

Large free-ranging felines in New South Wales: a review

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NSW panthers

Kurahaupo Consulting

1 Introduction

For more than a century, and particularly over the last two decades, New South Wales Government agencies have received reports from the public that large cats are present in the wild at various places around the state. Generally (but not always) when such cats are seen they are described as large and black, and so popularly called ‘panthers’¹. Similar reports have been made in eastern Victoria and indeed from New Zealand and England. These reports form a prima facie case for the presence large cats in NSW, but because they can be attributed to other species are not proof that can lead to an unequivocal conclusion about the existence of panthers. This uncertainty as to their existence and the absence of significant impacts such as predation on livestock, pets or wildlife that is not obviously additional to that commonly attributed to known predators such as dogs or foxes has not prompted any official response to the reports other than this and earlier reviews. Some of the citizens residing in areas from which reports originate are concerned about potential human safety if a large predator is actually present and are therefore agitating for a more active response from government. In July 2013, the NSW Department of Primary Industries (DPI) commissioned Kurahaupo Consulting to review the evidence for the existence of panthers and make appropriate recommendations based on that evidence.

The Hawkesbury region west of Sydney and bordering the Blue Mountains has been a recent ‘hot-spot’ for reports of large cats. A group of residents from Grose Vale has acted as a reception point for these reports and the local Hawkesbury City Council has collated and mapped these reports. This group and the council were visited by the author and Mr John Tracey of the Department of Primary Industries in July 2013 as a precursor to this discussion paper.

2 Objective

- To evaluate the material collated on the potential presence of large cat species in New South Wales

3 Approach to the review

The likelihood that an animal species exists in the absence of hard evidence (e.g. a body or unequivocal DNA) might range from highly unlikely, feasible but unlikely, to quite possible. Loch Ness monsters, yeti, yowie and bigfeet are highly unlikely to exist, or indeed ever have existed (Hone 1977). None of these animals has been given a binomial name because no specimen exists, a prerequisite for scientific legitimacy, and no live or recently dead specimen, definitive DNA samples, a clear photograph with appropriate scales and place identity has ever been produced to allow such a description.

¹ Panthers are melanic forms of two species of cats, leopards and jaguars.

On the other hand, thylacines (*Thylacinus cynocephalus*) were alive in Tasmania in the 1930s with the last known animal being alive in captivity in 1936 (Rounsevell 1983), and moose (*Alces alces*) were alive in the wild in New Zealand in the 1950s with the last known one being shot by a hunter in Fiordland in the 1952 (Tustin 2005). Thus reported sightings of thylacines or moose after these dates are more intrinsically believable than a sighting of the Loch Ness monster. Moose, of course, are still very common in their native range across the northern hemisphere so finding one now in New Zealand would not be as newsworthy as catching a living thylacine in Tasmania.

Large cats are common in Asia, Africa and central and South America, and some species are also held in captivity around the world and in Australia. Therefore, sightings of 'panthers' (as melanistic variants of leopards and jaguars are called) or other large cats, in the wild in Australia (Williams & Lang 2010) cannot be dismissed as being intrinsically impossible.

This report summarises, without judgement, the prima facie evidence of the presence of large cats in NSW and what they might be. However, the nature of the available evidence does not provide sufficient proof that panthers exist in the wild in New South Wales to justify an active response – at least by government agencies. Whether I add my name to those previous reviewers who are more (Menkhorst & Morison 2012) or less (Atkinson 2003, Bauer 2003) sceptical will not change the level of uncertainty.

4 Felidae in Australia

There were 21 species of Felidae in Australia in 2007 (Table 1) but only one, the feral cat (*Felis catus*) known to be certainly present in the wild – in hundreds of thousands if not millions. Apart perhaps from the snow leopard, all could find suitable habitats and food somewhere in Australia if they were introduced into the wild. Whether such species would establish breeding populations even if released into the wild is unclear. Apart from the obvious condition requiring at least one pregnant female, most exotic vertebrate species that have successfully established populations in Australia (and elsewhere) have required either many founding individuals and/or many release events (Forsyth & Duncan 2001).

Table 1. Cat species present in captivity in Australia (from VPC 2007) and held in NSW zoos and wildlife parks as at September 2013.

