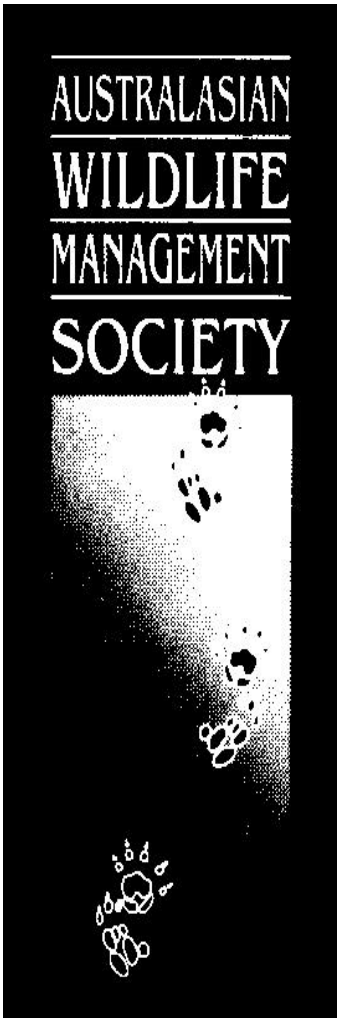

14th ANNUAL CONFERENCE

Australasian Wildlife Management Society

Dubbo 3rd – 5th December 2001

CONFERENCE PROGRAMME AND ABSTRACTS

NSW National Parks and Wildlife Service
Western Directorate

Conference Organisers:

Terry Korn
Robyn Molsher
Jodie Saville
Cathy Vandermaal
Liz Mazzer
Joshua Gilroy
Mike Fleming

All of the above are from the:

NSW National Parks and Wildlife Service
Western Directorate
PO Box 2111
Dubbo NSW 2830

Thanks also to:

Jill McCann
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12 Bishop St
Dubbo NSW 2830

AUSTRALASIAN WILDLIFE MANAGEMENT SOCIETY

14TH SCIENTIFIC MEETING AND AGM

DUBBO, NEW SOUTH WALES, AUSTRALIA
3RD – 5TH DECEMBER 2001

Hosted by:

NSW National Parks and Wildlife Service
Western Directorate

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AWMS Conference 2001 Programme

Sunday 2nd December

6:00 – 8:00 pm	Conference icebreaker and registration Dubbo Art Gallery (next to Civic Centre at 165 Darling St)

Monday 3rd December

8:00 – 8:30 am	Registration
8:30 – 8:50 am	**Opening Remarks and Welcome by local Indigenous Community**
8:50 – 9:00 am	Official Opening: Terry Korn, Director of NSW National Parks and Wildlife Service, Western Directorate

Symposium 1: Clearing and Fragmentation Effects on Native and Introduced Fauna

Chair: Joshua Gilroy

9:00 – 9:40 am	Keynote Speaker: SUE MCINTYRE
	Creating a sustainable landscape from the bottom up.
9:40 – 9:55 am	V.J. NELDNER & B.A. WILSON
	Extent and conservation status of remnant vegetation in the Brigalow Belt biogeographic region in Queensland.
9:55 – 10:10 am	D. MORGAN, I. SLUITER & G. KININMONTH
	Breeding season movements of the Regent Parrot in relation to fragmented mallee remnants in agricultural land near the Murray River
10:10 – 10:25 am	M. COX
	How does rainforest fragmentation affect non-flying Mammals on the eastern Dorrigo Plateau, NSW?
10:25 – 10:55 am	**Morning Tea**
10:55 – 11:10 am	J. WILLIAMS
	Hollow-bearing trees in the public forests of Northern New South Wales; abundance and distribution now and in the future.
11:10 – 11:25 am	B. RANKMORE* & O. PRICE
	Does Size Really Matter? Guidelines for the Retention of Habitat in the Top End.
11:25 – 11:55 am	M. DRIELSMA & M. ELLIS
	The Conservation Options for Regional Environments (CORE) trial
11:55 – 12:10 pm	A. BYROM
	Ferret use of habitat while foraging: Implications for native wildlife.
12:10 – 12:25 pm	A. PENN*, B. SHERWIN & D. LUNNEY
	The effects of a prescribed burn on the small mammals and skinks of a disturbed forest.

Monday 3rd December (continued)

12:25 – 1:30 pm **Lunch**

Symposium 2: Threatened Species Management 1

Chair: Robyn Molsher

1:30 – 2:10 pm Keynote Speaker: PAUL JANSEN

Endangered species conservation: A case study of two different approaches.

2:10 – 2:25 pm A. LEVERINGTON & N. LEES

An overview of threatened species management in Queensland

2:25 – 2:40 pm M. CAMERON

Securing "beachhead" populations – a critical first step in the recovery of widespread species.

2:40 – 2:55 pm J. HONE

Population growth rates and wildlife management.

2:55 – 3:15 pm **Afternoon Tea**

3:15 – 3:30 pm F. FRASER

Learning by doing: implementing a management model for a declining savanna bird species in Kakadu National Park.

3:30 – 3:45 pm D. L. OLIVER

Conservation and management of the endangered Plains-wanderer *Pedionomus torquatus* on the NSW Riverine Plain

3:45 – 4:00 pm T. F. CLANCY, A. BEARLIN, L. LUMSDEN & I. TEMBY

A structured decision-aiding approach for the establishment of an alternate camp site for the Grey-headed Flying-fox *Pteropus poliocephalus* in Melbourne.

4:00 – 4:15 pm R. SOUTHGATE

Habitat occupied by the Greater Bilby *Macrotis lagotis* (Marsupialia: Peramleidae) : is fire management important?

4:15 – 4:30 pm S. VENINGA
Conservation of the Striped Hyena (*Hyaena hyaena*) in the Khirthar National Park: A Pilot Study.

4:30 pm **Close**

5:00 – 6:00 pm **AWMS Annual General Meeting**

Tuesday 4th December

8:30 – 8:45 am Housekeeping

Symposium 3: Threatened Species Management 2

Chair: Elaine Murphy

8:45 – 9:00 am N. KING*, K. HIGGINBOTTOM & J. BAUER

Reintroduction programs for wildlife conservation: is there a place for tourism?

9:00 – 9:15 am J. TURBILL

Koala Habitat and the NSW Native Vegetation Conservation Act 1997: Outcomes of a project for dealing with Koala habitat in RVMPs

9:15 – 9:30 am D. GEERING & P CHRISTIE

Movements and habitat use by Regent Honeyeaters outside the breeding season: a radio tracking study

9:30 – 9:45 am K. MCCRAY, P. MEEK & B. CANN.

Is there HaRM in State Forests' pre-logging and pre-roading surveys ?

9:45 – 10:00 am N. M. RICHINGS*, M. B. RENFREE & P. D. TEMPLE-SMITH

The development of a follicle culture system for macropodid marsupials and its application in the management of threatened species.

10:00 – 10:15 am E. L. BURNS, B. A. HOULDEN, A. WHITE

Genetic Diversity And Gene Flow Among Green And Golden Bell Frog (*Litoria Aurea)* Populations.

10:15 – 10:45 am Morning Tea

Tuesday 4th December (continued)

Concurrent Open Sessions

	Predator Control for Threatened Species *Chair: Cheryl O'Connor*	***General Open Session 1*** *Chair: Liz Mazzer*
10:45 – 11:00 am	D. CHOQUENOT & A. ROBLEY	C. DAVEY AND R. PECH
	The management of foxes in Victoria's Parks: an Adaptive Experimental Management	Effect of reduced rabbit numbers on the reproductive success of wedge-tailed eagles (*Aquila audax*) in central-western New South Wales.
11:00 – 11:15 am	K. MOSEBY	G. GRIGG
	Research Initiatives at the Arid Recovery Reserve in Northern S.A	Comparative forage requirements of kangaroos and sheep: a reality check.
11:15 – 11:30 am	M. HAYWARD*, P. DE TORES & B. FOX	A. FAWCETT AND J. SHIELDS
	Population dynamics of the quokka (*Setonix brachyurus*) (Macropodidae: Marsupialia) in the northern jarrah forest of Western Australia	Densities and management of Greater Gliders (*Petauroides volans*) within state forests of the Hunter Region
11:30 – 11:45 am	C. RUMMERY, C. BRAY, A. MATTHEWS, O. CROWE, D. LUNNEY C. KIRTON & M. NORTON	F. DONALDSON, A. DE SILVA, W. SHERWIN, M. AUGEE & G. MCKAY
	Assessing the effectiveness of a 1080 fox baiting program for brush-tailed rock-wallaby colonies in the Hunter Valley/Hawkesbury region of NSW.	Defining conservation units for the ringtail possum genus *Pseudocheirus*.
11:45 – 12:00 pm	K. LONG, A. J. ROBLEY AND K. LOVETT	H. BRYANT, K. ROSE, AND C. BUNN
	An assessment of fox activity on the survivorship of reintroduced eastern barred bandicoots	Monitoring wildlife health in Australia : Case studies and a model for coordination.
12:00 – 12:15 pm	A. GLEN	H. BRYANT, K. ROSE, AND C. BUNN
	Uptake of baits by target and non-target animals during control programmes for foxes and wild dogs	Monitoring wildlife health in Australia : Case studies and a model for coordination (continued).

12:15 – 1:15 pm **Lunch and Poster Session**

Tuesday 4th December (continued)

Symposium 4: Wetland Management

Chair: Terry Korn

1:15 – 1:55 pm	Keynote Speaker: RICHARD KINGSFORD
	Managing wetlands, their wildlife and the threats.
1:55 – 2:15 pm	J. REID
	ARIDFLO – modelling ecological relationships to flow variability
2:15 – 2:30 pm	H. JONES
	Rehabilitation of Murray - Darling Wetlands
2:30 – 2:45 pm	P. J. JARMAN & J. MONTGOMERY
	Waterbirds and irrigation storages in the Gwydir Valley, NSW.
2:45 – 3:00 pm	J. BENNETT & S. WHITTEN
	Duck Hunting and Wetland Conservation: Compromise or Synergy.
3:00 – 3:20 pm	Afternoon tea
3:20 – 3:35 pm	C. HARDING, B. KENTISH & J. MILLER
	Application of remote sensing to locate potential Brolga *Grus rubicundus* breeding wetlands in south-western Victoria.
3:35 – 3:50 pm	B. W. BROOK, P. J. WHITEHEAD & P. G. BAYLISS
	Sustainable harvest rates for magpie geese in northern Australia.
3:50 – 4:05 pm	M. CROWLEY
	The Importance of Small Coastal Wetlands in Wader Conservation and some considerations for management. The Moruya Estuary: A Case Study.
4:05 – 4:20 pm	K. BEGGS* & C. BACH
	A closer look at Mary's para-sites: Are exotic pastures a threat to the avifauna of the Mary River Floodplains, Northern Territory?
4:20 – 4:35 pm	K. FERDINANDS*, P. WHITEHEAD & C. DEVONPORT
	Mary's going feral: GIS-based predictive modelling of the spread of *Urochloa mutica* in the Mary River wetlands, Northern Territory.
4:35 pm	Close
5:30 pm	**Tour of Western Plains Zoo**
7:00 pm	**Dinner at Western Plains Zoo (Savannah Room)**

Wednesday 5th December

Concurrent open sessions

	Fox Control *Chair: Arthur Georges*		***Threatened Species Ecology*** *Chair: Jocelyn Davies*
9:10 – 9:20 am	A. MURRAY & R. POORE "Project Deliverance" – An experiment in fox control and wildlife recovery in the forests of East Gippsland, Victoria. Part I: Project Outline.	9:00 – 9:15 am	D. PAULL Management of fire regimes for the Pilliga Mouse
9:20 – 9:30 am	A. MURRAY & R. POORE Project Deliverance – An experiment in fox control and wildlife recovery in the forests of East Gippsland, Victoria. Part II: Fox Control Methodology.	9:15 – 9:30 am	C. P. SLADE & V. JURSKIS Smoky Mouse Habitat in Southeast NSW: Distribution and Habitat in a Multiple Use Forest Mosaic
9:30 – 9:45 am	A. MURRAY & R. POORE Project Deliverance – An experiment in fox control and wildlife recovery in the forests of East Gippsland, Victoria. Part III: On-going Fox Control: the impact on non-target wildlife	9:30 – 9:45 am	P. MEEK Trying to unravel the mystery of the home range and habitat preferences of *Pseudomys oralis*: a radio tracking and spool-and-line study in Marengo State Forest.
9:45 – 10:00 am	J. WHITE, K. SNELL & N. SMALLMAN Foxes and blackberries: could habitat management offer another option in integrated fox control strategies?	9:45 – 10:00 am	T. PETIT & D. BICKERTON Relationships of the endangered pink-lipped spider orchid *Caladenia behrii* with animals in South Australia
10:00 – 10:15 am	M. CROWLEY & C. SLADE The Diet of Foxes, *Vulpes vulpes* and Dogs, *Canis familiaris* in the forests of south-eastern New South Wales.	10:00 – 10:15 am	D. HARLEY Nest boxes as a research and conservation tool for Leadbeater's Possum
10:15 – 10:30 am	N. DEXTER, P. MEEK, S. MOORE & H. RICHARDSON Population Responses of Critical Weight Range Mammals to Intensive Fox Control at Beecroft Peninsula, New South Wales	10:15 – 10:30 am	L. NELSON Thermal biology of the endangered Grassland Earless Dragon (*Tympanocryptis pinguicolla*) and implications for management.

Wednesday 5th December (continued)

10:30 – 10:45 am **Morning Tea**

Concurrent Open Sessions

	Predator Control *Chair: Mike Brayshe*r	***General Open Session 2*** *Chair: Quentin Hart*
10:45 – 11:00 am	A. BERESFORD*, M. BOYD, S. BROWN, A. HOOKE & D. KAY Establishing an effective target-specific baiting technique for fox control, determining the fate of baits using the thread-and-line method	N. CLEMANN, J. ODGERS & T. MCGEE A Snake in the Grass: Investigating Urban Snake Management in Southern Victoria
11:00 – 11:15 am	C. O'CONNOR & J. DUCKWORTH When is a wild-caught stoat acclimatised?	M. GUNN* & W. SHERWIN Quantitative traits in population bottlenecks
11:15 – 11:30 am	B. WARBURTON, A. BYROM, R. WEBSTER, D.GLEESON, & R. HOWITT. Use of DNA for mark-recapture analyses of stoats and possums	B. REDDIEX*, G. HICKLING, G. NORBURY & C. FRAMPTON Interactive effects of predation and rabbit haemorrhagic disease (RHD) on the dynamics of wild rabbit populations in New Zealand
11:30 – 11:45 am	D.W. COOPER Immunocontraception for Wildlife Management	M. WALTER* Abundance and Limitation of Feral Horses in the Australian Alps
11:45 – 12:00 pm	R. PECH, S. DAVIS, D. CHOQUENOT & A. ROBLEY Why are "critical weight range" fauna particularly susceptible to predation?	S. BEAUREPAIRE & M. SANDEMAN Acceptance of various bait types by European Rabbits (*Oryctolagus cuniculus*)
12:00 – 12:15 pm	P. WEST, G. SAUNDERS & S. BALOGH Pest animal survey and risk analysis for potential pest animal and exotic disease areas in NSW	L. G. PARDON, B. W. BROOK & A. D. GRIFFITHS Determinants of survival for the northern brown bandicoot under a landscape-scale fire experiment

12:15 – 1:00 pm **Lunch**

Wednesday 5th December (continued)

Concurrent Open Sessions

	General Open Session 3 *Chair: Peter Whitehead*	***Kangaroos*** *Chair: Josh Gilroy*
1:00 – 1:15 pm	J. DAVIES	P. PEGLER, S. TROY, J. WRIGHT & I. WALKER
	Indigenous Voices in collaborative scientific research	Ecological Rationale For Active Kangaroo Population Management
1:15 – 1:30 pm	P. MASTERS, T. BERDEN & G. MOSS	D. RAMP & G. COULSON
	Koala Management on Kangaroo Island: modelling population changes and calculating management costs	Ideal Free Distributions and Free-Ranging Mammalian Herbivores: Confronting Standing Crop Models with Empirical Data
1:30 – 1:45 pm	A. MORIARTY	G. MAGUIRE, D. RAMP & G. COULSON
	Where have all the deer come from? The three waves of invasion and the management of wild deer in Australia	Foraging behaviour and dispersion of eastern grey kangaroos in an ideal free framework
1:45 – 2:00 pm	J. TRACEY, J. HONE, P. FLEMING & R. VAN DE VEN	C. ADDERTON HERBERT, T.E. TRIGG, D.W. COOPER
	Assessing factors which influence visibility bias in aerial surveys of feral goat	Effects of Deslorelin, a slow release GnRH superagonist, on reproduction in the grey kangaroo: potential applications
2:00 – 2:15 pm	P. WEST, J. TRACEY, G. JONES, G. SAUNDERS, & B. LUKINS	A. BILTON*
	Spatial and temporal trends in bird damage to wine grapes: a case study using geographic information systems in vineyards within Orange, NSW.	The Facts: survivorship of Red Kangaroo young to weaning and its effect on population dynamics.

Wednesday 5th December (continued)

Concurrent Open Sessions

	General Open Session 3 *Chair: Peter Whitehead*	***Kangaroos*** *Chair: Josh Gilroy*
2:15 – 2:30 pm	L. S. WEBLEY, D. W. COOPER, A. W. ENGLISH & T. E. TRIGG Deer population management using a slow release implant of Deslorelin, a GnRH superagonist	H. BENDER Deterrence of kangaroos from roadways using ultrasonic frequencies – efficacy of the Shu Roo.
2:30 – 2:45 pm	D. CLARKE & J. WHITE Are powerline easements detrimental to small mammal diversity?	J. READ & D. WILSON The ecological implications of harvested kangaroo offcut and offal dumps in the Australian rangelands
2:45 – 3:00 pm	R. MONTAGUE-DRAKE* Distribution and abundance of small mammals and reptiles around artificial watering points in Sturt National Park, arid-zone NSW	D. R. MCCULLOUGH & Y. MCCULLOUGH Shifts in kangaroo species abundance at Yathong Nature Reserve
3:00 – 3:15 pm	**Presentation of student awards and closing remarks**	
3:15 – 3:30 pm	**Afternoon Tea**	
3:30 pm	**Close**	
3:45 – 7:00 pm	***Tour of Goonoo State Forest***	

** Participants in the student awards are marked with an asterix*

Symposium 1: Clearing and Fragmentation Effects on Native and Introduced Fauna

Keynote Paper:

Creating a sustainable landscape from the bottom up.

Sue McIntyre

CSIRO Sustainable Ecosystems, 120 Meiers Rd, Indooroopilly QLD 4068

At the broadest level, conservation planning in landscapes is about the apportioning biophysical energy between direct human uses and the maintenance of ecosystem function and stability. Different land uses and management levels represent different levels of diversion towards human use, while their extent across the landscape is related to the total allocation. Habitat extent and condition are discussed in terms of conservation and ecosystem function. Off-site effects of different management are an important part of the landscape design equation. Although extent and condition vary continuously, it can be useful to recognise broad states representing different levels of function and conservation status. I argue that the most important primary determinant of condition and landscape function is the relative amount of intensive land use (crops, improved pastures), compared with other more extensive land uses. Future challenges include defining the spatial scale at which land-use and management thresholds are best applied and providing the appropriate information at the required scales. To make appropriate generalizations, I consider ways of accounting for major differences between landscapes that could be used in a national level landscape classification.

Extent and conservation status of remnant vegetation in the Brigalow Belt biogeographic region in Queensland.

V. J. Neldner and B.A. Wilson

Environmental Protection Agency, Queensland Herbarium, Mt Coot-tha Botanical Gardens, Mt Coot-tha Rd. TOOWONG, QLD 4066.

The Brigalow Belt biogeographic region of Queensland extends in a mainly sub-coastal band from St George and Toowoomba in the south to Rockhampton and Townsville in the north. Systematic regional scale survey and mapping by the Queensland Herbarium documents the pre-clearing and current extent of regional ecosystems. Development for agriculture and pastoral activities has been widespread and 59% of the region had been cleared of native remnant vegetation in 1995. Clearing rates have continued to rise over the last decade, with average clearing rates per year of remnant vegetation of 1505 for the 1991-1995 period, 1940 km2 per year for 1995-1997, and 2515 km2 per year for the 1997-1999 period. Half to two thirds of the total amount of land clearing between 1992 and 1997 in Queensland occurred in the Brigalow Belt. Some parts of the region, particularly to the south, have less than ten percent of their area covered by remnant vegetation.

