



**Australian National
University**

April 24-27, 2003

Program and Abstracts

Thursday, 24 April 2003

18:00 - 20:00

Reception / registration / drinks

Friday, 25 April 2003

8:45 - 9:00

Introduction and Welcome Address

9:00 - 9:45

Leigh Simmons **Plenary Lecture**
Testing models of postcopulatory sexual selection: lessons from the dung heap

9:45 - 10:30

Session 1: Mating Strategies I **Chair: Rob Heinsohn**

9:45 - 10:00

Bradford, RR Do male cheetahs learn the sequence of behaviours that lead to successful mating?

10:00 - 10:15

Herberstein, ME, Barry, K, Wills, E, Youssef, C Why hang around? How effective is postcopulatory mate guarding in the St Andrew's Cross spider (Araneae, Araneidae)?

10:00 - 10:30

Stapley, J Causes and consequences of alternative male mating strategies in lizards

10:30 - 11:00

BREAK

11:00 - 12:30

Session 2: Mating Strategies II **Chair: Anne Goldizen**

11:00 - 11:15

Genital morphology and fertilisation success in the dung beetle *Onthophagus taurus* : an example of sexually selected male genitalia

11:15 - 11:30

Forster, I, Mulder, RA The paradise pretty-boy puzzle: do dichromatic males differ in behaviour?

11:30 - 11:45

Holwell, G, Barry, K, Herberstein, ME Mating behaviour in the non-cannibalistic praying mantis *Ciulfina*

11:45 - 12:00

Mulder, RA Mixed mating strategies of alternate male morphs in a paradise flycatcher

12:00 - 12:15

Bussiere LF, Abdul-Basit H, Gwynne DT Preferred males are not always good providers: female choice and male investment in tree crickets

12:15 - 12:30

Johnston G, Bouskila A Dull males do it in the dark: Activity pattern and sexual dimorphism in the Gecko *Ptyodactylus guttatus*

12:30 - 14:00

LUNCH

14:00 - 15:30

Session 3: Animal Welfare and Reproduction **Chair: Jochen Zeil**

14:00 - 14:15

Jongman, EC Welfare implications of an alternative pregnant mare urine (PMU) collection device under Australian conditions

14:15 - 14:30

Lansdowne R, Giles R, James, K, Wynn P Towards a practical measure of temperament in pigs

14:30 - 14:45

Davis, J, Collier-Baker, E Control and psychological well-being: An investigation of the concept of choice in captive primates

14:45 - 15:00

Arnold, A, Hemsworth, P, Jongman, E, Ng, K The effect of noise on the behavioural and physiological responses of heifers in an indoor raceway

15:00 - 15:15

Hawkins, M Monitoring platypus behaviour: contribution to captive breeding success

15:15 - 15:30

Rutstein, A Brood manipulation in zebra finches

15:30 - 16:00

BREAK

16:00 - 17:30

Session 4: Predators & Prey **Chair: Marie Herberstein**

16:00 - 16:15

Wignall, A Floral symmetry, crab spiders and honeybees

16:15 - 16:30

Wall, M Chemosensory predator detection in an Australian skink: phylogeny versus ecology

16:30 - 16:45

Bruce, MJ, Herberstein, ME, Griffiths, B Does a trade-off between prey and predator attraction explain the variation in orb-web spider foraging behaviour?

16:45 - 17:00

Herberstein, M, Elgar, MA Snacking from the pantry: Food storage in orb-web spiders (Araneae, Araneioidea)

17:00 - 17:15

Pix, W, Hemmi, J, Vorobiev, M, Marshall, J, Zeil J The variable colours of fiddler crabs and their relation to background and predation

17:15 - 17:30

Leavesley, AJ, Magrath, RD The alarm calls of the white-browed scrubwren (*Sericornis frontalis*) convey urgency

18:30

Bus leaves for Woolshed

19:00 - 23:00

BushDance + BBQ

Saturday, 26 April 2003

9:00-9:45	Plenary Lecture	Srinivasan M V	Small Brains, Smart Minds: Vision, Navigation and 'Cognition' in Honeybees	
9:45 - 10:30	Session 5: Cognitive abilities			Chair: Chris Evans
9:45 - 10:00	Cunningham JP	Learning, odour preference and flower foraging in moths		
10:00 - 10:15	Cheng, K	Interference, response competition and spatial memory in honeybees, <i>Apis mellifera</i>		
10:00 - 10:30	Reinhard, J, Guez, D, Srinivasan, M, Zhang, S	How honeybees remember where to go: associative learning and recall as navigational aids		
10:30 - 11:00	BREAK			
11:00 - 12:30	Session 6: Mechanisms of Behaviour/Theoretical Advances			Chair: Rob Magrath
11:00 - 11:15	Göth, A, Chambers, V, Evans, CS	Friend or foe? Species recognition in megapodes, birds without parental care		
11:15 - 11:30	Zhang, S, Srinivasan, MV, Zhu, H, Wong, J	Perceptual grouping of visual patterns by honeybees		
11:30 - 11:45	Baird, E, Zhang, S, Srinivasan, M	Flight speed control in the honeybee		
11:45 - 12:00	Kondo, J	How does diurnal thermoregulation affect the nocturnal performance of a rock-dwelling gecko <i>Oedura lesueurii</i>		
12:00 - 12:15	Hemmi, J, Zeil, J	Burrow surveillance in fiddler crabs: the mechanism of decision making		
12:15 - 12:30	Cockburn, A	A new predictive theory of avian cooperative breeding		
12:30 - 12:45	Beilharz, RG	Need to rethink animal evolution - from DNA back to Darwin		
12:45 - 14:00	LUNCH			
14:00 - 15:30	Session 7: The Design of Signals			Chair: Raoul Mulder
14:00 - 14:15	Magrath, RD, Scarl, J, Parks, E	The ecology of nestling call design		
14:15 - 14:30	Marshall, J	Flourescent communication in animals: Epiphenomenon or fact? Evidence for and against a variety of things		
14:30 - 14:45	Peters, RA, Evans, CS	Experimental analyses of an agamid lizard display: signal efficacy depends upon duration		
14:45 - 15:00	Kerswell, KJ, Hemsworth, PH, Bennett, P	Potential effects of morphology on social communication in the dog (<i>Canis lupus</i>)		
15:00 - 15:15	Nicholls, JA	Habitat-dependent signal design in satin bowerbird (<i>Ptilonorhynchus violaceus</i>) vocalisations?		
15:15 - 16:00	BREAK			
16:00 - 17:30	Session 8: The Functions of Signals			Chair: Shazza Downes
16:00 - 16:15	Platzen, D, Magrath, RD	Parental alarm calls: A signal that suppresses nestling vocalization in the white-browed scrubwren <i>Sericornis frontalis</i>		
16:15 - 16:30	Smith, J	The role of song as a mating strategy for humpback whales		
16:30 - 16:45	van Dongen, W	Functions of multiple ornamentation in the golden whistler (<i>Pachycephala pectoralis</i>)		
16:45 - 17:00	Detto T, Zeil J, Magrath R, Hunt S	Sex, size and colour in the semaphore crab, <i>Heloecius cordiformis</i>		
17:00 - 17:15	Evans, CS, Evans, L	Adaptive scepticism: tolerance of unreliable callers varies with the cost of failing to respond		
17:15 - 17:30	Rogers, A	The functions of duets in the eastern whippbird		
17:30 - 17:45	BREAK			
17:45 - 18:30	ASSAB General Meeting			
19:30 - 23:00	Conference Dinner at Vivaldi's			

Sunday, 27 April 2003

9:00 - 10:30	Session 9: Mate Choice	Chair: Andrew Cockburn
9:00 - 9:15	Bayly, K, Evans, C	The measure of a male: correlates of reproductive success differ when time for female assessment is less constrained
9:15 - 9:30	Adcock, GJ, Billing, TM, Carew, PJ, Mulder RA, Kraaijeveld K	Mate choice and dispersal history within a population of the mutually ornamented black swan
9:30 - 9:45	Gaskett, AC, Herberstein, ME, Downes, BJ, Elgar, MA	Lifetime male mate choice priorities in a sexually cannibalistic orb-web spider
9:45 - 10:00	Wong, BBM, Jennions, MD	Costs influence male mate choice in a freshwater fish
10:00 - 10:15	Jones, T	The importance of being average
10:00 - 10:30	Fisher, DO	Female choice and multiple mating in agile antechinus
10:30 - 11:00	BREAK	
11:00 - 12:45	Session 10: Conflicts and Competition/Life Histories	Chair: Justin Marshall
11:00 - 11:15	Taylor, PW	The mis-measure of animal contests: has direct assessment of rivals been overestimated?
11:15 - 11:30	Downes, S, Bauwens, D	How does the outcome of first encounters affect ensuing social relations within dyads of lacertid lizards?
11:30 - 11:45	Langkilde, T	Habitat use in montane skinks: do social interactions affect the shelter-site choice?
11:45 - 12:00	Hofer, AM	Influence of female reproductive state on male-male aggression in the Australian skink <i>Lampropholis guichenoti</i>
12:00 - 12:15	Maguire, GS	Population dynamics and breeding ecology of the southern emu-wren (<i>Stipiturus malachurus</i>) in Victoria
12:15 - 12:30	Dowling, DK, Antos, M, Sahlman, T	Dispersal and recruitment of juvenile red-capped robins
12:30 - 12:45	Sims, R, Cockburn, A	Causes of age-related improvements in reproductive success among female fairy-wrens: constraint or restraint?
12:45	Closing remarks	
13:00	LUNCH	
	Posters	(posters on display whole conference)
	Si, A, Helliwell, P, Maleszka, R	Memantine alleviates L-trans-2, 4-PDC-induced amnesia in the honeybee and suggests a role for glutamate and NMDA receptors in memory recall
	Lamont, R., Moritz S. and Srinivasan, M.V.	A vision system for tracking insect flight in three dimensions
	Langmore, NE, Kilner, RM	Escalation of a coevolutionary arms race through host rejection of brood parasitic young
	Wallef, S. J., Siebeck, U. E. and Marshall, N. J.	The possible role of ontogenetic colour change as intraspecific camouflage in damselfish
	Guay, P.-J.; Mulder, R.A.	Sexual selection in the extreme size-dimorphic musk duck (<i>Biziura lobata</i>)
	Mokany, A.	Let's get physical: Interactions between tadpoles and mosquito larvae

Posters

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A vision system for tracking insect flight in three dimensions.

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Escalation of a coevolutionary arms race through host rejection of brood parasitic young.

Langmore, NE and Kilner, RM

The possible role of ontogenetic colour change as intraspecific camouflage in damselfish.

Waller, SJ, Siebeck, UE and Marshall, NJ

Sexual selection in the extreme size-dimorphic musk duck (*Biziura lobata*).

Guay, PJ and Mulder, RA

Let's get physical: Interactions between tadpoles and mosquito larvae.

