

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/281069575>

FOXES

Data · August 2015

CITATIONS

0

READS

1,154

4 authors, including:



Glen Saunders

New South Wales Department of Primary Industries

118 PUBLICATIONS 3,323 CITATIONS

[SEE PROFILE](#)



Mike Braysheer

University of Canberra

27 PUBLICATIONS 821 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Project

Species from faeces: using scat DNA to detect Australian wildlife [View project](#)



Project

Writing a text book titled Managing Australia's pest animals a guide to strategic planning and effective management. [View project](#)

Bureau of Resource Sciences

Managing Vertebrate Pests: Foxes

**Glen Saunders, Brian Coman,
Jack Kinnear and Mike Braysher**

Australian Government Publishing Service
Canberra

© Commonwealth of Australia 1995

ISBN 0 644 29240 7 (set)

ISBN 0 644 (This publication)

This work is copyright. Apart from any use as permitted under the Copyright Act 1968, no part may be reproduced by any process without prior written permission from the Australian Government Publishing Service. Requests and inquiries concerning reproduction and rights should be addressed to the Manager, Commonwealth Information Services, Australian Government Publishing Service, GPO Box 84, Canberra ACT 2601.

Scientific editing by Mary Bomford.

Cover and publication design by Bob Georgeson, Bureau of Resource Sciences Design Studio.

Credits for cover photograph. Main: C. Marks, DCNR, Victoria. Insert: G. Chapman, CSIRO.

Typesetting and diagrams by Henryk Dekker.

The Bureau of Resource Sciences is a professionally independent Bureau established in October 1992 in the Department of Primary Industries and Energy. Its role is to enhance the sustainable development of Australia's agricultural, mineral, petroleum, forestry and fisheries resources and their industries by providing scientific and technical advice to government, industry and the community.

Author affiliations: Glen Saunders, NSW Agriculture; Jack Kinnear, Department of Conservation and Land Management, Western Australia; Brian Coman, Vernox Pest Management; Mike Braysher, Bureau of Resource Sciences.

Publication to be cited as:

Saunders, G., Coman, B., Kinnear, J. and Braysher, M. (1995) Managing Vertebrate Pests: Foxes. Australian Government Publishing Service, Canberra.

This publication, which is one in a series, provides land managers with 'best practice' national guidelines for managing the agricultural and environmental damage caused by foxes. Others in the series include guidelines for managing feral horses, rabbits, feral goats, feral pigs and rodents. The publication was developed and funded by the Vertebrate Pest Program in the Bureau of Resource Sciences. Production of the fox guidelines was aided by financial assistance from the Australian Nature Conservation Agency's Feral Pests Program.

To ensure that the guidelines are widely accepted as the basis for fox management, comment has been sought from state, territory and Commonwealth government agriculture, environmental and resource management agencies. Comments were also sought from land managers and community and other organisations, including the Australian Conservation Foundation, the National Farmers' Federation, the National Consultative Committee on Animal Welfare, the Anangu Pitjantjatjara Aboriginal Land Council and the Northern Land Council. The Standing Committee on Agriculture and Resource Management has endorsed the approach to managing fox damage set out in these guidelines.

Foxes are widely perceived by the wider community and by scientists and conservationists as a threat to native species due

to their role as predators. Despite this perception, there is little reliable information on the effects of fox predation on prey populations or of the effect of fox control on the recovery of prey species. The exception is in Western Australia, where some field experiments have shown that fox control can lead to the recovery of native species, including rock-wallabies, bettongs and numbats. Foxes may also detrimentally affect native species such as birds of prey and large reptiles by competing with them for food, but such impacts are speculative as no studies have been conducted.

Less is known about the agricultural impact of foxes, although there is increasing evidence that foxes may inflict severe levels of lamb predation which were previously unrecognised. Foxes are also implicated in deaths and injuries to calves and dairy cattle, although this impact has not been quantified. There is also a small risk that foxes could have a role in the spread of exotic diseases, such as rabies, should such diseases enter Australia.

There are diverse views about fox management. While economists would argue that spending on pest control should be justified in terms of the economic returns on such investments, this is clearly difficult when the impacts of foxes for both conservation and agricultural values, and the

responses of prey populations to fox control, are poorly quantified. Those with an interest in conservation place a high value on the protection of native species and often consider fox control to be a priority for endangered species protection. People interested in hunting foxes for commercial use or recreation want to retain foxes as a resource. The crash of fox pelt prices resulting from the actions of the anti-hunting lobby in Europe has reduced interest in fox harvesting in recent years. People concerned with animal welfare hope to ensure that fox control or harvesting is conducted using humane techniques. The authors have attempted to take all these divergent views and values into account in compiling the guidelines.