Of the 167 regional ecosystems recognised for the Brigalow Belt, 28 are classified as endangered, 57 are of concern and 82 are not of concern under the Vegetation Management Act 1999. The more productive ecosystems have a higher proportion of their pre-clearing extent cleared, a larger proportion of their remaining extent in smaller fragments and a lower proportion of their remaining extent in reserves, compared to less productive ecosystems. Productive ecosystems also often have a higher proportion of their pre-clearing extent remaining as regrowth or disturbed vegetation, which can have significant conservation value and could be used to compliment the value of undisturbed remnants.

Breeding season movements of the Regent Parrot in relation to fragmented mallee remnants in agricultural land near the Murray River.

[1]David Morgan, [2]Ian Sluiter and [3]Graeme Kininmonth

[1]Department of Zoology, The University of Melbourne, Victoria 3010
[2]Ogyris Ecological Research Pty Ltd, , P.O. Box 698, Merbein, Victoria 3505
[3]Murray Basin Titanium Pty Ltd, P.O. Box 4032, Mildura, Victoria 3502

The presence of a population of the nationally threatened Regent Parrot (*Polytelis anthopeplus anthopeplus*) near a mineral sand mine situated in farmland south of the Murray River in north-western Victoria prompted monitoring of Regent Parrot movement patterns at the height of the breeding season. Mature birds nest in large River Red Gums (*Eucalyptus camaldulensis*) in the riparian corridor of the Murray River and move into mallee vegetation communities within Victoria to feed.

Within the study area, a single large mallee reserve known as the Annuello Flora and Fauna Reserve (35,000 Ha) is separated from riparian plant communities beside the river by mainly cleared cropping land within which mallee survives mainly as discontinuous strips along roads and as small farmland remnants. A recently commissioned mineral sands mine also exists within the middle of the study area. The mine has an expected life of approximately 7 years with bird movement data collected pre-mining and during current mining activities.

Observational data were collected on sampling days by a team of observers placed at a set of sampling points between the river and the Annuello Flora and Fauna Reserve 10 – 12 km away. In data collected at the same time of year over three successive years, Regent Parrots appear to utilise small mallee remnants partly for food and for shelter during feeding, and also for potential shelter during relocation movements through the area. The paths followed by the birds during those movements appear to be highly dependent on the relative positions of the vegetation remnant. Flight paths seem to vary with seasonal factors and state of breeding, but the continued existence and placement of the vegetation remnants may be important to the birds' long-term breeding success in the district.

How does Rainforest Fragmentation Affect Non-flying Mammals on the Eastern Dorrigo Plateau, NSW?

Michelle Cox

Institute of Wildlife Research, University of Sydney, Heydon-Laurence Bld (A08), Sydney, NSW 2006.

One of the most common consequences of human impact on ecosystems is the fragmentation of natural habitats. In Australia, as elsewhere, the effects of habitat fragmentation require urgent attention. This is particularly the case for rainforest ecosystems that cover less than two million ha of our continent. This project aims to determine mammal diversity and abundance in warm-temperate rainforest fragments, and to investigate the importance of a variety of habitat and landscape factors on diversity and abundance.

Thirty-three rainforest fragments, ranging in size from 0.15ha to 997ha, and five sites within continuous rainforest, were surveyed for non-flying mammals on the Eastern Dorrigo Plateau of New South Wales. Mammal species were detected by live-trapping, spotlighting, diurnal transect walks and nest boxes. Vegetation surveys were conducted within fragments and landscape parameters such as area and disturbance were measured on-site, via aerial photographs or through discussion with land-owners.

Seventeen different non-flying mammal species were recorded, the most common being two possums (*Trichosurus vulpecula*, *Pseudocheirus peregrinus*), two native (*Melomys cervinipes*, *Rattus fuscipes*) and one introduced (*Rattus rattus*) rodent, a dasyurid (*Antechinus stuartii*) and a perameliid (*Perameles nasuta*). Preliminary results suggest that mammal species diversity is directly linked with landscape factors, in particular fragment area, while individual species abundance is associated with both landscape and habitat parameters within fragments.

Hollow-bearing trees in the public forests of Northern New South Wales; abundance and distribution now and in the future

Justin Williams

State Forest of NSW, PO Box 168 Wauchope, NSW 2446

Hollow-bearing trees are recognised as a key bio-structural resource in forests providing shelter and nest resources for many wildlife species. They decline or can be lost through natural or anthropogenic processes and take relatively long time periods to replace. Modern forest management practices often include techniques that aim to maintain hollow-bearing trees across the landscape now and into the future at densities that support wildlife populations. These prescriptions usually only consider the actual areas for harvesting and often fail to consider the spatial heterogeneity of existing and future hollow-bearing trees due to environmental variation and historical or proposed management regimes across the forest landscape. This paper examines the current density and spatial distribution of hollow-bearing trees in the public forests of Northern New South Wales from plot level data and mapped strata from a recent large-scale forest inventory project. Scenario models of the future density and spatial distribution and abundance under different management regimes and from a range of recruitment and mortality models are provided. The implications of the densities and spatial distribution of hollow-bearing trees under the range of scenarios for wildlife populations are discussed. Poor understanding of the recruitment and mortality rates of hollow-bearing trees has significant implications on predicted future densities of hollow-bearing trees. Better information on recruitment and mortality rates is required to confirm the effectiveness of management prescriptions.

Does Size Really Matter?
Guidelines for the Retention of Habitat in the Top End.

Brooke Rankmore* and Owen Price

Key Centre for Tropical Wildlife Management, NTU & Bioregional Assessment Unit,
Parks and Wildlife Commission of the Northern Territory, PO Box 496, Palmerston NT 0831

Since European settlement in Australia, the Northern Territory landscape has undergone little and limited land clearing. However, in recent years this situation has begun to change with opportunities emerging to exploit expanding markets for agricultural products. Although there is a substantial body of information on the effects of clearing habitat fragmentation on fauna in other areas of Australia, no information is available regarding how these activities may be affecting the wildlife of this region. Fauna surveys were undertaken in the rural area near Darwin in remnant habitat patches of variable size and isolation, cleared areas and undisturbed "continuous" bush. Results indicate that 95% of species will retained in savanna woodland where 30% of woodland is retained, with half of the area in patches at least 10 ha and with corridors between patches. However, fragmentation was found to negatively affect some mammal and bird species. The outcomes of this research have been used to develop guidelines for the retention of habitat, for future clearing in the Northern Territory.

The Conservation Options for Regional Environments (CORE) trial

Michael Drielsma[1] and Murray Ellis[2]

[1]NSW National Parks & Wildlife Service, PO Box 402, Armidale NSW 2350
[2]NSW National Parks & Wildlife Service, PO Box 2111, Dubbo NSW 2830

Fauna require landscapes where suitable habitat is sufficiently connected in order to facilitate access to resources, exchange of genetic information and re-colonisation following local extinctions. Fragmentation of habitat due to clearing of native vegetation has become a pressing concern for conservation planners faced with the task of ensuring the persistence of species. We investigated options for including spatial configuration considerations into vegetation planning using the Moree Plains Shire Regional Vegetation planning process as a trial. To aid the Moree Plains Shire Regional Vegetation Committee to decide what actions to take and where, we developed a GIS based decision support system that prioritises the landscape for the conservation and revegetation. The system integrates expert knowledge on the habitat preferences and mobilities of ten faunal groups in relation to vegetation type mapping, providing information that will enable the RVC to consider the spatial arrangement of habitat while pursuing vegetation targets.

Ferret use of habitat while foraging: implications for native wildlife

Andrea Byrom

Landcare Research, PO Box 69, Lincoln, New Zealand. ByromA@landcare.cri.nz

Predation by introduced mammalian predators is thought to be the primary cause of population declines for indigenous wildlife in New Zealand and Australia. The idea that habitat features such as ecotonal boundaries between habitat types may predispose wildlife to predation, particularly in highly disturbed or fragmented habitats, is of considerable interest in wildlife management. It is commonly assumed that predators use habitat boundaries to move around their home ranges, however the assumption has rarely been tested. I used a spool-and-line tracking technique to examine foraging movements of 31 adult ferrets (*Mustela furo*) in the Mackenzie Basin, New Zealand (a highly modified grassland/braided river community) from 1997 to 1999. I designed special collars (each containing 1050 m of red thread) to track each individual ferret. Ferrets were released at dusk, and nocturnal movements of each ferret were tracked the next day using GPS. "Spool trails" of individual ferrets were then compared with maps of vegetation cover and topographical information, to determine where ferrets foraged in relation to those features. Ferrets typically moved through their environment using edges such as vegetation cover, bases of river banks, small overgrown stream channels, or sloping terraces. To a lesser extent, pastureland adjacent to the riverbed was also used. Only rarely did ferrets move out onto the open gravel areas of the riverbeds. These results are in accordance with several international studies of predator movements and suggest that river bird nests located on habitat edges may be more susceptible to predation, because ferrets used those areas most during their nocturnal foraging activity. The results have important implications for our understanding of predator movements in habitat patches and in fragmented habitats, and raise two important questions: (1) are some ferrets more likely than others to prey on indigenous wildlife (i.e. could some individuals within the population be considered Arogue predators@)? and (2) can predation risk be predicted spatially (i.e., are river birds that nest on Aedges@ more susceptible to predation by introduced predators than birds that nest in the open gravel of the riverbeds)? I discuss the need for managers to investigate a variety of methods, including manipulating predator behaviour, to reduce predation on wildlife. Non-lethal methods of predator control should be investigated for predator-prey systems in New Zealand.

The effects of a prescribed burn on the small mammals and skinks of a disturbed forest

Angie Penn[a]*, Bill Sherwin[a] and Dan Lunney[b]

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We compared abundance and diversity of three small mammal and three skink species in sites with different levels of pre-existing disturbance in Mumbulla State Forest and the adjacent Biamanga National Park. A low intensity prescribed burn affected about a third of the study sites. *Antechinus agilis* and *A.swainsonii* declined after the prescribed burn and *R.fuscipes* initially increased. In those areas not affected by the burning, the numbers of *A.agilis* and *R.fuscipes* remained high but declined dramatically for *A.swainsonii*. Fifteen months post burn, the numbers of *Antechinus* spp. were still low and in some cases still declining, whereas the numbers of *R.fuscipes* had stabilised and were similar to before the burn. There was a decline in the skink *Lampropholis delicata* after the prescribed burn and numbers were still low fifteen months later. Both *L.guichenoti* and *Eulamprus heatwolei* were affected by the burning but to a lesser extent. *L.guichenoti* recovered fastest, and fifteen months post-burn were in greater abundance than previously. There were no changes to the community structure or composition of species in the forest after the prescribed burning.

Keynote Paper:

Endangered species conservation: A case study of two different approaches

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Historically New Zealand's endangered species conservation efforts have focused on birds. Close order management and extensive use of island refuges have solved many critical conservation problems. The decisions to use these techniques have been clear cut due to the perilously low numbers to which these species have declined and the urgent need for action. Examples of species which have been managed in this way are North and South Island saddleback, Chatham Island black robin, and kakapo.

The new conservation problem facing managers in New Zealand is maintaining biodiversity among extant endangered populations which are geographically dispersed on the mainland. This present numerous challenges among which are, the lack of islands with suitable habitat, techniques to manage mammalian predators to allow recovery, and the high financial cost of these techniques when applied to maintain regional populations. Examples of such species are blue duck, weka, and several taxon of kiwi. With developing techniques efforts to maintain population in situ are in progress.

This presentation compares two current endangered species programmes and examines the merits and potential pitfalls of each.

An overview of threatened species management in Queensland.

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Queensland has 137 threatened fauna and 457 threatened flora species listed under the *Nature Conservation Act 1992*. This paper gives an overview of the work currently undertaken on threatened species within Queensland, including the development and implementation of recovery plans. While some threatened species are managed within the protected area estate, many others occur on private lands. Strategies including translocation, specific habitat protection, and the provision of information to land managers are discussed. Case studies will be used to illustrate community and government participation in these programs. The legislative basis and management implications associated with improving the conservation status of threatened species are considered, and possible future directions for the role of QPWS in threatened species management are outlined.

Securing "beachhead" populations – a critical first step in the recovery of widespread species.

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The distribution of a given threatened species is an important determinant of the strategies to be employed to bring about its recovery. In this regard, species can generally be placed into one of three groups. The first group comprises those species known from only a few localities. The second group is composed of species restricted to a single region. The relatively restricted distribution of species within these groups means that it is often possible to efficiently gain an adequate understanding of species needs and develop appropriate recovery actions. Implementation is aided by the uniformity of issues and limited geographical area over which actions are to occur. The final group is made up of species that have a wide distribution. This group presents a particular challenge to wildlife managers. The community is generally less receptive to implementing restrictive recovery actions for such species. In the absence of detailed information we fall back on generic recovery actions, the effectiveness of which is questionable. It is possible, however, to achieve more effective conservation outcomes for widespread species by localising or regionalising the recovery response. This is achieved through the management of selected populations. The recovery of the species overall is achieved, in the longer term, through securing the future of an increasing number of populations over time. It is important to carefully select the first populations to be subjected to management. Securing the future of these first, or beachhead, populations will be critical to the overall success of the recovery program. Beachhead populations should generally be selected on the basis of (i) their potential to provide a platform from which other populations might more efficiently be brought under appropriate management, and (ii) that there is a high probability of securing their future in the short to medium term.

Population growth rates and wildlife management

Jim Hone

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It is suggested that population growth rate *r* is a key unifying variable linking the many facets of population ecology and management. Population growth rate summarises trends in wildlife abundance, indicating whether populations are increasing, stable or decreasing. Traditionally there has been a focus on identifying the form of density-dependence of population growth rates. Examples are provided. Alternative approaches for estimating the determinants of population growth rates are described, especially relating to demographic and mechanistic approaches and their combinations. Applications of these approaches in threatened species management are discussed.

Learning by doing: implementing a management model for a declining savanna bird species in Kakadu National Park.

Fiona Fraser

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A Habitat Suitability Index (HSI) model has been developed for a declining savanna species, the partridge pigeon, and is being trialed in Kakadu National Park using an adaptive management approach. The HSI model is based on the current understanding of nesting season habitat preferences, and predicts that suitable habitat is in part associated with small-scale patchy burning. An important aspect of the model is that it is intended to be easily used by land managers (Rangers and Traditional Owners) in Kakadu. The model is being tested using a management experiment, and involves the manipulation of management sites with fire.

There are two objectives of this project. The first is to assess how practical it is for land managers to implement the management model, in particular the small-scale burning prescriptions. The second is to begin actively managing habitat for this species. In doing so, as we learn more about the species-habitat relationships, the HSI model predictions (and thus burning prescriptions) can be verified or altered. This talk will describe the ecological basis for this management model, the process of implementing it and the outcomes so far.

Conservation and management of the endangered Plains-wanderer *Pedionomus torquatus* on the NSW Riverine Plain

Damon L. Oliver

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The Plains-wanderer is an endangered ground-dwelling bird, whose closest relatives occur in South America. Currently, the distribution of the national Plains-wanderer population centres on the native grasslands of the NSW Riverine Plains. This region has been the recent focus of broad-scale land use change. Large areas of native grassland are being converted to irrigated cropping land. As a consequence, there is potential for significant impact on Plains-wanderers and their habitat. As part of the Plains-wanderer recovery effort, a state recovery team was formed in 1999. The major recovery actions include broad-scale habitat mapping to identify key areas for protection and enhanced management. The purchase of a large grassland reserve, co-ordinated fox control, and community extention are other recommended actions.

A large-scale API mapping project to identify Plains-wanderer habitat and other native vegetation was undertaken by NPWS and the Western Riverina Regional Vegetation Committee between 1998 and 2001. The mapping area covered some 2.28 million hectares of which 56000 ha (2.5% of total area) was identified as primary Plains-wanderer habitat, and 102 000 ha (4.5% of total area) was secondary habitat. The mapping results indicate that the Plains-wanderer population on the NSW Riverine Plains is approximately 2500 pairs, which is 10% lower than the previous estimate of 5,500 birds. The mapping data are also to be used for making important landscape planning decisions that will protect Plains-wanderers and their habitat. Moderate grazing of Plains-wanderer habitat will continue in the region as it has been identified as important for maintaining structure and species composition.

A structured decision-aiding approach for the establishment of an alternate camp site for the Grey-headed Flying-fox *Pteropus poliocephalus* in Melbourne

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In March 2001, the Victorian Minister for Environment and Conservation announced the establishment of a Task Force to investigate the option of providing an alternative roost site for Grey-headed Flying-fox as part of a broader strategy to alleviate damage to the Melbourne Royal Botanic Gardens. Provision of an alternative roost site was seen as a positive way of reducing numbers of flying-foxes in RBG while still allowing for the conservation of the species in Victoria. A range of sources was used to build a conceptual model of what a potential camp site would look like and a structured decision aiding approach was applied to prioritise options for alternate site establishment. Potential sites were scored using a Multiple Criteria Decision Model (Fandel and Spronk 1983). The decision support tool used engages the decision maker in the process of assigning weights to the criteria selected. Weights were based on the best understanding of the biology of the Grey-headed Flying-fox and the best understanding of the factors that are likely to influence camp establishment including social issues and costs. The use of the decision aiding tool will be discussed with respect to how it assisted in delivery of a result under tight time constraints and in informing an active adaptive management framework required to implement any future relocation attempts. Also the role it may play in the garnering of support for the project from a variety of stakeholder groups, a key factor to the success of any attempted establishment of an alternative camp site for the species, will be explored.

Habitat occupied by the Greater Bilby *Macrotis lagotis* (Marsupialia: Peramleidae) : is fire management important?

Richard Southgate

University of Adelaide

Lee and Cockburn (1985) and Cockburn (1990) proposed that the high fecundity and fast growth of bandicoots allowed them to occupy temporally patchy environments such as early seral states that follow fire and it is now broadly accepted that patchy environments created by fire are important in supporting bandicoot populations particularly those occurring in arid environments (Burbidge, 1988; Gordon, 1989; Johnson, 1990; Braithwaite, 1995). If this notion is correct the habitat occupied by the greater bilby *M. lagotis* would be expected to commonly show sign of recent disturbance by fire. This would provide strong support for the use fire management to improve habitat conditions with an aim of increasing the population abundance of this threatened species. If the notion is incorrect, management should refocus attention toward protecting habitat from other threatening processes.

This study considers whether disturbance from fire was an important feature at sites where bilby sign was encountered across the species' current range and within the Tanami Desert. At 14 sites visited across the species' current range, there was evidence of recent fire at one site, fire-promoted plants ('fire-weeds') were present at seven sites and vegetation cover was sparse at several sites and not prone to frequent fire. Seed from fire-weeds was a dominant part of the diet at six sites however, abundant seed must have been produced at three of these sites in the absence of fire. Overall, it was clear that *M. lagotis* could occupy the complete spectrum of seral habitat states from recently burnt to long unburnt. The impact of fire acting on both habitat and diet was most evident in the northern part of the range of *M. lagotis* such as the Tanami Desert.

Within the Tanami Desert, 209 randomly located plots were visited distributed among three fire age classifications: recently burnt (<2 years old), intermediate (3-6 years old) and old (>6 years old) and three substrate types: drainage line and calcrete, laterite and rock features, sand plain and dune. Bilbies were found in all three fire-age classifications but sign was most frequently found in the more recently burnt class but this was not significant ($\chi^2_{,2}$ =5.0, p>0.05). Generalised linear modelling indicated that proximity from patches burnt in the previous year was important. However, bilbies associated strongly with laterite and drainage line substrate types and the probability of encountering bilby sign also decreased with increasing longitude and mean annual rainfall (as a latitudinal component).

Conservation of the Striped Hyena (*Hyaena hyaena*) in the Khirthar National Park: A Pilot Study.

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This study aims to determine the abundance and distribution of the striped hyena in the Khirthar National Park (KNP), Pakistan. Very little is known about this species, its population and ecological requirements, with the last recorded sighting of these animals in Pakistan being in 1977. This paucity of knowledge is likely to hamper any attempt to conserve it.

The KNP in southern Pakistan covers an area of approximately 3078 km2 providing refuge to a range of rare and endangered fauna as well as housing a human population of 10,500 people. The eastern half of the park was surveyed in three sections through the use of: baited soil plots, road soil plots, bait aided spotlighting, night observations, tracking spoor and direct observations. Anecdotal information about the hyena was also obtained from talking with local villagers.