Mokany, A

Abstracts

Adcock, G.J. and Billing, T.M. and Carew, P.J. and Mulder, R.A. and Kraaijeveld, K.
Department of Zoology, University of Melbourne, Melbourne 3010, VIC and Department of Biology, Darwin Building, UCL, Gower Street, London WC1E 6BT United Kingdom
Mate choice and dispersal history within a population of the mutually ornamented black swan.

Dispersal and mating behaviour were examined in the Lake Wendouree population of black swans (*Cygnus atratus*) using genotypic data from individuals over 4 successive years. Observations of behaviour and a positive correlation of ornamental feather numbers between each bird in a pair suggests that black swans of both sexes are involved in the process of mate choice. The genetic variation at 5 highly variable microsatellite loci was examined among individuals in this population for patterns suggestive of the consequences of this breeding system. Pair-wise relatedness estimates and heterozygosity levels for paired individuals and among individuals of each sex were examined to determine whether there is a genetic basis to mate choice. Population censusing and genetic assignment tests were used to identify individuals dispersing into the population and whether they dispersed from local populations, so that sex bias, pairing status and breeding success of dispersers versus non-dispersers could be examined.

Arnold, A.¹ and Hemsworth, P.^{1,2} and Jongman, E.² and Ng, K.²

¹University of Melbourne; ²Animal Welfare Centre, Victorian Institute of Animal Science, Werribee, VIC 3030.

The effect of noise on the behavioural and physiological responses of heifers in an indoor raceway.

In the milking shed environment, dairy cattle are exposed to unavoidable noise from a variety of sources. Characteristics of this noise, such as its intensity, unpredictability and (initially) novelty, suggest that it is likely to be fear-provoking for dairy cows. A methodology was developed in order to quantify the effect of noise on measurements of movement behaviour, heart rate and cortisol in dairy heifers. This involved a pre-treatment, treatment and post-treatment phase, each lasting for 5 days. During the treatment phase, 16 heifers were repeatedly presented with tape-recorded sounds of milking shed noise in an indoor raceway, and 16 animals acted as controls.

Heifers exposed to the noise showed an elevated heart rate (both before entry and while in the raceway) and an increase in speed of movement through the raceway compared to control animals. The change in speed persisted over the course of the 5-day treatment phase, however heart rate returned to control levels after the first day. There was a tendency for animals in the noise group to be more difficult to move if stopped in the raceway than control heifers. These results suggest that dairy heifers show at least a temporary physiological change in response to milking shed noise, as well as a distinct change in movement behaviour, consistent with habituation of an acute stress response.

Baird, E. and Zhang, S. and Srinivasan, M.

Centre for Visual Sciences, Research School of Biological Sciences, ANU, Canberra, ACT, 2601

Flight Speed Control in the Honeybee.

The importance of vision in the behaviour of flying insects has been highlighted by investigations into the ability of these insects to negotiate their environment with extreme precision and manoeuvrability. A series of earlier studies have demonstrated how insects use visual information acquired during flight to avoid obstacles, negotiate narrow gaps and to execute perfect landings. Earlier research by David (1982) and Srinivasan et al (1996) has suggested that flying insects may also use visual information to regulate flight speed. In the

present study we examine this hypothesis critically and in greater detail. Honeybees (*Apis mellifera*) were trained to fly to a food source at the end of a tunnel, which had moveable random dot patterns on the side walls. Flights were recorded using a video camera mounted above the tunnel; A computer program was then used to determine average flight speed. The results indicate that bees fly faster when the patterns move in the same direction as flight, and slower when the patterns move in the opposite direction. These and other findings indicate, clearly and unequivocally, that bees regulate flight speed by holding constant the speed of the image of the environment in their eyes.

Bayly, K. and Evans, C.

Animal Behaviour Laboratory, Macquarie University, Sydney, NSW 2109

The measure of a male: correlates of reproductive success differ when time for female assessment is less constrained.

Studies of male reproductive success in jungle and domestic fowl *Gallus gallus* have relied on tests in which females are required to choose between unfamiliar males. Results have consistently implicated static morphological features, particularly comb size, as the basis for choice. However, in nature fowl live in stable social groups. Females consequently often mate with familiar males. We examined the relationship between male reproductive success, morphology and behaviour under these conditions by studying groups of fowl in large aviaries. We tracked production of vocal signals and visual displays, and measured all of the morphological attributes previously shown to play a role in male attractiveness. Dominance status strongly influenced mating frequency, which was expected given the strongly hierarchical structure of flocks. When dominance was statistically controlled, only three other male traits were important, and two of these were vocal signals. There was a strong relationship between aerial alarm calling and successful copulation, which probably reflects both female choice and male perceived paternity. There was also a significant affect of food calling rate, attributable to female preference. Tail length was the only morphological feature that predicted mating frequency. These results contrast strongly with those of previous experiments. We suggest that the time available to females influences which traits they assess. Cues such as ornament size are readily available even in 'snapshot' simultaneous choice tests, while traits such as production of high-risk calls require integration over long periods. Choices made when selecting intra- and extra-group mates may also depend upon different criteria.

Beilharz, R.G.

School of Agriculture and Food Systems, University of Melbourne, Vic, 3010

Need to rethink animal evolution - from DNA back to Darwin.

For the last 100 years evolutionary thinking in animals has focussed increasingly on genes and away from natural selection. The result is that the Neutral Theory, Punctuated Equilibrium theory and other theories are seen as opposing Darwin. My research on the interaction of genes organisms and the environment (the Environmental Resource Allocation theory) shows that: genetic theory has assumed that natural selection is not acting; the environment selects organisms directly, and genes only indirectly (if they are in successful organisms); the basis of selection is most efficient use of environmental resources to maximise fitness of organisms; organisms cannot get better than what natural selection has achieved unless the environment improves; in a world where periods of chaotic environmental change are rare and shorter than periods of tranquillity, the main effect of natural selection is to prevent organisms changing from optimal phenotypes; and alleles important to efficient phenotypes are conserved while unimportant genes are free to show genetic drift of alleles. I briefly explain the logic of the Environmental Resource Allocation theory and elaborate some of its consequences for a better understanding of the process of evolution.

Bradford, R.R.

Royal Zoological Society of South Australia, Department of Biology, Flinders University, Adelaide, S.A. 5000

Do Male Cheetahs Learn the Sequence of Behaviours that Lead to Successful Mating?

The cheetah (*Acinonyx jubatus*) has been the focus of considerable study in the wild, yet their behaviour in captivity has received little attention. In the last two decades, the importance of keeping a sustainable captive population has led to research in reproductive biology, physiology and genetics. However, no solution to the captive breeding problem has been developed. Recently, research has begun to examine the captive behaviour of cheetahs, focusing on female stress and oestrus suppression as the underlying problems for the lack of breeding. However, the current study found preliminary evidence that male behaviour may be playing a far more important role than has been estimated.

For most species of mammals, courtship and mating is generally presumed to be instinctual. However the results from trials at Monarto Zoological Park suggest that the repertoire of courtship behaviours may not be innate and that learning is an important process for male cheetah. The study found that the male cheetah needed to progress through a sequence of different behaviours that lead to successful mountings and eventually copulation. Initial findings show that there are possibly two ways that males learn their courtship behaviour, 1) from females and 2) from other males, with a combination of these two methods producing the most significant results.

Bruce M.J. and Herberstein M.E.

Department of Biological Sciences, Macquarie University, NSW, 2109

Does a trade-off between prey and predator attraction explain the variation in orb-web spider foraging behaviour?

Orb-web spiders in the Genus *Argiope* often include conspicuous silk decorations in their webs. A number of hypotheses have emerged to explain both the function of web decorations and the observed variation in these structures. These theories include thermoregulation, web stabilisation, web advertisement, prey attraction and defense against predators. Recently, the web advertisement, prey attraction and predator defense theories have received most attention. However, an increasing body of evidence suggests that decorations attract insect prey to the web, thus increasing the spider's foraging success. However, this does not explain the fact that individuals frequently vary their decorating behaviour on a daily basis and that they are often found with incomplete or absent decorations. While testing the predator defense hypothesis we found that the praying mantid, *Archimantis latistylus* was attracted to the decorations of the St. Andrew's cross spider, *Argiope keyserlingi*. Furthermore, in the presence of another mantid predator, *Pseudomantis alofimbriata*, *A. keyserlingi* significantly reduces its investment in web decorations. These two results suggests that not only do these spiders face a trade-off between prey and predator attraction but they are able to detect the presence of a potential predator and reduce predation risk by tailoring their decorating behaviour. These results, at least in part, explain why there is such dramatic variation in the decorating behaviour of this spider despite the advantage of increased prey capture.

Bussiere, L.F. and Abdul-Basit, H. and Gwynne, D.T.

Biology Group, University of Toronto at Mississauga, Mississauga, Ontario, Canada L5L 1C6

Preferred males are not always good providers: female choice and male investment in tree crickets.

When females gain material (direct) benefits from choosing between mates, they are expected to prefer males providing more or better investments. Paradoxically, in some species of animals, such as some birds and insects, males preferred by females invest less than rivals. This pattern is also puzzling from the male perspective whenever male investment correlates with insemination success, as it does in many animals in which males feed their mates. In this study, we examined several hypotheses to account for the finding that female tree crickets (*Oecanthus nigricornis*) prefer large males but do not receive larger glandular courtship gifts

from these males. After establishing that the lack of a correlation between male size and male nuptial gifts is not due to low statistical power, we showed that larger males actually provide more proteinaceous (though not larger) food-gifts than rivals. This result explained female preferences for large males, but the male perspective remained puzzling because large males had larger total gift-giving reserves than rivals. We subsequently showed that re-mating could deplete the gift-giving reserves of preferred mates to account for their smaller than expected food-gifts. In addition, we showed that preferred males can adaptively decrease the size of courtship food-gifts provided (in order to conserve gifts for future mating events) when they perceive that the probability of multiple future mating opportunities is high. Thus the elevated mating rates of preferred males (both prior to and following a focal mating event) could account for the small size of their courtship food-gifts.

Cheng, K.

Department of Psychology, Macquarie University, Sydney, NSW 2109

Interference, response competition, and spatial memory in honeybees, *Apis mellifera*.

Honeybees use a sequence of memory-based servomechanisms to reach a target location. Different memories need to be retrieved, each at the right time. It is thought that appropriate contextual cues guide memory retrieval (context-memory link). One corollary is that learning a second task in the same context should interfere retroactively with memory for the first learned task. This is because the context will prime both memories, only one of which is appropriate. Free flying bees flew to a table in a lab or outdoors for reward (sugar water) whose location was specified by a landmark, e.g., always to the north of the landmark. The landmark-reward array was moved from trial to trial. This ensured that the landmark was the only valid predictor of the exact location of reward. They then learned a second task at the same site, and were tested again on the first task. Performance on re-test was worse if, and only if, the second task demanded a conflicting spatial response (searching in a different direction from another landmark). Learning a colour discrimination task or a second spatial task with a different landmark but with the same target direction from the landmark, did not disrupt performance on the first learned task. Results implicate response competition as the likely locus of retroactive interference.

