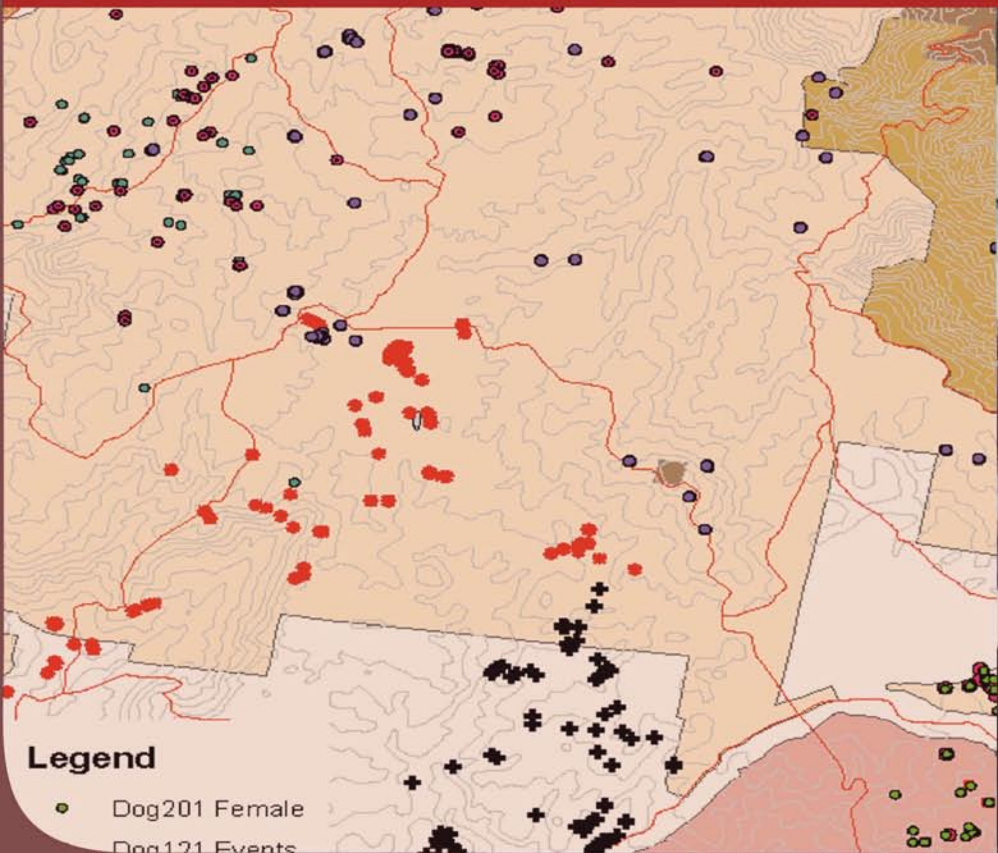
Invasive Animals Cooperative Research Centre



Proceedings of a workshop on remote monitoring of wild canids and felids

21-22 March 2007
Australian National University, Canberra

Edited by Peter Fleming and David Jenkins-

Invasive Animals CRC

NSW DEPARTMENT OF PRIMARY INDUSTRIES

Parasitech

Invasive Animals Cooperative Research Centre

"Together, create and apply solutions"

Proceedings of a workshop on remote monitoring of wild canids and felids

21-22 March 2007
Australian National University, Canberra

Peter Fleming and David Jenkins (eds)

Proceedings of a workshop on remote monitoring of wild canids and felids

21-22 March 2007

Australian National University, Canberra.

ISBN: 978-0-9803194-7-7

Edited by Peter Fleming[1] and David Jenkins[2]

[1] Vertebrate Pest Research Unit, NSW Department of Primary Industries, Orange Agricultural Institute, Forest Road, Orange, NSW 2800
[2] Parasitech, 12 Mildura Street, Fyshwick, ACT 2609

(IA CRC Project 1.T.5, Sub-project 2: ‘towards Best Practise for Management of Wild Canids and Felids)

Cover images: (top) courtesy of Glen Saunders, (middle) courtesy of Tony Buckmaster and (below) courtesy of David Jenkins.
Cover design: Kerryn Molloy, Invasive Animals CRC.

Prepared for publication by Kerryn Molloy.

Published by the Invasive Animals Cooperative Research Centre.

Available online at http://www.invasiveanimals.com.

This publication should be cited as Fleming, P. and Jenkins, D. (eds) (2007) Proceedings of a workshop on remote monitoring of wild canids and felids, Australian National University, Canberra, 21-22 March 2007. Invasive Animals Cooperative Research Centre.

Parasitech

Invasive Animals CRC

ORTA RECENS QUAM PURA NITES

NSW DEPARTMENT OF **PRIMARY INDUSTRIES**

Contents

Executive Summary

Thirty three people representing Invasive Animals Cooperative Research Centre (IA CRC) partners undertaking studies to improve the management of wild dogs, foxes and feral cats, and other known parties currently using remote monitoring, attended a workshop at the Australian National University in March 2007. The objective of the workshop was to develop a national collaborative approach to promote the efficient use of the expensive and novel remote monitoring technology to improve the management of wild canids and felids.

The specific aims of the workshop were:

- to identify research questions to be answered by the new technologies
- determine the technology required for each question
- identify common themes and the researchers involved in each theme
- identify resource and data sharing opportunities
- determine the funding requirements and availability for each question
- appoint applicants for joint funding proposals addressing funding requirements for each theme.