Species	NSW Zoos holding	Weight range (kg)	Melanic forms known
Leopard (<i>Panthera pardus</i>)		30 – 90	Yes
Jaguar (<i>Panthera onca</i>)		57 – 113	Yes
Feral cat (<i>Felis catus</i>)		2 – 16	Yes
Jaguarundi (<i>Herpailurus yaguaroundi</i>)		3 – 9	Yes
Asian golden cat (<i>Catopuma temminckii</i>)		9 – 16	Yes
Serval (<i>Leptailurus serval</i>)	Mogo	7 – 18	Yes
Caracal (<i>Caracal caracal</i>)		8 – 20	Yes
Geoffroy's cat (<i>Oncifelis geoffroyi</i>)		2 – 5	Yes
Clouded leopard (<i>Neofelis nebulosa</i>)		12 – 23	Rare
Cheetah (<i>Acinonyx jubatus</i>)	Mogo, Western Plains	21 – 72	Very rarely
Bobcat (<i>Lynx rufus</i>)		6 – 18	Very rarely
Jungle cat (<i>Felis chaus</i>)		3 – 16	No
Fishing cat (<i>Prionailurus viverrina</i>)	Taronga	5 – 16	No
Ocelot (<i>Leopardus pardalis</i>)		8 – 18	No
Lynx (<i>Lynx lynx</i>)		8 – 30	No
Pallas's cat (<i>Otocolobus manul</i>)		2 – 5	No
Lion (<i>Panthera leo</i>)	Taronga, Western Plains, Mogo, Bullens	150 – 250	No
Tiger (<i>Panthera tigris</i>)	Taronga, Western Plains, Mogo, Symbio, Bullens	165 – 306	No
Leopard cat (<i>Prionailurus bengalensis</i>) ¹		1 – 7	No
Cougar (<i>Puma concolor</i>)	Bullens	36 – 103	No
Snow leopard (<i>Uncia uncia</i>)	Taronga, Billabong, Mogo	27 – 75	No

¹ This species forms trans-generic hybrids with *Felis catus* called Bengal cats. They are bred in Australia but so far as I know do not produce melanic offspring.

Two species of large cats have reasonably common melanistic forms. The leopard (*Panthera pardus*) can have pure black or dark phases with an undercoat of its normal spots (Fig. 1). The jaguar (*Panthera onca*) also has black forms (Fig. 2). Some smaller wild cats such as the jaguarundi and of course feral domestic cats, have dark phases (Table 1) and are potential candidates for the animals sighted, if size is not a consideration. Feral cats (*Felis catus*) are very common in Australia, have melanistic individuals and can reach large sizes, at least compared with their domestic ancestors (Fig. 3).

Puma (cougar or mountain lion) (*Puma concolor*) are large cats that are also claimed to be present in the wild in Australia (see Menkhorst & Morison 2012) but as they do not have a melanistic phase are discounted as a potential candidate for (most) of the NSW reports.



Figure 1. Leopards (*Panthera pardus*) in three coat colours (taken from the web)





Figure 2. Jaguar (*Panthera onca*) in its normal and melanistic coat colours (taken from the web).



Figure 3. Large feral cat (*Felis catus*) killed by Waddeken Rangers, Arnhem Land, Northern Territory (see www.abc.net.au/news/2013-06-04/huge-feral-cats-arnhem-land/431696).

The three cat species that might fit the evidence in NSW are leopards, jaguars or feral cats. Further, if not feral cats, leopards rather than jaguars are the most likely candidate based on their longer history as a captive animal in zoos, menageries and private collections – especially as the melanistic form.

Leopards are native to Africa, across the Arabian Peninsula and across Asia as far south as Java with nine sub-species. Melanism is common in the wild (Stander 2009) and is determined by a recessive allele so must have some selective advantage. Black leopards were commonly held in zoos and menageries where they had probably been bred for generations. Wild descendents of these black leopards will always be black.

Jaguars are native to the Americas from the southern USA through central to South America, now being largely restricted to forested habitats. Jaguars also have a common melanistic variant determined, in this case, by a dominant allele so wild descendents may at times be spotted.

5 The evidence for the presence of ‘panthers’ in NSW

The evidence that large cats exist in the wild is presented at face value, i.e. without judgement as to its veracity or quality.

