

67<sup>th</sup> Annual Scientific  
Meeting of the  
Australian Mammal Society  
Virtual 2021



Conference Programme &  
Abstract List



# Conference Program

AWST	ACST	AEST	Tuesday 28 <sup>th</sup> September	
			Chair: Meg Martin	
9:00 – 11:00 AM	10:30 AM – 12:30 PM	11:00 AM – 1:00 PM	Workshop 1 - Preparing for life after PhD	
11:00 AM – 1:00 PM	12:30 – 1:30 PM	1:00 – 3:00 PM	<i>Break</i>	
			Chair: Natasha Tay	
1:00 – 2:30 PM	2:30 – 4:00 PM	3:00 – 4:30 PM	Workshop 2 - How to talk science with journalists	

AWST	ACST	AEST	Wednesday 29 <sup>th</sup> September		
9:00 AM	10:30 AM	11:00 AM	Conference welcome and Acknowledgment of Country and Housekeeping		
			Session 1	Chair: Natalie Warburton	Speaker
9:20 AM	10:50 AM	11:20 AM	AUSTRALASIAN MAMMAL TAXONOMY CONSORTIUM (AMTC): A CHECK-LIST FOR ALL AUSTRALIAN MAMMALS		Andrew Baker
9:25 AM	10:55 AM	11:25 AM	DEVELOPMENT OF THE SHORT-BEAKED ECHIDNAS TEMPORARY POUCH		Kate Dutton-Regester
9:30 AM	11:00 AM	11:30 AM	FRAGMENTATION BY LARGE DAMS AND IMPLICATIONS FOR THE FUTURE VIABILITY OF SMALL PLATYPUS POPULATIONS		Luis Mijangos
9:40 AM	11:10 AM	11:40 AM	BODY SIZE AND POUCH ASSOCIATION IN MARSUPIALS		Mariah Yoshikawa
9:45 AM	11:05 AM	11:45 AM	RECOGNISING BODY CONDITION OF NORTHERN QUOLLS USING MACHINE LEARNING		Lorna Hernandez Santin
9:50 AM	11:20 AM	11:50 AM	HIDING IN THE CRACKS: DOCUMENTING THE DIVERSITY OF AUSTRALIA'S SMALLEST MARSUPIAL CARNIVORES		Linette Umbrello
10:00 AM	11:30 AM	12:00 PM	THE PHYLOGENY OF THE NEW GUINEAN MARSUPIAL CARNIVORE GENUS MYOICTIS AND THE VALUE OF UPDATING GENBANK ACCESSIONS		Matthew Phillips
10:10 AM	11:40 AM	12:10 PM	THE EFFECTS OF CAPTIVITY ON BEHAVIOURAL AND COGNITIVE TRAITS IN FAT-TAILED DUNNARTS ( <i>SMINTHOPSIS CRASSICAUDATA</i> )		Emily Scicluna*
10:20 AM	11:50 AM	12:20 PM	CUTANEOUS AND RESPIRATORY CONTROL OF EVAPORATIVE WATER LOSS		Philip Withers
10:30 – 11:20 AM	12:00 – 12:50 PM	12:30 – 1:20 PM	<i>Break 1</i>		
			Session 2	Chair: Linette Umbrello	
11:20 AM	12:50 PM	1:20 PM	USING ANCIENT DNA TO INVESTIGATE THE PHYLOGEOGRAPHY OF THE WESTERN QUOLL ( <i>DASYURUS GEOFFROI</i> ) ACROSS AUSTRALIA		Caitlin Mudge*

11:30 AM	1:00 PM	1:30 PM	CRANIAL MORPHOLOGY IN THE FAT-TAILED DUNNART ( <i>SMINTHOPSIS CRASSICAUDATA</i> ); CAPTIVE VS WILD	Meg Martin
11:35 AM	1:05 PM	1:35 PM	REMOTE SENSOR CAMERA TRAPS PROVIDE THE FIRST DENSITY ESTIMATE FOR THE LARGEST NATURAL POPULATION OF THE NUMBAT ( <i>MYRMECOBIUS FASCIATUS</i> )	Sian Thorn
11:45 AM	1:15 PM	1:45 PM	THE SPACE USE OF A NATIVE MESOPREDATOR IS INFLUENCED BY SEX AND HABITAT TYPE	Mitchell Cowan*
11:55 AM	1:25 PM	1:55 PM	BODY SIZE MATTERS: RELATIONSHIPS BETWEEN BODY SIZE, DIET, AND DENTAL MICROWEAR TEXTURES IN QUOLLS THROUGHOUT AUSTRALIA	Larisa DeSantis
12:05 PM	1:35 PM	2:05 PM	A LANDSCAPE APPROACH TO NORTHERN QUOLL CONSERVATION: FROM MECHANISM TO PROCESS	Robyn Shaw
12:15 PM	1:45 PM	2:15 PM	OPTIMISING CAMERA USE TO DETECT AND ID A MARSUPIAL CARNIVORE	Melissa Taylor*
12:25 PM	1:55 PM	2:25 PM	PATERNITY BIAS IN REINTRODUCED WESTERN QUOLLS ( <i>DASYURUS GEOFFROII</i> ) AT ARID RECOVERY RESERVE	Tessa Manning*
12:35 PM	2:05 PM	2:35 PM	WHO'S AFRAID OF THE MARSUPIAL WOLF?	Douglass Rovinsky
12:45 – 1:35 PM	2:15 – 3:05 PM	2:45 – 3:35 PM	<i>Break 2</i>	
			Session 3	Chair: Saul Cowen
1:35 PM	3:05 PM	3:35 PM	CONTINENTAL-SCALE ADAPTIVE RADIATION REFLECTED IN CRANIAL SHAPE IN PERAMELEMORPHIAN MARSUPIALS	Natalie Warburton
1:45 PM	3:15 PM	3:45 PM	CONSERVATION GENOMICS OF ISLAND, MAINLAND AND REINTRODUCED POPULATIONS OF GOLDEN BANDICOOTS	Kate Rick*
1:55 PM	3:25 PM	3:55 PM	RESOLVING THE TAXONOMY OF THE GOLDEN BANDICOOT, <i>ISOODON AURATUS</i>	Kenny Travouillon
2:05 PM	3:35 PM	4:05 PM	MINI-ACOUSTIC SENSORS REVEAL OCCUPANCY AND POTENTIAL THREATS TO KOALAS ( <i>PHASCOLARCTOS CINEREUS</i> ) IN PRIVATE NATIVE FORESTS	Brad Law
2:15 PM	3:45 PM	4:15 PM	MOVEMENT OF FREE-RANGING KOALAS IN RESPONSE TO MALE VOCALISATION PLAYBACKS	Alex Jiang*
2:25 PM	3:55 PM	4:25 PM	LOVE THEM OR LOATHE THEM - CHANGING PUBLIC PERCEPTIONS OF KOALAS	Danielle Clode
2:35 PM	4:05 PM	4:35 PM	POST-RELEASE SURVIVAL OF KOALAS FROM AN ANALYSIS OF THE LONG-TERM REHABILITATION RECORDS OF FRIENDS OF THE KOALA IN NORTH-EAST NEW SOUTH WALES	Dan Lunney
2:45 PM	4:15 PM	4:45 PM	HEART RATE AS A METABOLIC INDEX FOR WILD KOALAS	Matthew Stanton^
2:50 PM	4:20 PM	4:50 PM	A GENETIC METHOD FOR DETERMINATION OF KOALA DIETARY EUCALYPTUS SPECIES FROM SCATS	Michaela Blyton

AWST	ACST	AEST	Thursday 30 <sup>th</sup> September	
			Session 4	Chair: Kym Ottewell
				Speaker
9:00 AM	10:30 AM	11:00 AM	USING NON-INVASIVE GENETICS TO INVESTIGATE ANTHROPOGENIC IMPACTS ON WILDLIFE POPULATIONS	Katrin Hohwieler

9:10 AM	10:40 AM	11:10 AM	TAKE IT OR LEAF IT? HOW VARIABLE IS THE NUTRITIONAL QUALITY OF KOALA FOOD?	Ben Moore
9:20 AM	10:50 AM	11:20 AM	HORMONES IN THE WILD: THE INFLUENCE OF ENVIRONMENTAL CONDITIONS ON STEROID HORMONE CONCENTRATIONS IN KOALA FAECAL PELLETS	Riana Gardiner
9:30 AM	11:00 AM	11:30 AM	WHAT DID THE MARSUPIAL TAPIR EAT? RECONSTRUCTING THE PALAEOBIOLOGY OF <i>PALORCHESTES</i> , A BIZARRE EXTINCT GIANT FROM SOUTHEAST QUEENSLAND	Eleanor Pease*
9:40 AM	11:10 AM	11:40 AM	WOMBATS OF SOUTH AUSTRALIA: COMPARING SOUTHERN HAIRY-NOSED AND COMMON WOMBATS	Mike Swinbourne
9:50 AM	11:20 AM	11:50 AM	PALAEO-HISTORY OF THE NORTHERN HAIRY-NOSED WOMBAT ( <i>LASIORHINUS KREFFTII</i> ) PROVIDES INSIGHTS FOR CONSERVATION OF MODERN POPULATIONS	Gilbert Price
10:00 AM	11:30 AM	12:00 PM	THE IMPACT OF CULTURAL BURNS ON KOALA DENSITY ON MINJERRIBAH, NORTH STRADBROKE ISLAND	Asitha Samarawickrama*
10:10 AM	11:40 AM	12:10 PM	RESPONSE OF A YELLOW-BELLIED GLIDER POPULATION TO THE 2019/20 WILDFIRES	Ross Goldingay
10:15 AM	11:45 AM	12:15 PM	BRUSHTAIL POSSUM ( <i>TRICHOSURUS VULPECULA</i> ) POPULATION CRASH ON A MURRAY RIVER FLOODPLAN AND THE IMPORTANCE OF CONSISTENT AND MULTIFACETED MONITORING OF ECOLOGICAL HEALTH	Tara McKenzie
10:25 AM	11:55 AM	12:25 PM	NOVEL FEATURES OF TOOTH DEVELOPMENT AND EVOLUTION IN THE HONEY POSSUM ( <i>TARSIPEX ROSTRATUS</i> )	Ziyun Li <sup>^</sup>
10:30 – 11:20 AM	12:00 – 12:50 PM	12:30 – 1:20 PM	<i>Break 1</i>	
			Session 5	Chair: Robyn Shaw
11:20 AM	12:50 PM	1:20 PM	THE DARK SIDE OF ENERGY-EFFICIENT LIGHTING: INVESTIGATING THE IMPACTS OF LED LIGHTING ON GLUCOCORTICOID EXPRESSION IN A NOCTURNAL MARSUPIAL	Alicia Dimovski
11:30 AM	1:00 PM	1:30 PM	HOW DO PERSONALITY, REHABILITATION PROTOCOL AND RELEASE METHODS AFFECT SURVIVAL IN REHABILITATED WESTERN RINGTAIL POSSUMS – PRELIMINARY RESULTS	Sara Corsetti*
11:40 AM	1:10 PM	1:40 PM	PLACEMENT OF TRAPS ON TREE BRANCHES INCREASES TRAP SUCCESS RATES OF NGWAYIR ( <i>PSEUDOCHEIRUS OCCIDENTALIS</i> )	Roberta Bencini
11:50 AM	1:20 PM	1:50 PM	INDIVIDUAL TRAITS VS. PREDATOR DENSITIES IN A BURROWING BETTONG REINTRODUCTION	Hannah Bannister
12:00 PM	1:30 PM	2:00 PM	CONSERVING WESTERN AUSTRALIAN BOODIES (BURROWING BETTONGS)	Heidi Nistelberger
12:10 PM	1:40 PM	2:10 PM	A NEW SPECIES OF BETTONG FROM THE NULLARBOR PLAINS: REVISION OF THE BRUSH-TAILED BETTONG (WOYLIE)	Jake Newman-Martin*
12:20 PM	1:50 PM	2:20 PM	WHAT DO WE KNOW ABOUT THE STATUS AND DISTRIBUTION OF THE NGUDLUKANTA ( <i>CALOPRYMNUS CAMPESTRIS</i> )?	Karl Vernes
12:30 PM	2:00 PM	2:30 PM	EASTERN GREY KANGAROO POPULATION GENETIC DIVERSITY & STRUCTURE IN A RAPIDLY URBANISING REGION	Beth Brunton
12:40 PM	2:10 PM	2:40 PM	INVESTIGATION OF FACTORS THAT MAY BIAS CAMERA TRAPPING FOR SMALL THREATENED MACROPODS	Darren McHugh

12:45 – 1:35 PM	2:15 – 3:05 PM	2:45 – 3:35 PM	Break 2	
			Session 6	Chair: Melissa Taylor
1:35 PM	3:05 PM	3:35 PM	USING MORPHOMETRICS TO TAXONOMICALLY CLASSIFY MACROPOD POSTCRANIA FROM BOODIE CAVE, BARROW ISLAND: IMPLICATIONS FOR UNDERSTANDING HUMAN SUBSISTENCE AND ENVIRONMENTAL CHANGE	Erin Mein*
1:45 PM	3:15 PM	3:45 PM	THE EVOLUTION OF MARSUPIAL SOCIAL ORGANISATION	Jingyu Qiu*
1:55 PM	3:25 PM	3:55 PM	EVALUATION OF TRACKING DEVICES WITH COLLAR BREAK-AWAY MECHANISMS TO MONITOR QUOKKA ( <i>SETONIX BRACHYURUS</i> ) ACTIVITY	Leticia Povh*
2:05 PM	3:35 PM	4:05 PM	FOSSIL FOOTPRINTS INDICATE ROTTNEST ISLAND, SW WESTERN AUSTRALIA, WAS A QUATERNARY QUOKKA BASTION	Aaron Camens
2:15 PM	3:45 PM	4:15 PM	SEX ALLOCATION: CONSTRAINTS IN A CHANGING WORLD	Amy Edwards
2:25 PM	3:55 PM	4:25 PM	RANGE EXTENSION OF EASTERN WALLAROO ( <i>OSPHRANTER ROBUSTUS ROBUSTUS</i> ) IN VICTORIA	Sakib Kazi
2:30 PM	4:00 PM	4:30 PM	CURRENT POPULATION STRUCTURE OF PETROGALE PENICILLATA FOLLOWING THE 2019/20 AUSTRALIAN BUSH FIRES	Melissa von Moger
2:35 PM	4:05 PM	4:35 PM	BONE HISTOLOGY IN A FOSSIL ELEPHANT FROM PULAU BANGKA, SUMATRA	Pauline Basilia*
2:45 PM	4:15 PM	4:45 PM	UNDERSTANDING DISPERSAL PATTERNS CAN INFORM TRANSLOCATION STRATEGIES: A CASE STUDY OF THE THREATENED GREATER STICK-NEST RAT	Isabelle Rose Onley*
2:55 PM	4:25 PM	4:55 PM	MUSEUM GENOMICS UNLOCKS A HISTORICAL RECORD OF EXTINCTION IN AUSTRALIA	Emily Roycroft
3:05 – 5:00 PM	4:35 – 6:30 PM	5:05 – 7:00 PM	Annual General Meeting	