Research questions and common themes

The current use of remote monitoring technologies was detailed in a series of brief presentations. Two papers showed the relevance of these technologies for investigating new IA CRC products for wild canid and felid control. Studies included completed studies of the movements of feral cats and urban dingoes, and current studies of wild dogs, foxes, feral cats and para-aminopropiophenone (PAPP). A table of research questions was developed to aid identification of common themes and the technological and human resources that were available amongst participants.

The common themes were:

- evaluation and improvement of control effectiveness
- investigation of spatial epidemiology of diseases involving wild canids and livestock
- investigation of dispersion and distribution of pure dingoes and other wild dogs
- evaluation of abundance and activity measures used in management plans and research, and

- investigation of the ecology of wild canids and felids, including: their home range and habitat use; their spatial interactions and those with sympatric native carnivores, livestock and other prey; biological differences between dingoes and hybrids, commensal and wild dogs and cats; and the effects of control on wild dog population dynamics and movements within controlled zones.

Available technologies

Previous work had concentrated on the use of Very High Frequency (VHF) radio-transmitting collars, faecal samples and sandplots. Analyses for these have been well established and they are in common usage for research and management. The labour cost and low return for search effort achievable for VHF radio-telemetry has nearly rendered this technology obsolete for wild canid and felid research. Sandplots, however, continue to be a cheap and easy- to-use method, particularly for management agencies. Faeces remain the sample of choice for wildlife parasitologists and ecologists studying canid and felid diets.

New remote monitoring technologies were in use for current projects or were planned to be used in future research within IA CRC projects and elsewhere in Australia.

These were:

- remotely released digital photographic equipment, including infrared still cameras, colour still cameras and video cameras
- collars mounted with Global Positioning System (GPS) data-loggers, transmitters to satellites, VHF transmitters and combinations of these. Some had additional features such as remotely-released or automatic drop-off clasps, proximity monitors, and USB ports for data downloads and battery recharging
- remotely-sourced DNA, from a variety of species specific hair and tissue traps, and from faeces, and
- microchip (PIT) tags and remote readers.

It was apparent that the volume of data obtainable from the GPS and satellite collars greatly exceeded the capacities of currently available analysis software.

Development of appropriate techniques for analysis was seen as a fruitful area for collaboration.

Collaborations

A number of possibilities to share resources were identified and this has led to one new agreement for sharing of GPS/satellite collars between partners and another two to add value to existing projects by co-locating GPS collars on sympatric animals. Opportunities exist to embed a number of research questions in the IA CRC Demonstration sites dealing with predators. There will be linkages between studies using DNA technologies for density estimation and assessment of indices of abundance, and GPS/satellite collars for assessing home range use and movement patterns at demonstration sites in Western Australia, Victoria and north-eastern NSW.

A shortcoming of the workshop was that inadequate time was available for the development of collaborations. However, the forum allowed researchers to identify common interests and provided a stepping-off point for future collaborations. An informal email network to share information about developments in analyses for the new techniques and to foster collaborations has resulted.

Introduction

Wild canids (dogs– *Canis lupus familiaris*, *C. l. dingo* and hybrids and foxes – *Vulpes vulpes*) and wild felids (feral cats– *Felis catus*) are high on the IA CRC's priorities for improved management. An IA CRC sponsored workshop of national stakeholders was held in Adelaide in October 2005 (Fleming 2006) to set priorities for wild canid and felid research within the IA CRC, with best practice objectives in mind. Best practice includes using the best combination of techniques, in the best places, at the best times. The workshop identified advances in remote monitoring technologies to assist research into best practices as a major opportunity and a priority.

To implement best practice, one must know what effects control programs are having on target and non-target organisms and their populations, and the best sites and times to place control technologies to maximise effectiveness while minimising expense and unintended negative environmental outcomes. The movements of wild canids and feral cats in Australia are little reported (exceptions include Harden 1985; Thomson 1992; Meek and Saunders 2000; Edwards et al 2001), although a number of studies have been undertaken or are in progress (see Abstracts of Invited Papers) and the spatial interactions between these species have not been addressed with the new remote technologies.

New developments in remote sensing, including GPS and satellite collars, remotely released cameras and remotely-sourced genetic material, potentially open up many areas of research pertaining to improved control of wild canids and felids. The workshop, held at the Australian National University on 21-22 March 2007, was the first step in a national collaborative approach to efficient use of this expensive and novel technology.

The objectives of the workshop were to identify:

- research questions to be answered by GPS/ Satellite/ VHF telemetry/camera and genetic technology
- design and technology requirements
- common themes and the researchers involved in each theme
- resource data sharing opportunities and agreements
- funding requirements compared with availability
- applicants in joint funding proposals addressing each theme.

The workshop was not exclusively of IA CRC partners but included all known parties currently or planning to use GPS, Satellite and VHF telemetry for wild canid and felid movement studies, researchers using new remotely-released camera technologies and those developing DNA techniques for identifying individual wild dogs, cats and foxes and their familial relationships. The attendees (see List of Participants) included people from all mainland States and the ACT, and representatives from the Victorian and New South Wales IA CRC demonstration sites. Attendees prepared lists of their research questions, their research sites, equipment and resources, and funding availability and shortfalls in relation to research questions.

The planned outcomes of the workshop were to develop a collaborative approach to technology and data-sharing to enable robust experimental designs for movement studies of wild canids and felids. The attendees were to identify research that was already adequately addressed and identify knowledge deficiencies that could be better addressed with collaboration. The bringing together of participants who had experience with new technologies with those who planned to use the technologies in their projects, would encourage collegiality and improve the efficiency of application of the technologies. As many of the participants were students in the IA CRC Education Program, the workshop would provide an opportunity for extending the range of mentors available to assist in students' projects.