5.1 Possible sources of big cats in NSW

If large cats exist in the wild in NSW they would need to have come from some existing or past captive source.

Panthers (both leopards and jaguars) have been held in public and private zoos, menageries and circuses in the past, but neither species are currently held in zoos and wildlife parks in NSW (Table 1). It is unlikely that animals would be released or escape and remain unaccounted from the main registered zoos in NSW, but the regulatory oversight for several previous private menageries and wildlife ventures was apparently less satisfactory so they are potential (but unproven) sources. Three ventures might have been potential sources of founding panthers.

Apparently the last black panther (presumably a leopard) held in captivity in NSW was held at Bullens Animal World at Wallacia near Sydney which closed in 1985 or the nearby Bullens African Lion Sanctuary which closed in 1991. The fate of the animals at these ex-circus displays is not known to me, but the panther apparently died (C. Coffey, pers. comm.) so these two parks are unlikely to be sources.

Notre Dame Zoo west of Sydney near Mulgoa was a private zoo established in the early 1980s that held lions, pumas, tigers, jaguars, leopards and bobcats among 3000 animals on display. In the late 1990s it was fined under the Exhibited Animals Protection Act 1986 for holding proscribed species without a permit and was closed. What happened to its felines is unclear. Some were killed and two jaguars and two tigers were sent to Mogo Zoo in 1997 under an

approved transfer, but rumours circulated that black panthers had been offered for sale more widely by the owners of this facility.

Ashton's Circus held animals, including large cats, near Londonderry in the 1990s. A second-hand report by a Justice of the Peace from Bilpin (R.S. Byrne, unpubl. letter) claimed big cats (species not noted) were released rather than destroyed.

None of these anecdotes, usually second hand and unconfirmed, are in anyway proof that one or more panthers escaped or were released, but perhaps show that biosecurity at private zoos and menageries was inadequate last century especially with respect to the fate of animals when, for one reason or another, these facilities were shut.

5.2 Sightings of big cats in the wild by the public in NSW

The Grose Vale Group with an interest in panthers, largely prompted by the members' own sightings, has a database of reports (n = 497) of large, almost always black, jet black or shiny black cats (91% of reports), seen by members of the public and reported to the Grose Vale Group going back to 1946 (Appendix 1). A few reports (2%) are of black cats with spots, while the rest are of brown or tan cats. If the latter are large cats this would imply that a species other than panthers are present. Reports of two or three large black cats together, or of an adult with cubs have also been made. Sightings are common in daylight hours (Fig. 4) probably simply reflecting human activity patterns, but it does mean many sightings are not confounded by lack of visibility at night. Reports were rare until 1998 but increased since 1998 with a peak of 39 reports in 2003. The number of reports has been declining since that time (Fig. 5). It is unclear whether the increase in the late 1990s reflects a real increase in 'panthers' or simply that the ability of people to report matters more easily through the Grose Vale Group has resulted in more reports.

There is a lot of social science on the reliability of eyewitnesses, usually to allow the judiciary to interpret criminal cases. People rarely describe with precision an event, simply because they do not see all the details, but more importantly they also subconsciously process their observations to fill in 'gaps' so when they later recall or recount what they have seen they are less accurate than if they describe events closer to the time they occur. That is, eyewitness testimonies are most accurate when the observer writes down what they have seen before they discuss or recount it with others (Sarmen (2011)). Thus, while the reporters of panthers may well be seeing cats, the fact of recounting their memories to the collators (rather than sending notes taken at the time) would (if we were before a court) weaken the evidence.

If the database is to be continued, the database collators should ask people who phone in a report to write down what they saw and send that in, then terminate the call without discussion with a promise to call back once the written report is received. The primary evidence is the dated written report (reports written on the day of the sighting are more useful than those written some some later), while any secondary points raised in subsequent discussion have to be given less weight.