Cockburn, A.

School of Botany and Zoology, ANU, Canberra, ACT, 0200

A new predictive theory of avian cooperative breeding.

Despite four decades of intense empirical effort, we lack a theory that predicts the distribution of cooperative breeding in birds, aside from the strong but unexplained result that migratory birds rarely exhibit cooperative breeding. The most popular hypothesis for cooperative breeding, the ecological constraints model, fails because most birds are ecologically constrained. The newer life history hypothesis is also inadequate because most birds are long-lived and have low clutch sizes, but most such birds do not breed cooperatively. I will report a new comparative synthesis which indicates that: i) cooperative breeding arises early in the evolutionary history of many clades of birds; ii) such cooperative clades show much lower rates of speciation than their pair-dwelling relatives, explaining about 3/4 of the variation in the incidence of cooperative breeding among clades of birds; and iii) the lower rates of speciation arise because cooperative clades do not colonise habitats suitable for seasonal migrants, do not colonise and speciate on oceanic islands, and do not often move from their landmass of origin to new landmasses where they can radiate. This failure seems to result from philopatry of at least one sex. These results undermine the assumptions that drive students of both behavioural ecology and macroevolution.

Cunningham, J.P.

Department of Zoology, Goddard Building, University of Queensland, St Lucia, Brisbane

Learning, odour preference and flower foraging in moths.

Floral volatiles play a major role in plant-insect communication. We examined the influence of a number of single floral odours on the innate and learnt foraging behaviours of the moth

Helicoverpa armigera. In dual-choice wind tunnel tests, adult moths showed innate preferences for particular odours. These preferences were significantly changed when exposure to these volatiles was paired with a feeding stimulus. We tested the influence of single odour learning in the context of flower foraging by training moths to feed on flowers that were augmented using different single odours. Choice tests showed a significant preference for the flower type augmented with the odour on which the insects were trained. In subsequent choice tests we showed that (1) moths could learn single odours present in flowers on which they had foraging experience and (2) when trained on a single odour, Moths could distinguish between genetically transformed tobacco plants which differed only in this one component. The results imply that moths can discriminate among odour profiles of individual flowers from the same species. We discuss this behaviour within the context of nectar foraging in moths and odour signalling by flowering plants.

Davis, J. and Collier-Baker, E.

School of Psychology, University of Queensland

Control and Psychological Well-being: An Investigation of the Concept of Choice in Captive Primates.

The concept of psychological well-being in captive primates has become a contentious issue of late. Workers have struggled to define and quantify psychological well-being, it's promotion now being a compulsory component of primate management in the USA. One possible contender to reduce psychological discomfort in primates is the provisioning of control. Many primates housed in laboratories and zoological collections are subject to uncontrollable stress, a condition that has been empirically shown to lead to learned helplessness. Learned helplessness is commonly used as a reliable animal model for the study of depression in humans, suggesting that uncontrollable stress could be a contributing factor in abnormal behaviours seen in some institutions housing primates. Other studies involving experiments where the subjects are able to exert control report improved performance and mental and physical health benefits. This presentation will outline the current literature on control and in humans and animals and briefly discuss it's potential to ameliorate stereotypes and abnormal behaviours in captive primates.

Detto, T.¹ and Zeil, J.¹ and Magrath, R.² and Hunt, S.³

¹*Research School of Biological Sciences, Australian National University, PO Box 475, Canberra, Australian Capital Territory 2601, Australia;* ²*School of Botany and Zoology, Australian National University, Canberra, Australian Capital Territory 0200, Australia;* ³*School of Biological Sciences, University of Bristol, Woodland Road, Bristol BS8 1UG, U.K*

Sex, size and colour in the semaphore crab, *Heloecius cordiformis*.

We investigated the relationship between sex, size and colour in the little studied Australian endemic semaphore crab, *Heloecius cordiformis*, and related it to the crabs' social system with the aim of identifying the potential signalling function of claw colour.

Comparisons of sex, body size, claw size and claw colour revealed a strong relationship between size and colour that differed in males and females. Purple-clawed males were larger than pink-, orange- or green-clawed males. Due to the positive allometric growth of male claws, purple-clawed males also had larger claws, relative to carapace size, than the other colour classes. Conversely, the largest females had pink claws, and the few with purple claws were no larger than immature green-clawed crabs. Female claws grow isometrically with the body so the relative claw size did not differ among the female colour classes. Quantitative measurements of claw colour revealed sexual differences in the spectra of the various colour classes. Purple claws, and male claws in general, contrasted more strongly against the mudflat background.

Copulation mostly occurred on the surface between neighbouring crabs, so a male's access to females may be determined by his ability to defend a burrow. Larger males had an advantage during conflicts, so claw colour could function as secondary signal of competitive ability. Copulation also probably occurred underground, within the male burrow, following the

attraction of a female with a waving display. In such cases, claw colour may function as a secondary signal of male size, particularly as larger males are more conspicuous.

Dowling, D.K.¹ and Antos, M.² and Sahlman, T.³

¹*Department of Zoology, University of Melbourne, VIC, 3010;* ²*School of Ecology and Environment, Deakin University, VIC, 3125;* ³*EBC, Department of Population Biology, Uppsala University, Sweden*

Dispersal and recruitment of juvenile red-capped robins.

Data on the dispersal and recruitment of juvenile birds following fledging are largely unreported for Australian birds. In this study, we investigated the short-distance dispersal of a sample of colour-banded, juvenile red-capped robins, *Petroica goodenovii*, in Terrick Terrick National Park, Victoria. Of 64 colour-banded juvenile birds that successfully reached independence during the 2000-2001 breeding season, eight were recruited into the study area or adjacent areas for the following breeding season. One bird was resighted in Gunbower State Forest, 36.1 km from where it was banded. This is the furthest recorded movement of a red-capped robin. Of 59 colour-banded juvenile birds that reached independence during the 2001-2002 season, four remained within the study area for the remainder of the breeding season, but these were not present in the study area during the following breeding season. Juvenile birds that successfully reached independence and dispersed were heavier as nestlings, when controlled for age and date, than birds that disappeared (assumed dead) before reaching independence. The sex ratio of resighted colour-banded juvenile birds within the study area and adjacent areas was female-biased, and this trend approached statistical significance. Estimates of red-capped robin densities within Terrick Terrick National Park were greater than those of nearby eucalypt woodlands, suggesting that the white cypress-pine woodlands within the park offer good quality habitat for red-capped robins, and may be saturated with breeding territories. Thus, juveniles may be forced to establish breeding territories far from their natal territories.

Downes, S.¹ and Bauwens, D.²

¹*School of Botany and Zoology, Australian National University, Canberra, ACT, 0200, Australia;* ²*Institute of Nature Conservation, Kliniekstraat 25, B-1070 Brussel, Belgium*

How does the outcome of first encounters affect ensuing social relations within dyads of lacertid lizards?

We used an experimental approach on pairs of conspecific newborn lacertid lizards to examine the association between the outcome of first encounters and the formation of social relations during the ensuing three weeks. Differential expression of behaviour within dyads was examined by calculating the difference between values for the two individual lizards. During brief first encounters access to a localized basking site was determined by agonistic interactions between lizards. Cohabitation of two lizards during prolonged encounters resulted in differences in their thermal habitat usage, which in turn induced divergence of their growth rates. The direction and magnitude of the differences in thermal habitat use and divergence in growth rates during prolonged encounters mirrored differences in the interactions exhibited during the first encounter. Thus, the formation of social relations within dyads seems to be largely influenced by the outcome of first social encounters. Moreover, differences between two lizards in initial social interactions, and in thermal habitat use and growth rate during prolonged encounters parallel differences in thermal habitat use exhibited when lizards were housed alone. Thus, it may also be possible to predict the outcome of social interactions within dyads based on the differential expression of traits between two lizards housed in isolation.

Evans, C.S. and Evans, L.

Animal Behaviour Lab, Macquarie University

Adaptive scepticism: tolerance of unreliable callers varies with the cost of failing to respond.

We have previously shown that the reliability of low-cost vocal signals such as chicken food calls is maintained by a social constraint. Playback experiments in which the apparent honesty of individual males was manipulated reveal that hens are sensitive to this attribute, responding differentially after three days of experience. The costs of such 'scepticism' should vary with signal type. If hens fail to respond to a food call, they might lose a preferred food item. In contrast, failure to respond to an aerial alarm call potentially increases predation risk. This logic generates the prediction that receivers should tolerate lower levels of signalling reliability when the costs of Type II error are high. We report the first test of this model. Spectrogram cross-correlation reveals that male identity accounts for 85% of the variance in aerial alarm call structure. Individual males are thus acoustically distinctive. We next tested the effects of variation in reliability. Hens heard a series of alarm calls from two males, one reliable (each playback was followed by a hawk animation presented overhead) and the other unreliable (the monitor displayed a blank background). Playbacks were repeated daily for 10 days, using a large set of call exemplars and predator stimuli to prevent habituation. In striking contrast to the effects of identical experience with food calls, hens continued to respond to unreliable alarm callers. These results suggest that receivers do not use a fixed rule for assessing reliability, but have flexible criteria that reflect the environmental event predicted by the signal.

Fisher, D.O.

Division of Botany and Zoology, ANU, Canberra, A.C.T. 0200.

Female choice and multiple mating in agile antechinuses.

Antechinus agilis is a small, insectivorous marsupial. All males live for one year and die after a single short, synchronised mating season. Both sexes are highly promiscuous; a recent genetic fingerprinting study (Kraaijeveld-Smit et al.) found an average of four fathers and a maximum of seven per litter of ten in the field. Mating behaviour in the wild is poorly-known, because the animals are secretive, nocturnal, and males congregate in arboreal nests during the mating season. Thus, we do not know if female promiscuity is due to female choice, forced copulation by multiple males in nests, or non-discriminating acceptance of multiple males. A lek mating system with active female choice has been suggested, because radiotracking previously revealed that females visit trees containing male aggregations. Male body size should be a good criterion for a mate choice in female agile antechinuses because body weight is variable, even though all males are the same age, males are on average 30% larger than females, suggesting potential sexual selection on body size, and Kraaijeveld-Smit et al. recently found a greater share of paternity for larger males in the field, even though larger males were not more likely to sire offspring in laboratory matings. In this study, I examined female choice in *Antechinus agilis*, as part of an experimental investigation into the causes of female multiple mating. The initial results indicate that body size is not the basis for female choice and female promiscuity is a result of female choice, although females rarely discriminate against individual males.

Forster, I. and Mulder, R.

Department of Zoology, The University of Melbourne, Victoria

The paradise pretty-boy puzzle: do dichromatic males differ in behaviour?

