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Principles and strategies for managing vertebrate pests

Mike Braysher

ABSTRACT

Past pest management aimed at eradication or reduction of vertebrate pests to as Iowa level as possible has not worked except in rare circumstances. Pests are a complex management issue and involve many players besides farmers and wildlife managers. The Bureau of Resource Sciences has developed a more strategic and coordinated approach that incorporates:

- Defining the problem in terms of the desired outcome and determining major stakeholders and all major factors operating;
- Collecting the information necessary to clarify the problem;
- Setting clear, quantifiable and, if possible, time-limited objectives and developing performance criteria;
- Identifying management options and if practical, experimentally testing the alternatives; Implementing the strategy;
- Monitoring effectiveness and efficiency of the management strategy against the objective.

The general principles learned from this management approach are illustrated by reference to two ACT urban animals which happen to be native animals, the Australian magpie, *Gymnorhina tibicen* and the pink-tailed legless lizard, *Aprasia parapulchella.*

INTRODUCTION

Pest animals such as rabbits, foxes, feral pigs and feral goats make up 10 percent of Australia's mammal species. They cause millions of dollars in lost production annually as well as damage to the natural environment. Although for most species the level of damage has not been accurately determined, rabbits are estimated to cost $22 million annually in lost production in South Australia while feral pigs can take up to 40 percent of Iambs born in some areas. From a conservation perspective, foxes are a major factor threatening the survival of some native fauna while rabbits at less than 1 per hectare can prevent regeneration of some native plants.

How effective has been our past management of pests?

Not very effective. Apart from some successes such as the introduction of myxomatosis and the impact of some land use changes, there is little evidence that past management has influenced the distribution and abundance of introduced pests. Why? (In defence of past pest managers, and I include myself in this, this is a gross simplification which, while essentially accurate, misses some of the strengths of Australia's past actions in this area. At a technical and operational level, Australia has been both innovative and progressive, especially when compared with others on the international scene).

Focus on numbers

Past practice, supported by legislation, concentrated on trying to reduce pests to as Iowa level as possible and, if practical, to eradicate them. Bonuses were often a key element with approximately $27 million (1994$) returned on rabbits in New South Wales in 1887 alone.

We now know that there are sound reasons why eradication policy rarely works. Bomford and O'Brien (1994) have outlined these. Briefly, for eradication, the pest must be removed at a rate greater than replacement at all densities. There are a number of criteria which must be satisfied to achieve this:

- **Immigration must be zero.** This is possible for offshore islands or where effective barriers can be erected and maintained. But it is rarely achievable on the mainland.
- **All individuals must be at risk from the control techniques used.** If animals are trap shy or bait shy, then a subset may no longer be at risk.
- **The animal must be able to be monitored at low densities.** It this is not possible, survivors may not be detected.
- **The socio-political environment must be suitable.** For example, if certain groups object strongly to the eradication of a species or the methods to be used, they can directly thwart the program or politically influence the program. Species of major animal welfare concern or those that are commercially valuable are examples.
- **Discounted cost benefit analysis must favour eradication over control.** Discount rates are used to estimate the value of future benefits against the costs of actions in present dollars. Calculating discount rate is the reverse equation to that used to calculate interest on invested savings. It is difficult to meet this criterion because of the high initial cost of eradication and because the benefits accrue over a long period. Rarely is the discounted benefit greater than the cost of eradication for production pests. For native wildlife it is difficult to put a value on species so eradication on islands has proceeded without close attention to this criterion.

The failure of eradication as a goal is clearly illustrated by the fact that no pest has been eradicated from mainland Australia. An indication of the cost is provided by the removal of rabbits from Phillip Island, a 200 hectare island off Norfolk Island. Although costs were not fully documented, it took about 700 field-person days. The manager of the national park at the time, John Hicks, also states that rabbits were eradicated twice, once in 1986 and again in 1988!