The principles underlying the strategic management of vertebrate pests have been described in *Managing Vertebrate Pests: Principles and Strategies* (Braysher 1993). The emphasis is on the management of pest damage rather than on simply reducing pest density. The guidelines recommend that wherever practical, management should concentrate on achieving clearly defined conservation or agricultural production objectives.

These guidelines will help land managers reduce damage to agriculture and native fauna caused by foxes through the use of scientifically-based management that is humane, cost-effective and integrated with ecologically sustainable land management.

A handwritten signature in black ink, reading "Peter O'Brien". The signature is fluid and cursive, with a large initial "P" and "O".

Peter O'Brien
Acting Executive Director
Bureau of Resource Sciences

CONTENTS

FOREWORD	iii
ACKNOWLEDGMENTS	viii
ACRONYMS AND ABBREVIATIONS	ix
GLOSSARY	x
SUMMARY	1
INTRODUCTION	7
1. <i>HISTORY</i>	11
<i>Summary</i>	11
1.1 Europe and America	11
1.2 Australia	11
2. <i>DISTRIBUTION AND BIOLOGY</i>	15
<i>Summary</i>	15
2.1 Distribution and abundance	15
2.2 Biology	18
3. <i>ECONOMIC AND ENVIRONMENTAL IMPACTS</i>	27
<i>Summary</i>	27
3.1 Environmental impact	28
3.2 Economic impact	37
3.3 Resource value and use	41
4. <i>RABIES AND FOXES</i>	43
<i>Summary</i>	43
4.1 The disease	43
4.2 Management techniques for rabies control	45
4.3 Implications for Australia	46
4.4 Implications for fox management	47
5. <i>COMMUNITY ATTITUDES AFFECTING FOX MANAGEMENT</i>	48
<i>Summary</i>	48
5.1 Perceptions of the fox	48
5.2 Sport hunting	48
5.3 Animal welfare	49
5.4 Implications of fox harvesting for damage control	54
6. <i>PAST AND CURRENT MANAGEMENT</i>	56
<i>Summary</i>	56
6.1 History	56
6.2 Legislation and coordination of management programs	57
7. <i>TECHNIQUES TO MEASURE AND CONTROL FOX IMPACT AND ABUNDANCE</i>	63
<i>Summary</i>	63
7.1 Introduction	63
7.2 Assessing impact	64
7.3 Measuring fox abundance	68
7.4 Use of fox impact and density measurements	70
7.5 Control techniques	72

8.	<i>STRATEGIC MANAGEMENT AT THE LOCAL AND REGIONAL LEVEL</i>	88
	<i>Summary</i>	88
	8.1 Economic frameworks	89
	8.2 Strategic approach	89
	8.3 Problem definition	89
	8.4 Management plan	90
	8.5 Implementation	94
	8.6 Monitoring and evaluation	94
	8.7 Hypothetical example of strategic management at local and regional level — conservation	95
	8.8 Hypothetical example of strategic management at local and regional level — agriculture	98
9.	<i>IMPLEMENTING MANAGEMENT OF FOX DAMAGE</i>	101
	<i>Summary</i>	101
	9.1 Introduction	101
	9.2 Role of government and landholders	101
	9.3 Use of community groups	102
	9.4 Community awareness	104
10.	<i>DEFICIENCIES IN CURRENT KNOWLEDGE AND APPROACHES</i>	106
	<i>Summary</i>	106
	10.1 Introduction	106
	10.2 Specific deficiencies	107
	REFERENCES	112
	APPENDIX A Native species believed to be at risk from fox predation	126
	APPENDIX B Technique for the manufacture and use of cyanide capsules	127
	APPENDIX C Instructions for the use of FOXOF F® baits	128
	APPENDIX D Criteria for eradication	132
	APPENDIX E Best practice extension in pest management	133
	APPENDIX F Economic framework for feral pig management	135
	INDEX	139
	FIGURES	
	Figure 1 Strategic approach to managing fox damage.	8
	Figure 2 Spread of the red fox in Australia.	12
	Figure 3 Interrelationship between fox and rabbit populations.	13
	Figure 4 Relative distribution of foxes and rabbits in Australia.	14
	Figure 5 Present-day world distribution of the red fox.	16
	Figure 6 Variations with time of rabbit and predator (cat and fox) numbers in central-western New South Wales.	20
	Figure 7 Variation in fox and feral cat numbers in relation to changes in rabbit numbers in south-western Western Australia.	21