AWST	ACST	AEST	Friday 1 <sup>st</sup> October	
			Session 7	Chair: Trish Fleming
				Speaker
9:00 AM	10:30 AM	11:00 AM	ONE SIZE, ONE SHAPE? A PRELIMINARY STUDY OF SHAPE DIFFERENCES IN THE SKULL OF MICE FROM DIFFERENT HABITATS	Vera Weisbecker
9:10 AM	10:40 AM	11:10 AM	ARTIFICIAL REFUGES ASSIST WITH MONITORING SHORT-TERM SUCCESS OF REINTRODUCTIONS OF TWO THREATENED RODENTS	Saul Cowen
9:20 AM	10:50 AM	11:20 AM	PREDATOR-PREY INTERACTIONS: ANTI-PREDATOR RESPONSES OF AN AUSTRALIAN NATIVE RAT TOWARDS THE ODOUR CUE OF AN INTRODUCED PREDATOR IN A SEMI-NATURAL FIELD-BASED ENVIRONMENT	Elizabeth Harper*
9:30 AM	11:00 AM	11:30 AM	GIANT RATS ( <i>UROMYS</i> SPP.) FROM THE PLEISTOCENE OF CENTRAL QUEENSLAND	Jonathan Cramb
9:40 AM	11:10 AM	11:40 AM	PATTERNS OF FEMALE CLUSTERING INFLUENCE THE EVOLUTION OF TESTES SIZE IN AUSTRALIAN RODENTS	Renee Firman
9:50 AM	11:20 AM	11:50 AM	THE EVOLUTION OF GENITAL MORPHOLOGY: BACULUM SHAPE DIVERSIFICATION IN MUROID RODENTS	Jessie Tanner

10:00 AM	11:30 AM	12:00 PM	RUN, RABBIT, RUN: USING AUSTRALIAN LAGOMORPHS TO INVESTIGATE HOW RUNNING ABILITY DRIVES ADAPTATION OF THE POSTCRANIAL ANATOMY	Ellen Martin*
10:10 AM	11:40 AM	12:10 PM	MACACA MULATTA AS A MODEL ANIMAL FOR MANDIBULAR FIXATION RESEARCH	Hyab Mehari Abraha*
10:20 AM	11:50 AM	12:20 PM	HOW FAR WILL A BAT FLY? GPS TRACKING OF FINE-SCALE MOVEMENTS OF THE THREATENED SOUTH-EASTERN LONG-EARED BAT, <i>NYCTOPHILUS CORBENI</i>	Leroy Gonsalves
10:30 – 11:20 AM	12:00 – 12:50 PM	12:30 – 1:20 PM	<i>Break 1</i>	
			Session 8	Chair: Holly Raudino
11:20 AM	12:50 PM	1:20 PM	RESPONSES OF INSECTIVOROUS BATS TO SPATIAL AND TEMPORAL CHARACTERISTICS OF FIRE REGIMES	Kate Senior
11:30 AM	1:00 PM	1:30 PM	REMARKABLE ADAPTATIONS IN THE CANINE TEETH OF MAMMALIAN CARNIVORES REVEALED BY 3D GEOMETRIC MORPHOMETRICS AND FINITE ELEMENT ANALYSIS	Tahlia Pollock*
11:40 AM	1:10 PM	1:40 PM	DISTINCTIVE DIETS OF DINGOES, FOXES AND CATS	Trish Fleming
11:50 AM	1:20 PM	1:50 PM	DOES THE FORAGING ECOLOGY OF FERAL CATS CHANGE AFTER THE ERADICATION OF FOXES?	Anthony Rendall
12:00 PM	1:30 PM	2:00 PM	CAN LIVESTOCK GUARDIAN DOGS PROTECT THREATENED SPECIES? THE EFFECT OF MAREMMA SHEEPDOGS ON DISTRIBUTION AND BEHAVIOUR OF FOXES	Linda van Bommel
12:10 PM	1:40 PM	2:10 PM	RECORDS OF LEOPARD SEALS <i>HYDRURGA LEPTONYX</i> STRANDED IN SOUTH AUSTRALIA, 2017 TO 2019	Peter Shaughnessy
12:15 PM	1:45 PM	2:15 PM	THE DIET OF DINGOES, FERAL CATS AND EASTERN BARN OWL ON PULLEN PULLEN RESERVE, SOUTHWEST QUEENSLAND	Stephen Kearney^
12:20 PM	1:50 PM	2:20 PM	DUGONG ABUNDANCE AND DISTRIBUTION IN SHARK BAY AND NINGALOO FOLLOWING A PROLONGED HEATING EVENT	Marlee Hutton
12:30 PM	2:00 PM	2:30 PM	LIFE HISTORY PARAMETERS OF COMMON DOLPHINS IN SA: A PRELIMINARY STUDY	Catherine Kemper
12:40 PM	2:10 PM	2:40 PM	ARE YOU FROM MY MOB (MUMMAGUL)? GENETIC CONNECTIVITY OF SNUBFIN DOLPHINS IN THE KIMBERLEY	Delphine Chabanne
12:45 – 1:35 PM	2:15 – 3:05 PM	2:45 – 3:35 PM	<i>Break 2</i>	
			Session 9	Chair: Nahiid Stephens
1:35 PM	3:05 PM	3:35 PM	REGIONAL ABUNDANCE ESTIMATES OF BOTTLENOSE AND HUMPBACK DOLPHINS IN THE PILBARA, WESTERN AUSTRALIA	Holly Raudino
1:40 PM	3:10 PM	3:40 PM	PYGMY BLUE WHALE DIES OF CHRONIC HEART DEFECT ON YORKE PENINSULA, SOUTH AUSTRALIA	Ikuko Tomo
1:50 PM	3:20 PM	3:50 PM	PALAEOECOLOGY AND SEA LEVEL CHANGES: DECLINE OF MAMMAL SPECIES RICHNESS DURING LATE QUATERNARY ISLAND FORMATION IN THE MONTEBELLO ISLANDS, NORTH-WESTERN AUSTRALIA	Cassia Piper*
2:00 PM	3:30 PM	4:00 PM	GEOMETRIC MORPHOMETRICS OUT-PERFORMS LINEAR-BASED METHODS IN THE TAXONOMIC RESOLUTION OF A MAMMALIAN SPECIES COMPLEX	Pietro Viacava*
2:10 PM	3:40 PM	4:10 PM	GLOWING MAMMALS: FLUORESCENCE OR NOT?	Christine Cooper

2:15 PM	3:45 PM	4:15 PM	SYSTEMATIC REVIEW OF METHODS FOR QUANTIFYING ANTI-PREDATOR RESPONSES AND ITS APPLICATION FOR AUSTRALIA'S CRITICAL WEIGHT RANGE MAMMALS	Natasha Harrison^
2:20 PM	3:50 PM	4:20 PM	EVER-GROWING TEETH IN RABBITS: A COROLLARY OF SKULL ASYMMETRY AND DENTAL MALOCCLUSION	Qamariya Nasrullah
2:30 PM	4:00 PM	4:30 PM	ZOOS VICTORIA'S EMERGENCY RESPONSE TO AUSTRALIA'S BLACK SUMMER: WILDLIFE CONSERVATION, WELFARE AND RESILIENCE FOR THE FUTURE	Marissa Parrott
2:40 PM	4:10 PM	4:40 PM	SOMETHING TO CHEW ON: SOFT DIETS MAY IMPACT SUCCESSFUL REINTRODUCTION OF CAPTIVE-REARED WILDLIFE	D. Rex Mitchell
2:50 PM	4:20 PM	4:50 PM	UNITING MICROBES AND HOSTS TO UNDERSTAND MAMMAL ECOLOGY, PHYSIOLOGY, AND EVOLUTION	Raphael Eisenhofer
3:00 – 3:30 PM	4:30 – 5:00 PM	5:00 – 5:30 PM	Award Ceremony and end of conference	

5:00 – 8:00 PM	6:30 – 9:30 PM	7:00 – 10:00 PM	Conference Dinner	
5:00 – 5:30 PM	6:30 – 7:00 PM	7:00 – 7:30 PM	Arrival and ordering	
5:30 – 5:45 PM	7:00 – 7:15 PM	7:30 – 7:45 PM	Zoom welcome	
5:45 – 7:00 PM	7:15 – 8:30 PM	7:45 – 9:00 PM	Limerick creation	
7:00 – 7:30 PM	8:30 – 9:00 PM	9:00 – 9:30 PM	Zoom Limerick competition	
7:30 – 8:00 PM	9:00 – 9:30 PM	9:30 – 10:00 PM	Last drink!	

\*Students presenting for the Bolliger award

^Students presenting for the Lyne award





# Alphabetical list of abstracts

## INDIVIDUAL TRAITS VS. PREDATOR DENSITIES IN A BURROWING BETTONG REINTRODUCTION

**Bannister, Hannah**<sup>1,2</sup>; Letnic, Michael<sup>1</sup>; Blumstein, Daniel T.<sup>3</sup> and Moseby, Katherine<sup>1,4</sup>

<sup>1</sup> Centre for Ecosystem Science, The University of New South Wales, Sydney, NSW, Australia

<sup>2</sup> South Coast Natural Resource Management, Albany, WA, Australia

<sup>3</sup> Department of Ecology and Evolutionary Biology, The University of California, Los Angeles, California, USA

<sup>4</sup> Arid Recovery, Roxby Downs, SA, Australia

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Predation is a key factor in many failed reintroductions, and predation risk varies between individuals. Thus, selecting for advantageous traits may improve reintroduction success. We sought to test whether prior exposure to predators, morphological or behavioural traits could explain variation in post-release survival of burrowing bettongs at low and moderate predator densities. We exposed bettongs to feral cats for  $\geq 3$  years, and then conducted two translocations of cat-exposed and control bettongs ( $n = 40$  and  $n = 50$ ) to a release site where feral cats were present at moderate and then at low density. Variation in survival was not explained by prior exposure to cats, but at lower cat density bettong survival was influenced by hind foot length and sex. Trait divergence between cat-exposed and control populations may not yet be sufficient to result in a survival advantage between treatments, or bettongs may simply be 'outgunned' by feral cats. Long-term exposure to feral cats with periodic testing by translocating individuals is required to determine whether predator exposure can prepare bettongs for life with novel predators in a reintroduction context. Our results suggest predator activity at release sites must be low to enable the benefits of intraspecific variation to be revealed.



## BONE HISTOLOGY IN A FOSSIL ELEPHANT FROM PULAU BANGKA, SUMATRA

\***Basilia, Pauline**<sup>1</sup>; Miskiewicz, Justyna J.<sup>2,3</sup>; Price, Gilbert J.<sup>4</sup>; Nganvongpanit, Korakot<sup>5</sup>; Zaim, Jahdi<sup>6</sup>; Rizal, Yan<sup>6</sup>; Aswan<sup>6</sup>, Puspaningrum, Mika R.<sup>6</sup>; Trihascaryo, Agus<sup>6</sup>, and Louys, Julien<sup>1</sup>

<sup>1</sup> Australian Research Centre for Human Evolution, Griffith University, Nathan, QLD 4114, Australia

<sup>2</sup> School of Archaeology and Anthropology, Australian National University, Canberra, ACT 0200, Australia

<sup>3</sup> School of Social Science, University of Queensland, St Lucia, 4072, Australia

<sup>4</sup> School of Earth and Environmental Sciences, The University of Queensland, St Lucia, QLD 4067, Australia

<sup>5</sup> Animal Bone and Joint Research Laboratory, Department of Veterinary Biosciences and Public Health, Faculty of Veterinary Medicine, Chiang Mai University, Chiang Mai, 50100, Thailand

<sup>6</sup> Geology Study Program, Institut Teknologi Bandung, Jawa Barat, 40132, Indonesia

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The Island Rule describes a graded trend of body size evolution in response to insular conditions. On islands, large mammals can become smaller (dwarfing), with the opposite occurring for small mammals (gigantism). According to life history studies, life-history traits scale allometrically with body size. The smaller body mass of dwarfed species suggests metabolic investment towards reproduction and achieve earlier maturation than larger mainland counterparts. In order to test this, we use hard tissue histology to reconstruct ancient metabolism by examining fossil remains at a microscopic level. We describe the histology of a dwarfed fossil Asian elephant rib, vertebra, and humerus from Pleistocene deposits of Bangka Island, south Sumatra. Secondary osteon population density (OPD), and osteon and Haversian canal area (On.Ar, H.Ca.Ar) were recorded as proxies for bone metabolic activity, and compared intra-skeletally with available bone histology data for extant elephants (*Elephas maximus*) from Thailand. The fossil rib reflected the highest bone remodelling rate because it is unaffected by loading mechanisms experienced by the humerus and vertebra. Comparisons of rib and humerus on fossil and extant *Elephas* found that the mean On.Ar and H.Ca.Ar are smaller for the dwarfed species, indicating a faster metabolic rate than their modern Thai counterparts. High metabolic rates suggests that fossil insular dwarfed elephants lean towards the same life history traits as smaller mammals with earlier maturation, rather than towards its larger relatives, as a response towards a rapidly changing environment as well as climatic changes at the end of the Pleistocene.

## Speed talk

### AUSTRALASIAN MAMMAL TAXONOMY CONSORTIUM (AMTC): A CHECK-LIST FOR ALL AUSTRALIAN MAMMALS

**Baker, A.M.**<sup>1,2</sup>; Eldridge, M.D.B.<sup>3</sup>; Fisher, D.O.<sup>4</sup>; Frankham, G.J.<sup>5</sup>; Jackson, S.M.<sup>3,5</sup>; Potter, S.<sup>3,6</sup>; Travouillon K.J.<sup>7</sup> and Umbrello, L.S.<sup>7</sup>

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<sup>2</sup> Natural Environments Program, Queensland Museum, PO Box, 3300, South Brisbane, QLD 4101, Australia

<sup>3</sup> Australian Museum Research Institute, Australian Museum, 1 William Street Sydney, NSW 2010, Australia

<sup>4</sup> School of Biological Sciences, University of Queensland, St Lucia 4072, Queensland, Australia

<sup>5</sup> Vertebrate Pest Research Unit, NSW Department of Primary Industries, Orange Agricultural Institute, 1447 Forest Road, Orange, NSW 2800, Australia

<sup>6</sup> Division of Ecology and Evolution, Research School of Biology, Australian National University, Acton, ACT 0200, Australia

<sup>7</sup> Collection and Research, Western Australian Museum, 49 Kew Street Welshpool, Western Australia 6106, Australia

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The recently formed Australasian Mammal Taxonomy Consortium (AMTC) is an affiliated body of the AMS, proposed and endorsed on 18 November 2020. The structure of the AMTC includes both a Steering Committee (the AMTCSC) and a broader membership base. The AMTC aims to:

1. promote stability and consensus in the use of Australasian mammal scientific names via updatable online species lists approved by AMTC members, thereby supporting more rigorous study of mammals and their biodiversity;
2. provide advice and guidance on taxonomy, and promote its cause and importance, to scientists and laypersons; and
3. promote the importance of taxonomic-based research and foster and enable collaborative taxonomy-focussed research projects.

