Draft national targets for feral cat management: Towards the effective control of feral cats in Australia – targets with teeth

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Summary

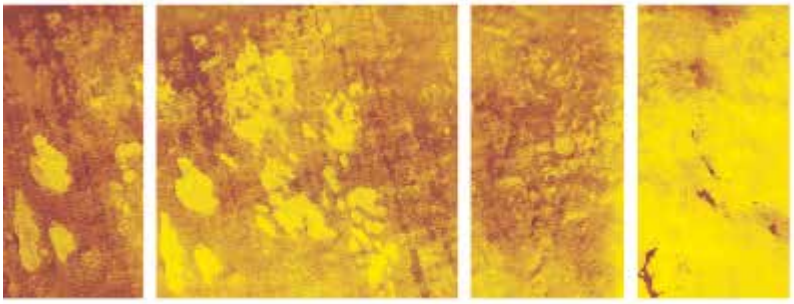
Feral cats have been present in Australia since soon after European settlement. They are now numerous and pervasive across the continent, and occur on many islands. Although they have been recognised as a Key Threatening Process to Australian biodiversity under the EPBC Act since 1999, and there has been a Threat Abatement Plan for them in place since 2008, there has to date been little progress towards their effective management.

The challenges to effective control of feral cats in Australia are formidable. The geographic scale of concern is immense; many potential control mechanisms (such as trapping and shooting) typically have only superficial, transient and localised benefits; design of effective baits has only recently progressed substantially; there may be significant non-target impacts (including for threatened species such as quolls) from such toxic baits; baiting programs may need to be sustained for many years, and in many places need to also consider integration with control of foxes; reduction in cat numbers may have unwanted consequences (increases in other pest species, such as rabbits or introduced rodents); control programs will be expensive; and there will be some community concern about cat control.

However, progress towards the effective control of feral cats will achieve marked biodiversity benefits. Such control is likely to be substantially more efficient and cost-effective, and produce more enduring outcomes, than alternative conservation approaches based on intensive management for individual threatened species.

Here, we propose short-term (one year) targets towards the effective control of feral cats in Australia. These targets are set within a broader contextual and long-term (ca. 20 years) objective:

> No further extinctions of Australian wildlife, and pronounced recovery (and return to the wild) of at least 40 currently threatened animal species.



The targets recommended here are designed strategically to help establish a robust foundation for the decadal-scale campaign likely to be required to achieve enduring success. This should not be taken to indicate that significant progress can be achieved, if at all, only at glacial speed. Rather, explicit and dramatic short-term targets set now are required to overcome inertia, to recognise that this is a problem that should be confronted, to demonstrate that successful outcomes are possible, and because the continuing existence of some threatened species requires immediate action.

The targets proposed here are multi-dimensional, recognising that overall benefit will arise most substantially from attention directed at complementary aspects of this problem.

The 5 recommended immediate (one year) targets (some with subsidiary targets) are:

- at least 10 animal species, currently most imperilled by feral cats, are secured or recovered through intensive management (primarily through networks of exclosure fencing);
- feral cats are effectively managed in more than 1% of Australia (i.e. >75,000 km^2);
    - programs have been commenced to eradicate cats from at least 5 biodiversity-significant islands within 5 years;
    - consultation is initiated to implement cat eradication programs for at least 20 additional islands over the next 10 years;
    - a coherent policy framework and biosecurity management program is developed to stop the introduction of cats to islands that are currently cat-free;
    - cat populations have been reduced by >80% across >10,000 km^2 of Australia, through broad-scale cat-baiting programs;
    - cat populations and predation pressure have been reduced by >50% across >20,000 km^2 of Australia through broad-scale trial environmental management (e.g. fire) programs;
- exemplary feral cat management programs are established and implemented effectively on all Commonwealth lands, particularly conservation reserves managed by Parks Australia;
- a harmonised national approach is developed and implemented for the management of stray and domestic cats;
- a coherent set of priority research and monitoring programs is implemented, aimed at allowing more effective and cost-efficient broad-scale management of cats;

- the economic costs of toxoplasmosis to livestock production, and the extent to which the effective control of feral cats can mitigate these costs, is determined;
- research aimed at the development of more effective cat eradication options is supported;
- effective protocols are developed and applied for monitoring cat populations, impacts and responses of cat-affected species to management;
- the management implications of feral cat interactions with other species (notably Tasmanian devils, dingoes, foxes and pest prey species) are resolved through research and adaptive management trials.