If eradication of pests is not technically feasible or economically sensible for much of Australia, then we need to accept that pest animals will be a component of our land management systems for the foreseeable future. The challenge then is to clearly identify what we want to achieve from management and where and how we apply our limited resources to obtain maximal return. This requires managing pest impact with a more strategic and coordinated approach.

There are other factors which make pest management complex. These include:

- **Changing attitudes and community concerns**
  There is growing community expectation that all animals including pests, are treated humanely. Some pest control techniques are inhumane, rabbit leg-hold traps being an example. These legitimate community concerns can greatly influence control. For example, while Australia was able to introduce myxomatosis to control rabbits in the late 1940's, public concern in New Zealand was such that in 1993, government decided against introducing this disease.
- **Pest or resource?**
  This is often a hotly debated issue but it is not clear why. A pest animal is one that causes net damage compared to its benefits. However, the pest status of an animal can vary both in time and space. An example is deer in New Zealand. Government agencies spent millions in deer control until the animals became a valued resource when it was worth while to use helicopters to anaesthetise and capture animals for deer parks. Similar changes are occurring with some species in Australia. For example, commercial harvest of pest animals is an industry now worth in excess of $100 million annually. The challenge is to determine whether commercial harvest of a pest has a role and how the harvest can best be integrated into the management aim for a particular area.

It may be that for some systems, wild harvest of native and exotic animals such as feral goats and kangaroos or a combination of wild harvest along with a reduced density of domestic stock may be more ecologically and economically sustainable than trying to reduce non-domestic herbivores to low densities and maximising livestock numbers.

NEED FOR A FRESH APPROACH

The preceding discussion illustrates that pests are a complex management issue involving a number of players. Past management has had limited success. A more coordinated and strategic approach is required. It needs to concentrate on managing damage, not numbers *per se*, and integrating pest management as part of a whole system approach to land management. The approach includes consideration of all the factors that influence the profitability and/or biodiversity of the production or conservation system to be managed. Factors include commodity prices, climatic conditions, weeds, genetic variety of crops and livestock, other pests, and land management practices.

WHERE TO FROM HERE? -VERTEBRATE PEST PROGRAM

Under its Vertebrate Pest Program (VPP) the Bureau of Resource Sciences is developing a series of guidelines for managing the damage caused by Australia's major vertebrate pests. The work is being done in cooperation with the states and territories and relevant community groups. The guidelines aim to promote cost effective management of vertebrate pests through better coordination, planning and implementation of control programs based on current scientific and technical information. Pests being addressed are the feral horse, rabbit, fox, feral pig, feral goat and rodents.

The basic elements for planning and implementing a program to manage pest damage are (Braysher 1993):

- Define the problem to be addressed in terms of the desired outcome, bound the dimensions of the problem including determining the factors influencing the problem and identifying the major stakeholders/players;
- Set quantifiable objectives in terms of outcomes and determine indicators of performance;
- Identify management options and determine the most appropriate strategy to address the problem;
- Monitor performance - both operational efficiency and effectiveness in achieving the objective(s).

Let me apply this approach to managing two urban wildlife species in the Australian Capital Territory (ACT), a common species, the Australian magpie *Gymnorhina tibicen* and a declared endangered species, the pink-tailed lizard *Aprasia parapulchella.*

THE AUSTRALIAN MAGPIE

This is an insectivorous, sedentary and territorial bird which needs little introduction to most Australians. It is a common breeding resident of Canberra and most of Australia.

The problem

What are the elements?

- Conservation of the taxon - contribute to overall conservation of this species throughout its range.
- Urban amenity - have magpies around for their aesthetic beauty (flight, carolling, physical presence).
- Minimise the stress and injury to humans due to magpies.

Bound the problem

Conservation status

This does not seem to be an issue. Given the amount of suitable habitat and other necessary resources, and their common status, magpies are and are likely to remain a common breeding resident in Canberra and the rest of Australia. Sub-adult and territorial birds form flocks which are a non-breeding reserve which can readily replace any lost territorial birds.