Over a four-week study period, from the 10/01/01 till 9/02/01, no animals were seen, however baited and road soil plots proved successful with both spoor size and direction of travel being recorded. Hyenas unlike other canids have four toes on both front and hind feet. The front foot is also distinctly larger than the hind foot making their spoor easily distinguishable from other large carnivores such as the caracal (*Felis caracal*) or Asiatic jackal (*Canis aureus*) in the area. Through these recordings and the tracking of spoor, the abundance of the striped hyenas was determined for the eastern half of the KNP.

The results indicate that approximately eight hyenas were found on the eastern side of the KNP. Anecdotal information given by the villagers indicates that poaching of hyenas was still ongoing and that the population was decreasing in size within the boundaries of the national park. There is no current management plan for the striped hyena in Pakistan. It is therefore critical that a management plan be developed and implemented as soon as possible to preserve the remaining population of striped hyena in the KNP.

Reintroduction programs for wildlife conservation: is there a place for tourism?

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Since Europeans settled Australia, the rate of mammal extinctions has increased dramatically. Twenty-seven of our mammal species have gone extinct in the last 200 years, compared with about fifty mammal and bird species in the previous 30 000 years. Many of our animal species survive in only one or two populations in Australia, or in captive breeding programs in zoos. Restoration of these species usually relies on captive breeding, translocation and reintroduction programs. However, these programs are difficult and the costs can be considerable.

Tourism can assist reintroduction programs by increasing public awareness and support of programs and generating revenue. In Australia, there have been a few cases of reintroduction programs which have attempted to use tourism, including Earth Sanctuaries Ltd in South Australia and New South Wales and CALM's reintroduction programs in Western Australia. There have also been some international examples, such as in South Africa where many privately owned game reserves have reintroduced native animals. There are a number of important policy and legal issues which affect the success of attempts to integrate reintroductions and tourism. This paper reviews some of the key issues affecting such attempts, and makes preliminary recommendations for how reintroductions and tourism could be better integrated.

Koala Habitat and the NSW Native Vegetation Conservation Act 1997. Outcomes of a project for dealing with Koala habitat in RVMPs

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In NSW koalas are a threatened species listed as 'Vulnerable" on Schedule 2 of the *Threatened Species Conservation Act 1995* (TSC Act). As such a number of legislative requirements apply to the koala with respect to environmental and land use planning.

The *Native Vegetation Conservation Act 1997* (NVC Act) requires that certain matters must be dealt with when preparing a draft Regional Vegetation Management Plan. One of these matters relates to "the conservation of native vegetation and native species (particularly threatened species) and their habitat" (sec 27 (1)(a)).

Additionally, sec. 27 (2) of the NVC Act requires that "in preparing a draft Regional Vegetation Management Plan, if any part of the land to which the plan is intended to apply is core koala habitat within the meaning of *State Environmental Planning Policy No 44 – Koala Habitat Protection*, the plan must make provision, consistent with any guidelines under that Policy, for appropriate protection and management with respect to that habitat."

Sec 32 (2) of the Act also requires that "the Minister for the Environment may make recommendations in respect of the whole plan, but should have particular regard to any comments provided by the Director-General of NPW under section 26 (4) and to any *provisions of the plan relating to the protection and management of koala habitat* as referred to in section 27(2)."

This paper presents the outcomes of a project carried out by the NSW National Parks and Wildlife Service, Conservation Programs and Planning Division Coffs Harbour to address the requirements of the Act in making provision for the identification and appropriate assessment of koala habitat in Regional Vegetation Management Plans within north-east NSW.

Movements and habitat use by Regent Honeyeaters outside the breeding season: a radio tracking study

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The Regent Honeyeater *Xanthomyza phrygia* has declined in recent decades and is now nationally endangered. Many of its breeding sites are known but its location outside the breeding season is poorly known, which hampers conservation of suitable habitat.

In 2000/01 a radio tracking study was initiated in the Capertee Valley, central NSW, to determine the movement patterns and habitat usage of Regent Honeyeaters during an eleven week period immediately following the breeding season. Radio-tags were fitted to 16 Regent Honeyeaters in early December. By mid-December, without the benefit of radio telemetry, a conclusion would have been drawn that the birds had left the valley, as is reported most years. The radio-tagged Regent Honeyeaters, along with other Regent Honeyeaters that were not tagged, were located in scree slope forest dominated by Western Scribbly Gum *Eucalyptus rosii*, Grey Gum *E. punctata* and Broad-leaved Ironbark *E. fibrosa*. This forest type had previously been considered as generally unsuitable for Regent Honeyeaters. Distances moved by the tagged birds at this time was short, typically only a couple of kilometres from their initial point of capture.

During late December 2000 to mid January 2001 flowering *E. rosii* was most often the core tree species utilised with Regent Honeyeaters largely feeding on insects. No instance of feeding on the nectar of this species was observed. In late January *E. punctata* commenced flowering and there was an immediate shift by Regent Honeyeaters to foraging on the nectar of this tree.

With the advent of the flowering of *E. punctata* the tagged birds initiated longer distance movements, up to 20 kilometres being recorded for two birds. This suggested that the widespread availability of a nectar supply was conducive to more adventurous "wanderings".

It remains uncertain if the behaviour of Regent Honeyeaters in this study is typical or an artefact of the conditions prevailing at the time. The study should be repeated with an effort made to extend the period that the birds can be monitored. Regardless, it appears that the *E. rosii/E. punctata* forests that commonly occurs on the scree slopes around the Wollemi and Goulburn River National Parks are of importance to this significant population of Regent Honeyeaters

Is there HaRM in State Forests' pre-logging and pre-roading surveys ?

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The Hastings River Mouse *Pseudomys oralis* has been considered to be very rare in New South Wales. Only a few studies have been undertaken on the biology and ecology of this species and its distribution and range is patchy. Under the terms of the Threatened Species License, State Forests of NSW are required to conduct habitat assessments and trapping surveys in areas known or predicted to be suitable for the species. Historical trapping surveys for this species led researchers to the conclusion that the species was elusive and difficult to trap. In the last two years SFNSW staff have been undertaking surveys which indicate that the species is easy to trap when present and has broadened our understanding of habitat values for this species. This paper will present results of trapping surveys throughout the upper and lower north east of New South Wales. We will describe how these results are translated into prescriptions which exise areas from logging as a means of managing the species and its habitat.

The development of a follicle culture system for macropodid marsupials and its application in the management of threatened species.

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The ovaries of female mammals contain many more oocytes than an animal will ovulate during her reproductive lifetime. Though the death of a female means the end of her reproductive output, it may be possible to salvage her reproductive potential by harvesting oocytes post-mortem. This is a particularly pertinent consideration for threatened species. Ovaries can be excised from a deceased female and transported to the laboratory where, in theory, a range of assisted reproductive techniques can be employed to generate live, healthy offspring. This would require the development of a number of techniques including an appropriate culture system to mature the oocytes (*in vitro* maturation or IVM). The complex requirements of the developing oocyte are not fully understood therefore follicles, which are the structural units in which oocytes grow and mature, are usually cultured rather than isolated oocytes. The development of IVM systems for laboratory and domestic eutherian mammals is well documented (1) and the technology has also been applied to endangered species (2). There are however few reports on the application of this work in marsupial species. The aim of this study was to develop an *in vitro* oocyte maturation system for macropodid marsupials.

Excised ovaries of tammar wallabies (*Macropus eugenii*) were dissected to isolate preantral follicles. These follicles (n=55) were cultured individually in drops of medium (Dulbecco's modified essential medium with various additives) at 37°C in a humidified gas environment of 6%CO_2 in air for 4 days. Follicles were measured and observed each day and the length and width were recorded and used to calculate a cross-sectional area. Growth rates were expressed in terms of proportional increase in length, width and area over the culture period. At the end of the culture period, the general condition of the outer follicular layer (theca) was evaluated as an indicator of follicle integrity.

Almost all follicles (54/55) increased in either length or width over the culture period and the average increase in length, width and cross-sectional area was 15%, 17% and 35%, respectively. At the end of the culture period the condition of the thecal layer was good to excellent for most follicles (48/55) suggesting that the cultured follicles had good structural integrity.

The proportional increase observed in these follicles was significantly lower than that reported for other mammalian species (1) indicating that modifications to the system are required to achieve optimal follicular growth. It is also necessary to determine the influence of the culture system on the maturation and competence of the oocyte. This preliminary work has shown, however, that it is possible to grow macropodid ovarian follicles in a culture system based on systems developed for eutherian species. The development of a successful *in vitro* oocyte maturation system for marsupials would not only generate general information on the biology of marsupial oocytes, but also have applications in research and species conservation.

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Genetic diversity and gene flow among Green and Golden Bell Frog (*Litoria aurea)* populations

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Green and Golden Bell Frogs (*Litoria aurea)* were once considered to be one of Australia's more common Hylids. This species, however, has been in decline for the past 30-40 years, and is now listed as endangered in New South Wales under the Threatened Species Conservation Act, 1995. Although the Green and Golden Bell frog still persists from the far North Coast of NSW to East Gippsland in Victoria, remaining populations are mostly small and fragmented. The viability of existing populations may have been undermined by local population bottlenecks and increased isolation of breeding colonies. It is probable that these events have led to a reduction in genetic variability through inbreeding and genetic drift, with the possibility for a loss of evolutionary potential. A panel of *L. aurea* -specific microsatellite markers was developed to analyse levels of genetic variation within and between populations. Surprisingly, preliminary analysis of southern catchment populations indicates relatively high levels of allelic diversity (A = 6.5 to 7.5) and heterozygosity (He = 0.57 to 0.81). Furthermore results indicate low levels of genetic differentiation and high levels of gene flow between populations within this catchment.

The management of foxes in Victoria's Parks: an Adaptive Experimental Management.

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Parks Victoria (PV) currently invests considerable amounts of operating funding and time in order to control foxes on many of its reserves. Most of this control work is based on either deployment of buried 1080 baits, spotlight shooting, or a combination of both. The intensity with which these activities are carried out (i.e. the percentage of a reserve that is covered and the frequency with which poisoning and shooting are undertaken) varies within and between reserves according to the perceived level of threat posed by foxes, the accessibility of the terrain, and the resources available for fox control. In a broad sense, the different intensities with which PV controls foxes at various locations can be thought of as representing a range of fox control strategies. Currently, PV has no process that allows it to formally assess the performances of these strategies in terms of their effect on the density of foxes or their prey. As such, the relative cost-effectiveness of PV's fox control strategies remains unknown. If PV can systematically relate the conservation benefits achieved through fox control to the intensity (and hence cost) of the strategies it employs, it will be able to address a number of key questions:

- How do the costs and benefits of fox control vary with different spatial intensities of application?
- How do the costs and benefits of fox control vary with different temporal intensities of application?
- Under what circumstances can buffers be used to increase the efficiency of fox control (i.e. reduce required spatial or temporal frequency with no loss in benefit)?
- What are the key environmental factors that affect the efficiency of fox control in different environments?

While these questions are obviously critical to PV's capacity to resource and target fox control efficiently, they will also be critical to the organisations longer-term capacity to contrast the benefits of investment in fox control with investment in other conservation activities.

Adaptive experimental management (AEM) offers the opportunity to systematically link the benefits and costs to different intensities of fox control. This paper documents how AEM is to be used to address key questions about fox control on reserved lands, and outlines the experimental design for doing so.

Research Initiatives at the Arid Recovery Reserve in Northern S.A.

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The Arid Recovery Project is a joint conservation initiative which facilitates restoration of arid zone ecosystems through on ground works, applied research and industry/conservation partnerships. The project has constructed a 1.8m high rabbit, cat and fox-proof fence and removed all rabbits, cats and foxes from a 60km² Reserve north of Roxby Downs in arid South Australia. The project has successfully re-introduced four threatened species; the Greater Bilby, Burrowing Bettong, Greater Stick-nest Rat and Western-barred Bandicoot. This paper reviews and summarises project initiatives to date including designing and testing a cat-proof fence, strategies for the complete eradication of rabbits on a large scale and successful re-introduction protocols for threatened species including timing and release strategies. Long term management plans for the area will also be outlined including the establishment of large buffer zones, the use of soak areas and eventually releasing animals outside the fenced Reserve. A summary of some initiatives follows.

A successful cat-proof fence was designed using a small 20x20m pen and 33 wild-caught feral cats. Feral cats were placed within the pen individually and their attempts to escape were recorded on video. Although the first cat escaped within 35 seconds, alterations to the fence design over a 6 month period eventually led to a cat-proof design.

Rabbit densities, conservatively estimated using spotlight counts, at Roxby Downs prior to Rabbit Calicivirus typically averaged 150 per km². The release of RCD led to a short-term decline in density to approximately 2 per km², providing a window of opportunity for large scale rabbit eradication. The 60km² area was divided into 4 manageable units of between 8 and 30km², each separated by a low rabbit-proof fence. Rabbit control methods included poisoning with 1080, shooting, fumigation, trapping and explosives. The optimal timing and order of methods is outlined and the initial vegetation response is illustrated.

Re-introduction of threatened species began in 1999 with the Greater Stick-nest Rat. This native herbivore now numbers in the hundreds but undergoes an annual abundance cycle, with low numbers in late Summer due to high mortality from heat and low reproductive output, and high numbers in Spring after Winter breeding. Re-introduced Greater Bilbies, however, appear unaffected by the high summer temperatures with high reproductive output in the summer months when invertebrate numbers are high. Recommended re-introduction protocols for all 4 re-introduced species vary and include releasing Stick-nest Rats in Autumn and using a 8ha acclimatisation pen for up to 1 month after first releases. The costs and benefits of providing supplementary food and water are discussed.

Population dynamics of the quokka (*Setonix brachyurus*) (Macropodidae: Marsupialia) in the northern jarrah forest of Western Australia.

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The quokka (*Setonix brachyurus*) (Quoy & Gaimard 1830) is a small macropodid marsupial that is listed as vulnerable on Western Australian and Commonwealth legislation. Extensive trapping and population estimation using mark-recapture techniques of eight quokka populations revealed numbers attained a maximum of 36 individuals while populations at some sites extant in 1996 are now presumed extinct. Fecundity is such that population numbers were expected to be substantially higher following the minimisation of predation pressure through the initiation of fox control. Other factors inhibiting the anticipated population growth are discussed and management recommendations for extant quokka populations are considered from a metapopulation dynamics perspective.

Assessing the effectiveness of a 1080 fox baiting program for brush-tailed rock-wallaby colonies in the Hunter Valley/Hawkesbury region of NSW.

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In 1996, an experimental study was established to determine the effect of intensive and repetitive fox control implemented around colonies of the brush-tailed rock-wallaby (BTRW), in the Hunter Valley/Hawkesbury region. 1080 fox control was implemented between March 1997 - February 2001 on private land adjacent to BTRW colonies at two areas in the Hunter: Broke and Milbrodale. Poison baits were laid for one week of each month, at 500m intervals along fire trails below the rock-wallaby colonies and extending out for approximately 6 kms on two sides on the colonies. The total area baited at Broke was 40km2 and at Milbrodale 20km2. Two other sites, Watagan Mountains/Congewai Valley, and St. Albans, were left unbaited, to act as experimental controls. Spotlight counts of the fox populations at both Broke and Milbrodale, indicate that although fox abundance was lower following the commencement of baiting, these lowered densities were not substantially different from fox densities at the non-baited sites.

The relative abundance of BTRW populations at both baited and unbaited sites was monitored using permanent pellet quadrats (3X1 m) distributed systematically within the complex rocky areas of the colonies. Quadrats were cleared on a 6-week basis to coincide with the beginning, middle and end of a season, with data for the individual quadrats pooled to give a seasonal total. Analysis of the slope of regression lines fitted to the pellet data (across time; all seasons summer 1997 to summer 2001), revealed no significant difference ($P>0.05$) between baited and unbaited colonies. A similar analysis of the slope of regression lines fitted to the summer pellet counts only, also showed no significant difference ($P>0.05$) between baited and unbaited colonies. Examination of the slopes of the individual colonies, reveals that there was variation between colonies within treatment. Only one baited colony shows a positive slope. These results suggest that there was no overall increase in rock-wallaby numbers in concurrence with the fox baiting program.

The observed variable responses between colonies within treatments created difficulties in the interpretation of the results. However, an examination of the rates of change of the slopes of summer wallaby pellet counts (1997 to 2001), indicated that the baited colonies were declining at a significantly slower rate than non-baited colonies ($P<0.01$) and that this result was dependent on the summer 2001 data. These slower rates of decline suggest that an effect of baiting may be just beginning to show. Baiting may be having an effect by preventing more rapid decline of the BTRW colonies. This result and that of the spotlight counts indicate that a more intensive baiting program (spatially or temporally) may be required to reverse the downward trend of the BTRW population.

An assessment of fox activity on the survivorship of reintroduced eastern barred bandicoots

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Eastern barred bandicoots are now restricted to a single wild population, and recovery efforts are focussed on establishing new populations at reintroduction sites. To date the success of these reintroduction's has been variable and post-release survivorship has not been accurately quantified. Despite the implementation of predator control programs at release sites it is believed that predation by foxes is largely responsible for the post-release loss of bandicoots. In an attempt to better understand the relationship between fox activity and bandicoot survivorship an intensive fox control and monitoring program was established at Woodlands Historic Park, near Melbourne, prior to the release of 10 eastern barred bandicoots. Despite constant levels of bait take by foxes, fox activity remained high. Eight of the ten released bandicoots were recaptured following their release and by the end of the project 70% of the released animals were still alive. Post-release weight loss appeared to play a larger role in bandicoot mortality than did predation. It is hypothesised that the presence of suitable refugia for bandicoots allows the persistence of a low density population despite high predation pressure.

Uptake of baits by target and non-target animals during control programmes for foxes and wild dogs

Alistair Glen

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The introduced red fox (*Vulpes vulpes*) is a serious environmental and agricultural pest in Australia, due to its impacts on livestock and native species. Similarly, the wild dog (*Canis lupus*) is considered a major pest of the sheep and cattle grazing industry. Control programmes for these species involve the distribution of poison baits on grazing properties and conservation estate. Concern has been raised over the potential effects of poison baiting on native, non-target animals, in particular the spotted-tailed quoll (*Dasyurus maculatus*).

This study investigated methods for monitoring removal of baits used in vertebrate pest control, and tested various procedures which might reduce the removal of baits by non-target animals. Simulated baiting programmes were conducted in the central and northern tablelands of NSW, and the removal of non-toxic baits was monitored using remote photography and observation of tracks in sand plots. Animals which removed baits included foxes, wild dogs, spotted-tailed quolls, Australian brush-turkeys (*Alectura lathami*), superb lyrebirds (*Menura novaehollandiae*) and various small mammals (not identified to species).

Monitoring bait removal using sand plots achieved a high degree of accuracy during dry weather, but was highly unreliable when rain fell. Quolls were able to detect and excavate baits buried at 7 cm, but were significantly less likely to remove baits buried under the ground surface than those buried in bait stations constructed above the ground surface. With a spacing of 400 m, individual quolls were recorded removing baits from 3 - 4 bait stations in one night.

In a pilot study to investigate whether quolls might avoid the odour of a potential predator or competitor, fox faeces appeared ineffective as a deterrent. The results of this study have important implications for the future planning of vertebrate pest control programmes.

Effect of reduced rabbit numbers on the reproductive success of wedge-tailed eagles (*Aquila audax*) in central-western New South Wales.

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From July 1994, spotlight counts have provided an index of the abundance of species that occur in the diet of wedge-tailed eagles at Lake Burrendong (32^0 42' S, 149^0 10' E). Of the two potential major prey items, the abundance of eastern grey kangaroos has increased in from 8.0 km^{-1} to 16.0 km^{-1} whilst the rabbit density fluctuated from a drought-induced low of 5.0 km^{-1} in 1994 to 30.0 km^{-1} in 1996 and, following the initial epizootic of rabbit haemorrhagic disease (RHD) in 1996, has remained at about 2.5 km^{-1}.

Since October 1996 the location of territories, the number of active nests, and the number of chicks at 4-6 weeks of age, at fledging and at three months post-fledging have been monitored for up to 15 eagle territories. Productivity has been around 1.2 chicks per territory except in 1998 when only 0.4 chicks per territory were recorded. In all years fledging success has been high at around 76% apart from 2000 when the success dropped to 47%. Over five years there have been 3.3 fledged chicks per pair, which appears to be a relatively high rate for a long-lived species.

Food remains from under active nests collected before, during and after the breeding seasons, indicate that, despite their low availability since the arrival of RHD, rabbits remain an important source of food for wedge-tailed eagles.