To meet our primary aim, this year, the AMTC will publish the inaugural list of Australian mammal species and subspecies, which will be updated annually. In this talk, members of the AMTCSC will briefly overview AMTC aims and aspirations, outlining some species listing criteria that should help guide authors of future mammal taxonomy works.

## PLACEMENT OF TRAPS ON TREE BRANCHES INCREASES TRAP SUCCESS RATES OF NGWAYIR (*PSEUDOCHEIRUS OCCIDENTALIS*)

Webb, Evan<sup>1</sup>; Corsetti, Sara<sup>1</sup>; Urso, Arianna<sup>1</sup>; Yokochi, Kaori<sup>2</sup> and **Bencini, Roberta**<sup>1</sup>

<sup>1</sup> School of Agriculture and Environment, The University of Western Australia, 35 Stirling Hwy, Crawley, WA 6009, Australia

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The ngwayir (*Pseudocheirus occidentalis*) is not amenable to conventional trapping leading to the use of challenging methods such as nest robbing or immobilising them with tranquilizers using dart guns or pole syringes. We tested if placing traps above ground would increase the trap success rate (TSP) of the species, using Sheffield cage traps (220x220x450 mm, Welshpool, WA) baited with universal bait and pieces of fruit. Between 2010 and 2013, we deployed four trapping grids in Locke Nature Reserve near Busselton (WA) and adjacent campsites with traps placed on the ground for 1985 trap nights (number of traps x number of nights). Between March and November 2019 we placed cage traps on horizontal tree branches, fallen trees or, in campsites, on fences, about 1–2 meters above ground for 752 trap nights. On the trapping grids deployed on the ground we captured 10 western ringtail possums in 1985 trap nights (TSP = 0.5). Placing traps above ground between March and June 2019 we trapped 28 western ringtail possums in 452 trap nights (TSP = 6.2%). In November 2019 we captured 55 western ringtail possums in 300 trap nights (TSP = 18.3%). These results show that placing traps above ground increases dramatically the capture rate of ngwayir.

# A GENETIC METHOD FOR DETERMINATION OF KOALA DIETARY *EUCALYPTUS* SPECIES FROM SCATS

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An animal's diet forms part of their fundamental ecological niche, especially for dietary specialists like the koala (*Phascolarctos cinereus*). Yet the current methods used to determine koala dietary species are labour intensive, biased and/or unreliable. We have developed and tested the utility of DNA barcoding and SNP based methods for determining koala dietary tree species from scats. We show that four eucalypt barcoding genes (*ITS*, *ETS*, *CCR* and *matK*) were unable to provide species level resolution. By contrast, the DArTSeq platform returned a large number of species-specific SNPs for potential koala dietary eucalypts. After identifying specific-specific SNPs from a set of potential dietary *Eucalyptus* species we were able to detect those SNPs in koala faecal DNA using the DArTag platform. This enabled us to quantitatively characterise the diets of koalas at two study sites with disparate *Eucalyptus* assemblages. The dietary species identified were in broad agreement with previously identified koala food tree species but also revealed additional species that may contribute to koala diet. These approaches provide an important new tool for use in koala ecology and conservation and may prove useful in diet determination for other species where high taxonomic resolution is crucial and dietary DNA is scarce.

# EASTERN GREY KANGAROO POPULATION GENETIC DIVERSITY AND STRUCTURE IN A RAPIDLY URBANISING REGION

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Eastern grey kangaroo (EGK) populations have declined (40%) across the Sunshine Coast (SC) region of Queensland since 2000. Ongoing urbanisation poses a threat to the viability of EGK populations through habitat loss and the isolation of sub-populations via habitat fragmentation. This project aimed to establish baseline genetic profiles of EGKs in the region and provide insights into the viability and management of remaining populations. Using 60 tissue samples from South-East Queensland (SEQ), NSW, ACT and Victoria we developed a targeted genetic probe (DARTag) to generate a high density, genome-wide SNP array for individual genotyping. The DARTag probe was used to generate baseline genetic profiles of populations using scat samples collected from 27 locations. Sunshine Coast EGK populations had relatively similar levels of genetic diversity with little evidence of inbreeding at the population level. There was no evidence of different levels of genetic diversity between urban and non-urban populations. However, there was evidence of genetic differentiation within the SC region, with six genetic clusters identified. At a broader geographic scale, SC EGKs were genetically distinct compared to ACT populations and from other SEQ populations. This research will help inform local government management of EGK in the SC region.

## FOSSIL FOOTPRINTS INDICATE ROTTNEST ISLAND, SW WESTERN AUSTRALIA, WAS A QUATERNARY QUOKKA BASTION

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Rottnest Island, 20km west of Perth, Western Australia, is world-renowned due to the presence of the iconic macropodid marsupial *Setonix brachyurus* (the Quokka). Today the Quokka is restricted to the extreme southwest of Western Australia. In 2011 we surveyed the Tamala Limestone on Rottnest Island that revealed vertebrate trace fossils at 45 different locations around the edge of the island. Traces were exposed on fallen slabs as moulds, on underhangs as casts and in cliff faces as cross-sections. Macropodid footprints, many of which are likely attributable to *S. brachyurus*, were the most abundant trace found, indicating that the diminutive macropodine inhabited the area prior to its island isolation. A wide variety of other traces indicate a fauna potentially including larger macropodids, quolls, Tasmanian devils, thylacines, wombats, rodents, emus, oystercatchers and invertebrates. Isolated depressions at two sites are consistent with diprotodontid footprints found elsewhere. OSL dating of the host sediments at four locations suggests that most of the sediments were deposited during the Last Glacial Maximum (17–24 ka). This is of particular interest as the coast would have been 15–20 km west at this time, indicating extensive dunefields extending > 20 km inland.

## Speed talk

### ARE YOU FROM MY MOB (MUMMAGUL)? GENETIC CONNECTIVITY OF SNUBFIN DOLPHINS IN THE KIMBERLEY

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Understanding patterns of connectivity between populations of wildlife can inform conservation. Here, we investigated the genetic structure and gene flow patterns between endemic, vulnerable Australian snubfin dolphins (jiigeedange: *Orcaella heinsohni*) from the Prince Regent River (Malandum) and other sites across the western Kimberley region, Western Australia. Eight snubfin tissue samples were collected in the Prince Regent River in 2019 and 2020 and compared to samples previously collected in Roebuck Bay (Yawuru Nagulagun), Cygnet Bay (Borragoron) and Cone Bay (Yaloon). Eleven microsatellite loci and the mitochondrial DNA were used for analyses, including assessments of genetic diversity, differentiation and population structure, and contemporary gene flow. We detected low genetic connectivity between snubfin dolphins in the Prince Regent River and those sampled further west in the Kimberley. Based on our limited samples, we suggest that Prince Regent River snubfins are unlikely to migrate, with gene flow limited to potential migration of snubfins from Cygnet Bay, either temporarily for breeding or permanently. For management purposes and based on current samples, snubfins from the Prince Regent River should be regarded as a distinct management unit that is potentially vulnerable to localised pressures, given low numbers and limited connectivity to snubfins further west in the Kimberley region.



## LOVE THEM OR LOATHE THEM – CHANGING PUBLIC PERCEPTIONS OF KOALAS

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Koalas occupy a complex space in conservation biology. They are simultaneously regarded as endangered, even ‘functionally extinct’ in parts of the eastern states while thriving and subject to culling in other areas. They are the international poster child for Australian conservation, raising millions in emotional bushfire appeals, and yet commonly described as stupid, maladapted, disease-ridden and destined for inevitable extinction. In the course of writing a narrative nonfiction book on koalas for a general audience, I’ve investigated the historical and cultural origins of these varying perceptions, the impact this has had on koala management and the implications for future management plans. In particular, I am interested in how local variations between koala populations, state-based environment programs and the detailed, in-depth nature of scientific research itself has influenced the way we see koalas and plan for their long-term future. Can the broad and more personal approach of narrative nonfiction – one that encompasses both scientific understanding and emotional responses – offer any new paths towards a more cohesive national approach to koala survival?

## Speed talk

### GLOWING MAMMALS: FLUORESCENCE OR NOT?

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Recent publications documented an optical phenomenon appearing to be fluorescence of the preserved pelts of flying squirrels and platypus, leading to anecdotal reports of “glowing” mammals. However, it is unclear how widespread this phenomenon is amongst mammals, if the observations are fluorescence or optical scatter, and if they are an artefact of skin preservation. We examined the mammalian skin collection of the Western Australian Museum under UV light to assess the potential for fluorescence amongst mammals. Seven species which appeared to fluoresce were photographed and likely fluorescent regions identified; white areas of koalas, devils, echidnas and bilbies, brown wombat and bandicoot fur and ventro-lateral fur of the platypus. These regions were then examined by fluorescence spectroscopy at 325 nm and 350 nm excitation wavelengths. No shift was observed in the emission maxima of around 430–450 nm, indicating the observed phenomenon is fluorescence rather than scatter. There was little difference between fresh (frozen) and preserved pelts, with the exception of the platypus. Our observations of the preserved platypus replicated the published images, but the observed fluorescence of our fresh platypus was negligible. It is unclear what, if any, role fluorescence has for mammals.

# HOW DO PERSONALITY, REHABILITATION PROTOCOL AND RELEASE METHODS AFFECT SURVIVAL IN REHABILITATED WESTERN RINGTAIL POSSUMS – PRELIMINARY RESULTS

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Each year wildlife carers rehabilitate up to 200 critically endangered western ringtail possums, *Pseudocheirus occidentalis*. Only 25–50% survive and are released, but little is known about their fate due to lack of monitoring. We are investigating how personality, preparation for release and release methods affect their survival. Possums are placed in a pre-release facility to standardize conditions and their personality is evaluated. They are released at sites containing suitable habitat and under fox control and are radio-tracked to assess survival. All fatalities are retrieved and causes of demise determined including melt curve analysis to detect predators' DNA. Two groups of 20 possums each were released near Yallingup (WA) in Spring 2019 and 2020. Of the first group, just one survived (5%), a bold female that also produced 2 pouch young; from the second group, 4 possums (20%), survived possibly due to dedicated shooters dispatching a cat and 4 foxes. Recently we released 2 groups of 20 possums each in Autumn and Winter 2021 near Margaret River. Their radio-tracking is on-going, but predation impact is evident. Despite intensive shooting eliminating 44 foxes only 14 survive with 40% of fatalities caused by foxes. These results highlight the importance of fox control and will underpin management guidelines.

## THE SPACE USE OF A NATIVE MESOPREDATOR IS INFLUENCED BY SEX AND HABITAT TYPE

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Animal conservation requires a sound understanding of the movement ecology and habitat requirements of the species in question. One species lacking this information is the endangered mesopredator, the northern quoll (*Dasyurus hallucatus*), particularly in the Pilbara region of Western Australia. We estimated short-term (six-day) home ranges from 13 northern quolls from which we compared the proportion of four habitat types (rocky habitat, spinifex sandplain, *Acacia* stands, riverbed) within 'used' and 'randomly placed' home ranges. We then investigated potential determinants of home range size including sex and the proportion of each habitat type. Northern quolls selected short-term home ranges with higher proportions of rocky habitat and riverbed, and lower proportions of spinifex sandplain than random home ranges. Male home ranges were larger than females and home range size decreased with increasing proportions of rocky habitat and riverbed and increased with increasing proportions of spinifex sandplain. Our study highlights that the amount of preferred habitat within a home range can be an important driver of home range size. The lack, or fragmentation, of preferred habitats can inflate home ranges as animals must use multiple patches connected by non-preferred habitat, potentially leading to detrimental effects like increased exposure to predation or decreased fitness.

## ARTIFICIAL REFUGES ASSIST WITH MONITORING SHORT-TERM SUCCESS OF REINTRODUCTIONS OF TWO THREATENED RODENTS

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Evaluating the success of mammal reintroductions relies on effective monitoring for the presence of individuals, and this can be particularly challenging for smaller species. Encouraging release site fidelity is one method that can improve monitoring efficacy and the provision of artificial refuges can assist this. In April/May 2021, we undertook reintroductions of the nationally Vulnerable Shark Bay mouse (*Pseudomys gouldii*) and greater stick-nest rat (*Leporillus conditor*) (GSNR) to Dirk Hartog Island and employed artificial refuges at release sites. Burrows made from artificial materials were installed at 10 of 17 Shark Bay mouse release sites and GSNRs were released into 'proto-nests', made from natural vegetation and incorporating their wooden transport boxes. Both types of refuge were monitored using camera traps. We found that both SBMs and GSNRs used the artificial refuges, with evidence that GSNRs were augmenting the proto-nests with structural and nest material. Interactions between individuals of both species were observed at the refuges and many were still being used at the conclusion of the monitoring period. The provision of artificial refuges may assist with post-release monitoring in some small mammals, but further investigation will determine if this translates to overall translocation success in the longer term.

## GIANT RATS (*UROMYS* SPP.) FROM THE PLEISTOCENE OF CENTRAL QUEENSLAND

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Australia's native murid rodents remain an understudied component of the continental mammal fauna. This is particularly so in regard to their fossil record, with the number of described taxa still within single digits. Cave deposits in the vicinity of Mount Etna in central Queensland contain a rich succession of vertebrate faunas that document regional ecological change during the late Quaternary (recent to middle Pleistocene). We recently described a new species of mosaic-tailed rat, *Uromys aplini*, from middle Pleistocene deposits at Mount Etna. It is represented by numerous isolated teeth, mandibles, and two partial skulls, allowing an assessment of its phylogenetic position to be made. Our analysis suggested that the *U. aplini* lineage diverged close to the base of the *Uromys* subgenus, and raised the possibility that this subgenus originated in Australia. *Uromys aplini* became extinct after 170–205 thousand years ago due to the loss of closed rainforest habitats from the area. Surprisingly, during the Late Pleistocene a second species, *U. caudimaculatus*, entered the area. These fossils are the most southerly record of this extant species, and suggest that it was able to circumvent known biogeographic barriers.

## BODY SIZE MATTERS: RELATIONSHIPS BETWEEN BODY SIZE, DIET, AND DENTAL MICROWEAR TEXTURES IN QUOLLS THROUGHOUT AUSTRALIA

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Quolls, carnivorous marsupials native to Sahul, span a range of body sizes from the smallest northern quoll, *Dasyurus hallucatus*, to the largest tiger quoll, *Dasyurus maculatus*. As the size of predators often has a significant effect on the size of prey consumed, and potentially the parts of animals consumed (e.g., flesh vs. bone), we investigated if and how body size affects hard-food consumption both within and among Australian quoll species via dental microwear texture analysis. Casts of quoll teeth were analysed using a confocal microscope and compared across space, time, and between different quoll species. While there are no significant relationships between the individual body sizes of specimens of *Dasyurus hallucatus* and any DMTA attribute examined (*Asfc*, *epLsar*, *Tfv*), *Dasyurus hallucatus* eats softer foods than other quolls including *Dasyurus maculatus*. Further, larger quolls of the genus *Dasyurus* do eat significantly harder foods (i.e., higher *Asfc* values with larger body sizes) than smaller quolls, when examining all *Dasyurus* specimens across multiple species. Thus, body size does seem to constrain hard-food eating in quolls. Collectively, these data provide insight into the dietary ecology of quolls in Australia while also indicating conserved diets across space and time among certain species (e.g., *Dasyurus hallucatus*).