Potential threats include:

- Road casualties;
- Non-target poisoning from insecticide and other chemicals;
- Predation:
  - birds of prey,
  - nest predation (currawongs and ravens),
  - cats and other exotic predators;
- Incidental losses such as through twine used for nest material;
- Direct human intervention.

However, from the records of the Canberra Ornithological Group (COG), it is clear that the ACT population is common and self sustaining.

Urban amenity
This should be met through the objective of conservation.

Human injury
During the magpie breeding season, spring to early summer in Canberra, territorial magpies, predominately males, vigorously defend their unfledged chicks. Their usual behaviour is to swoop potential threats from a high perch, and attacking from behind. They fly low over the intruder loudly clacking their beak but the intruder is rarely hit. As the intruder gets closer to the nest, the attack intensity increases. At its extreme, the bird may alight in front of the intruder and fly into the intruder's face attacking with claws and beak. Natural intruders include currawongs and ravens but some humans are also attacked.

Who are the stakeholders?

- Parents/school children; aged residents - especially aggregations of vulnerable groups;
- Local residents - cyclists are especially vulnerable;
- Government and non-government conservation agencies.

What is the objective?

To have a self-sustaining population of magpies in urban Canberra (at a density of 'x' adult magpies per ha) which shows the delights of the species but which causes minimum damage to the local community .

Performance indicators:

- Population monitoring shows that the population density is not declining below the parameters set;
- The number of complaints received are fewer than 20 per year;
- Complaints are less numerous;
- Reported injuries are fewer than 6 per year;
- The extent to which press articles and letters to the editor reflect a positive attitude toward magpies and the strategies adopted for their management.

Strategy

- Conservation and urban amenity;
  no specific strategy appears necessary to maintain the population. The COG monitoring program should give adequate information on changes to magpie status.
- Injuries caused by magpies;
  evidence is that certain rogue birds, primarily territorial males with unfledged chicks, cause the majority of the attacks. These birds may have had negative interactions with humans (attacked with stones etc). If theses birds are eliminated, it should be possible to replace them with naive, more placid individuals.

Testing this theory: birds were removed from areas and the incidence of subsequent attacks were recorded.

Other strategies were also tested:

- destruction of the nest - where the nest was removed the bird nested again and attacked with more vigour;
- removal of flight feathers from attacking birds -these birds soon learned to adjust and continued to attack.

Adopted strategy:

- Targeted education strategy which aims to make the key groups and the community in general aware of magpie behaviour and what they can do to alleviate the impact;
- Erect warning signs to inform residents of attacking birds;
- Provide a point of contact for complaints and a rapid assessment and response system to deal with serious problems;
- Capture and destroy problem birds;
- Encourage residents to get to know and care for resident birds. Monitoring and evaluation

Monitoring and evaluation

- Monitor magpie population including assistance from COG;
- Monitor calls, newspaper articles, letters to the editor, correspondence;
- Survey of key clients.

Assessment against the objective

The above process summarises the approach taken to magpie management by the ACT Parks and Conservation Service. The strategy has greatly defused the issue of magpies as urban wildlife in the ACT without affecting their conservation status. The process involved clear identification of the problem, who the target audience was, elaboration of alternative strategies, setting a strategy in place, and monitoring outcomes.

The strategy described has reduced complaints from 300 in 1980 to 93 in 1990. The severity of the complaints were also considerably less.

THE PINK-EARED LEGLESS LIZARD *Aprasia parapulchella*

This animal is an 18 cm long, slender, nocturnal and fossorial[1] legless lizard of the family Pygopodidae. It inhabits open grassy areas primarily dominated by *Themeda* spp but also occurs amongst *Stipa* spp, *Danthonia* spp and *Poa* spp. A suitable environment must also contain moderate to extensive cover of partially buried flat rocks (Jenkins and BarteIl 1980; Osborne et al. 1991).

