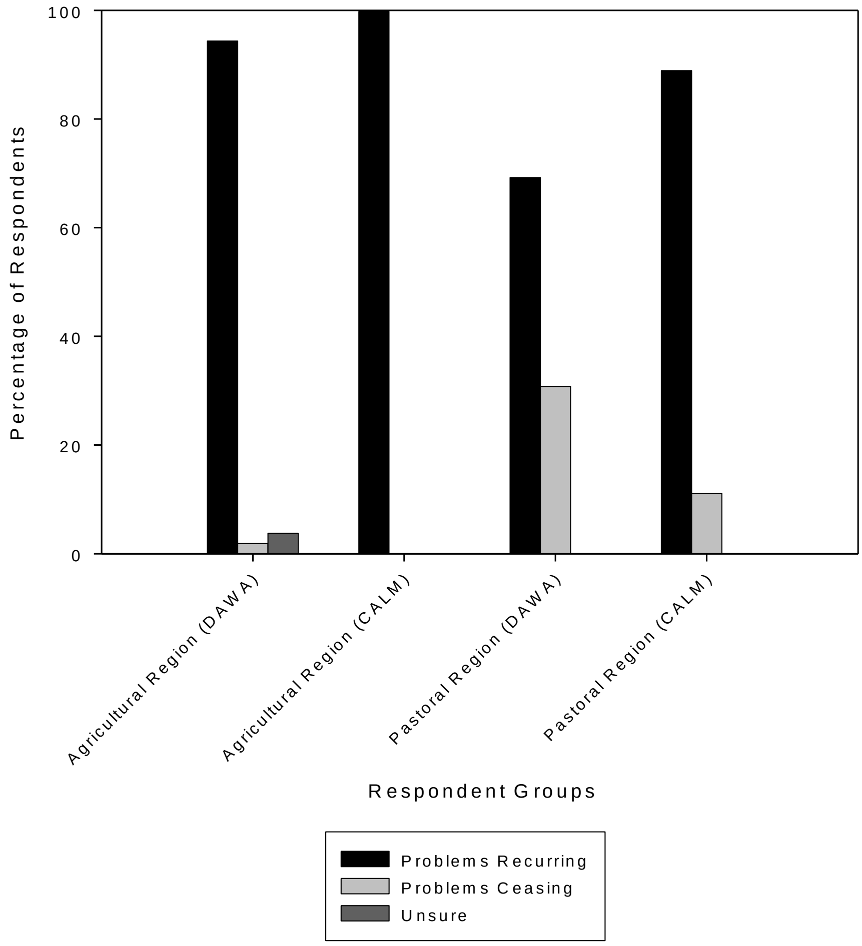
There are many techniques that can be used to control rabbits (Figure 51), with some more commonly used than others. Respondents from DAWA in the agricultural region suggest that the most widely used technique to control rabbits is poisoning with 1080, followed by hunting/shooting, and poisoning with pindone. Respondents from CALM in the agricultural region suggest that poisoning with 1080 is almost exclusively the only technique used to control rabbits. In the pastoral region, shooting/hunting is the most commonly used method to control rabbits (Figure 51). In terms of which methods are perceived to be the most effective to control rabbits, there are clear regional differences (Table 11). Poisoning with 1080 is perceived to be the most effective technique in the agricultural region, yet it is not perceived to be as effective in the pastoral region. Reliance on the biological control agents of myxomatosis and RHD also rate highly as perceived effective control techniques, but these techniques are not generally facilitated by land managers. Components of holistic approach to rabbit control, such as ripping and blasting, are not generally perceived to be effective control techniques, despite evidence to demonstrate that they are (e.g. Williams *et al*. 1995). Despite control efforts, rabbit problems are generally thought to persist (Figure 52).

Of the three recommended techniques to poison rabbits, respondents from the agricultural region suggested that baiting with 1080 one-shot oats was the most commonly used method. In the pastoral region, DAWA respondents suggested that pindone baiting is more commonly used than 1080 one shot oats, whereas CALM respondents suggest conventional 1080 baiting is exclusively used for rabbits. There were also regional differences in the perceived effectiveness of baiting application methods. In the agricultural region, both CALM and DAWA respondents perceived trail baiting with a furrow to be the most effective method of baiting rabbits (Figure 54). In contrast, DAWA respondents in the pastoral region perceived bait stations to be the most effective application, and CALM respondents perceived scatter baiting to be the most effective method. Even though there may be regional differences and the need for site-specific applications, the fact that there are clear differences between the regions and agencies suggests that there is a need for better extension about optimum methods for rabbit control.

Table 11. Control techniques for rabbits ranked according to their perceived effectiveness for each of the respondent groups.

Control Techniques	DAWA Agricultural	CALM Agricultural	DAWA Pastoral	CALM Pastoral
Hunting and/or Shooting	5	6	1	3
Myxomatosis	2	not rated	3	3
RHD	4	not rated	2	1
Habitat Modification	8	8	10	not rated
1080 Poisoning	1	1	7	4
Exclusion Fencing	9	3	8	not rated
Fumigation	6	4	6	not rated
Blasting	11	not rated	9	not rated
Trapping	10	not rated	5	not rated
Pindone	3	8	4	not rated
Ripping	7	5	11	5
Aerial Baiting	not rated	not rated	not rated	not rated
Other	not rated	2	not rated	not rated

Figure 52. Recurrence of rabbit problems after control efforts for each of the respondent groups.



The biological agents of myxomatosis and RHD are an important component of the population dynamics of the rabbit. For RHD, most respondents were unsure of the timing of outbreaks (Figure 55). However, 34% of DAWA staff from the agricultural region suggested that RHD occurred annually and another 32% of respondents suggested that it occurred irregularly. All respondents from the agricultural region suggested that RHD did occur, but some pastoral region staff (23% of DAWA and 11% of CALM) suggested that RHD was never present in their districts. When RHD did occur, most respondents did suggest that it was effective, but this needs to be qualified by the high number of respondents that were unsure of its effectiveness (Figure 56). This suggests that the respondents generally had little understanding about the dynamics of RHD in their districts, and it highlights an important research gap. Similar results were gained for myxomatosis. DAWA staff in the agricultural region appeared to have the greatest understanding of the dynamics of myxomatosis, with only 5% of respondents unsure of the timing of outbreaks (Figure 57). Other respondent groups were generally unsure of the timing of outbreaks. Most respondents agreed that outbreaks were irregular. The consensus was that myxomatosis was effective at reducing rabbit numbers (Figure 58). However, there were a large number of respondents that were unsure of the effectiveness of myxomatosis. Once again this may represent research, education and extension gaps.

Figure 53. Usage of three recommended poisoning techniques by each of the respondent groups.

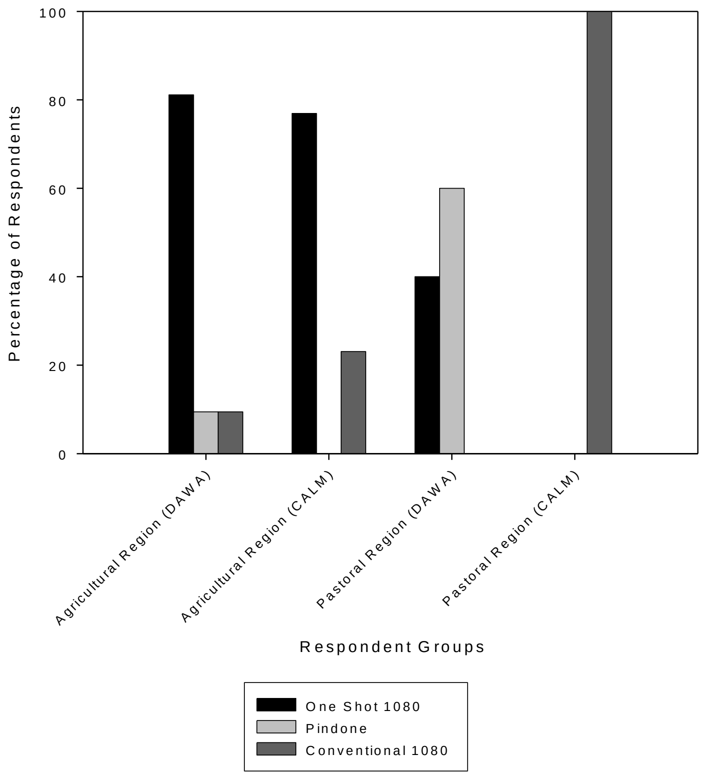


Figure 54. Perceived effectiveness of different methods for poisoning rabbits for each of the respondent groups.

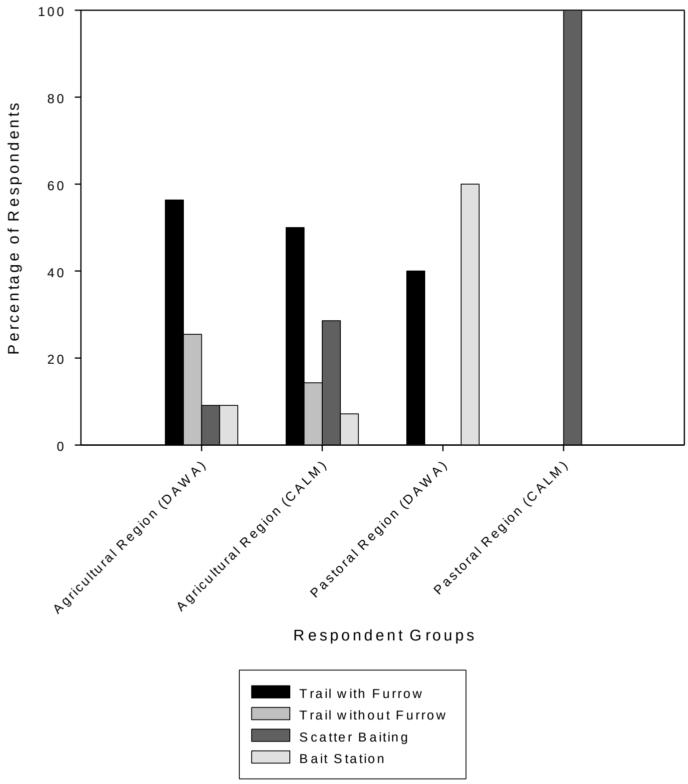


Figure 55. Timing of outbreaks of RHD for each of the respondent groups.

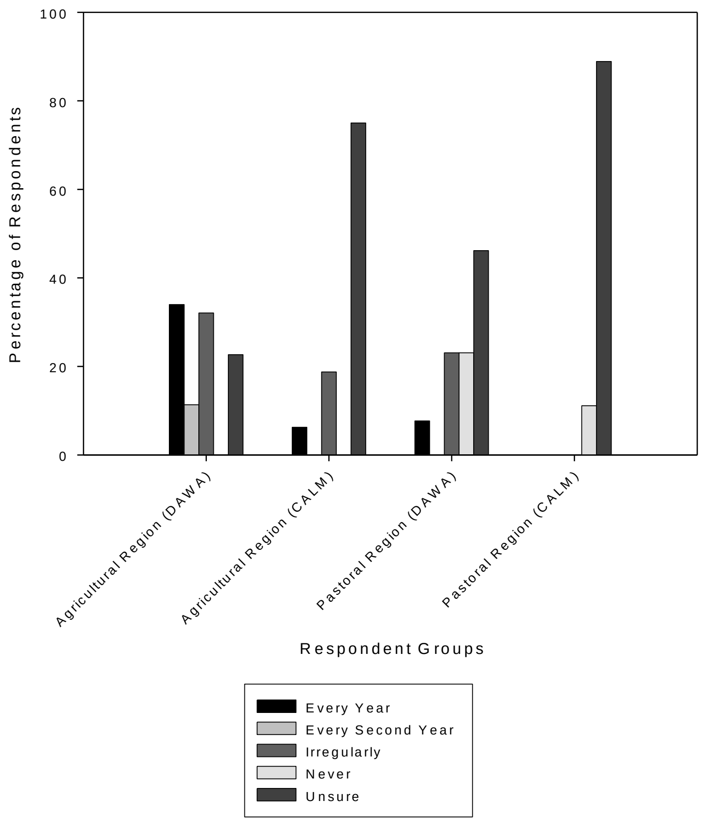


Figure 56. Effectiveness of outbreaks of RHD at reducing rabbit numbers for each of the respondent groups.

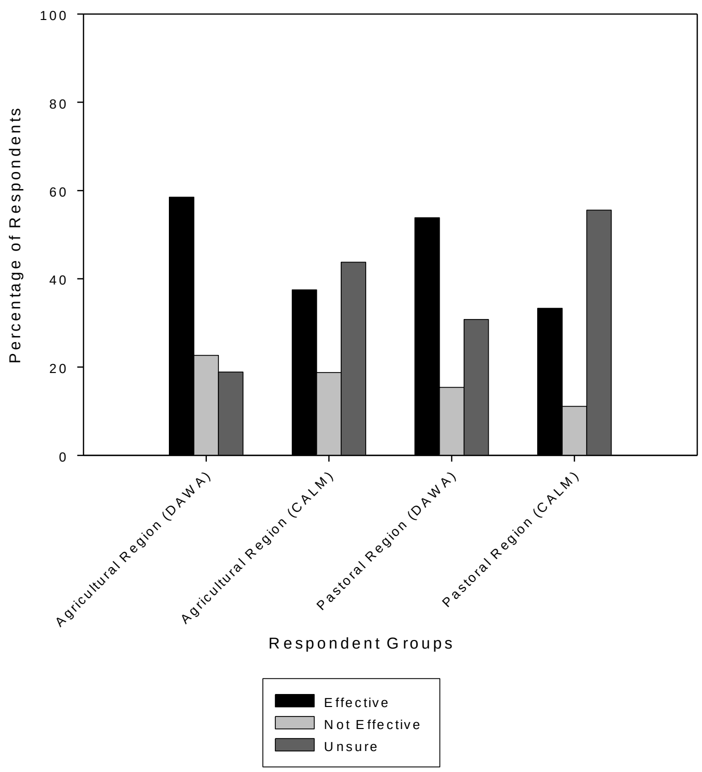


Figure 57. Timing of outbreaks of Myxomatosis for each of the respondent groups.

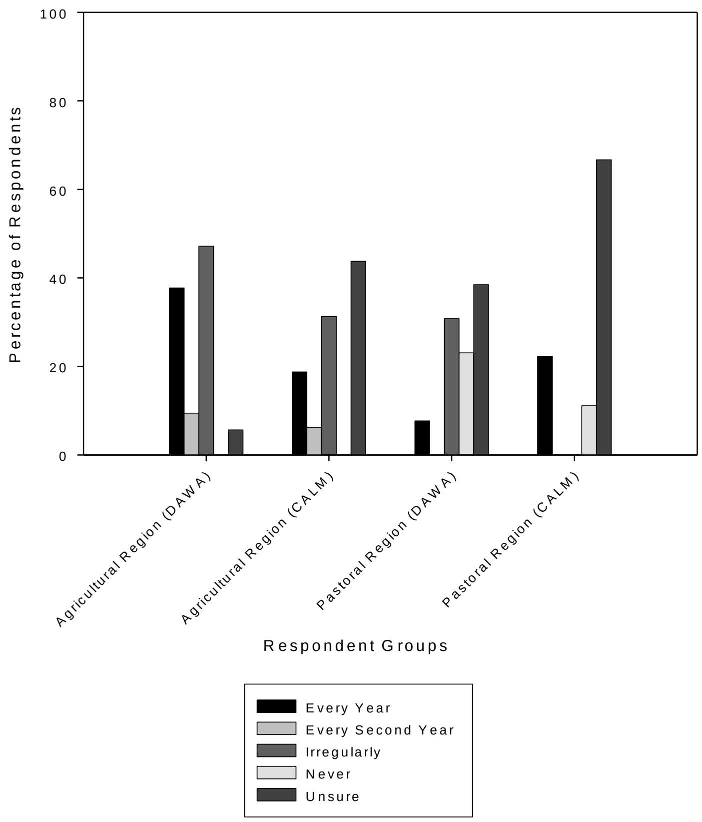
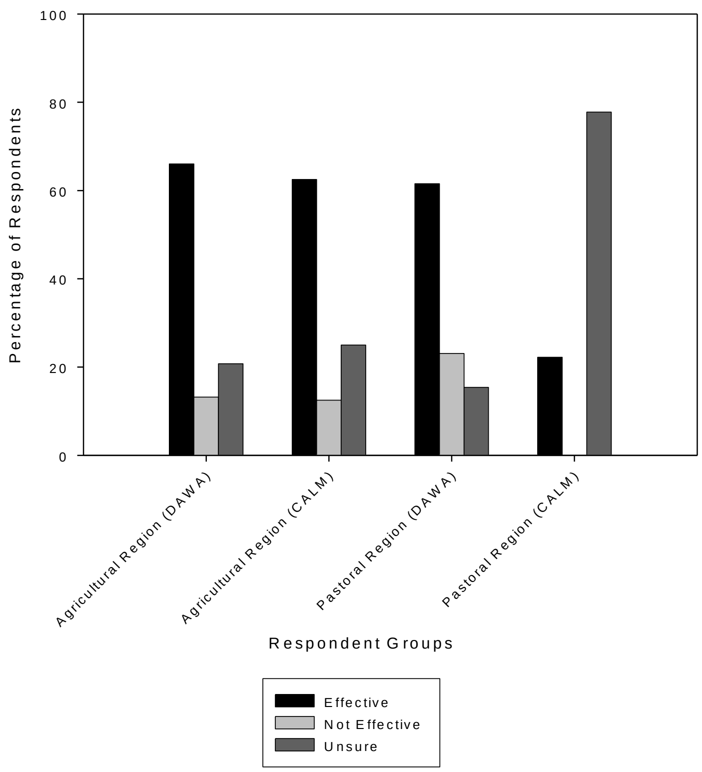


Figure 58. Effectiveness of outbreaks of Myxomatosis at reducing rabbit numbers for each of the respondent groups.



5.3 Pest Animals – Rangeland Only Responses

5.3.1 Feral Camels

Distribution and abundance of feral camels

Feral camels were most commonly reported in the arid interior of WA (Figure 59). The key areas of high abundance include the Great Sandy Desert and the Great Victoria Desert. This information concurs with Short *et al.* (1988) as the areas of high camel density. As a general description, feral camels are found in the eastern-most pastoral leases, with the gradient of abundance increasing towards the desert country. Feral camels are not known to be present in the agricultural region of WA.

Corporate understanding of feral camel

Feral camels are an emerging pest in Western Australia. Both agencies are becoming progressively more aware of the impacts that camels can have on pastoral enterprises and conservation estates. There is a coincidental increase in feral camel numbers in other parts of Australia (Edwards *et al.* 2004) and reported occurrences of impacts.

Most respondents reported the presence of feral camels because they knew or believed they were present. It is true that officers do cover vast areas; nevertheless feral camels are widely distributed in pastoral areas (at varying densities; Figure 60A). Where feral camels were present, most respondents were familiar with their distribution (Figure 60B). Department of Agriculture staff suggested that, where feral camels were present their abundance was generally uncommon (Figure 60C). Of those staff from both agencies that reported feral camels to be very common, most had areas of responsibility in the eastern pastoral area or true desert country.

There were inter-agency differences in the perceived impacts of these species. DAWA staff reported that damage to pastoral infrastructure (watering points, fences etc.) was the most significant impact caused by feral camels. This was followed by damage to native vegetation and then competition with livestock for pasture (Figure 61). CALM staff rated damage to native vegetation as the key impact, followed closely by damage to watercourses and soil erosion. Only DAWA staff thought that disease spread was a likely impact of feral camels.

When describing the impacts caused by feral camels, it is interesting to note that the views of the respondents generally represent the broad roles of each of the Departments. For example, DAWA respondents focus primarily on pastoral production impacts and CALM respondents focus primarily on impacts to conservation values. However, it is important to consider that the views of other focus groups (e.g. indigenous communities) have not been sought. These focus groups may identify other impacts of feral camels.

Both agencies reported that opportunistic ground and aerial shooting were the most commonly used techniques to control feral camels (Figure 62) and were also the most effective (Table 12). Commercial harvesting was not generally perceived by respondents as a useful or effective way to control feral camels.

Figure 59. Reported distribution and abundance of feral camels in Western Australia.

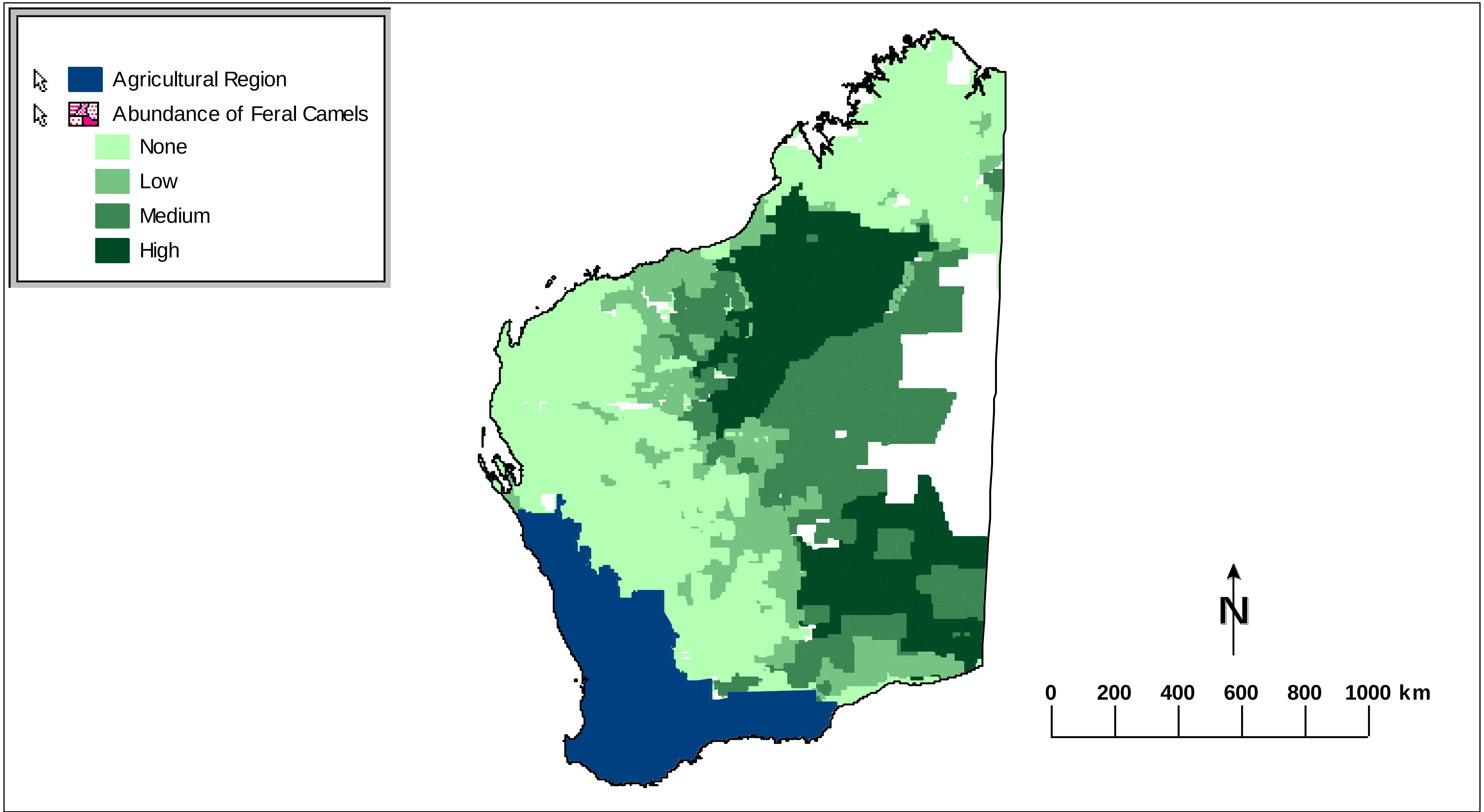


Figure 60. Presence (A), familiarity (B) and abundance (C) of feral camels in the rangelands described by both respondent groups.