The Madagascar paradise flycatcher (*Tersiphone mutata*) is a socially monogamous, sexually dimorphic passerine with male plumage dichromatism. Males may be either rufous or white in colour. Sexual dimorphism is positively correlated with extra-pair paternity (EPP: Moller & Birkhead 1994) suggesting that bright plumage in males plays a role in extra-pair mate choice. Rates of EPP in the flycatcher are high (~50%) and vary between the two male morphs (Mulder, unpubl. data). I studied the behaviour of the two male morphs to determine whether they have alternative reproductive strategies. I found no difference between the male

morphs in the amount of time spent on behaviours related to protection of paternity with their own female, and obtaining extra-pair fertilization. Hence, there is no evidence that differences in male behaviour play an important role in determining patterns of extra-pair paternity.

Gaskett, A.C.¹ and Herberstein, M.E.² and Downes, B.J.³ and Elgar, M.A.⁴

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Lifetime male mate choice priorities in a sexually cannibalistic orb-web spider.

Selection should favour male mate choice when male reproductive costs prevent indiscriminate mating with multiple females. Whilst males are expected to choose females that offer greater fertilisation success, different female qualities may provide this throughout his lifetime. Thus, males may change their mate choice criteria during their lives according to factors such as their own previous sexual history and the potential for future matings. We have identified such changes in male mate choice in the St. Andrew's Cross Spider (*Argiope keyserlingi* Araneae: Araneidae). Laboratory experiments revealed that ~50% of males mate only once. Those that survive are always cannibalised during their second mating. This is likely to be due to limits imposed by male functional sterility. We assessed the preferences of virgin and singly mated males for females of different sexual status using laboratory and field choice bioassays involving airborne and web-based pheromones. Virgin males strongly preferred penultimate and virgin females over mated females. In contrast, mated males did not prefer any female mating status, and more often accepted available females rather than seeking alternatives. Virgin female St. Andrew's Cross spiders are less likely than mated females to cannibalise males before copulation can commence. Virgin females may provide higher fertilisation success if not all females mate multiply. However, for a mated male embarking on his second and therefore final copulation, survival may be a lesser priority. Mated males may increase copulation duration by encouraging cannibalism and thus mated males may ensure high fertilisation success, regardless of the risk of sperm competition.

Göth, A. and Chambers, V. and Evans, C.

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Species recognition without early experience: brush turkey chicks use visual cues to aggregate with conspecifics.

One of the fundamental problems in the study of behavioural development is understanding the mechanisms by which animals recognise conspecifics. Species recognition is important because it ensures short-term survival and influences mate choice decisions in adulthood. In most birds and mammals, offspring initially associate with their parents; early experience thus plays a critical role. But one remarkable group of Australian birds, the megapodes, reveals that other developmental pathways can evolve: chicks do not meet their parents after hatching and thus have no opportunity to learn from them. Here we describe recent work on species recognition in chicks of the Australian brush-turkey *Alectura lathami*. Simultaneous choice experiments using taxidermically-prepared robots presented under optical filters show that socially-naïve hatchlings prefer to approach conspecifics of similar colour and that short wavelengths are responsible for this effect. In addition, chicks prefer moving robots to static ones, and pecking movements to a control in which the head sweeps from side to side. Morphology and behaviour hence act synergistically to account for the aggregation response. We discuss the implication of these results for the current debate concerning species recognition and speciation. In northern Queensland, two megapode species (the brush-turkey and the Orange-footed megapode *Megapodius reinwardt*) occur sympatrically and incubate their eggs in the same incubation mounds. Chicks look similar to the human eye. The mechanisms responsible for species recognition are thus likely to be highly specific, ensuring that no 'mistakes' in mate choice are made and no interbreeding occurs.

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Snacking from the Pantry: Food storage in orb-web spiders (Araneae, Araneioidea).

Food hoarding in spiders is rarely documented, yet *Nephila edulis*, an Australian orb-web spider incorporates previously captured prey into the web. While the function of these prey bands remains somewhat controversial. We have previously shown that *Nephila* can utilise them during times of deprivation. Here we expand on these initial results. In a series of experiments we examined storage behaviour *Nephila* with respect to prey density, prey encounter rate and prey type.

First, we varied prey density creating a high and a low prey density feeding treatment. Predictably, spiders experiencing a higher feeding rate also incorporated more prey into their external caches.

Second, we observed storage behaviour of at different prey encounter rates. One group was fed a constant rate while the other group received prey at a random, unpredictable encounter rate. Nevertheless, groups received the same amount of food in either treatment. Prey encounter rates affected storage behaviour. Under unpredictable conditions, spiders ingested most prey while they established external caches when prey arrived at constant, predictable rates.

Third, *N. edulis* was offered different prey types and sizes: blow-flies or crickets. These prey were either attacked and fed upon or rejected entirely. If prey were attacked the spiders either ingested the entire item without any remains, stored the remains in the web or discarded the remains to the floor. We found that crickets were more likely to be ingested completely or stored in the web, while blow-flies were more likely to be discarded.

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Sexual selection in the extreme size-dimorphic musk duck (*Biziura lobata*).

Musk ducks (*Biziura lobata*) exhibit extreme sexual size dimorphism (males may be up to three times as heavy as females), as well as unusual secondary sexual characters in males (a leathery black lobe attached to the lower mandible and breeding-limited emission of a pungent musk-like odour), and intriguing behaviour (males perform elaborate treading water displays while vocalising). These characteristics and behaviours have been the subject of considerable speculation, but no detailed study. We will combine behavioural observations of individually recognisable musk ducks with gas-chromatography/mass spectrometry analysis of the odour. We will then conduct experimental manipulations of odour and playback experiments of vocalisations to better understand their function.

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Monitoring Platypus Behaviour: Contributing to captive breeding success.

Platypus have been successfully bred at Taronga Zoo this year for the first time, after many years of holding the species and attempting to breed them. The longevity of platypus in captivity has much improved in recent years but there have been on-going difficulties in achieving captive breeding. Platypus have been bred only three times in captivity since the original success of David Fleay in 1945, twice at Healseville Sanctuary in Victoria in 1998 and 2000, and now at Taronga Zoo. In the wild platypus are considered vulnerable and therefore it is becoming important to be able to maintain a captive population.

The success at Taronga has had several contributing factors, husbandry changes, exhibit changes and a close collaboration between the platypus husbandry staff and the team monitoring behaviour.

The Animal Watch Programme has been observing platypus at the Zoo since 1989 by both direct observation and video monitoring and a large amount of data has been collected. A lot has been learnt, particularly in the areas of daily activity patterns, social interaction and

breeding behaviour. This past year, continuous video monitoring has been carried out since September. The video information has given a unique insight into the round-the-clock activity of the breeding platypus and the rapid feedback of this information to the husbandry team has enabled a rapid response to behavioural needs. The analysis of the data is still progressing but the aim is to identify behavioural markers to map the progress of breeding, which in combination with husbandry responses will make captive platypus breeding reproducible.

Hemmi, J. and Zeil, J.

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Burrow surveillance in fiddler crabs: The mechanism of decision making.

Animals must constantly make decisions about which stimuli they need to respond to and which stimuli they can safely ignore. Ignoring an important stimulus can be very costly or even dangerous. Conversely, responding too often costs time and energy. The ability of animals to make the correct decision strongly depends on the information they have available. Fiddler crabs, in their quest to defend their burrows from conspecifics, face exactly such a dilemma. The crabs live in dense colonies where each animal occupies and defends a burrow which is vital to the animal's survival. The study presented herein set out to identify the information fiddler crabs use to decide whether or not to respond to an approaching conspecific. We show that fiddler crabs defending their burrows can judge how close other crabs are to their burrow, even when the burrow is invisible and some distance away. When confronted with small dummy crabs, the burrow owners assess the dummy's position and motion relative to their burrow rather than to themselves. Furthermore, the mean dummy-burrow distance at which the crabs respond is constant and independent of the dummy's direction of approach. This is an impressive achievement for an animal with low resolution compound eyes and which has, due to its size and closely set eyes, restricted depth perception. To solve this sophisticated task of relative distance judgement, the crabs may combine visual information on dummy position and direction with information on burrow location.

Herberstein, M.E.¹ and Barry, K.¹ and Wills, E.¹ and Youssef, C.¹ and Elgar, M. A.²

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Why hang around? How effective is postcopulatory mate guarding in the St Andrew's Cross spider (Araneae, Araneidae)?

Mating is a traumatic event for male St Andrew's Cross spiders: only 50% of males survive their first mating with many losing legs in their attempt to escape the female. Surprisingly, after leaping off the web in self-defence, the male almost immediately returns to the female and remains in her web for several hours. In our field studies we monitored male behaviour after returning to the female. While the majority of males returned, none re-mated with the female, suggesting these males guard the female from subsequent males. In laboratory experiments we tested whether first males can successfully prevent females from re-mating if they remain in the web. When we removed the first male, 75% of females re-mated with a second male that we introduced into the web. However, when the first male was allowed to remain in the web, he reduced re-mating frequency to about 47% by fighting with and chasing off the second male. Furthermore, even if the female re-mated, the presence of the first male reduced copulation duration of the second male. Finally, while we never observed first males re-mating with the same female in the field, in the presence of a second male, first males were more likely to court and attempt to mate with her again.

Hofer, A.M.

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Influence of female reproductive state on male-male aggression in the Australian skink *Lampropholis guichenoti*.

I used a small scincid lizard to examine the influence of female reproductive status, as mediated by both visual and chemical cues, on male-male aggression. *Lampropholis*

guichenoti is highly communal, non-territorial and monomorphic. I used an experimental approach in which groups of three males had access to female conspecifics in the form of chemical cues (scented paper) and visual cues (an animal in an airtight aquarium). I applied five treatments: (1) chemical cues of a receptive female, (2) visual cues of a receptive female, (3) chemical and visual cues of a receptive female, (4) chemical and visual cues of a non-receptive female, or (5) no chemical and visual cues (experimental control). During a 20-minute observation I scored all interactions between males and calculated an aggression index by assigning different weight to interactions based on intensity. Additionally, I recorded the number of tongue-extrusions by a focal male. The results show no significant difference among treatments in the total number of interactions or in the overall aggression score. However, the aggression score relative to the number of encounters is significantly higher when males had access to (1) visual and to (2) visual and chemical cues of receptive females. These results indicate that vision of receptive females plays an important role for males when finding and defending potential mates, whereas chemical cues do not appear to be crucial in this process. This outcome is emphasized by the finding of no significant difference in number of tongue flicks towards treated paper strips between treatments.

Holwell, G. and Barry, K. and Herberstein M.E.

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Mating behaviour in the non-cannibalistic praying mantis *Ciulfina*.

The classic example of sexual cannibalism commonly referred to in the literature on insect mating behaviour is the praying mantids. Studies so far, however have been inconclusive as to the frequency and evolutionary significance of this behaviour in mantids. Observational results for *Ciulfina*, a non-cannibalistic genus, highlight the idea that cannibalism is far from ubiquitous in this group. Nevertheless, *Ciulfina* sp. exhibit a number of unusual phenomena associated with their mating behaviour. Three unusual aspects of courtship and mating in *Ciulfina* are discussed: (1) Post-copulatory female feeding on products transmitted by males during copulation, (2) Fore-leg stretching, in the presence of potential mates, suggesting a sexual signalling function, (3) Markedly different male genitalia between different populations.