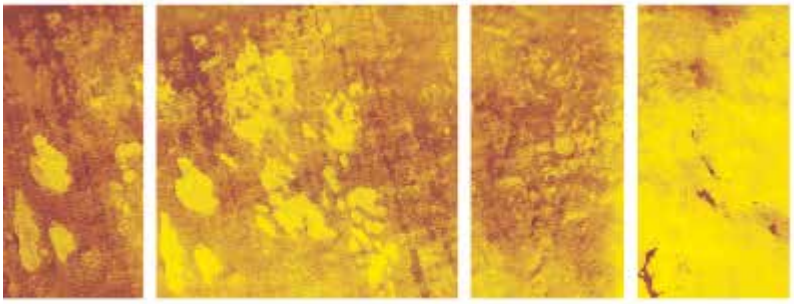
These targets are broadly consistent with, or complement, the objectives and actions now being drafted in revision of the *Threat abatement plan for predation by feral cats*.

Note that another possible national target – an annual tally of the total number of feral cats culled – is not recommended because (i) it focuses on activity rather than on conservation outcomes, (ii) it would be extremely difficult to measure reliably, (iii) (given rapid recruitment) it would not well indicate the extent to which the overall population size of feral cats is reduced, (iv) it may encourage a far more scatter-gun than strategic approach to the problem, and (v) it may unhelpfully alarm that section of society sympathetic to cats and with animal welfare concerns.

Background

Rationale – the need for action

Much Australian biodiversity is in decline. This has been shown most recently and starkly in the comprehensive review of the fate of the Australian mammal fauna since European settlement: this concluded that between 28 and 30 Australian mammal species (more than 10% of that fauna) had been rendered extinct since the 1840s, that the rate of extinction (of 1-2 mammal species per decade) was continuing unabated, and that very many mammal species were now threatened and/or declining rapidly (Woinarski *et al.* 2014). That review concluded that predation by feral cats was the factor responsible for the most extinctions, and for most current declines, in the Australian mammal fauna. It also concluded that the single action that could provide the greatest benefit for the conservation of the Australian mammal fauna was the effective control of feral cats. Without such control, conservation efforts directed towards many to most threatened land mammals are likely to be severely constrained, piecemeal and cost-ineffective, and may deliver benefits that are only short-term. Although the evidence is strongest for cat impacts



upon native mammals, predation by feral cats is also likely to be a primary threat for some threatened bird and reptile species (Doherty *et al.* 2015), such as the western ground parrot.

In addition to causing ongoing decline in many species, feral cats have also inhibited or prevented many attempted reintroduction and other recovery efforts, rendering those investments an ineffective and frustrating use of the limited resources available for conservation (Christensen and Burrows 1994). One of the notable conservation success stories for Australian mammals, the recovery of many species associated with a sustained large-scale fox-baiting campaign in south-western Australia (Western Shield), may now be jeopardised by a resulting increase in cat predation, with reversals again for several mammal species that had previously been recovering (Marlow *et al.* 2015).

The impacts of predation by feral cats are profound. But feral cats may also pose significant detriment through spread of disease to Australian wildlife (and to livestock and humans). Cats are the primary vector (the definitive host) for toxoplasmosis (Fancourt and Jackson 2014), with spread to many native mammal and bird species through contact with food, soil or water contaminated with infective oocysts that are shed by cats in their faeces. The lethal and sub-lethal consequences of toxoplasmosis to Australian wildlife are poorly resolved, but may be substantial.

Challenges: impediments that constrain progress

The control of feral cats is a difficult problem. In part, this is because of characteristics of the cats themselves, because of societal attitudes, because of limited knowledge, and because of potential detrimental environmental consequences of some cat control mechanisms.

Feral cats are now pervasive and abundant, in all environments, across the Australian mainland and on many islands. Eradication on the mainland is not feasible in the foreseeable future. This recognition is mutually reinforcing, as the problem may be seen to be intractable and hence not worth investing in. However, effective control of feral cats over large mainland areas may now be possible.

Unlike some other threats to biodiversity, feral cats were considered until recently to pose little or no threat to agricultural productivity or other community values, so the ability to draw on resources for their management is relatively limited. (However, recent reports from Tasmania have indicated some at least localised cases of major losses of lambs due to toxoplasmosis.) Furthermore, given the popularity of pet cats, there may be antipathy from some sections of the community towards cat control generally, and some control options specifically. Around settled areas, there may be ongoing recruitment to the feral cat population from stray and pet cats, and

population increase arising from the deliberate or untargeted provision (e.g. rubbish dumps) of food and other resources.