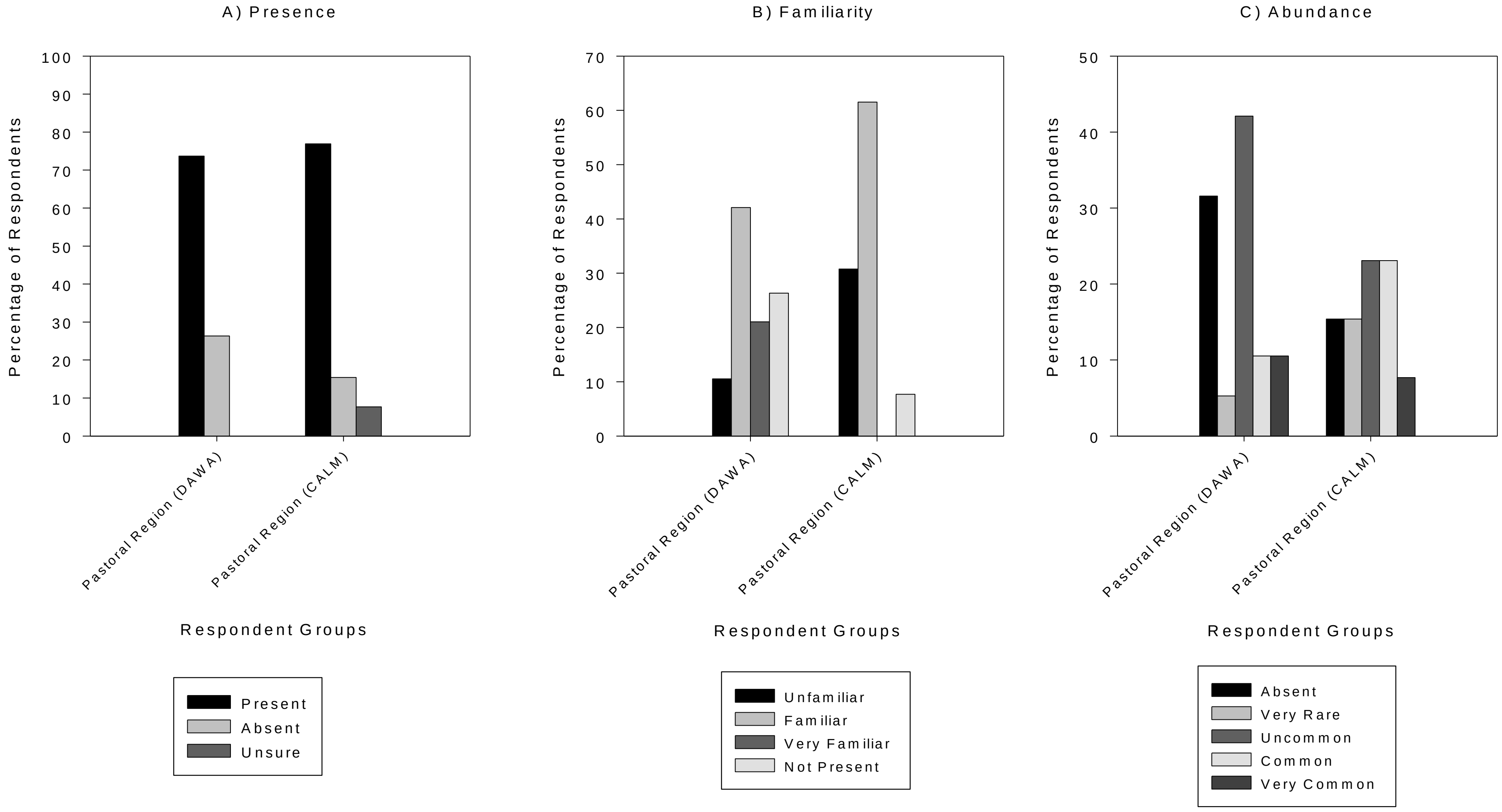


Table 12. Control techniques for feral camels ranked according to their perceived effectiveness for both of the rangeland respondent groups.

Control Techniques	DAWA Pastoral	CALM Pastoral
Hunting and/or Shooting	1	1
Judas Techniques	not rated	not rated
Exclusion Fencing	not rated	not rated
Commercial Harvesting	3	3
Trapping	not rated	not rated
Aerial Shooting	2	2
Mustering	not rated	not rated
Other	not rated	not rated

Both agencies also report that the problems caused by feral camels recur after control efforts (Figure 63). One explanation may be that control of feral camels is a low priority and control efforts are often opportunistic and therefore ineffectual. Co-ordination, or at the least, a better understanding of the demographic structure and impacts of feral camels may be required to demonstrate the need for control. Knowledge of these factors is particularly important for such a highly mobile, large herbivore that can move considerable distances (see Edwards *et al.* 2002).

From an EAD perspective, it becomes clear that contact is possible between feral camels and livestock (generally cattle; Figure 64). As described above, DAWA staff did rate the spread of disease as a potential impact of feral camels. The reality is that the direction of disease spread would likely be from livestock to the disease-free feral camel. Hence, feral camels are likely to be a low risk species at present.

Figure 61. Impacts of feral camels in the rangelands assessed by staff of the Department of Agriculture and Department of Conservation and Land Management.

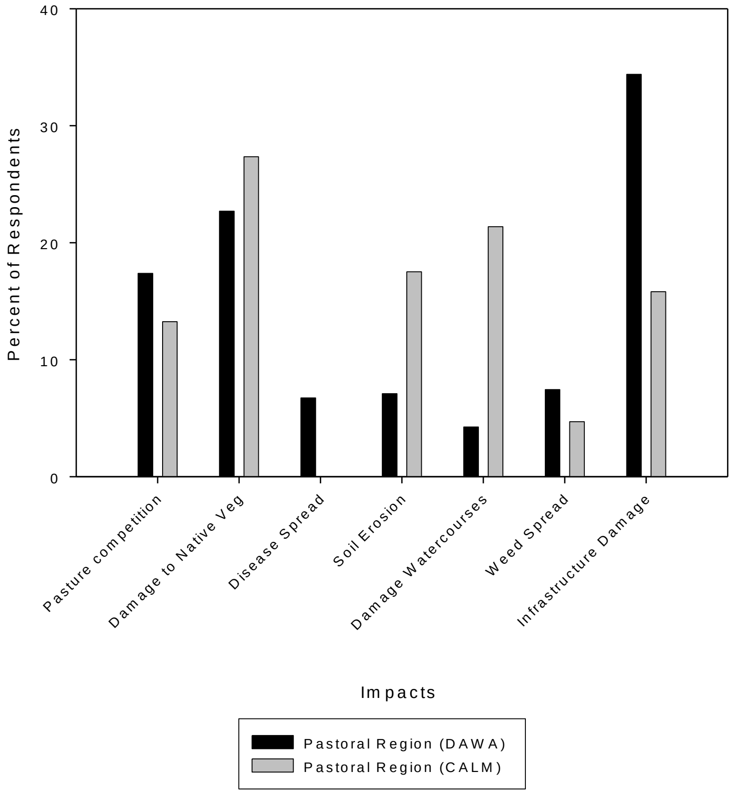


Figure 62. Use of techniques for the control of feral camels reported by both the rangeland respondent groups.

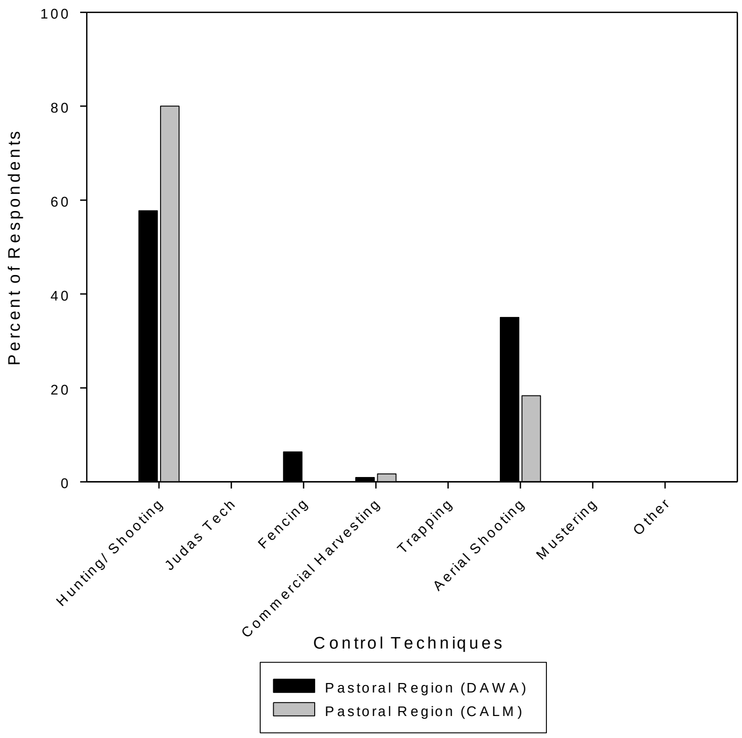


Figure 63. Recurrence of feral camel problems after control efforts for both of the rangeland respondent groups.

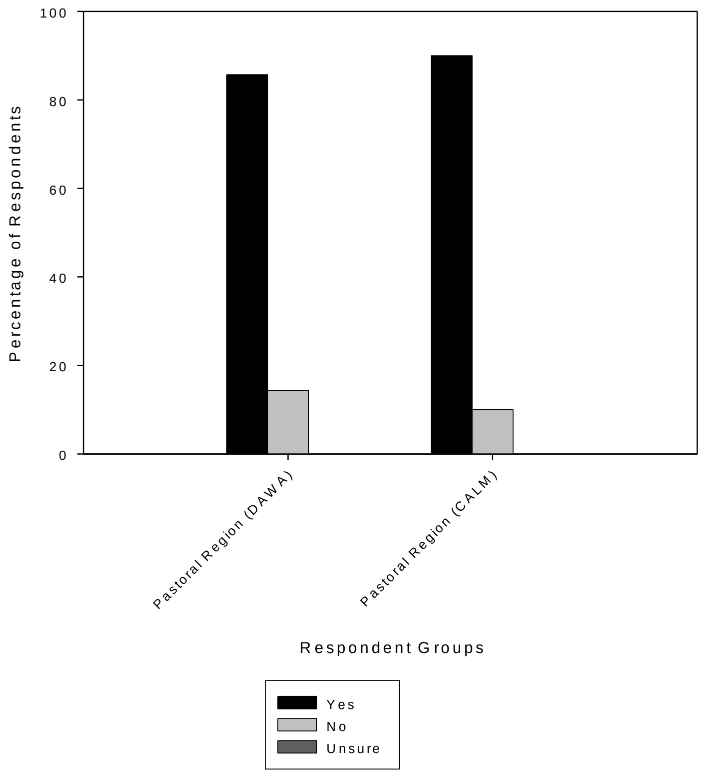
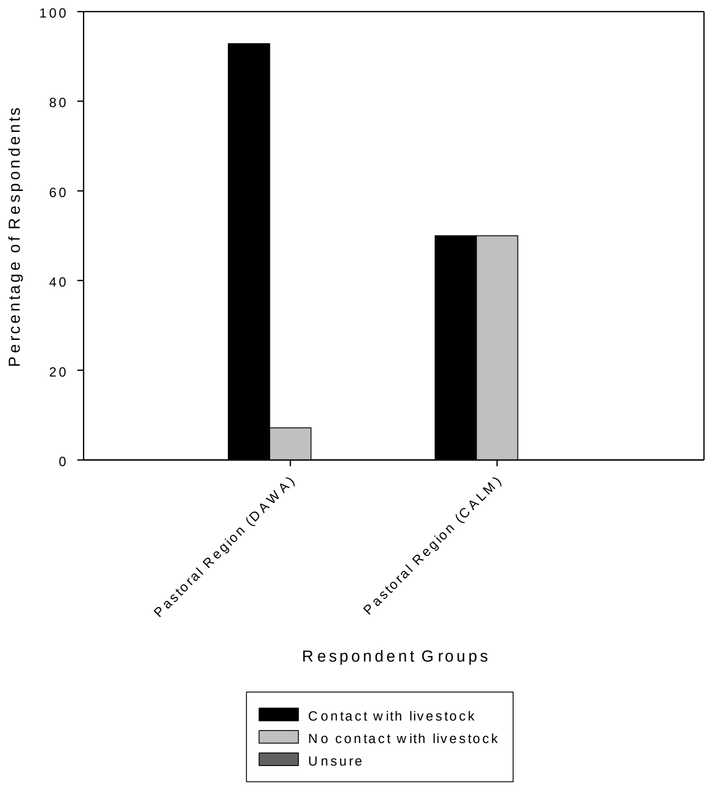


Figure 64. Potential for close contact between feral camels and domestic stock for both of the rangeland respondent groups.



5.3.2 Feral Donkeys

Distribution and abundance of feral donkeys

Feral donkeys were most commonly reported in the Murchison, Pilbara and Kimberley region of WA, although their distribution continues into the Goldfields (Figure 65). Their abundance has been reduced through a well-coordinated control program. This has lead to local eradication of donkeys from some pastoral leases in the Kimberley.

Corporate understanding of feral donkeys

The Department of Agriculture has had a long history of control operations against feral donkeys. Control of feral donkeys, with helicopter and ground shooting began in the Kimberley in 1978 and in 1994 the Judas control program began. This very successful control program has lead to a decline of donkey numbers in the Kimberley from densities of about 2 donkeys per km^2 in some areas to local eradication. This control program has been expanded into the Pilbara. The information provided for feral donkeys is therefore probably the most reliable of all the pest animals.

Nearly all respondents from both agencies in the pastoral region reported feral donkeys to be present in their areas of knowledge (Figure 66A). Most respondents were also familiar or very familiar with the distribution of feral donkeys in the rangelands (Figure 66B). Over 50% of DAWA rated the abundance of feral donkeys to be common in the areas of which they had knowledge (Figure 66C). In contrast, CALM respondents suggested donkeys were either common (30%) or uncommon (46%), suggesting that donkeys may be less abundant on CALM managed properties.

DAWA staff rated feral donkeys as having the greatest impacts on pasture competition, soil erosion and damage to native vegetation. Similarly, damage to native vegetation and soil erosion were rated as high by CALM staff, but they also rated damage to watercourses as the third highest impact (Figure 67). Both groups of respondents rated disease spread as an impact for feral donkeys. However, in terms of exotic diseases, feral donkeys are not susceptible to as many diseases as ruminants (AUSVETPLAN 2000) so the risk may be lower.

Techniques used for the control of feral donkeys revolve around shooting (ground shooting, aerial shooting and aerial shooting using a Judas animal; Figure 68). CALM staff also reported the use of fencing as a means to control the impacts of feral donkeys. In terms of the perceived effectiveness of techniques, shooting is unanimously rated as the best technique (Table 13). It is important to note that there may be some overlap related to aerial shooting and Judas techniques by respondents since both essentially are aerial shooting approaches.

Despite considerable control efforts, the majority (over 50%) of respondents consider that feral donkey problems are continuing (Figure 69). This figure needs to be put into perspective, since some operational areas are further developed than others. For example, the Judas program has lead to complete eradication on some pastoral leases while it is just beginning on others.

Feral donkeys are reportedly closely associated with domestic stock (Figure 70). Furthermore, the social nature of donkeys, exploited by the Judas program, means that a Judas-Jenny is likely to associate with cattle if there are no other donkeys present in the area. In terms of disease risk, this association with other domestic stock, as described above, is unlikely to represent a significant EAD risk.

Figure 65. Reported distribution and abundance of feral donkeys in Western Australia.

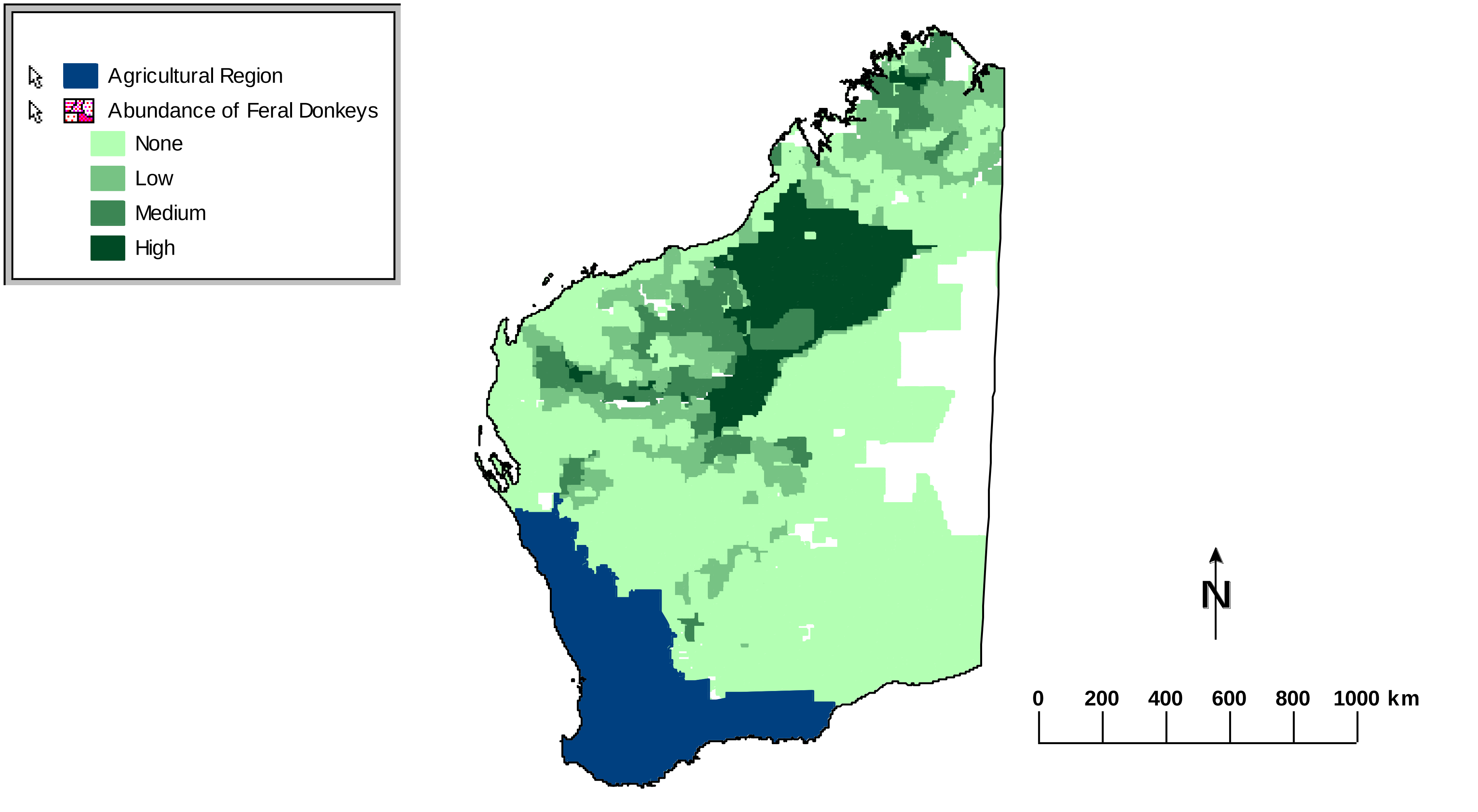


Figure 66. Presence (A), familiarity (B) and abundance (C) of feral donkeys in the rangelands described by both respondent groups.

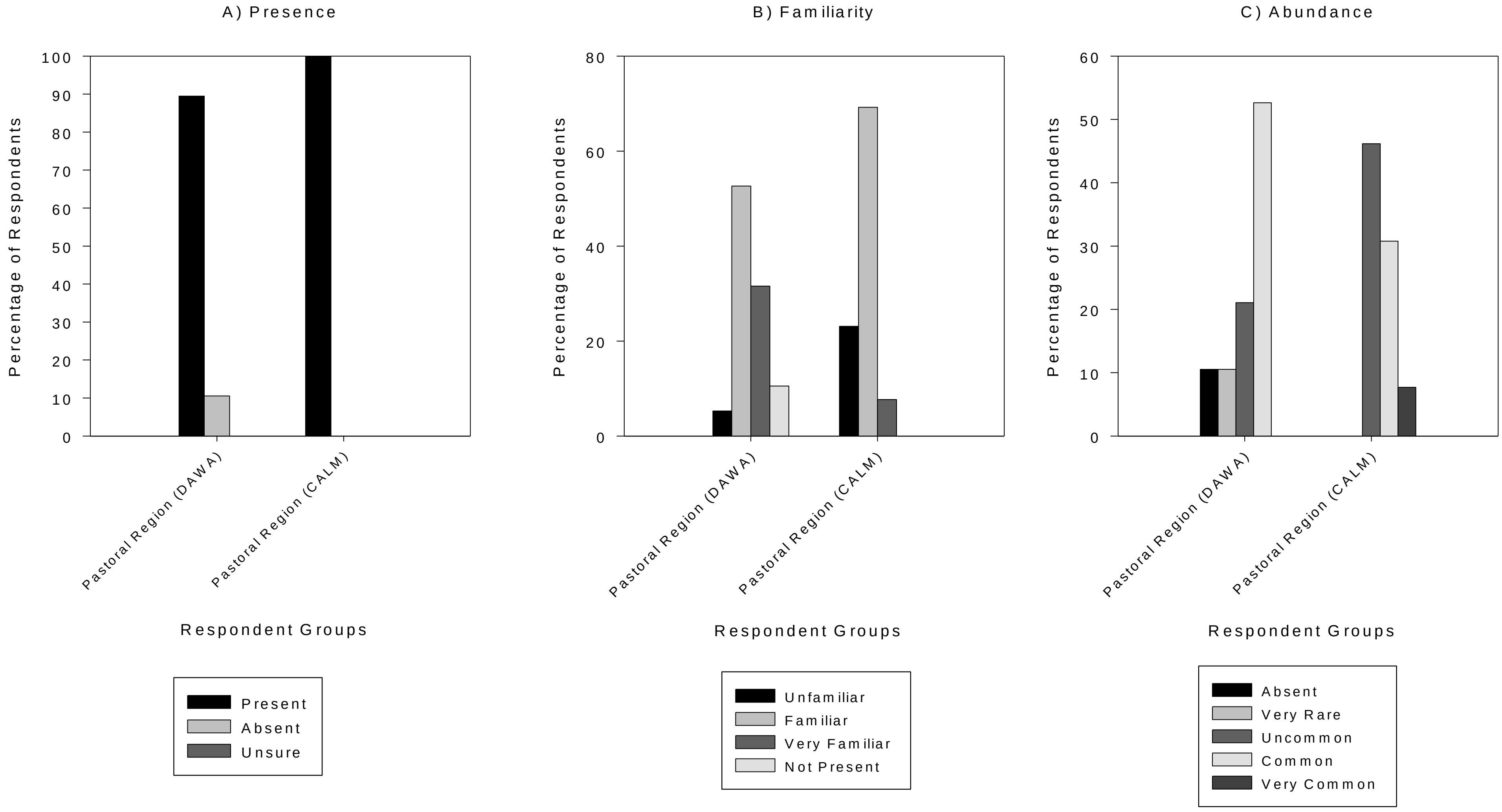


Table 13. Control techniques for feral donkeys ranked according to their perceived effectiveness for both of the rangeland respondent groups.

Control Techniques	DAWA Pastoral	CALM Pastoral
Hunting and/or Shooting	1	1
Judas Techniques	3	2
Exclusion Fencing	4	3
Commercial Harvesting	5	4
Trapping	not rated	not rated
Aerial Shooting	2	5
Mustering	not rated	not rated
Other	not rated	not rated

Figure 67. Impacts of feral donkeys in the rangelands assessed by staff of the Department of Agriculture and Department of Conservation and Land Management.

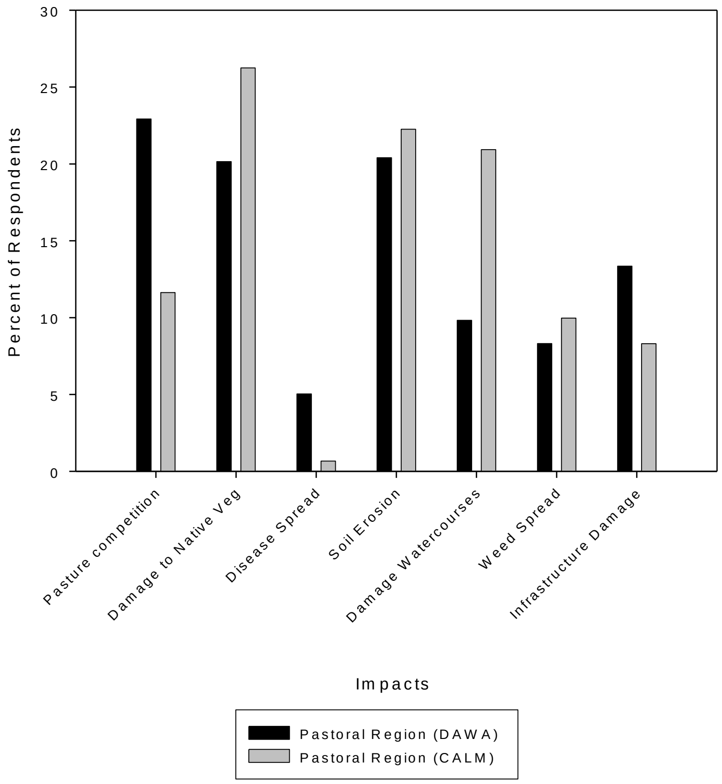


Figure 68. Use of techniques for the control of feral donkeys reported by both the rangeland respondent groups.