The problem

A. parapulchella is a nationally declared endangered species.

Conservation status
What is its taxonomic status and its past and present distribution and abundance? Fig 1 shows its distribution in the ACT region. It has also been recorded in Tarcutta and near Bathurst. Recently a population of *Aprasia* spp has been discovered in central Victoria (Bendigo - Inglewood) which appears indistinguishable both morphologically and electrophoretically from *A. parapulchella* in the ACT and the Blue Mountains (Mark Hutchinson, S.A. Museum, pers. comm. 1994). If this population is indeed *A. parapulchella*, it indicates that this lizard species is much more widely distributed than previously believed.

Due to its behaviour it is difficult to collect or detect. Some herpetologists suggest that this may have led to false status as an endangered species. (Jenkins and Barte111980; Ehnnann and Cogger 1985). Also there are significant areas of suitable habitat through much of the believed range of the species (Jenkins and Bartell1980; Mark Hutchinson, S.A. Museum, pers. comm. 1994).

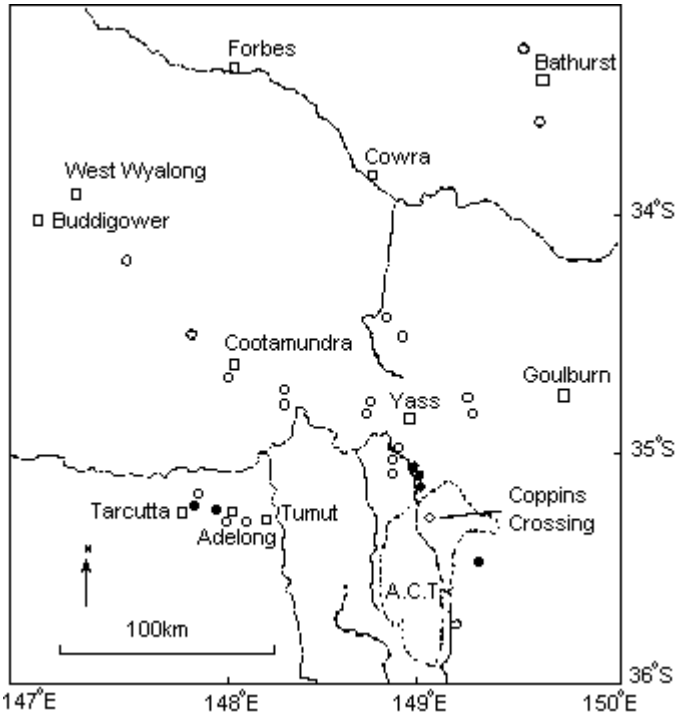

Fig. 1. Location of sites surveyed for *A. parapulchella* in NSW. Closed circles are sites where *A. parapulchella* were found; open circles where they were not found; squares represent locality names; diamond represents the type locality (From Osborne et al. 1991).

If the evidence is that it is endangered, the question that then needs to be asked is' At what taxonomic level should conservation be directed - species, sub species, population?' ACT and Victorian guarantee legislation requires conservation of wildlife to be addressed at the population level, but this can cause major difficulties. For example, under the USA Endangered Species Act, 22 different sub-species of a pocket gopher and 15 sub-species of a chub fish are to be listed, despite evidence that existing strategies and limited resources are unlikely to achieve few if any of the currently endangered species reaching the status where they can be removed from the list (Tear et al. 1993). The same situation appears to exist under the Victorian Flora and Fauna Guarantee Act (Wilson and Clark in press).

At the next level the question of what is a viable population size and how many such populations are necessary needs to be asked. The answer is difficult to determine but there are techniques such as Population Viability Analysis. Essentially this assesses for a species, the probability that a population of a given size will persist for a given number of years. Caughley (1994) discusses this technique but its applicability is often limited by lack of relevant information.

I have not attempted to answer all the questions I have raised in determining the problem. While some can be addressed by science, others are mainly socio-political issues. This emphasises the importance of determining who the relevant players are and incorporating them into the management planning process.