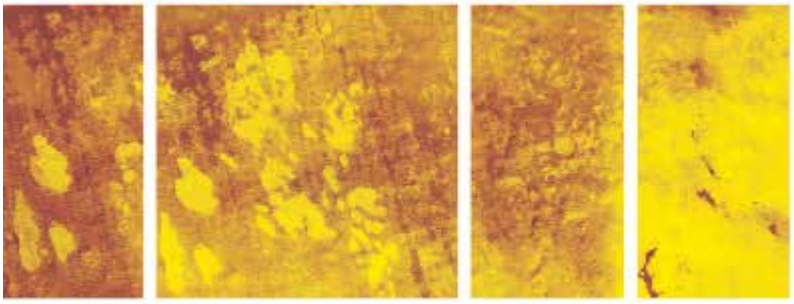
Feral cats have a flexible ecology and an extremely broad diet. This helps drive their ecological impact as they can kill and consume all individuals of a species in an area, causing local extinction, and then readily shift to another prey item without lasting consequences to their own population. A broad diet, and wariness, also means that they may take baits (or enter traps) only when little other food is available, constraining options for broad-scale control (Algar *et al.* 2007). Cats also have a high reproductive output, meaning that individual control measures that simply reduce local population size may have only short-term benefits. Some studies have indicated that individual cats may hunt selectively and particularly effectively on individual threatened species, such that reduction in feral cat populations in an area to even very low numbers may be insufficient to provide protection to that threatened species (Christensen and Burrows 1994; Frank *et al.* 2014). We don't yet know whether there are 'safe' thresholds of feral cat density below which their impacts upon threatened species are negligible – or more likely, these thresholds will differ between different threatened mammal species.

Available control mechanisms for feral cats have some significant limitations. Shooting, trapping and hunting with trained dogs are likely to be effective only in circumscribed sites that can and need to be intensively managed, such as on small islands or at sites used for the establishment of exclosure fencing. Such predator exclosure fencing is effective for the protection of many threatened mammals highly susceptible to cat predation, but establishment (ca. $20-40,000/km) and ongoing maintenance costs dictate that such exclosures will be relatively small scale.

Baiting is more likely to be effective over larger areas, but is unlikely to kill all cats in the baited area. Whatever the control mechanisms, it will need to be sustained over multiple years because of the high rate of cat recruitment and (except on islands) immigration from adjacent areas; and some control methods may have diminishing efficacy over years. There are also substantial costs associated with current cat control options – for example, an aerial baiting program to control feral cats over an area of 2500 km^2 costs about $60,000 per year.

There are also concerns about direct mortality of threatened species (such as northern quoll) from cat baits in some regions. Dingoes are also susceptible to baits laid for feral cats: this raises some Indigenous cultural concerns and also may render the baiting counter-productive, with any reduction in dingo numbers potentially leading to increases in cat abundance.

In some situations, control of feral cats may also bring detriment for threatened species and other values, if such control results in subsequent increase in pest



species (such as rabbits or introduced rodents) that are currently limited by cat predation.

Current action and progress

A Threat Abatement Plan sets the broad framework for the management of feral cats in Australia (Department of the Environment, Water, Heritage and the Arts 2008). That Plan is currently being revised. However, there has been relatively little progress of actions to date, with little previous resourcing and little coherent national implementation. This is the case even for Commonwealth lands, for which the *Environment Protection and Biodiversity Conservation Act 1999* stipulates that Threat Abatement Plans must be implemented.

A 2006 review concluded that annual control operations of feral cats across Australia then comprised a total area of about 34 km^2 (Reddiex *et al.* 2006). It is likely to have increased substantially since, but no national tally is maintained.

However, there have been some significant achievements. Many Australian islands have very high conservation values and eradication of threats is far more feasible on islands than on mainland regions. Feral cats were eradicated from Hermite Island (Montebello group; 10 km^2) in 1999, from Macquarie Island (128 km^2) in 2001, and Faure Island (51 km^2) in 2002. There are current programs aimed at eradication of feral cats on Christmas (135 km^2), Dirk Hartog (586 km^2), and West (Pellew group: 134 km^2) Islands. Substantial biodiversity benefit has been demonstrated as a consequence of localised control of feral cats on Christmas Island and, after subsequent eradication of other pest species, on Macquarie Island.