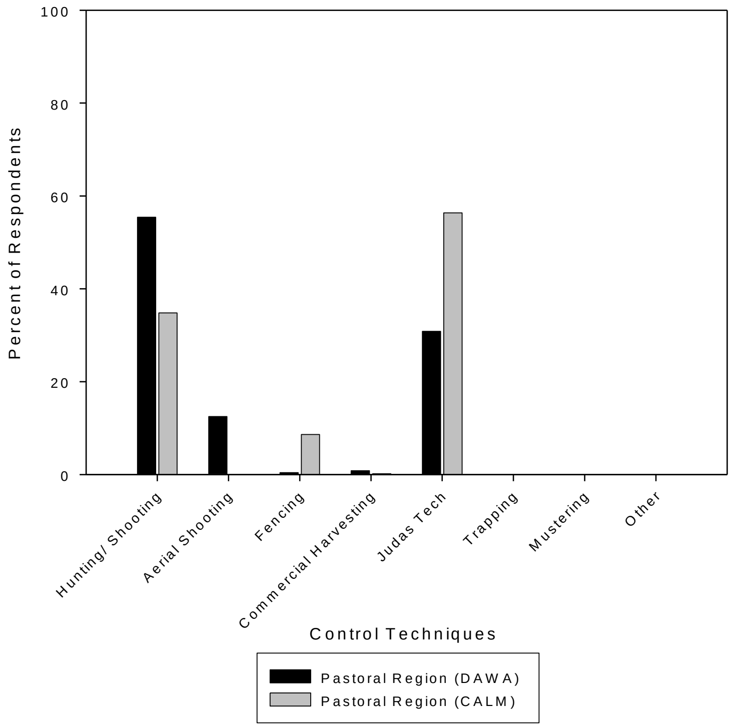


Figure 69. Recurrence of feral donkey problems after control efforts for both of the rangeland respondent groups.

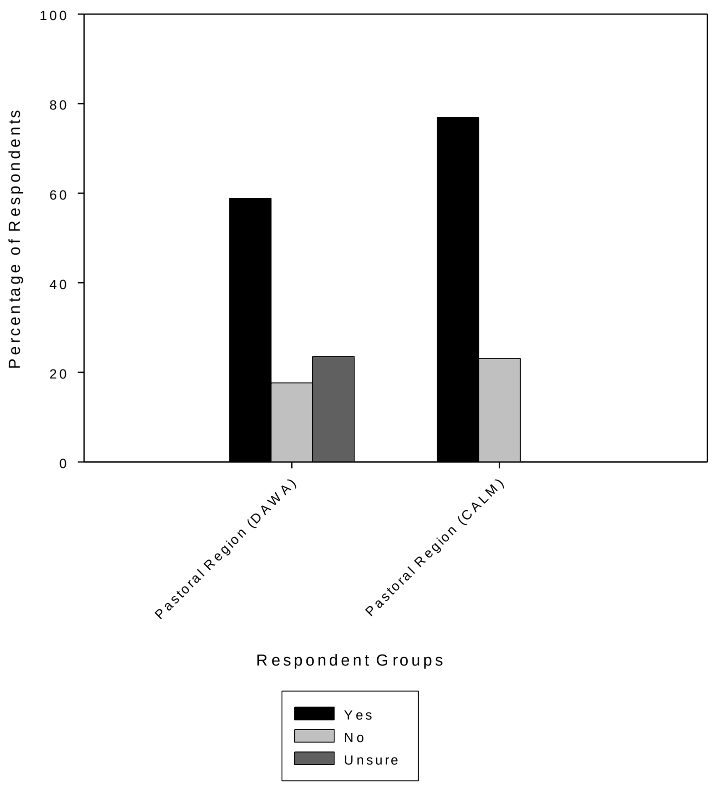
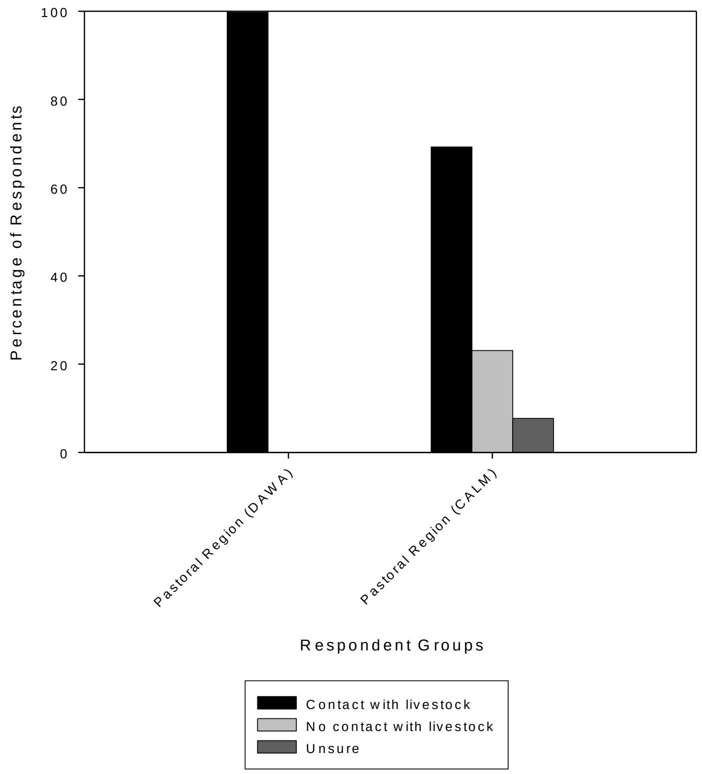


Figure 70. Potential for close contact between feral donkeys and domestic stock for both of the rangeland respondent groups.



5.3.3 Feral Horses

Distribution and abundance of feral horses

Feral horses were most commonly reported in the Pilbara region of WA, although their distribution extends into the Kimberley and Goldfields (Figure 71). The distribution of feral horses appears closely associated with eastern-most pastoral leases. Feral horses, particularly when in small numbers, are often difficult to separate from station horses. Nonetheless, feral horses appear to have a widespread distribution and abundance in the rangelands.

Corporate understanding of feral horses

In Western Australia, feral horses are a species that generally receive less attention than other rangeland pests such as wild dogs or feral donkeys. As such, over 20% of CALM staff and over 5% of DAWA staff were unsure if feral horses were present in the areas that they managed (Figure 72A). As described above, this may be because of difficulties distinguishing between feral and non-feral horses. Nonetheless, feral horses were reported to be present by over 80% of DAWA respondents and over 60% of CALM respondents (Figure 72A). Over 45% of CALM respondents were unfamiliar with the distribution of feral horses. In contrast, over 70% of DAWA respondents were familiar or very familiar with the distribution of feral horses (Figure 72B). In terms of abundance, 31% of DAWA staff reported that feral horses were common in abundance (Figure 72C). In contrast, just 7% of CALM respondents reported that feral horses were common, with the majority of respondents suggesting that feral horses were either uncommon (53%) or very rare (23%).

The perceived impacts caused by feral horses differed according to each agency. DAWA staff rated pasture competition to be the most important impact, followed by damage to native vegetation and then soil erosion (Figure 73). CALM staff also rated damage to native vegetation and soil erosion highly, but they rated the spread of weeds by feral horses as the third highest impact. Only DAWA staff suggested that the feral horse could have an impact by spreading disease. Whether the perceived disease spread is between the station horses and feral horses, or between feral horses and domestic livestock is unclear. However, the general intent of the survey question was orientated towards disease threat of domestic livestock. This will require further refinement for any future survey questions.

Techniques used to control feral horses include shooting (ground and aerial), mustering, and commercial harvesting (Figure 74). Shooting (ground and aerial) is also perceived to be the most effective control technique (Table 14). However, despite control efforts, problems associated with feral horses are widely thought to continue (Figure 75).

Both DAWA and CALM staff believe that feral horses have the potential to come into close contact with domestic stock (Figure 76). Feral horses are susceptible to the same suite of EADs as feral donkeys, with the addition of Japanese encephalitis (AUSVETPLAN 2000). As such, their EAD risk may be slightly lower than feral ruminants. However, their broad distribution across the rangelands and sympatric association with feral donkeys increases the risks of an undetected equine disease.

Figure 71. Reported distribution and abundance of feral horses in Western Australia.

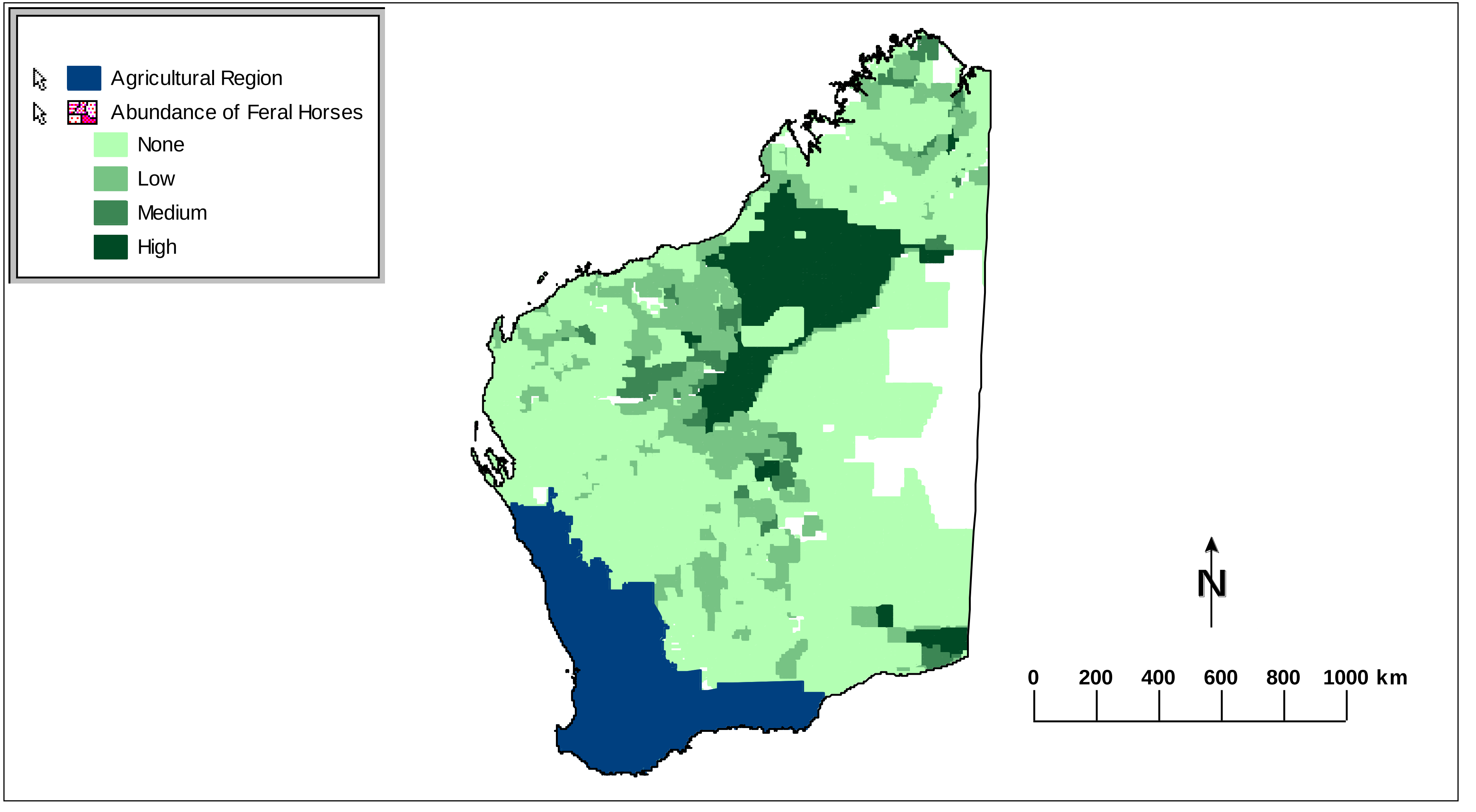


Figure 72. Presence (A), familiarity (B) and abundance (C) of feral horses in the rangelands described by both respondent groups.

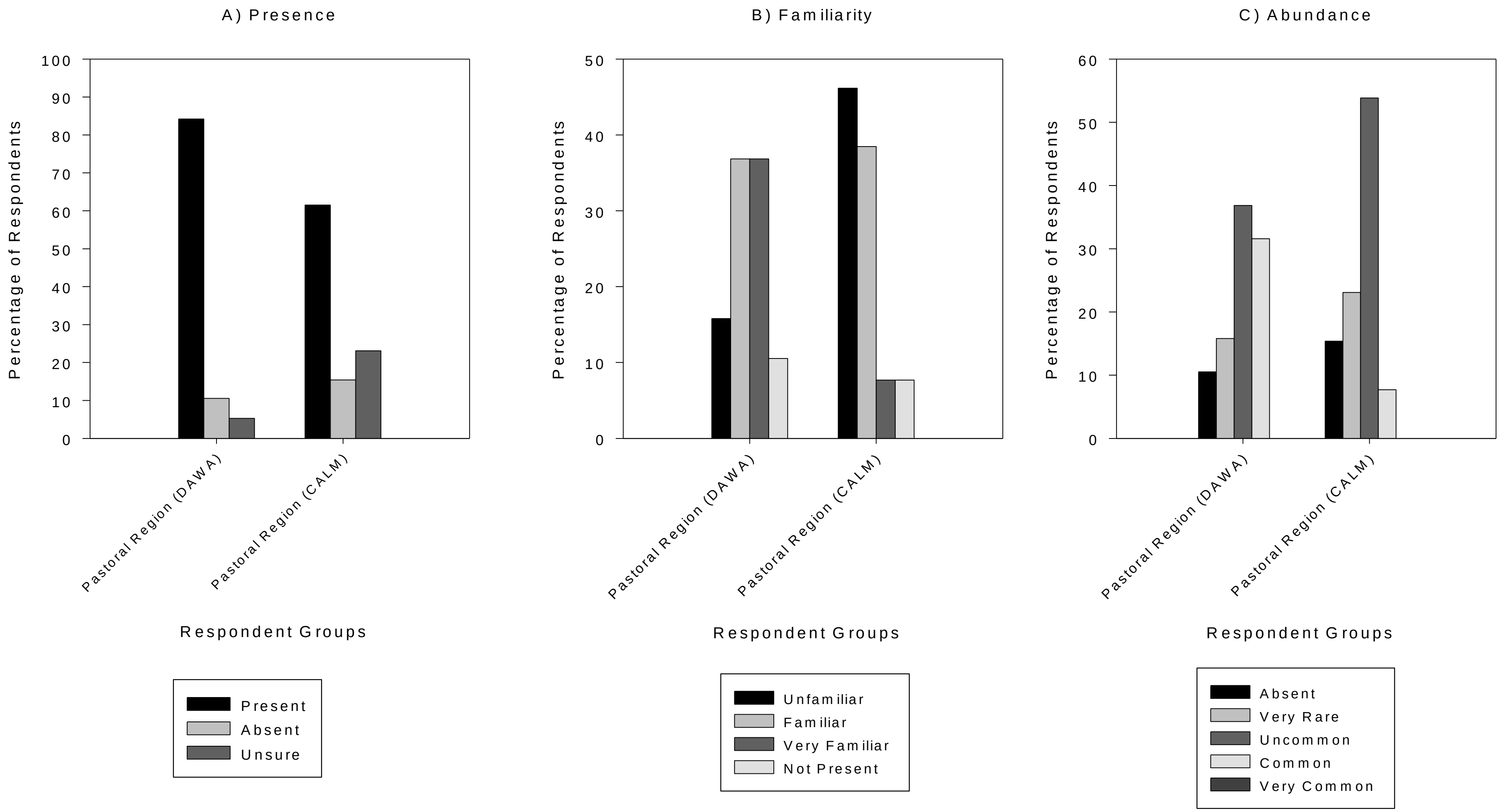


Table 14. Control techniques for feral horses ranked according to their perceived effectiveness for both of the rangeland respondent groups.

Control Techniques	DAWA Pastoral	CALM Pastoral
Hunting and/or Shooting	1	1
Judas Techniques	5	not rated
Exclusion Fencing	7	not rated
Commercial Harvesting	3	3
Trapping	6	not rated
Aerial Shooting	2	2
Mustering	4	4
Other	not rated	not rated

Figure 73. Impacts of feral horses in the rangelands assessed by staff of the Department of Agriculture and Department of Conservation and Land Management.

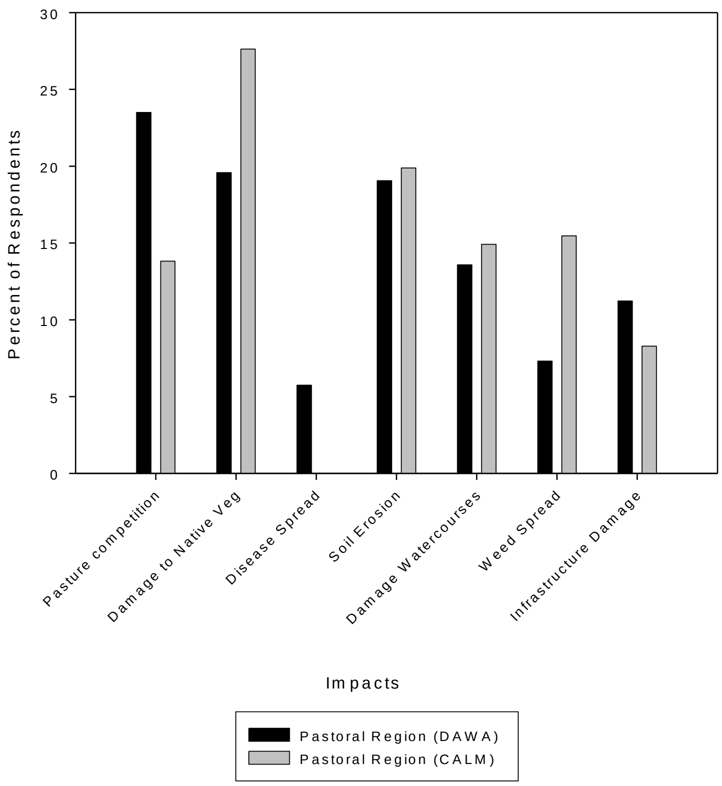


Figure 74. Use of techniques for the control of feral horses reported by both the rangeland respondent groups.

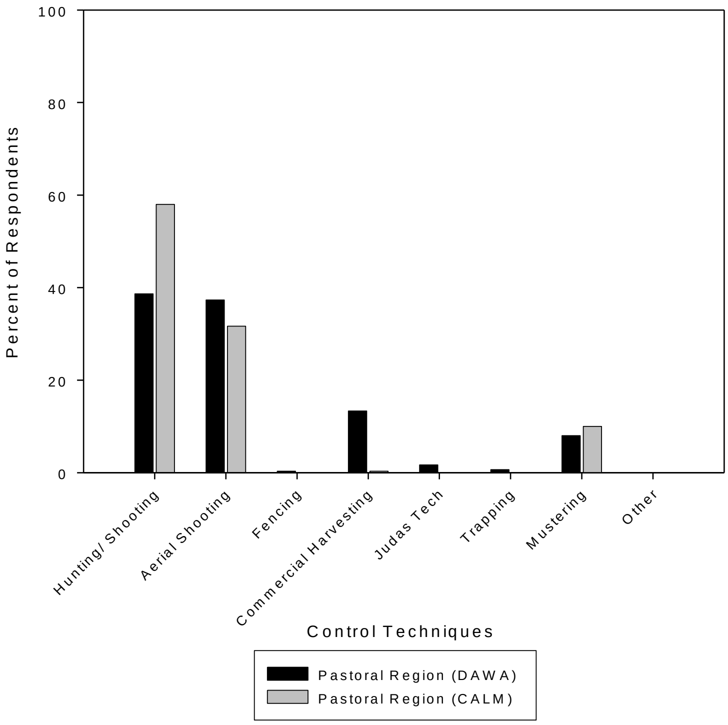


Figure 75. Recurrence of feral horse problems after control efforts for both of the rangeland respondent groups.

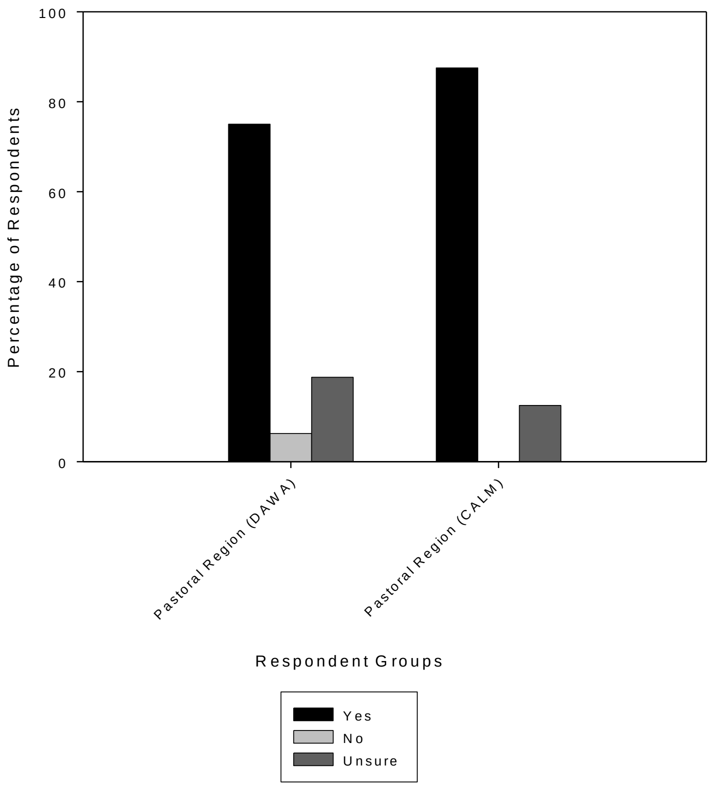
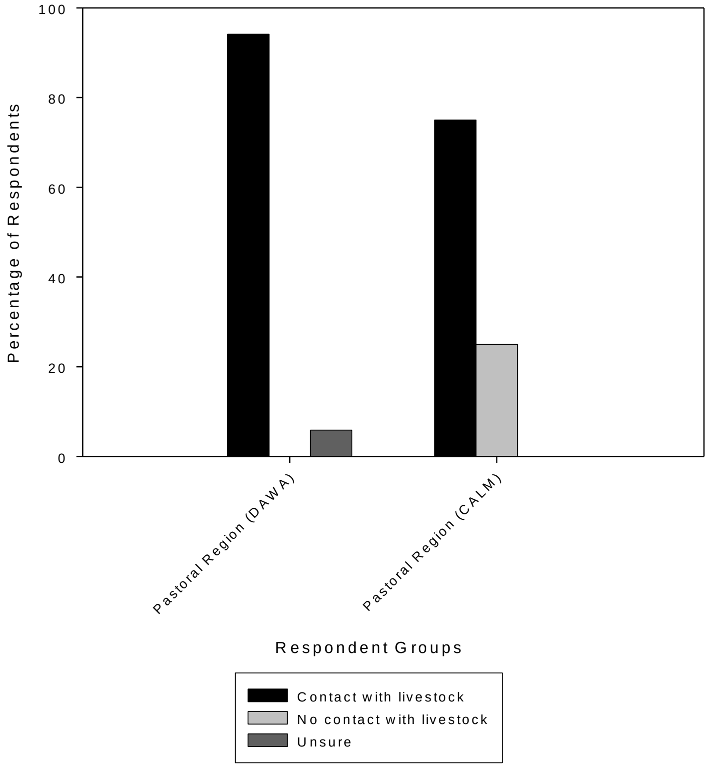


Figure 76. Potential for close contact between feral horses and domestic stock for both of the rangeland respondent groups.



5.3.4 Feral Cattle

Distribution and abundance of feral cattle

The distribution of feral cattle is clearly linked to cattle pastoral enterprises and how these enterprises are managed. Feral cattle were reported to be in high abundance in the Kimberley (Figure 77), where it is possible for cattle to avoid musters over long periods of time. Furthermore, many staff from the Department of Agriculture have good knowledge of both the Kimberley and the Pilbara through the donkey control program, and hence have a good knowledge of feral cattle distribution.

Corporate understanding of feral cattle

Nearly 70% of DAWA respondents and over 90% of CALM respondents reported the presence of feral cattle in the areas that they manage (Figure 78A). As described above, each respondent may have knowledge of large areas of land, so presence does not equate to distribution. Furthermore, the definition of feral cattle may vary between agencies. For example, any cattle on public land will be considered as feral by CALM but DAWA may consider any cattle that is ever mustered or has potential to be mustered as domestic stock.