Figure 8	Predator removal experiment conducted over eight years in Western Australia for five colonies of rock-wallabies.	29
Figure 9	The relative abundance of Rothschild's rock-wallaby, before and after fox control in the Dampier Archipelago.	30
Figure 10	Percentage capture rate of bettongs after five years of fox control in Tutanning Nature Reserve. ³¹	
Figure 11	Numbat sightings in Dryandra State Forest between 1979 and 1992.	32
Figure 12	The quantity of 1080 and the number of baits used for fox control in New South Wales between 1980 and 1993.	55
Figure 13	Bounty payments in Western Australia.	57
Figure 14	Determining the cause of lamb death.	66
Figure 15	Example of a simple map of four hypothetical properties showing the key factors that landholders should record and use to plan fox management.	71
TABLES		
Table 1	Density estimates of Australian fox populations.	17
Table 2	Comparison of mean home range estimates for foxes in different habitats.	22
Table 3	Percentage occurrence and percentage volume of major food items identified in the stomachs of foxes.	23
Table 4	Quantity and value of wild red fox pelts supplied during 1982–83 from the major exporting countries involved.	41
Table 5	Number and value of raw fox pelts exported from Australia.	41
Table 6	Number of 35 milligram strychnine baits prepared for fox control in South Australia in 1984–85 to 1990–91.	61
Table 7	State and territory legislative requirements for fox poisoning.	75

The Vertebrate Pests Committee's Working Group, which is overseeing the preparation of the guidelines — Peter Allen, Roger O'Dwyer, John Hicks, Don Pfitzner, Kevin Heinrich, Neil Hogstrom and John Auty — provided valuable input and comments.

Special acknowledgment is given to the following people who made helpful comments on the draft manuscript: Peter Alexander, Peter Bird, Peter Catling, Terry Korn, Geoff Lundie-Jenkins, Clive Marks, Nicky Marlow, Nick Mooney, Glenys Oogjes, Jeff Short, Linton Staples, Jim Thompson and Paul de Torres.

Several individuals from the Bureau of Resource Sciences deserve mention. Quentin Hart and Hazel Small helped edit the manuscript and figures. Deborah McLeod assisted with preparation of the manuscript. Mary Bomford provided extensive scientific and other editorial comment. Quentin Hart and Mary Bomford organised the final collation and publication.

The draft manuscript was circulated to the following organisations for comment:

- Commonwealth Department of Primary Industries and Energy
- Standing Committee on Agriculture and Resource Management
- Australia and New Zealand Environment and Conservation Council
 - Standing Committee on Conservation
 - Standing Committee on the Environment
- Land and Water Research and Development Corporation
- Meat Research Corporation
- Rural Industries Research and Development Corporation
- International Wool Secretariat
- Australian Conservation Foundation
- National Consultative Committee on Animal Welfare
- National Farmers' Federation
- Murray Darling Basin Commission
- Australian Veterinary Association
- Anangu Pitjantjatjara Land Council

We wish to thank all these groups for their contributions. Many other people, too numerous to acknowledge individually, also gave us the benefit of their experiences by commenting on drafts of the manuscript. The Australian Nature Conservation Agency provided financial assistance.

ACRONYMS AND ABBREVIATIONS

ANCA	Australian Nature Conservation Agency	LandCare	Victorian Landcare Program
ANZFAS	Australian and New Zealand Federation of Animal Societies	MAFF	Ministry of Agriculture, Fisheries and Food (United Kingdom)
APB	Agriculture Protection Board (Western Australia)	NLP	National Landcare Program (now part of the Natural Heritage Trust)
APCC	Animal and Plant Control Commission (South Australia)	PMIS	Pest management information system
AUSVETPLAN	Australian Veterinary Emergency Plan	RLPB	Rural Lands Protection Board
AVA	Australian Veterinary Association	RSPCA	Royal Society for the Prevention of Cruelty to Animals
BRS	Bureau of Resource Sciences	SCARM	Standing Committee on Agriculture and Resource Management
CALM	Department of Conservation and Land Management (Western Australia)	VPP	Vertebrate Pest Program (BRS) (now National Feral Animal Control Program)
CCNT	Conservation Commission of the Northern Territory (now Parks & Wildlife Commission of the Northern Territory)		
CRC	Cooperative Research Centre for Biological Control of Vertebrate Pest Populations		
CSIRO	Commonwealth Scientific and Industrial Research Organisation		
DCNR	Department of Conservation and Natural Resources (Victoria) (now Department of the Natural Resources and the Environment)		
DEST	Department of Environment, Sport and Territories		
ERIN	Environmental Resources Information Network		
ESAC	Endangered Species Advisory Committee		
FPP	Feral Pests Program (ANCA)		
GIS	Geographic information system		
HCAV	Hunt Clubs Association of Victoria		
HIPD	Hunting indicator of population density		
Landcare	Commonwealth Landcare Program		

abortifacient: a chemical used to induce abortion

ad hoc measures: specially arranged for the purpose

anticoagulant: a substance that slows or prevents blood clotting. Anticoagulants may be used as poisons to kill pest animals.