However, feral cats remain present on at least 50 Australian islands (Abbott and Burbidge 1995), and cats have continued to be introduced to previously cat-free islands (Woinarski *et al.* 2011). Biosecurity programs are inadequate for all but a few islands.

Over recent decades, cat-free islands have been used very successfully as translocation sites for many threatened Australian mammals, and such actions have prevented extinction and allowed recovery for some species, such as the mala (Langford and Burbidge 2001). However, translocation to islands is not a feasible option for some threatened species, not all islands are suitable for translocation, and marooning of threatened species on islands may best be seen as a necessary stepping-stone (towards eventual successful return to previous mainland range) rather than a conservation end-point.

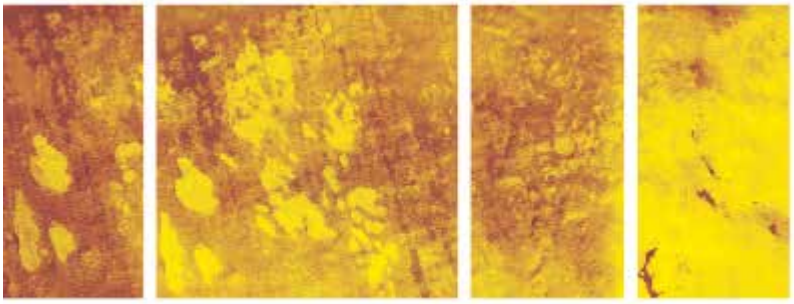
More recently, 'mainland islands' (sites at which otherwise pervasive threats are excluded or otherwise intensively controlled) have become a major focus for conservation effort for threatened mammals. About 30 such predator-proof

exclosures have now been established in Australia. The most notable examples include four sites maintained by the Australian Wildlife Conservancy (with total area of 171 km^2 and largest exclosure of 80 km^2), Arid Recovery (with total predator-exclosure area of 60 km^2), WA Parks and Wildlife's Matuwa (Lorna Glen) (predator-exclosure area of 11 km^2) and Perup Sanctuary (4 km^2), and Mulligan's Flat Woodland Sanctuary (predator-exclosure area of 4.5 km^2). These programs have demonstrated remarkable recovery of many threatened mammal species when feral cats (and foxes) are excluded.

There has been some substantial recent progress with development and trialling of baits specifically targeting feral cats, most notably the *Eradicat*® and Curiosity baits. Some larger-scale (>1000 km^2) programs using these baits are now being implemented, notably including at Matuwa (Lorna Glen) and Fortescue Marsh in the Pilbara region, with results demonstrating substantial reduction in feral cat numbers (e.g. 85% mortality at Fortescue: Clausen *et al.* (2014)) to levels that allow the persistence of some, but not all, threatened mammal species. However, it is likely that baiting programs may vary appreciably in their effectiveness depending upon seasonal conditions and prey abundance.

Environmental management may have a key and more cost-effective, enduring and large scale role to play in cat control. Recent studies in the Kimberley have demonstrated that feral cats select extensively burnt areas for foraging, and that their impact upon native mammals is much higher in such areas than in unburnt areas and in areas burnt with a fine-scale mosaic (Leahy 2013; McGregor *et al.* 2014), probably because the extensively burnt areas provide less protective shelter (such as hollow logs and dense grass) and fewer food resources for native mammals (so they must forage for longer and take more risks). Accordingly, in mainland regions now subject to frequent fire, improved fire management may allow threatened species to persist or recover even in the absence of targeted cat control. Over-grazing (by livestock and feral animals) may similarly lead to increased predation impacts.

Another environmental management option relates to interactions ('trophic cascades') amongst predator species. Mainland Australia's apex predator, the dingo, regulates to some extent the abundance and impacts of foxes and feral cats (Letnic *et al.* 2012). Broadly, a higher abundance of dingoes leads to less impact on threatened fauna from foxes and cats, and less overall predation impact. However, dingoes (and wild dogs) are currently subject to broad-scale control programs in many (pastoral) parts of Australia. An increase in dingo numbers in such areas is likely to benefit some threatened mammal species. Some current research trials indicate that the undesirable consequences to pastoralists of any increase in dingo abundance may be mitigated effectively and cost-efficiently by use of guardian dogs (Van Bommel and Johnson 2012). Comparably, a strategic reintroduction of



Tasmanian Devils to some mainland areas may cause a decrease in the abundance and impacts of feral cats, and hence provide a net benefit for some threatened species.