Staff from both agencies were generally familiar or very familiar with the distribution of feral cattle where present (Figure 78B). Where they were present, DAWA staff suggested that they were generally either very rare or uncommon in abundance (Figure 78C). In contrast, CALM respondents suggested that the abundance of feral cattle was mostly common when present (Figure 78C).

The impacts caused by feral cattle were generally perceived to be environmental rather than associated with agricultural production. Both DAWA and CALM staff rated damage to native vegetation and soil erosion to be the highest of the impacts caused by feral cattle (Figure 79). It is interesting to note that all impacts were rated to be greater than 5%, with the exception of disease spread as interpreted by CALM staff. This suggests that the impacts of feral cattle are broad, rather than specific towards a single type of impact.

Both DAWA and CALM staff suggest that mustering is a common (Figure 80) and effective (Table 15) form of feral cattle control. DAWA staff also indicated that shooting (both ground and aerial) was used for control of feral cattle (Figure 80). Staff from CALM reported that fencing was the best method to control impacts from feral cattle (Table 15). In contrast, fencing is not perceived to be effective by DAWA staff, compared to other control techniques.

One hundred percent of CALM staff report that the problems of feral cattle persist after control efforts (Figure 81). The figure is significantly less for DAWA staff, with about 50% of respondents reporting a recurrence of feral cattle problems after control. This may be reflective of different strategies to manage feral cattle between agricultural and conservation land managers, or, as described above, differences in the definition of feral cattle.

Unanimously, feral cattle are thought to have potential for close contact with domestic stock (Figure 82), which is more than likely to be other cattle. If the potential is realised, feral cattle may need to be included in the monitoring of endemic diseases and definitely included in EAD preparedness. We expand on this further in section 6.4.3.

Figure 77. Reported distribution and abundance of feral cattle in Western Australia.

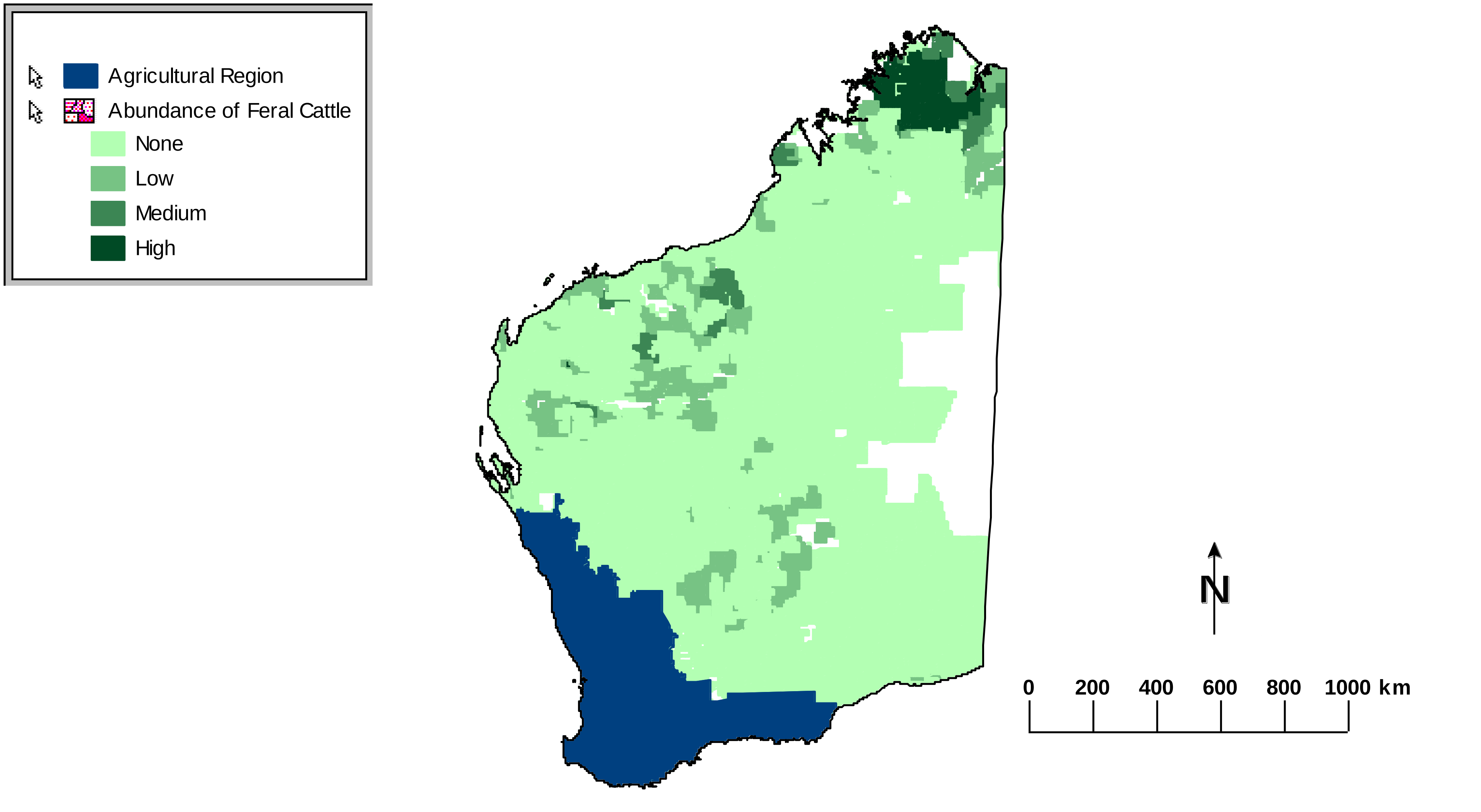


Figure 78. Presence (A), familiarity (B) and abundance (C) of feral cattle in the rangelands described by both respondent groups.

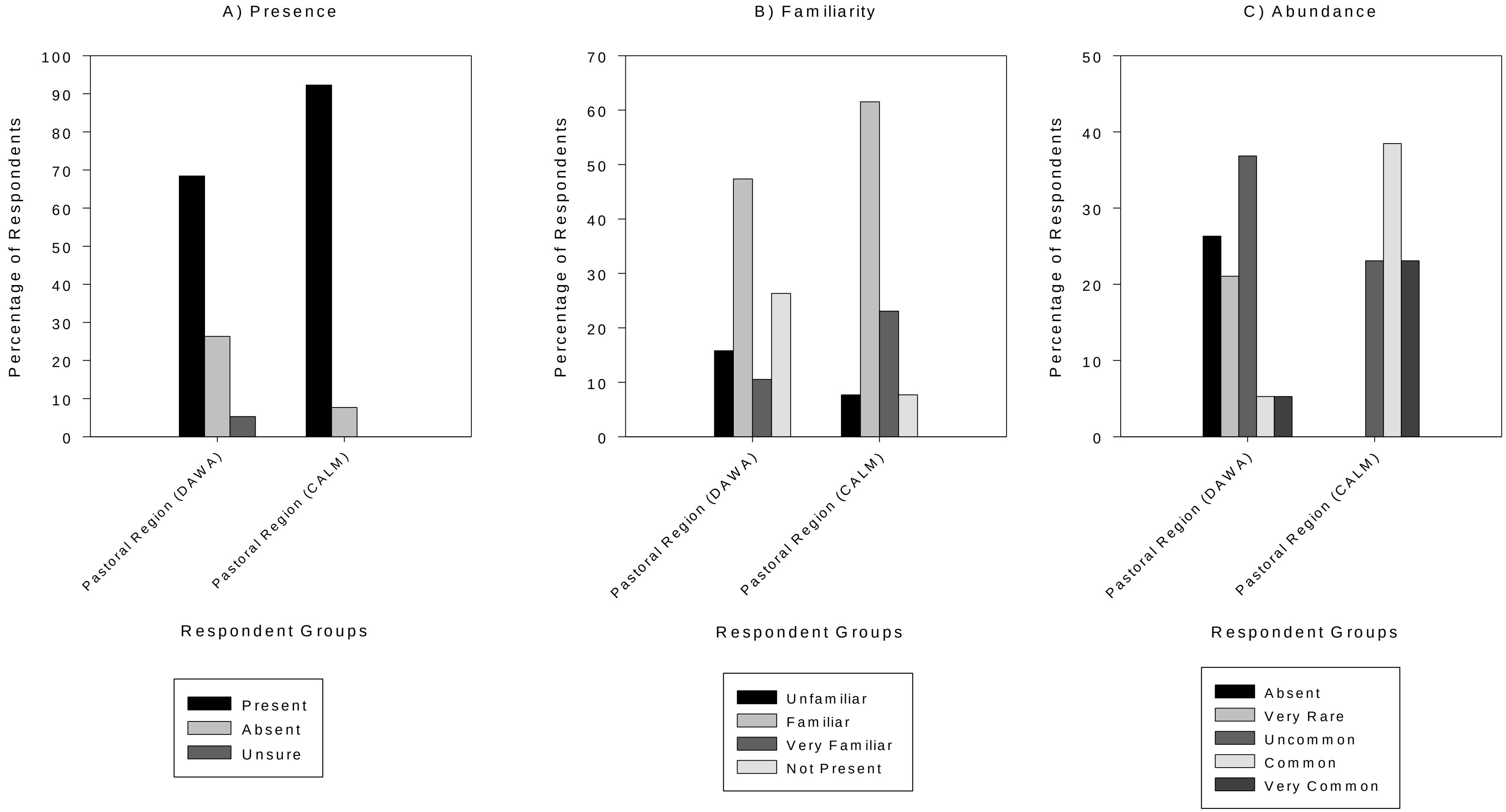


Figure 79. Impacts of feral cattle in the rangelands assessed by staff of the Department of Agriculture and Department of Conservation and Land Management.

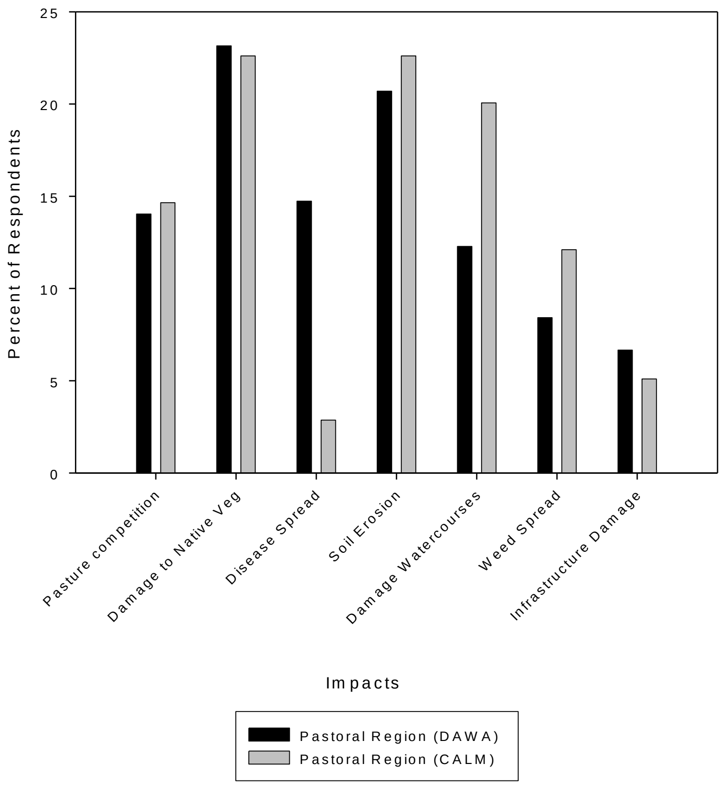


Figure 80. Use of techniques for the control of feral cattle reported by both the rangeland respondent groups.

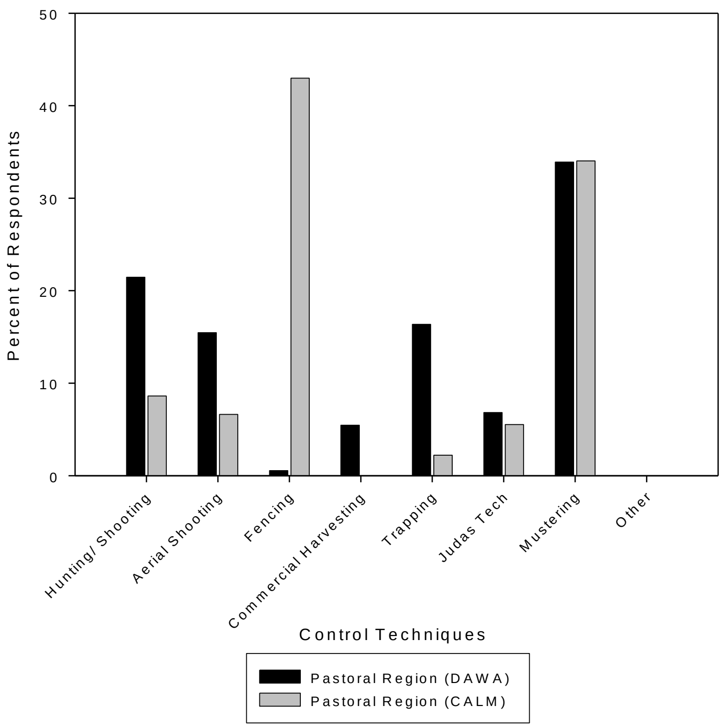


Table 15. Control techniques for feral cattle ranked according to their perceived effectiveness for both of the rangeland respondent groups.

Control Techniques	DAWA Pastoral	CALM Pastoral
Hunting and/or Shooting	2	3
Judas Techniques	4	5
Exclusion Fencing	7	1
Commercial Harvesting	6	not rated
Trapping	3	6
Aerial Shooting	4	4
Mustering	1	2
Other	not rated	not rated

Figure 81. Recurrence of feral cattle problems after control efforts for both of the rangeland respondent groups.

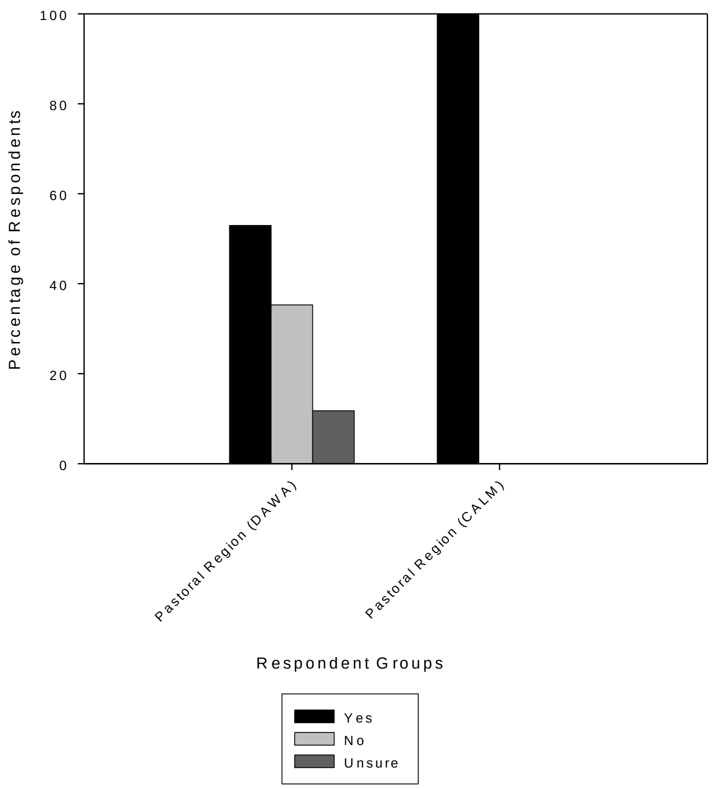
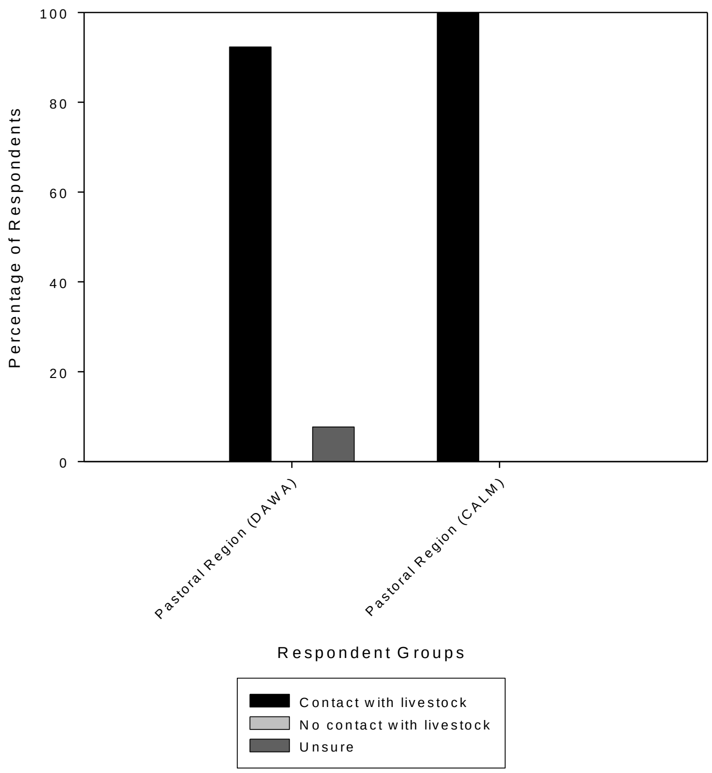


Figure 82. Potential for close contact between feral cattle and domestic stock for both of the rangeland respondent groups.



5.3.5 Feral Sheep

Distribution and abundance of feral sheep

Feral sheep include exotic sheep breeds and Australian merinos, with the former potentially being an emerging pest issue. As such, we expected the distribution to be very restricted and the abundance to be low. This was observed in our data. Low abundances were reported in the Upper Gascoyne/Ashburton and the Goldfields regions (Figure 83).

Corporate understanding of feral sheep

Feral sheep in the rangelands of WA are predominantly Australian merinos (Figure 84). These sheep are likely to be unmanaged in terms of escaping mustering for shearing or moving from a pastoral lease to a conservation estate. Feral sheep may also be remnant animals when stations switch enterprises (sheep to cattle, and perhaps mining). Exotic breeds present in the rangelands were generally cross breeds or damaras (Figure 84).

Feral sheep, as described in Figure 83, are generally not widespread in the rangelands. Most rangeland respondents reported feral sheep to be absent or not present in their reporting regions (Figure 85A, B & C). Where feral sheep were present, respondents were familiar with their distribution and abundance.

The key impacts of feral sheep are reported to be damage to native vegetation, competition with livestock and native herbivores for pasture, and the spread of weeds (Figure 86). These responses were consistent across both agencies.

To control feral sheep, each agency responded differently. CALM, for example, identify fencing as the main technique for controlling the impact of feral sheep (Figure 87), and rate the technique as most effective (Table 16). This approach may protect discrete areas such as rare flora. In contrast, DAWA respondents suggest that mustering and trapping are the most frequently used control techniques (Figure 87) as pastoralists attempt to get some economic gain from the animals, but hunting and/or shooting was the most effective technique (Table 16). The reality is that feral sheep are generally not subjected to organised control operations because of their limited distribution and abundance, although there have been some exceptions.

Both agencies suggest that problems caused by feral sheep continue to occur after control efforts (Figure 88). For CALM, the issues of some sheep getting through fences and fence maintenance will be ongoing. However, some DAWA respondents found that appropriate control did stop the problems caused by feral sheep.

From the EAD perspective, both agencies reported that feral sheep have the potential to come into close contact with domestic/managed stock (Figure 89). Both DAWA and CALM staff also rated disease spread as one of the impacts of feral sheep (Figure 86). However, because of the current sparse distribution and low abundance of feral sheep in the rangelands, the real EAD risk is likely to be low.

As described in 3.4.2, we believe that the feral sheep, specifically the exotic damara, could be a “sleeper” vertebrate pest species. If our beliefs are found to be true in the future, revisiting the information captured above will provide valuable insights into distribution, abundance and perceptions of a non-established vertebrate pest.

Figure 83. Reported distribution and abundance of feral sheep in Western Australia.

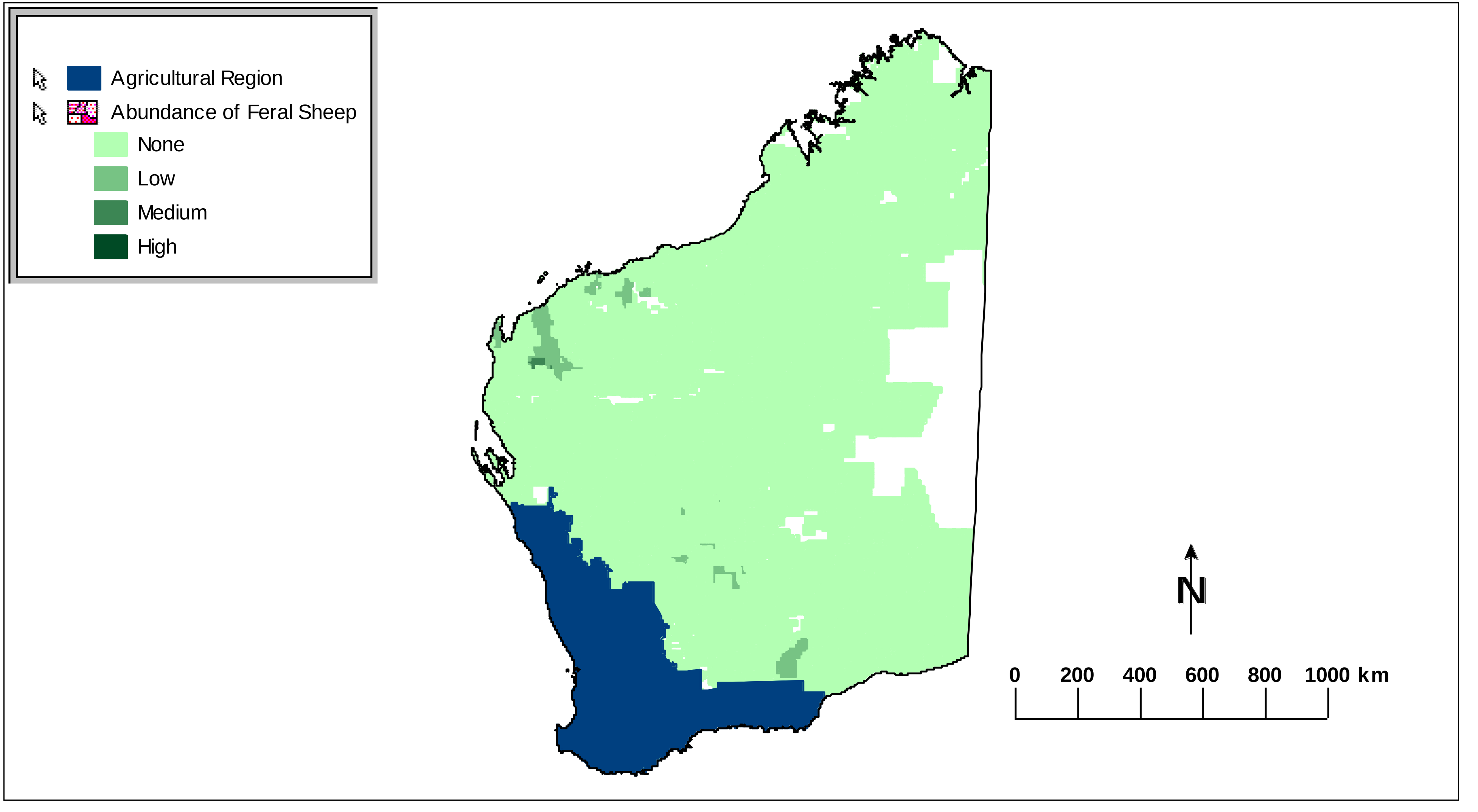


Figure 84. Types of feral sheep present for both of the rangeland respondent groups.