# THE DARK SIDE OF ENERGY-EFFICIENT LIGHTING: INVESTIGATING THE IMPACTS OF LED LIGHTING ON GLUCOCORTICOID EXPRESSION IN A NOCTURNAL MARSUPIAL.

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Artificial light at night (ALAN) is one of the most common and fastest growing forms of urban pollution and has been identified as a key threat to biodiversity. ALAN fundamentally changes the night-time environment by masking natural light cues and desynchronising the internal clock. We investigated the effect of short-wavelength white LED lighting (standard urban lighting) and long-wavelength amber LED lighting (proposed wildlife friendly lighting) on glucocorticoid expression in the Krefft's glider (*Petaurus notatus*). The amber lights were designed to exclude short wavelengths, and therefore are predicted to have little effect on circadian rhythms. Wild-caught *P. notatus* were randomly allocated to one of three treatments: 1) control (no lighting), 2) white LED lighting, or 3) amber LED lighting. Faecal glucocorticoid metabolites (FGM) were monitored at regular intervals throughout the experiment to examine changes in hormone expression over 4-weeks of exposure to dim light at night. Our results indicate that exposure to white LEDs increases FGM concentrations, while exposure to amber LEDs resulted in a decrease in FGM concentrations. Findings from this study will improve our understanding of physiological impacts of artificial light at night on wildlife and support the development of "wildlife-friendly" lighting.

## Speed talk

### DEVELOPMENT OF THE SHORT-BEAKED ECHIDNA'S TEMPORARY POUCH

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The short beaked echidna is an egg laying mammal. Following gestation, the echidna lays an egg and guides it to its abdominal area where a temporary pouch has formed. Despite this fascinating biology, control of pouch development is unknown. The aims of this study were to investigate the relationship between pouch development and plasma progesterone concentrations and to create a pouch grading system. Plasma samples were collected, and pouch morphology assessed three times a week. The pouch of the echidna only develops during gestation and it was possible to create a four-stage grading system based on changes in colour and thickening of the lateral margins. While early pouch development coincided with increasing progesterone concentrations, maximum development was associated with declining concentrations. By egg laying, the lateral margins had become deep pink in colour and the pouch was completely closed, as if pulled together by a drawstring; this occurred when progesterone concentrations were basal. In summary, control of pouch development in echidnas is not yet clear. Given the pouch begins to regress immediately following egg removal, the ability of the pouch to close in a drawstring manner may not be under endocrinological but mechanical influences of the egg in the pouch.

## SEX ALLOCATION: CONSTRAINTS IN A CHANGING WORLD

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Sex allocation theory predicts that mothers would benefit from sex-biased differential investment into offspring in relation to their current local condition when it maximised their lifetime reproductive return. In mammals, however, the extent of the sex bias at birth is often unpredictable, suggesting mothers are constrained in their ability to adjust sex ratios. Here we investigate possible constraints on these mothers and discuss how rapidly changing environments may exacerbate the unpredictability of sex ratios. Using the mammalian model, the house mouse, we discuss how a mismatch between pre- and post-natal environments leads to a skewed sex ratio in the next generation. However, artificially returning the post-natal environment to match that of the pre-natal environment reversed the effect. Additionally, we look at the constraints that fathers may have on sex allocation, using both the mouse and a marsupial model, the Tammar wallaby. We show that sperm sex ratios are not only variable, but they correlate with coital rate, and in some instances may be reflected in offspring sex ratios. Our study in the Tammar wallaby suggested that in some instances, these biases may be overridden by maternal selection. Overall, we have provided some explanations into previously unexplained variation in sex allocation research and have shown that this variation may increase under increasingly variable environmental conditions.

# UNITING MICROBES AND HOSTS TO UNDERSTAND MAMMAL ECOLOGY, PHYSIOLOGY, AND EVOLUTION

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Animal phenotypes are more than the sum of their genetics. A growing body of evidence is highlighting the important roles of symbiotic microbes in host ecology, physiology, behaviour, and health. We therefore need to unite our study of host genomics with microbial metagenomics (together, **hologenomics**) to better understand animals as a whole. In this talk, I will introduce the **Earth Hologenome Initiative** (EHI, [www.earthhologenome.org](http://www.earthhologenome.org)), which seeks to do this on a global scale using standardised procedures. The EHI is based on the core principles of transparency, openness, and collaboration, and aims to create an international, interdisciplinary network of researchers to tackle fundamental and applied questions relating to animal biology. I will also showcase one of the EHI flagship projects, namely **Convergence Hologenomics**, which aims to leverage the convergent evolution of host traits/ecological strategies within the mammalian tree to better identify and understand the host genomic and microbial metagenomic features responsible. Australian marsupials represent prime candidates for such comparative work given their independent evolution and radiation to cover diverse niches across Australia. My hope is that this work will improve our understanding of Australian marsupials and shine an international spotlight on Australia's unique mammal diversity.

# PATTERNS OF FEMALE CLUSTERING INFLUENCE THE EVOLUTION OF TESTES SIZE IN AUSTRALIAN RODENTS

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Previously, we performed comparative phylogenetic analyses on Australian rodents (Muridae: Hydromyini) and found that social organisation (“social” vs. “non-social”) shapes the evolution of body size dimorphism – an important trait in premating intrasexual competition. In this investigation, we used relative testes size (RTS) as a proxy for the strength of postmating selection and tested two competing hypotheses linked to the social organisation, and therefore variation in the spatial clustering of receptive females, in Australian rodents. Our analysis revealed that males of social species have smaller RTS compared to males of non-social species, suggesting that alpha-male reproductive monopolisation in social species leads to decreased female remating rate and a reduction in the level of sperm competition. Further, we assessed whether temporal clustering of receptive females influenced the strength of postmating sexual selection. Here, we calculated net primary productivity for each species distribution and applied it as the length of the breeding season. Our analysis revealed that species with shorter breeding seasons, and therefore where female receptivity is temporally concentrated, have larger testes. I discuss our results in relation to similar analyses performed on other mammal groups and the social/breeding structure of a charismatic Western Australian rodent, the pebble mound mouse.

## DISTINCTIVE DIETS OF DINGOES, FOXES AND CATS

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Australian marsupials, having evolved on this continent in relative isolation for 60 million years, were not prepared for an onslaught of highly successful eutherian predators. In addition to habitat loss, predation by the dingo (*Canis familiaris*; male weight 12–22 kg), red fox (*Vulpes vulpes*; 5–8 kg) and domestic cat (*Felis catus*; 3–7 kg) have contributed to the 34 Australian mammal species extinctions since 1788, and substantial range restrictions for many other species. Reviewing published data, we found significant dietary differences for these three eutherian predators (non-metric multidimensional scaling analysis  $p < 0.001$ ). Mammals were most common in dingo diet (frequency of occurrence d:  $69 \pm 17\%$ , f:  $66 \pm 22\%$ , c:  $60 \pm 23\%$ ). Dingoes take the most macropods (d:  $35 \pm 23\%$ , f:  $8 \pm 14\%$ , c:  $2 \pm 7\%$ ) and both dingoes and foxes commonly take livestock (d:  $15 \pm 16\%$ , f:  $14 \pm 22\%$ , c:  $2 \pm 4\%$ ). Cats show preference for smaller prey, with rodents (c:  $34 \pm 24\%$ , f:  $24 \pm 23\%$ , d:  $10 \pm 11\%$ ), birds (c:  $26 \pm 20\%$ , f:  $14 \pm 15\%$ , d:  $8 \pm 8\%$ ) and reptiles (c:  $21 \pm 21\%$ , f:  $10 \pm 14\%$ , d:  $6 \pm 13\%$ ) more common in their diet. Foxes have a broad diet and substantial overlap with dingoes and cats but consume more invertebrates than the other two species (f:  $40 \pm 27\%$ , c:  $29 \pm 22\%$ , d:  $9 \pm 11\%$ ) and also use a substantial amount of plant material (f:  $29 \pm 27\%$ , c:  $22 \pm 16\%$ , d:  $22 \pm 25\%$ ). Their distinctive diets suggest complementary predation impacts of these three eutherian predators.

# HORMONES IN THE WILD: THE INFLUENCE OF ENVIRONMENTAL CONDITIONS ON STEROID HORMONE CONCENTRATIONS IN KOALA FAECAL PELLETS

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The koala is a cryptic species of conservation concern, in which faecal pellets provides a means of non-invasive monitoring for DNA profiling, gut microbiome and hormone analyses. Once defecated faecal samples are exposed to environmental variables that may influence hormone concentrations. Understanding this impact is critical for field studies, yet has rarely been considered. Using koala faecal pellets we evaluated the influence of environmental conditions (i.e. temperature, humidity, rainfall, sunlight) on faecal glucocorticoid concentrations. Fresh koala faecal pellets (n =19 koalas) were placed in koala habitat in winter (June, July), and sampled at T0, T1, T2, T4 and T7 days. Our results show that there was no influence of time since defecation for either cortisol or corticosterone metabolite concentrations. Instead, water content in the scats, as a result of rainfall, artificially altered faecal glucocorticoid concentrations. On average, koala pellets lost 50% of their weight due to water loss, the rate of which was highly variable and related to rain and humidity. Additional laboratory trials will be conducted to mimic summer conditions to determine how higher ambient temperatures will impact hormone integrity over time. Ideally, koala faecal pellet collection efforts should avoid rainfall events to avoid inaccuracies in faecal hormone analysis.



## Speed talk

# RESPONSE OF A YELLOW-BELLIED GLIDER POPULATION TO THE 2019/20 WILDFIRES

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The black summer wildfires of 2019/20 burnt through a vast forest area in south-eastern Australia. This revealed gaping holes in our knowledge of how species respond to wildfire. The yellow-bellied glider (*Petaurus australis*) is one species where knowledge is poor. The 2019/20 wildfires overlapped approximately 40% of its geographic range in New South Wales. I used a novel approach to investigate site persistence of yellow-bellied gliders following the Currowan megafire in the Shoalhaven region of NSW. Eucalypt sap forms a major part of the diet of the yellow-bellied glider, though glider groups harvest sap from only a few trees. The feeding scars on these trees can be used as definitive evidence of glider presence and recent feeding. I located the sap-feeding trees of 25 glider groups across 30 km of forest, with 20 located pre-fire. Eleven of the 25 groups were exposed to the 2019/20 wildfire, which was predominantly of high severity. Sap-feeding trees were monitored three times post-fire. Occupancy modelling suggests the wildfire induced a decline in occupancy of over 50% (unburnt:  $0.93 \pm 0.11$ ; burnt:  $0.39 \pm 0.16$ ). This monitoring approach is being applied in two other landscapes to enable generalisation of the response to fire.

## HOW FAR WILL A BAT FLY? GPS TRACKING OF FINE-SCALE MOVEMENTS OF THE THREATENED SOUTH-EASTERN LONG-EARED BAT, *NYCTOPHILUS CORBENI*

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The south-eastern long-eared bat (*Nyctophilus corbeni*) is a narrow space bat that is listed, both nationally and in New South Wales as Vulnerable. Inappropriate fire regimes and habitat fragmentation have been identified as key threats. While roost selection in relation to disturbances has been assessed recently, foraging habitat and movements have been difficult to define. We outline the first use in Australia of miniature GPS tags on insectivorous bats to assess movements of *N. corbeni* at three sites in the Pilliga that represented mosaics of disturbance (patchy management burn, extensive wildfire, harvesting, thinning and cleared). Bats made large movements in the non-maternity season, with a maximum of ~21 km recorded as a one-way movement from the point of release or roost site. However, on average, the maximum one-way distance travelled was  $6.2 \pm 1.4$  km. Interestingly, these large movements frequently included time in cleared land with scattered trees adjacent to extensive forested areas. Such large movements are unexpected for a closed space species that specialises in foraging within closed spaces of vegetation and clutter. The implications of this scale of movement are discussed in relation to assessment of the impacts of disturbance on this threatened species.

## ANTI-PREDATOR RESPONSES OF AN AUSTRALIAN NATIVE RAT TOWARDS AN INTRODUCED PREDATOR SCENT IN A SEMI-NATURAL CAPTIVE ENVIRONMENT.

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Rodents use a diverse range of anti-predator responses to reduce risk of predation. Anti-predator responses rely on three core phases: detection, recognition and response. Prey naivety can impair either detection or recognition of a predator. It is thought that prey species that have not coevolved with a novel predator exhibit non-existent or ineffective anti-predator responses. However, this ignores that individuals of a “naïve” species could learn and develop anti-predator response through their life experiences. Studies on anti-predator behaviour of rat species, has mostly focused on co-evolved predators. Research on the anti-predator responses of naïve rat species has been limited to field tests with varying results. We tested the anti-predator responses of native bush rats (*Rattus fuscipes*) to an introduced/novel predator in a semi-natural experimental setup. Treatment combinations of cat fur, possum fur and control (no odour) were presented over several nights. Rats exhibited slight cumulative response to predator stimuli, yet avoidance behaviour changed overtime. Time spent near cat fur, as well as the proportion of time spent feeding while near cat fur, increased overtime. This suggests bush rats are not completely naïve to the introduced predator and are capable of learning and assessing predation risk at very short time scales.

## Speed talk

# SYSTEMATIC REVIEW OF METHODS FOR QUANTIFYING ANTI-PREDATOR RESPONSES AND ITS APPLICATION FOR AUSTRALIA'S CRITICAL WEIGHT RANGE MAMMALS.

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Australia's mammals are facing alarming rates of extinction, largely due to introduced predators such as feral cats and foxes. The creation of predator-free havens (islands and fenced areas) is increasingly relied upon as a primary strategy for species conservation and recovery. While havens have successfully secured many species, evidence is emerging that in the absence of predators, havened populations are losing anti-predator responses. This jeopardises conservation efforts as it may render individuals unfit for reintroduction into the wild, where exotic predators still exist. The success of multiple translocations has been compromised by the predation of naïve animals. To address the loss of these crucial responses, we require robust and repeatable assays for quantifying anti-predator behaviour. In this study, we systematically review existing methodology from both academic and specialist sources, using the Collaboration for Environmental Evidence guidelines. By collating and critically appraising these methods, we reveal techniques that have been successful, and highlight aspects that are misrepresented or lacking, such as replicate measures and type of predator cue. Our review then anticipates how best to develop behavioural assays of anti-predator behaviour, focusing on methods that will be most accessible to end users.