The workshop laid a foundation for collaboration between CRC partners (and others) to investigate means of improving the placement and effectiveness of technologies for the control of feral cats, foxes and wild dogs, and for conservation of dingoes and improved biodiversity. This will be imperative to achieve best practice management of these species and IA CRC goals.

This report lists the program and attendees, and includes abstracts of all presentations. Edited notes on the discussions are given to encapsulate the main foci and decisions of the workshop. Common themes, potential studies and collaborations, and desired actions are identified. Because identification of all common themes was only completed after the workshop, some tasks had not been allocated at the time of this report.

Workshop Programme

Day 1: Wednesday 21 February 2007

12.00 pm: Arrive, Light lunch

Session 1: "Around the traps"

12:25-12:35

David Jenkins and Peter Fleming

Housekeeping, objectives and desired outcomes of the workshop.

12.35 -1.00 pm

Brad Purcell and Rob Mulley

"Dingo/wild dog ecology within the Southern Blue Mountains World Heritage Area".

1.00 -1.25 pm

Ben Allen

"The spatial ecology and zoonoses of urban dingoes, and the use of Traversed Area Polygons (TAPs) to calculate home range sizes".

1.30-1.55 pm

Lee Allen and Damian Byrne

"Satellite-tracking studies to monitor the seasonal movement and dispersal of wild dogs in Queensland".

2.00- 2.25 pm

Alan Robley et al

"Preliminary evaluation of GPS-collars for analysis of movement and activity of wild dogs in southern New South Wales".

3.00 - 3.25 pm

Alison Towerton et al

"Defining the fine-scale movements and habitat preferences of the red fox (*Vulpes vulpes*) in a forested environment".

3.30 – 3.55 pm: afternoon tea break

Day 1: Session 1 continued

4.00 – 4.25 pm

Kåren Watson

“Aspects of the history, home range and diet of the feral cat (*Felis catus*) in the Perisher Range resort area of Kosciuszko National Park, New South Wales”

4.30 – 4.25 pm

Andrew Claridge and Douglas Mills

“Dogs in space”.

5.00 - 5.25 pm

Rob Hunt

“Field trials of innovative wild dog and fox management techniques”.

5.30 - 5.55 pm

David Dall et al

“A new candidate agent for lethal control of feral vertebrate predators in Australia”.

Day 2: Thursday, 22 February 2007

Session 2: Where to from here?

8.30am – 12.30pm

Jenkins and Fleming

1. Round-up of day one; what has been done and the telemetry used (Jenkins, Fleming)
    - What are the research questions that are being asked with movement collars, remote cameras and DNA?
    - What are the resource needs to answer these questions: collar types and numbers, people?
    - What resources do we have, inventory of collars, person power and their location?
    - Where are the gaps in the movement data collected thus far?
    - what still needs to be done, by whom and with what resources, identify shortfalls in resources?

2. Put names to tasks for collaborative projects, the inter-agency agreements needed and research funding applications to meet the resource shortfalls (this may carry over after coffee).

10.45-11.00 am: morning coffee/tea break

11:30-12:30

2. Put names to tasks for collaborative projects (continued)

- How do we apply what we have learned to achieve better outcomes in control and conservation?
- Dissemination of the data to interested parties (conservation groups, farmers, relevant government agencies, the general public).

Abstracts of Invited Papers

1. Dingo/wild dog ecology within the Southern Blue Mountains World Heritage Area

Brad V Purcell and Rob C Mulley

School of Natural Sciences & Ecology and Environment Research Group, University of Western Sydney, Locked Bag 1797, Penrith South DC, NSW 1797.

Collaborators: Sydney Catchment Authority; NSW Department of Environment & Conservation; Moss Vale Rural Lands Protection Board; NSW Department of Primary Industries.

The Southern Blue Mountains World Heritage Area (SBMWHA) is an important conservation site in the context of national and international wilderness preserves and in a dual role provides a collection site for high quality potable water for the city of Sydney. This national park is co-jointly managed by Sydney Catchment Authority and NSW Department of Environment and Climate Change, though the Moss Vale Rural Lands Protection Board and NSW Department of Primary Industries also have management responsibilities. These stakeholder organisations needed a better understanding of the role dingoes/wild dogs played in this managed ecosystem, in accordance with recent amendments to the *Rural Lands Protection Act (1998)* Wild Dog Control. An intensive research program studying aspects of the ecology of these animals, and in response to the specified amendments, commenced in 2004.

The Australian dingo *Canis lupus dingo* is considered threatened due to hybridisation with domestic dogs *Canis lupus familiaris*. Most management plans are based on studies where hybridisation has not been tested in the animals studied and these data may not have adequately addressed holistic management practices for “wild dogs” as they are often called. Genetic evaluation of the dogs in SBMWHA has revealed that the population is largely comprised of hybrid animals (96.8%). Subsequent to this finding the research program has addressed questions regarding basic biology and ecology of dingo hybrids to assist the development of management plans for this area that suit management regimes of all stakeholders. The extent of introgression of exotic dog genes into the dingo population is a key conservation issue in this study, with other areas of research concentrating on morphometrics, disease, diet and patterns of movement for home range estimation using novel GPS data-logging collars.

Feral animals (deer, pig, goat, fox, rabbit) and endemic marsupial activity on road infrastructure is being correlated with dog activity using Passive Activity Indices, to assist with investigation of the influence dogs have on vertebrate species in this area. Diet analysis through faecal examination is also being used to identify prey species and trends in selection of prey year round. These data will inform and guide managers on best practice management for top order and/or meso-carnivores in the area. Results so far suggest that the dingo hybrids have annual patterns of activity that clearly relate to biological seasons of the dingo.