The data from Lake Burrendong show that if rabbit numbers are reduced to a level of about 2-3 rabbits per spotlight km, wedge-tailed eagles do not switch to alternative prey but continue to use rabbits as a major prey source and maintain reproductive rates and territory sizes. The importance of rabbits in post-fledging survival is unknown. This information is needed to determine whether the wedge-tailed eagle population can persist at pre-RHD levels, and whether the observed reproductive success is consistent with long-term trends deduced from data collected by Birds Australia.

Comparative forage requirements of kangaroos and sheep: a reality check.

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The factor of 0.7 DSE (dry sheep equivalent), by which kangaroo numbers are usually translated into forage lost to sheep, is certainly an over-estimate, and possibly a gross overestimate. The 'traditional' value of 0.7 is derived from the resting metabolic rate of marsupials being about 70% that of eutherians. Two factors which militate against the application of this to population forage requirements appear to have been overlooked. The first is that the comparison applies to (resting) animals at comparable body weight. However, the 'average' kangaroo in a population is much lighter than the 'average' sheep. Taking body weight into account, the DSE should be about 0.4. But applying this, derived from measurements of resting metabolic rate, to the populations as a whole, assumes that the 'field' metabolic rate (FMR), also, of marsupials is 70% that of eutherians. Two quite independent (and long published) studies measuring FMR in marsupials and eutherians, however, challenge such an assumption very strongly and, if validated by further work, suggest that the real DSE for kangaroos is likely to be as little as 0.15-0.2. This would mean that kangaroos are a much smaller component of the 'total grazing pressure' than is generally accepted. Such a result is in strong contrast with a recent modelling study which claimed that a kangaroo harvest of about 10% could lead to a 25% increase in wool production. Even a DSE of 0.4 instead of 0.7 raises a significant question about the assumption that major benefits flow to wool producers from reducing kangaroo numbers. If values closer to 0.15-0.2 are substantiated by further research, the hope of getting a significant improvement in wool production by pest control of kangaroos is probably doomed to failure.

Densities and management of Greater Gliders (*Petauroides volans*) within State Forests of the Hunter Region.

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The Greater Glider is targeted in surveys conducted as part of the regular pre-logging assessment of all compartments within estate managed by State Forests of NSW in the Hunter Region. Surveys conducted since 1998 consisted of walked spotlight transects undertaken by 2 people using 50W spotlights. The density per hectare of Greater Gliders detected along each spotlight transect was calculated and statistical comparison of densities was undertaken. Current State Forest management practises of the Greater Glider and large forest owls is discussed.

Defining conservation units for the ringtail possum genus *Pseudocheirus.*

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This paper reports the findings of morphometric and mitochondrial DNA studies which were applied to examine variation within the genus *Pseudocheirus* with the aim of making conservation management proposals. The most recent taxonomic revision of the genus divides the genus into two species, *Pseudocheirus peregrinus* found in eastern mainland Australia, the Bass Strait islands and Tasmania, and *Pseudocheirus occidentalis* found only in south-western Western Australia. Although *P. peregrinus* is abundant throughout its range, *P. occidentalis* is in decline and has been recognised by the Western Australian government as having rare and endangered status.

The phylogeny of *Pseudocheirus* was reconstructed using sequence data from the mitochondrial gene *cytochrome b* (*cytb*). *P. peregrinus* and *P. occidentalis* were found to be reciprocally monophyletic, indicating long-term genetic separation. Within *P. peregrinus* several geographic regions were also found exhibit reciprocal monophyly. No variation was found within *P. occidentalis*. Analysis of Molecular Variance, Φ_{ST} and F_{ST} calculations confirmed the groupings identified in the *cytb* phylogeny within *P. peregrinus.* Multivariate morphometric techniques were used to examine variation in cranial and dental measurements of both species. Specimens from Western Australia could be clearly distinguished from all other sampling sites by several dental and cranial measures. Tasmanian specimens where found to be distinct from mainland specimens for several cranial measures.

The results of these studies indicate that *P. occidentalis* is significantly different from *P. peregrinus* both genetically and morphologically; thus *P. occidentalis* warrants management as a separate species to preserve diversity in the genus *Pseudocheirus*. Within *P. peregrinus* several distinct groups were identified that we suggest should be managed as separate units.

Monitoring wildlife health in Australia : Case studies and a model for coordination.

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Why monitor wildlife health?
Wildlife populations are more intensively managed now than ever before. Biologists, conservationists, and researchers are monitoring and handling both threatened and extensive populations of native and feral animals with increasing frequency. Modified farming practices and increased land clearance bring agricultural animals and wildlife into closer proximity than ever before. In the past decade, these changes have led to an increase in the number of "emerging diseases" involving wildlife throughout Australia.

A series of wildlife health incidents will be discussed to illustrate the significance of wildlife health to Australia's agroeconomy, human health, wildlife management and conservation programs, and biodiversity. The benefits of monitoring to demonstrate disease freedom will also be discussed.

How should we monitor wildlife health?
While the principles of wildlife health monitoring have been well established overseas through wildlife health cooperatives, surveillance in native and feral animals in Australia has been patchy, isolated, and existing information is often not freely available. There is an ideal opportunity in Australia to implement active and passive wildlife health monitoring, training and education programs, information management, and communication networks. We have all the essential elements required to establish an effective national wildlife health monitoring program. How do we bring these elements together?

The Australian Wildlife Health Network is being established to coordinate and promote wildlife health monitoring and investigations across Australia. While our founding principles are built on a tripartite or triple bottom line approach – environmental/ conservation, economic/trade, and social/human health - financial commitment has only been forthcoming from agriculture. Why? When the conservation value of wildlife and the increasing commercial value of wildlife for tourism and game meat also underscore the need for national coordination of wildlife surveillance information management systems.

An integrated approach to the collection, reporting and follow up of surveillance information essentially must involve the key stakeholders – agriculture, wildlife/conservation, industry, human health and the community. Wildlife – native and feral animals – are managed and accessed by such a diversity of individuals and organisations, as distinct from domestic livestock, that a unique system, which may involve incentives, is desirable. The development of a national database linked to a website that can be easily accessed to enter data will form the core of this system, with reporting made easy through regular teleconferences. Only with such information will it be possible to make informed policies regarding public health and the health of domestic and native animals.

Symposium 4: Wetland Management

Keynote Paper:

Managing wetlands, their wildlife and the threats

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Wildlife management has traditionally focussed on species or populations with a secondary emphasis on habitats and threats. For example, research on waterfowl in Australia, the best known avian group, investigated breeding biology, population dynamics, feeding ecology and behaviour of the main game species of waterfowl from the1950s to1990s. Wildlife management was implementation of this information ed to increase waterfowl populations. Hunting, the major threat identified appeared to have little but a local transitory effect on waterfowl populations. Research on threats to wetlands and their ecology were comparatively rare, particularly at the scale necessary to demonstrate the ecological effects. Wetland ecology and management was more often regarded as an isolated branch of aquatic ecology, seldom linked to river management or research. Wetland reserves and Ramsar sites were identified, figuratively fenced and often forgotten under the misapprehension that their values would remain intact. Similarly the interaction between river and wetland policies were poorly defined. Research around the world in the last ten years has demonstrated that water resource development on the world's rivers has had a major impact on wetlands, including floodplains. Wetlands used for water storages have had their ecology fundamentally shifted from variability to constancy while extensive floodplains on major rivers no longer receive the water they used to because it is now stored for human use in dams. Structures, including roads and levees have further isolated parts of floodplains on many rivers. These factors have detrimentally affected species richness, abundance and biological processes (e.g. breeding, recruitment) of wildlife. The future challenge for managing wetlands for their wildlife will be to focus on the right spatial scale of management, particularly in relation to river management. Costs of new water resource developments need to be debated in the community and whatever opportunities exist for restoring wetlands need to be embraced.

ARIDFLO - modelling ecological responses to the variable hydrology of large rivers in the Lake Eyre Basin

Julian Reid

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Australian arid zone intermittent rivers are typically unregulated and maintain a high level of biodiversity and ecological health. Understanding the biotic responses and ecosystem functions found in these rivers requires an understanding of the hydrology of the system. The rivers of the Lake Eyre Basin are typified by highly variable hydrological regimes and a paucity (often a complete absence) of hydrologic and hydrographic data to describe these flow regimes. Yet hydrological variability is seen to be a key in understanding how these rivers function ecologically and support, at times, large populations and production of fish and waterbirds. This paper presents a case study of a multi-disciplinary research project (ARIDFLO) examining hydrology-biology relationships in some of these river systems. Data on the distribution and abundance of riparian vegetation, algae, zooplankton, macroinvertebrates, fish and waterbirds are currently being collected at 40 waterbodies across three rivers over a two-year period. Hydrological patterns are being modelled using data from remote sensing imagery, onsite hydrologic data loggers, and the few gauging stations in the basin. One aim of the project is to identify those facets of the hydrology that best correlate with measures of river health and biodiversity value, e.g. fish density, assemblage taxon richness, initiation of breeding events, and breeding event size. This information can then be used to assist policy decisions about use of water resources in the Lake Eyre catchment and guide river restoration in the Murray Darling Basin. Some preliminary results are presented.

Rehabilitation of the Murray – Darling Wetlands

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The NSW Murray Wetlands Working Group is an incorporated body consisting of community and Government representatives. The focus of the Group is to rehabilitate wetlands associated with the Murray and Darling Rivers.

An example of our work is the rehabilitation of Moira Lake within the Barmah-Millewa Forests. Moira Lake was a substantial fishery during the late nineteenth and early twentieth centuries, that was severely impacted on by river regulation. In 1996 the Group installed regulators on the Lake's inlets, allowing drying of the lake bed for the first time in 60 years. Subsequent dryings have produced a staffering regeneration of native vegetation.

In the summer of 2000 / 01 the Group was able to allocate 26,500 ML of its Environmental Water Allocation to supplement the Barmah-Millewa Environmental Flows. The additional allocation water allowed the Lake and surrounds to benefit from an extended wetting phase that provided the resource for the most successful and productive bird breeding event in 30 years.

Waterbirds and irrigation storages in the Gwydir Valley, NSW.

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The irrigated-cotton industry has built over 200 water storages in the lower Gwydir Valley, northern NSW, averaging about 60ha each. Together these dispersed storages cover c.120 km^2, 1.13% of the landscape. Naturally flooding land covers 1.20% and natural wetlands only 0.14%. Irrigation storages are much more widely dispersed across the landscape than are natural wetlands. What do these irrigation storages contribute to the maintenance of biodiversity values, particularly waterbirds, in the region?

From September 1999 to August 2001, we identified and counted waterbirds approximately monthly on a representative sample of 19 wetlands between Moree and Collarenabri. Total counts on individual storages in any month ranged from zero usually to a few hundred, but occasionally as many as 1000, birds. Most storages consistently carried very few birds; only a few storages consistently held many birds. Waterbird species differed in their distribution across storages and across months. Some bird species were regularly numerous on only a few storages, and absent from the rest. Others occurred across a broad range of the storages and in most months. We discuss factors influencing the numbers, and fluctuations, of species on storages. Extrapolating from our sample, we believe that irrigation storages in the whole valley are unlikely to carry more than 30,000 waterbirds in the average summer month, and as few as 10,000 in winter.

Most storages provide minimal opportunities for waterbirds to breed; but one-third of sampled storages contain dead trees standing in water, on which some birds may nest. We recorded darters, cormorants, egrets, herons, spoonbills and ibises nesting in late summer (February to April) in both 2000 and 2001, on 4 and 6 storages respectively. However, each year most birds abandoned nests when water levels in the storages were drawn down. Such management reduces the value of the storages as breeding sites for birds.

We discuss the potential for irrigation storages to contribute much more to biodiversity values through simple modification of their structure and management.

Duck Hunting and Wetland Conservation: Compromise or Synergy

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Duck hunting is an issue that generates both benefits and costs to society. In the first instance, hunters enjoy benefits from engaging in their sport whilst those who have ethical concerns regarding the shooting of ducks endure costs. At another level, some in the community fear that duck hunting puts pressure on the continued ecological viability of the hunted species whilst others argue that the demand for hunting provides sufficient economic incentive for wetland conservation. Put simply, some fear that duck hunting will cause a cost to society in lost biological diversity whilst others suggest that it will benefit society through enhanced biological diversity protection. Hence it is not suprising that duck hunting remains controversial, with different groups in society taking opposing views. Whether society as a whole should permit or restrict duck hunting is to some extent an empirical question: Are the costs to society of allowing duck hunting greater or less than the benefits it generates. Evidence presented in this paper goes someway to answering this question. The extent of the benefits enjoyed by people who hunt ducks in the Upper South East of South Australia are estimated using the travel cost method. The ethical costs born by the general community because of duck hunting are estimated using the choice modeling technique. Finally the arguments regarding the ecological impacts of hunting are considered in terms of the incentive effects hunting has for wetland conservation in the Upper South East with reference to the activities of Wetlands and Wildlife.

Application of remote sensing to locate potential Brolga *Grus rubicundus* breeding wetlands in south-western Victoria.

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Brolgas (*Grus rubicundus*) are listed as vulnerable in Victoria and population decline in south-western Victoria has been attributed to drainage of breeding wetlands. This research investigated the use of satellite imagery to identify potential nesting habitat for Brolgas in south-western Victoria in wet (1992) and drier (2000) years. Known Brolga nest sites were located in the Skipton area of south-western Victoria. Supervised classification procedure was applied to Landsat TM data to locate spectrally similar land use categories. Thematic maps were produced and the area of potential nesting habitat estimated providing a landscape assessment of existing and potential Brolga nest sites. Accuracy assessment of the classified Landsat image revealed 98% of predicted nesting habitat was correctly classified. Proximity analysis of the distribution of nest sites provided explanations for potential, but unused, nesting habitat.

The majority of known nest sites were on private land that is susceptible to drainage. Long-term conservation of the south-western Victorian Brolga population will depend on resolving the conflicts between economic and community conservation issues.

Sustainable harvest rates for magpie geese in northern Australia

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Huge, apparently thriving, flocks of magpie geese (*Anseranas semipalmata*) are an iconic symbol of the wetlands of the 'Top End' of the Northern Territory. Yet by the turn of the last century, this species had vanished from most of its former range in south-eastern Australia, due probably to deliberate destruction and habitat modification. In northern Australia, magpie geese populations are subject to both recreational hunting and indigenous off-take, but the long-term sustainability of these activities is uncertain. To address this issue, we used existing autecological and environmental data to develop a stochastic stage-structured matrix simulation model of the population dynamics of magpie geese, with survival rates following a logistic density dependence function. A plausible range of values for the maximum intrinsic rate of population increase (r_m) was determined via a sensitivity analysis of the reproductive and survival rates, and through body-mass allometry. Our results suggest that harvests of the order of those thought to be occurring in some regions may be unsustainable, unless density dependence of population responses to harvest is very strong and environmental variation is weak, in contrast with previous predictions.

The Importance of Small Coastal Wetlands in Wader Conservation and some considerations for management. The Moruya Estuary: A Case Study.

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The Moruya estuary is a typical small coastal estuary (c100ha) on the NSW south coast. A ten year systematic study reveals that sixteen trans-equatorial wader species, six resident wader species and one trans-Tasman species are regularly recorded on the estuary. These species comprise almost the entire suite of waders that are regularly recorded on the east coast of Australia.

Trans-equatorial species use the estuary either as a staging post on migration or as a permanent destination during the austral summer. Approximately 200 individuals are recorded daily during spring, 130 daily during summer and autumn and 60 daily during the winter. Seven resident waders occur on the estuary, and four, Red-capped Plovers, Pied Oystercatchers, Masked Lapwings and Hood Plovers regularly breed there or on the adjacent beaches. Double-banded Plovers, migrants from New Zealand, use the estuary as both a staging post and permanent destination during the autumn and winter.

Coastal estuaries such as the Moruya estuary face a number of issues which require careful management considerations. These include:

- disturbance of feeding and roosting sites.
- predation of adults, young and eggs.
- natural succession changes to vegetation which make areas unsuitable for waders.
- inappropriate development of foreshores and waterways.
- management responsibility being split between different government agencies.

While the numbers of waders utilising the Moruya estuary may seem small by international standards, this study demonstrates the cumulative importance of such estuaries. Their proper management may be vital to the long term viability of wader populations along the east coast of Australia.

A closer look at Mary's para-sites: Are exotic pastures a threat to the avifauna of the Mary River Floodplains, Northern Territory?

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The seasonally inundated coastal floodplains of the Northern Territory, including the nationally significant Mary River system, contain Australia's largest relatively unmodified wetlands. The conservation significance of the Mary River floodplain wetlands derives not from the incidence of rare or unique wildlife communities, but its unusually high productivity. This high productivity has been attributed to the complex mosaic, both temporal and spatial, of wetland habitats. The Mary River wetlands consistently support a rich avifauna and serve as a major breeding habitat for waterbirds such as magpie geese.

The diversity and richness of the Mary River wetlands have attracted a range of interests to exploit their natural resources, including pastoralism, and in recent years exotic pastures such as para grass (*Urochloa mutica*) have been planted in many areas. These invasive grasses have subsequently spread onto non-pastoral lands including conservation reserves and in some areas have formed large monocultures. These monocultures reduce plant diversity and hence the availability of a variety of food resources and nesting habitats. As such introduced pastures have the potential to be a significant threat to avifauna in the Mary River wetlands, however, until now, no research has been undertaken to address this issue. As part of broader wildlife and vegetation monitoring projects, spot bird counts, vegetation and habitat assessments were done at over 650 locations on the Mary River floodplain. Surveys were conducted in both wet and dry seasons between May 1999 and April 2001. Results to date and management implications are discussed.

Mary's going feral: GIS-based predictive modelling of the spread of *Urochloa mutica* in the Mary River wetlands, Northern Territory.

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The Australian National Weeds Strategy (NWS) recognises weeds as a major threat to biodiversity and hence conservation in Australia; a finding reflected in the scientific literature. As is the case with many conservation issues the body of scientific knowledge required to make informed decisions is limited. Despite this limitation management decisions need to be made now. If the decisions we are forced to make now are to be rigorous then novel approaches for utilising the existing information is required. In this paper we outline the an approach which uses existing digital environmental datasets and field data collected during the project with the spatial modelling capabilities of geographic information systems. We developed a GIS-based predictive model for the spread of an invasive weed. The target species was an introduced pasture grass, *Urochloa mutica*, also known as para grass; however, the intent is to develop a modelling procedure that can be applied to other invasive weed species. The study area is the Mary River wetlands, Northern Territory. The model was used to identify areas that are highly likely to contain populations of para grass, or that are not currently mapped and are at high risk of future invasion. Bayesian modelling was used to create a surface showing probability of occurrence. A cost-distance algorithm was then used to combine known areas of infestation with the probability surface; the output, subject to assumptions relating to weed spread, shows the potential spread of para grass through the study area. We present some preliminary results of this modelling to show the potential impact of *Urochloa mutica* on the composition of wetland flora, the implications of this for vertebrate fauna and discuss the limitations of the present model and steps that are being taken to refine it. This study is one part of larger project that aims to improve wildlife conservation in the Mary River catchment using an adaptive management approach, improved monitoring systems and sustainable landuse practices.

"Project Deliverance" – An experiment in fox control and wildlife recovery in the forests of East Gippsland, Victoria. Part I: Project Outline.

Andrew Murray and Rob Poore

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Project Deliverance is a large-scale, manipulative, field-based project that aims to monitor the response of a range of terrestrial and semi-terrestrial "Critical Weight Range" mammals in forested habitats in far East Gippsland, Victoria, to broad-scale, on-going fox control. Four paired study sites are being monitored, each site consisting of a "Treatment Site" where fox control is undertaken on a regular basis, and a "Non-treatment Site", in which foxes are not controlled. Collectively the project covers approximately 80,000 hectares of forest. Regular trapping sessions take place throughout the year in order to monitor the population response of CWR mammals. Established transect lines consisting of 60 treadle-style cage-traps are located within each Treatment and Non-treatment Site. This paper will discuss the methodology that has been established to monitor the population of CWR mammals, and discuss the results to date.

Project Deliverance – An experiment in fox control and wildlife recovery in the forests of East Gippsland, Victoria. Part II: Fox Control Methodology.

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Little has been published regarding effective fox control techniques in native ecosystems as a management tool for the conservation of terrestrial fauna, especially in eastern Australia. This is despite the acknowledgment that foxes pose at least some threat to a wide range of species. One of the key objectives of Project Deliverance was to develop an effective fox control program that could be applied across large areas of forest in a cost-effective way. This paper will outline the methodology used in controlling foxes as part of this research, and how it might be applied across much larger areas of forest, as well as other types of habitat, in a manner which is cost-effective.