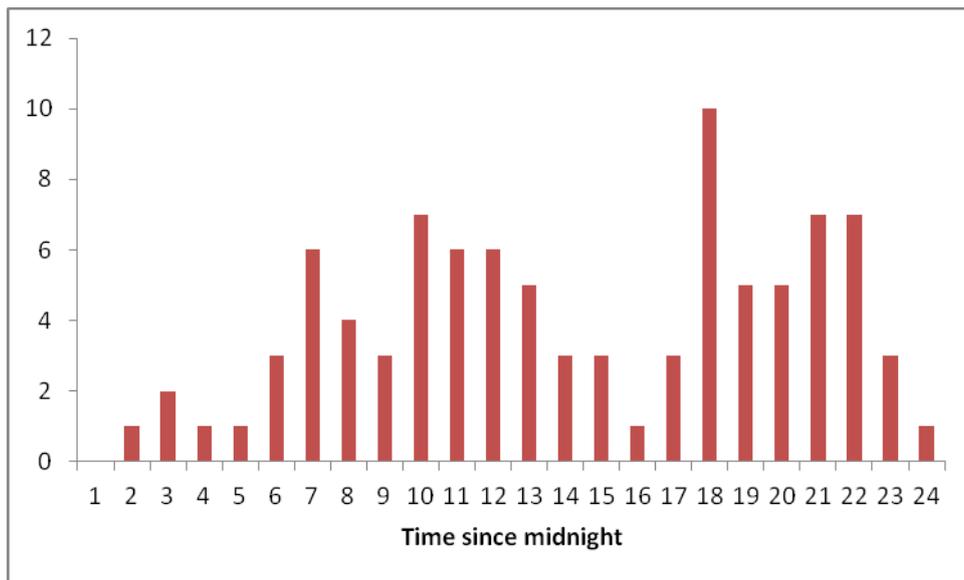


Figure 4. Number of sightings at different times of day.

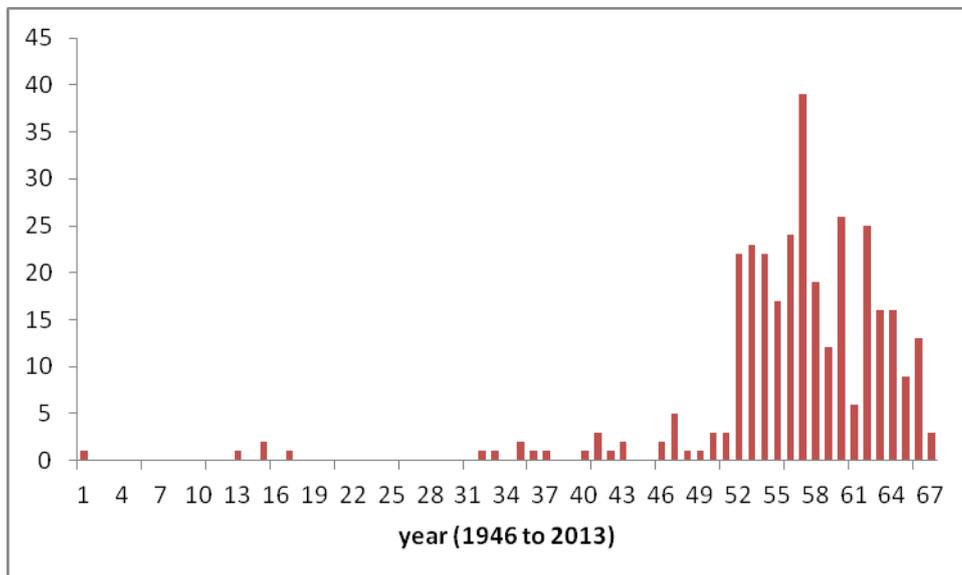


Figure 5. Number of reports per year collated by the Grose Vale group. Most sightings are from the Hawkesbury area (see Appendix 1).

5.3 Physical evidence of big cats in NSW

The Grose Vale Group has photographs of paw prints, the lower set purporting to show where the animal’s tail has touched the dust on the concrete slabs (Fig. 5). The tracks fit with

descriptions of ‘panther’ prints – the inside toe is in front of the outside toe, the toe pads are teardrop shaped, the central pad is lobed, the leading edge of the heel pad is squared off, and no claw marks are present. The size of the prints could have been made by a large dog. Dog prints have the front toes level with one another, the heel pad is curved, and prints usually show claw marks. The size (about 80 mm long) is about twice the length of feral cat prints. The only clear cat-like feature viz a viz a dog is the lack of claw marks.