Response: target options

Here, we recommend a multi-dimensional approach to achieving substantial conservation benefit through the management of feral cats and of species affected by feral cats. We emphasise that control of feral cats is a means to an end (biodiversity conservation), so targets should not focus solely on cats themselves, but also on the management of cat-affected threatened species and on securing areas not currently occupied by cats.

Accordingly, we do not recommend a numerical cull target, such as an annual tally of the total number of feral cats killed. We advise against such a target because (i) it focuses on activity rather than on conservation outcomes, (ii) it would be extremely difficult to measure reliably, (iii) (given rapid recruitment) it would not well indicate the extent to which the overall population size of feral cats is reduced, (iv) it may encourage a far more scatter-gun than strategic approach to the problem, and (v) it may unhelpfully alarm that section of society sympathetic to cats and with animal welfare concerns.

For the set of targets we propose, we recommend a longer-term (*ca*. 20 years) objective that sets broad context:

> *No further extinctions of Australian wildlife, and pronounced recovery (and return to the wild) of at least 40 currently threatened animal species*.

The enhanced management of feral cats will make a substantial contribution to this goal, probably more so than any other single factor.

Substantial and enduring conservation benefits for cat-affected threatened species will be achieved only with a coherent, long-term and strategic program. Short-term (one year) targets are necessary to provide impetus and direction to that program, to demonstrate commitment, and to allow an assessment of progress. However, they need to be encapsulated within longer-term commitments that allow continuity of management actions.

Here, we propose a series of complementary *one-year targets* that are achievable, measurable and, if implemented, will deliver significant conservation progress. These targets can readily be expanded in a strategic manner in subsequent years. These targets are described below.

TARGET 1. At least 10 animal species, currently imperilled by feral cats, are secured or recovered through intensive management. This should be done particularly through networks of exclosure fencing, but also including captive breeding, translocation and intensive baiting.

Rationale: Longer-term programs aimed at increasing the landscape-scale control of feral cats may come too late for highly imperilled species (such as bridled nailtail wallaby, western ground parrot, mountain pygmy-possum, Gilbert's potoroo, numbat, red-tailed phascogale, woylie and others): to avert extinction, these species need immediate attention. Some of these species are currently the subject of conservation management actions (in some cases based on recovery plans), but some of these programs are tenuous and need further support.

Options: The number of target species and the size and number of predator-proof exclosures can be varied, but a target of 10 species in a one-year timeframe is tractable.

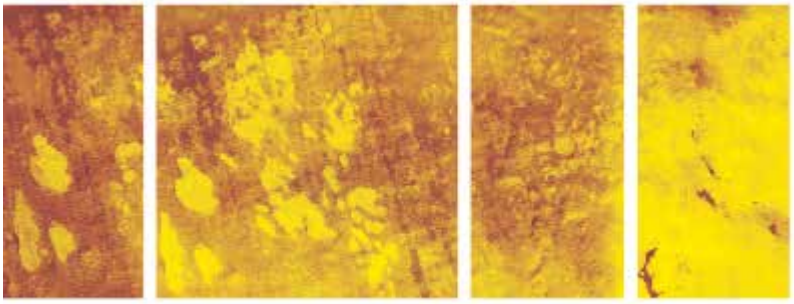
TARGET 2. Feral cats are effectively managed in more than 1% of Australia (i.e. >75,000 km^2).

Rationale: This target provides a national indicator that can be readily increased and monitored over longer time frames. The initial target may appear unambitiously small, but this level highlights the extent of the problem.

Options: The only previous available national estimate for the extent of active feral cat control operations for Australia is that of 34 km^2 (Reddiex *et al.* 2006), or a nugatory 0.0004% of the Australian landmass. With the dedicated increase (described in the following subsidiary targets) in the area of predator exclosures, island eradications, broad-scale baiting and broad-scale environmental modification programs aimed at reducing cat impacts, this proportion could be increased readily to 0.2%. Inclusion of currently cat-free islands for which enhanced biosecurity measures could be implemented would increase the area to *ca*. 1% (i.e. 76, 920 km^2).

Target 2a. Programs have been commenced to eradicate cats from at least 5 biodiversity-significant islands within 5 years.