Twelve dingo hybrids have been trapped and fitted with GPS telemetry collars to observe patterns in monthly and annual movements. A further ten animals have been fitted with radio-telemetry collars to compare the precision of the two technologies and to monitor survival rates and dispersal. Results so far show home ranges to be strongly delineated along natural geographic boundaries, with one male displaying extensive exploratory activity during the breeding season. Analysis of daily movement patterns is also being assisted by the use of passive infra red camera traps placed strategically in locations of high activity.

This study will be broadened in the future to more accurately define sympatric assemblages of native and exotic species within herbivore and carnivore populations endemic to the Greater Blue Mountains World Heritage Area. These studies will provide reference data for development of an effective environmental management program to assist preservation of this unique landscape.

2. The spatial ecology and zoonoses of urban dingoes, and the use of Traversed Area Polygons (TAPs) to calculate home range sizes

Ben Allen

Pest Animal and Wildlife Sciences, PO Box 8516, Bargara, Queensland 4670, Australia.

Populations of urban dingoes and wild dogs (*Canis lupus dingo* and hybrids) inhabit many cities and towns within their extended range, and can present significant economic, social, and environmental impacts in affected areas. Despite this, very little is known about their general ecology in urban areas, including their home range sizes, activity patterns, habitat use, and their disease and parasite epidemiology. To provide baseline information on the above, GPS collars were fitted to nine urban dingoes to record their home range sizes, activity patterns, and habitat use at five minute intervals between September 2005 and June 2006. Results show urban dingoes to have small home range sizes (mean 2.17km^2), crepuscular activity patterns, and flexible habitat use. In essence, most urban dingoes occupied a small patch of either bushland or sugarcane/grassland and were most active at dawn and dusk. At all times, urban dingoes were within 700m of residential homes, were often within 200m of homes, and were regularly in very close proximity to homes. Faecal analysis showed 57% (17 out of 30) of urban dingo scats to contain zoonoses, though this is probably an underestimate of the true prevalence of zoonoses in urban dingo populations. A new method of home range calculation (Traversed Area Polygons) was also developed in this study, which is useful for using large amounts of autocorrelated data, such as that obtained from GPS/satellite tracking studies, which has the ability to objectively incorporate concave angles into a polygon based on biological merits. The results of this preliminary study indicate that the spatial ecology of urban dingoes is dissimilar to that of rural dingoes, and is more similar to that of urban foxes and coyotes.

3. Satellite-tracking studies to monitor the seasonal movement and dispersal of wild dogs in Queensland

Lee Allen and Damian Byrne

Department of Natural Resources & Water, PO Box 318, Toowoomba, Queensland 4350, Australia.

Over a three year period, 2003 to 2006, we conducted 61 surveys to evaluate the effectiveness of large-scale 1080 baiting programs in three adjoining central-west Queensland shires. Over 105 tonne of meat bait and 24,000 "Doggone" baits were laid in these shires during this time. However, while there were seasonal differences and differences in wild dog activity between shires, the mean activity of wild dogs on baited compared to non-baited properties over the three years was no different (mean AI 0.09 ±0.02 and 0.1 ±0.02, on non-baited and baited properties respectively).

Baiting programs conducted between May and September on average reduced wild dog activity by 46.5%, but baiting programs conducted at other times of the year often resulted in higher levels of wild dog activity post-baiting (up 82.5% for programs conducted in March and April and up 219% for programs conducted in October-November). From this, and previous studies in southwest and far north Queensland, we have noted that wild dog activity peaks in April/May, corresponding to their mating season, and troughs late in the year after whelping and weaning.

The objective of the current satellite-tracking studies is to monitor the seasonal movement and dispersal of wild dogs, particularly juveniles and yearlings, to determine how far and when wild dogs disperse, and understand why "activity" changes throughout the year so that control methods can be better targeted.

To date we have tracked a dispersing male yearling make three, 100km forays. We have also recorded two occasions where wild dogs appeared to have left their previously occupied area shortly after 1080 baits were laid, and discovered four wild dogs poisoned by bait.

A significant reduction (50% and 95% Minimum Convex Polygons (assumed as core use area and territory respectively) was discovered between mating and whelping. We also saw some surprising post-trapping foot injury, apparently caused by rubber-jawed traps.

4. Preliminary evaluation of GPS-collars for analysis of movement and activity of wild dogs in southern New South Wales

Alan Robley[A,F, D] *. Jenkins*[B,C] *, C. Rhynehart*[D] *, M. Goldspink*[D] *, P. Haenig*[D] *, A. McDougall*[E] *and M. Scroggie*[A]

[A]Arthur Rylah Research Institute, Department of Sustainability and Environment, PO Box 137, Heidelberg, Victoria 3084.

[B]Parasitech, 12 Mildura Street, Fyshwick, ACT 2609.

[C]School of Botany and Zoology, Faculty of Medicine, Australian National University, Canberra, ACT 2600.

[D]NSW Department of Primary Industries, PO Box 90, Tumbarumba, NSW 2653.

[E]Yass Rural Lands Protection Board, PO Box 10, Yass, NSW 2582.

We attached collars fitted with a GPS receiver, a VHF transmitter and mortality sensor to nine wild dogs captured in state forest in southern New South Wales during autumn 2004. Collars also contained a remote drop-off mechanism programmed to detach 1 month after attachment. The collars weighed 280 gm. GPS-collars were programmed to acquire a location every 2 hours from 1900 hours to 0700 hours, seven nights a week for 30 nights. Data stored on board was latitude, longitude, time (GMT), date, fix status (>3D = 5 or more satellites used to calculate a position location, 3D = four or more satellites, 2D = three satellites and 1D = less than three satellites).