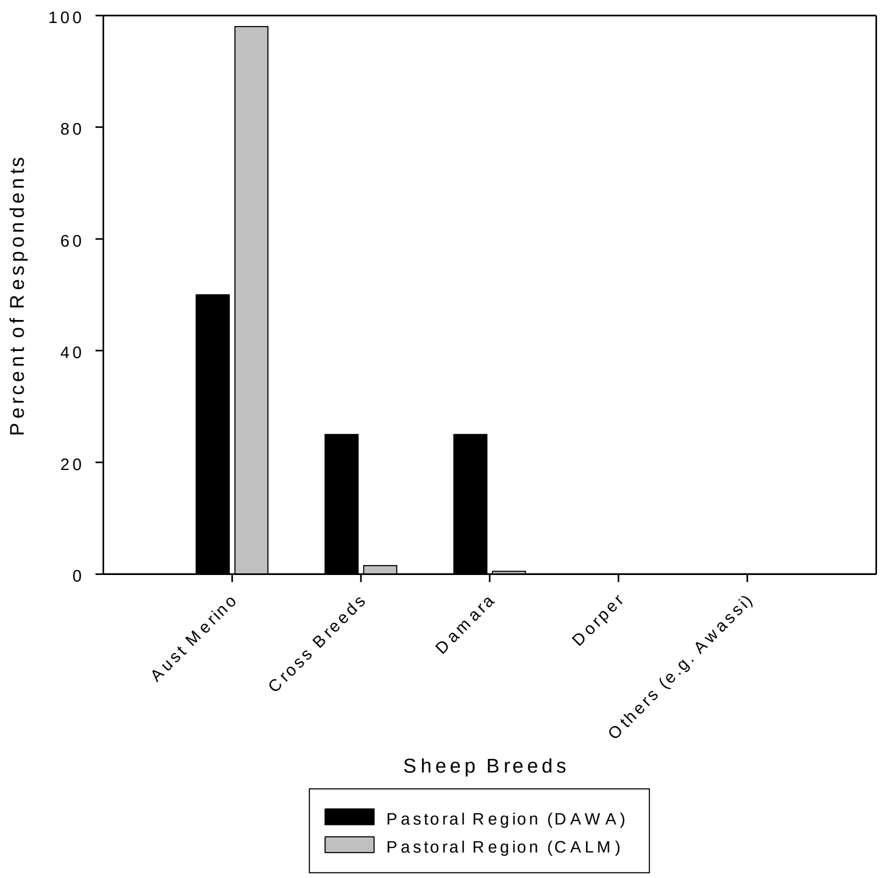


Table 16. Control techniques for feral sheep ranked according to their perceived effectiveness for both of the respondent groups.

Control Techniques	DAWA Pastoral	CALM Pastoral
Hunting and/or Shooting	1	not rated
Judas Techniques	not rated	not rated
Exclusion Fencing	4	1
Commercial Harvesting	3	4
Trapping	5	4
Aerial Shooting	not rated	not rated
Mustering	2	4
Other	not rated	not rated

Figure 85. Presence (A), familiarity (B) and abundance (C) of feral sheep in the rangelands described by both respondent groups.

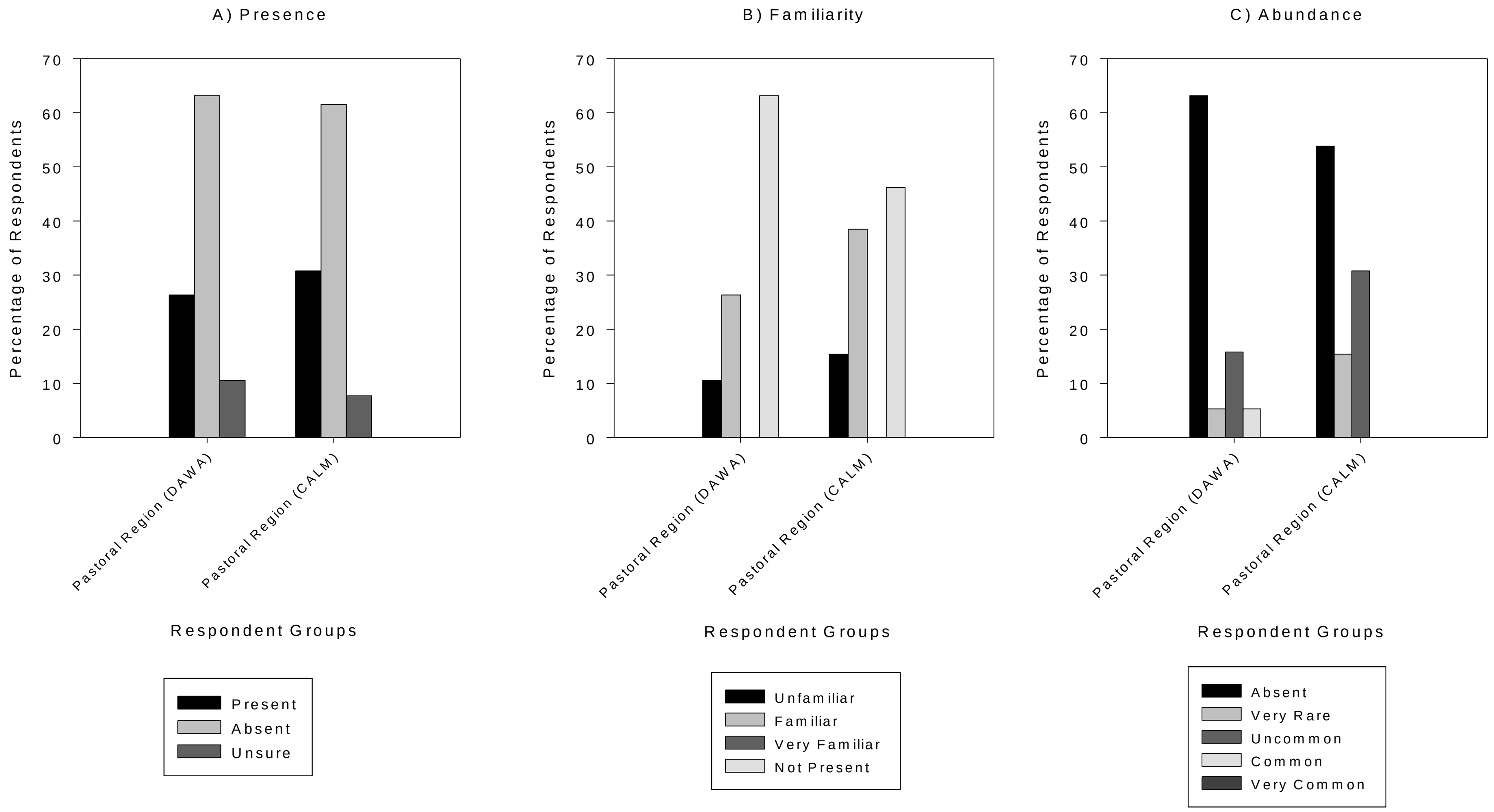


Figure 86. Impacts of feral sheep in the rangelands assessed by staff of the Department of Agriculture and Department of Conservation and Land Management.

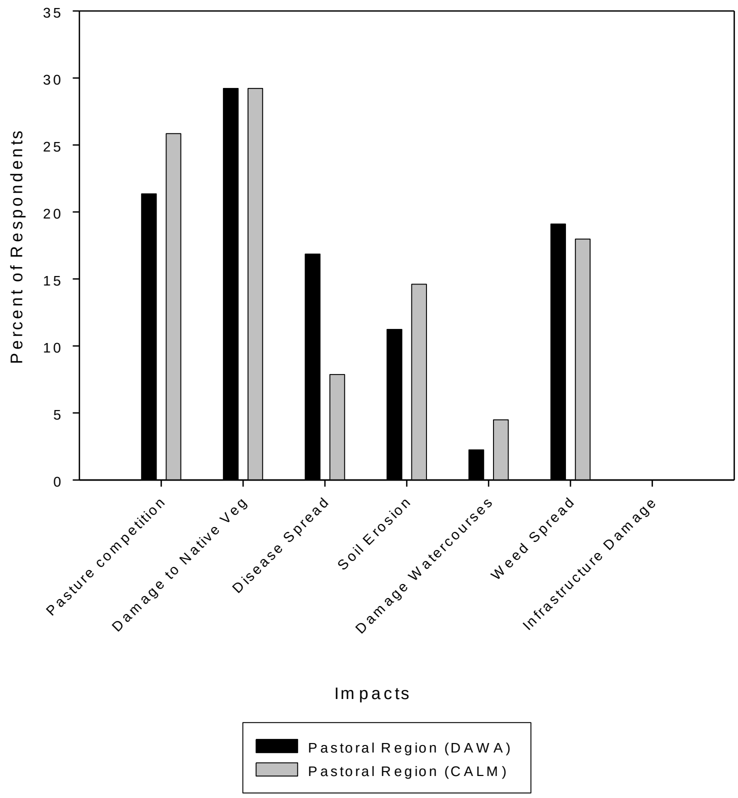


Figure 87. Use of techniques for the control of feral sheep reported by both the rangeland respondent groups.

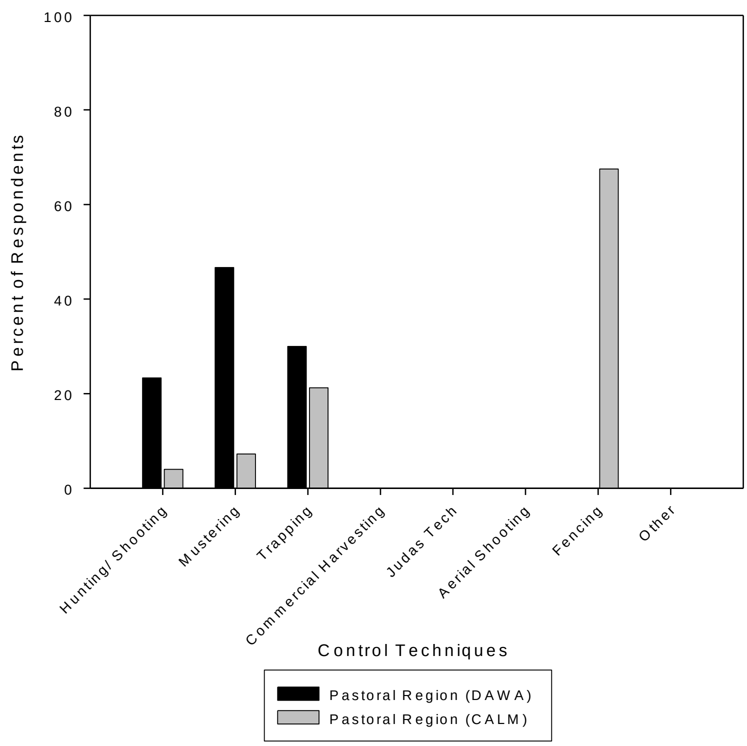


Figure 88. Recurrence of feral sheep problems after control efforts for both of the respondent groups.

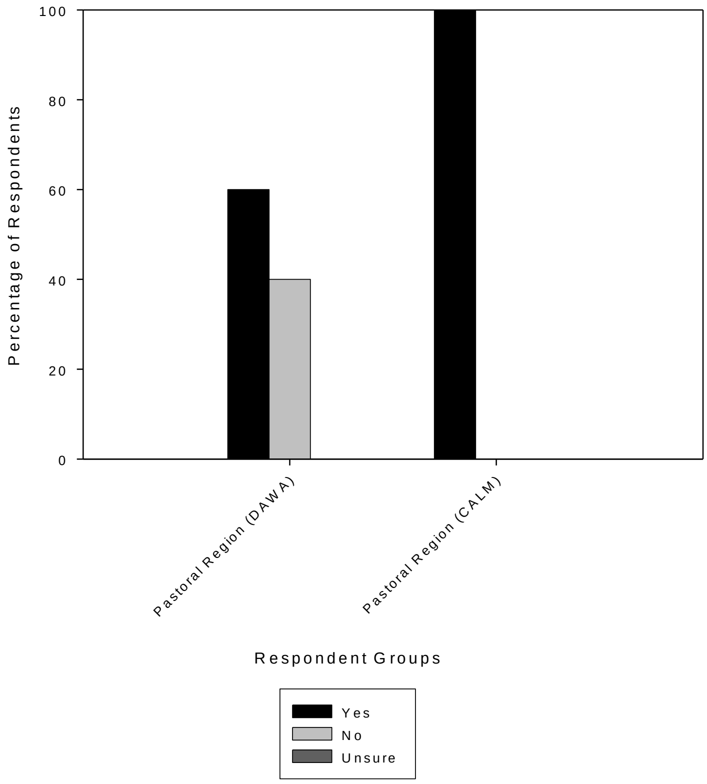
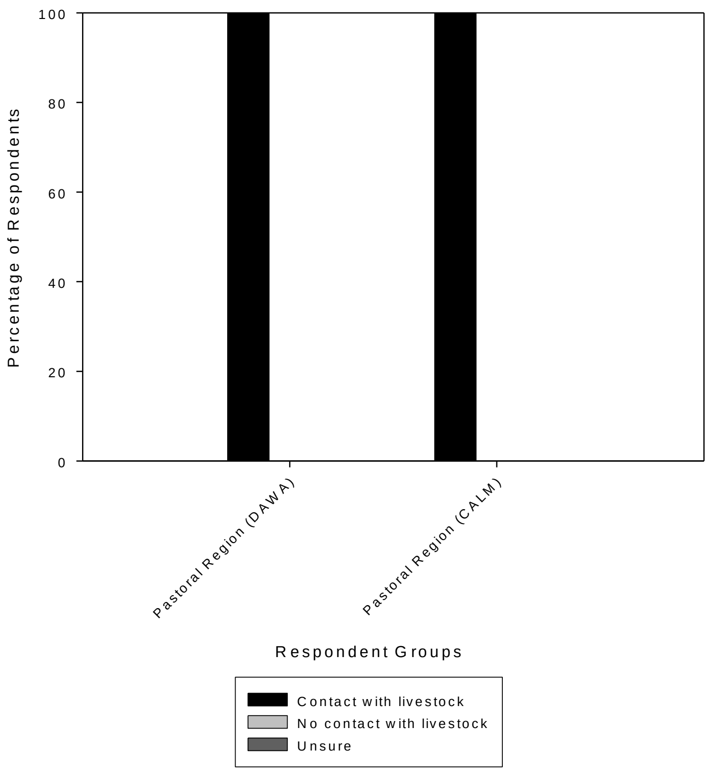


Figure 89. Potential for close contact between feral sheep and domestic stock for both of the respondent groups.



6. GENERAL DISCUSSION

The paper by Woolnough, West and Saunders (2004) provides an overall summary of the survey process. It specifically addresses issues of using institutional knowledge for describing pest animal distribution and abundance, minimising perception bias, using GIS as a tool for pest animal management, and most importantly, standardisation of data across spatial scales (e.g. region, state, nation). The following discussion identifies a few of the key issues in a little more detail than Woolnough *et al.* (2004), particularly highlighting some areas where we encountered challenges and where our work can be improved upon. It also generalises about some of the pest animal issues affecting Western Australia.

6.1 Pest Animals in Western Australia – Generalisations and Perceptions

This survey process focussed specifically on selected mammalian pest animals in Western Australia, and is therefore only partially representative of the pest animal issues in this state. Pest birds were excluded from the survey, as were pest rodents, pest fish and invertebrates. Some of the widespread animals, such as foxes, rabbits, and feral cats were only briefly covered in the questionnaire, because of the excessive abundance of these pests. This was particularly the case for the feral cat. The current approach might not be the best way to describe the distribution and abundance of these overabundant species.

Information management tool

The interview process proved to be a very good method for capturing good information about pest animals in a cost effective manner. The same process may also be used as a means to identify and prioritise areas of pest animal management. For example, we had not expected the distribution and abundance of the feral horse (Figure 71) to be as extensive as was reported. Consequently, this information could be used as a support mechanism for further investigations into management of feral horses in WA.

Generalising about impacts

Clearly, pest animals impact heavily on agricultural production and the environment. For herbivore pests (including the omnivorous feral pig), the key impacts were generally perceived to be damage to native vegetation, pastures and crops, which can compound into issues of soil erosion and damage to watercourses. For carnivore pests, the key impacts were the predation of livestock and native animals. Even though generalising about the perceived impacts of pest animals can be beneficial from a pest management reporting system, it may no be specific enough for local problems.

Identifying a development area

Our survey structure did not adequately capture social perceptions and impacts of pest animals. For example, some of the major impacts caused by pests like wild dogs can be social, rather than economic or environmental. This is perhaps an area that could be expanded upon, particularly if our approach is applied beyond government agency staff.

Animal disease preparedness

From an exotic disease preparedness perspective, the distribution and abundance of pest animals in WA, particularly ruminants, is perhaps greater than is currently acknowledged. The role that these pest animals may play in an EAD emergency, or even endemic disease maintenance and persistence, may require more detailed investigation and consideration. Some of these issues are expanded below.

Results of the questionnaire also suggest that there are some issues about animal diseases that could benefit from further research and/or training. From a staff management perspective, there is definitely scope to provide training about disease risks to staff from both agencies and how they may be involved in an emergency response. From a biological perspective, data from the questionnaire highlight that there is a high probability of contact between feral animals and domestic populations, and that these multi-species contacts require further investigation to describe and quantify the risks.

Control of pest animals

The questionnaire also highlights that there are differences in approaches to control of pest animals. These differences were at both the agency level and the individual level. Although the information on the appropriate techniques is available, or is being investigated through research, there is perhaps a need to have Standard Operating Procedures (SOPs) that are specific to Western Australian conditions and legislative requirements.

6.2 Data Quality

One of the key issues with data of this nature is that it is only as good as the source of the data. How the data is interpreted and then used is very much subjected to the caveats described in Section 4.2.6. However, we believe the overall quality of the data is sufficient to be used as a guide for:

- Describing the distribution and abundance of pest animals at a broad scale (state, region and shire).
- Exotic disease preparedness by identifying potential high risk areas.
- Identifying potential pest animals that should be considered in an EAD.
- Broad-scale management decisions about pest animals.

6.2.1 A Positive Interview Process

The 2-part interview process proved to be a very good strategy for minimising perception bias (see Woolnough *et al.* 2004).

In a positive example of survey process, one survey respondent was adamant that they did not have sufficient knowledge of their local area to adequately complete the mapping information section of the interview. What we found, was the interview process allayed any fears or insecurities about providing information to an unknown third party and that the quality of the mapping component was high and representative of that district. Also, the detail was more than sufficient for an appropriate ground-truthing investigation to be undertaken if unlimited resources were available.

It is likely that this observation of the survey respondent above was more common than just this one case. The two-part approach is therefore a very valuable method of building trust, ensuring self-confidence and gaining the best possible data.

6.2.2 Issues of Accuracy

As described by Woolnough *et al.* (2004), we made the assumption that the "credibility of the information collected was uniform across all participants, and that the consistency of interview process maintained the integrity of the results". Generally, we believe that our assumptions hold true. However, there were some exceptions identified within the 104 respondents.

Three cases presented themselves where the quality of the data was questioned by the survey team or a third party. In the first case, we became aware that the survey respondent tried to 'second guess' the information collecting process. This manifested itself in the mapping exercise, where the respondent guessed where pest animals were *likely* to be present (based on good knowledge of pest animal biology) rather than from first hand knowledge that they were present. These data was not included in any of the analyses.

The second case was similar, however, rather than question the accuracy of the data, the timing of the information needed to be taken into account. With subsequent inquiries, it came to our attention that the pest animal in question (feral pig) was probably absent from a group of properties at the time of the survey, but it had been there in the past and, more than likely, would be there again. However, because the verification information was supplied by a third party, we could not dispute either source of knowledge (respondent or landholders). The only means of addressing the contradiction would have been by ground-truthing.

The third example resulted from the respondent interpreting the definitions of pest abundance (Table 1) contrary to our intentions. Other factors, primarily extreme public opinion related to wild dogs in the particular district at the time, appeared to have influenced how the respondent reported the abundance of this pest animal. We clarified our definitions with the respondent and asked for a reassessment of the distribution and abundance. The response was identical to the initial interview. We do not dispute that the interpretation was accurate to the best of the respondent's knowledge and understanding of the questionnaire. Nor do we doubt the presence of the pest animal. However, we do question the comparability of this data to other regions.

These three cases highlight that there can be a need to ground truth some data, particularly when the information needs to be more specific than that obtained using our approach. This then presents issues of time, money and who has the skills to undertake such ground-truthing.

These cases are also representative of a change in function of biosecurity work undertaken by the DAWA; from a hands-on role to an advisory role. The change in role probably means that the intimate knowledge of every property that once existed with staff from the DAWA and the Agriculture Protection Board is declining. Furthermore, the changes in the structure of the workplace mean that the concept of 'jobs for life' and for staff to remain in the same office for many years has changed.

6.2.3 Issues of Precision

Along with the accuracy of the data, we also became aware that the precision of the data in the mapping exercise was not always consistent. In some scenarios, particularly when a pest animal was widespread across an area, the respondent drew generalised distributions across the area rather than precisely indicating animal distribution and abundance on a property-by-property basis. Even though this less precise information is very useful, particularly at the broader scales, it may produce a few problems when ground-truthing. In one example, where the distribution and abundance of feral pigs was assessed independently of this project, feral pigs were found on more properties than had been indicated originally. Whether this was a factor of the generalised distribution, lack of knowledge, temporal differences in the distribution and abundance of feral pigs, or some other factor is hard to determine. In general, the number of respondents that 'stylised' their responses in the mapping exercise was few. This issue can also be reduced through appropriate facilitation by the interviewer during the interview process.

6.3 GIS reporting

One of the greatest challenges of the project was how to report the large volume of data we collected. Reporting of the questionnaire data generally followed the protocols of West and Saunders (2003). However, the property information associated with the spatial information created a number of challenges not encountered by West and Saunders (2003) which needed to be addressed.

6.3.1 Privacy

One of the major issues encountered in this project was the issue of privacy, or more specifically, how to report the data with out compromising privacy.

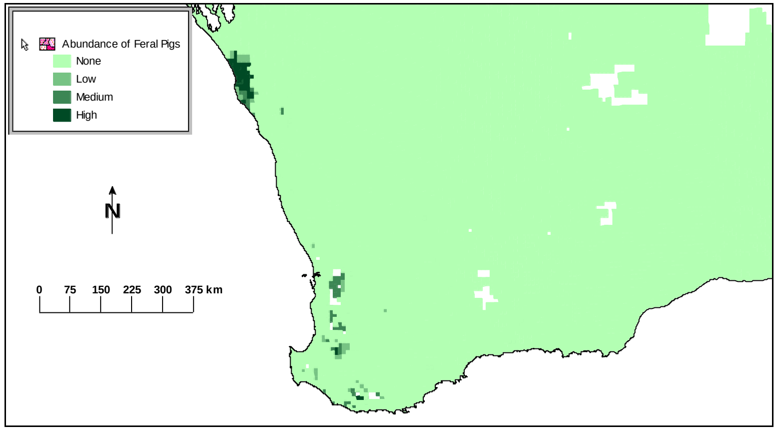
Data were collected on a property basis. From the perspectives of a government agency and exotic disease management, having data on the distribution and abundance of pest animals associated with property information is very important. As described above, property-based pest animal information may help with management decision making and resource allocation. Furthermore, from an exotic disease perspective, emergency responses are likely to be managed on a property basis. Having access to all the property information (e.g. owners, contact details, type of enterprise etc.) and pest animal information may greatly assist with informed decision making in an emergency scenario.

However, the issue of privacy needs to be considered when publicly reporting distribution and abundance data on a property basis. Having property and pest animal information may compromise the privacy of the land holder. For example, reporting the distribution of feral goats on a pastoral lease basis may lead to economic choices being made by potential new pastoralists (i.e. buying a lease with high goat abundance and basing their pastoral enterprise on this information). These data are not reliable enough for this type of economic decision making. Instead, we needed to deconstruct the data from a property basis to grid cells (10 km x 10 km) to report the data publicly.

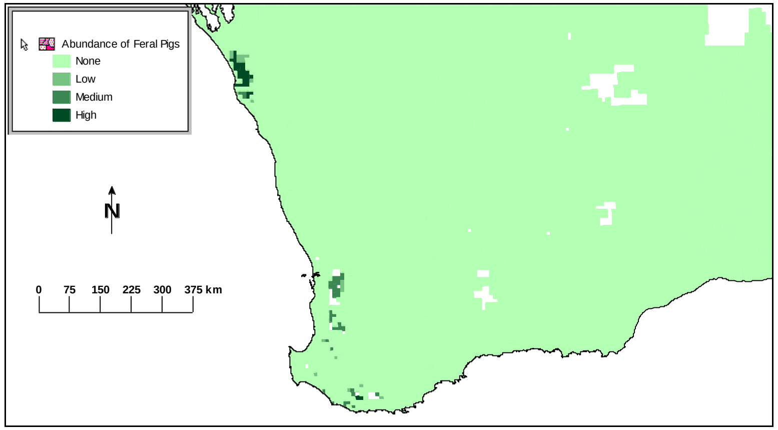
6.3.2 Deconstruction for reporting purposes

The process of deconstruction essentially lays a 10 km by 10 km grid over the whole state. For the deconstruction process, we only used the databases for pastoral leases, freehold land greater than 10 ha in the agricultural region, CALM managed estates and unallocated crown land. Some of the smaller databases containing only a few records were excluded. Since the original data sets were constructed on a land tenure basis, the process of deconstruction changed the structure of the data. This change in structure affected how the data sets joined together.