## Speed talk

# RECOGNISING BODY CONDITION OF NORTHERN QUOLLS USING MACHINE LEARNING

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Ecologists have been camera-trapping for decades, as it provides a non-invasive solution to monitor mammal activity and abundance. However, the analysis of camera-trapping data can be time-consuming and the results typically lack information on the state of the individual. Researchers increasingly use machine learning (ML) techniques to detect and identify species from camera-trap images. Could we also use ML to quantify individual condition? The goal of this study was to test if ML can accurately assess body condition of northern quolls from camera-trap images. Quolls are readily camera-trapped and present large variation in condition because facultatively semelparous males show an obvious deterioration after the mating season. We used camera-trapping data of northern quolls in the Pilbara, collected between Sep 2013 and Jun 2015. We used ~500 images to train/test the model created in Python (packages: tensorflow, keras), using the categories 'good body condition' (~400 images) and 'bad body condition' (~100 images). We used the remaining images to predict results that we validated visually. Our preliminary results show that our model can accurately predict body condition with confidence levels >98%.

## USING NON-INVASIVE GENETICS TO INVESTIGATE ANTHROPOGENIC IMPACTS ON WILDLIFE POPULATIONS

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Habitat loss and fragmentation has been identified as one of the biggest threats for biodiversity worldwide and is presenting many challenges for wildlife populations, such as loss of connectivity and reduction of population size. These effects are known to negatively impact genetic diversity, which is crucial for any species to cope with any future changes in their environment and is therefore important to investigate as part of a holistic conservation approach. Not only is it important to understand how genetically impacted a population of interest is by historic events, genetics can also shed light into contemporary threats, barriers, and causes for diseases and mortality. Here, we used non-invasive genetic samples of a vulnerable species that inhabits anthropogenic environments, the koala (*Phascolarctos cinereus*). We collected scats on a fine scale throughout different regions to analyse population genetic data and support Local Government Areas in their conservation management planning. We investigated methods that can illuminate contemporary rather than historic genetic patterns and show how they could be utilised to inform management decisions. We further analysed how quickly genetic diversity can erode in a vulnerable population and investigated to which degree anthropogenic pressures might impact the genetic integrity of populations.

## DUGONG ABUNDANCE AND DISTRIBUTION IN SHARK BAY AND NINGALOO FOLLOWING A PROLONGED HEATING EVENT

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A marine heatwave in 2011 led to extensive seagrass loss in Shark Bay, Western Australia, and triggered concerns for the resident dugong population. In 2018 data on dugong were collected via aerial survey as part of a long-term monitoring program for Shark Bay and Exmouth. This allowed contemporary abundance estimation of dugong in Shark Bay and Ningaloo/Exmouth Gulf. Dugong data were modelled to account for biases and correction factors were applied using two different techniques. Resulting estimates of dugongs in Shark Bay in 2018 ranged from 11,778 + 2,151 (SE 18%) to 18,555 + 3,396 (SE 18%) and for Ningaloo/Exmouth Gulf 2,524 + 1,039 (SE 41%) to 4,831 + 1,965 (SE 40%). Seagrass extent and cover when modelled with dugong density and distribution were highly correlated. The dugong population has been stable over a 30-year period based on the monitoring data, but decadal-scale time lags may mean that population level effects on dugongs may not be evident yet. In contrast to soon after the marine heatwave, a relatively large proportion (14%) of dugong sighted in Shark Bay in 2018 were calves. We propose the proportion of calves as another important indicator of population condition. This dugong population and the seagrass it depends on is increasingly vulnerable to extreme climatic events.

# MOVEMENT OF FREE-RANGING KOALAS IN RESPONSE TO MALE VOCALISATION PLAYBACKS

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Effective conservation strategies rely on knowledge of seasonal and social drivers of animal behaviour. Koalas are generally solitary and their social arrangement appears to rely on vocal and chemical signalling. Male koala vocalisations, known as bellows, are believed to be closely related to their breeding behaviour. Previous research suggests that oestrous female koalas use bellows to locate unique males to mate with, and that males can similarly use bellows to evaluate the physical attributes of their peers. We tested the behavioural responses of 20 free ranging koalas to bellow recordings collected from small (< 6 kg) and large (> 8.5 kg) adult male koalas. Individual koala movement was reported by hourly-uploaded GPS coordinates. We report evidence of intra-male competition, with adult males approaching bellow playbacks, particularly those from small-sized males. In contrast, males under three years of age were averse to the playbacks. No patterns in the response of females were detected. Our results provide the strongest evidence yet that bellows are primarily a means by which males occupy and control space during the breeding season. We speculate that females can also detect male characteristics through the bellow, but that their response to bellows is driven by their reproductive status.



## Speed talk

### RANGE EXTENSION OF EASTERN WALLAROO (*OSPHRANTER ROBUSTUS ROBUSTUS*) IN VICTORIA

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The Eastern Wallaroo (*Osphranter robustus robustus*) is a large macropodid commonly found in New South Wales and Queensland, but rare in Victoria. Previously only known in north-east Victoria from a resident population near Suggan Buggan, and isolated records < 50 km from the NSW border, we report camera trap observations of *O. r. robustus* from Mt Loch, near Hotham Heights. This represents the furthest Victorian record from NSW, the highest altitude observation in Victoria (1720 m asl), and a south-westerly range extension of 73 km.

## Speed talk

### THE DIET OF DINGOES, FERAL CATS AND EASTERN BARN OWL ON PULLEN PULLEN RESERVE, SOUTHWEST QUEENSLAND.

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Predator diet provides important data to inform management actions as well as an enhanced understanding of the fauna of a region. In this study, we compare the diet of dingo, feral cat, and eastern barn owl from Pullen Pullen Reserve in western Queensland. Dingo diet was dominated by macropods, while the diet of feral cat and barn owl was dominated by small mammals. Birds and reptiles each accounted for > 20% of prey for feral cats and birds accounted for > 10% for dingoes and barn owl. We compared the results of the predator diet analysis with those from concurrent fauna surveys on the reserve and found that five mammal species were only recorded in predator diets. There are three important conclusions from this short study: (1) no remains of threatened species were recorded in the diet of any predators; however the presence of many small mammals and birds suggest that the prospect of threatened species predation is real; (2) predator diet analyses are an important complement to traditional methods used to inventory species; and (3) feral predator management needs to involve not just control but the integration of a process of diet data collection and analysis to inform management approaches.

## LIFE HISTORY PARAMETERS OF COMMON DOLPHINS IN SA: A PRELIMINARY STUDY

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Common dolphins (*Delphinus delphis*) experience fatal entanglements in the purse seine sardine fishery in South Australia. Modelling fishery impacts on the population requires knowledge of life history and age-related survival rates. Museum specimens (> 450) collected during 1985–2019 were studied. Age was estimated by counting incremental lines in decalcified, thin-sectioned teeth. Relative age groups were assigned using developmental features, and physical and sexual maturity (testes, ovaries, uteri, mammary glands). Maximum age was 28 years. Females were sexually mature at 8–15 years (most by ~8) and body lengths of 176–194 cm. Males were sexually mature at 8–13 years and 172–200 cm. Skeleton maturity occurs in females when 9–17 years and males when 11–16 years. Testis size was related to reproductive status as determined by histology: immature ( $\leq 157$  g combined weight), regressing/developing, non-spermiogenic (189–603 g), mature/spermiogenic (322–1618 g). Body length data suggest males were longer than females, a trend found in other common dolphin populations but this needs testing. Results are consistent with studies of common dolphin life history in other world regions. The study is preliminary because age estimates need to be confirmed and a full assessment of male sexual maturity undertaken.

## MINI-ACOUSTIC SENSORS REVEAL OCCUPANCY AND POTENTIAL THREATS TO KOALAS (*PHASCOLARCTOS CINEREUS*) IN PRIVATE NATIVE FORESTS

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Traditionally it has been difficult for researchers to access private land to undertake systematic surveys. We used mini-acoustic sensors sent via the post to survey koalas using passive acoustics, with repeat detections over consecutive nights to account for imperfect detection in an occupancy modelling framework. Over three years, we surveyed 130 sites and recorded 2,560 male bellows. Detection probability was high, but varied substantially between years, due to use of different sensors, housings and weather conditions. After accounting for detection probability, modelling revealed that koalas were widespread in private native forests of the study region with a moderately high probability of occupancy ( $0.58 \pm 0.08$ ). Occupancy varied with the landscape extent of sealed roads (-ve), NDVI (-ve) and a habitat suitability model (+ve, but minor). There was no support for occupancy in private forests to be related to a range of other factors including extent of surrounding cleared land or timber harvesting history. We conclude that mini-acoustic recorders posted to landholders were effective for assessing koala occupancy on private land. Private native forests in partly cleared landscapes are frequently occupied by koalas, but sealed roads have more influence on occupancy than measured habitat features.

## Speed talk

### NOVEL FEATURES OF TOOTH DEVELOPMENT AND EVOLUTION IN THE HONEY POSSUM (*TARSIPES ROSTRATUS*)

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A key mammalian feature is the evolution of highly specialised teeth for different diets. The honey possum (*Tarsipes rostratus*), a marsupial from southwest Australia, is the only non-flying mammal that feeds exclusively on nectar and pollen. The extreme reduction in tooth size and number represents the greatest modification of the dentition in a marsupial, and so the pattern of tooth development in this species could provide valuable insights into dental evolution. This study aims to identify the tooth classes and numbers present in the honey possum, as well as the replacement pattern and the variability among individuals. We used micro-CT scanning and contrast-enhanced iodine staining alongside histological analysis to examine 21 specimens. 3D models of tooth development and mineralisation were reconstructed. Our results indicate for the first time that two primary premolars are present in each upper and lower quadrant, along with a variable number of molars. Additionally, we show that the formation of the lower incisor is a prolonged process and so can be used as an indicator of age. This study demonstrates the developmental pathway by which extreme dental reduction has occurred in a marsupial.

# POST-RELEASE SURVIVAL OF KOALAS FROM AN ANALYSIS OF THE LONG-TERM REHABILITATION RECORDS OF FRIENDS OF THE KOALA IN NORTH-EAST NEW SOUTH WALES

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We asked: will a koala released from rehabilitation re-join the wild population and survive? We sifted the 31-year set of records (1989–2020) of a koala rehabilitation group called Friends of the Koala in Lismore, north-east NSW. We focused on the 1771 koalas that were released. Given that 66% of the 270 koalas that were released, and then readmitted, came back after 6 months or more in the wild, and 33% after 2 years or more, we are looking at long-term post-release survival. We note that some koalas need to be readmitted after a very brief period post-release. We also compared the proportion of admission causes on first admission with second and subsequent admissions. The figures for chlamydiosis are instructive. On the first admission, 43% (n = 2039) were due to chlamydiosis, and of those that returned 49.5% of 107 koalas admitted again with chlamydiosis, i.e., a similar rate of admission. We conclude that released koalas can survive long-term, with one remarkable example of 13 years before readmission. The success of rehabilitation and release, as judged by readmitted tagged koalas, is a more robust view of success for koala survival after rehabilitation than simply the proportion of released versus non-released koalas.

PATERNITY BIAS IN REINTRODUCED WESTERN QUOLLS (*DASYURUS GEOFFROI*)  
AT ARID RECOVERY RESERVE

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Reintroductions often face issues maintaining genetic diversity due to founder effects and reproductive biases in the first few generations. In 2018, twelve adult quolls (4M, 8F) were reintroduced into the Arid Recovery Reserve. The quolls bred in the year of release producing 30 known offspring. Genetic analysis, using 10 microsatellite loci, of all adults and 23 offspring showed that five of the eight females and three of the four males produced offspring. One male sired 65% (15 of 23) of the sampled offspring including the only incidence of multiple paternity. This male was significantly smaller but had the largest home range, compared to the other three males. He was also released four days prior to two of the other males, possibly allowing him early access to females or to establish a home range without competition. A strong paternity bias suggests there is a significant chance of genetic drift and future inbreeding that may need to be managed through additional releases of males to the reserve. Future reintroductions of quolls should aim to release all males simultaneously, and paternity should be measured through several generations to determine if paternity bias is a reintroduction protocol issue or one that is common in small populations more generally.

## RUN, RABBIT, RUN: USING AUSTRALIAN LAGOMORPHS TO INVESTIGATE HOW RUNNING ABILITY DRIVES ADAPTATION OF THE POSTCRANIAL ANATOMY

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Shifting from the lateral "sprawl" of ancestral tetrapods to dorsoventrally orientated limbs was an innovation in mammalian evolution that enabled the development of many distinct locomotor styles. One specialisation that is prevalent in therians is cursoriality, i.e., the ability to run. Highly cursorial animals typically display a suite of specific traits, namely the proportions and robusticity of their appendicular skeleton. A group that exemplifies these adaptations is the Lagomorpha (hares, rabbits and pikas), whose members vary in their level of cursoriality based on lifestyle and habitat, but all use a characteristic half-bounding gait. We applied morphometrics to capture the lengths, ratios, and densities of postcranial skeletal elements from 80 specimens of the two invasive lagomorphs in Australia (European rabbits and hares) imaged with X-ray Computed Tomography. Using multivariate statistical analyses to investigate these variables, we identify where these species lie on cursoriality gradients previously described exclusively in American species, as well as conduct further exploration into patterns of morphological integration. Exploring these biomechanical and evolutionary patterns deepens our understanding of how the anatomy of mammals evolves to create more efficient cursorial morphologies, as well as opening inquiries into how pest species adapt to Australia's landscape.



## Speed talk

### CRANIAL MORPHOLOGY IN THE FAT-TAILED DUNNART (*SMINTHOPSIS CRASSICAUDATA*); CAPTIVE VS WILD

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Behavioural, morphological, and genetic changes can occur to a population when wild animals are kept and bred in captivity. As more species become endangered in the wild, captive breeding for reintroduction is increasingly relied upon as a conservation technique. However, morphological changes occurring in captivity may be detrimental to the fitness of the animals. Given that cranial morphology is strongly linked to functionality, the mechanical properties of captive diets as well as feeding behaviour may change cranial morphology. To assess any effects of captivity on cranial morphology of wild vs. captive individuals, and whether length of captivity is associated with cranial shape, we used geometric morphometrics to quantify the shape of 52 captive fat-tailed dunnarts (*Sminthopsis crassicaudata*) of known genetic origins and 20 wild animals from similar geographic ranges. Preliminary results reveal no clear separation between generations on PC1/PC2, however, Procrustes ANCOVAs indicate shape differences between individuals of earlier generations (12–16) *versus* later generations (17–18). Captive specimens also appear to have relatively larger brain cases. Conclusions from this study will provide information as to whether captive breeding programs husbandry and genetic management are sufficient in limiting the morphological cranial changes to ensure reintroduced individuals have maximum likelihood of survival.

## Speed talk

### INVESTIGATION OF FACTORS THAT MAY BIAS CAMERA TRAPPING FOR SMALL THREATENED MACROPODS

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Conservation of threatened species requires effective population monitoring. Camera trapping has become the go-to method to monitor many species but its reliability depends on knowledge of factors that may influence species' detection. We used occupancy modelling to investigate the influence of season, distance to road, topography, vegetation community and microhabitat on detection and occupancy of the nationally vulnerable long-nosed potoroo (*Potorous tridactylus*) and the regionally threatened red-legged pademelon (*Thylogale stigmatica*). We operated 60 baited camera traps across a 1200 ha-grid in each of two reserves in north-east NSW over three 4-week periods. Both species showed pronounced seasonal variation in the probability of detection ( $\pm$ se): potoroo ( $0.10\pm 0.04$ – $0.31\pm 0.04$ ); pademelon ( $0.32\pm 0.06$ – $0.60\pm 0.03$ ). Detection of neither species was influenced by the distance of a site to a road (range 5–1305 m), topography (gully, slope, ridge), vegetation community (rainforest, eucalypt forest), shrub or ground cover. The occupancy of the species differed in the reserves. The potoroo had higher occupancy in the Border Ranges ( $0.60\pm 0.07$ ) compared to Richmond Range ( $0.33\pm 0.07$ ), whilst it was reversed in the pademelon ( $0.97\pm 0.02$  v  $0.30\pm 0.06$ ). Our study suggests winter surveys will provide the best targeting of both species whereas camera placement can be close to roads without causing bias.