attenuated strains: a weak strain of an infectious organism

biltong: strips of sun-dried, lean meat

biocontrol/biological control agent: a living organism (or a virus) used to control the population density of another species

brittilised capsule: a capsule for oral dosing of animals that has been made brittle so it will easily shatter when eaten but is safe to carry

cadastral information: usually includes property boundaries, land tenure and roads

Canidae, canids: the family of animals that includes dogs, foxes and wolves

carcinogenic: cancer causing

carrying capacity: the maximum number of animals that the resources available in an area of land can support

chenopod: plant of the family Chenopodiaceae. In arid areas of Australia chenopods are mostly salt-tolerant shrubs such as blue bush and salt bush.

crepuscular: animals active at dawn and dusk

dasyurids: animals in the family of carnivorous marsupials Dasyuridae, including quolls, dunnarts, antechinuses, planigales, ningauis and the Tasmanian devil

diurnal: animals active during the day

dystocia: difficult birth

endangered species: species in danger of extinction and whose survival is unlikely if the causal factors leading to their decline continue to operate

endocrine function: the release, distribution and effects of hormones in an animal's body

endoparasite: animals that live inside another animal's body, such as tapeworms and the bacteria in the digestive tract

enzootic areas: areas where a disease occurs in wildlife

European rabbit flea: a flea introduced to assist the spread of myxomatosis

family group: occupants of a fox territory, usually composed of a monogamous adult pair and their offspring from the previous breeding season; a dominant adult pair, subordinate adults and offspring, or other common combinations

forb: a soft herb-like plant with a non-woody stem, especially a pasture plant that is not a grass

geographic information system (GIS): a computer-based system for displaying, overlaying and analysing geographic information such as vegetation, soils, climate, land use and animal distributions

gestation: pregnancy

home range: the area an animal ranges over during its normal daily activities

immunosterility: causing an animal to become sterile by immunising it against one of the proteins or hormones involved in the reproductive process

index, indices: a measure which is correlated with a value but is not an actual estimate of that value. For example spotlight counts give an index of fox numbers but do not give an estimate of total numbers.

intraperitoneal: into the abdominal cavity

intubation: to insert a tube into

LD₅₀: the quantity of poison or lethal dose that will kill 50% of treated animals

macropods: animals in the Macropodidae superfamily which includes kangaroos, wallabies, bettongs, rat kangaroos, potoroos, pademelons and tree kangaroos

minimum convex polygon: a simple method for calculating the area enclosed by an animal's home range. It involves drawing the smallest possible convex polygon around the outermost locations or sightings of the animal.

monoestrus: become reproductively receptive only once per year

neophobia: fear of new things

nocturnal: animals active at night

one-shot oats: technique for poisoning rabbits using 1080 and oats where every only one in one hundred oat grains contain 1080 poison, sufficient to kill an adult rabbit

oral delivery: a dose swallowed in food or drink

parturition: birth

pelt: the skin and fur, either raw or dressed

population turnover: the average time it takes to replace a generation

RD₅₀: the concentration of a sensory irritant which produces a 50% decrease in an animal's breathing rate

recombinant virus: a virus which has been modified by artificial genetic manipulation

relict population: a small isolated population of a species that was once more widespread and abundant

scat: faeces

secondary poisoning: intoxication or death of animals caused by ingestion of other poisoned animals

spotlight traverse: a fixed line of travel over which animals in a spotlight beam are counted

sylvatic: involving one or more wildlife species

tarbaby: a technique for killing foxes where 1080 poison in grease is squirted into a fox den. The fox dies from ingesting the poison grease from fur and paws.

territory: the area an animal or group of animals defends from intruders

tetanic spasms: violent generalised muscular contractions with flailing limbs

transect: a rectangular plot in which data collection occurs

translocation: moving a species to a different place or habitat

ultrasound scanning: use of low frequency sound to investigate the internal structure of an animal without surgery, used for counting foetuses

vectors: organisms or substances that are vehicles to spread a biocontrol agent or disease among animals. For example, mosquitoes are vectors of myxomatosis.

vulnerable species: species believed likely to become endangered in the near future if the causal factors continue to operate

Note: All money values throughout the guidelines are in 1993-94 Australian dollars.