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Genital morphology and fertilisation success in the dung beetle *Onthophagus taurus*: an example of sexually selected male genitalia.

In animals with internal fertilisations and promiscuous mating, male genitalia show patterns of rapid and divergent evolution. Three hypotheses have been suggested to explain the evolutionary processes responsible for genital evolution; the lock-and-key hypothesis, the pleiotropy hypothesis and the sexual selection hypothesis. Here we determine whether variation in male genital morphology influences fertilisation success in the dung beetle, *Onthophagus taurus*, as predicted by the sexual selection hypothesis. Variation in four of five genital sclerites of the endophallus influenced a male's fertilisation success, supporting the general hypothesis that male genitalia can evolve under sexual selection. Furthermore, different genital sclerites were found to enhance first versus second male paternity, suggesting that different sclerites serve offensive or defensive roles. Genital trait variability was comparable to that exhibited in genital traits in other species but was less variable than a non-genital sexually selected trait (head horns). We suggest that directional selection for genital elaboration may be countered by natural selection, which should favour genitalia of a size and shape necessary for efficiency of coupling and sperm transfer.

Johnston, G.^{1,2,3} and Bouskila, A.²

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Dull males do it in the dark: activity pattern and sexual dimorphism in the Gecko, *Ptyodactylus guttatus*.

Geckoes are generally nocturnal, show no sexual dichromatism, and males are usually smaller than females. *Ptyodactylus guttatus* is an unusual gecko. It is active by day and night, is sexually dichromatic, and males are larger than females. We studied *P. guttatus* that inhabited the walls of buildings at the Hazeva Field Research Station in Israel. The density of lizards on these buildings was 390/ha-1, which is 195 times the density in other, natural habitats. Adult males inhabited large home ranges, which generally overlapped with one or more smaller home ranges of females. The pattern of home range overlap presumably reflects opportunities for mating. A path analysis was consistent with females spacing themselves to gain access to food in the form of insects attracted to fluorescent wall lights on the buildings. Males seem to space themselves for access to female mates, but showed no independent relationship with wall lights. We did not find evidence of territoriality, but observed mate guarding behaviour among males. Large male body size may provide priority access to mates, and brighter male colouration may have arisen because light does not constrain the use of visual signals in these unusual, largely diurnal geckos. In many ways, *P. guttatus* behave more like unrelated, diurnal lizards, than they do to other nocturnal geckos.

Jones, T.M. and Elgar, M.A.

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The importance of being average.

Models of age-related mate choice predict female preference for older males as they have proven survival. However, these models rarely address differences in male mating history when evaluating the potential benefits gained by females from older partners. We used a novel experimental design to assess simultaneously the relative importance of these two parameters in the hide beetle, *Dermestes maculatus*. We present a two part experiment that first explores age-related female preferences and then examines the consequences of such preferences, while controlling for male age and mating history. When presented with a choice of males varying in age, females preferentially mated with intermediate-age males. To test the consequences of such age-related mating preferences, a second set of females were mated to males varying in age (young, intermediate-age and old) and mating history (numbers of previous matings). Comparison across these females showed that male age was a critical determinant of reproductive success. Females mated to intermediate-aged males enjoyed consistently higher fecundity and fertilisation. In contrast, the oldest males spent longer courting females, but were less fertile. A male's previous mating history determined his current reproductive effort; virgin males spent longer in copula than males with prior mating opportunities. However, this did not translate into differences in fertilisation success. Our experiments indicate that preference for intermediate-aged males is maintained in this species through fertilisation benefits accrued by discriminating females. We propose that age-related female preference in the hide beetle is based on chemical cues which potentially degrade with male age.

Jongman, E.C.

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Welfare implications of an alternative Pregnant Mare Urine (PMU) collection device under Australian conditions.

An alternative collection procedure for pregnant mare urine has been developed in Australia, which allows mares to be kept outdoors in paddocks, rather than in tethered stalls as is

common practice in Canada. We examined the welfare risks to mares of collecting urine using this alternative procedure.

The study involved 24 pregnant mares at 3 to 5 months of gestation. The mares were allocated to two treatments: twelve mares were fitted with the PMU collection device and twelve mares acted as control mares. Mares were kept in two large paddocks during the day in two groups of 12. During the night, mares were kept in six small yards in groups of four, while the PMU treatment mares wore the collection device.

Mares wearing the PMU collection device showed little or no behavioural change relative to the control mares. The only difference in behaviour was that fewer horses were observed lying down at night in the PMU collection treatment (4/11 vs. 10/12). It is unclear what implication this may have on horse welfare since there was no evidence of a rebound in this behaviour when the device was removed. Based on heart rate and cortisol concentrations measured on days 1 and 2 of study and at the end of the study, there was no evidence of acute or chronic stress associated with fitting the device. Therefore it is concluded that wearing the PMU collection device at night for 5 nights per week for a total of 6 or 7 weeks does not pose a serious challenge to the welfare of pregnant mares.

Kerswell, K. J.¹ and Hemsworth, P.H.¹ and Bennett, P.²

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Potential Effects of Morphology on Social Communication in the Dog (*Canis lupus*).

The current understanding of signalling in dogs depends on them having a lupine appearance, however selective breeding have led to a variety of non-lupine morphologies in the dog meaning that some dogs may now be unable to send effective signals due the omission of signalling structures. This situation would logically leading to one of three circumstances: First, that morphologically dissimilar dogs may be unable to communicate effectively. Second, since communication is learnt in early life, dogs may learn how to communicate within their morphotype, but be less capable of communicating with different morphotypes. Third, canine communication may have adapted to accommodate the range of morphologies, negating any effect on communication. Presently, it is assumed that communication, other than olfactory (seen as being truthful and unmodified) is ignored, and that visual signals are largely seen as being untrustworthy and thus unimportant in dog communication.

This study seeks to investigate the fate of signalling given the range of morphotypes seen in the dog. Litters from a variety of dog breeds with different morphologies are currently being surveyed weekly for half an hour during and after feeding to give a baseline of behaviours for each breed. This data will then be analysed by morphological characteristic, breed and breed group to investigate any differences that may be present. Later work will investigate the effect of the presence of individuals of a different breed or morphotype on the signals seen by studying the interactions of dogs in puppy socialisation classes.

Kondo, J. and Downes, S. and Keogh, J.S.

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How does diurnal thermoregulation affect the nocturnal performance of a rock-dwelling gecko *Oedura lesueurii*?

Nocturnal reptiles thermoregulate within retreat-sites during the day and are active at night when air temperature is lower than their preferred body temperature. We used a nocturnal rock-dwelling gecko (*Oedura lesueurii*) to investigate whether thermal opportunities experienced during the day affect performance at night. We mimicked natural variation in the thermal condition of diurnal retreat-sites by housing lizards during the day in rocks heated to three different regimes spanning from preferred to sub-optimal temperatures. Our experiments were conducted at night when geckos were cooled to the same body temperature. Geckos from cooler diurnal retreat-sites were less active and had lower endurance than did geckos from warmer diurnal retreat-sites. We staged contests with size-matched pairs of geckos. One

lizard from a thermally optimal diurnal retreat-site was matched with an opponent from a diurnal retreat-site that was relatively: (1) hot, (2) warm, or (3) cold. There was no significant variation among treatments in the tendency of opponents to win contests. However, contests between geckos from hot vs. cold diurnal retreat-sites were significantly more aggressive than were those between hot vs. hot and hot vs. warm geckos. Moreover, during hot vs. cold contests, the lizards from cooler diurnal retreat-sites were more aggressive than their warmer counterparts. Lizards from cooler diurnal retreat-sites may compensate for a lower physiological performance by being more aggressive and thereby increasing their chance of winning territorial contests.

Lamont, R. and Srinivasan, M.V.

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A Vision System for Tracking Insect Flight in 3 Dimensions.

We have developed a vision-based system for tracking the flight trajectories of individual insects in 3 dimensions. The system uses stereo information acquired by a pair of high resolution progressive scan cameras fitted with 200MM lenses. The cameras view the flying insects head-on at distances ranging from a maximum of 48 metres to a minimum of 28 metres. The largest field of view is 2100 MM wide and 1530MM high. Images are recorded at 30 uncompressed, stereo images per second to the hard drive of a computer. The images captured can be analysed immediately or burned to a DVD-R (holds up to ten minutes) for later analysis. Analysis consists of viewing the images and tracking moving insects within them semi-automatically, using a purpose-designed graphical user interface. The output of a tracking session for a single insect consists of a set of X, Y and Z coordinates for a sequence of frames which is fed into a 3-D graphical visualisation interface. The system is currently being used to obtain a better understanding of the principles of insect vision and navigation, and, specifically, to investigate the factors that determine the speed and height of flight. In principle the system can be applied, with modification, to study flight trajectories of a variety of small insects.

Langkilde, T.

Biological Sciences, Sydney University, Sydney, NSW, 2006

Habitat use in montane skinks: do social interactions affect shelter-site choice?

Montane animals may be under particular threat from global warming due to the limited availability of suitable habitat, which will contract if ambient temperature increases. Alpine and subalpine environments in South-Eastern Australia contain high abundances (and sometimes, diversities) of lizards and snakes, and hence we need to know more about patterns of habitat use in these herpetofaunal assemblages. In particular, an understanding of the processes that generate these patterns may be of significant value in predicting species-specific vulnerability to climate change. I studied shelter-site use by five species of viviparous scincid lizards (three *Egernia*, and two *Eulamprus* species) in Kanangra Boyd National Park, west of Sydney. These species are diurnally active heliotherms, which exhibit a strong attachment to a permanent shelter-site, and with the majority of their activities focussed around this site. I conducted a preliminary study to quantify patterns of habitat use and identify habitat factors that cause interspecific differences in distribution of these species, and used shelter-choice experiments to explore the effects of social interactions on shelter-site selection.

Analysis of microhabitat characteristics of shelter-sites showed that these species are genuinely syntopic, and use similar types of shelter-sites. However, individuals are never found sharing shelter-sites with heterospecifics. The choice trials suggest that the presence of a larger, more aggressive species will alter the shelter-site use of individuals indicating that aggressive interactions, not habitat preference, are influencing the patterns of shelter-site use observed for these species.

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Escalation of a co-evolutionary arms race through host rejection of brood parasitic young.

Cuckoo nestlings that evict all other young from the nest soon after hatching impose a high reproductive cost on their hosts. In defence, hosts have coevolved strategies to prevent brood parasitism. Puzzlingly, they do not extend beyond the egg stage. Thus, hosts adept at recognising foreign eggs remain vulnerable to exploitation by cuckoo nestlings. Here we show that the breach of host egg defences by cuckoo nestlings creates a new stage in the coevolutionary cycle. We found that defences used during the egg laying period by host superb fairy wrens (*Malurus cyaneus*) are easily evaded by the Horsefield's bronze cuckoo (*Chrysococcyx basalis*), a specialist fairy-wren brood parasite. However, although hosts never deserted their own broods, they later abandoned 40% of nests with a lone Horsefield's bronze cuckoo nestling, and 100% of nests with a lone shining bronze cuckoo nestling (*Chrysococcyx lucidus*), an occasional fairy-wren brood parasite. Our experiments demonstrate that host discrimination against evictor-cuckoo nestlings is possible, and suggest that it has selected for the evolution of nestling mimicry in bronze cuckoos.