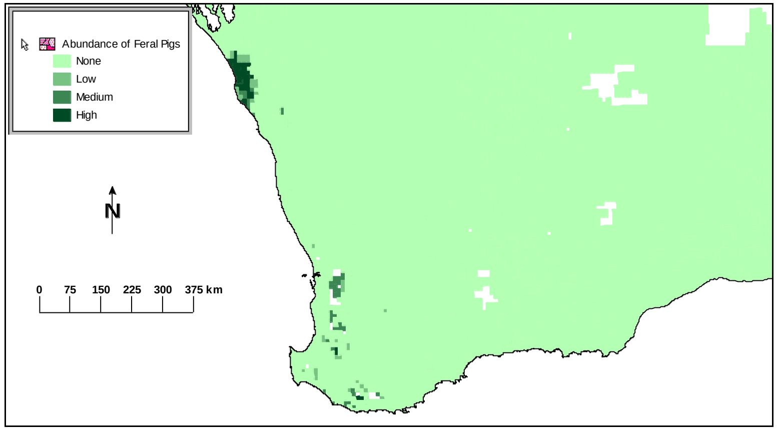
Figure 90. Effects of GIS layering using 10 km x 10 km grid cells.



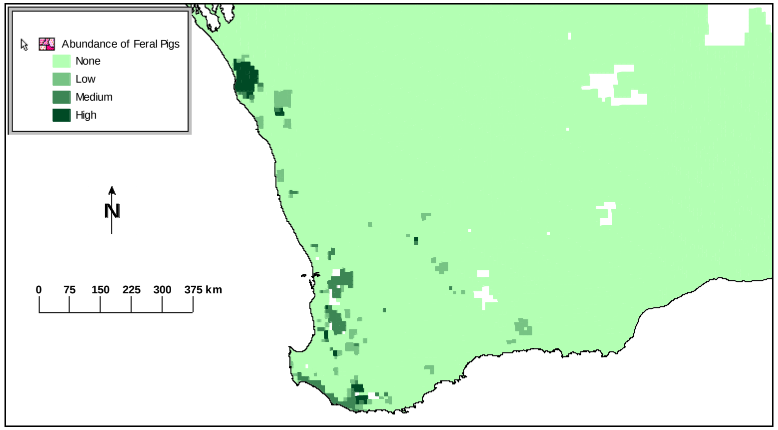
A. Reported distribution and abundance of feral pigs with 'agricultural region land parcels' being the top layer of the GIS.



C. Reported distribution and abundance of feral pigs with 'unallocated crown land' being the top layer of the GIS.



B. Reported distribution and abundance of feral pigs with 'pastoral leases' being the top layer of the GIS.



D. Reported distribution and abundance of feral pigs with 'CALM managed land parcels' being the top layer of the GIS.

The process of deconstruction essentially determines the abundance of each pest animal for every 10 km x 10 km cell of our grid. For each cell, an average of pest animal abundance (species by species) was then calculated, since one grid cell may be made up of more than one land parcel. The average calculations were made for each of the four databases. This process essentially changes the boundaries of the properties and may subtly increase or decrease the distribution and abundance of a species. These subtle changes then affect how the data are reported by the GIS.

The mapping outputs of our GIS are essentially layers of information. By inference, our GIS essentially has four layers of information. When our four layers are reporting on a property basis, they fit neatly together because land tenure fits neatly together. However, data deconstruction has resulted in some variability between the layers. Selecting which layer to place on top may affect how the data are interpreted, because it may mask the data in lower layers. Figure 90 shows the effects of layering. In this figure, we have changed which of the four GIS layers is on top. For feral pigs in the south-west of WA, we can see that the distribution and abundance changes slightly depending on what is the top layer.

The mapping within this report follows the layering in Figure 90A. This weights the data from the agricultural properties higher than the other data sets, and may therefore represent a conservative distribution. However, it is important to note that this is only an issue for reporting of the data using deconstructed data sets. The underlying property data is not spatially compromised or weighted in anyway and so can still be utilised by DAWA.

6.4 Development and Future Applications

6.4.1 Hazard Identification in Emergency Responses

The data described in this report are *potentially* a valuable tool for exotic disease preparedness, and potentially even for emergency responses. Because data and the underlying information system are based on property boundaries, we essentially have a ready-to-go tool in an emergency response. In the hypothetical exotic animal disease scenario in Figure 91, we can quickly establish what information is available and what are likely to be key risks in the emergency response. One of the first considerations in this hypothetical scenario may be to initiate the Wild Animal Management Manual of AUSVETPLAN because of the potential risk of wildlife in a disease outbreak. As described elsewhere, the underlying data may not be entirely accurate, but the value of the data is in identifying potential hazards that should be considered.

Another benefit of this approach in a real time exotic disease emergency may be the reduced dependence on local knowledge, because the corporate knowledge has been already captured. If, for example, there is a new staff member in an area, their local knowledge may be limited. With an ageing workforce, staff turnover and changing role from an operational capacity to more of an advisory role, the loss of corporate knowledge becomes a real risk for DAWA. Having reliable and accessible local knowledge is a vital component of an EAD response.

As described above, this approach has *potential* for enhancing EAD preparedness and response. The potential of this approach is only realised if it becomes recognised as a useful tool and incorporated into existing corporate policy and planning structures.

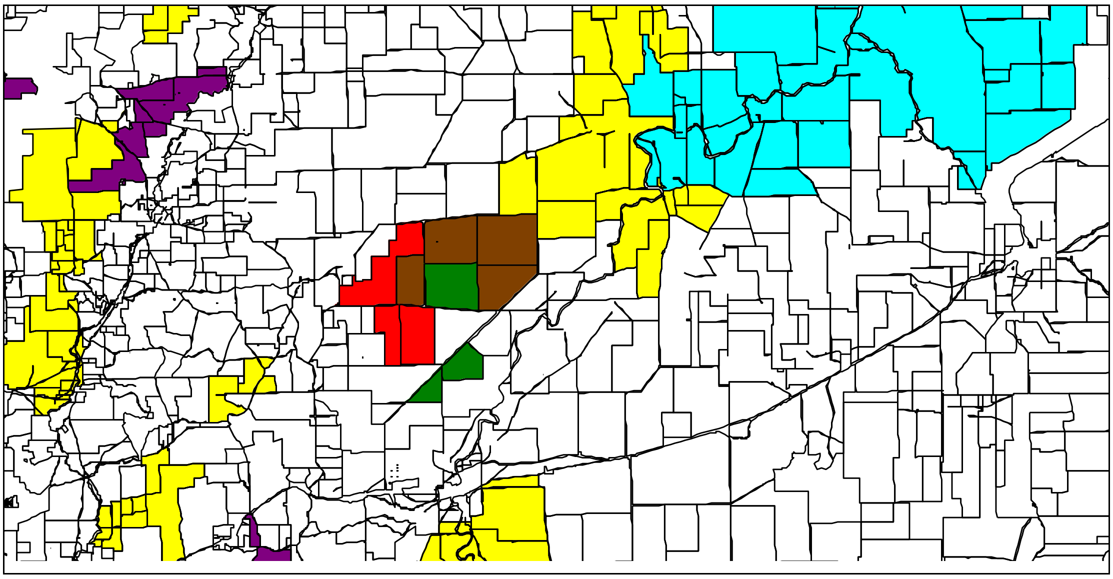


Figure 91. Hypothetical example of how the data could be used.
Red represents an infected premise (IP), brown represents a suspected IP, green is an unknown IP, purple represents the distribution of feral deer, blue represents the distribution of feral goats and yellow represents the distribution of feral pigs.

6.4.2 Identification of High Risk Areas

These data may also be used to proactively determine potential high risk areas, for both EAD and pest animal management. For example, Figure 92 highlights an area where four high risk feral animals (feral pigs, feral deer, feral goats and wild dogs) are present and in close proximity to each other. This is potentially a high risk area for disease transmission within the feral animal population and between livestock in overlapping farming properties. It is also an area that is in need of pest animal management.

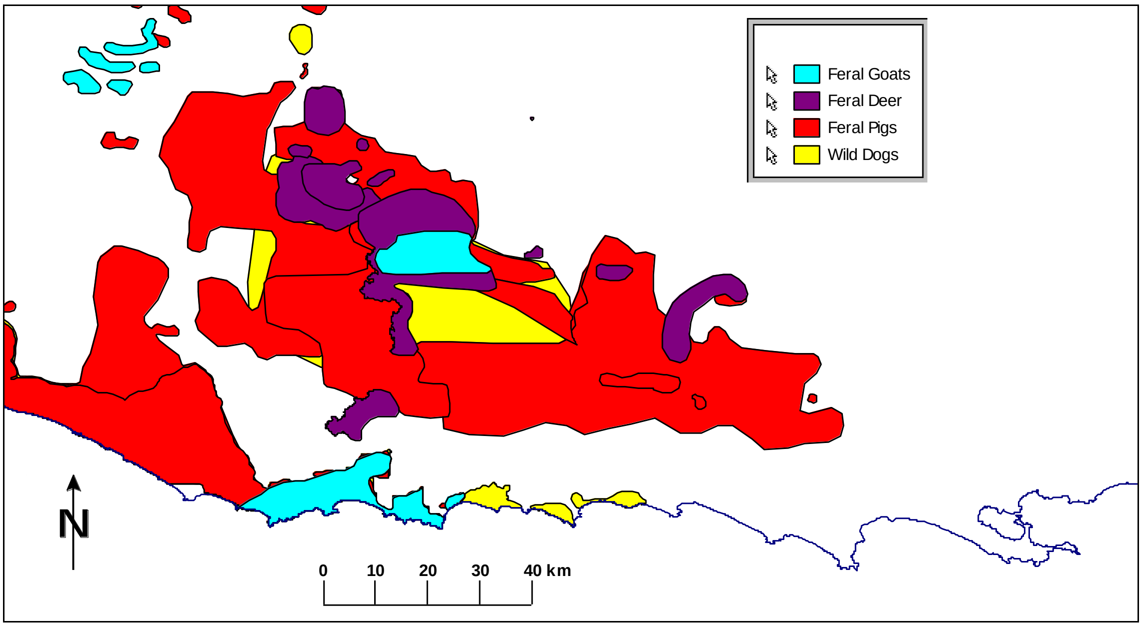


Figure 92. Identifying areas with high risk potential for exotic disease.

6.4.3 Endemic Disease Surveillance

Another area where the data may be used as an informative tool is in the management and surveillance of endemic diseases. For example, Figure 93 describes the possible zones of Bluetongue virus activity in Western Australia. In the disease-active areas of the Pilbara and the Kimberley, there are a number of land parcels that have potentially susceptible hosts, particularly feral cattle. For example, our data suggest that feral ruminants (including feral cattle, feral goats and feral camels) are present in 39% of the Bluetongue active area in the Pilbara. We suggest that our data could be used as a value-adding mechanism, particularly for disease surveillance and detection protocols which include pest animals.

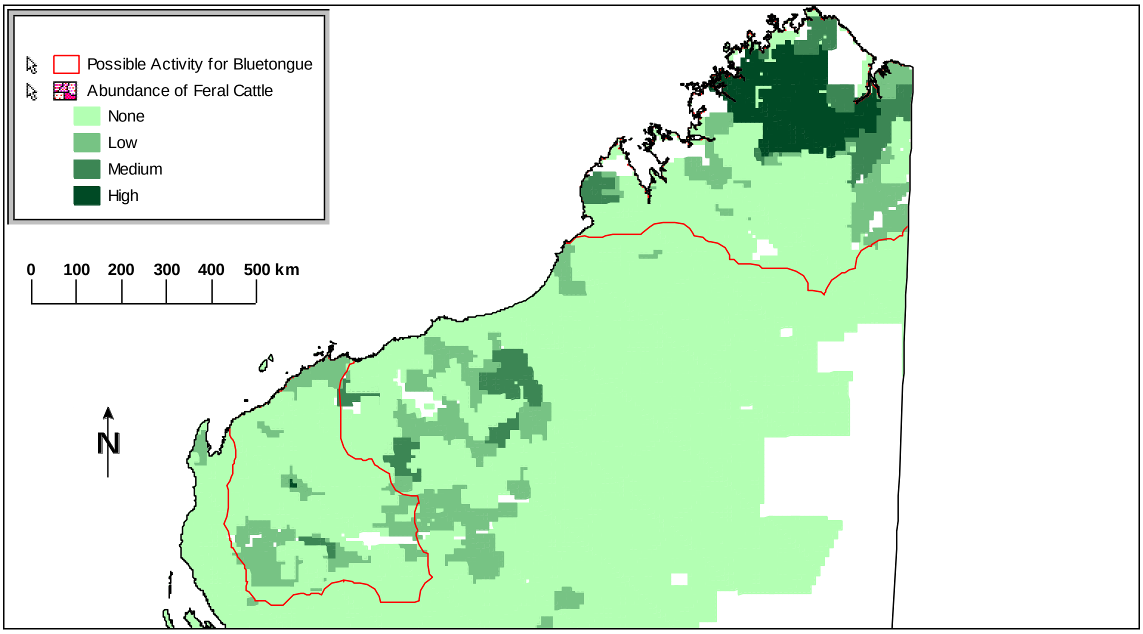


Figure 93. Bluetongue zoning map (from www.namp.com.au) for north-western Western Australia. The map indicates possible areas of disease activity and along with the distribution and abundance of potentially susceptible feral cattle.

6.4.4 Cross-discipline Applications

One of the key outcomes of this project has been the marrying of mapping data with genetic population data. This integration of approaches may allow us to better understand pest animal populations and how they can potentially be managed. In the example described by Spencer and Woolnough (2004), we combined our joint knowledge of feral pig population biology to describe the genetic boundaries of this pest and identify operational management units for the south-west of WA. These operational units have equal applicability for on-the-ground pest animal management or disease incident management. In both examples, having knowledge of population boundaries can lead to the development of appropriate containment strategies. Naturally, any containment strategy needs to be practicable at a landscape scale.

7. ACKNOWLEDGEMENTS

This project was funded by two research grants from the Wildlife and Exotic Disease Preparedness Program (WEDPP) of the Commonwealth Department of Agriculture, Fisheries and Forestry, with additional funds from the Western Australian Department of Agriculture. We thank Chris Bunn and his WEDPP team for providing ongoing support for the project and kindly allowing us to provide a joint report for both grants.

A project of this scope is not possible without the contribution of many people. The following briefly acknowledges their contributions.

In the early evolution of our work (pre-WEDPP), we thank Peter Mawson from CALM for contributing to our ideas and DAWA staff for contributing to our preliminary survey questionnaires.

As the project evolved (with WEDPP funding) we were greatly assisted by the input from Peter West from NSW Department of Primary Industries. Together, both NSW DPI and DAWA contributed to what we hope will develop into a National protocol for the simple measurement of the distribution and abundance of pest animals. We adopted Peter West's tried and tested interview approach, and further refined the survey content, structure and data management, with his ongoing and valued input. The cooperation with Peter West and Glen Saunders has lead to successful publication of our joint approach in the journal Ecological Management and Restoration (Appendix 5) highlighting the National usefulness of our joint approach.

This project could not have happened with out the corporate support from both the Department of Agriculture and Department of Conservation and Land Management. Along with all the staff members listed in Appendix 1 and their managers, this project would not have happened without the support from Greg Pickles (Manager of Animal Pest and Emergency Services, DAWA) and Alan Walker (Director of Nature Conservation, CALM).

We also thank a number of people that have contributed to specific aspects of the project. Peter Spencer and Jordan Hampton from Murdoch University added value to our data and contributed to our knowledge of feral pig population biology. Marc Kabay kindly provided us with details on endemic diseases. Ned Stephenson, Damian Shepherd, Avril Russel-Brown and Greg Beeston have all provided valued advice and assistance on the GIS component of the project.

Finally, we also acknowledge and value the input, time and cooperation from our colleagues from the Vertebrate Pest Research Section: Laurie Twigg, Peter Thomson and Marion Massam.

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9. APPENDIX 1 LIST OF PARTICIPANTS

Staff from the Department of Agriculture

Agricultural Region

Biosecurity Officer	Region	Office
Ken Andrews	Central Agricultural Region	Narambeen
Martin Atwell	Central Agricultural Region	Wickerpin
John Barden	Southern Agricultural Region	Cranbrook
Graham Blacklock	Southern Agricultural Region	Kojonup
Natalie Bort	Northern Agricultural Region	Moora
Allan Browne	South-West Agricultural Region	Bridgetown
Adrian Chesson^	Southern Agricultural Region	Dumbleyung
Jonathan Cole	Southern Agricultural Region	Albany
Ashley Cook	Central Agricultural Region	Northam
Barry Davies	Central Agricultural Region	Merredin
Ray Eakins*	Northern Agricultural Region	Geraldton
Gary Farrelly	South-West Agricultural Region	Margaret River
Rosemary Fletcher	Central Agricultural Region	Hyden
Ken Franklin	Southern Agricultural Region	Esperance
Colin Goodwin	Central Agricultural Region	Mukinbudin
Ray Gwynne	Southern Agricultural Region	Esperance
Julianne Hill	Southern Agricultural Region	Ravensthorpe
Allan Howitt*	Northern Agricultural Region	Geraldton
Dean Jolly	Central Agricultural Region	Southern Cross
Peter Jolly	Southern Agricultural Region	Katanning
Mike Jones	Northern Agricultural Region	Morawa
Ray Kerslake	South-West Agricultural Region	Waroona
Brian Kimber	Central Agricultural Region	Lake Grace
Ted Knight	Southern Agricultural Region	Mt Barker
Errol Kruger	Northern Agricultural Region	Moora
Wayne Ledger	Southern Agricultural Region	Jerramungup
David Lisle	Northern Agricultural Region	Geraldton
Harry Little*	Southern Agricultural Region	Esperance
David Long^	Southern Agricultural Region	Pingrup
Paul Manera	Central Agricultural Region	Goomalling
Neville McInerney	Central Agricultural Region	Port Hedland
Paul Merks	South-West Agricultural Region	Manjimup
Yvette Murphy*	Northern Agricultural Region	Coorow
Peter Nielsen	Central Agricultural Region	Boddington
Ken Noack	South-West Agricultural Region	Donnybrook
Eileen O'Neill	Southern Agricultural Region	Katanning
Eric Orchard	South-West Agricultural Region	Bunbury
Colin Parry	Southern Agricultural Region	Albany
Tony Pocock	South-West Agricultural Region	Busselton
Ron Pryde	Southern Agricultural Region	Esperance
Andrew Reeves	South-West Agricultural Region	Bunbury
Craig Robins	Northern Agricultural Region	Three Springs
Tim Stevens	Northern Agricultural Region	Wongan Hills
Alex Stewart	Central Agricultural Region	Narrogin
Ken Talbot	Northern Agricultural Region	Gingin
Mike Taylor	Southern Agricultural Region	Denmark

Agricultural Region (continued)

Biosecurity Officer	Region	Office
Geoff Thomas	Central Agricultural Region	Dowerin
Brett Vukelic	South-West Agricultural Region	Bunbury
Dean Wainwright	South-West Agricultural Region	Boyup Brook
Nicole White	Central Agricultural Region	Beverley/Avondale
Pip Wilkins*	Northern Agricultural Region	Cervantes
Harry Williams	Central Agricultural Region	Pingelly
Phil Williams	South-West Agricultural Region	Busselton

Rangelands

Biosecurity Officer	Region	Office
Chris Collins	Carnarvon	Carnarvon
Mick Everett	West Kimberley	Derby
Derek Goddard	East Kimberley	Kununurra
Bill Gorie	Goldfields	Kalgoorlie
James Harrison	Goldfields	Southern Cross
Tom Hodder	Meekatharra	Yalgoo
John James*	Meekatharra	Meekatharra
John Kerr	Goldfields	Kalgoorlie
Simon Kniveton	Pilbara	Karratha
Andrew Longbottom	Pilbara	Karratha
Neville McInerney	Pilbara	Port Hedland
Rob Parr	Pilbara	Karratha
Terry Pinner	Goldfields	Kalgoorlie
John Russell-Pell*	Meekatharra	Mt Magnet
Ron Spicer	Goldfields	Kalgoorlie
John Stretch	Carnarvon	Carnarvon
PJ Waddell	Goldfields	Kalgoorlie
Lindsay Ward	East Kimberley	Halls Creek
Rod Williams	Carnarvon	Carnarvon
Noel Wilson	East Kimberley	Kununurra

*Have since retired or left the DAWA, ^Employees of Shires rather than DAWA.

Staff from the Department of Conservation and Land Management

Agricultural Region

CALM Officer	Region	Office
Karlene Bain	South Coast	Walpole
Rob Brazell	South-West	Collie
Greg Chant	Wheat Belt	Merredin
Peter Collins	South Coast	Albany
Anthony Desmond	Midwest	Geraldton
Mike Fitzgerald	South Coast	Esperance
Greg Freebury	South Coast	Albany
Mal Grant	South Coast	Ravensthorpe
Steve Gunn	Swan	Dwellingup
Keith Hockey	Midwest	Jurien Bay
Glyn Hughes	Swan	Wanneroo
Kevin Marshall	Midwest	Geraldton
Dennis McDonald	Swan	Mundarring
Brian McMahon	Wheat Belt	Narrogin
Des Plumb	Wheat Belt	Katanning
Greg Voigt	South-West	Busselton
Kim Williams	South-West	Bunbury
Ian Wilson	South-West	Manjimup

Rangelands

CALM Officer	Region	Office
Chris Davis	Midwest	Exmouth
Brad Rushforth	Kimberley	Kununurra
Allan Thomson	Kimberley	Kununurra
David Grosse	Kimberley	Kununurra
Ian Kealley	Goldfields	Kalgoorlie
David Blood	Midwest	Geraldton
Brett Fitzgerald	Midwest	Carnarvon
Arvid Hogstrom	Midwest	Exmouth
Kingsley Miller	Kimberley	Broome
George Watson	Pilbara	Karratha
Steve Van Leeuwen	Pilbara	Karratha
Brad Barton	Goldfields	Kalgoorlie
Peter Kendrick	Pilbara	Karratha

10. APPENDIX 2 AN EXAMPLE OF THE QUESTIONNAIRES (DAWA STAFF, RANGELANDS)

Department of Agriculture
Government of Western Australia

Recorder	*Date*
Protection Officer	

Pest Animal Survey

Thank you for participating in this survey.

Background
This survey is all about people-centred learning. We believe the greatest asset of the Department of Agriculture is its staff and this survey will attempt to document your knowledge.
The survey has several key outcomes:
1. To document the abundance and distribution of pest animals (vertebrates) and produce useful maps.
2. To allow us to undertake risk assessments of exotic disease potential and pest animal problems.
3. To use your knowledge to provide an insight into the issues of animal pest management.

This survey has financial support from the Commonwealth Department of Agriculture, Fisheries and Forestry Australia (AFFA) through their Wildlife and Exotic Disease Preparedness Program (WEDPP). It is an important part of the work of the Vertebrate Pest Research Section and has support from the Animal Health program. This survey closely follows a similar survey conducted by the VPRS in the Agricultural Region of WA. With your assistance we are trying to set National standards for wildlife exotic disease preparedness. It will also help to develop best-practice management of pest animals (vertebrates) in Western Australia.

The Survey
The survey is a two-part process. The first part is a questionnaire about pest animals in <u>your District</u>. Please answer each question to the best of your knowledge. Also, please note that there are no correct or wrong answers and not knowing or zeros are valuable answers. The questionnaire is an interactive process, so if you have any contributions or comments to make, please feel free to do so.
The second part is an interactive mapping exercise. In this exercise we will ask you to identify properties where pest animals occur and what densities these animals occur at. Again, your actual knowledge is what we are trying to capture and unknowns are valuable answers.
Results of the survey will be available in a report at the completion of the project.

Part A

Generic Information

Name of the DAWA Officer: ______________________________

A1. What area/s will you be reporting on?

Shire/s: ______________________________

____

CALM Reserves: ______________________________

____

Other: ______________________________

____

A2. How long have you worked in your area?
(Please circle one option)

Less than 1 Year	1 – 2 Years	3 – 5 Years
6 – 10 Years	11 – 20 Years	Greater than 20 Years

A3. Are you aware of the AUSVETPLAN?
(Please circle one option)

Yes	No

A4. Within your District, are animal pest **impacts** changing?

(Please tick only one option per landholding size)

	INCREASING	STABLE	DECREASING	NOT APPLICABLE	UNKNOWN
Pest Impacts					

A5. What livestock enterprises are present in your District?