Rationale: Many Australian islands have very significant conservation values. However, on some islands these values are being jeopardised by feral cats. Eradication of cats on islands is far more feasible than on mainland areas.



Options: The number of islands and the time period for eradication programs can be varied, but the suggested values are realistic. Note that there are current control programs at various states of progress for four islands.

Target 2b. Consultation is initiated to implement cat eradication programs for at least 20 additional islands over the next 10 years.

Rationale: Feral cats are present on at least 50 Australian islands. Control programs may need to have substantial consultative periods. Note that islands should be prioritised based on biodiversity value and tractability of eradication (Dickman *et al.* 2010). Consultation will need to involve relevant land-owners, state agencies and other stakeholders.

Options: The number of islands and the time period for eradication programs can be varied, but the suggested values are realistic.

Target 2c. A coherent policy framework and biosecurity management program is developed to stop the introduction of cats to islands that are currently cat-free and to increase biosecurity programs for islands of particular conservation significance.

Rationale: Cat-free islands offer a diminishingly small haven for many threatened species, and there is currently no consistent national approach for retaining their cat-free status. Note that this target will require consultation and coordination with state and territory governments and other relevant stakeholders.

Options: The present ad hoc approach could be retained, or left to different jurisdictions to act individually, but a coherent national approach would better highlight the issue. In some cases, legislative change may be required.

Target 2d. Cat populations have been reduced by >80% across >10,000 km^2, through broad-scale cat baiting programs.

Rationale: There has been considerable recent progress with the design of baits and baiting protocols, but there remain unresolved issues about the optimal scale, sustainability, longer-term effectiveness at reducing cat abundance to acceptably low levels, cost-efficiency, non-target impacts, and net biodiversity benefits. These issues can be addressed only with well-designed large-scale management trials that are closely monitored. Large-scale baiting programs may offer the most practical short- to medium-term option for increasing the area in which cats are intensively controlled beyond the small area of more expensive cat exclosures and islands. Note that baiting programs would need to operate over at least several years to allow assessment of efficacy. Note also that there are at least two current such

baiting trials, in the Pilbara. Note that implementation of such programs will need to be complemented by careful monitoring of impacts upon cat numbers and on threatened species.

Options: The number of management programs and the area over which they are implemented can be varied, but the suggested values are realistic. Note that this action focuses on mainland areas, but could reasonably also include large islands (Tasmania, Groote Eylandt).

Target 2e. Cat populations and predation pressure have been reduced by >50% across >20,000 km^2 through broad-scale trial environmental management (e.g. fire, native predator) programs.

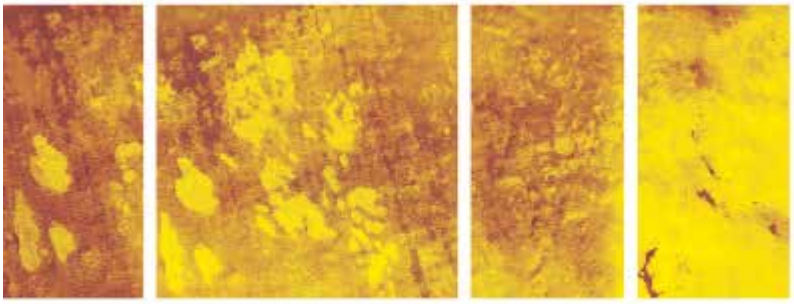
Rationale: Management of fire (to reduce the extent of intensively-burnt areas) and dingoes (to restore populations to areas in which they have been substantially reduced) – and possibly livestock and feral herbivores – may offer the only immediately available cost-effective mechanism to reduce the impacts of feral cats over very large areas. However, while there have been some limited, brief and localised studies that indicate that these approaches may be beneficial to some cat-affected threatened species, proof-of-concept is required over larger areas and longer periods. Note that implementation of such programs will need to be complemented by careful monitoring of impacts upon cat numbers and on threatened species.

Options: The number of management programs and the area over which they are implemented can be varied, but the suggested values are realistic.

TARGET 3. Exemplary feral cat management programs are established and implemented effectively on all Commonwealth lands, particularly conservation reserves managed by Parks Australia.

Rationale: The EPBC Act (s. 269) stipulates that the Commonwealth must implement a threat abatement plan to the extent to which it applies on Commonwealth land. However, to date there has been little or no effective implementation of the feral cat threat abatement plan (or any other effective management of feral cats) on any Commonwealth lands. Use of this target would indicate national conservation leadership and help provide for the recovery of threatened species on Commonwealth lands, particularly conservation reserves.