Project Deliverance – An experiment in fox control and wildlife recovery in the forests of East Gippsland, Victoria. Part III: On-going Fox Control: the impact on non-target wildlife.

Andrew Murray and Rob Poore

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One of the most important aspects to take into account when undertaking any form of feral pest management is the possible effect that the control technique used might have on non-target species. It is certainly an important factor to consider when undertaking predator control programs using baits injected with the toxin sodium monofluoroacetate (1080). Considerable debate surrounds the use of this toxin, and the threat its use poses to non-target species by the numerous methods by which it is deployed. Across the four study-sites that make up Project Deliverance, over 400 bait stations are regularly baited on a three to five week interval. Uneaten baits are removed and retained for later disposal and fresh baits are placed during each visit. From the outset of this project it has been a fundamental priority to ensure that baits are presented in such a way as to minimise the risks to all non-target species, while at the same time ensuring the baits were accessible and attractive to foxes. As a result of the success in removing foxes in each of the Treatment Sites, the opportunity exists for a wide range of non-target species to visit the bait stations. This paper presents data that supports the claim that the method of bait deployment has minimal impact on populations of non-target species.

Foxes and blackberries: could habitat management offer another option in integrated fox control strategies?

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This study focuses on determining the importance of blackberry on the ecology of foxes in the Dandenong Creek Valley, Victoria, and how this information can be used in fox management. This talk will focus on some studies we have been conducting on home range size and habitat use of foxes during the day and night. Fox home ranges in the Dandenong creek valley are extremely small (as low as 14ha) when compared to a number of both national and international studies, suggesting high resource availability. We have proposed that blackberry may be a resource that has allowed foxes to have such small home ranges.

During the day foxes appear to use blackberry disproportionately more than it is available within the landscape matrix. These results suggest that foxes are selecting patches of blackberry as optimal daytime habitat. Habitat selection at night appears to be random, with most habitat types being used in some way by the foxes. It appears that blackberry may play an important role in providing safe daytime refuge habitats for foxes. The importance of this information will be discussed in the context of integrated fox management in the Dandenong Creek Valley

The Diet of Foxes, *Vulpes vulpes* and Dogs, *Canis familiaris* in the forests of south-eastern New South Wales.

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Two introduced vertebrate carnivores occur in the forests of southeastern New South Wales - the Red Fox, *vulpes vulpes* and the dog, *Canis familiaris*. These species are known to prey upon a variety of native animals including some threatened species. The collection and analysis of predator scats is one of a suite of surveys carried out as part of the terms of the Threatened Species Licence for timber harvesting in state forests of New South Wales. The diet of foxes and dogs reported here is derived from scat collection and analysis carried out between 1996 and 2001 in the production forests of south-eastern New South Wales.

While other studies have shown that rabbits are a common prey species of both of these carnivores, this species is virtually absent from the study area and comprised only a very minor part of the diet of foxes and dogs.

Results of this study indicate that there is a considerable difference in the diet of foxes and dogs. Dogs appear to rely on only a few species, mainly larger animals such as macropods, brush-tailed possums, wombats and pigs. The diet of foxes was more varied with 25 difference species of prey appearing in scats. The weight range of the majority of prey species was between 25g (White-footed Dunnart) and 4.5kg (Brush-tailed Possum) – ie Critical Weight Range Vertebrates.

While most vertebrate pest control efforts by government agencies are aimed at dogs, usually as a response to stock losses, the results of this study indicate that in the absence of rabbits, foxes pose a greater threat to biodiversity than dogs.

Management in areas where threatened critical weight range vertebrates occur in the presence of low rabbit numbers should include:

- measures that regularly monitor fox densities, and
- appropriate control techniques when fox densities exceed threshold levels.

Population Responses of Critical Weight Range Mammals to Intensive Fox Control at Beecroft Peninsula, New South Wales.

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The population responses of a range of terrestrial and arboreal critical weight range mammals to a fox control program were monitored over a five year period at the Beecroft Peninsula, New South Wales. Three species of critical weight range mammal, long-nosed bandicoot *Perameles nasuta*, common ringtail possum *Pseudocheirus peregrinus* and bush rat *Rattus fuscipes*, responded with population increases. There was a significant increase in ringtail possum abundance while long-nosed bandicoot went from being unrecorded on the Peninsula in historic times, to a cage trap success rate of 15%. Bush rat also went from being unrecorded to a trap success rate of 4%. The abundance of sugar gliders *Petaurus breviceps*, *Antechinus stuartii*, and the introduced black rat *Rattus rattus* did not change significantly over the course of the study. The diet of foxes based on scat analysis changed over the course of the baiting program from predominantly black rat *R. rattus*, eastern grey kangaroo *Macropus giganteus* and ringtail possum in 1996 to long-nosed bandicoot and ringtail possum in 2000.

Management of fire regimes for the Pilliga Mouse

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This paper examines the results of a study conducted in Pilliga East State Forest (1997-2000) of the ecology of the Pilliga Mouse *Pseudomys pilligaensis.* This species is able to tolerate a wide variety of habitat types (9 out of 14 sampled) though highest numbers were found in just four types; moist gullies in recently burnt scrub; regenerating Broombush *Melaleuca uncinata* scrub (1-2 years after fire); mature Broombush scrub; and mature Kurricabah (*Acacia burrowii*)-Bloodwood (*Corymbia trachyphloia*) scrub/woodland.

The post-fire responses of the Pilliga Mouse were studied in an area burnt by an extensive fire in December 1997. Populations were also studied in three successional stages of broombush scrub. These represent major wildfire events in the Pilliga, 1997, 1985 and 1951. The results indicate that *P. pilligaensis* is able to use a variety of vegetation successional stages from recent (less than six months old), to mature scrub (50 years old).

The post-fire response of the Pilliga Mouse was to immediately evacuate from areas of flat ground into moister gullies and into unburnt vegetation. After a year, Pilliga Mice were being caught in the burnt sites and breeding commenced in these areas the following spring, 18 months after the fire. Highest numbers of Pilliga Mouse were detected in vegetation 18 months and 50 years old.

Understanding the fire ecology of the Pilliga Mouse is necessary for its long-term management. Knowing the pyric dynamic of its preferred habitats is also necessary for determining what are the appropriate fire regimes to maintain optimal population health of this species. The dominant plant from the selected habitat in this study, Broombush, has a relatively short cycle of about 50 years or so. After which, it starts to die out and cypress pine is able to establish. Broombush becomes mature, or gains its mature community structure, at around 20 to 25 years of age.

The Pilliga Mouse requires both young post-fire regrowth and mature Broombush vegetation for its survival, offering both a wider choice of habitat type and areas of refuge immediately after major fire events. Optimal conditions need to be maintained both spatially and temporally so that at any one time there is; old vegetation available for this species to use throughout the distribution of this habitat in the Pilliga; and, at any one place, the frequency of burning is managed to ensure that it receives a fire no less than every 25 years and no more than every 50 years.

Smoky Mouse Habitat in Southeast NSW: Distribution and Habitat in a Multiple Use Forest Mosaic

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The ecology of Australian rodents in multiple use forests has been investigated for many years, but few clear recommendations for the management of threatened species have ensued. The Smoky Mouse, *Pseudomys fumeus*, is sparsely distributed in southeastern Australia, occurring in forested environments in the ACT, NSW and Victoria. In southeast NSW, surveys have been conducted to determine the habitat requirements of this species. Surveys are required prior to logging under the Integrated Forestry Operations Approval for Eden. Detection of Smoky Mouse results in the exclusion of logging from large areas of forest. This paper presents results of trapping surveys in south-east New South Wales since 1997 and information on habitat. Research questions still remain regarding the specific habitat requirements and seasonal habitat use. Key information needs to develop better management prescriptions are outlined.

Trying to unravel the mystery of the home range and habitat preferences of *Pseudomys oralis*: a radio tracking and spool-and-line study in Marengo State Forest.

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The Hastings River Mouse *Pseudomys oralis* was historically reported to have specific habitat requirements that were closely linked to riparian habitat and certain vegetation types (grass, sedge and rush). The natural history and habitat preferences of this species across its distribution are not definitively known as there has been only one detailed scientific investigation into the species in NSW (Townley 1999). In Marengo State Forest, northern NSW, we have radio tracked and spool tracked the species to collect fine and broad scale information on habitat use and home range size. Fourteen mice were radio tracked and five were spool tracked. The largest home range size (100%MCP) was 1.4 ha with a core area of 0.27 ha (60%MCP). The median home range size for males was 0.8 $\pm$ 0.12 SE ha and females 0.35 $\pm$ 0.23 SE ha. Hollow logs from previous logging events were used as nest and refuge sites more than rock crevices and natural burrows. Assessment of microhabitat indicates that fern and grass understorey with high plant species diversity and abundant hollow logs are favoured habitat for the species in Marengo State Forest.

Relationships of the endangered pink-lipped spider orchid *Caladenia behrii* with animals in South Australia

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The nationally endangered pink-lipped spider orchid *Caladenia behrii* depends on a series of ecosystem functions and organisms, making it a potential indicator of ecosystem health in those areas of the Mount Lofty Ranges to which it is endemic. It is thought to deceive its wasp pollinator by producing a pheromone similar to that of the female wasp. Pollination, however, is a limiting step in the life of the orchid. Predation also limits the orchid populations, despite the protection offered by grass trees. Predators include kangaroos, hares, and possibly large lizards and birds. In addition, orchids depend on mycorrhizae, the availability and dispersal of which may be influenced by the presence of small mammals such as echidnas at the sites. A missing link in the chain of events needed for the survival of a *C. behrii* population would cause its loss, and we suggest that fragmentation and loss of habitat in South Australia have severely affected the resilience of this and related systems.

Nest boxes as a research and conservation tool for Leadbeater's Possum

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In order to study the ecology of Leadbeater's Possum in lowland swamp forest at Yellingbo Nature Conservation Reserve, 120 nest boxes were installed and subsequently monitored at 6-8 week intervals between 1995-1998. They were rapidly colonised by Leadbeater's Possum, and over the entire study approximately 80% showed signs of use by the possum (ie. nesting material) and 60% were occupied on the day of inspection on at least one occasion. The nest boxes enabled the possum's distribution and abundance at Yellingbo to be determined and greatly facilitated collection of data on the species' social organisation, reproduction and dispersal. Importantly, the nest boxes enabled all the members of a colony to be examined at a single point in time, overcoming the problem of trap prone/shy individuals.

The results of this study suggest nest boxes should be installed in two stages: an initial survey phase and a second phase that involves concentrating nest boxes around known colonies. Providing the entrance hole diameter is small (approx. 50 mm), Leadbeater's Possum does not appear to be highly selective in terms of nest box design, occupying all six nest box shapes and sizes installed. As nest site availability is the major factor limiting Leadbeater's Possum populations, nest boxes have considerable potential to contribute to the species conservation if used in conjunction with other forest management strategies.

Thermal biology of the endangered Grassland Earless Dragon (*Tympanocryptis pinguicolla*) and implications for management.

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Environmental temperatures affect lizard body temperatures which in turn affect a range of physiological and behavioural factors. If thermally favourable microclimates are limited, different trade-offs can occur which can ultimately influence life history parameters of populations. This paper will compare the thermal environments available to populations of the endangered *Tympanocryptis pinguicolla* surviving at different elevations on the Southern Tablelands of NSW. The relationship between thermal niche and differences in temperature selection, SVL:mass ratios, time of egg laying and growth of individuals will be compared for populations at two elevations. Some implications of these differences for habitat management, including biomass control, fire management, basking sites and artificial shelters, will be presented.

Establishing an effective target-specific baiting technique for fox control, determining the fate of baits using the thread-and-line method

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A common method used to control the introduced fox (*Vulpes vulpes*) in Australia is with toxic baits. Cotton bobbins were attached to non-toxic and toxic (strychnine) baits in order to determine their fate. Chicken pieces and eggs were chosen as the bait type in the agricultural study area. Risk assessment for non-target species was applied using 1 m² soil plots, from which animal tracks were recorded.

Few foxes were attracted to surface laid baits, whereas non-target species were, particularly raptors. Consequently, all baits were buried 10 cm below the surface, attracting primarily foxes, and it was found that 14.6% of all baits taken were cached at distances ranging from 30 - 200 m. Within a one-week period all cached baits were taken again. These results have been compared to a subsequent study involving wild dogs.

Foxes were then encouraged to consume baits at the baiting stations by two methods. Chicken pieces were wired to fixed pegs, and eggs were cracked just short of collapse. Subsequently, all uncovered egg baits were consumed. The majority of chicken pieces have been consumed while still attached to the anchor. Those that were removed appear to have been consumed, as indicated by the condition of the retrieved cotton bobbins.
The success of this baiting program is reflected by the reduction of a 40% kid loss in the 2000 season to 0% for 2001.

When is a wild-caught stoat acclimatised?

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Stoats are one of New Zealand's most destructive predators and are implicated in the continuing decline of native bird species. In the wild > 90% of stoats are pregnant from December to July. However there has never been a birth recorded in captivity in New Zealand. To assess possible reasons for this failure, we monitored blastocyst survival in wild-caught stoats during acclimatisation to captivity. In addition, behavioural changes were assessed in these animals to determine how long wild-caught stoats require to adjust to captivity. This is important to ensure their responses in experiments are not compromised due to stress effects. Time since capture has had no obvious influence on blastocyst survival in 17 female stoats. An average of 6-9 blastocysts have been recovered 0, 4 and 12 weeks following capture, and there were no differences in ovarian tissue and reproductive tract weights after different periods in captivity. In addition, 31 animals (including the 17 female stoats above) have been subjected to both 'feeding' and 'behaviour response' tests since capture. Initial observations indicate adaptational changes in feeding behaviour after 6 weeks and in response to humans after 8 weeks in captivity. Immunological responses improve between 4 and 12 weeks in captivity. We would recommend therefore that an 8-week period of acclimatisation to captivity is required for stoats.

Use of DNA for mark-recapture analyses of stoats and possums

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Monitoring the relative abundance of pests, and the effectiveness of pest control operations, is an essential part of pest management. Yet innovative monitoring methods have lagged behind advances in pest control. Estimating abundance using standard index methods can result in biased estimates, and using traditional mark-recapture methods can be expensive. An alternative approach for estimating animal abundance is to use DNA profiling, which offers the potential of being able to identify individuals in a population without having to physically capture and/or mark animals. With multiple sampling periods, "recaptures" can be identified, which allows sophisticated mark-recapture software to be used to estimate absolute numbers. Recent developments with the use of DNA markers, and novel tissue capture techniques, offer new possibilities for the measurement of such population and behavioural parameters. In particular, these methods offer new options for accurate population abundance estimates for species that are especially difficult to capture in conventional traps due to their habitat and behaviour, such as stoats (*Mustela furo*), or for species such as possums (*Trichosurus vulpecula*) where it has become essential to audit the success of contractors carrying out large-scale control operations.

We have optimised six microsatellite loci for estimating genetic variability within and among stoat populations, and have developed techniques that enable DNA profiling of individuals using hair samples from the field. We have had similar success extracting DNA from faecal samples of possums. Field trials are planned to evaluate the success and cost-effectiveness of the techniques on a large scale for both stoat and possum populations. We will present results from analyses of population structure and variability of stoats in New Zealand, along with a discussion of how genetic tags can be used to estimate population parameters in mammals. We will also discuss the applicability of these methods for examining aspects of the mating behaviour and social structure of stoats.

Immunocontraception for Wildlife Management

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Immunocontraception involves eliciting an immune response against eggs, sperm or hormones so that successful reproduction is prevented. Work on human immunocontraception has been going on for several decades. Several groups around the world are attempting to develop it for regulating population numbers of large mammals. Work in Australasia is aimed at rabbits, foxes, mice, brushtail possums, koalas and kangaroos.

Two fundamental problems have been inadequately addressed in this research. This is despite a very large amount of effort around the world. The vaccines involved all contain self antigens or their relatives. The first problem is that it is difficult to obtain strong immune responses against self antigens and so the vaccines may be ineffective. Most published data on the effect of immunocontraceptives on reproduction involve the use of an adjuvant of which there are many kinds. The materials enhance the immune response greatly. The most frequently used is Freund's adjuvant which can cause chronic suffering. Its use on wildlife could lead to very negative public perceptions. There has been no convincing demonstration that successful immunocontraception is possible with any method of vaccination likely to be used in the field, if success is defined as contraception of a proportion of the population high enough for management requirements.

If it is assumed that success can be achieved, the second fundamental problem arises with two potential consequences. Even with adjuvant, a substantial minority of the vaccinated animals remains fertile. The first consequence is that since failure to be contracepted is likely to be in part genetic, there is likely to be rapid selection for these non-responders. The method will become ineffective in a few generations.

The second consequence is that the offspring of the animals which breed will have altered immune responses. Their capacities to respond to their own pathogens or to harbor pathogens of other species in the same ecosystem are likely to be changed. The particular outcomes are essentially unpredictable. However, the presence of chlamydia in koalas and bovine tuberculosis in New Zealand possums means that responses to these pathogens would have to be studied in offspring of immunocontracepted parents to ensure that they were not more susceptible to them. The precautionary principle embodied in the Gene Technology Act (2000) may negate any use of the technique in the field.

Again on the generous assumption that successful immunocontraception is possible, New Zealand intentions to put an immunocontraceptive into a brushtail possum gut worm must be viewed with caution by Australia. The eggs of transgenic worms will be easily transplanted either accidentally or deliberately back into Australia, and so infect brushtails in Australia.

Other approaches, which rely on fences, steroids, peptide hormone analogues, 1080, pathogens, or manipulation of environmental variables are much more likely to be used successfully and economically in Australasia over the next one to two decades. The very large expenditure on immunocontraception research is now highly questionable.

Why are "critical weight range" fauna particularly susceptible to predation?

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The decline of terrestrial mammal species in the critical weight range (CWR) of approximately 35g to 5.5kg is usually attributed to degradation of their habitat by livestock and rabbits (exacerbated by environmental variability particularly in arid areas of Australia), with predation by foxes and feral cats as an additional factor in the extinction of some species. Although there appears to be an upper limit of approximately 3-5kg to the size of animals these predators can kill, by itself this does not explain why predation should be particularly important for CWR species. Foxes and cats often take prey weighing less than 35g and young animals can be vulnerable to predators even if adults are heavier than the upper limit to the CWR.

A simple age-structured model is used to calculate the rate of increase for two categories of prey species: (i) both juveniles and adults vulnerable to predation, corresponding to species where adults are smaller than the maximum size of prey taken by foxes and feral cats, and (ii), only juveniles vulnerable, which corresponds to species where adults are large enough to be safe from foxes and cats. The modelled rate of increase is different for each of the two categories of prey. Because a prey species cannot persist if its rate of increase is less than zero, the condition for persistence is also different. Using the allometric relationship between the intrinsic rate of increase and body size, the model can be used to specify the minimum adult size for persistence of each category of prey, depending on the level of predation.

Large-sized prey in category (ii) can persist under high levels of predation. As soon as adults are small enough to be vulnerable to foxes and cats (setting the upper limit to the CWR), the prey species switches to category (i) and can be driven to extinction by a much wider range of predation levels than slightly larger category (ii) prey. At the lower limit to the CWR, very small-sized prey have high intrinsic rates of increase that allow them to persist under high levels of predation.

Pest animal survey and risk analysis for potential pest animal and exotic disease areas in NSW.

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Pre-emptive control of wildlife populations in response to perceived long-term exotic animal disease risks eg. FMD is neither practical nor cost-effective. What is required is an ability to respond rapidly to real short-term threats such as suspected focal outbreaks or the likelihood of a disease occurring as a consequence of an outbreak elsewhere. The ability to interpret and/or predict likely disease interactions with wildlife distributions and population densities is critical to this process. AUSVETPLAN recognises the need to accurately establish the distribution and densities of disease hosts and susceptible species to respond efficiently to an emergency exotic disease outbreak in Australia

There have been three previous pest animal mapping exercises undertaken in NSW (1979, 1985 and 1996). Although information from these surveys have been used as a guide to pest distributions, maps have lacked validation and may lead to poor decision making. The purpose of this project is to conduct a state-wide interview-based survey similar to those of previous years and inclusive of pigs, goats, deer, sheep, cattle, foxes, rabbits, and wild dogs/dingoes. Surveys will be conducted through consultation with local information sources, primarily Rural Lands Protection Boards, and information will be collated using GIS mapping technology. To overcome some of the inaccuracies of previous surveys, a stratified sampling approach will be used in selected areas to identify and validate survey reports using more precise population assessment techniques. GIS will be used to examine data from this and previous surveys to establish spatial and temporal population changes. The sum of this information will then be utilised in a risk analysis of threats posed by pest animal populations in the event of exotic disease outbreaks in NSW.