Lansdowne, R.¹ and Giles, R.² and James, K.² and Wynn, P.¹

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Towards a practical measure of temperament in pigs.

There have been several studies into behavioural and physiological characteristics associated with active and passive temperament of pigs. Most studies have centered on the 'backtest' as a key indicator of temperament. The backtest, as first described by Hessing et al., (1993) consists of holding a piglet (prior to weaning) on its back for one minute to record the number of escape attempts.

A practical measure of temperament needs to fulfil a number of attributes before it is likely to be adopted by the pork industry. In the first instance, a practical measure of temperament needs to be quantitatively associated with growth and carcass quality. The second characteristic must include speed and simplicity of measurement without a requirement for additional labour inputs. Thirdly and most importantly, adoption of a practical measure of temperament is likely to be rapid if the new measure of temperament can be incorporated into existing husbandry practices.

Existing measures of temperament in pigs do not meet the above attributes. In collaboration with Ruddweigh International Scale Company at Guyra, a device, which measures movement in pigs, has been developed. This device measures weight continuously and records a value every 0.4 seconds. The standard deviation is then calculated in order to get a measure of movement.

The timing of movement recordings has been established using sequential standard deviations, and includes a rest period of around 15-20 seconds, and this has been found to be a repeatable measure. Furthermore a correlation between the backtest at weaning and movement readings at slaughter has been established. More importantly an association between growth and the backtest has been observed.

The 'movement meter' offers enormous potential for the pork industry, as it is practical, requires no additional labour, would be capable of fitting into any commercial production system, and above all, may offer significant returns in production through animal selection.

Leavesley, A.J. and Magrath, R.D.

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The alarm calls of the White-browed Scrubwren (*Sericornis frontalis*) convey urgency.

Alarm calling is an anti-predator behaviour, commonly observed in group-living mammals and birds. Alarm calls signal the presence of a predator and typically provoke heightened vigilance or escape behaviour. Some alarm calling systems also convey the degree of danger

that a predator poses. The urgency of the response of receivers of such calls depends on the degree of danger encoded in the call. Although alarm calling is apparently common in birds, evidence from playback experiments is scant. The only playback evidence in a bird comes from a laboratory study of the domestic chicken (*Gallus gallus*). The White-browed Scrubwren is small territorial passerine common in thickly vegetated habitats of South-eastern Australia. The Pied Currawong (*Strepera graculina*) is an important predator of the scrubwren taking scrubwren eggs, nestlings, fledglings and occasionally adults. The scrubwren gives a trill call containing a varying number of elements when predators are detected. This study used playback experiments to demonstrate that the trill call of the scrubwren was an alarm call. Degree of danger was encoded in the call by the number of trill elements; the greater the danger, the more elements in the call. The urgency of the response of scrubwrens to playback trill calls depended on the number of elements in the call. To our knowledge, this is the first study to demonstrate that an avian alarm calling system conveys urgency.

McNamara, K

Department of Zoology, University of Melbourne, VIC 3010

A Paternity Advantage for Re-mating Males in the Hide Beetle, *Dermestes maculatus*.

In many species males may mate both multiply with several different females, and/or repeatedly with the same female. While the benefits to a male from multiply mating are well documented, the effect of re-mating with the same female on male paternity share, in a competitive context, is rarely investigated. We test this idea explicitly in the polygamous hide beetle, *Dermestes maculatus*, using reciprocal mating trials that manipulated the frequency and order of mating. To vary mating frequency a total of 60 females received three matings from two males. One male was permitted a single mating and the other mated twice. The repeated mating with the same male was performed by either the first or last male. The proportion of eggs sired by each male was revealed using standard irradiated male techniques. Males that re-mated with the same female sired significantly more offspring than his singly mating rival. There was no evidence of a mating order effect and paternity was not influenced by the duration of copulation. These data suggest that, in the hide beetle, there is random sperm mixing and the number of eggs fertilised is dependent on the numerical representation of a male's sperm in the female's reproductive tract. Males, therefore, benefit from re-mating as this increases their sperm load, diluting the sperm stores of current or future rivals.

Magrath, R.D. and Scarl, J. and Parks, E.

School of Botany & Zoology, ANU, Canberra, ACT 0200.

The ecology of nestling call design.

Environmental conditions affect the design of acoustic signals. For example, bird alarm calls can be designed to reduce the risk of eavesdropping by predators, and the same may be true of nestling begging calls. However, the studies of begging calls are equivocal partly because they have ignored the affect of the physical environment on sound propagation. We argue that it is important to measure the acoustic properties of nests and nest sites, including the pattern of radiation of sound, when interpreting the evolution of nestling calls and the risk of eavesdropping. We studied white-browed scrubwrens, which build domed nests with a side entrance. Nestlings have two common calls: "peeps" are given commonly in the absence of parents, while "whines" only when parents are at the nest. We predicted that: (1) peeps will have design features making them difficult for predators to overhear compared to whines, and (2) sound will propagate asymmetrically, with calls being louder at the front of the nest compared to the sides or back. Our results support both predictions. First, peeps are short, high frequency and low amplitude compared to whines, all characteristics that should reduce the risk of eavesdropping. Second, call propagation was directional, with both peeps and whines attenuating more quickly towards the back and sides compared to the front. We finish by outlining our experiments, not yet analysed, which seek to find out if the directional propagation was due to nest, the nest site or the nestlings

Maguire, G.S.

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Population dynamics and Breeding ecology of the Southern Emu-wren (*Stipiturus malachurus*) in Victoria.

The Southern emu-wren, *Stipiturus malachurus*, is one of Australia's smallest birds and is characterised by a long unusual tail of reduced plumage, and reduced flight capabilities. Its secretive behaviour and inhabitation of densely vegetated heathland and swampland environments, has resulted in a distinct lack of information regarding the species biology. Over three field seasons, we have monitored a population of emu-wrens inhabiting a swamp/coastal heathland system at Portland, in far-west Victoria. We have focussed largely on a) population demography and dynamics, b) breeding ecology, and c) parental care. Greater insight into juvenile dispersal, longevity of pair bonds and territory dynamics has been gained. Video surveillance equipment has provided detailed information on parental care, highlighting different gender roles and significant variation in care across pairs. Breeding success has been limited across all seasons with a high rate of nest failure. This together with high adult mortality rates, mostly attributable to predation, highlight the vulnerability of this species to local extinction.

Marshall, J.

Vision Touch and Hearing Research Centre, SBMS, UQ, Brisbane, Q 4072

Fluorescent communication in animals - Epiphenomenon or fact? Evidence for and against a variety of things.

A number of animals, including human females at certain times, possess fluorescent parts. Does this emitted light contribute to functional signals in any animal? Signal is used in the loosest possible way here to mean involved in anything from camouflage to aggressive or sexual communication. Evidence is presented for and against in birds, in particular the parrots, as well as in other animals including reef fish and stomatopods (a marine crustacean of surprising violence). Evidence for includes behavioural experiments and visual modelling along with much circumstantial evidence. Evidence against includes behavioural experimentation, which appears to misinterpret or at least misunderstand what fluorescence is and blunt statement. The nature of fluorescence will be examined from first principles.

Mokany, A.

School of Botany and Zoology, Australian National University, 0200

Let's get physical: Interactions between tadpoles and mosquito larvae.

Tadpoles and mosquito larvae co-exist at high densities in many natural fresh water bodies. Although these organisms are often found in sympatry, their ecological and behavioural interactions remain poorly understood. The primary aim of my study was to determine if the behaviour of tadpoles and mosquito larvae was significantly affected by the presence of competitors. To address this aim, I conducted a series of laboratory experiments investigating factors that may influence the physical interactions between tadpoles and mosquito larvae. I investigated two systems of co-occurring tadpoles and mosquitoes. These were the striped marsh frog (*Limnodynastes peronii*) with *Culex quinquefasciatus* mosquito larvae, and the tadpole of the Common Eastern Froglet (*Crinia signifera*) with *Ochlerotatus australis* mosquito larvae. My results demonstrated that strong behavioural interactions occurred between the tadpoles and mosquito larvae via physical interference. In addition, the position of food, size of the tadpole and chemicals associated with other organisms all influenced the outcome of interactions between tadpoles and mosquito larvae. These results have significant implications for both the structure of ecological communities and the biological control of mosquito larvae.

Mulder, R.A. and Adcock, G.J.

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Mixed mating strategies of alternate male morphs in a paradise flycatcher.

Polymorphism in sexually selected traits is known from a diverse range of animal taxa, and is often associated with alternative mating strategies. However, few studies have been able to quantify the fitness consequences of expressing alternative morphs. Males of the Madagascar paradise flycatcher (*Terpsiphone mutata*) are highly ornamented with ribbon-like tail streamers of up to three times their body length. There are two morphs of males; one is predominantly white, while the other has rufous plumage. The two male morphs coexist in resident populations throughout Madagascar and form socially monogamous pair bonds with females, allowing components of fitness to be reliably estimated for each morph. In a previous field experiment we presented sparrowhawks with stuffed birds of both colourations and found that white males are more often attacked, suggesting there is a predation cost to white plumage. Here we present data on relative reproductive success of males (within their own broods and through extra-pair copulations with other females, using microsatellite markers) to determine whether the predation costs of white plumage are balanced by reproductive advantages.

Nicholls, J.A.

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Habitat-dependent signal design in satin bowerbird (*Ptilonorhynchus violaceus*) vocalisations?

One explanation for intra-specific variation in avian vocalisations is that it is a response to variation in the acoustic properties of different habitat types. For example, vocalisations from denser habitats are predicted to utilise lower frequencies and shorter trills. This study tests whether habitat type and structure influence variation in the advertisement call of the satin bowerbird in the predicted manner. Advertisement calls were recorded from males from 16 populations occurring in a variety of habitat types. Discriminant function analyses were used to examine whether frequency and temporal characteristics of calls differed between sites and across habitat types. Relationships among call measures and vegetation characteristics around the bowers were also examined. The first discriminant analysis was capable of distinguishing among nearly all populations, with little or no overlap between the clusters of points from each population. When calls were grouped by habitat there was no overlap in discriminant function scores between calls from different habitats except in two structurally similar habitats. As predicted, trill length, peak and minimum frequencies were inversely correlated with the density of trees around the bowers. This study suggests that the structure of satin bowerbird advertisement calls is influenced by the habitat in which the caller lives. Although each population has a distinct advertisement call, birds in structurally similar habitats have converged on similar call properties. Future work will involve investigating the transmission qualities of different habitats and testing how the various calls attenuate as they pass through the different habitat types.

