Control tools

Requirements of tools to control feral cats

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Introduction

In 2008, the background document to the 'Threat abatement plan for predation by feral cats' (DEWHA 2008) considered the main control techniques for feral cats as trapping, shooting and exclusion fencing. Baiting was recognised as the most cost-effective method for broad-scale control, but was not commonly employed on the Australian mainland, although it had been used successfully in island eradications (Campbell *et al*. 2011). A sausage bait using 1080, *Eradicat*, had recently been developed and employed in Western Australia (Algar and Burrows 2004), but there were concerns over its application to the eastern states where native species are less tolerant of 1080 (Johnston *et al*. 2011). Development of an effective, humane cat-specific toxin and bait was seen as a high priority for feral cat management in Australia (DEWHA 2008). There has been progress on this front with development of the *Curiosity* bait using PAPP as a toxin (Johnston *et al*. 2011, Johnston *et al*. 2012) and other toxin delivery methods (Read 2010, Read *et al*. 2014). There have also been further applications of *Eradicat*, including on the mainland (Algar *et al*. 2013), and other control methods, and there is a better understanding of cat ecology and impacts, which will help improve strategies for their control. A review of control techniques and their application is thus timely.

As a precursor to papers in this workshop on particular control techniques, this paper provides a brief guide on what is required for a technique to be acceptable. Suitable control techniques for feral cats need to meet a number of criteria, including being:

- Target specific
- Humane
- Available to all members of the feral cat population
- Feasible (technically and economically)
- Applicable on a broad scale
- Effective in all environments and seasons
- Long-lasting (e.g. biocontrol, habitat manipulation, fencing)
- Publically acceptable (e.g. domestic cat owners opposed to biocontrol)

These are largely self-explanatory and represent an ideal. The control method selected for use by a pest manager or approved by a regulatory authority will to some extent be a compromise, such as between efficacy and non-target risk. The level of risk that is acceptable cannot be objectively determined and comes down to community or stakeholder values. Target specificity can be achieved in a number of ways including using the control tool at a time or place where a non-target is not susceptible (e.g. goannas in cooler months and outside the tropics, placing baits above ground) or using a species recognition system (Falzon *et al*. 2014). Most conventional lethal control methods require reapplication to stop population recovery through immigration and reproduction of survivors. Efficacy of cat control is notoriously variable, such as cats being generally reluctant to take baits when natural prey are readily available (Short *et al*. 1997, Algar *et al*. 2007, Johnston *et al*. 2012). Public acceptability of pest control goes beyond animal welfare, particularly when the pest subject to lethal control is also a popular domestic pet.

The presentations on particular control techniques in this workshop will address a number of the above suitability criteria. The emphasis in this paper is on efficacy and exploring what is required through population modelling.

Efficacy

Lethal control

Efficacy is obviously critical and the extent to which cat abundance needs to be reduced will vary case-by-case, possibly involving upper thresholds in cat abundance or lower thresholds in threatened prey numbers. Baxter *et al.* (2008) modelled the cost effectiveness of five contrasting predator control strategies in conserving threatened native prey. An ‘upper-trigger’ harvest strategy, where predators are removed when they are above a certain density, gave the lowest probability of prey extinction and the best return on investment. Other strategies (eradication, fixed number and lower trigger harvests) struggled to meet removal targets when predator density was low. This may be particularly relevant to managing arid zone cat populations that can increase dramatically at a site through immigration and reproduction following an increase in prey abundance (Letnic and Dickman 2006, Johnston *et al*. 2012). Sinclair *et al*. (1998) offered an alternative approach that focuses on the prey population. In the light of predator-prey theory, they examined the rates of increase of small, reduced extant populations and rates of increase of and predation rates on reintroduced populations of Australian mammals threatened by introduced predators, including cats. The data conformed to theoretical predictions and suggested the density of prey and amount of predator control needed for persistence of prey.