The projected life of the collars was one month, with a storage capacity of 211 positions. We retrieved all nine collars by initially radio tracking from the air, followed by ground searches. However, one of the nine collars failed to detach as programmed. This was retrieved after the animal was captured in a control program 13 months later.

Collars recorded three to five locations (out of a possible seven each night) per animal. Sixty-seven percent of all attempted fixes were successful, with no difference between males and females.

Locations were more accurate from 1900 hours to 0100 hours, compared to 0300 hours to 0700 hours. We found that the use of GPS collars in forested habitat can provide information on a range of aspects of wild dog ecology.

5. Defining the fine-scale movements and habitat preferences of the red fox (*Vulpes vulpes*) in a forested environment

Alison Towerton, Rod Kavanagh, Andrew Haywood, Trent Penman and Chris Dickman

Forest Resources Research, NSW DPI Science and Research, Forests NSW, PO Box 100, Beecroft NSW 2119.

There is little information on the movements and habitat preferences of foxes in the forested landscape and their response to predator control events. The distribution and abundance of this predator is difficult to measure, but valuable for effective management of their impact on native forest fauna and livestock. This study aims to fill this gap in our understanding of fox activities and behaviour as they move within and across land tenure boundaries in the Goonoo landscape near Dubbo, home to a threatened mallee fowl population.

To date, a total of fifteen foxes and one cat have been trapped. Ten foxes and the cat were fitted with VHF collars, one fox with a GPS collar, and the other four foxes were not radio-tracked.

The status of the radio-tagged foxes was either shot by an adjacent landowner (1), poisoned during the baiting program (6) or missing, fate unknown (4), while the cat is still being tracked.

The GPS collar was retrieved with a dataset of around 1700 points collected over a two month period. Sandplots were used before and after baiting to provide an index of fox activity. Scats have been collected to provide details of fox diet in the forest. DNA samples have also been collected to investigate the genetic relationships of fox populations occurring both within and around the forest.

Data from the control programs have been collated and, along with the sandplot and radio tracking data, will be analysed to provide information on the distribution and movements of foxes in relation to forest stand structural, floristic and landscape features.

This study will assist conservation land managers to increase the efficiency of predator control programs, by targeting areas of high activity by foxes. This study will also provide recommendations for improving pest control operations in this region and the groundwork established will assist in the continued monitoring of this pest species.

6. Aspects of the history, home range and diet of the feral cat (*Felis catus*) in the Perisher Range resort area of Kosciuszko National Park, New South Wales

Kåren Watson

Conservation Council of the SE Region and Canberra, PO Box 544, Canberra, ACT 2601.

This work is comprises three related components which explore some of the history and ecology of feral cats in the snow country of New South Wales. The history component suggests that cats were not present in the snow country prior to permanent human settlement and that numbers of cats increased significantly during the construction of the Snowy Hydroelectric Scheme.

Three of six cats originally trapped in the Perisher Blue Ski Resort, where the endangered Mountain Pygmy-possum (*Burramys parvus*) had shown a recent rapid ecline in numbers, became the focus of a radiotracking study spanning intermittent periods over twelve months.

Home range locations were obtained using sightings, exact locations, triangulation techniques and observation of frequented sites. The two male cats were found to have larger home ranges than the sole female cat. All three cats appeared to reduce the size of their home range during the snow covered period (June to September) and ranges were found to overlap, particularly in the non-snow covered period.

All three cats were found using human-built resources at times during the study--one cat used built structures as den sites all winter. Home ranges encompassed several habitat types, all of which provided cover, shelter and prey.

Snowgum woodland, heath adjacent to creeklines and boulderfields provided the preferred habitat during the non-snow periods, while individual cats had differing habitat or den preferences during the snow covered period.

The diet component of the study, using scats and stomach contents of cats removed from the study area during the winter of 2005, showed that feral cats may be directly implicated in the decline of a vulnerable native rodent, the Broad-toothed Rat (*Mastacomys fuscus*) and in conjunction with the home range data, suggest that cats are potentially implicated in the decline of the Mountain Pygmy-possum.

7. Dogs in Space

Andrew W. Claridge and Douglas J. Mills

NSW Department of Environment and Conservation, Parks and Wildlife Division, Planning and Performance Unit, Southern Branch, PO Box 2115, Queanbeyan, NSW 2620.

'Dogs in Space' is a recent initiative by the Parks and Wildlife Division of the NSW Department of Environment and Climate Change to track the movement behaviour of wild dogs using satellite technology. The major aim of this exercise is to describe the extent of home range and pattern of habitat use by free-ranging wild dogs in key conservation areas in south-eastern mainland Australia, and to use this information to better manage these animals where necessary.

Thus far, over 20 animals have been tracked across five conservation reserves in southern NSW and adjacent Victoria. Animals have been tracked for a period of a few weeks to over 12 months. Preliminary results indicate that for the most part they occupy larger home ranges than previously documented in earlier telemetry studies.

This difference is most likely due to improved tracking technologies rather than any changed behaviour. The scale of movement observed in animals tracked, combined with the high level of hybridisation among free-ranging wild dog populations in our study region, makes it difficult to envisage dingo gene pools being maintained in the wild across the study region.

The large home range sizes recorded also have implications for current wild dog control efforts in time and space.

8. Field trials of innovative wild dog and fox management techniques

Rob Hunt

NSW Department of Environment & Conservation, National Parks and Wildlife Division, PO Box 1189, Queanbeyan NSW 2620, Australia.

Recent progress related to the tracking and mapping of wild dog movements across a range of Australian environments has allowed insight into the behaviour of wild dogs previously not available to pest animal managers.