A Snake in the Grass: Investigating Urban Snake Management in Southern Victoria

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Between 1000 and 2000 elapid snakes may be translocated around greater Melbourne and Geelong each year. Using questionnaire surveys, this scoping study investigated the issue of snake removal and translocation by licensed snake controllers in southern Victoria, principally around greater Melbourne and Geelong.

Three groups were surveyed: licensed snake controllers, residents who have utilised these controllers, and "first contact" organisations that are likely to receive calls from people wishing to have a snake removed. Issues investigated included scale (i.e. numbers of snakes translocated), seasons and species involved, geographic trends, factors influencing the choice of release sites, resident's choice of "first contact" organisations, resident's perceptions of why snakes occurred on their properties, whether residents noted snakes on their properties following the initial removal, and how "first contact" organisations respond to calls for snake removal. Controllers (n=14 respondents) and "first contact" organisations (n=12) receive calls from September to April, with most calls occurring between November and February.

Four species of large venomous snakes are commonly involved, mostly Eastern Tiger Snakes *Notechis scutatus* and Lowland Copperhead Snakes *Autrelaps superbus*.

Although correlated with the area of operation of the controller, geographic trends are evident - Tiger Snakes are more frequently encountered in the north, west and south-west of Melbourne, whereas Copperhead Snakes are more frequently encountered in the east and south-east. Western suburbs produce the highest frequency of calls. Controllers reported choosing release sites based upon permit stipulations, perceived suitability of habitat for the species, and distance (both near and far) from capture site/location of residents. Ten controllers use various release sites, three always use the same release site for all captures. Residents (n=7) suggested a variety of perceived reasons (e.g. prey and shelter availability, and proximity to "snake habitat") that snakes occurred on their property, and most detected more snakes following the initial removal. "First contact" organisations (mainly councils) typically received 4-40 snake-related calls from residents each year. Some of these organisations have permanent staff licensed to remove snakes, however most referred calls elsewhere. The effectiveness of the current management policy is discussed, as are the potential impacts of translocation on both snakes and release sites. Proposed future work includes radio-telemetry study of translocated versus non-translocated snakes.

Quantitative traits in population bottlenecks

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Microsatellite markers are a popular method of determining the level of variation in an endangered species' genome. The assumption is made that these neutral markers behave in the same manner as quantitative traits, which directly affect survival.

We are conducting bottleneck experiments using Drosophila melanogaster to test the assumption that variation in microsatellite markers declines at the same rate as variation in quantitative traits under balancing selection. We have initiated a number of bottleneck populations of varying effective population size and inbreeding time. We are collecting data from microsatellites, egg numbers and sternopleural bristle numbers. Preliminary results from sternopleural bristle numbers indicate that variation is not being lost at the same rate as predicted using neutral theory.

Interactive effects of predation and rabbit haemorrhagic disease (RHD) on the dynamics of wild rabbit populations in New Zealand

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In New Zealand, research suggests that rabbit (*Oryctolagus cuniculus*) populations in areas of lowland improved pasture are regulated by a combination of predation and environmental factors. In contrast, rabbit populations in low-rainfall inland areas are thought to escape predator regulation because rabbit breeding is more erratic and predators lack alternative prey as a buffer during periods when young rabbits are scarce. One prediction of this hypothesis, which has yet to be properly tested, is that epidemics of rabbit haemorrhagic disease (RHD) are likely to depress rabbit abundance and recruitment so that the populations will more often fall within the range of densities at which predator regulation can occur.

To investigate this prediction, the impact of predator-removal and RHD on rabbit population dynamics was compared between improved pasturelands in North Canterbury and semi-arid rangelands in Otago. In each region, rabbit population dynamics were monitored on four 30 ha sites, two of which were subject to predator-removal. RHD spread through all sites during the study.

In North Canterbury, the outbreak of RHD caused rabbit densities to decline on all sites, with the declines being significantly greater in the two sites where predators had not been controlled. In contrast, rabbit densities on all four Otago sites at first increased and only later experienced significant declines associated with RHD and late-season increases in predator abundance. In Otago, there was no difference in rabbit densities between predator treatments. Potential explanations for this disparity between regions, including differences in rabbit density and RHD efficacy are discussed in relation to these results.

This study therefore generally supports the hypothesis that in regions with improved pastures, predation in combination with other factors such as RHD can reduce rabbit populations to low levels, whereas in semi-arid regions no such predation/disease interaction is evident, although other explanations for the results need to be considered.

Abundance and Limitation of Feral Horses in the Australian Alps

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Wild horses in the Australian Alps national parks are cultural heritage in some peoples' eyes and feral pests in others. Any management needs to be well informed. This paper presents two parts of a larger project on the population ecology of wild horses in the Australian Alps national parks, 1) Estimating abundance using helicopter aerial survey, and 2) population limitation by brumby-running. Three frequently used aerial survey techniques were used to estimate abundance of feral horses. These were strip, mark-recapture and line transect techniques. The highest estimates (approximately 5000) were achieved using line transect estimation (negative exponential model) and mark recapture estimation of individual horses over 0-50m. Precision was in the order of 30% CV. Negative bias was strong when strips greater than 0-50m were used in strip and mark-recapture analyses. Brumby-running involves horse riders chasing and catching wild horses with a rope. In Victoria, the activity is permitted under a contractual agreement with Parks Victoria. Brumby-runners submit information on the number, age and sex of horses that they catch each year. A simple model using these data and population estimates from aerial survey suggest that brumby-running is limiting the Victorian feral horse population, reducing abundance by half. Several hypotheses are proposed to illustrate the interaction between brumby-runners and feral horses.

Acceptance of various bait types by European Rabbits (*Oryctolagus cuniculus*)

Sarah Beaurepaire and Mark Sandeman

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In the past there has been significant studies of rabbit control methods, particularly using poison baits. While poisons such as sodium monofluoroacetate (1080) and pindone have been successfully delivered to rabbits in Australia using chopped carrot and oat baits, there has been no significant developments or improvements in the target specificity, storability, toxic content or weathering of rabbit bait types for at least 15 years in Victoria. Therefore the aim of this project was to investigate the acceptability of another bait type, manufactured pellets to identify how acceptable pellet baits are to rabbits compared with the acceptability of older bait types. While pellet bait types have previously been suggested for use in rabbit poisoning operations, there is currently no pellet bait type available for use in Victoria. A new pellet bait developed in New Zealand that has been suggested to be highly palatable to rabbits was compared with carrot and oats. Trials were conducted using captive rabbits in which rabbits were offered free choices of the three bait types over consecutive nights and the relative amounts consumed were measured and compared for 'acceptance'. The results indicated the pellets were at least as acceptable to rabbits as carrot and oat baits. Further investigations are now required to establish how a wider range of effective bait types can be used in future rabbit control operations.

Determinants of survival for the northern brown bandicoot under a landscape-scale fire experiment

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At least half of all Australian bandicoots (family Peramelidae) are extinct, endangered or vulnerable, and changed fire regimes in arid and semiarid Australia have been implicated as an important agent in their decline. The northern brown bandicoot (*Isoodon macrourus* Gould) is currently regarded as one of the most common Australian bandicoots. However previous studies at Kapalga, in Kakadu National Park, Northern Territory have shown this species to be prone to large fluctuations in abundance, apparently linked to the occurrence of intense fires. This study examines the influence of four experimental fire management regimes (no fire, early dry season, late dry season and progressive burning several times through the year) on the survival of the northern brown bandicoot using mark-recapture data obtained during a landscape-scale fire experiment conducted at Kapalga, in Kakadu National Park, Northern Territory from 1989 to 1995. Our analysis extends upon earlier work by performing a detailed examination of bandicoot survival, using information theoretic model selection methods. This approach provides a more robust and meaningful alternative to simplistic indices based on trap success. Results indicate that fire regime is the most important determinant of bandicoot survival and that the relative importance of other factors such as gender, age, habitat type, time of year and rainfall are minor in comparison. All experimental fire treatments (including fire exclusion) were associated with decline in survival rates and population size over time, indicating either that none of the management approaches tested could be considered appropriate for this species, or that other unknown processes are contributing to a general pattern of decline. Despite this general trend, it was clear that burning in the late dry season or many times in the year produced substantially more severe declines in survival than did early dry season fires or no fires at all. The results demonstrate the importance of the frequency and seasonal timing of fires in determining the survival of this species, and suggest that uniform and repetitive approaches to fire management are inappropriate for bandicoot conservation in the north Australian savannas.

Indigenous Voices in collaborative scientific research

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This paper aims to report on discussions and conclusions from the Indigenous Voices conference, hosted by the Rainforest CRC (forthcoming, October 23-25 2001). The conference involves invited indigenous people and researchers from CRCs concerned with natural resource management questions. It intends to provide a dialogue about indigenous research ethics, theories and practices and for discussions of ways for indigenous people to interact with researchers in CRCs and elsewhere. Issues in the progress of native title claims, implementation of the EPBC Act, and social justice agendas make this conference's focus on ethical research and practical outcomes of critical importance.

Koala Management on Kangaroo Island: modelling population changes and calculating management costs

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Koalas were introduced to Kangaroo Island in 1925, and since then the population has flourished. However overbrowsing on riparian habitat, particularly Manna Gum, has increased to an unsustainable level. Owing to the charismatic nature of the species, management options are limited to sterilisation and translocation. These are expensive management techniques and require substantial resources. To determine the ecological and financial costs of the Koala Management Program on Kangaroo Island we used:

1. data collected over the last four years to identify present koala distribution and abundance, and a sustainable koala density,
2. a population model developed by the Marsupial CRC to identify population changes under different management scenarios; and
3. costs calculated from previous management actions to clarify the financial implications of future management scenarios.

This information provided a solid base for decisions to be made regarding the resources required for future koala management actions.

Where have all the deer come from? The three waves of invasion and the management of wild deer in Australia

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Deer species, which have formed wild populations in Australian ecosystems, are a growing problem. Fallow, Red, Sambar, Chital, Rusa, and Hog deer have formed wild populations in many habitats ranging from arid woodland to rainforest. Despite the potential for deer species to become important pests, the ecology, impact and potential management of wild deer in Australia is poorly understood. The first wave of wild deer introductions into Australia was in the 18th and 19th centuries by various acclimatisation societies, who introduced deer to enhance the aesthetics of the local environment and provide sport for gentry. All of the larger well established wild deer populations surviving in Australia at present are derived from this initial wave of introductions. The second wave of invasion was influenced by the popularity of deer as an alternate farm commodity from the 1970's to the 1990's. During this period the escape of small numbers of deer from farms was common. However a downturn in the deer commodity market and a drought in 1994 and 1995 triggered the largest liberation of deer. This saw many farmers unable to support their herds and as a result they were turned loose into the bush to fend for themselves. The third wave of liberation of deer into Australia was caused by hunters and hunting agencies releasing herds of deer into remote areas for future trophy development. The translocation of deer by hunters and the escape of deer from game farms and deer farms over the last decade and at present is common. As a result it is estimated the number of wild deer herds in Australia has increased six fold over the last decade. Without adequate attention to the 'human' dimension of wild deer management this figure is predicted to increase in the future. Rural, urban fringe, conservation and management issues relating to wild deer in Australia will also be discussed.

Assessing factors which influence visibility bias in aerial surveys of feral goats

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Accuracy of abundance estimates using aerial surveys is dependent upon appropriate accountability of associated biases. Group size, vegetation cover, observer, survey height, speed of the aircraft, width of the transects, time of day, temperature, weather conditions, colour, behaviour and distribution of species affect the visibility bias of wildlife in aerial surveys. The influence of some of these factors can be reduced through rigorous standardisation procedures, particularly when only indices of abundance are required. However, the biases associated with other factors such as animal behaviour, vegetation cover and weather conditions, should be considered for each survey.

Thirty four helicopter surveys of feral goats were conducted over seven properties in the Coolah Tops NSW. We investigate some controlled and uncontrolled factors that influence the estimates of these surveys in a number of ways. Various statistical models using the underlying counts, visibility bias calculated by double count methods and ground observations were used to test the effects of site, survey, vegetation cover, speed of the aircraft, observer and animal behaviour.

Spatial and temporal trends in bird damage to wine grapes: a case study using geographic information systems in vineyards within Orange, NSW.

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Damage to grapes by native and introduced birds is believed to cause significant productivity losses to the wine industry. In the Orange region of New South Wales, numerous bird species have been implicated. The value of Geographic Information Systems (GIS) for addressing problems involving spatial and temporal information is increasingly being recognised. In this study we used ArcView GIS (version 3.2) to examine damage trends to several vineyards near Orange throughout the ripening season of 2000 and 2001.

At each vineyard, grape varieties were visually examined and scored for damage at several stages of growth. These data were then spatially projected. Losses within each vineyard exhibited a significantly clustered pattern. Birds primarily caused 'fringe damage' to vine blocks, feeding on the outer-most vines. This was corroborated by observations of bird feeding behaviour, in particular for introduced Starlings (*Sturnus vulgaris*). Damage also occurs on a temporal scale, possibly associated with changing bird species composition throughout the season. In this paper we consider various factors that may influence spatial and temporal variation in damage to grapes. We also discuss possible management strategies for reducing this damage; which by necessity will require the recognition of when, where and which species are implicated. This in turn will also reduce unnecessary impacts on native bird species not involved in losses to the wine industry.

Deer population management using a slow release implant of Deslorelin, a GnRH superagonist

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There is an increasing concern that feral deer in Australia are adversely affecting native fauna and flora. All deer in Australia are exotic, and have adapted well to the Australian environment. Feral populations of Chital, Fallow, Hog, Red, Rusa and Sambar deer have established populations in many Australian habitats. Javan Rusa deer are a concern for NSW National Parks and Wildlife Services because a large population has been established in the Royal National Park and surrounding areas in south Sydney. The number of deer in the Royal National Park has increased greatly since their release in 1907.

An effective population management tool is required. Traditional management control methods such as culling are becoming publicly unacceptable, as seen by the public concern with the feral horses in Guy Fawkes River National Park, NSW. This brings about the need for a more humane, publicly acceptable method of population management.

Deslorelin, a gonadotrophin releasing hormone (GnRH) superagonist, is a long acting contraceptive that is being tested for suppressing fertility in Javan Rusa deer. Peptech Animal Health Ltd. has developed Deslorelin for the domestic animal market. The subcutaneous contraceptive implant acts by inhibiting the production of reproductive hormones. Deslorelin implants provide a chronic exposure to gonadotroph cells in the anterior pituitary, suppressing the release of luteinizing hormone (LH) and follicle stimulating hormone (FSH). These are suppressed to the point that folliculogenesis, ovulation and spermatozoa production are prevented.

The principle aim is to test the effectiveness of Deslorelin implants at suppressing reproduction in adult Javan Rusa hinds and stags. Results will be presented from preliminary experiments.

This work is supported by the Australian Research Council.

Are powerline easements detrimental to small mammal diversity?

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The objective of this project is to determine if powerline easement vegetation offers functional habitat and is therefore, important for the long term conservation and management of Victoria's small mammal biodiversity. This study aims to determine movement patterns, breeding regimes and habitat utilization, of small mammals found in the area. The overall objective of this research is to determine the optimum management strategies for maintaining high species diversity and richness of small mammals found utilizing powerline easement habitat across Victoria.

Distribution and abundance of small mammals and reptiles around artificial watering points in Sturt National Park, arid-zone NSW.

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The distribution and abundance of small mammals and reptiles at varying distances from artificial watering points was examined in Sturt National Park, arid-zone NSW, using both pitfall and Elliotttraps. No ‘decreaser’ trends were apparent, with animal distribution being instead correlated with microhabitat opportunities. The notion of artificial watering points as drought refuge areas is discussed.

ECOLOGICAL RATIONALE FOR ACTIVE KANGAROO POPULATION MANAGEMENT

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Where the balance between the ecological integrity of parks and their kangaroo populations is at risk, scientifically credible assessments of those populations and their impacts on environmental values is essential in establishing the requirement for appropriate kangaroo population management programs. Parks Victoria is currently implementing ongoing kangaroo population control programs within four parks over a total area of 1386 km².

To determine the need for intervention, environmental values at risk from grazing pressure, their biodiversity significance and the conservation goals for their management are identified. The condition of vegetation communities at risk is assessed, and measures of the type and extent of risk posed by grazing pressure from kangaroos and other grazers are collected. The impact of kangaroo grazing on values is assessed on the basis of this information which also provides baseline data for measuring the performance in achieving the set objectives of a particular program. Specific targets for the achievement of reduction in risk are established, including extent of reduction in grazing pressure, and target measures for the improvement of vegetation condition parameters

Ideal Free Distributions and Free-Ranging Mammalian Herbivores: Confronting Standing Crop Models with Empirical Data

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Models relating the distribution of consumers to resource availability can be considered within the framework of Ideal Free Distribution theory. The majority of studies have examined situations where resources are immediately consumed upon entering a patch. For many herbivores, however, the notion that resources are immediately consumed is not realistic, resulting in the development of a standing crop of resources on which herbivores can forage at will.

IFD models that allow resources to form standing crops have received some experimental investigation, but no studies have so far examined the implications of these models for natural populations of free-ranging mammalian herbivores. Eastern grey kangaroos satisfy most of the assumptions inherent in IFD models, so provide a prime opportunity for collecting data from natural populations.
This study examined the distribution and foraging behaviour of a population of eastern grey kangaroos in relation to the predictions of IFD standing crop models. Only partial agreement with the predictions of the simplest form of the model was obtained, indicating that microhabitat dispersion may be being influenced by interference competition and/or predation risk sensitivity.

Foraging behaviour and dispersion of eastern grey kangaroos in an ideal free framework

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Most studies of resource selection in herbivores have been correlative, matching temporal and spatial patterns of population density with heterogeneity in forage abundance and quality. Ideal Free Distribution theory (IFD) offers a powerful alternative approach. IFD describes a set of rules that predict the dispersion of a population of free-ranging individuals throughout a foraging environment, where each individual acts to maximise its resource uptake in the face of variable forage suitability and intra-specific competition. In essence, not every consumer can occupy the 'best' patch, because negative feedback reduces patch suitability through the depletion of available forage, which in turn reduces the intake rates of consumers. Individuals are predicted to distribute themselves so that each maximises its resource intake rate, reaching an equilibrium state when none can gain by switching patches. As a consequence, the standing crop of forage is predicted to be depleted to matching levels across patches. To investigate the applicability of IFD models to free-ranging herbivores, we quantified the dispersion and foraging behaviour of a population of eastern grey kangaroos (*Macropus giganteus)* among habitat patches of differing suitability. We did not observe precise matching of resource input and kangaroo density. However, lower intake rates were recorded in the most suitable habitat, which also attracted the highest density of competitors. There were differences in indirect (scramble) competitive ability among different sex-age classes in the high-density patches, but little evidence of direct competition at any time. Predation risk may also have influenced intake rates in some patches.

Effects of Deslorelin, a slow release GnRH superagonist, on reproduction in the grey kangaroo: potential applications

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Kangaroo populations can reach high numbers in reserves and parkland near urban areas resulting in a number of management implications. The animals may pose a risk to their own welfare, have a negative effect on other aspects of the local biodiversity or may threaten human-oriented activities. In such cases active management of the population may be sought to mitigate their negative effects. The difficulty wildlife managers' face is that traditional management techniques such as culling are not feasible in these areas due to vocal public opposition and concerns for human safety. New management techniques are needed to control populations near urban settlement.

We have been investigating the use of *Deslorelin*, a slow release GnRH superagonist, to control the fertility of kangaroos and wallabies. This contraceptive acts by switching off the production of pituitary luteinizing hormone (LH) and follicle stimulating hormone (FSH), both required for male and female reproduction. Studies on a model marsupial species, the tammar wallaby, have demonstrated that application of this contraceptive inhibits reproduction specifically by inhibiting follicular development. Application of *Deslorelin* does not inhibit pregnancy and subsequent birth of a dormant blastocyst, or lactation, but it does inhibit further matings. Results from grey kangaroos suggest that *Deslorelin* has a similar mode of action in this species as in the tammar wallaby.

The results from trials on a captive grey kangaroo population will be reported. These results will be discussed in terms of the potential applications of this contraceptive to manage grey kangaroo populations in captivity and in the field.

The facts: survivorship of Red Kangaroo young to weaning and its effect on population dynamics.