The relatively high maximum rate of increase of cats (exponential r_m = 0.99 or finite R = 2.69) can trivialise control removals to which cats rapidly compensate. This estimate is based on vital rates (age at first reproduction and annual fecundity)(Hone *et al*. 2010) and is supported by field data (Short and Turner 2005). Assuming logistic population growth and an r_m of 0.99, the reduction in a population's size from its carrying capacity from an on-going removal of animals can be determined. Figure 1 shows that the effort required is substantially greater than a suite of other pest animals in Australia. It is important to emphasise that the harvest must continue each year for many years to achieve the reduction identified on the *x*-axis in Figure 1. This difficulty will be exacerbated by immigration. McCarthy *et al*. (2013) painted a more pessimistic picture in their individual-based model of a stray cat population, which suggested annual removal rates of >80% are needed over more than a decade to eradicate a population. Annual removal rates of nearly 60% for a decade may only reduce population size by 25%. The density dependence used in these modelling exercises is likely to be overly strong for a population in a fluctuating environment such as arid Australia. The harvest rates for a particular percentage reduction are therefore likely to be overestimated in this environment (Caughley 1977).

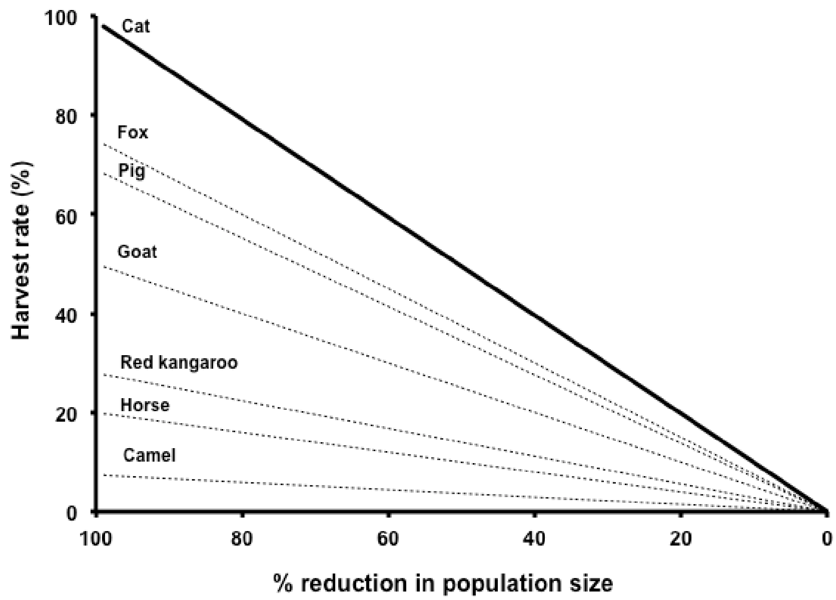

Figure 1. Percentage reduction in population size at carrying capacity for seven mammal species in Australia assuming logistic growth and long-term, annual instantaneous harvest rates.

Fertility control

While fertility control through trapping or darting is only feasible on a small scale, the modelled outcomes are of interest to managing broad-scale populations if a contraceptive can be administered in bait or through a self-disseminating agent. It is also relevant to eradication programs on human-populated islands with a domestic cat population. McCarthy *et al*.'s (2013) individual-based model of managing a closed stray cat population contrasted lethal control with castration/ovariohysterectomy of typical trap-neuter-release (TNR) programs and trap and release following vasectomy and hysterectomy (TVHR). Fertility control through TVHR can be more effective than TNR and lethal control as sexually active but infertile cats compete for matings and prevent less dominant animals from breeding. The modelled population was eliminated in 11 years by TVNR with a capture rate of 57%, whereas TNR and lethal control achieved only modest reductions. Again, immigration will compromise control efforts.