This level of information now raises questions relating to the impact of existing control operations on wild dog populations across landscapes much broader than those adjoining areas of domestic livestock.

In order to retain viable populations of higher order predators such as wild dogs, regardless of genetic purity, an evaluation of existing control operations including areas targeted and methods used must be undertaken.

9. A new candidate agent for lethal control of feral vertebrate predators in Australia

David J Dall[1], Ricky J Spencer[1], Chris DS Buller[2] and Steven J Lapidge[3]

[1]Pestat Ltd, LPO Box 5055, University of Canberra, Bruce ACT 2617.

[2]Invasive Animals CRC, PO Box 284, Canberra, ACT 2601.

[3]Invasive Animals CRC, 48 Oxford Tce, Unley Park, SA 5061.

Predators such as foxes and feral cats have significant impacts on birds, reptiles and small mammals in the Australian environment. As a consequence, considerable effort is invested in their control, commonly using methods such as trapping and shooting, and in the case of foxes, poisoning with monofluoroacetate ('1080'). Since mid-2003 a consortium of agencies led by the Invasive Animals Cooperative Research Centre has been investigating the potential of the chemical para-aminopropiophenone (PAPP) for use as a humane lethal control agent for predators.

This research has now validated a formulation of PAPP that, when ingested, kills foxes and cats reliably, quickly, and in an apparently humane manner. Furthermore, the effectiveness of another (harmless) chemical that can be used as an antidote to poisoning with the agent has been proven. Although ingestion of a single lethal fox bait containing PAPP is predicted to have no effect on most domestic dogs (ie, those larger than ~5kg), the antidote can be used for small dogs, or in cases where multiple baits are eaten.

The spectrum of activity of PAPP for a range of other 'non-target' species has also been investigated, as has the characteristics of the chemical in the environment. With appropriate cautions, the agent is considered to be suitable for deployment for predator control purposes. We expect that additional refinements to the manner and timing of delivery will allow minimisation of risk to non-target species.

Field trials of PAPP for fox control will soon commence.

List of Participants

Participant	Organisation
Allen, Ben	BAllen@bses.org.au
Allen, Lee	Lee.Allen@dpi.qld.gov.au
Bean, Josh	josh.bean@environment.nsw.gov.au
Bird, Peter	Bird.Peter@saugov.sa.gov.au
Buckmaster, Tony	tonybuckmaster@bordernet.com.au
Byrne, Damien	Damien.Byrne@dpi.qld.gov.au
Carey, Danielle	dans1100@yahoo.com.au
Claridge, Andrew	Andrew.Claridge@environment.nsw.gov.au
Clark, Mick	clarkeym@bigpond.com
Clarke, Alex	Arid.Recovery@bhpbilliton.com
Crawford, Cathy	cathy.crawford@dpi.nsw.gov.au
Dall, David	david.dall@pestat.com.au
Diment, Alex	alex@diment.org
Ellis, John	John.Ellis@uts.edu.au
Fleming, Peter	Peter.Fleming@dpi.nsw.gov.au
Hunt, Rob	Rob.Hunt@environment.nsw.gov.au
Jenkins, David	djenkins@effect.net.au
King, Jess	jessking1307@aol.com
McBride, Gemma	gemma.mcbride@anu.edu.au
McDougall, Andrew	a.s.mcdougall@gmail.com
Marshall, Penelope	p.marshall@student.canberra.edu.au
Mills, Doug	Doug.Mills@environment.nsw.gov.au
Mulley, Rob	R.MULLEY@uws.edu.au
Newsome, Tom	tnew5216@mail.usyd.edu.au
Oakman, Barry	Barry.Oakman@yless4u.com.au
Purcell, Brad	B.Purcell@uws.edu.au
Robley, Alan	Alan.Robley@dse.vic.gov.au
Slapeta, Jan	Jan.Slapeta@usyd.edu.au
Spencer, Ricky	ricky.spencer@pestat.com.au
Towerton, Alison	alisont@sf.nsw.gov.au
Wilton, Alan	a.wilton@unsw.edu.au
Windsor, Peter	pwindsor@camden.usyd.edu.au
Watson, Kåren	bushcare@consact.org.au

Synthesis of discussions

This section represents the interpretations of the editors—we have attempted to capture the most salient points presented at the workshop. There were three groups of technologies that were being used, or had recently been used by attendees for researching wild canids and felids to inform best practice. These were:

- remotely-released cameras
- transmitters and data-loggers attached to collars
- animal tracks and traces.

Remotely-released cameras included standard digital cameras, infra-red cameras and digital video. VHF transmitters mounted on collars were being replaced with collar-mounted GPS dataloggers, with or without satellite upload capability, and these were the most desired technology. Sandplots provided low-cost remote monitoring and faeces were potentially useful for monitoring occurrence of canids and felids, their parasite prevalence, and for collecting DNA. A variety of tissue and hair traps was also being used to capture samples for DNA analysis. Faeces samples held potential for diet, disease, density, dispersal and distribution studies.

The research questions posed by the different projects fell into the following groups:

1. Evaluation of the effectiveness of new toxins, baits and other control methods (e.g. abstracts 8 and 9).
2. Movements and dispersal including long range movements, seasonal space use, short range movements in relation to control zones, and movements of livestock guarding dogs in relation to their home properties (e.g. abstracts 3-7).
3. Disease transmission including zooneses and agriculturally important diseases transmitted by wild canids and felids (e.g. abstract 2).
4. Home range, habitat use and overlap of wild canids and felids (e.g. abstracts 1, 5 and 6).
5. Density estimates and evaluation of abundance indices of wild canids and felids for management and research.
6. Distribution of dingo genes in the national wild dog population for conservation management.
7. Spatial activity of herbivorous prey species of wild canids and felids.
8. Space use by non-target native carnivores in relation to risk from control programs.