# BRUSHTAIL POSSUM (*TRICHOSURUS VULPECULA*) POPULATION CRASH ON A MURRAY RIVER FLOODPLAN AND THE IMPORTANCE OF CONSISTENT AND MULTIFACETED MONITORING OF ECOLOGICAL HEALTH

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Restoration of the Murray-Darling Basin floodplains is a complex undertaking, requiring long-term and adaptive monitoring to inform management actions. In this region, common brushtail possums (*Trichosurus vulpecula*) are found along the riparian margin. Detailed studies have examined possum populations in other locations; however, little is known about the response of possum populations to identified threats and management activities along the Murray River. We investigated 20 years of possum monitoring data from Calperum Station, SA, and related this to fractional cover values extracted from satellite imagery. This data was examined in the context of rainfall and floods, grazing pressure, and tree condition, which had been stable or improved over the past 20 years and was considered a primary measure of overall ecological health. We expected possums would respond to vegetation cover changes and tree condition. Possum density declined to its lowest level in 20 years in 2018–19, despite the improving tree condition. Possum density was positively correlated with vegetative cover, suggesting that high grazing pressure and drought contributed to population declines. Our results highlight the danger of focusing on a single measure of ecological health, e.g., tree condition, in a complex system and the importance of consistency in long-term monitoring programs.

## MACACA MULATTA AS A MODEL ANIMAL FOR MANDIBULAR FIXATION RESEARCH

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Lower jaw fractures have severe implications on health due to post-operative complications including difficulty eating, yet the best methods for fixing a fractured jaw and rehabilitating feeding are unknown. Our current knowledge of fracture fixation is largely based on research in sheep, dogs and minipigs which differ from humans in masticatory morphology and behaviour, limiting their relevance to human craniofacial research. We propose that rhesus macaques are a more appropriate animal model because they chew and swallow like humans. This study compares the biomechanical behaviour of the human and macaque mandibles pre and post angle fracture and fixation using finite element analysis (FEA). Our results show that strain and deformation regimes in the healthy and post-fracture and fixation are very similar between humans and macaques. In both species, rigid fixation better approximates healthy bone strains than non-rigid fixation. In addition, in both humans and macaques chewing on the opposite side to the fracture exacerbates bone strains near the fracture hardware and increases the degree of movement between fracture segments. Overall, these findings support the hypothesis that rhesus macaques are an excellent animal model for oral and maxillofacial research due to the biomechanical similarities pre- and post- fracture fixation between species.

# USING MORPHOMETRICS TO TAXONOMICALLY CLASSIFY MACROPOD POSTCRANIA FROM BOODIE CAVE, BARROW ISLAND: IMPLICATIONS FOR UNDERSTANDING HUMAN SUBSISTENCE AND ENVIRONMENTAL CHANGE

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In this paper we present new quantitative methods for the taxonomic identification of macropodid postcranial remains using traditional morphometrics and the results of its application to faunal assemblages from Boodie Cave, Barrow Island. Excavated between 2013 and 2015 as part of the Barrow Island Archaeological Project, this faunal assemblage provides evidence of human subsistence and environmental change over the past 50,000 years. However, an ongoing challenge is increasing the resolution of taxonomic data from marsupial postcranial remains which make up most of the assemblage. Identification of macropodid postcrania to genus or species is often particularly difficult owing to high species diversity. We aimed to test whether a traditional morphometric approach, using linear measurements, could taxonomically discriminate complete and fragmented macropodid postcranial remains. Using discriminant analysis, with modern reference collections as a training dataset, we were able to classify complete and fragmented macropodid remains from Boodie Cave to genus and, in some cases, species level. These preliminary results provide evidence for environmental and biogeographic changes along this arid coastline and indicate the potential presence of now extinct macropodid species. Further, these morphometric methods for discriminating macropodid postcrania have potential applications across northwest Australia in both archaeology and palaeontology.

## FRAGMENTATION BY LARGE DAMS AND IMPLICATIONS FOR THE FUTURE VIABILITY OF SMALL PLATYPUS POPULATIONS

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Populations of the unique platypus (*Ornithorhynchus anatinus*) have experienced major declines and local extinctions. Although spending most of their time in the water, platypuses can move over land. Still significant uncertainties remain whether large dams across the platypus' distribution pose barriers to movement, limiting gene flow and dispersal. Here we examined disruption of gene flow between platypus groups below and above large dams. Platypuses were surveyed above and below four dams, matched to three adjacent rivers without dams. Platypus groups were differentiated genetically, above and below dams, comparable to differentiation between groups on adjacent rivers systems. This indicates that high dams represent significant barriers for platypus movements. Further,  $F_{ST}$  between populations was significantly correlated with the year in which the dam was built, increasing by 0.012 every generation. Platypus genetic diversity was similar to other species with small population sizes, such as the Koala (*Phascolarctos cinereus*). This study provides evidence of gene flow restriction which jeopardises the long-term viability of platypus populations, when populations are fragmented by large dams. Avoiding building large new dams on rivers would mitigate such impacts in other rivers, while assisted translocations may be beneficial between populations above and below dams.

## SOMETHING TO CHEW ON: SOFT DIETS MAY IMPACT SUCCESSFUL REINTRODUCTION OF CAPTIVE-REARED WILDLIFE

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The rearing and rehabilitation of rescued wildlife young represents a vital contribution to conservation efforts. However, numerous authors have suggested that incongruous captive diets may alter cranial morphology and be detrimental to the successful reintroduction of animals to the wild. Despite these claims, the impact that food material properties have on skull development, and associated feeding mechanics, has not yet been tested. Here, we reared a generation of rats on four diets: (1) exclusively hard pellets or (2) exclusively soft meal from weaning to adulthood; (3) a switch from pellets to meal at the juvenile stage; and (4) a corresponding switch from meal to pellets. Using the Finite Element Method, we demonstrate that a diet of soft foods throughout ontogeny limits bone deposition in the cranium, thereby increasing stress experienced during biting. A captive diet lacking more challenging foods may therefore reduce access to some harder/tougher resources in the wild. We also find something unexpected: the zygomatic arch is significantly weaker among rats that switched from hard pellets to soft meal. Rescued juveniles fed softer or overly processed foods after an initially more challenging wild diet can therefore develop suboptimal crania as adults, which may result in injury after reintroduction.

## TAKE IT OR LEAF IT? HOW VARIABLE IS THE NUTRITIONAL QUALITY OF KOALA FOOD?

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Koala tree choice is known to be related to leaf toxins and proximate measures of leaf nutritional quality, such as protein concentrations. However, the nutritional benefit of feeding has only been directly quantified for a single species (*Eucalyptus punctata*) of eucalypt previously. We undertook complete faecal and urine collections and monitored intake by Victorian koalas of two eucalypt species (*Eucalyptus viminalis* – highly preferred; and *E. obliqua* – a less preferred koala food tree). We also administered markers to koalas to determine the gut passage rate of particulate and solute components of digesta. The two tree species have similar gross energy densities and were consumed in equivalent amounts in captivity, however the greater digestibility of *E. viminalis* and lower urinary energy losses allowed koalas to gain almost 2.5 times the energy density than they did from feeding on *E. obliqua*. Although *E. viminalis* contains only slightly more nitrogen (N) than *E. obliqua*, that N is much more digestible. When feeding on *E. viminalis*, koalas excrete surplus N in urine, whereas koalas feeding on *E. obliqua* are in negative N balance. Surprisingly, koalas retain *E. obliqua* particles for 50% longer and solutes for > 3 x longer than for *E. viminalis*.



## USING ANCIENT DNA TO INVESTIGATE THE PHYLOGEOGRAPHY OF THE WESTERN QUOLL (*DASYURUS GEOFFROI*) ACROSS AUSTRALIA.

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Australia has lost over 10% of its endemic mammalian fauna in the last 200 years, while many other species have suffered massive range contractions. Using ancient DNA, we can characterise the diversity and distributions of these mammal populations prior to European arrival. The western quoll (*Dasyurus geoffroi*) is a small carnivorous marsupial confined to the south-west corner of Western Australia that suffered a range contraction of up to 70%. This population decline is largely due to land clearing, introduction of invasive species and direct killing. We aimed to reconstruct the demographic history of the western quoll and investigate the genetic evidence of potential sub-species<sup>1</sup>, *Dasyurus geoffroi geoffroi* and *Dasyurus geoffroi fortis*, using whole mitochondrial genomes generated from museum specimens, frozen tissue banks and fossil deposits. Here we present preliminary results and implications from the first phylogeographic analysis of the western quoll across its historic range. The diversity of the western quoll necessitates a catered approach to the conservation of contemporary populations and careful selection of founder populations for translocation programs. Refining our understanding of the faunal landscape in Australia prior to European arrival is critical for conservation managers to determine suitable present-day diversity targets to preserve remaining wildlife.

# EVER-GROWING TEETH IN RABBITS: A COROLLARY OF SKULL ASYMMETRY AND DENTAL MALOCCLUSION

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Rabbits have elodont incisor teeth, meaning they grow continually during life. Normal occlusion of the upper and lower incisors during feeding, along with a diet of coarse food, results in continuous wear on the cutting edge, maintaining their proportional length. However sometimes the incisors do not wear away, resulting in curved overgrown incisors and malocclusion, the misalignment between upper and lower teeth when the jaws close. Our aim was to use a comparative approach to infer the developmental basis behind this pathological issue, where skull asymmetries manifested before birth were more likely to result in dental malocclusion in mature specimens. We characterised patterns of skull shape variation and malocclusion within the European rabbit (*Oryctolagus cuniculus*) using landmark-based geometric morphometrics. We sampled skull specimens of wild rabbits in the South Australian Museum collection (~50 specimens, half with overgrown incisors and half with normal length incisors) using X-ray micro computed tomography. Multivariate shape analysis was used to investigate patterns of left-right asymmetry and craniomandibular covariation between malformed and 'normal' groups. Malformed specimens exhibited a greater degree of asymmetry and low craniomandibular covariation. Increased disparity in skull shape compared to the 'normal' group suggests there are multiple developmental pathways to malocclusion and subsequently overgrown incisors in rabbits. We make interpretations on these pathways based upon known genetic rodent models. This dataset, utilising museum collections, provides a unique opportunity to understand the developmental basis of this pathology in natural populations.

## A NEW SPECIES OF BETTONG FROM THE NULLARBOR PLAINS: REVISION OF THE BRUSH-TAILED BETTONG (WOYLIE)

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The Brush-tailed Bettong or Woylie (*Bettongia penicillata*) was previously thought to occupy much of the southern part of the Australian continent with two recognised subspecies, *B. penicillata ogilbyi* in the south-west of Western Australia, and *B. p. penicillata* in the south-east of the range. The discovery of new bettong species on the Nullarbor Plain, from historical DNA recovered from mummified specimens, is testing our understanding of the distribution of the Woylie. To understand how skull morphology differs in preserved specimens across the known range, cranial and dental measurements were analysed using a PCA. The results show that the new Nullarbor Bettong is clearly distinct from the Woylie. Furthermore, within Woylie specimens, skull variation is too high to represent a single species. These results support Pacioni *et al.* (2013), who found genetically distinct populations in the south-west of WA. Originally the genetic differences were thought to be due to population genetic diversity; however, distinct cranial morphology would suggest instead the existence of a new taxon within the southwest. As such, a complete review of Woylies across southern Australia is required to fully understand the species and its history.

## CONSERVING WESTERN AUSTRALIAN BOODIES (BURROWING BETTONGS)

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Boodies, once widespread in distribution, went extinct on the Australian mainland in the 1960s. Remnant natural populations persisted on just three Western Australian offshore islands and since 1992, boodies have been translocated from these islands to various mainland havens – fenced areas subject to predator control – and to several nearby predator-free islands to boost population size and provide insurance against future population loss. Seven translocated populations now exist, that together support over 16,000 boodies. In this collaborative project, we used reduced representation sequence data (ddRADseq) to provide species-wide genomic data on the current state of boodie populations. We focussed on the impact that founder source has on patterns of genomic diversity and load when establishing translocated populations. The results highlight the importance of mixing different island sources as part of the translocation process. We discuss our findings in the broader context of long-term conservation management of boodie populations.

## UNDERSTANDING DISPERSAL PATTERNS CAN INFORM TRANSLOCATION STRATEGIES: A CASE STUDY OF THE THREATENED GREATER STICK-NEST RAT

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Dispersal behaviour and sociality are significant factors influencing survival at the individual and population level. In translocation programs, social structure and dispersal should be considered in order to maximise conservation outcomes. We use the greater stick-nest rat (*Leporillus conditor*) as a case study to understand how knowledge of dispersal behaviour can inform management strategies. We combine high-throughput DNA sequencing with field trapping data from a translocated population of greater stick-nest rats at Arid Recovery Reserve, South Australia and provide the first empirical evidence of female philopatry and male biased dispersal in this species. Males were found to disperse up to 1.5 km from their natal nest, while females cohabiting in nests were highly related. Based on these findings, we make key recommendations for future translocations of the species; that founders should be harvested in family groups spaced at least 1.5 km apart, and released as family cohorts into optimal habitat patches. The results of this study have implications for conservation and reintroduction biology as a whole, and highlight the importance of considering spatial genetic structure during all stages of translocations to improve outcomes, as well as the value of combining genetic and field data to better understand species' social and spatial preferences.

## ZOOS VICTORIA'S EMERGENCY RESPONSE TO AUSTRALIA'S BLACK SUMMER: WILDLIFE CONSERVATION, WELFARE AND RESILIENCE FOR THE FUTURE

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Worldwide, zoos are taking a leading role in wildlife disaster management, welfare and conservation. Over six months in 2019–2020, a series of more than 15,000 bushfires burned across Australia in a catastrophic event named Australia's Black Summer. An estimated > 3 billion native animals, and entire ecosystems, were impacted by the fires. Zoos Victoria played a key role in a state-led bushfire response and recovery effort to assist wildlife, alongside government and key partners. We will detail Zoos Victoria's role in emergency planning; threatened species evacuation, recovery and resilience; wildlife welfare and triage; media; and fundraising during and after the fires. We will provide examples on the evacuation and return of endangered brush-tailed rock wallabies (*Petrogale penicillata*) and eastern bristlebirds (*Dasyornis brachypterus*); the care, release and monitoring of injured koalas (*Phascolarctos cinereus*); and the trialing of a nutritionally suitable supplementary food and emergency feeding of critically endangered mountain pygmy-possums (*Burrhamys parvus*). We share strategies for future resilience and the readiness to mobilise quickly during disasters. By outlining our contributions as a zoo-based conservation organisation, and presenting strategies to prepare for the future, we hope to assist other wildlife organisations in preparations to help wildlife before, during, and after catastrophic events.