Biocontrol

The attraction of biocontrol is the possibility of self-dissemination and long-lasting control. Biocontrol with feline panleucopaenia virus proved successful in suppressing an initially naïve and high-density cat population on Marion Island, but this needed to be supplemented with conventional lethal control to achieve eradication (Bester *et al*. 2002). Other pathogens may have better characteristics for population control such as higher transmission rates. Courchamp and Sugihara (1999) modelled the impact of two feline retroviruses, feline immunodeficiency virus and feline leukemia virus, as promising alternatives. Eradication was possible with feline leukemia virus, with low natural immunity, but not feline immunodeficiency virus, although the latter could provide effective long-term control. Oliveira and Hilker (2010) considered the modelling by Courchamp and Sugihara (1999) was flawed and so used an alternative modelling approach for feline immunodeficiency virus and similarly found that it was unlikely to eradicate cats, but could reduce their population size sufficiently to allow recovery of endangered prey.

Dingoes and other predators provide alternative biological controls for feral cats (e.g. Brook *et al*. 2012), but the situations (including densities) where these predators provide effective control need to be clarified (Allen *et al*. 2014). Part of the problem is that dingoes and foxes are also predators of threatened species.

Conclusion

On a positive note, while cat control has proven difficult, island populations have been successfully eradicated and mainland feral cat populations have been controlled (i.e. their impacts managed) at a local scale. New tools and strategies founded on past experience (including integration of techniques) offer some cause for optimism.

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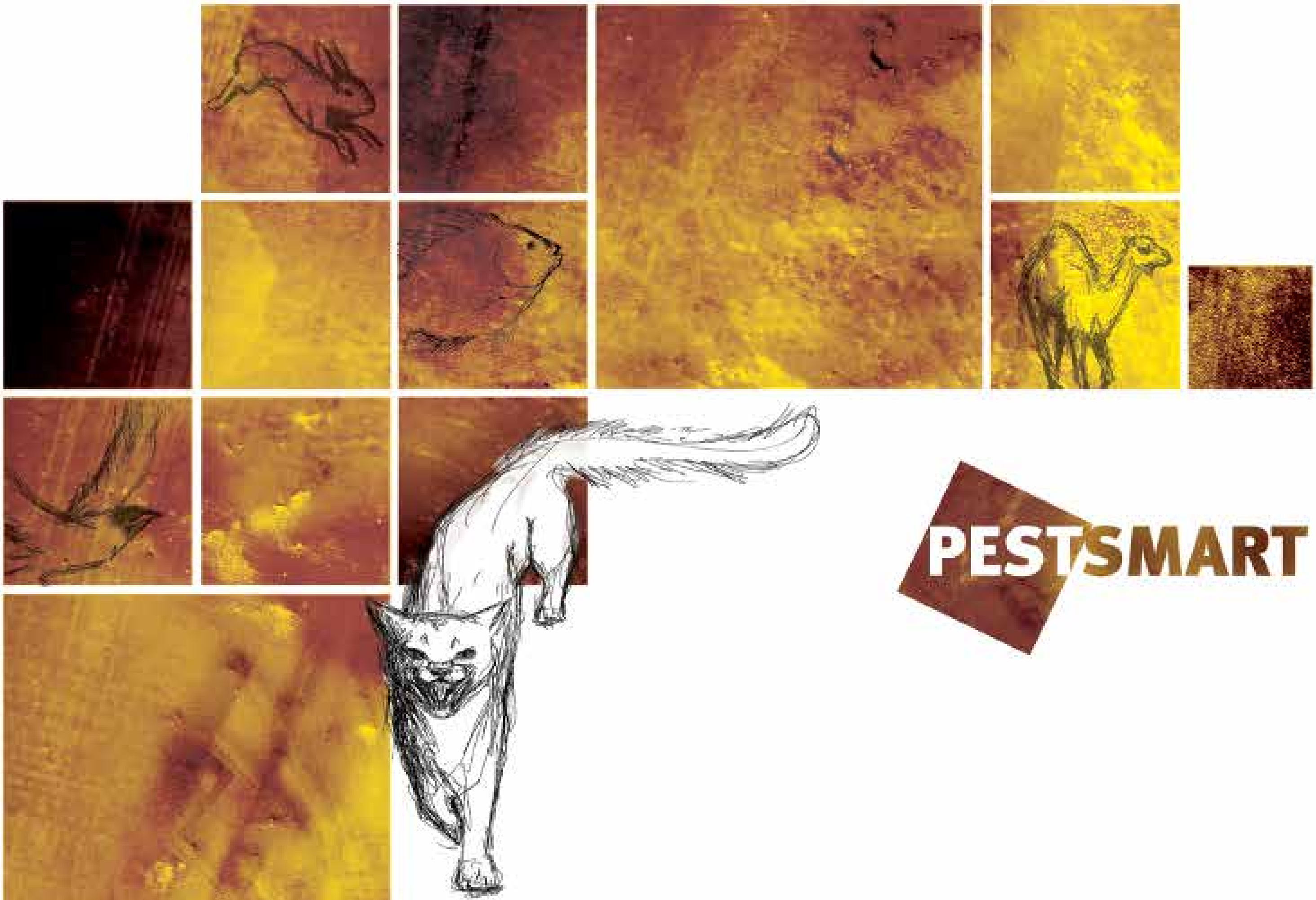