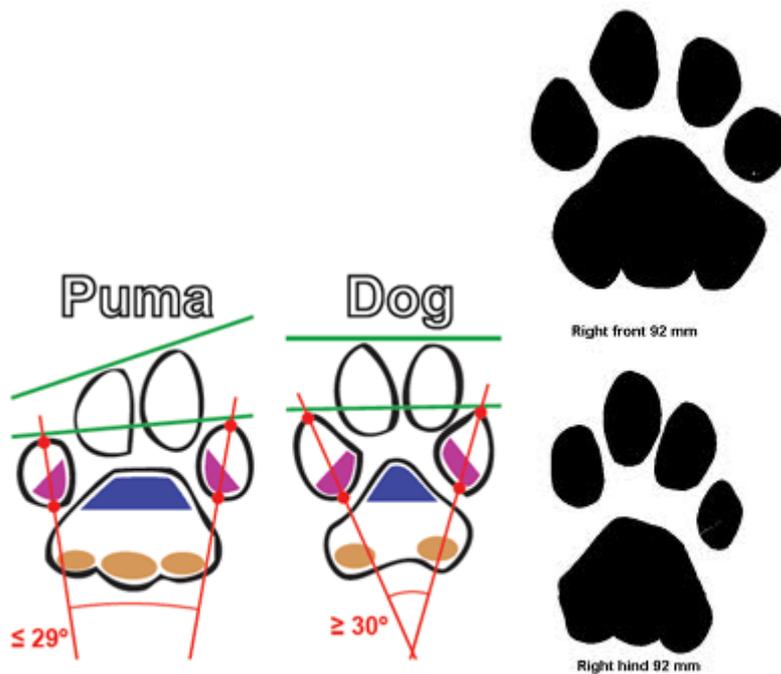


Figure 5. Footprints on concrete slabs at Grose Vale (photos provided by the Grose Vale Group). The top photograph was taken after sounds of a commotion at 0200 h that resulted in a domestic cat being killed with 2 puncture wounds on each side of its body (K. Pullen, pers. comm.). The bottom diagrams are taken from Menkhorst & Morison (2012) comparing a puma and dog footprint and for a leopard taken from the web.

There have been attempts to identify hair, saliva and faecal samples using either morphology or unique DNA. Only one set of results have been published, in an honours thesis (Magnik 2000). This study attempted to identify the species that had attacked and killed sheep in southern Gippsland, Victoria by detecting feline or canine microsatellite markers in saliva from the carcasses and in faecal scats collected in the vicinity. Only canine DNA was detected.

Animal hairs in large faecal scats collected in Winchelsea (Victoria) were morphologically similar to melanistic leopard hairs taken from an animal at Melbourne zoo while the part of mitochondrial DNA from the hairs tested (taken from the laboratory where both the known and scat hairs were present) was identical to published sequences from leopards (unpubl. data quoted in Menkhorst & Morison (2012)). The researchers in these cases concluded *P. pardus* was a possibility but that certainty could not be assigned to the diagnosis because of flaws in the forensic chain of evidence.

Leopards in the wild often take prey items up into trees or cover them with vegetation, presumably to avoid having their prey stolen by other predators or scavengers. There are anecdotal reports of this in Australia, but apparently no photographs. There are many photographs of prey (wallabies, sheep, goats) with atypical predation symptoms, i.e. not as dogs, foxes or pigs usually leave evidence on animals they kill or scavenge. The problem with such carcasses is that there are many potential scavengers that add their sign to that left by the original predator making diagnosis difficult.

5.4 Conclusions on this evidence

None of the above evidence can give unequivocal proof of the presence of large exotic cats in the wild in NSW. The sightings are mostly of black animals but the occasional reports of brown or tan cats suggest either more than one species is present or that people are mistaking other animals for cats. Large dogs, large feral cats or swamp wallabies have been suggested as candidates by some people (e.g. Menkhorst & Morison 2012). The paw prints have some characteristics of cats' prints but are not distinct enough to preclude a dog.

6 Methods to detect panthers

6.1 DNA

The simplest solution is to see if DNA from a large cat species can be detected in faecal scats, hair follicles or saliva taken from putative prey carcasses. This has been attempted in the past in NSW and Victoria but the samples have been either of poor quality or the forensic chain of evidence (from an animal, to deposition of the sample, to its collection, storage and transport to a laboratory) has been so compromised that the usual tests (PCR analyses) are not possible. Nevertheless, the equipment required is cheap and sampling protocols are simple so sampling can be collected by anyone with limited training – assuming suspect prey items are found.