Who are the players?

- Government - national and local (political and legal aspects);
- Non-government conservation organisations;
- Scientists (conservation and research program);
- Developers (housing, government utilities etc);
- Recreational users (walkers, trail bike riders, horse riders);
- Landholders (in this debate, particularly rock collectors).

Threats

It is important to identify the important threat(s), especially for endangered or threatened species, so as to employ the appropriate strategy(ies). Failure in either of these areas can have serious consequences.

Failure to identify the correct threat - the Californian Condor. This example comes from Caughley (1994). This bird once ranged from British Columbia in the north to New Mexico in the south. By 1940 the species had contracted to a small area north of Los Angeles. The population declined to 19-21 birds in 1983 until the last eight birds were taken into captivity in 1985. Anecdotal evidence suggested that the decline may have been due to shooting and habitat loss. The link between eggshell thinning in some bird species and organochlorines was identified in the 1960's but was not associated with possible decline of the condor until the mid 1970's. After the ban on organochlorines, subsequent measurement of eggshells in Californian condors seemed to show that they were thicker. This led to the view that the cause of the decline had been arrested. However, following the breakage of a collected egg in 1986, further investigations implicated lead from lead shot ingested from shot carcases left for condors. '*This shows the paramount need to determine, not assume the causes of decline, to review correlations not as results but testable hypotheses, and to investigate and exonerate suspected causal agents by disciplined application of scientific method'* (Caughley 1994).

Undoubtedly Australia has been guilty of assuming causal factors without testing alternatives. Decline in a wide range of native fauna being primarily assigned to predation by feral cats could be an example.

Identify options

If we mistake the threat then the species may be lost. Ideally we would want to be able to test out alternatives if such exist. Waiters and Holling (1990) use a technique called experimental or adaptive management. It involves modelling the issue to determine the best strategies and testing these on a large scale. This, however, is not always practical for an endangered species. Nonetheless, the consequences of being wrong can be serious. Maybe this highlights the need to take action to protect a species before it has declined to a level where experimentation to determine the real threats and to test alternative strategies is no longer practicable.

What are the potential threats to *A. parapulchella?* (See Osborne et al. 1991):

- grazing/farming;
- weed invasion;
- rock collectors, rock disturbance;
- herpetologists;
- predators (raptors, cats, foxes, currawongs, ravens, magpies and other predatory birds);
- climatic variations;
- small population size;
- fire.

What then is the problem?

At this stage we appear not to have all the necessary information. The primary task may be to gather that information. Tasks required include:

- Determine the taxonomic status and distribution and abundance of the animal;
- In cooperation with key stakeholders, determine the desired outcome for the taxon;
- Determine and experimentally examine the key threats;
- Identify the appropriate strategy or alternative strategies and test the approaches.

Footnote
[1]Burrowing: used in burrowing *(77re Concise Oxford Dictionary* 1964)

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ABOUT THE AUTHOR

Mike Braysher
Bureau of Resource Sciences, PO Box Ell,
Queen Victoria Terrace, Parkes ACT 2600

Mike Braysher undertook his PhD in zoological sciences at the University of Adelaide. He is currently a Principal Research Scientist managing the Vertebrate Pest Program for the Bureau of Resource Sciences. He spent 17 years with the ACT Parks and Conservation Service being responsible for wildlife policy and research. He has been contracted to BRS to prepare national guidelines for managing Australia's major vertebrate pests and to manage a program which is establishing key projects to demonstrate 'best practice' pest management. He recently published a book *Managing Vertebrate Pests: Principles and Strategies* which establishes principles and a strategic approach toward managing vertebrate pests. This book is the basis of subsequent pest animal guidelines. He also published 'Managing Vertebrate Pests: Feral Horses' with Will Dobbie and David Bernan. This is the first in the series of pest animal guidelines which include rabbits, feral goats, feral pigs, foxes and rodents.

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