Peters, R.A. and Evans, C.S.

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Experimental analyses of an agamid lizard display: signal efficacy depends upon duration.

Many animal signals have introductory components that alert receivers. Examples from the acoustic and visual domains show that this effect is often achieved with high intensity, simple structure, and short duration. Quantitative analyses of the Jacky dragon (*Amphibolurus muricatus*) visual display revealed that introductory tail-flicks have lower velocities than subsequent components, but longer durations. In a series of video playback experiments with digitally animated tails, we explored tail-flick efficacy in terms of the trade-off between intensity and duration. We began by validating the use of the animated tail by comparing responses to digital video footage of a lizard tail-flick with those to a precisely matched 3D animation. We then examined the effects of variation in stimulus velocity/acceleration, by

expanding and compressing the time scale of the sequence. Results identified several variables that might mediate recognition. Two follow-up studies assessed the importance of tail-flick amplitude, movement speed, and signal duration. Lizard responses to this array of stimuli reveal that duration is the most important characteristic of the tail-flick, and that intermittent signaling has the same effect as continuous movement. We suggest that signal design reflects a trade-off between efficacy and cost.

Pix, W.¹ and Hemmi¹, J. and Vorobiev, M.² and Marshall, J.² and Hofmann, M.¹ and Zeil, J.¹.

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The variable colours of fiddler crabs and their relation to background and predation.

The fact that fiddler crabs have variable body colours has long been known, but a functional interpretation is still lacking. Here we report that neighbouring populations of *Uca vomeris* in Australia exhibit at least to the human eye - different carapace colours, which range from mottled green-brown to bright blueish-white. These colony differences are stable over years, although we know for individual crabs, that the bright colours can change to dull on the time-scale of minutes. We used a spectrographic imager (casi, Itres, Canada), and an Ocean Optics fibreoptics spectrograph to determine the spectral characteristics of the carapace colours of *U. vomeris* and of the sand and mud substratum the crabs inhabit. We find that the mottled colours of crabs are cryptic against the mudflat background, while the bright colours contrast strongly. Bright crabs are thus more conspicuous from the viewpoint of both conspecifics and bird predators. We tested the hypothesis that crab populations may become cryptic under the influence of bird predation by recording bird behaviour simultaneously at three sites, with either predominantly dull, intermediate or colourful crabs, as measured with an Ocean Optics spectrograph. "Dull" colonies indeed experience a much higher level of bird presence, compared to "colourful" colonies. The crabs thus modify their social signalling system under the influence of their assessment of predation risk.

Platzen, D. and Magrath, R.D.

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Parental alarm calls: A signal that suppresses nestling vocalization in the White-browed Scrubwren *Sericornis frontalis*.

The begging display of nestling birds has become a model for examining the evolution of animal signals. Theoretical models suggest that nestling begging must be costly to be an honest signal of need. Several studies show that nest predation is one potential cost factor, however none of these studies considers the possible influence of parental activity on the risk of predation. Parent birds give warning calls when a predator approaches the nest which may be directed at the nestlings to silence them. This can potentially suppress vocalization both during and between feeding visits.

In a field experiment we tested the reaction of nestling Scrubwrens to playbacks of parental mobbing calls. The nestlings reacted immediately to mobbing calls by falling almost completely silent. During a subsequent simulated feeding visit, a series of parental contact and provisioning calls, begging activity was still significantly reduced.

Our study is the first controlled field experiment to show that parental alarm calls suppress nestling vocalization. The stronger response of nestlings in the absence of parents compared to the simulated approach implies that vocalization when parents are absent poses a greater risk than vocalization during a feeding visit.

Reinhard, J. and Guez, D. and Srinivasan, M. and Zhang, S.

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How Honeybees Remember Where To Go: Associative Learning and Recall as Navigational Aids.

During foraging flights honeybees learn the position of a food source by visual cues, such as the location and colour of a flower patch. They also learn the chemical stimuli associated with the food source, such as the scent and the taste of the nectar. Here, we investigated how the honeybee's capacity for associative learning and cross-modal recall assists her in navigating back to a known food source. We trained marked bees to forage on feeders at two different locations, equidistant from the hive. The feeder at location A was scented with rose, and that at location B with lemon. In subsequent tests the feeders were replaced by similar vials that were empty and unscented, and the two scents were offered alternately to the bees by blowing them into the hive for brief periods. Blowing the rose scent caused the majority of the trained bees to arrive at A, whereas blowing lemon caused most of the same bees to arrive at B. Thus, odour does not merely trigger unspecific foraging in anticipation of food. Rather, it induces recall of a specific food site and causes bees to navigate successfully to it, even when the site is unscented, as was the case in the tests. When a bee returns to the hive after visiting an attractive food site, she often distributes nectar samples to potential recruits. Our findings suggest that the odour and taste of the nectar may facilitate and expedite foraging in the recruits by triggering recall of visual memories such as direction and distance of the site, as well as the landmarks and colours at the destination.

Rogers, A.

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The function of duets in the eastern whipbird.

Numerous hypotheses have been proposed to explain why some birds coordinate their vocalisations in the form of pair duets. However, there is no current consensus as to the function of these striking acoustic displays. Traditionally, studies focus on female-led duets and a cooperative function for duetting. Australia's eastern whipbird forms highly coordinated male-led duets, which are particularly unusual in that females regularly form precise duets with males other than their own partner. Pairs were exposed to playback of (i) a solo male; (ii) a solo female and (iii) a duetting pair. Focal males and females showed a highly sex-specific response to playback, males reacted more strongly to playback of solo male calls and females to playback of solo female calls. Females were most likely to respond to their partner to form a duet in response to simulated intrusions by a solo female. This suggests females were more likely to answer their partners and form a duet as intra-sexual competition increased. The possible function of duets as a method of acoustic mate guarding in the eastern whipbird is discussed.

Rutstein, A.

University of St. Andrews, Scotland, U.K.

Brood manipulation in zebra finches.

Reproduction is costly and therefore there is a trade-off between current and future reproductive effort. Female birds face two major decisions concerning resource allocation: firstly, how much of their resources should they invest in a reproductive attempt, and secondly, how should these resources be partitioned within the brood? This study investigated resource allocation between and within broods by female zebra finches in relation to diet quality and mate attractiveness.

Experimental manipulation of diet quality had a very large effect on reproductive output. Females on a high quality diet laid a greater number of heavier eggs with higher levels of yolk testosterone, compared with females on a low quality diet. On the high quality diet, egg mass increased with laying sequence, whereas on the low quality diet the reverse was true. In asynchronously hatching species such differences may represent strategies to mitigate or enhance competitive hierarchies within the brood. Females on the low quality diet also

produced a greater proportion of males at laying, which may be adaptive, given that females fare worse than males in a food-impooverished environment. In a second experiment, male attractiveness was artificially manipulated using coloured leg rings. Females mated to attractive males laid heavier eggs for their body mass than those mated to unattractive males. There was no sex ratio bias at laying, which might reflect a weaker selection pressure on sex ratio adjustment in relation to mate attractiveness, compared with diet quality.

Si, A. and Helliwell, P. and Maleszka, R.

Research School of Biological Sciences, ANU, Canberra, ACT

Memantine alleviates L-trans-2, 4-PDC -induced amnesia in the honeybee and suggests a role for glutamate and NMDA receptors in memory recall.

In contrast to vertebrates the involvement of glutamate and NMDA receptors in brain functions in insects is both poorly understood and controversial. Here we have examined the effects of a non-competitive N-methyl-D-aspartate (NMDA) receptor antagonist, memantine, on learning and memory in amnesic honeybees (*Apis mellifera*) using the classical conditioning of the proboscis extension reflex (PER). Memantine is well tolerated by honeybees, and injections prior to training have either no effect (in 4 and 8-day old bees), or slightly improve the performance of honeybees (7-days old) in the PER paradigm. We induced memory deficit by injecting harnessed individuals with a glutamate transporter inhibitor, L-trans-2, 4-PDC. This treatment impairs long-term (24hrs), but not short-term (1hr), memory in honeybees. We show that L-trans-2, 4-PDC-induced amnesia is antagonised by memantine injected either before training, or before testing, suggesting that memantine restores memory recall rather than memory formation or storage. Our results are consistent with the distribution of glutamate-like immunoreactivity in the honeybee brain and support the role of glutamatergic transmission in memory processing in this insect.

Simmons, L.

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Testing models of postcopulatory sexual selection: lessons from the dung heap.

For a variety of reasons, the females of many animals mate with more than a single male during a reproductive episode. Parker first recognised how polyandry would generate sexual selection after copulation, favouring adaptations in males that allow them to pre-empt rival sperm, while at the same time, avoid their own sperm being pre-empt by males that may encounter their mates in the future. Thus, sperm competition has been seen very much as an extension of male contest competition. More recently attention has swung to how female choice may influence patterns of paternity following multiple mating, so called cryptic female choice. I use an insect model, the dung beetle *Onthophagus taurus*, to test models of postcopulatory sexual selection. First, I review sperm competition game models which predict how sperm competition will shape male ejaculation strategies. I then examine patterns of genetic variance in ejaculate traits and their implications for possible mechanisms of cryptic female choice. Finally, I describe a series of experiments aimed to test some predictions from models of cryptic female choice. Collectively the data suggest that both sperm competition and cryptic female choice may be important components of postcopulatory sexual selection in these beetles.

Sims, R. and Cockburn, A.

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Causes of age-related improvements in reproductive success among female superb fairy-wrens: constraint or restraint?

The roles of constraint and restraint in age-related improvements in reproductive success among birds cannot be understood without examination of the proximate causes behind such patterns. Female superb fairy-wrens (*Malurus cyaneus*) significantly improve reproductive performance between their first and second breeding seasons due to within-individual improvements in the date of onset of breeding, clutch size, fledging success and the

probability of re-nesting. The proximate mechanisms behind these improvements were examined by observing body condition, egg size, nest construction and nestling provisioning behaviour. Yearling females built lower, more conspicuous nests, fed nestlings at a lower rate, and were less vigilant during food deliveries than older females. High nestling predation rates experienced in the first year of breeding are therefore likely to result from constraints in the form of deficiencies in a range of reproductive skills required to avoid nest detection by predators. By contrast, there was no effect of female age on body condition prior to breeding or egg size. The shorter breeding season and smaller clutch sizes of yearlings may result from reproductive restraint by females during their first breeding season, to create a low cost opportunity to practice the range of skills required for successful reproduction in later years.

Smith, J.

Department of Zoology and Entomology, University of Queensland, 4072

The role of song as a mating strategy for humpback whales.