# WHAT DID THE MARSUPIAL TAPIR EAT? RECONSTRUCTING THE PALAEOBIOLOGY OF *PALORCHESTES*, A BIZARRE EXTINCT GIANT FROM SOUTHEAST QUEENSLAND

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Palaeoecological studies of extinct fauna can provide valuable insights for modern species and ecosystems, but to be effective these must be based on robust palaeobiological data. Such data is limited for even the most well-known and recently extinct Australian mammal taxa. Here, we apply a range of methods to reconstruct the dietary habits and life history of the “marsupial tapir” (*Palorchestes*), one of the most morphologically bizarre and poorly understood of Australia’s marsupial megafauna. Using fossils collected from the Darling Downs, southeast Queensland, we reconstruct several aspects of *Palorchestes*’ palaeobiology using a combination of tooth-wear studies and stable isotope geochemistry. While quantitative data is still undergoing collection (available by August 2021), preliminary observations suggest *Palorchestes* was a non-migratory browsing specialist that inhabited small home ranges within open-canopy forests. Linking this with its large body-size and unusually robust morphology, we suggest it may have been a keystone herbivore in prehistoric ecosystems, clearing vegetation and opening habitats around itself in a manner similar to modern elephants. This study will provide the most detailed information to date on this bizarre and charismatic member of the Australian megafauna, and hopefully set a precedent for future high-resolution palaeoecological studies of extinct Australian fauna.

## THE PHYLOGENY OF THE NEW GUINEAN MARSUPIAL CARNIVORE GENUS *MYOICTIS* AND THE VALUE OF UPDATING GENBANK ACCESSIONS

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We investigate the influence of taxonomic misattributions for reconstructing the phylogeny of three-striped dasyures, which include four recognised *Myoictis* species (Marsupialia: Dasyuridae) that are distributed across New Guinea and nearby islands. Molecular phylogenetic studies that have focused on dasyurids consistently resolve the interrelationships of these small carnivores, grouping *M. leucura* with *M. wavicus*, and placing *M. wallacei* and *M. melas* as successively deeper divergences from these. Two recent marsupial and mammalian supermatrix phylogenies instead favour an alternative *Myoictis* topology that is discordant with each of these relationships. We add new nuclear and mitochondrial sequences and employ randomised accession resampling that shows the supermatrix topologies are an artefact of several outdated taxonomic attributions in GenBank. Updating these accessions brings agreement across *Myoictis* phylogenies with randomly resampled accessions. We encourage authors to update GenBank taxonomic attributions and we argue that an option is needed for flagging accessions that are not demonstrably incorrect, but that provide anomalous results. This would serve both as a caution for future supermatrix construction and to highlight accessions of potentially significant biological interest for further study; an example here is a specimen from the Arfak mountains that extends the range of *M. leucura* by more than 1000 km.



PALAEOECOLOGY AND SEA LEVEL CHANGES: DECLINE OF MAMMAL SPECIES RICHNESS DURING LATE QUATERNARY ISLAND FORMATION IN THE MONTEBELLO ISLANDS, NORTH-WESTERN AUSTRALIA

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Changes in sea level and formation of islands impact the distributions and abundances of local fauna, with palaeo-environmental investigations providing context for conservation. Palaeo-environmental knowledge of north-western Australia during the Holocene is sparse, particularly the impact of island formation on local faunas. In 1991 and 1993, Veth and colleagues conducted archaeological surveys of the Montebello Islands, an archipelago 90 km off the present-day coastline of north-western Australia. A group of three caves were found; two caves were analysed by Veth and colleagues in the early 1990s. The last cave, Morgan's Cave, remained unanalysed because it contained negligible archaeological material. It provides an opportunity to refine palaeo-environmental knowledge, including the pre-European fauna of the north-west shelf, the formation of the islands due to sea level rise and the impact on local faunas. Fossil fauna from Morgan's Cave was sorted, identified to the lowest taxonomic level possible, and counted for analysis on relative abundance for paleoenvironmental interpretation. There are marked patterns of species loss and changing relative abundances in certain species, consistent with island formation due to sea level rise. This palaeoecological interpretation can be used in conservation efforts on nearby Barrow Island, a Class A ecological reserve, and management conservation reserves and on islands.

# REMARKABLE ADAPTATIONS IN THE CANINE TEETH OF MAMMALIAN CARNIVORES REVEALED BY 3D GEOMETRIC MORPHOMETRICS AND FINITE ELEMENT ANALYSIS.

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Mammalian canine teeth are the first point of contact between predator and prey, acting as essential tools for killing, dismembering, and consuming food. Yet despite their importance, few form-function associations are established. We undertook the first comprehensive analysis of canine shape and biomechanics across the breadth of mammalian carnivores (Carnivora, Didelphimorphia, Dasyuromorphia). First, we measured shape in a sample of 203 teeth using 3D geometric morphometrics. Then, we assessed how this variation impacted tooth stress via finite element analysis, with loading conditions applied to mimic biting, pulling, and shaking behaviours. We found that canines vary predominantly in robusticity and curvature, and that this correlates with von Mises stress and/or tooth deformation, as well as specific diets and killing behaviours. For example, robust canines experience low stress magnitudes under all loading conditions and are found in carnivores like the Tasmanian devil that regularly consumes the 'harder' parts of a carcass, including bone. Curved canines impact the way a tooth deforms when biting and are associated with carnivores like the dingo that shake and tear prey. These form-function relationships reveal how canine teeth are adapted to suit diverse diets and feeding behaviours, enabling mammals to sit among nature's most successful predators.

## EVALUATION OF TRACKING DEVICES WITH COLLAR BREAK-AWAY MECHANISMS TO MONITOR QUOKKA (*SETONIX BRACHYURUS*) ACTIVITY

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Understanding how individuals in a population use available habitat and change their home ranges following hazard reduction burning, is essential for their effective population management, particularly of a threatened species. To determine the impact of prescribed burns on mainland quokkas in the northern jarrah forest, Western Australia, we fitted 28 individuals with VHF and GPS tracking collars, before and after prescribed burns, between 2018–2020. We tested two types of collar break-away mechanisms, comparing a cotton thread weak-link, and a Sirtrack automatic timed-release device. Of the 17 radio collars with a cotton thread, six fell off and were recovered  $148 \pm 64$  (SD) days after deployment, one fell off and was not recovered (the animal was recaptured 136 days after deployment without a collar). The 11 GPS collars with TRD, three fell off and were recovered  $205 \pm 171$  (SD) days, five fell off an estimated  $351 \pm 40$  (SD) days. Two individuals were recaptured without a collar and one collar was either in mortality or drop off function, but the faint signal from the collar was not sufficient to locate it. Quokkas did not show evidence of collar wear, or significant changes in body mass ( $P = 0.202$ ).

## PALAEO-HISTORY OF THE NORTHERN HAIRY-NOSED WOMBAT (*LASIORHINUS KREFFTII*) PROVIDES INSIGHTS FOR CONSERVATION OF MODERN POPULATIONS

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The critically endangered Northern Hairy-nosed Wombat (NHW) is an iconic marsupial of Australia. Once widespread, the species is today restricted to two areas: a natural population in Epping Forest National Park (central eastern Queensland), and a translocated 'insurance' population at St George (southern central Queensland). In 2002, a near-complete NHW fossilised skeleton was recovered in Winton (central Queensland) around 300 km west of Epping, far outside the known geographic range of the species. More recently, we conducted geochemical analyses of the individual's teeth to reconstruct its palaeo-environment. Dating shows that the individual is ~30,000 years old. Carbon and oxygen stable isotopes (indicators for diet and rainfall/water-intake, respectively) of tooth enamel suggests that the region was (and still is) dominated by C4 grasses, but at a time markedly more humid than Winton today. Our data suggest that the loss of the Winton population was due to a climatic shift towards progressively drier conditions. Moreover, we argue that climate conditions at St George today are unsuitable for sustainability of a long-term population due to low annual rainfall. Selection of sites for potential future 'insurance' populations should ideally consider areas more humid than St George.

## THE EVOLUTION OF MARSUPIAL SOCIAL ORGANISATION

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It is generally believed that marsupials are primitive mammals and as such are mainly solitary living, representing the ancestral form of social organisation of all mammals. The aim of this study was to test in the first phylogenetically controlled comparative analyses whether the marsupial's ancestor was in fact solitary-living. We further predicted pair- and group-living to be more common in harsh environments, and that species occupying diverse habitats have a more variable form of social organization. We collected social organization data from the primary literature, covering 359 papers of 61 species. The ancestral state and ecological effect were estimated using a Bayesian phylogenetic mixed-effects model. The model indicated that marsupial's ancestor had an almost equal probability of being strictly solitary (45%) or showing a sociable social organization (55%). No association was found between habitat heterogeneity and social organization, and the prediction that sociality is more common in harsh environments was not supported. Our results suggest that modern marsupials are more sociable than previously believed. Surprisingly, there was no convincing evidence that the marsupial ancestor was solitary living. Thus, the assumption of solitary living as the ancestral default stage of marsupials and as such of all mammals demands further investigation.

## Speed talk

### REGIONAL ABUNDANCE ESTIMATES OF BOTTLENOSE AND HUMPBACK DOLPHINS IN THE PILBARA, WESTERN AUSTRALIA

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Dolphins have ecological value in their ecosystem role as top order predators and social and cultural value as iconic species. The Australian humpback dolphin (*Sousa sahulensis*) is considered by the International Union for Conservation of Nature as vulnerable to extinction and the Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) as near threatened. Data paucity on abundance across their respective distributions precludes conservation assessments of these species in Australia. We aimed to resolve this knowledge gap by collecting data on both species across the Pilbara region using manned aerial surveys annually for three years (2015–2017). Distance sampling and density surface modelling were used to produce abundance estimates (uncorrected for availability bias). Too few sightings of humpback dolphins prevented abundance estimation in 2015 and led to survey design changes for later years which produced an abundance estimate of 664 (95% CI 402–1098) (CV = 0.26) in 2016 and 1388 (95% CI 928–2075) (CV = 0.21) in 2017 for this species. The abundance of bottlenose dolphins across the same area was estimated to be 2,162 (95% CI 1584–3019) (CV 0.17) in 2015, 2099 (95% CI 1267–3476) (CV = in 2016 0.26) and 844 (95% CI 539–1321) (CV = 0.23) in 2017. These estimates provide a baseline for assessing trends in abundance of these dolphin species in a region of increasing anthropogenic impacts.

## DOES THE FORAGING ECOLOGY OF FERAL CATS CHANGE AFTER THE ERADICATION OF FOXES?

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Invasive species control has resulted in unintended consequences where the control of one species causes increased impacts of a co-occurring species. Red foxes (*Vulpes vulpes*) and feral cats (*Felis catus*) co-occur throughout Australia – with control and regulation of fox's commonplace, a greater understanding of how feral cats will respond in the absence of foxes is needed. We use feral cat diet to assess potential ramifications of red fox control. Feral cat stomach contents were sampled between 1983–1994 on Phillip Island, Victoria when both feral cats and red foxes were abundant; and again from 2016–2019 when foxes were eradicated. A total of 277 feral cats were sampled between 1983–1994 and 415 from 2016–2019. Diet comparisons between the two time periods suggest no substantial shift in feral cat diet with only slight increases in invertebrates and black rats observed. Invasive prey (European rabbits, black rats, and house mice) still formed most of feral cat diet. We reinforce the role of seasonality, surrounding land use and sex as factors influencing cat diet. Our results suggest red fox control in the presence of cats may still achieve conservation benefits.

## CONSERVATION GENOMICS OF ISLAND, MAINLAND AND REINTRODUCED POPULATIONS OF GOLDEN BANDICOOTS

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Islands are important for the conservation of many species as they can provide refugia from threatening processes and often consist of unique lineages thereby retaining high species biodiversity. However, these populations are subject to genetic erosion which can ultimately contribute to an elevated extirpation risk. Using high-resolution genomic markers through double-digest restriction site-associated sequencing (ddRAD-seq), we conducted a genomic assessment of the threatened Golden Bandicoot; a species of high conservation interest consisting of fragmented populations, majority of which are found on offshore islands. Preliminary results reveal the Golden Bandicoot to consist of highly structured and genetically differentiated populations, reflecting the three currently recognized subspecies: *I. a. barrowensis*, *I. a. auratus* and *I. a. arnhemensis*. Islands had lower diversity than the mainland, likely reflecting smaller population sizes and therefore increased subjectivity to stochasticity. Genomic diversity was also retained over time in each of the translocated populations relative to their source populations. We highlight how species-wide genomic data can be used to inform conservation practices and encourage managers to incorporate such genomic information into adaptive management frameworks. Our findings have important consequences for conservationists which utilise remnant island populations for the preservation of declining species, such as the Golden Bandicoot.



## WHO'S AFRAID OF THE MARSUPIAL WOLF?

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Convergent evolution – where two unrelated organisms evolve similar phenotypes in response to similar pressures – can be a powerful way to infer the behaviour and ecology of an extinct organism that we cannot directly observe. The Thylacine (or Tasmanian Tiger) is considered a textbook example of convergent evolution – after all, it is sometimes even called the ‘Marsupial Wolf’. This has led to the assumption that the Thylacine is ecologically similar to that analogue, the Gray Wolf and its close relatives, like the Dingo. But what if that was wrong? Here, I used high-density 3D geometric morphometrics and two tests of convergence to find more precise morphological analogues with the Thylacine across faunivorous mammals. I find little support for convergent evolution between the skulls of the thylacine and the Gray Wolf or Dingo. There is, however, strong support for convergent evolution between the skulls of the Thylacine and a mixed group of other canids: African jackals and South American ‘foxes’. All of these canids are ecologically distinct from the Gray Wolf, specialising in hunting relatively small prey, not big game. The Thylacine was likely very similar: a mid-sized mesopredator, not a big bad wolf.

## MUSEUM GENOMICS UNLOCKS A HISTORICAL RECORD OF EXTINCTION IN AUSTRALIA

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Australia has the worst rate of recent mammalian extinction in the world, with 34 terrestrial species declared extinct since European settlement of the continent in 1788. Native rodents have been the most severely affected by these recent extinctions, however it remains unclear whether their declines were wholly the result of anthropogenic impacts since 1788, or whether a reduced adaptive capacity via pre-existing genetic erosion accelerated this process in the species which are now lost. Using museum specimens up to 174 years old, we generate genomic-scale data from across the entire assemblage of Australian hydromyine rodents, i.e., eight extinct species, and their 42 living relatives. We find no evidence for reduced genetic diversity in extinct species just prior to, or during decline, indicating that their extinction was extremely rapid. This suggests that populations of extinct Australian rodents were large prior to European settlement, and that genetic diversity does not necessarily protect species from catastrophic extinction. Importantly, we also ‘resurrect’ a species from extinction, Gould’s mouse (*Pseudomys gouldii*), surviving on an island in Shark Bay, Western Australia. Our results highlight the capacity of collections-based research to inform conservation and management of persisting species.