(Please tick only one response per enterprise)

Livestock Enterprise	*Present*	*Absent*	*Unsure*
Sheep – Merinos			
Sheep – Exotic Breeds			
Cattle – Beef			
Cattle – Dairy			
Goats – Managed/Improved			
Goats – Harvesting of Ferals			
Pigs – Commercial			
Pigs – Non-Commercial			
Poultry – Commercial			
Poultry – Non-Commercial			
Horses			
Deer			
Camels			
Other Camelids (alpacas etc.)			
Ostriches			
Other (please specify)			

PART B

Pest Animal populations

B1. Do you have any vertebrate pest animals within your District? Please list the animals.

________________________ ________________________

________________________ ________________________

________________________ ________________________

________________________ ________________________

B2. How familiar are you with the **distributions** in your District of the following pest animals **in the last 12 months**?

(Please tick only one response per animal)

	Unfamiliar	Familiar	Very Familiar	Not Present
Feral Pigs				
Feral Goats				
Feral Deer				
Foxes				
Rabbits				
Wild Dogs				
Feral Cats				
Feral Horses				
Emus				
Kangaroos				
Feral Donkeys				
Feral Camels				
Feral Cattle				
Feral Sheep				

B3. How do you rate the **impact** of the following species on **Agricultural Production** in your District **in the last 12 months**?

(Please tick only one response per animal)

	Nil	Low	Moderate	High	Very High	Unknown	Not Present
Feral Pigs							
Feral Goats							
Feral Deer							
Foxes							
Rabbits							
Wild Dogs							
Feral Cats							
Feral Horses							
Emus							
Kangaroos							
Feral Donkeys							
Feral Camels							
Feral Cattle							
Feral Sheep							

B4. How do you rate the impact of the following species on the **Environment** in your District **in the last 12 months**?

(Please tick only one response per animal)

	Nil	Low	Moderate	High	Very High	Unknown	Not Present
Feral Pigs							
Feral Goats							
Feral Deer							
Foxes							
Rabbits							
Wild Dogs							
Feral Cats							
Feral Horses							
Emus							
Kangaroos							
Feral Donkeys							
Feral Camels							
Feral Cattle							
Feral Sheep							

B5. How do you rate the **Community Concern** of the following species on your District **in the last 12 months**?

(Please tick only one response per animal)

	Nil	Low	Moderate	High	Very High	Unknown	Not Present
Feral Pigs							
Feral Goats							
Feral Deer							
Foxes							
Rabbits							
Wild Dogs							
Feral Cats							
Feral Horses							
Emus							
Kangaroos							
Feral Donkeys							
Feral Camels							
Feral Cattle							
Feral Sheep							

B6. How **abundant** were the following animal pests in your District in the **last 12 months**?

(Please tick only one response per animal)

	Unsure	Absent	Very Rare	Uncommon	Common	Very Common
Feral Pigs						
Feral Goats						
Feral Deer						
Foxes						
Rabbits						
Wild Dogs						
Feral Cats						
Feral Horses						
Emus						
Kangaroos						
Feral Donkeys						
Feral Camels						
Feral Cattle						
Feral Sheep						

B7. Over the past five years, what are the trends in the **DISTRIBUTION** of pest animals (or area occupied by these animals) in your District?

(Please select one response per animal)

RESPONSES

Large Decline	**Constant**	**Large Increase**
Moderate Decline	**Absent**	**Moderate Increase**
Small Decline	**Unknown**	**Small Increase**

Feral Pigs ____________________

Feral Goats ____________________

Feral Deer ____________________

Foxes ____________________

Rabbits ____________________

Wild Dogs ____________________

Feral Cats ____________________

Feral Horses ____________________

Emus ____________________

Kangaroos ____________________

Feral Donkeys ____________________

Feral Camels ____________________

Feral Cattle ____________________

Feral Sheep ____________________

B8. If there have been changes in the **DISTRIBUTION** of pest animals in your District, what do you think has caused the change/s? Please list by species for those species where you have comments.

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B9. Over the past five years, what are the trends in the **ABUNDANCE** of pest animals (or number of these animals) in your District?

(Please select one response per animal)

RESPONSES

Large Decline	**Constant**	**Large Increase**
Moderate Decline	**Absent**	**Moderate Increase**
Small Decline	**Unknown**	**Small Increase**

Feral Pigs ______________________

Feral Goats ______________________

Feral Deer ______________________

Foxes ______________________

Rabbits ______________________

Wild Dogs ______________________

Feral Cats ______________________

Feral Horses ______________________

Emus ______________________

Kangaroos ______________________

Feral Donkeys ______________________

Feral Camels ______________________

Feral Cattle ______________________

Feral Sheep ______________________

B10. If there have been changes in the ABUNDANCE of pest animals in your District, what do you think has caused the change/s? Please list by species for those species where you have comments.

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B11. Over the past five years, what are the trends in the **CONTROL EFFORT** used for the management of pest animals in your District?

(Please select one response per animal)

RESPONSES

Large Decline	**Constant**	**Large Increase**
Moderate Decline	**Absent**	**Moderate Increase**
Small Decline	**Unknown**	**Small Increase**

Feral Pigs ____________________

Feral Goats ____________________

Feral Deer ____________________

Foxes ____________________

Rabbits ____________________

Wild Dogs ____________________

Feral Cats ____________________

Feral Horses ____________________

Emus ____________________

Kangaroos ____________________

Feral Donkeys ____________________

Feral Camels ____________________

Feral Cattle ____________________

Feral Sheep ____________________

B12. If there have been changes in the CONTROL EFFORT of pest animals in your District, what do you think has caused the change/s? Please list by species for those species where you have comments.

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B13. Over the past five years, what are the trends in the **EFFECTIVENESS OF CONTROL METHODS** used for the management of pest animals in your District?

(Please select one response per animal)

RESPONSES

Large Decline	**Constant**	**Large Increase**
Moderate Decline	**Absent**	**Moderate Increase**
Small Decline	**Unknown**	**Small Increase**

Feral Pigs ______________________

Feral Goats ______________________

Feral Deer ______________________

Foxes ______________________

Rabbits ______________________

Wild Dogs ______________________

Feral Cats ______________________

Feral Horses ______________________

Emus ______________________

Kangaroos ______________________

Feral Donkeys ______________________

Feral Camels ______________________

Feral Cattle ______________________

Feral Sheep ______________________

B14. If there have been changes in the EFFECTIVENESS OF CONTROL METHODS for pest animals in your District, what do you think has caused the change/s? Please list by species for those species where you have comments.

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B15. How would you rate the **RISK** of an exotic disease, such as Foot and Mouth Disease, to become established in a pest animal population in your District?

(Please circle one response)

RESPONSES

No Risk	**Moderate Risk**
Very Low Risk	**High Risk**
Low Risk	**Very High Risk**

Part C

Feral Pigs

P1. Are feral pigs present in your District?

(Please circle one option)

Yes	Unsure	No

(If 'no' or 'unsure' please go to the next animal pest)

P2. Please rank the **impacts** listed below that are caused by feral pigs in your District. Ranking should **start at 1** for highest impact. Please indicate if there is no impact by feral pigs associated with any categories.

Impacts	**Ranking**	**No Impact (tick)**	**Unsure**
Crop Damage			
Pasture damage or competition with livestock			
Damage to native vegetation			
Spread of livestock diseases			
Soil erosion and land degradation			
Damage to watercourses			
Spread of weeds			
Infrastructure damage			
Other (please specify)			

Additional Comments

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P3. What month/s do you consider the **impact** of feral pigs to be the **worst** in your District?
(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the impact of feral pigs is highest at this time/s?

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P4. What month/s do you consider the **abundance** of feral pigs to be the **highest** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the abundance of feral pigs is highest at this time/s?

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P5. Please list the control techniques that are used for feral pigs in your District **AND** estimate their proportion of use as a percentage.

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P6. Please rank the effectiveness of control techniques listed below for feral pigs in your District. Ranking should **start at 1** for most effective. Please indicate if the control technique is not relevant for feral pigs in your District.

Control Techniques	**Ranking**	**Not Applicable (tick)**
Recreational Hunting and/or Shooting		
Judas Techniques		
1080 Poisoning		
Exclusion Fencing		
Commercial Harvesting		
Trapping		
Aerial Shooting		
Other (please specify)		

Additional Comments

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P7. Are the problems with feral pigs recurring in your District despite control efforts? (Please circle one option)

Yes	Unsure	No

P8. Do feral pigs have close contact with domestic livestock in any parts of your District?
(Please circle one option)

Yes	Unsure	No

P9. If Poison baits are used to control the impacts of feral pig control in your District, what do you think works best? In order of effectiveness for each poison bait type used, please provide details of the bait type, pre-feeding periods, poison type, poison mixing ratio and best method of placement for baits.

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P10. Are any of these baits successful in reducing the damage caused by feral pigs?

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P11. Are feral pigs deliberately introduced or moved in your District?
(Please circle one option)

Yes	Unsure	No

P12. Are pigs accidentally or deliberately released from captivity in your District?
(Please circle one option)

Yes	Unsure	No

Feral Goats

G1. Are feral goats present in your District?

(Please circle one option)

Yes	Unsure	No

(If 'no' or 'unsure' please go to the next animal pest)

G2. Please rank the **impacts** listed below that are caused by feral goats in your District. Ranking should **start at 1** for highest impact. Please indicate if there is no impact by feral goats associated with any categories.

Impacts	**Ranking**	**No Impact (tick)**
Crop Damage		
Pasture damage or competition with livestock		
Damage to native vegetation		
Spread of livestock diseases		
Soil erosion and land degradation		
Damage to watercourses		
Spread of weeds		
Infrastructure damage		
Other (please specify)		

Additional Comments

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G3. What month/s do you consider the **impact** of feral goats to be the **worst** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the impact of feral goats is highest at this time/s?

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G4. What month/s do you consider the **abundance** of feral goats to be the **highest** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the abundance of feral goats is highest at this time/s?

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G5. Please list the control techniques that are used for feral goats in your District **AND** estimate their proportion of use as a percentage.

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G6. Please rank the effectiveness of control techniques listed below for feral goats in your District. Ranking should **start at 1** for most effective. Please indicate if the control technique is not relevant for feral goats in your District.

Control Techniques	**Ranking**	**Not Applicable (tick)**
Recreational Hunting and/or Shooting		
Judas Techniques		
1080 Poisoning		
Exclusion Fencing		
Commercial Harvesting		
Trapping		
Aerial Shooting		
Mustering		
Other (please specify)		

Additional Comments

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G7. Are the problems with feral goats recurring in your District despite control efforts? (Please circle one option)

Yes	Unsure	No

G8. Do feral goats have close contact with domestic livestock in any parts of your District?
(Please circle one option)

Yes	Unsure	No

Feral Deer

De1. Are feral deer present in your District?
(Please circle one option)

Yes	Unsure	No

(If 'no', please go to the next animal pest)

De2. What species of feral deer are present in your District?

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De3. Please rank the **impacts** listed below that are caused by feral deer in your District. Ranking should **start at 1** for highest impact. Please indicate if there is no impact by feral deer associated with any categories.

Impacts	**Ranking**	**No Impact (tick)**
Crop Damage		
Pasture damage or competition with livestock		
Damage to native vegetation		
Spread of livestock diseases		
Soil erosion and land degradation		
Damage to watercourses		
Spread of weeds		
Infrastructure damage		
Other (please specify)		

Additional Comments

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De4. What month/s do you consider the **impact** of feral deer to be the **worst** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the impact of feral deer is highest at this time/s?

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De5. What month/s do you consider the **abundance** of feral deer to be the **highest** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the abundance of feral deer is highest at this time/s?

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De6. Please list the control techniques that are used for feral deer in <u>your District</u> **AND** estimate their proportion of use as a percentage.

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De7. Please rank the <u>effectiveness</u> of control techniques listed below for feral deer in <u>your District</u>. Ranking should **start at 1** for most effective. Please indicate if the control technique is not relevant for feral deer in your District.

Control Techniques	**Ranking**	**Not Applicable (tick)**
Recreational Hunting and/or Shooting		
Judas Techniques		
1080 Poisoning		
Exclusion Fencing		
Commercial Harvesting		
Trapping		
Aerial Shooting		
Mustering		
Other (please specify)		

Additional Comments

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De8. Are the problems with feral deer recurring in your District despite control efforts?
(Please circle one option)

Yes	Unsure	No

De9. Do feral deer have close contact with domestic livestock in any parts of your District?
(Please circle one option)

Yes	Unsure	No

De10. If you are familiar with the species of feral deer within your District, please rank them in order of abundance. Ranking should **start at 1** for most abundant.

Species	**Ranking**	**Unsure (tick)**	**Not Present (tick)**
Fallow Deer			
Rusa Deer			
Red Deer or Elk			
Hog Deer			
Sambar Deer			
Chital Deer (or Axis)			

De11. Are feral deer deliberately introduced or moved in your District?
(Please circle one option)

Yes	Unsure	No

De12. Are deer accidentally or deliberately released from captivity in your District?
(Please circle one option)

Yes	Unsure	No

Foxes

F1. Are foxes present in <u>your District</u>?

(Please circle one option)

Yes	Unsure	No

(If ‘no’ or ‘unsure’ please go to the next animal pest)

F2. Please rank the **impacts** listed below that are caused by foxes in <u>your District</u>. Ranking should **start at 1** for highest impact. Please indicate if there is no impact by foxes associated with any categories.

Impacts	**Ranking**	**No Impact (tick)**
Predation of native animals		
Predation of livestock		
Spread of livestock diseases		
Spread of weeds		
Infrastructure damage		
Other (please specify)		

Additional Comments

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F3. What month/s do you consider the **impact** of foxes to be the **worst** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the impact of foxes is highest at this time/s?

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F4. What month/s do you consider the **abundance** of foxes to be the **highest** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the abundance of foxes is highest at this time/s?

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F5. Please list the control techniques that are used for foxes in your District **AND** estimate their proportion of use as a percentage.

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F6. Please the effectiveness of control techniques listed below for foxes in your District. Ranking should **start at 1** for most effective. Please indicate if the control technique is not relevant for foxes in your District.

Control Techniques	**Ranking**	**Not Applicable (tick)**
Recreational Hunting and/or Shooting		
1080 Poisoning (Baits)		
Exclusion Fencing		
Other Poisons		
Trapping		
Guard Animals (dogs or alpacas)		
Bounty Hunting		
Other (please specify)		

Additional Comments

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F7. Are the problems with foxes recurring in your District despite control efforts? (Please circle one option)

Yes	Unsure	No

Wild Dogs

Wild dogs are defined as all wild-living dogs, including feral dogs, dingoes and hybrids.

WD1. Are wild dogs present in your District?

(Please circle one option)

Yes	Unsure	No

(If 'no' or 'unsure' please go to the next animal pest)

WD2. Using the following dog groups, please allocate a percentage contribution (summed to 100%) of **dog incidents with livestock** in your District. Please tick the box if you are unsure.

Town Dogs (Unrestrained domestic dogs) ____________

Wild Dogs

Feral Dogs (Wild-living dogs of domestic breeds) ____________

Dingoes and Hybrids ____________

Unsure (please Tick) ☐

WD3. Please rank the **impacts** listed below that are caused by wild dogs in your District. Ranking should **start at 1** for highest impact. Please indicate if there is no impact by wild dogs associated with any categories.

Impacts	**Ranking**	**No Impact (tick)**
Predation of native animals		
Predation of livestock		
Spread of livestock diseases		
Killing of farm dogs		
Infrastructure damage		
Other (please specify)		

Additional Comments

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WD4. What month/s do you consider the **impact** of wild dogs to be the worst in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the impact of wild dogs is highest at this time/s?

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WD5. What month/s do you consider the **abundance** of wild dogs to be the highest in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the abundance of wild dogs is highest at this time/s?

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WD6. Please list the control techniques that are used for wild dogs in your District **AND** estimate their proportion of use as a percentage.

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WD7. Please rank the effectiveness of control techniques listed below for wild dogs in your District. Ranking should **start at 1** for most effective. Please indicate if the control technique is not relevant for wild dogs in your District.

Control Techniques	**Ranking**	**Not Applicable (tick)**
Recreational Hunting and/or Shooting		
Ground Baiting (1080)		
Aerial Baiting (1080)		
Exclusion Fencing		
Other Poisons		
Trapping		
Guard Animals (dogs or alpacas)		
Bounty Hunting		
Other (please specify)		

Additional Comments

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WD8. Are the problems with wild dogs recurring in your District despite control efforts? (Please circle one option)

Yes	Unsure	No

Rabbits

R1. Are rabbits present in your District?

(Please circle one option)

Yes	Unsure	No

(If 'no' or 'unsure' you have completed the questionnaire)

R2. Please rank the **impacts** listed below that are caused by rabbits in your District. Ranking should **start at 1** for highest impact. Please indicate if there is no impact by rabbits associated with any categories.

Impacts	**Ranking**	**No Impact (tick)**
Crop damage		
Pasture damage or competition with livestock		
Damage to native vegetation		
Spread of livestock diseases		
Soil erosion and land degradation		
Damage to watercourses		
Spread of weeds		
Infrastructure damage		
Other (please specify)		

Additional Comments

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R3. What month/s do you consider the **impact** of rabbits to be the worst in <u>your District</u>?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the impact of rabbits is highest at this time/s?

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R4. What month/s do you consider the **abundance** of rabbits to be the highest in <u>your District</u>?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the abundance of rabbits is highest at this time/s?

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R5. Please list the control techniques that are used for rabbits in your District **AND** estimate their proportion of use as a percentage.

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R6. Please rank the effectiveness of control techniques listed below for rabbits in your District. Ranking should **start at 1** for most effective. Please indicate if the control technique is not relevant for rabbits in your District.

Control Techniques	**Ranking**	**Not Applicable (tick)**
Recreational Hunting and/or Shooting		
Biological Control - Myxo		
Biological Control – Calicivirus (RHD)		
Habitat Modification (Harbour Removal)		
1080 Poisoning (Baits)		
Exclusion Fencing		
Fumigation		
Blasting		
Trapping		
Pindone Poisoning		
Ripping		
Aerial Baiting (1080)		
Other (please specify)		

Additional Comments

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R7. Are the problems with rabbits recurring in your District despite control efforts? (Please circle one option)

Yes	Unsure	No

R8. Which method of poisoning rabbits has been **the most effective** in your District?

Ranking should **start at 1** for most effective.

Poison Method	**Ranking**	**Not Used (please tick)**
Conventional 1080 (with pre-feed)		
One-Shot 1080		
Pindone		

R9. Which method of poison application has been **the most effective** for the control of rabbits in your District over the last five years?

Ranking should **start at 1** for most effective.

Application Method	**Ranking**	**Not Used (please tick)**
Bait Trail with Furrow		
Bait Trail without Furrow		
Bait Station		
Scatter Baiting		
Aerial Baiting		

R10. RHD (Calicivirus)

If RHD outbreaks occur in your District, how often do they happen?

(Please circle one option)

Unsure **Every year** **Never**

Every Second Year **Irregularly**

Is RHD effective in reducing rabbit numbers overall in your District?

(Please circle one option)

Yes	Unsure	No

R11. Myxomatosis (Myxo)

If Myxo outbreaks occur in your District, how often do they happen?

(Please circle one option)

Unsure **Every year** **Never**

Every Second Year **Irregularly**

Is Myxo effective in reducing rabbit numbers overall in your District?

(Please circle one option)

Yes	Unsure	No

R12. If RHD and myxo are present in your District, do you believe that outbreaks of myxo occur at the same time of year since the arrival of RHD?

(Please circle one option)

Yes	Unsure	No

Feral Camels

C1. Are feral camels present in your District?

(Please circle one option)

Yes	Unsure	No

(If 'no' or 'unsure' please go to the next animal pest)

C2. Please rank the **impacts** listed below that are caused by feral camels in your District. Ranking should **start at 1** for highest impact. Please indicate if there is no impact by feral camels associated with any categories.

Impacts	**Ranking**	**No Impact (tick)**
Crop Damage		
Pasture damage or competition with livestock		
Damage to native vegetation		
Spread of livestock diseases		
Soil erosion and land degradation		
Damage to watercourses		
Spread of weeds		
Infrastructure damage		
Other (please specify)		

Additional Comments

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C3. What month/s do you consider the **impact** of feral camels to be the **worst** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the impact of feral camels is highest at this time/s?

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C4. What month/s do you consider the **abundance** of feral camels to be the **highest** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the abundance of feral camels is highest at this time/s?

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C5. Please list the control techniques that are used for feral camels in your District **AND** estimate their proportion of use as a percentage.

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C6. Please rank the effectiveness of control techniques listed below for feral camels in your District. Ranking should **start at 1** for most effective. Please indicate if the control technique is not relevant for feral camels in your District.

Control Techniques	**Ranking**	**Not Applicable (tick)**
Recreational Hunting and/or Shooting		
Judas Techniques		
Exclusion Fencing		
Commercial Harvesting		
Trapping		
Aerial Shooting		
Mustering		
Other (please specify)		

Additional Comments

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C7. Are the problems with feral camels recurring in <u>your District</u> despite control efforts? (Please circle one option)

Yes	Unsure	No

C8. Do feral camels have close contact with domestic livestock in any parts of <u>your District</u>?
(Please circle one option)

Yes	Unsure	No

Feral Donkeys

DK1. Are feral donkeys present in your District?

(Please circle one option)

Yes	Unsure	No

(If 'no' or 'unsure' please go to the next animal pest)

DK2. Please rank the **impacts** listed below that are caused by feral donkeys in your District. Ranking should **start at 1** for highest impact. Please indicate if there is no impact by feral donkeys associated with any categories.

Impacts	**Ranking**	**No Impact (tick)**
Crop Damage		
Pasture damage or competition with livestock		
Damage to native vegetation		
Spread of livestock diseases		
Soil erosion and land degradation		
Damage to watercourses		
Spread of weeds		
Infrastructure damage		
Other (please specify)		

Additional Comments

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DK3. What month/s do you consider the **impact** of feral donkeys to be the **worst** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the impact of feral donkeys is highest at this time/s?

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DK4. What month/s do you consider the **abundance** of feral donkeys to be the **highest** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the abundance of feral donkeys is highest at this time/s?

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DK5. Please list the control techniques that are used for feral donkeys in your District **AND** estimate their proportion of use as a percentage.

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DK6. Please rank the effectiveness of control techniques listed below for feral donkeys in your District. Ranking should **start at 1** for most effective. Please indicate if the control technique is not relevant for feral donkeys in your District.

Control Techniques	**Ranking**	**Not Applicable (tick)**
Recreational Hunting and/or Shooting		
Judas Techniques		
Exclusion Fencing		
Commercial Harvesting		
Trapping		
Aerial Shooting		
Mustering		
Other (please specify)		

Additional Comments

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DK7. Are the problems with feral donkeys recurring in your District despite control efforts? (Please circle one option)

Yes	Unsure	No

DK8. Do feral donkeys have close contact with domestic livestock in any parts of your District?
(Please circle one option)

Yes	Unsure	No

Feral Horses

H1. Are feral horses present in your District?

(Please circle one option)

Yes	Unsure	No

(If 'no' or 'unsure' please go to the next animal pest)

H2. Please rank the **impacts** listed below that are caused by feral horses in your District. Ranking should **start at 1** for highest impact. Please indicate if there is no impact by feral horses associated with any categories.

Impacts	**Ranking**	**No Impact (tick)**
Crop Damage		
Pasture damage or competition with livestock		
Damage to native vegetation		
Spread of livestock diseases		
Soil erosion and land degradation		
Damage to watercourses		
Spread of weeds		
Infrastructure damage		
Other (please specify)		

Additional Comments

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H3. What month/s do you consider the **impact** of feral horses to be the **worst** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the impact of feral horses is highest at this time/s?

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H4. What month/s do you consider the **abundance** of feral horses to be the **highest** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the abundance of feral horses is highest at this time/s?

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H5. Please list the control techniques that are used for feral horses in your District **AND** estimate their proportion of use as a percentage.

______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________

H6. Please rank the effectiveness of control techniques listed below for feral horses in your District. Ranking should **start at 1** for most effective. Please indicate if the control technique is not relevant for feral horses in your District.

Control Techniques	**Ranking**	**Not Applicable (tick)**
Recreational Hunting and/or Shooting		
Judas Techniques		
Exclusion Fencing		
Commercial Harvesting		
Trapping		
Aerial Shooting		
Mustering		
Other (please specify)		

Additional Comments

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H7. Are the problems with feral horses recurring in your District despite control efforts? (Please circle one option)

Yes	Unsure	No

H8. Do feral horses have close contact with domestic livestock in any parts of your District?
(Please circle one option)

Yes	Unsure	No

Feral Cattle

FC1. Are feral cattle present in your District?