The common themes were:

- evaluation and improvement of control effectiveness,
- investigation of spatial epidemiology of diseases involving wild canids and livestock
- investigation of dispersion and distribution of dingoes and other wild dogs
- evaluation of abundance and activity measures, and
- investigation of the ecology of wild canids and felids, in relation to management.

A number of possibilities to share resources were identified and this has led to one agreement for sharing of GPS/satellite collars between partners and another two to add value to existing projects by co-locating GPS collars on sympatric animals.

Opportunities exist for embedding a number of research questions in the IA CRC demonstration sites dealing with predators. There will be linkages between studies using DNA technologies for density estimation and assessment of indices of abundance, and GPS/satellite collars for assessing home range use and movement patterns at demonstration sites in Western Australia, Victoria and north-eastern NSW.

All wild dog projects could potentially provide specimens for a national genetic study, and collaborations between some IA CRC partners and others have already been established. Further discussions between participants should see more collaboration and data sharing.

As many of the technologies were new, analysis software was still in development and most proprietary home range software was inadequate for the highly autocorrelated and huge datasets that were being achieved. In addition, although precise, the accuracy and sources of bias of GPS and satellite collar fixes have been little studied and not at all for Australian animals and environments. The workshop has led to the testing of GPS collars for bias in different vegetation types in the Southern Ark demonstration site and will be undertaken for wild dogs in the north eastern demonstration site. An informal email network has been set up by Doug Mills and this has encouraged discussion of new analyses and collaborations.

A proposal to set up a log of publications from workshop participants was also suggested and we hope that this can be facilitated through the IA CRC website (www.invasiveanimals.com), www.feral.org.au, or perhaps as a blog. In the tables below, the general themes are each listed with the research teams and the species they are studying. Also listed are the technical resources that were on hand or order at the time of the workshop. We hope that this information aids collaborations to achieve replication in space and time, so that more generic conclusions can be drawn than have been logistically possible previously.

Table 1: Codes for research groups and existing collaborations as used in Tables 3-9

Code	Research group / collaboration
A	Ben Allen
B	IA CRC Southern Ark demonstration site: Tony Buckmaster, Alex Diment, Chris Dickman
C	IA CRC dog DNA subproject: Danielle Carey, Tom Newsome, Oliver Berry et al
D	Andrew Claridge, Doug Mills, Josh Bean
E	Peter Fleming, Mike Letnic, Ben Russell, John Tracey
F	Rob Hunt et al
G	IA CRC WA integrated predator control: Dave Algar, Paul de Torres, Nicky Marlow et al
H	IA CRC NSW dog demonstration site: Guy Ballard, Gerhard Körtner et al
I	IA CRC dog DNA subproject: Tom Newsome, Guy Ballard, Mike Dodkin et al
J	IA CRC PIGOUT® project: Steve Lapidge et al
K	Dave Jenkins et al
L	Jess King, Dave Jenkins, Peter Windsor, John Ellis, Peter Fleming
M	Lee Allen and Damien Byrne
N	PAPP project: Ricky Spencer, David Dall et al
O	Brad Purcell and Rob Mulley
P	Alan Robley et al
Q	Renee Visser, Brendan Mackey, Dave Jenkins, Peter Fleming
R	Tanami dingo project: Tom Newsome, Bill Low
S	Alison Towerton
T	Kåren Watson
U	Alan Wilton, Barry Oakman

Table 2: Codes used for species in Tables 3-9

Number	**Species Group**
1	feral cats
2	dingoes
3	wild dogs
4	foxes
5	feral goats
6	feral pigs
7	quolls
8	livestock
9	prey
10	urban dogs
11	varanids
12	livestock guarding animals

Table 3: Proposed and current use of new technologies for evaluating control effectiveness and improvements			
Research group	**Species**	**Technology**	**Items on hand**
A	10	GPS/VHF collars	3
A	10	camera	10
D	7	infra-red camera	12
D	2, 3	GPS/satellite collars	12
D	2, 4	satellite collars	10
F	2, 3, 4	camera	?
F	2, 3, 5	sandplots	
G	1, 4, 7, 11	VHF collars	?
G	1, 2, 3, 4, 7, 11	sandplots	
H	7	GPS/VHF collars	4*
I	1, 2, 3, 4, 7, 9	sandplots	
J	6	cameras	?
J	6	VHF collars	?
M	2, 3	sandplots	
M	2, 3	satellite collars	7
N	1, 2, 3, 4	camera	30
N	1, 2, 3, 4	satellite collars	10
P	1	GPS/satellite collars	20
P	2, 3, 4	GPS/satellite collars	14
P	1, 2, 3, 4	sandplots	
P	1, 2, 3, 4	DNA	
S	4	GPS/VHF collars	3

* = on order

? = number uncertain

Table 4: Proposed and current use of new technologies for evaluating density, activity and abundance measures

Research group	**Species**	**Technology**	**Items on hand**
A	10	camera	10^{+}
B	1, 4	GPS/VHF collars	14
C	2, 3, 4	DNA	
C	1,2,3,4,7,9,11	sandplots	
C	1,2,3,4,7,9,11	camera	
G	1,2,3,4,7,9,11	DNA	
G	1,2,3,4,7,9,11	sandplots	
G	9	trapping grid	
I	1,2,3,4,7,9,11	sandplots	
M	1,2,3,4,9	sandplots	
O	2,3	infra red camera	8
O	2,3	sandplots	
P	1,2,3,4	GPS/satellite collars	12^{+}
P	1,2,3,4	camera	
P	1,2,3,4	DNA	
P	1,2,3,4	sandplots	
R	2, 10	sandplots	

$^{+}$ = same items as listed in table 3 above for the research group.