Humpback whales (*Megaptera novaeangliae*) migrate annually from high latitude summer feeding grounds to low latitude winter breeding and calving grounds. There are clear seasonal contrasts in the behaviour exhibited by both sexes. During the breeding season male humpback whales engage in direct male-male competition and produce long, complex songs. While song is probably used as an acoustic reproductive display, the exact role that song plays in the humpback whale mating system and its relative importance in male-male competition and mate attraction remains unknown. This is a consequence of a lack of focal studies concentrating on the behaviour of singers and the difficulty in accurately determining the sex of individuals interacting with singers from visual observations. The aim of this study is to determine the function and relative importance of song in intra- and inter-sexual interactions. Singers will be tracked using an acoustic hydrophone array during the 2003 southward and 2004 northward migration past Peregian Beach, south-east Queensland. Interactions will be examined using both land-based observations of all individuals within the study area and boat-based visual observations of close interactions involving singers. Biopsy samples will be taken for sex determination. Preliminary results from a pilot program conducted in 2002 will be presented that demonstrate the feasibility of the project.

Srinivasan, M.V. and Zhang, S.

*Centre for Visual Sciences, Research School of Biological Sciences,
Australian National University*

Small Brains, Smart Minds: Vision, Navigation and 'Cognition' in Honeybees.

Anyone who has watched a fly make a flawless landing on the rim of a teacup, or marvelled at a honeybee speeding home after collecting nectar from a flower patch several kilometres away, would know that insects possess visual systems that are fast, reliable and accurate. Insects cope remarkably well with their world, despite possessing a brain that carries fewer than 0.01% as many neurons as ours does. This talk will explore the secrets of their success, by describing research aimed at understanding the principles and mechanisms underlying visual perception, navigation, learning, memory and 'cognition' in honeybees.

Stapley, J.

School of Botany and Zoology, ANU Canberra ACT

Causes and consequences of alternative male mating strategies in lizards.

Mating system studies that have utilised molecular tools have revealed unexpected patterns of paternity, owing to the diverse behavioural tactics of individuals. These alternative mating strategies appear to be widespread among many groups of animals, however there remain large gaps in our understanding of the evolution and maintenance of these strategies. Alternative male strategies may be facultative, meaning individuals can switch between tactics or may be genetically hard wired. In the latter, the alternative strategies may be indicative of an overall difference in the behavioural phenotype or personality of the individual. In this sense males with different mating strategies may also have different behaviours outside of the mating context. To investigate this I used a combination of field and

laboratory based studies to test if males of the southern water skink, which adopt different mating strategies, also differ in behaviours not related to mating. During the field study I identified male mating strategies and measured their reproductive success using molecular markers. Following this I measured male exploratory and predator avoidance behaviours in the lab to test for correlations between mating and non-mating behaviours, and to identify if male mating strategies are linked to a broader male personality.

Taylor, P.W.

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The mis-measure of animal contests: has direct assessment of rivals been overestimated?

Mutual assessment of differences in resource holding potential (RHP) is usually expected as an economical means of contest resolution; weaker rivals can retreat when they detect their inferiority and can thereby avoid futile, costly, persistence. Models of contest resolution in which retreat decisions are based on assessed RHP difference predict that contest duration should diminish as RHP difference between the rivals increases because differences are more readily detected. This prediction appears to have been fulfilled in contests of many different species, generating the impression that assessment of RHP differences is ubiquitous. But few studies have considered alternative models in which each rival simply persists in accord with its own RHP ('own RHP-dependent persistence'). In contests decided by own RHP-dependent persistence weaker rivals may retreat first because they are inherently less persistent. In these contests, duration depends primarily on the weaker (losing) rival's RHP rather than RHP difference between the rivals. However, the analyses most commonly employed to detect effects of RHP differences cannot discriminate between these alternatives. Many studies purporting to show a negative relationship between RHP difference and contest duration may thus actually reflect an incidental association between weaker rival (loser) RHP and RHP difference. I will discuss the importance and scope of this mis-measure of animal contests. I will also suggest some alternative analytical techniques capable of discriminating true effects of RHP difference.

Van Dongen, W.

Department of Zoology, University of Melbourne 3010

Functions of multiple ornamentation in the golden whistler (*Pachycephala pectoralis*).

Studies of avian sexual selection typically focus on the maintenance of single ornaments. However, males of many bird species possess multiple display signals (ie both elaborate plumage and complex singing behaviour). The maintenance of multiple ornamentation in birds has received much theoretical attention but empirical studies are scant. We are investigating the functions of multiple display signals in the golden whistler, a socially monogamous passerine. Males express both complex song and elaborate ornamental plumage, thus providing a useful model in which to investigate the maintenance of multiple ornaments amongst birds. We have previously found that, in this species, different ornaments advertise different aspects of male quality or are directed toward different receivers. We experimentally tested one of these relationships the fact that males with larger throat patches defend larger territories (suggesting that this ornament is used as a signal of dominance during male-male conflicts). We performed throat patch manipulation experiments using field-based simulated territory intrusions and found that test males with reduced throat patches induced a reduced response from subject males but not females. In addition, subject males with larger throat patches responded to test males with less intensity than 'subordinates'. These findings are discussed in relation to the function of this ornament in the golden whistler.

Wall, M.

School of Biological Sciences, University of Sydney, Sydney, NSW 2006

Chemosensory predator detection in an Australian skink: phylogeny versus ecology.

The Australian pygopodid Burton's legless lizard (*Lialis burtonis*) represents an independent evolution of the snake foraging mode; functionally limbless, it subsists via infrequent ingestion of large prey items. Like many of its elapid competitors, *Lialis* preys largely upon

skinks, which tend to have highly developed chemosensory capabilities. I investigated the resolving power of these capabilities in a predator-detection context. Feeding trials suggested that garden skinks (*Lampropholis guichenoti*) perceive saurophagous elapids as much graver threats than *Lialis*; skinks often fled or froze when placed in an arena with a snake but rarely did so when confronted with a Burton's. To test this preliminary observation, I presented garden skinks with cotton swabs bearing the scents of *Lialis*, a sympatric arthropod-eating pygopodid (*Pygopus lepidopodus*), various elapids, and controls, and scored tongue-flick rates and the incidence of fleeing. Skinks tongue-flicked and fled significantly more in response to elapid scent; *Lialis* and *Pygopus* scent elicited reactions statistically indistinguishable from the controls. Pygopodids may simply smell like their gecko ancestors, conferring on *Lialis* an enormous advantage. Interestingly, garden skinks reacted as strongly to the scent of bandy-bandies (*Vermicella annulata*), an elapid that specializes on blindsnakes, as they did to saurophagous snake scent, suggesting that *L. guichenoti* cues on some aspect of skink chemistry common to the Elapidae, or to its Australian representatives. A high percentage of Australian elapids prey primarily on skinks, so it may make little evolutionary sense to distinguish among them.

Waller, S. J. and Siebeck, U. E. and Marshall, N. J.

Vision, Touch and Hearing Research Centre, School of Biomedical Sciences, University of Queensland, Brisbane, Queensland 4072.

The possible role of ontogenetic colour change as intraspecific camouflage in damselfish.

Coral reef fish exhibit an amazing diversity of colours and markings and many undergo ontogenetic colour changes. However, despite these changes being extremely striking, their role in the behavioural ecology of fish is not well understood. In families of reef fish that include highly territorial species, it has been hypothesised that the striking colour changes function as "intraspecific camouflage" allowing juveniles to go unrecognised as competitors by adults (Fricke, 1973). This investigation aims to tackle this hypothesis by using a combination of spectrophotometric measurements of the reflectance spectra from live fish, behavioural trials and an assessment of the colour vision capabilities of all the life stages studied. Reflectance spectra from three damselfish species, *Neoglyphidodon melas*, *N. nigroris* and *Dascyllus albisella* are presented and show the significant differences between juvenile, intermediate and adult phases, some of which are beyond the perception capabilities of the human colour vision system. Preliminary results from a pilot study reveal that *N. melas* attacks conspecific adults more readily than conspecific juveniles or heterospecific juveniles, supporting the "intraspecific camouflage" hypothesis. The importance of measuring colour objectively is discussed in light of past studies of animal colouration being confounded by the traditional assumption that animals view the world in the same way that we do. Future research will include analysis of ontogenetic colour change across 7 families of reef fish and further behavioural trials to try and go some way to answering the question "Why do reef fish change colour?"

Wignall, A.¹ and Heiling, A.² and Cheng, K.³ and Herberstein, M.⁴

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Floral symmetry, crab spiders and honeybees.

Predators can exploit the sensory biases of prey to increase their foraging success. Crab spiders, *Thomisus spectabilis*, use flowers to prey on the honeybee, *Apis mellifera*. Many flowers exhibit symmetry, and innate preferences for symmetry in pollinators such as honeybees are documented. Choice experiments were performed to test the prediction that crab spiders exploit a bias for floral symmetry in honeybees. Flowers (*Argyranthemum frutescens*) were manipulated to contain asymmetrical and symmetrical patterns, with olfactory cues excluded. In the first experiment, crab spiders and honeybees were presented with one asymmetrical and one symmetrical flower, and choices recorded. Both crab spiders

(62.5%) and honeybees (62.5%) exhibited a significant preference for symmetrical flowers. However, the predicted independent probability of a spider and a honeybee selecting the same flower of a pair, calculated from the observed percentages, was 0.53. Whilst close to chance, this may provide sufficient opportunities for crab spiders to capture prey. A second choice experiment tested preference for bilateral or radially symmetric flowers. Honeybees exhibited a significant preference for radial symmetry, but no corresponding effect was recorded in crab spiders. Further analysis demonstrated that spider condition, flower reflectance or orientation of the axis of symmetry did not affect crab spiders' decisions. An analysis of spider choices in the field on *A. frutescens* revealed no significant difference in the standard deviations of petal lengths between occupied and unoccupied flowers. Spiders and honeybees may use another flower characteristic, for example olfactory cues, in combination with floral symmetry, in making their foraging decisions.

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Costs influence male mate choice in a freshwater fish.

It is well known that female mate choice decisions depend on the direct costs of choosing (either because of search costs or male-imposed costs). Far less is known about how direct fitness costs affect male mate choice. We conducted an experiment to investigate male mate choice in a fish *Pseudomugil signifer*. Preferred females were larger, probably because larger females are also more fecund. Males, however, were consistent in their choice of female only when the costs of associating with prospective mates were equal. In contrast, males were far less consistent in their choice when made to swim against a current to remain with their initially preferred mate. Our results suggest that males may also respond adaptively to changes in the costs of choosing.

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Perceptual Grouping of Visual Patterns by Honeybees.

An important trait of human cognition is the apparent ease with which we are able to group together things that are similar, and to establish a concept that links them together. The ability to categorize objects was long thought to be a faculty that was exclusive to humans, because it was believed to have originated from the ability to communicate concepts through language. More recent work, however, has revealed that categorization is performed by apes as well as pigeons. We now show that the ability to categorize visual images extends to an invertebrate the honeybee. Bees can be trained to distinguish between different types of naturally occurring scenes in a rather general way, and to group them into four distinct categories: landscapes, plant stems and two different kinds of flowers. Categorization may thus be a faculty that is possessed and used by a large variety of animal species to identify biologically relevant objects in their environment and to respond appropriately to them.