(Please circle one option)

Yes	Unsure	No

(If 'no' or 'unsure' please go to the next animal pest)

FC2. Please rank the **impacts** listed below that are caused by feral cattle in your District. Ranking should **start at 1** for highest impact. Please indicate if there is no impact by feral cattle associated with any categories.

Impacts	**Ranking**	**No Impact (tick)**
Crop Damage		
Pasture damage or competition with domestic livestock		
Damage to native vegetation		
Spread of livestock diseases		
Soil erosion and land degradation		
Damage to watercourses		
Spread of weeds		
Infrastructure damage		
Other (please specify)		

Additional Comments

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FC3. What month/s do you consider the **impact** of feral cattle to be the **worst** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the impact of feral cattle is highest at this time/s?

....

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FC4. What month/s do you consider the **abundance** of feral cattle to be the **highest** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the abundance of feral cattle is highest at this time/s?

....

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FC5. Please list the control techniques that are used for feral cattle in your District **AND** estimate their proportion of use as a percentage.

______________________ ______________________

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FC6. Please rank the effectiveness of control techniques listed below for feral cattle in your District. Ranking should **start at 1** for most effective. Please indicate if the control technique is not relevant for feral cattle in your District.

Control Techniques	**Ranking**	**Not Applicable (tick)**
Recreational Hunting and/or Shooting		
Judas Techniques		
Exclusion Fencing		
Commercial Harvesting		
Trapping		
Aerial Shooting		
Mustering		
Other (please specify)		

Additional Comments

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FC7. Are the problems with feral cattle recurring in your District despite control efforts? (Please circle one option)

Yes	Unsure	No

FC8. Do feral cattle have close contact with domestic livestock in any parts of your District?
(Please circle one option)

Yes	Unsure	No

Feral Sheep

S1. Are feral sheep present in your District?

(Please circle one option)

Yes	Unsure	No

(If 'no' or 'unsure' please go to the next animal pest)

S2. Using the following groups, please allocate a percentage contribution (summed to 100%) of **feral sheep breeds** in your District. Please tick the box if you are unsure.

	Australian Merino	________
	Other Australian Breeds (e.g. Border/Merino Crossbred etc.)	________
Exotic Breeds	Damara	________
	Dorper	________
	Others (e.g. Awassi, Karakul, Afrikaner etc.)	________
	Unsure (please Tick)	☐

S3. Please rank the **impacts** listed below that are caused by feral sheep in your District. Ranking should **start at 1** for highest impact. Please indicate if there is no impact by feral sheep associated with any categories.

Impacts	**Ranking**	**No Impact (tick)**
Crop Damage		
Pasture damage or competition with domestic livestock		
Damage to native vegetation		
Spread of livestock diseases		
Soil erosion and land degradation		
Damage to watercourses		
Spread of weeds		
Infrastructure damage		
Other (please specify)		

Additional Comments

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S4. What month/s do you consider the **impact** of feral sheep to be the **worst** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the impact of feral sheep is highest at this time/s?

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....

S5. What month/s do you consider the **abundance** of feral sheep to be the **highest** in your District?

(Please circle the month or months)

January	May	September
February	June	October
March	July	November
April	August	December
Constant/No Peak	Unsure	

Can you suggest why the abundance of feral sheep is highest at this time/s?

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S6. Please list the control techniques that are used for feral sheep in your District **AND** estimate their proportion of use as a percentage.

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S7. Please rank the effectiveness of control techniques listed below for feral sheep in your District. Ranking should **start at 1** for most effective. Please indicate if the control technique is not relevant for feral sheep in your District.

Control Techniques	**Ranking**	**Not Applicable (tick)**
Recreational Hunting and/or Shooting		
Judas Techniques		
Exclusion Fencing		
Commercial Harvesting		
Trapping		
Aerial Shooting		
Mustering		
Other (please specify)		

Additional Comments

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S8. Are the problems with feral sheep recurring in your District despite control efforts? (Please circle one option)

Yes	Unsure	No

S9. Do feral sheep have close contact with domestic livestock in any parts of your District?
(Please circle one option)

Yes	Unsure	No

You have now completed the Questionnaire.

Thankyou for your time and knowledge!

Part D

Mapping Exercise

Please read the following notes before completing the Mapping Exercise (Part D).

In this exercise, we are trying to establish the distribution and abundance of feral pigs, feral deer, feral goats, feral camels, feral donkeys, feral horses, feral cattle, feral sheep and wild dogs on pastoral leases. Why these species? These species have the greatest potential to be involved in an exotic disease outbreak. They are also very damaging vertebrate pests. Consequently, it is important to know where they occur and in what sort of numbers.

What we would like you to do is fill in the tables to the best of your knowledge. Remember there are no right or wrong answers and no information is valuable information. The key to the mapping exercise is describing the animal densities using the codes provided. On the next page, there is a table with definitions. For each pastoral lease please ALLOCATE ONE ABUNDANCE CODE PER RESERVE FOR THE PEST SPECIES. The following is a mock example.

Example

AGPACS_ID	Property Name	SHIRE	F PIGS	F DEER	F GOATS	WILD DOGS	F CAMEL	F DONKEY	F HORSES	F CATTLE	F SHEEP
1507670	MT ELVIRE STATION	SHIRE OF MENZIES	**N**	**N**	**M**	**L**	**N**	**L**	**UL**	**N**	**UL**

Please note the list of pastoral leases may not be complete. If we have omitted a pastoral lease that you know well, please add it to the extra spaces provided at the bottom of each table. If you know of an identifying number that is associated with the pastoral lease, like the ones in the left hand column of the table, could you please add it to the lease name. That will assist us greatly when putting your data into the GIS. Also note that the reserve names have come from a GIS database so please forgive any shortening of the reserve names.

You may also like to fill in the maps provided, particularly for the larger pastoral leases. If feral pigs were present, we would like to identify what part/s of the pastoral leases pigs inhabit. By drawing on the map you will provide us with more detailed information about the distribution and abundance of feral pigs within the lease.

Once you have completed Part D that concludes the pest animal survey. We thank you for your time and knowledge.

Pest Animal Density definitions

Density	Definition	Abundance Code
High	**Many** animals seen any time and much sign of activity. ie. Animals always observed, reliable sightings or otherwise evidence of high abundance.	**H**
Medium	**Some** animals seen at almost any time and/or much active sign. ie. Frequent but unreliable sightings of animals	**M**
Low	**Few** or no sightings and/or little active sign. Ie. Rare sightings/evidence of animals	**L**
Nil	**No** animals. ie. Very unusual to see evidence of their presence.	**N**
Unknown	Unknown - Unsure, no data, no information	**U**
	Unknown - Impression of low pest density	**U L**
	Unknown - Impression of medium pest density	**UM**
	Unknown - Impression of high pest density	**U H**

If you have any questions regarding any part of the Pest Animal Survey, please contact one of the following people from the Vertebrate Pest Research Section:

Andrew Woolnough	Ph (08) 9366 2327	E-mail: awoolnough@agric.wa.gov.au
Garry Gray	Ph (08) 9366 2338	E-mail: ggray@agric.wa.gov.au
Gary Martin	Ph (08) 9366 2333	E-mail: gmartin@agric.wa.gov.au
Ken Rose	Ph (08) 9366 2345	E-mail: krose@agric.wa.gov.au
Tim Lowe	Ph (08) 9366 2329	E-mail: tlowe@agric.wa.gov.au

11. APPENDIX 3 AWARENESS & EXTENSION

Awareness campaign of project

Department of Agriculture Staff Mail-Out

WE NEED YOUR HELP!

The Vertebrate Pest Research Section is currently running a project to **MAP THE DISTRIBUTION AND ABUNDANCE OF PEST ANIMALS IN THE AGRICULTURAL AREAS OF WA.** The success of the project depends on capturing the most valuable asset of the Department – your skills and knowledge.

The project

The main purpose of the project is to provide reliable information on the abundance and distribution of pest species. We will be building on the Field Reporting System (FRS) to produce species-specific maps, which are not currently available. This is a vital element for risk minimisation and preparedness strategies for exotic diseases in wild and domestic animals.

What we will be doing is conducting one on one interviews with all District Biosecurity Officers in the Agricultural areas of WA (with plans to expand to the rangelands in the future). The interviews will consist of a questionnaire about pest animals followed by a mapping exercise, where you show us on a map of your district where the pest animals are. We will collate the answers to the questionnaires (in the form of a report) and capture your mapping data into a GIS and ultimately into CRIS.

The success of the project will ultimately depend on your contributions. A staff member from the VPRS will contact you to make interview arrangements sometime over the next 8 months.

If you would like further information, please call or e-mail either of the following contacts:

Andrew Woolnough	Tel: (08) 9366 2327	E-mail: awoolnough@agric.wa.gov.au
Gary Gray	Tel: (08) 9366 2338	E-mail: ggray@agric.wa.gov.au

This project is financially supported by the Commonwealth Department of Agriculture, Fisheries and Forestry Australia, through the Wildlife and Exotic Disease Preparedness Program (or WEDPP), and the WA Department of Agriculture.

Awareness campaign of project: Department of Agriculture Newsletter.

AgBrief

ISSN number 1324-1478 Vol.12 No. 22 - 7 November 2002
A newsletter for the staff of the Department of Agriculture

Distribution and abundance of pest animals in the Agricultural Region

The Vertebrate Pest Research Section (VPRS) is asking for the help and cooperation of all District Biosecurity Officers in the Agricultural Region over the next eight months.

Staff from the VPRS will be conducting a series of one on one interviews to document the valuable knowledge each District Biosecurity Officer has accumulated on vertebrate pest animals.

The interview will consist of a questionnaire about pest animal issues followed by a mapping exercise to document the distribution and abundance of animals, such as feral pigs and feral deer within their area of operation.

With financial help from the Wildlife and Exotic Disease Preparedness Program (WEDPP) of the Commonwealth Department of Agriculture, Fisheries and Forestry and the Department of Agriculture, this VPRS project will assist with the Department's biosecurity program. This project will also try to convert some of the valuable knowledge gained by District Biosecurity Officers into a corporate asset.

For more information on the project, please contact:
Andrew Woolnough (08) 9366 2327
Peter Thomson (08) 9366 2310
Garry Gray (08) 9366 2338

Awareness campaign of project: Keeping in Touch Newsletter, September 2002. Published by the Department of Agriculture

Keeping in Touch Newsletter

Page 8

Distribution and Abundance of Pest Animals in Agricultural Areas

The VPRS has been successful in attracting funding from the Wildlife and Exotic Disease Preparedness Program (WEDPP) of the Commonwealth Department of Agriculture, Fisheries and Forestry Australia. The grant will enable VPRS to describe the distribution and abundance of pest animals in the Agricultural Region of Western Australia.

Feral species such as pigs, deer and foxes can act as important reservoirs in the maintenance and transmission of exotic disease (e.g. FMD, rabies etc.). Reliable information on the abundance and distribution of pest species is a vital element of preparedness plans involving outbreaks of exotic diseases in wild and domestic animals.

One of the most cost-efficient ways of obtaining this information on pest populations is to capture the corporate knowledge of staff. This project aims to capture the local knowledge of staff and use it to map the distribution of vertebrate pests. Over the next 12 months, VPRS staff will be visiting each office in the Agricultural Region and will be collecting the information through an interview-base survey. Staff will be contacted to undertake this.

The information obtained will form a baseline for future surveys, and will be valuable for other biosecurity planning and priority setting. The data from the surveys will be linked through the Client and Resource Information System (CRIS) with data from actual ground and aerial survey, as well as with other data currently collected through Field Reporting System (FRS).

Northern Pastoral Memo

Northern Pastoral Memo, December 2003, Volume 24, Number 4

Excerpt:

MAPPING FERAL ANIMALS IN THE RANGELANDS

A major project by the Department of Agriculture to map potential disease-carrying feral animals will be showcased at a meeting of leading wildlife researchers in New Zealand next month.

Department researcher Andrew Woolnough is attending the Third Wildlife Management Congress in Christchurch to discuss the importance of mapping high risk feral animals to prepare for outbreaks of disease in animals.

Dr Woolnough said pest animals such as feral pigs, feral deer and foxes could act as important reservoirs to spread exotic disease such as foot and mouth disease and rabies.

Public Forum on Feral Pig Control

PUBLIC FORUM
FERAL PIG CONTROL WORKSHOP AGENDA

Date: Friday 5th September 2003
Venue: St John's Ambulance Hall, Mount Barker Street, Mount Barker.
Commencing at 9.30 am

9.30: Registration and Morning tea

10.00: Project review - Tony Higgs, Darrel Drage (Local Feral Pig Committee)
Trapping results update - Ted Knight (Dept Ag)

10.30: Wildlife Exotic Disease Preparedness Program
(WEDPP) Feral Survey - Andrew Woolnough (Dept Ag)

10.50: DNA Studies – Broad-scale Australia-wide patterns - Peter Spencer (Murdoch Uni)

11.05: DNA Studies – Patterns in south-west WA - Jordan Hampton (Murdoch Uni)

11.30: Bait Development/ Refinement of Control Strategies
New Research & 1080 Review Update - Laurie Twigg (Dept Ag)

12.15-1.00: Lunch (supplied).

1.00: Wilderness areas and implications for feral animal control - Paul Roberts (CALM)

1.40 A modern appreciation of the threat of feral pigs to biodiversity - Christine Freegard (CALM)

2.10 A perspective from the timber industry – Wayne Burton (Great Southern Plantations)

2.20: Issues associated with feral pigs and forward planning – Kevin Forbes (President, Plantagenet Shire).

Comments to be sought from attendees and may include issues such as future control methods, areas to conduct control work, illegal releases, wilderness areas, biosphere reserve, etc.

3.00 Close and Afternoon Tea

12. APPENDIX 4 MEDIA RELEASES

Department of **Agriculture**

Government of **Western Australia**

Media Statement: Nowhere to hide for feral pigs

3 Baron-Hay Court, South Perth, Western Australia 6151

Tel: (08) 9368 3641 Fax: (08) 9474 2018

v.agric.wa.gov.au

5 September 2003

NOWHERE TO HIDE FOR FERAL PIGS

The Department of Agriculture is drawing on the experience of its staff to map some of the State's most troublesome vertebrate pests.

Speaking today at the Feral Pig Conference in Mt Barker, research officer Andrew Woolnough said understanding the distribution and abundance of feral animals was vital to prepare for potential outbreaks of disease in animals.

"Pest animals such as feral pigs, feral deer and feral goats can act as important reservoirs in spreading exotic diseases such as foot and mouth disease," Dr Woolnough said.

Dr Woolnough said agricultural enterprises generally had a good understanding of livestock numbers and location, but there was a lack of documented knowledge of high risk, free-ranging pest animals.

He said the Vertebrate Pest Mapping Project aimed to cost-effectively obtain the information from experienced departmental officers of the Department of Agriculture and CALM.

"We have interviewed more than 50 biosecurity and vertebrate pest experts who possess important local knowledge on animal pests with potential to spread and maintain exotic diseases," Dr Woolnough said.

"The officers were asked to map the populations of feral pigs, feral deer, feral goats and wild dogs in the various districts of the State's Agricultural Region based on a set of standard abundance definitions."

Dr Woolnough said the information was used to develop a GIS-database and enabled the production of maps on the distribution and abundance of the four pest species at the scale of individual properties.

He said the results could also be used to target and improve management strategies for areas with significant vertebrate pest problems such as feral pigs in the South West.

“The mapping project has highlighted the presence of feral pigs in more localities than originally expected,” Dr Woolnough said.

“By overlaying the abundance criteria, we can see what areas have high numbers of feral pigs and where a concerted effort is needed to manage the problem.”

The Vertebrate Pest Mapping Project, funded by the Department of Agriculture and the Commonwealth Department of Agriculture Forestry and Fisheries, was recently extended to investigate the Rangelands.

Media contact:

Andrew Woolnough, research officer, 9366 2327

Alison Blake, media liaison, 9368 3641

Department of **Agriculture**

Government of **Western Australia**

Media Statement: Mapping Feral Animals in the Rangelands

3 Baron-Hay Court, South Perth, Western Australia 6151

Tel: (08) 9368 3641 Fax: (08) 9474 2018

w.agric.wa.gov.au

13 November 2003

MAPPING FERAL ANIMALS IN THE RANGELANDS

A major project by the Department of Agriculture to map potential disease-carrying feral animals will be showcased at a meeting of leading wildlife researchers in New Zealand next month.

Department researcher Andrew Woolnough is attending the Third Wildlife Management Congress in Christchurch to discuss the importance of mapping high risk feral animals to prepare for outbreaks of disease in animals.

Dr Woolnough said pest animals such as feral pigs, feral deer and foxes could act as important reservoirs to spread exotic disease such as foot and mouth disease and rabies.

The Department has completed mapping the distribution and abundance of feral animals in WA's agricultural region and recently commenced examining the pastoral regions of the rangelands.

Dr Woolnough said one of the most cost-efficient ways of obtaining the information was to capture the knowledge of biosecurity and wildlife officers working in the region.

"Firstly we are conducting a series of interviews with about 40 officers from the Departments of Agriculture and Conservation and Land Management in various locations from Kununurra to Kalgoorlie," he said.

"The questionnaire will collect information on feral animals such as pigs, goats, deer, rabbits, foxes, wild dogs, feral livestock (sheep and cattle), donkeys, horses and camels.

"It will capture the officers' knowledge on the abundance and distribution of these pest animals, trends in animal populations, effectiveness of current control techniques and animal disease preparedness."

Dr Woolnough said the information would be collated in a GIS-database which describes the distribution and abundance of the high-risk animals and will be added to the Department's client resource information system for use in an emergency situation.

"By completing the rangeland component of the study, we will have mapped the distribution and abundance of pest animals on properties in Western Australia that are greater than 10 hectares in size," Dr Woolnough said.

"The information will identify areas of key risk and can be used to prepare a rapid response in an emergency animal disease situation.

"This will be an extremely valuable tool for managing animal diseases and feral animals."

Dr Woolnough's work on the control of European starlings using the 'Judas' technique will also be presented at the Congress. Department researcher Dr Laurie Twigg will present two papers on the role of vertebrate pesticides in wildlife management and immunocontraceptives in rabbits.

Media contacts:

Andrew Woolnough, research officer, 9366 2327.

Alison Blake, media liaison officer, 9368 3641.

13. APPENDIX 5 SCIENTIFIC COMMUNICATIONS

Third International Wildlife Management Congress

Abstract and poster presented at the Third International Wildlife Management Congress, Christchurch, New Zealand, December, 2003.

CORPORATE KNOWLEDGE: AN ASSET FOR EXOTIC DISEASE PREPAREDNESS IN WILDLIFE MANAGEMENT.

Woolnough, Andrew P., Garry S. Gray, Win E. Kirkpatrick, Tim J. Lowe, Gary R. Martin and Ken Rose.

Vertebrate Pest Research Section, Department of Agriculture, 100 Bougainvillea Avenue, Forrestfield, Western Australia, 6058, Australia.

Large organisations, such as government departments, often under-exploit their best asset: their staff. Understanding the distribution and abundance of high-risk animals (i.e. potential carriers) is of fundamental importance for exotic disease preparedness. Economic incentive generally drives agricultural enterprises to maintain a good understanding of the distribution and abundance of domestic animals, but for free-ranging, high-risk animals a lack of documented knowledge is often a problem. Feral animals such as feral pigs, feral deer (several species) and foxes can act as important reservoirs in the maintenance and transmission of exotic disease (e.g. foot and mouth disease, rabies etc.). Reliable assessment of the abundance and distribution of animal pests is therefore vital in preparing for potential outbreaks of disease in wild animals. One of the most cost-efficient ways of obtaining this information is to capture the corporate knowledge of staff from an appropriate government department. Biosecurity Officers of the Western Australian Department of Agriculture possess important local knowledge on a variety of animal species, some of which have high potential to spread and maintain exotic disease. Their knowledge is specific to a given area and is loosely based on local government boundaries. Through a series of interview-based, interactive mapping exercises with each Biosecurity Officer (N = 53), we developed a GIS-database that enabled us to describe the distribution and abundance of four high-risk groups of animals (feral pigs, feral deer, feral goats and wild dogs) in the Agricultural Region of Western Australia. This database approach captured data at the scale of individual properties, thereby maximising potential for any emergency response plan based on an ‘infected premise’ concept. In addition to their role in exotic disease preparedness, our results also allow targeting of resources, both community and government-based, thereby enabling more informed management of areas with significant vertebrate pest problems.

Government of Western Australia
Department of Agriculture

CORPORATE KNOWLEDGE: AN ASSET FOR EXOTIC DISEASE PREPAREDNESS

ANDREW WOOLNOUGH*, GARRY GRAY, WIN KIRKPATRICK, TIM LOWE, GARY MARTIN & KEN ROSE
VERTEBRATE PEST RESEARCH SECTION
DEPARTMENT OF AGRICULTURE, WESTERN AUSTRALIA

Australian Government
Department of Agriculture, Fisheries and Forestry
WILDLIFE AND EXOTIC DISEASE PREPAREDNESS PROGRAM (WEDPP)

Figure 1. Community groups discuss issues of feral pigs and feral deer with staff from the Department of Agriculture and Department of Conservation and Land Management. This community consultation process provides additional feedback on some of the problems caused by pest animals.

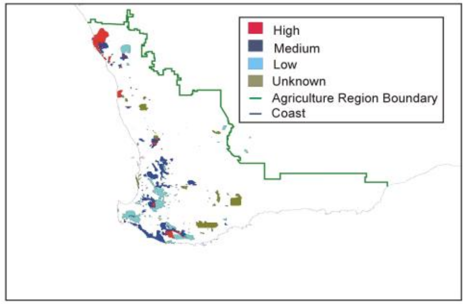

Figure 2. Generalized distribution and abundance of feral pigs in the agricultural region of Western Australia. Areas of high abundance (red) quickly become clear.

Large organizations, such as government departments, often under-utilise their best asset: *their staff*. Field staff involved in wildlife management can have considerable knowledge of the distribution and abundance of animal pests. The challenge was to capture this knowledge and turn it into a decision making asset.

Through a series of interview-based, interactive mapping exercises a GIS-database was developed that enabled the documentation of the distribution and abundance of four high-risk groups of pest animals (feral pigs, feral deer, feral goats and wild dogs) in the agricultural region of Western Australia. Information collected represents part of the corporate knowledge of the Department of Agriculture and Department of Conservation and Land Management and captures information on pest animal distribution and abundance for both public and private land holdings.

The process of collecting the data used a protocol developed in collaboration with New South Wales Agriculture. This will enable comparisons of data to be made at local, regional and national scales.

Valuable information captured includes:

1. **Exotic disease preparedness for pest animal populations.**
2. **Understanding the distribution and abundance of pest animals.**
3. **Identifying areas requiring management of pest animals and/or protection of social, environmental and agricultural values.**
4. **Government and community interaction on issues of pest animal management.**
5. **A tool for informed decision making.**

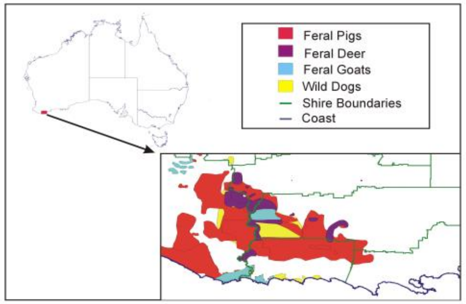

Figure 3. An example of an area where contact is possible between populations of feral pigs, feral deer, feral goats and wild dogs. This area has been identified as a potential high risk area for exotic disease. It has also been identified as an area that isin need of pest animal management

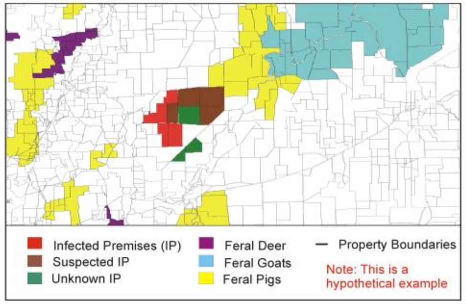

Figure 4. Using the data in an exotic disease simulation, properties that could be implicated in an exotic disease outbreak can be quickly identified and an appropriate response initiated.

Titles of papers accepted for publication

Woolnough, A.P., West, P.B. and Saunders, G.R. (in press). Institutional knowledge as a tool for pest animal management. *Ecological Management and Restoration* **5**: 226-228.

Spencer, P.B.S. and Woolnough, A.P. (2004). Size should matter: Distribution and genetic considerations for pest animal management. *Ecological Management and Restoration* **5**:231-233.

Titles of manuscripts in preparation

This report is being prepared for publication as a Miscellaneous Publication of the Department of Agriculture.

Other

Data from this report will be used in the 2006 State of Environment Report (see http://www.deh.gov.au/soe/index.html)