Options: The target could be restricted to Commonwealth-managed conservation reserves, or could be phrased to provide more explicit quantitative outcomes.



TARGET 4. A harmonised national approach to the management of stray and domestic cats is developed and implemented.

Rationale: Around settled areas, the population of feral cats is supported by provision of food sources and recruitment from pet and stray cats; and pet and stray cats cause at least localised biodiversity impacts. However, there is no coherent management of pet and stray cats across local and state/territory governments, and many cat owners have little awareness of these impacts, or of the extent of the conservation problem imposed by feral cats more broadly. There is likely to be little community support for ambitious programs aimed at the extensive management of feral cats unless that awareness is increased.

Options: The extent to which pet and stray cats contribute to the national population of feral cats is poorly resolved, and it may be that this issue is relatively insignificant, so this target may be less important than others.

TARGET 5. A coherent set of priority research and monitoring programs is implemented, aimed at allowing more effective and cost-efficient broad-scale management of cats.

Rationale: There have been substantial recent advances in the knowledge of feral cat ecology and management, and in development of baits and baiting protocols, but there are still some major knowledge gaps that significantly impede management. The set of research and monitoring programs proposed here represents the priority actions that can most enhance knowledge of the role and impacts of feral cats and of our ability to manage them more effectively.

Target 5a. The economic costs of toxoplasmosis to livestock production, and the extent to which the effective control of feral cats can mitigate these costs, are determined.

Rationale: Societal attitudes to cats are complex. A demonstration of significant economic detriment to agricultural production due to feral cats may help refine those attitudes, and provide some impetus for ongoing resourcing of cat control.

Options: This target does not relate directly to biodiversity conservation, so may be inappropriate to include here.

Target 5b. Research aimed at the development of alternative more effective cat eradication options is commenced.

Rationale: The currently available cat control options are impractical to apply at national scale, so will never entirely resolve the conservation problem posed by feral cats. Such continental scale control is likely to require a biocontrol agent; however, the development and trialling (to ensure no undesirable non-target impacts) of any such agent may take decades.

Options: It may be inappropriate to include a consideration of a longer-term research program within a package of short-term targets.

Target 5c. Effective protocols for monitoring cat populations, impacts and responses of cat-affected species to management are developed and implemented.

Rationale: There is no reliable estimate of the feral cat population in Australia, or in local areas; and few estimates of the effects of management actions on the population size or viability of cats (or cat-affected native species) in managed areas. Furthermore, these variables may be substantially influenced by seasonal conditions. Without more reliable and consistent protocols, it will be difficult to evaluate alternative options for cat management or to measure the extent of success of imposed management actions.

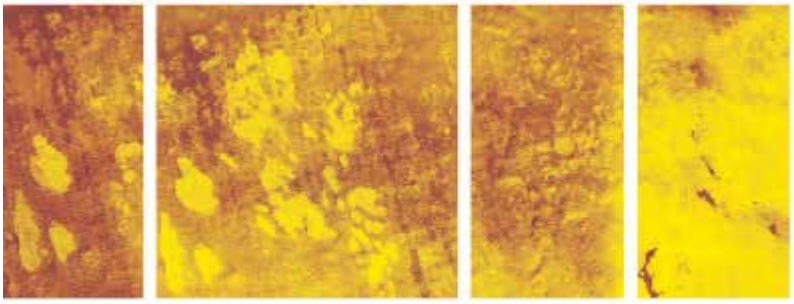
Options: There may be no pressing need for a national population estimate for feral cats, or for nationally consistent protocols for assessment of local population size or impact, or of responses to management.

Target 5d. The management implications of feral cat interactions with other species (notably dingoes, foxes and pest prey species) are resolved through research and adaptive management trials.

Rationale: Management focus solely on feral cats may come at considerable risk if there are undesirable ecological reverberations of cat control (such as consequential increases in rabbits or introduced rodents). Furthermore, across much of Australia, both feral cats and foxes exert considerable and additive predation pressure on many threatened species, and management directed only at one of these pest species may have net detriment if predation pressure due to the other species increases. Note that some research on interactive management of foxes and cats is currently being undertaken in SW Australia.

Acknowledgements

We thank the Threatened Species Commissioner, Gregory Andrews, for requesting this paper.



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