PCR amplifies the DNA from a minute amount found in most samples *to* a quantity that can be sequenced. This means any contaminant (a few molecules from a domestic cat left on the collector's hands) will also be amplified and the saliva from a carcass allocated to the pet. Surgical gloves should be worn to handle each sample.

Forensic sampling must follow a strict protocol otherwise it is worthless. The nearest laboratory I know with experience in wildlife DNA forensics is at the University of Canberra. They, for example, have done the DNA tests for identifying foxes in Tasmania (Berry et al. 2007). They suggest the following sampling protocol:

1. Hair samples

These give good quality DNA if they can be obtained. The hairs must include their follicles because that is where the DNA is found, not in the hair shaft. It might be possible to collect hairs from a place where the target animal is moving through a barbed-wire fence?

About 10 hairs with their follicles should be collected and stored in a new manilla envelope along with a piece of filter or blotting paper to keep it dry. Label the sealed envelope with details of the sample.

2. Saliva swabs

A swab of saliva from around wound sites on prey has been used to identify the predator (e.g. to identify individual dogs responsible for predation on kiwi in New Zealand; ref). The protocol to collect samples is:

- Cut a cotton bud in half and only handle the non-bud end of the bud.
- Put on surgical gloves (a new pair for each carcass sampled) and swab the carcass around any puncture wounds and around the edge of eaten parts.
- Air dry the cotton buds for 24 hours in a place where the swabs cannot touch anything that may have had contact with a predator, i.e. somewhere where your domestic cat has never had access. Do not let individual swabs come in contact with each other.
- Once dried, place each swab in a manila envelope with a piece of filter paper and seal the envelope.
- Label the envelope with details of the sample, e.g., where taken, species of prey, estimated time since death, name of the person who collected the sample, etc.

6.2 Camera traps

Fixed cameras are now commonly used to detect animals (e.g. Wang & Macdonald 2009) and are used in many studies around Australia (Meek & Pittet 2012). So far as I know, no Australian user has reported anything of interest to this report. Of course most camera trap studies are not set in places from where panthers have been reported, so the absence of panthers is not informative. However, one study in east Victoria (from where panthers have been reported – Menkhorst & Morison 2012) set cameras to determine what species visit sambar deer carcasses. Foxes, dogs, and feral cats have been filmed, but no panthers (D. Forsyth, ARI, pers. comm).

If camera traps were to be used in the Hawkesbury area to detect rare (or possibly absent) animals when most or all data are zeros we need to be able to interpret these zero results. Of course if an animal is detected then it is present, but if none are detected for a given camera surveillance effort we want to know the probability that no animals were present to be detected. Ramsey et al. (2011) did this with cameras to try and validate the attempt to eradicate feral cats from an island in California. Twenty six cameras were placed across the 5896-ha island and it was estimated that they would have to operate for eight nights to ensure that, if at least one cat was present, one would be detected with a 95% probability. In the absence of data on the putative panthers, this result gives a rough estimate of the effort that might be required to check an area where panthers had been recently reported – and interpret negative results.

Camera trapping requires proactive effort, in areas where panthers have been reported, and thus would have to be funded and conducted by government agencies.

6.3 Detector dogs

Dogs can be trained to detect specific animals or their faeces – from ants, to snakes to foxes and cats (e.g. Shapira et al. 2011, Savidge et al. 2011). The use of dogs trained to detect fox scats in Tasmania is a model that could be used to detect panthers. The detection probability

for such dogs searching for fox scats is known (Parkes & Anderson 2011 and subsequent unpublished work by D. Ramsey) so the probability that no fox scats are present when none are found can be estimated. In the absence of such data for panthers' scats the Tasmanian data could be used. Dogs would need to be trained on real leopard (or jaguar) scats from a zoo and if necessary such real scats could be deployed to test that the fox scat data reflect similar canine abilities to detect panther scats.

This use of dogs may actually detect live panthers if any are really present, but if the dogs do indicate interest in scats these can be collected and tested for panther DNA as above.