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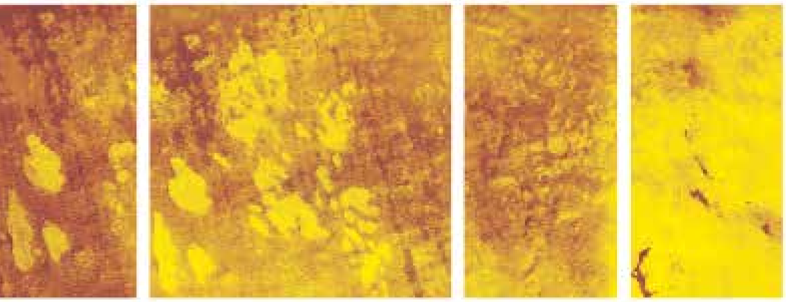

Summaries of discussions held at the National Feral Cat Management Workshop are included in these proceedings to provide addition information on issues raised by participants. These summaries have been edited for brevity, to avoid repetition or where comments were unclear. In some instances, attribution may be incorrect. The reader is advised that individual participants and their organisations have not endorsed the views expressed.

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Contents

Summary

Feral cats (*Felis catus*) are widespread across Australia and New Zealand, occupying most habitats. They are a significant predator of mammals, birds and reptiles (Doherty et al 2015) and are identified as a major threat to endangered fauna, particularly on islands (Medina et al. 2011). Consequently predation by feral cats has been listed as a key threatening process in Australia under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act). However, feral cat management and legislation is highly variable across Australia, and investment in research to seek longer term solutions has been *ad hoc* with limited national coordination. This workshop was held to address these issues, and to guide national strategies and actions under the *Threat abatement plan for predation by feral cats*.

These proceedings outline high impact research and innovation priorities and national actions for feral cats within five key areas: impacts, monitoring, control tools, management strategies and community engagement. A collection of papers is also provided that outline the strategic direction and review the most current research and innovation initiatives for feral cats and their management in Australia.

The workshop and review identified significant gaps in knowledge that must be addressed to effectively manage feral cats in Australia. Better information on impacts is required, in particular, on how impacts vary between prey species and across the landscape. We also require improved monitoring tools and use of technology, including the improved collection, automation and analysis of large data sets for predators and prey. Further development of traps and baiting tools is recommended, including, grooming traps, implants, lethal collars and kill traps; and standard operating procedures and support tools to ensure the animal welfare and effective adoption of these methods. Management should focus on eradication of feral cats on priority islands and fenced reserves, and on understanding the influence and role of predators, baiting, fire, grazing and rabbits on widespread feral cat populations. A national engagement strategy and facilitator, knowledge sharing, alternative funding models and improved ways to engage with communities are also identified as priorities.

It is hoped that these proceedings will assist key groups, particularly the Commonwealth and State governments and Ministers, the Threatened Species Commissioner, the Invasive Plants and Animals Committee, the Invasive Animals Cooperative Research Centre, universities and conservation and community groups to prioritise funding and resources to reduce the impacts of cats. Outcomes will also be used in the preparation of an updated *Threat abatement plan for predation by feral cats,* and a national *Threatened Species Strategy*.