Table 5: Proposed and current use of new technologies for disease epidemiology and genetics, dispersion and distribution of the species of interest.

Research interest	**Research group**	**Species**	**Technology**	**Items on hand**
Disease epidemiology	A	10	faeces	
	H	2	GPS/satellite collars	4+
	H	8	GPS collars	6*
	I	1, 2, 3, 4	faeces	
	K	2, 3, 4	faeces	
	K	10	GPS/VHF collars	
	L	2, 3, 4	faeces	
	L	8	bloods	
Genetics, dispersion & distribution	A	10	DNA	
	B	1, 4	DNA	
	C	2, 3	DNA	
	D	2, 3	DNA	
	G	1, 2, 3, 4, 7	DNA	
	I	2, 3	DNA	
	K	2, 3	DNA	
	M	2, 3	DNA	
	O	2, 3	DNA	
	P	1, 2, 3, 4	DNA	
	R	2	DNA	
	R	2, 10	DNA	
	U	2, 3	DNA	

* = on order

+ = same items as listed in tables 3 and 4 above for the research group.

Table 6: Proposed and current use of new technologies for home range and habitat use analysis for the species of interest.

Research group	**Species**	**Technology**	**Items on hand**
A	10	GPS/satellite collars	3 +
B	1, 4	GPS/satellite collars	
B	1, 4	sandplots	
D	2, 3	GPS/satellite collars	12 +
D	2, 3	satellite collars	10 +
E	5	GPS/satellite collars	
G	1, 2, 3, 4	VHF collars	?
G	1, 2, 3, 4	GPS/satellite collars	?
H	7	faeces	
H	7	GPS/VHF collars	4 +
I	1, 2, 3, 4	GPS/satellite collars	14 +
I	1, 2, 3, 4	faeces	

+ = same items as listed in tables 3 to 5 above for the research group

? = number uncertain.

Table 7: Proposed and current use of new technologies for studying movements after control for the species of interest

Research group	Species	Technology	Items on hand
B	1, 4	GPS/VHF collars	10
C	2, 3	GPS/VHF collars	10 +
D	2, 3	satellite collars	10 +
D	2, 3	GPS/satellite collars	12 +
E	5	GPS/satellite collars	
I	1, 2, 3, 4	GPS/satellite collars	10 +
I	1, 2, 3, 4	sandplots	
M	2, 3	satellite collars	7 +
P	2, 3	GPS/VHF collars	15

+ = same items as listed in tables 3 to 6 above for the research group

? = number uncertain.

Table 8: Proposed and current use of new technologies for home range and habitat use analysis for the species of interest.

Research group	Species	Technology	Items on hand
A	10	GPS/satellite collars	
B	1, 4	GPS/satellite collars	
D	2, 3	satellite collars	10 +
D	2, 3	GPS/satellite collars	12 +
G	1,2,3,4,7, 11	VHF collars	?
G	1, 2, 3, 4	GPS/satellite collars	?
K	2, 3	VHF collars	9
K	2, 3	PIT tags	56
M	2, 3	satellite collars	7 +
M	12	GPS/satellite collars	4 +
O	2, 3	GPS/VHF collars	9
P	1, 2, 3, 4	GPS/satellite collars	34 +
T	1	GPS/satellite collars	

+ = same items as listed in tables 3 to 7 above for the research group

? = number uncertain.

Table 9: Proposed and current use of new technologies for studying spatial and temporal interactions and niche separation of the species of interest.

Research group	**Species**	**Technology**	**Items on hand**
H	2, 3, 7	GPS/satellite collars	
I	1, 2, 3, 4, 7	GPS/satellite collars	14 +
I	1, 2, 3, 4, 7	sandplots	
L	8	GPS collars	4 +
M	12, 8	GPS/satellite collars	4 +
P	1, 2, 3, 4	GPS/satellite collars	34 +
Q	1, 2, 4	IR video camera	2

+ = same items as listed in tables 3 to 7 above for the research group

Acknowledgements

Lee Allen provided a draft spreadsheet that greatly assisted the preparation of themes by participants prior to the meeting and during discussions.

We especially thank Rob Mulley, Ben Allen, Peter Windsor, Brad Purcell, Karen Watson, John Ellis, Penelope Marshall, Barry Oakman and Andrew McDougall, who all attended in their own time, and the apologies of Paul de Tores and Renee Visser are noted.

References

Edwards, G.P., de Preu, N., Shakeshaft, B.J., Crealy, I.V. and Paltridge, R.M. (2001) Home range and movements of male feral cats (*Felis catus*) in a semiarid woodland environment in central Australia. Austral Ecology 26, 93-101.

Fleming, P. (2006) 'Priorities for Wild Dog Research in the Invasive Animals Cooperative Research Centre: A brief to Chris Buller, Deputy CEO, IA CRC on a Workshop held in Adelaide 12th October 2005.' Unpublished internal report to IA CRC.

Harden, R.H. (1985) The Ecology of the Dingo in North-Eastern New South Wales I. Movements and Home Range. Wildlife Research 12, 25-37.

Meek, P.D. and Saunders, G. (2000) Home range and movement of foxes (*Vulpes vulpes*) in coastal New South Wales, Australia. Wildlife Research 27, 663-668.

Thomson, P.C. (1992) The behavioural ecology of dingoes in north-western Australia. IV. social and spatial organisation, and movements. Wildlife Research 19, 543-563.