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Quantifying recruitment of juvenile animals to the adult population is vital to understanding population dynamics. To date, popular belief holds that Red Kangaroos are fast, efficient and successful breeders, as deduced from their so-called 'high' population densities. Contrary to this, results on the reproductive success of a population of free-ranging female Red Kangaroos in Western NSW, show that suvivorship of juvenile young is actually very low. This information needs to be taken into consideration when assessing population dynamics and the best management practice for the species.

Deterrence of kangaroos from roadways using ultrasonic frequencies – efficacy of the *Shu Roo*.

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Vehicle collisions with native wildlife are an increasing problem in Australia. Methods for minimising serious collisions include reducing vehicle damage and avoiding collisions altogether. One popular method of avoidance uses sonic deterrents, such as the Shu Roo. The manufacturers of this ultrasonic 'deterrent' device claim that it warns kangaroos of impending danger, enabling them to flee from the path of the vehicle. This study tested the efficacy of the Shu Roo by rigorously evaluating the claims made by the manufacturer in a static and dynamic environment on eastern grey kangaroos and red kangaroos. The results of these tests generated four clear conclusions; (i) the Shu Roo is not purely ultrasonic, (ii) the Shu Roo does not produce sound that is detectable at 400 m, (iii) the Shu Roo does not alter the behaviour of either eastern grey kangaroos or red kangaroos, and (iv) the Shu Roo makes no difference to the number of kangaroos hit when fitted to vehicles.

The ecological implications of harvested kangaroo offcut and offal dumps in the Australian rangelands

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Hundred of thousands of kangaroos are harvested annually in Australian rangelands in order to control total grazing pressure and increasingly, for human consumption as a commercial venture. Harvesting kangaroos differs from conventional stock management in that the offcuts (eg heads, feet, tails) and offal remain at the point of harvest. Therefore, these resources remain available to local ecosystem processes rather than being exported from the rangelands to abattoirs etc.

Kangaroo offcuts and offal provide resources for a range of native and introduced predators, scavengers and detritivores. Harvested kangaroo offcuts and offal dumps are relatively consistently available throughout the year over wide areas, compared to the more localised and infrequent major natural die-offs of kangaroos during drought or heat waves. Therefore, populations of species that use these resources are likely to be maintained at unnatural levels, which may have associated ecological implications. Control of feral foxes and cats and management of dingo and raptor numbers may be strongly influenced by the timing and distribution of kangaroo harvesting, particularly in areas where rabbit numbers have been reduced by Rabbit Calicivirus.

This paper presents preliminary information on the scale of kangaroo offcut and offal resources, the identity of major predator, scavenger and detritivores species, the speed of consumption or decomposition, and the influence on soil nutrient status near Roxby Downs in arid South Australia.

Shifts in kangaroo species abundance at Yathong Nature Reserve

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This paper reports on changes in abundance of co-occurring red, western grey, and eastern grey kangaroos on Yathong Nature Reserve (located between Cobar and Hillston in western NSW) between 1985-86 and 200l. From June 1985 to July 1986, population estimates by line-transect and mark-resight methods showed red kangaroos to be most abundant (density about 7.3/km^2), western grey kangaroos about two-thirds of red kangaroos (4.7/km^2), and eastern grey kangaroos relatively scarce (1.3/km^2). Systematic counts conducted on the same routes by daylight and night spotlight in September 2001 showed western grey kangaroos to be most abundant species (66.8% of 6502 observations), with red kangaroos being fewer (30.4%) and eastern grey kangaroos least abundant (2.8%). Comparison of numbers observed by the same methods shows that western grey kangaroos were much greater in absolute numbers in the recent period, and red kangaroos somewhat more abundant. Eastern grey kangaroos were low in both periods. According to the resident manager, red kangaroos were low about 4 years ago, suggesting an earlier die-off of this species. These results show changes in both absolute abundance and species composition of kangaroos due to rainfall patterns. The current prevalence of western grey kangaroos suggestions that this species is less subject to the vagaries of weather than is the green-feed specialist, the red kangaroo.

Poster Session

ANDY SHARP, KERRY HOLMES, MELINDA NORTON & ADAM MARKS. 1080 fox baiting for conservation outcomes in western New South Wales.

ANDY SHARP*, MELINDA NORTON & ADAM MARKS. Fox predation limits Yellow-footed Rock-wallaby (*Petrogale xanthopus*) populations in western New South Wales.

HIDEYUKI TOKUSHIMA AND PETER JARMAN. Population and dietary ecology for the management of the Pilliga Mouse (*Pseudomys pilligaensis*).

VICKI STOKES, TONY ARTHUR, CHRIS DAVEY, EDDIE GIFFORD, STEVE HENRY & ROGER PECH. Behavioural response of *Antechinus flavipes* and *Sminthopsis murina* to predation risk

MELINDA NORTON, MIKE BELSHAW, IAN JACKETT, CAMERON KIRTON & CATHERINE RUMMERY. The Kangaroo Valley experience: working with the community to conduct a 1080 fox baiting program for the protection of the local Brush-tailed Rock-wallabies.

NATASHA SCHEDVIN, TODD SODERQUIST, JACK BAKER & IAIN TAYLOR. One Barking Owl – 6000 ha of forest.

PETER WEST & GLEN SAUNDERS. Spatial heterogeneity in rabbit distributions: utilising geographic information systems to examine relationships between rabbit warrens and foraging behaviour.

DAVID FAIRBRIDGE. Field assessment of non – target uptake of buried 1080 baits – a Quality Assurance approach to 1080 baiting

KERRY DARCOVICH. Conservation Management of the Green and Golden Bell Frog at Sydney Olympic Park

CHRIS BUNN & HEDY BRYANT. Australian Wildlife Health Network

MATT GENTLE, GREG JONES, PETER WORSLEY & GLEN SAUNDERS. Density and den preference of European Red Foxes in the Central Tablelands of New South Wales

BRIAN TOLHURST, ANNA LLOYD & PAUL MEEK. Surveys and management of threatened species in State Forests of NSW

GEOFF BROWN & RALPH MAC NALLY. Reptiles and Habitat Fragmentation in the Box-Ironbark Forests of Central Victoria, Australia.

DEBRA WHITE, PETER JARMAN & CARLO GAZZOLA. Grazing impacts of Black-striped Wallabies on Central Queensland developed pastures

DEBRA WHITE, PETER JARMAN & CARLO GAZZOLA Black-striped Wallaby Distribution within a Central Queensland Remnant Brigalow Scrub.

TONI BERDEN, PIP MASTERS & GRAEME MOSS. Kangaroo Island's Koala Management Program: actions and outcomes

JULIA BURNARD. Habitat use of the Australasian Shoveler, *Anas rhynchotis*, in the southeast of South Australia and management implications

MICHELLE LE DUFF, MARTIN WESTBROOKE & PATRICK PREVETT. Habitat utilisation by mammals and the impact of native forest silviculture in mixed-species eucalypt open forest

MICHELLE LE DUFF & SUSAN CARTHEW. The impact of habitat fragmentation on arboreal marsupials in the South East region of South Australia

BRUCE WILSON, WILL SMITH & JIAORONG LI. Vegetation survey and mapping information and its use in regional biodiveristy planning in the Queensland Murray-Darling Basin

GEOFF BROWN & RALPH MAC NALLY. Reptiles and Habitat Fragmentation in the Box-Ironbark Forests of Central Victoria, Australia.

RICHARD KINGSFORD AND KRISSIE AULD. Colonial Waterbirds as a Guide to River Health and Management: The Macquarie Marshes, NSW, a test case.

MARCO SACCHI. Effect of Habitat Fragment Size on the the Herpetofauna of the Mount Lofty Ranges, South Australia

1080 fox baiting for conservation outcomes in western New South Wales.

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This study reports on observations made during a 1080 fox baiting program conducted as part of a predator-removal experiment within the NSW population of yellow-footed rock-wallabies. Between 1995 and 1999, baiting was carried out around one wallaby sub-population, while the another remained unbaited as an experimental control. Baiting was conducted on a fortnightly basis along a transect immediately adjacent to the wallaby colonies between June 1995 and June 1998; with baits left in place between baiting runs. Baiting was also conducted along a buffer line surrounding the wallaby colonies at a distance of between 2 and 6 km. During the 1995 to 1996 period, baits were laid along the buffer line for a one week period during September, March and June, with baits replaced daily. Between 1996 and 1999, the buffer line was baited on a monthly basis, with baits left in place between baiting runs. Foxoff Econobaits© were the principle bait medium used, though fresh meats baits were used periodically along the core inner baitline from 1996 onwards. Initial bait-take was high (50% to 80%) and did not decline below 10% until five months into the program. Over the subsequent 20 months, occasional peaks in bait-take occurred during periods consistent with the dispersal of juvenile foxes (February to June) and when the fresh meat baits were applied. The distinctive peaks in bait-take associated with the application of meat baits suggests that some foxes were reluctant to take the Foxoff baits. The obvious implication of this observation is that the sporadic use of a variety of bait mediums is required to achieve a maximum reduction in fox numbers.

During the period 1995 to 1999, yellow-footed rock-wallaby numbers within the baited area increased by 615%, while no change was observed in the un-baited control population. From 1999 onwards, the baiting program was extended to include the previously unbaited control site. Baiting at this site was carried out in a similar fashion, with a inner core baitline adjacent to the wallaby colonies and a system of buffer lines. However, baiting intensity was reduced to a monthly basis on all lines. Wallaby surveys carried out in 2000 and 2001 have revealed no detectable rise in rock-wallaby numbers within the newly baited population. This was in contrast to previous results from the other wallaby population, which displayed an exponential rate of increase of xxx during the first two years of baiting. These data suggest that the monthly baiting protocol was insufficient to reduce the fox population below the point where mortality due to predation was exceeded by recruitment into the wallaby population. For species trapped within "predator pits", baiting may need to be intensive during the initial phases of recovery programs to enable population growth.

Fox predation limits yellow-footed rock-wallaby (*Petrogale xanthopus*) populations in western New South Wales.

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Annual helicopter surveys, conducted since 1980, indicate that the NSW population of yellow-footed rock-wallabies underwent a slow decline until reaching low, but apparently stable, numbers from 1992 onwards. The aim of the current study was to examine the hypothesis that predation by red foxes was acting to limit the recovery of the wallaby population. A predator-removal experiment was established in June 1995, with an intensive fox baiting program being established around half of the wallaby colonies (Coturaundee Range) and with the remaining colonies acting as an un-baited experimental control (Gap Range). The existence of only two extant wallaby sub-populations in NSW limited the experimental design, however potential confounding effects were also monitored (ie. pasture cover, goat, cat and wedge-tailed eagle abundance and wedge-tailed eagle diet). Helicopter surveys over the period 1995 to 1998 indicated that the baited wallaby sub-population had increased in size by 615%, while no change was observed in the un-baited sub-population (0%). ANCOVA revealed no significant differences ($P>0.05$) between the slopes of regression lines fitted to the population indices of the baited and un-baited sites during the 4 year period prior to baiting (1992 to 1995; r = -0.27 and 0.16, respectively). However, following the commencement of baiting the slope of the regression line fitted to the baited sub-population indices was significantly higher ($P< 0.01$) than that of the unbaited sub-population (r = 0.65 and 0.01, respectively). Examination of the alternate treatment effects suggested that confounding effects were absent (Sharp 2000). Comparative demographic data from a wallaby colony in each sub-population indicated that juveniles were common at the baited colony, but rare at the un-baited site. These data suggested that fox predation was primarily focused on juvenile wallabies. This observation was supported by an observed high adult survival rate within the un-baited colony (annual $\Phi = 0.97 - 0.98$). Despite the limits to experimental design, the results of this study provide compelling evidence that fox predation was acting to limit the recovery of the NSW yellow-footed rock-wallaby population. However, the results do not provide any insight into whether fox predation was acting in a regulatory fashion and was the main causal agent of the populations initial decline. Such conclusions can only be drawn from a two phase experimental procedure, whereby the treatment effects are reversed and the effects on each sub-population observed (Sinclair 1991, Pech *et al.* 1995).

Population and dietary ecology for the management of the Pilliga Mouse (*Pseudomys pilligaensis*).

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The Pilliga Mouse (*Pseudomys pilligaensis*) is an Australian endemic mouse and classified as 'Vulnerable', under the NSW Threatened Species Conservation Act 1995. Its range is extremely restricted compared to other native rodent species. Despite these facts, no intensive ecological study has yet provided the ecological information needed for its management, mainly because of low trappability. In this study, population fluctuation has been monitored for over four years and diet was analysed to contribute to a proper management plan for this species.

After a large wild fire in 1997, the population of *P. pilligaensis* fluctuated dramatically. An extremely high capture rate was recorded in April 2000, and it appears that *P. pilligaensis* increased its population number at the early successional stage of vegetation after fire. A demonstrable relationship between capture rates and time since fire in the former trapping records supports this. Furthermore, relatively good rainfalls have been recorded after the 1997 fire in the Pilliga region. Fire followed by good rains seemed to create optimum conditions for *P. pilligaensis* and resulted in the population explosion in April 2000.

Faecal analysis showed that seed and fruit were the chief components of its diet all year round. Invertebrates were also consumed in some proportions in all seasons. We also found that *P. pilligaensis* consumed fungus and moss in small amounts. A clear contrast in diets between before and after the fire was found. Mice relied on fungus and moss materials more before the fire. Various seed species were identified in its diet, which indicates that *P. pilligaensis* is not associated with any particular plant species. These results show that *P. pilligaensis* is a generalist granivore although it can eat a wide variety of food types.

The early successional stage of vegetation after fire is characterised by a high plant species diversity, especially in the understorey, which can provide food and shelter to mice almost all year round. Our findings confirm that fire is one of the most important factors to influence *P. pilligaensis* population; an appropriate fire regime should be determined for the management of this species. However, further study, especially focused on special population fluctuation (including refuging) of *P. pilligaensis* after fire, is needed for a proper management plan.

Behavioural response of *Antechinus flavipes* and *Sminthopsis murina* to predation risk

Vicki Stokes, Tony Arthur, Chris Davey, Eddie Gifford, Steve Henry and Roger Pech

CSIRO Sustainable Ecosystems, PO Box 284, Canberra, ACT, 2601.

The poster presents the findings of a study examining the behavioural response of two small native mammal species (*Antechinus flavipes* and *Sminthopsis murina*) to perceived predation risk. Predation risk in eucalypt woodland at Lake Burrendong (central-western NSW) was manipulated by using wire netting at ground level to provide artificial refuge.

Foraging behaviour of both species was assessed with giving-up-densities (GUDs). The technique uses feeding stations with food items in a non-food matrix (in this case, trays with 20 mealworms mixed in 1.5L of vermiculite) to measure the quitting harvest rate in response to perceived predation risk. Both species foraged trays under the netting to lower GUDs (number of mealworms remaining) than trays in the open. This behavioural response indicates that animals perceive the netting as refuge.

Preference for the netting was demonstrated using two additional techniques. Visits to tracking tunnels and fluorescent pigment trails generally indicated that animals used the 20% of the site under the netting relatively more than areas in the open.

The Kangaroo Valley experience: working with the community to conduct a 1080 fox baiting program for the protection of the local Brush-tailed Rock-wallabies.

Melinda Norton[1], Mike Belshaw[1], Ian Jackett[1], Cameron Kirton[2] and Catherine Rummery[3].

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The NSW National Parks and Wildlife Service Brush-tailed Rock-wallaby (BTRW) program in the Shoalhaven region implements 1080 fox baiting around BTRW colonies in the Kangaroo Valley area. These BTRW colonies occur largely on private land, making community involvement an important aspect of the population's management. The community based fox-baiting program began in the Kangaroo Valley area in 1994. Participating landholders conduct their own baiting or allow NPWS to conduct baiting for them. This paper discusses the approaches taken to incorporate community involvement into the program and how this involvement has changed over time.

Between 1998-2001, the program received funding from Environment Australia, to implement intensive monitoring of the effect of the fox baiting on both foxes and rock-wallabies. The Kangaroo Valley area was nominated as the baited area and the Bugong area, where no baiting had been conducted, as the experimental control site. The response of the fox population was monitored using standard spotlighting counts along fixed transects. The response of rock-wallaby populations was monitored using estimates of relative abundance derived from counts of faecal pellets from permanent quadrats.

Spotlight counts over the 3 years suggest that fox abundance in the baited area fluctuated, while in the unbaited area it remained relatively stable. Spotlight counts in both the baited and unbaited areas at the start of monitoring were not substantially different to those recorded at the end of the 3 years of monitoring. However, it is important to note that fox monitoring began 3 years after the commencement of baiting in this area, and hence the initial effects of the baiting on fox abundance were not recorded.

Analysis of the pellet data from four colonies from winter 1998 to summer 2000, showed a significant difference in the slope of the regression of pellet count on time, between baited and unbaited colonies ($P<0.05$). The slopes for the baited colonies were each higher on average than those for the unbaited colonies. This significant difference, however, should be treated with caution as there were only 2 degrees of freedom for "between colonies within baiting". Further analysis on additional data using ANOVA on the actual pellet counts from all 5 colonies between autumn 2000 and summer 2001, showed that baited colonies had significantly higher number of pellets than non-baited colonies ($P<0.05$) for all seasons except summer 2001 ($P>0.05$). These data indicate that the effect of baiting in the Kangaroo Valley region previously reflected through reduced slopes has continued, and is now showing in differences in mean pellet count between baited and unbaited sites.

One Barking Owl – 6000 ha of Forest

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The precise nature of the relationship between the decline of Barking Owls *Ninox connivens* in southern Australia and their habitat is as yet unresolved. The species' general habitat of dry woodland and forest has been greatly modified through agricultural clearing and timber cutting, although much of its prey (i.e. medium-sized mammals and birds, including common species like rabbits and rosellas) remain relatively abundant. Furthermore, as a species willing to use forest edges, Barking Owls would not seem as hampered by recent forest clearing and fragmentation as are many Australian owls, yet they are one of the rarest species and very sparsely distributed. Clearly, an important conservation issue is to determine how Barking Owls exploit their habitat. In this study we radiotracked the female of a pair of owls using contiguous Cypress Pine – Ironbark forest near Dubbo, NSW in Goonoo State Forest. Based on 25 nights of tracking during a 4 month period prior to the breeding season, the female covered a total area of over 6000 ha (concave polygon method). This area is greater than any other published home range of an Australian owl. Even discounting several of her longer forays, this owl used a central area of 4100 ha (95% minimum convex polygon). Within this home range she focussed her foraging effort in several patches adding up to 430 ha (75% kernel), many of which were along drainage lines. High fidelity was shown to four roost sites in close proximity, which were not centrally located in the home range. Although these values derive from only a single bird, it is of great conservation concern that this Barking Owl used such a large area to fulfil her foraging requirements, and that the pair was only one of two in the entire 65,000 ha of Goonoo State Forest.

Spatial heterogeneity in rabbit distributions: utilising geographic information systems to examine relationships between rabbit warrens and foraging behaviour.

Peter West and Glen Saunders.

Vertebrate Pest Research Unit, NSW Agriculture, Forest Rd, Orange, NSW 2800 Australia

Geographic Information Systems (GIS) and air-photo interpretation were used to examine variation in the distribution of wild rabbits (*Oryctolagus cuniculus*) at Oaky Creek (149°22'00" E, 33°24'40" S) in the Central Tablelands of NSW. The site contained 1520 rabbit warrens (1200 active and 320 inactive) in late winter of 1998, ranging in size from 1 – 41 active entrances. Mean number of warrens per hectare was 6.03. Overall, warrens exhibited a significantly clustered pattern (t =160.3; df = 795; P<0.05).

Slope and Aspect analysis revealed warrens were more abundant than expected on eastern facing aspects, and on gradients between 8.5 and 19.3 degrees slope. Proximity analysis indicated nearest distance to creeks had no significant effect on the spatial distribution of rabbit warrens.

A comparison between the use of drainage categories for warren construction, with the drainage categories used by spotlight rabbits revealed rabbits were active/foraging on more exposed mid-slopes, whereas warrens were more abundant on low undulating slopes adjacent to gullies. These findings indicate the distributions of rabbits and warrens do not always completely correspond. This disparity raises concern for reliance on these methods (if used alone) as indices of fine-scale spatial variation in rabbit abundance. Hence, these results have implications for control programs.

Field assessment of non – target uptake of buried 1080 baits – a Quality Assurance approach to 1080 baiting

David Fairbridge

Victorian Institute of Animal Science, PO Box 48 Frankston Victoria

Baiting using the toxin 1080 is currently considered a highly effective method of feral predator control in Australia although a perennial issue related to the toxin's use is the potential for accidental poisoning of non–target animals. The risk faced by an individual or a population is dependant on a variety of factors including sensitivity to 1080, diet preference, body weight and level of exposure.