6.4 Traps

Panthers can be trapped and indeed people have attempted to do this in Australia usually using a goat as a lure – with some animal welfare consequences but without success.

7 Conclusions

- There is no conclusive evidence that large cats exist in the wild in NSW. The sightings and other evidence presented, mostly from the Hawkesbury region, are at best prima facie evidence.

8 Acknowledgements

I thank John Tracey from DPI for hosting my visit to Hawkesbury. Jeff Organ and Chris Amit of Hawkesbury City Council and Chris Coffey, Karen Coffey, Ken Pullen and Chris Daley of the Grose Vale Group for discussions on their collation of reports of panthers in the region.

9 References

- Atkinson B (undated). Report on information available on the reported large black cat in the Blue Mountains. NSW Agriculture.
- Bauer JJ (undated). Evaluation of evidence of an unknown animals in the vicinity of Richmond. Unpubl. letter to NSW Agriculture.
- Berry O, Sarre SD, Farrington L, Aitken N (2007). Faecal DNA detection of invasive species: the case of feral foxes in Tasmania. *Wildlife Research* 34: 1–7.
- Department of Primary Industries (2008). New South Wales invasive species plan 2008 – 2015. NSW DPI, Orange.
- Forsyth DM, Duncan RP (2001). Propagule size and the relative success of exotic ungulate and bird introductions to New Zealand. *The American Naturalist* 157: 583–595.

- Hone J (1977). Dynamics of Loch Ness monsters. *New Scientist* 76: 791.
- Magnik C (2000). Using saliva and faecal samples to identify a mystery predator in Gippsland. Honours Thesis, Department of Genetics, La Trobe University.
- Meek PD, Pittet A (2012). User-based design specifications for the ultimate camera trap for wildlife research. *Wildlife Research* 39: 649–660.
- Menkhorst PW, Morison L (2012). Assessment of evidence for the presence in Victoria of a wild population of ‘big cats’. Arthur Rylah Institute for Environmental Research, Heidelberg, Victoria, Australia.
- Parkes JP, Anderson D (2011). What is required to eradicate red foxes (*Vulpes vulpes*) from Tasmania? In: Veitch CR, Clout MN, Towns DR (Eds.). Island invasives: eradication and management. *Occasional Paper of the IUCN Species Survival Commission No. 42*: 477–480.
- Ramsey DSL, Parkes JP, Will D, Hanson CC, Campbell KJ (2011). Quantifying the success of feral cat eradication: San Nicolas Island, California. *New Zealand Journal of Ecology* 35: 163–173.
- Reiss A, Woods R (2011). National zoo biosecurity manual. Department of Agriculture, Fishing and Forestry, Australia.
- Rounsevell DE (1988). Thylacine. Pp. 82–83. In: Strahan R (Ed.). The Australian Museum complete book of Australian mammals. Angus & Robertson, North Ryde, NSW.
- Sarmon F (2011). Eyewitness testimonies: the memory and meta-memory effects of retelling and discussions with non-witnesses. PhD Thesis, Lund University, Sweden.
- Savidge JA, Stanford JW, Reed RN, Haddock GR, Yackel Adams AA (2011). Canine detection of free-ranging brown treesnakes on Guam. *New Zealand Journal of Ecology* 35: 174–181.
- Shapira I, Buchanan F, Brunton DH (2011). Detection of caged and free-ranging Norway rats *Rattus norvegicus* by a rodent sniffing dog on Browns Island, Auckland, New Zealand. *Conservation Evidence* 8: 38–42.
- Stander P (2009). Leopard. Pp. 646–647. In: MacDonald DW (Ed.). Oxford University Press.
- Tustin KG 2005. Moose. Pp. 465–470. In: King CM (Ed.). The handbook of New Zealand mammals. Oxford University Press, Melbourne.
- Vertebrate Pests Committee (2007). List of exotic vertebrate animals in Australia.
- Wang SW, Macdonald DW (2009). The use of camera traps for estimating tiger and leopard populations in the high altitude mountains of Bhutan. *Biological Conservation* 142: 606–613.

Williams M, Lang R (2010). Australian big cats an unnatural history of panthers. Strange Nation Publishing, Hazelbrook, NSW, Australia.

10 Appendix: Map of sightings of collected by the Grose Vale Group

Attached as separate file

NSW panthers