Burial of baits has long been considered an important strategy in reducing non target exposure to the toxin but the ability of different native species to locate and consume buried baits in the field is not well understood. This study used a marker (Rhodamine B) in non - toxic baits to assess bait uptake by non - target mammals in the field during simulated buried baiting operations.

Trials demonstrated that 8 non target mammal species (including 3 arboreal species) were capable of accessing, and at least partly consuming, fox baits when buried according to standard practice in Victoria.

The levels of bait uptake detected suggested that impacts on populations of common species with high recovery capacity are likely to be minimal. However rare or threatened species may be less resilient and the loss of even a small number of individuals due to accidental poisoning may have serious consequences for local populations. Attention to bait placement, burial and design of bait stations is of critical importance in preventing non- target poisoning.

Conservation Management of the Green and Golden Bell Frog at Sydney Olympic Park

Kerry Darcovich

Sydney Olympic Park Authority (SOPA), Locked Bag 3, HOMEBUSH BAY 2127

Sydney Olympic Park - the main site of the Sydney 2000 Olympic and Paralympic Games - is home to one of the largest known remaining populations of the endangered Green and Golden Bell Frog. When the population was first discovered in 1993, site managers faced a considerable challenge - how to conserve an endangered species in the midst of one of Australia's largest and busiest construction sites. The Sydney Olympic Park Authority (SOPA; formerly Olympic Co-ordination Authority) has worked closely with the Australian Museum in conserving the species throughout redevelopment of the site, and gone beyond establishing a dedicated refuge for the species. Ponds, wetland areas, grassy habitat, road underpasses and fences have been constructed within the new Millennium Parklands, and stringent management protocols were implemented to protect the species during site redevelopment. That one of the largest remaining populations of the frog continues to survive and prosper demonstrates the success of the measures put in place to protect and conserve the species throughout development and into the future. SOPA's management of the frog is an excellent example of how to integrate development and conservation and is a testament to SOPA's commitment to ecologically sustainable development. Co-operation between developers, scientists, landscape architects, contractors and parkland managers has been integral to achieving these results.

AUSTRALIAN WILDLIFE HEALTH NETWORK

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Aim:
To promote and facilitate collaborative links in the investigation and management of wildlife health in support of human and animal health, and biodiversity.

The story so far:

- National Conference in November 1999
- Multi-organisational steering committee with project officer 2000-2002
  - Feasibility study, networks and email lists developed
  - Business plan and national policy
- Standing Committee on Agriculture and Resource Management endorsed core funding for 2002-2005

The future:

- Establishment of the network to commence July 2002
- Management of the network by a host agency, state/commonwealth management committee and Coordinator
- Development of a national database of wildlife health and surveillance information and expertise
- Planning and coordination of wildlife health surveillance, education and research priorities and activities
- Promotion of wildlife heath emergency preparedness and response strategies

Density and den preference of European Red Foxes in the Central Tablelands of New South Wales

Matt Gentle, Greg Jones, Peter Worsley and Glen Saunders

Vertebrate Pest Research Unit, NSW Agriculture, Orange Agricultural Institute, Forest Road, Orange 2800

Systematic ground searches for natal, active and inactive dens are currently being undertaken as part of a project investigating management strategies and behaviour of the European red fox (*Vulpes vulpes*). Natal den counts can provide an accurate means of estimating fox population density, assuming monogamous pairing. These, in turn are compared to other measures of absolute and relative density, in order to determine the best means of evaluating fox control programs. Dens were considered active if they displayed obvious signs of fox activity between July and September. Dens that continually displayed signs of activity throughout September, October and November were considered natal dens. Litter size was estimated by observing cubs outside dens at dusk. As an aside to the primary objective of this study, ground control points for each den were obtained using hand-held Global Positioning Systems (GPS) and integrated into a Geographical Information System (GIS – ArcView). A Digital Elevation Model was then added to generate slope and aspect functions to investigate possible preference of den sites. In this poster we will present recent findings on estimates of fox density and den preferences and comparisons with previous studies.

Surveys and management of threatened species in State Forests of NSW

Brian Tolhurst, Anna Lloyd and Paul Meek

State Forests of NSW, P.O. Box 535 Coffs Harbour NSW 2450

Extensive flora and fauna surveys are carried out each year by State Forests of NSW (SFNSW) as part of its obligation to manage threatened species under the *Threatened Species Conservation Act 1995*. SFNSW operates under threatened species licenses that were developed by NSW NPWS, SFNSW and a panel of experts during the NSW Regional Forest Agreements. Under the terms of these licences, State Forests conducts pre-logging and pre-roading surveys and implements protection measures for threatened flora, fauna and habitat. All specified forestry activities must satisfy the conditions of these licenses. General and species specific surveys are conducted for a wide range of taxa. Surveys are triggered by the presence of known habitat and/or modelled habitat. These surveys are conducted diurnally, nocturnally and seasonally for those species listed in the license. Records are taken of individuals, sign and habitat features and protective prescriptions are applied. Ecological management is also carried out on a landscape basis and SFNSW is currently developing species management plans for selected species. State Forests' corporate policy is to carry out all forestry operations in a ecologically sustainable manner

Reptiles and Habitat Fragmentation in the Box-Ironbark Forests of Central Victoria, Australia.

Geoff Brown[1], Ralph Mac Nally[2]

[1] Arthur Rylah Institute for Environmental Research, Department of Natural Resources and Environment, Heidelberg, Victoria 3084;
[2] Section of Ecology, Department of Biological Sciences, Monash University 3800, Australia.

There are few published accounts addressing the impact of habitat fragmentation on biodiversity of terrestrial reptiles. We provide information on the saurofaunas of fragments of box-ironbark forest of central Victoria, gathered over three years. Data for fragments of four size-classes (10, 20, 40, 80 ha) are compared with similar information for 'reference areas', sites of the same size-ranges but set within large blocks of continuous forest (> 10 000 ha). These comparisons are used to differentiate fragmentation effects from normal species-area relationships. Two sets of data are presented: an 'extensive' set based on 68 fragments and reference areas surveyed by using transect counts and area searches; and an 'intensive' set that also included pitfall trapping, but was restricted to 17 fragments and reference areas. The reptilian fauna was both depauperate and of low general abundance. Differences in capture-rates and species richness between fragments and reference areas collectively are minor, but there are significant differences in species richness between area-classes, and there are important differences in the occurrence of certain species. The two most abundant species in reference areas were very rare in fragments, while a number of species were either in much greater numbers or only occurred in fragments. The saurofaunas are 'nested subsets' by area, with strongest nesting apparent in the intensive data-set for reference areas.

Grazing impacts of Black-striped Wallabies on Central Queensland developed pastures

Debra H. White[1], Peter Jarman[2] and Carlo Gazzola[1]

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[2]Department of Ecosystem Management, School of Natural Resources, UNE, Armidale, NSW.

Black-striped wallabies (*Macropus dorsalis*) can reach high densities where patches of retained Brigalow (*Acacia harpophylla*) scrub are contiguous with developed pasture. Wallabies are then commonly blamed for decreased cattle production, and for reducing biodiversity values in remnant brigalow communities. These problems are being studied at Brigalow Research Station, Theodore, Central Queensland, which, although mainly devoted to beef cattle, includes a large area of remnant brigalow and softwood scrub communities adjacent to developed pastures.

This poster presents a study evaluating the impact of Black-striped wallabies on the Research Station's grazing enterprise. Seasonal changes in pasture standing biomass, scat density and other parameters have been measured in three exclusion treatments (pens) which exclude all large grazers, exclude cattle but not wallabies, or do not exclude any grazers. After 8 months growth, pens giving access to all grazers and to wallabies only have 19 and 14%, respectively, as much pasture standing biomass as the un-grazed pens. Scat counts indicate the wallaby-only pens were the most heavily used by wallabies. Preliminary results suggest that grazing by Black-striped wallabies on Brigalow Research Station removes substantial amounts of potential biomass from developed pasture that would otherwise be available for stock, but only in a limited area adjacent to retained scrub.

Black-striped Wallaby Distribution within a Central Queensland Remnant Brigalow Scrub.

Debra H. White[1], Peter Jarman[2] and Carlo Gazzola[1]

[1]Queensland Department of Primary Industries, PO Box 5545, CQ Mail Centre QLD 4702
[2]Department of Ecosystem Management, School of Natural Resources, UNE, Armidale, NSW.

Throughout Central Queensland, Black-striped wallabies (*Macropus dorsalis*) are found in suitably sized patches of both remnant and regrowth Brigalow (*Acacia harpophylla*) communities. A substantial population of Black-striped wallabies on Brigalow Research Station, near Theodore, Central Queensland, use a large area of remnant scrub, containing at least three differing brigalow communities, for daytime sheltering. The wallabies emerge at night to feed in adjacent pasture. We could not observe wallabies in the scrub without disturbance. Wanting to know what characteristics of scrub are selected by sheltering wallabies, we studied the distribution of wallaby occupance of the scrub communities by counting scats (faecal pellets) in quadrats along 21 transects in September 2000 and September 2001. Long-standing surveys and on-ground assessments were used to categorise the vegetation types along the transects.

Scats were not distributed homogenously, being consistently more dense in some areas of the scrub than in others. Moreover, that pattern of heterogeneity was consistent from year to year. The heterogeneity was not explained just by wallaby preference for some vegetation community types, which was weak, at best. Distance from the scrub/paddock boundary, or access to pasture, influenced scat densities more strongly. For example, scat densities were significantly lower within 20m of the scrub boundary than deeper into the scrub; densities were particularly low where a fence prevented direct access to adjacent pasture.

The results suggest that black-striped wallabies are, indeed, selective for diurnal shelter habitat. In choosing shelter, they appear to avoid camping right at the edge of the scrub; they choose vegetation types probably for the concealment provided by their structure, rather than for their floristics; and they probably use preferred resting sites habitually and possibly socially.

Kangaroo Island's Koala Management Program: actions and outcomes

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History shows that koalas have a high and charismatic social profile, and on Kangaroo Island where koala numbers are increasing there are distinct benefits for tourism. However their increasing numbers and highly selective browsing now presents a significant pressure not experienced before by Kangaroo Island's unique vegetation communities. Signs of over-browsing amongst riverine vegetation dictated that some form of management was necessary if the integrity of these unique vegetation communities is to be retained. In the mid 1990s a Koala Management Task Force was established to investigate options for Koala Management on Kangaroo Island.

After considerable media attention and public debate a Management Program was approved that included:

- A large scale fertility control program to reduce the future birth-rate of koalas;
- Translocation of some koalas from Kangaroo Island to areas of suitable habitat on the mainland;
- Implementation of a habitat protection and restoration program; and
- A community education program.

To date the Kangaroo Island Koala Management Program has been the first attempt in Australia at controlling an over-abundant wild animal population using the integration of surgical fertility suppression and translocation of younger individuals.

This presentation will briefly outline what the Kangaroo Island Koala Management Program has achieved since its inception in 1997.

Habitat use of the Australasian shoveler, *Anas rhynchotis*, in the southeast of South Australia and management implications

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The Australasian shoveler is one of the least studied of the Australian ducks and is listed as rare in South Australia and vulnerable in Victoria. It has been reported to be declining in numbers over much of its range. Given the lack of knowledge of ecology of the Australasian shoveler, the aim of this Ph.D. project is to investigate the habitat use of the shoveler and to make recommendations for management of the species. The thesis, therefore, has three main foci, the first examines the temporal and spatial variation in distribution and abundance of the Australasian shoveler in order to support or refute reports of declines in abundance of the species. The second focus is to investigate the feeding ecology of the shoveler through observations of feeding behaviour, and food availability and abundance. The breeding ecology of the shoveler will also be investigated. Nest site selection, nesting and brood success, and habitat use of ducklings will be studied. This study will focus on shoveler populations in the southeast of South Australia, in part around the Watervalley Wetlands, where stronghold populations of shovelers occur.

Habitat utilisation by mammals and the impact of native forest silviculture in mixed-species eucalypt open forest

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Habitat utilisation by mammals has been extensively studied in some harvested native forests, for example the montane ash forests of the Central Victorian Highlands. However, very little information has been collected for the mixed-species eucalypt open foothill forests, such as the Wombat State Forest (WSF), where harvesting regimes and ecological relationships are different. The Midlands Forest Management Plan (DNRE 1996)[1], which includes the WSF, contains provision for the retention of suitable habitat to mitigate the impact of silviculture on fauna. Yet there is little evidence for the use of such habitat by fauna. Current research in the WSF aims to determine the impact of silviculture on faunal habitat and to examine the use of retained habitat by ground-dwelling, semi-arboreal and arboreal mammals. Sampling of unharvested forest and forest at different stages of the harvesting cycle will capture the habitat variation across the landscape. Preliminary Elliott trapping results suggest that densities of the ground-dwelling bush rat, *Rattus fuscipes*, are higher in harvested sites than unharvested sites. Limited spotlighting has revealed low numbers of arboreal marsupials in both harvested and unharvested sites. Scat counts to assess densities of larger mammals, such as wallabies and wombats, will take place in the future. Radio-tracking of key indicator species is also proposed. This research will have implications for ecologically sustainable forest management and the conservation of mammal diversity in forests managed for timber production.

[1]Department of Natural Resources and Environment (1996). *Forest management plan for the Midlands forest management area.* Department of Natural Resources and Environment, Melbourne, Victoria.

The impact of habitat fragmentation on arboreal marsupials in the South East region of South Australia

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A system of fragmented native vegetation exists in the South East of South Australia, where only 13% of the original vegetation remains (Croft *et al. 1999)*[3]. Arboreal marsupial populations are considered to be under threat in this region as a result of the fragmentation process. This study aimed to determine the diversity and habitat preferences of arboreal marsupials in 28 isolated habitat patches. Systematic spotlighting resulted in the detection of five species. In order of decreasing abundance they included the common ringtail possum *Pseudocheirus peregrinus,* common brushtail possum *Trichosurus vulpecula,* sugar glider *Petaurus breviceps,* koala *Phascolarctos cinereus* and yellow-bellied glider *Petaurus australis.* Multiple regression analyses revealed relationships between habitat patch characteristics and the relative abundance, or presence, of the three most common species. Patch variables significantly related to animal presence or abundance included, surrounding land use, average tree diameter, patch size, abundance of some eucalypt species, density of dead trees and time since wildfire. Using combinations of these variables, a system for ranking the suitability of patches was developed. This suitability analysis has potential for application in the design of future management plans for arboreal marsupials and other fauna in fragmented landscapes.

[3]Croft, T., Carruthers, S., Possingham, H. and Inns, B. (1999). Biodiversity Plan for the South East of South Australia. Department for Environment, Heritage and Aboriginal Affairs.

Vegetation Survey And Mapping Information And Its Use In Regional Biodiveristy Planning In The Queensland Murray-Darling Basin

Bruce Wilson, Will Smith and Jiaorong Li

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The regional scale (1:100 000) mapping produced by the Queensland Herbarium provides maps and statistics on the distribution and extent of vegetation.

The production of pre-clearing and remnant vegetation maps allows ecosystem types that have been extensively cleared to be identified. This information is an essential data layer for developing regional land use strategies and biodiversity targets.

There are 227 regional ecosystems mapped across the Queensland MDB, and these have been grouped into 12 broad vegetation types. While 54% of the Queensland MDB is covered with remnant vegetation, a number of broad vegetation types (BVT) have been heavily cleared. Only 14% of the pre-clearing distribution of the Brigalow BVT remained in 1999, while the Vine and rain forests BVT was reduced to 35% of its pre-clearing distribution. The Poplar box and silver leaved ironbark woodland BVT has been reduced to 37% pre-clearing area, and also was being cleared at the highest rate between 1997 and 1999, with 3% of the pre-clearing distribution (153,867 hectares) cleared during this period.

While not recommended for property scale use without additional ground truthing, the regional scale mapping is used as a guide for carrying out more detailed mapping and planning.

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Geoff Brown[1], Ralph Mac Nally[2]

[1] Arthur Rylah Institute for Environmental Research, Department of Natural Resources and Environment, Heidelberg, Victoria 3084;
[2] Section of Ecology, Department of Biological Sciences, Monash University 3800, Australia.

There are few published accounts addressing the impact of habitat fragmentation on biodiversity of terrestrial reptiles. We provide information on the saurofaunas of fragments of box-ironbark forest of central Victoria, gathered over three years. Data for fragments of four size-classes (10, 20, 40, 80 ha) are compared with similar information for 'reference areas', sites of the same size-ranges but set within large blocks of continuous forest (> 10 000 ha). These comparisons are used to differentiate fragmentation effects from normal species-area relationships. Two sets of data are presented: an 'extensive' set based on 68 fragments and reference areas surveyed by using transect counts and area searches; and an 'intensive' set that also included pitfall trapping, but was restricted to 17 fragments and reference areas. The reptilian fauna was both depauperate and of low general abundance. Differences in capture-rates and species richness between fragments and reference areas collectively are minor, but there are significant differences in species richness between area-classes, and there are important differences in the occurrence of certain species. The two most abundant species in reference areas were very rare in fragments, while a number of species were either in much greater numbers or only occurred in fragments. The saurofaunas are 'nested subsets' by area, with strongest nesting apparent in the intensive data-set for reference areas.

Colonial Waterbirds as a Guide to River Health and Management: The Macquarie Marshes, NSW, a test case.

Dr Richard Kingsford and Krissie Auld

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Impacts of water resource development on the flooding of the Macquarie Marshes and their waterbirds are reasonably well established (Kingsford and Thomas, 1995; Kingsford and Johnson 1999). However the success of current and future management regimes needs to be monitored.

The Macquarie River was the first NSW catchment to have environmental flow provisions included in river management arrangements (DLWC, 2001). These rules were based on those set originally in the 1986 Macquarie Marshes WMP was amended in 1996. Monitoring of the effectiveness of the flow rules is imperative. There are few measure of wetland health available that allows quantification of the management of flows to the Marshes. Fifteen years of data on breeding, flooding and flows is available and makes the Macquarie Marshes the only large site with such a comprehensive data set.

Impacts of water resource development on the flooding of the Macquarie Marshes and their waterbirds are reasonably well established (Kingsford and Thomas, 1995; Kingsford and Johnson 1999). General relationships between water flows and colonial waterbird breeding have already been established (Kingsford and Johnson 1999), however the challenge is to devise effective biological measures that inform river management. Waterbird breeding offers a useful index to river flow management in the Macquarie Marshes

Effect of Habitat Fragment Size on the Herpetofauna of the Mount Lofty Ranges, South Australia.

Marco Sacchi *

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The native vegetation in the Mount Lofty Ranges near Adelaide has largely been cleared since European settlement in 1836. Now less than 15% remains with 74% on private land and only 23% is protected in Parks. The vegetation that is left is protected from further large scale clearance but some degradation still occurs. These fragments of the native vegetation are often small, separated by pastoral/agricultural land and are often infested with weeds and feral animals.

58 reptile and 10 frog species have been recorded in the Mount Lofty Ranges. 6 of the reptiles and 1 frog have official conservation ratings although some other species are also of concern. No species are thought to have become extinct overall but some have disappeared from large parts of their former distributions and may now be represented by few individuals; e.g., the heath goanna, *Varanus rosenbergi*.

This study, in its second year, aims to discover whether local extinctions in habitat remnants of varying size in the southern Mount Lofty Ranges is random or follows characteristic patterns. The degree of nestedness is being determined using nested subset analysis across about 22 remnant patches of stringybark (*Eucalyptus obliqua / E. baxteri*) open forest in the study area. It is hoped that analyses of nested subset structure (or other non random patterns) will allow inferences to be made about the vulnerability of species to extinction and on the conservation value of individual habitat fragments. The work involves: selecting comparable remnants varying in size from 0.001ha to a large "mainland" area of >3,000ha; exhaustive sampling to determine the resident species; collection of ecological information on the remnants; and, analysis of the degree of nestedness in presence/absence matrices.

The second phase of the study involves a study of the dispersal abilities of selected species. Various experiments examine how the herpetofauna in the Mt. Lofty Ranges deals with obstacles such as roads, fire-breaks or walking tracks. Movement from native vegetation across pastoral land and pine plantations is also studied. The third part of the study deals with management implications.

Early results for 12 sites suggest that the analysis is useful, that the order of extinction of reptiles may not be random and is possibly influenced by factors such as remnant size. The information on frogs is less amenable to analysis and this group may have to be dealt with separately. It seems likely that the reptile work will contribute to conservation management in the region.