## THE IMPACT OF CULTURAL BURNS ON KOALA DENSITY ON MINJERRIBAH, NORTH STRADBROKE ISLAND.

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Large and intense wildfires present a major threat to koala populations across eastern Australia. Although fire has been a key factor influencing Australian ecosystems, post-colonial fire regimes are having negative consequences for Australia's wildlife. The bushfires of 2019–2020 had a severe impact on Australia's koala population, and more frequent, hot fires under anthropogenic climate change could push the koala to the brink of extinction. Indigenous cultural burning could be used to mitigate the risk of large wildfires on koalas, but this is yet to be examined. We investigated the impacts of cultural burning on koala density on Minjerribah (North Stradbroke Island), where the practice of cultural burning has recommenced. These burns aim at reducing the likelihood of future high intensity fires and therefore the risk of killing koalas and old growth canopy species. We conducted drone surveys with a thermal sensor to establish a baseline koala density prior to fire and reassessed density post fire at control and experimental sites. We compared the density estimates together with vegetation characteristics and fire temperature data to establish if cultural burning practices can reduce the threat and impact for koalas from wildfires in a changing climate across the entire koala range.

## THE EFFECTS OF CAPTIVITY ON BEHAVIOURAL AND COGNITIVE TRAITS IN FAT-TAILED DUNNARTS (*SMINTHOPSIS CRASSICAUDA*)

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Species extinction has reached crisis point globally and the development of effective methods to manage endangered species populations is critical. Australia holds the record for the greatest number of mammal extinctions in the world, and while captive breeding and reintroduction are key approaches in conservation, the success of these programs has been variable. The choice of candidates for release is often based on genetic relatedness, age, sex and health status. However, there is growing recognition that an individual's behavioural type is also related to fitness. Thus, behavioural traits may influence survival, though are rarely considered in the context of reintroduction success. My research aimed to assess behavioural and cognitive traits in captive bred and wild fat-tailed dunnarts (*Sminthopsis crassicaudata*) to identify potential impacts of captive breeding. In over 200 individuals, activity-exploration, boldness-shyness, predator avoidance-recognition, and aggression trials were conducted to categorise personality. Y-maze trials were used as a cognitive assessment. Preliminary data indicates differences within captive individuals, as well as between captive and wild dunnarts. Captive animals appear to exhibit higher rates of aggression toward handlers, and increased territorial behaviour than wild individuals. Potential behavioural changes are being investigated further, including whether this may influence reintroduction success.

## RESPONSES OF INSECTIVOROUS BATS TO SPATIAL AND TEMPORAL CHARACTERISTICS OF FIRE REGIMES

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Ongoing changes to fire regimes are a significant threat to native mammal populations. Bats comprise ~25% of Australia's terrestrial mammal fauna, however most research focuses on the effect of fire regimes on non-volant mammals, and little is known about how fire influences microbat occurrence. We aimed to determine how spatial and temporal variation in fire regimes correlates with occurrence of microbats in semi-arid, 'mallee' woodlands. We built species distributions models for nine species, including both generalists and arid-zone specialists and above and below canopy foragers. Predictor variables included fire, climate, and other environmental measures, with spatial measures of fire such as the area, diversity and configuration of landscape elements, and temporal measures such as time since fire and fire frequency. Microbats shown a surprising level of uniformity in response to fire, with seven species more likely to occur as time since fire increased and eight species less likely to occur in landscapes with a higher diversity of post-fire ages. These responses are likely due to the influence of fire on tree hollows, a critical resource for microbats that are negatively impacted by high frequency canopy fires. Management strategies to enhance microbat persistence should therefore focus on retaining long-unburnt vegetation.

## Speed talk

### RECORDS OF LEOPARD SEALS *HYDRURGA LEPTONYX* STRANDED IN SOUTH AUSTRALIA, 2017 TO 2019

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The leopard seal *Hydrurga leptonyx* is one of five southern phocid species with circumpolar distribution in the Southern Ocean. None breed on the Australian coast. The South Australian Museum maintains records of non-resident seals that come ashore in South Australia (SA), using reports from coastal officers of SA Department of Environment and information from the public. We document records of six leopard seals (two collected specimens and four sightings) in SA between 2017 and 2019. All animals were juvenile or subadult in poor condition. One of the specimens was a subadult male weighing 136 kg and of 2.60 m standard length with small testes. Small goose barnacles *Lepas australis* were attached to its ventral pelage, indicating it was a long time at sea. Its stomach contained semi-digested toadfish and a few cormorant feathers. Its lungs showed chronic moderate pneumonia. The other specimen has not yet been examined. All six leopard seals were recorded between June and December, similar to the seasonal distribution reported previously in SA and Tasmania. These six records suggest that the period between 2017 and 2019 coincided with the peak of the cycles of duration 4 or 5 years that have been observed on Macquarie Island.

## A LANDSCAPE APPROACH TO NORTHERN QUOLL CONSERVATION: FROM MECHANISM TO PROCESS

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The Pilbara region of Western Australia is a stronghold for the threatened northern quoll (*Dasyurus hallucatus*). This population is of high conservation value, as it is genetically distinct and outside of the current distribution of cane toads, which have been implicated in their decline in other regions. In order to sustain healthy populations of northern quoll in the Pilbara, there is urgent need to develop novel, landscape-scale approaches to conservation. To achieve this, we must facilitate the fundamental mechanisms underlying survival; the ability to reproduce, disperse and adapt. Our study combines occurrence records, high resolution genomic data, and spatial environmental data to understand how northern quolls use and move through the Pilbara landscape. We show that different life stages require different resources and landscape characteristics. For example, while habitat suitability is primarily driven by terrain ruggedness, dispersal is facilitated by proximity to watercourses and impeded by soils with high silt content. Furthermore, although there is limited evidence for physical barriers to dispersal in the Pilbara, climate drives patterns of genetic turnover. By understanding these meta-population dynamics, we can plan for future threat mitigation in the Pilbara and promote resilient populations of northern quolls into the future.

## Speed talk

### HEART RATE AS A METABOLIC INDEX FOR WILD KOALAS

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Koalas are declining in areas being impacted by a warming climate and increasing rainfall variation. By closely examining koala behaviour and measuring their thermal and metabolic response to varying conditions we aim to improve the mechanistic physiological model of koala habitat tolerances. As an index of metabolic rate we are measuring heart-rate in wild koalas faced with real-world conditions. We subcutaneously-implanted a tiny logger collecting heart-rate (ECG) and temperature data every 15 minutes. Collar-mounted GPS and accelerometry allowed a comparison with movement and activity. Early results from a period of mild weather are presented, to indicate the range of normal male metabolism and associated behaviour. The method gave highly reliable ECG results (98% of samples). Our study koala's heart-rate was lower in the wild and captivity than previously reported for captive koalas. Heart-rate was lower during the day corresponding with diel movement and activity patterns, however, rapid heart rate ( $\leq 240$  BPM) and activity could occur at any time. As the first continuous measure of a koala metabolic rate proxy, this study allows a view of koala metabolic flexibility and variation in energy use. Resulting habitat models will better focus koala management strategies to ensure long-term conservation of koala populations.



# WOMBATS OF SOUTH AUSTRALIA: COMPARING SOUTHERN HAIRY-NOSED AND COMMON WOMBATS

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South Australia is unique in having significant populations of two wombat species; southern hairy-nosed wombats (SHNW) (*Lasiorhinus latifrons*) and common wombats (CW) (*Vombatus ursinus*). This provides the opportunity to examine both species in order to compare the landscape factors which affect their distribution and abundance at different spatial scales, and to predict how they will respond to future changes in their respective ecosystems. The species are geographically separated by the Murray River. There is also a climate divide, with SHNW inhabiting regions where annual rainfall is between 160–470 mm and mean annual temperature is > 15.5 °C. In contrast, CW occur only in regions where rainfall is > 400 mm/annum and mean annual temperature is < 16 °C. The CW population is highly fragmented, due mainly to land clearance for agriculture and forestry. While land clearance for cropland agriculture has a significant impact on both species, land clearance for grazing agriculture has little overall impact on SHNW, and may result in an increase in local area abundance. However, this creates a ‘boom and bust’ cycle, with overpopulated areas experiencing declines during drought periods. Both species of wombats are likely to be negatively affected by climate change; however, habitat modification will have a greater impact on CW.

# THE EVOLUTION OF GENITAL MORPHOLOGY: BACULUM SHAPE DIVERSIFICATION IN MUROID RODENTS

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Genital morphology is one of the most strikingly variable and evolutionarily divergent traits in animals. The mammalian baculum (os penis) displays remarkable among-species variation in size, shape, and complexity. However, despite widespread and longstanding interest in understanding the evolutionary pressures underlying baculum diversification, the evidence for postcopulatory selection as a causal mechanism remains equivocal. Positive covariation between testes mass (a proxy for the strength of postcopulatory sexual selection) and baculum length has been documented in carnivores, rodents and pinnipeds, but studies from primates and bats have not supported the sexual selection hypothesis. Evidence from experimental evolution of the house mouse, *Mus musculus*, suggests baculum shape is a far more important target of postcopulatory sexual selection than baculum length. Here, we present preliminary results from a phylogenetic comparative analysis testing the hypothesis that the rate of baculum shape divergence is related to the strength of postcopulatory selection across muroid rodents. We demonstrate the use of x-ray microtomography (microCT) imaging and Generalized Procrustes Surface Analysis of three-dimensional shapes to study genital morphology.

## OPTIMISING CAMERA USE TO DETECT AND ID A MARSUPIAL CARNIVORE

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Accurate population size estimates are improved by being able to identify individuals. This is most feasible in species with unique identifiable marks such as pelage patterns. The chuditch (*Dasyurus geoffroii*) is a medium sized carnivorous marsupial found largely in the south west of Western Australia. It is classed as Vulnerable under state and national legislation. They are a nocturnal, solitary species that have had large variability in population estimates largely using capture rates. Camera traps can be used to gather large amounts of data, identify individuals and even track individual movements across the camera array. Optimising their use can therefore increase the reliability and useability of this data. This project compared two camera models (Reconyx and Swift) in four positions (single, paired at 30 cm, 1 m and 2 m) using a non-reward lure (fish oil). The aim was to determine which combination improves detection and identification rates for chuditch. The results of the project can be used to improve monitoring of chuditch and other similar species.

# REMOTE SENSOR CAMERA TRAPS PROVIDE THE FIRST DENSITY ESTIMATE FOR THE LARGEST NATURAL POPULATION OF THE NUMBAT (*MYRMECOBIUS FASCIATUS*)

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The numbat (*Myrmecobius fasciatus*) is a diurnal termitivorous marsupial that was once widespread across southern Australia, but now persists in only two natural populations in Western Australia and in several reintroduced populations. Due to comparatively dense understorey vegetation and sparse road networks, standard population monitoring methods for this species (driving transects and sign surveys), have failed to provide accurate density estimates for the largest natural population, in the Upper Warren region of Western Australia. We conducted spatial population modelling using images captured incidentally during a large camera trapping project and found that numbats could be individually identified by stripe patterns, and that camera images could be used in conjunction with capture recapture modelling to provide a density estimate. We obtained a density estimate of  $0.017 \text{ ha}^{-1} \pm 0.004$  (CV = 0.26), which applied across the estimated extent of distribution suggests a substantially larger numbat population in the Upper Warren (~1930 adults) than previously assumed. Further, we explored a range of camera trap designs to assess optimal sampling methods for this numbat population. This study shows that camera trapping is a feasible method for monitoring population density of numbats and population trends in response to management actions such as translocations.

## PYGMY BLUE WHALE DIES OF CHRONIC HEART DEFECT ON YORKE PENINSULA, SOUTH AUSTRALIA

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The endangered pygmy blue whale (*Balaenoptera musculus brevicauda*) feeds in the Bonney Upwelling off southern Australia. All previous SA strandings have been of dead whales but in October 2016 a 15 m juvenile stranded alive and survived for 5 days. Observations and palliative care were undertaken for 3 days and a post-mortem examination conducted. Severe sunburn was observed over 60% of the dorsum. On days 3 and 4, breathing was regular (30 sec intervals), the eyes were open and the whale responded to external stimuli. On day 5 breathing was reduced (48 sec), eyes closed and the whale was more lethargic. Shortly before death blood began to fill the mouth and breathing was laboured. The whale was very emaciated and barnacles observed. Gross necropsy revealed extensive oedema and swollen lymph nodes, a large nodule on the aortic valve, and gastrointestinal trematodes and cestodes. Histology confirmed the heart nodule was consistent with chronic endocarditis. Chronic enteritis, acute interstitial bronchopneumonia and lymphadenopathy were also observed. These results confirm a chronic circulatory disorder that led to the whale's death. This case emphasises the need for careful observation of live-stranded cetaceans and for conducting post-mortems to determine cause of death.

## RESOLVING THE TAXONOMY OF THE GOLDEN BANDICOOT, *ISOODON AURATUS*

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The taxonomy of the Golden Bandicoot, *Isoodon auratus*, has been a problem since its first description in 1887. It has been considered a full species with no subspecies, as subspecies of the Southern Brown bandicoot (*I. obesulus auratus*), and as a species with up to 3 subspecies (*I. a. auratus*, *I. a. barrowensis* and *I. a. arnhemensis*). Past attempts at resolving the taxonomy have included both morphological and molecular methods, yet none have come to the same conclusion. To address this issue, we have opted for a total evidence approach, using both morphological and molecular techniques, including sampling specimens from their historical and extant distributions. Types were also examined and sampled for DNA analyses. Molecular data were generated from 1000s of nuclear gene loci using exon capture as part of the Oz Mammal Genomics initiative. Our results show that the Golden Bandicoot is a more complex taxonomic entity than previously thought, with the Kimberley and Marchinbar populations being distinct from the currently named taxa. Our results have important implications for the conservation management of the Golden Bandicoot, and current translocation plans of mixing populations.

## HIDING IN THE CRACKS: DOCUMENTING THE DIVERSITY OF AUSTRALIA'S SMALLEST MARSUPIAL CARNIVORES.

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Australia is home to a suite of unique endemic mammal species, including the minute insectivorous *Planigale* and *Sminthopsis*. *Sminthopsis* is the most diverse genus of Australian marsupial with 18 recognised species, but some of these contain cryptic taxa. *Planigale* has five recognised species, yet phylogenetic studies suggest a further six that are undescribed, most of which occur in northern and arid Australia. While these species remain undescribed, they cannot be properly assessed for conservation management, which is cause for concern given current trends of mammal declines in northern Australia. We shall undertake a full taxonomic revision of *Planigale* spp., *Sminthopsis macroura*, *S. virginiae* and the monotypic genus *Antechinomys*. This project combines traditional (linear measurement) morphology, 3D geometric morphometrics and next-generation DNA sequencing, to assess and describe the diversity within the species complexes. The information generated on the distribution of the new taxa will be crucial to inform conservation of these species at the state and federal level in the face of current threatening processes.

# CAN LIVESTOCK GUARDIAN DOGS PROTECT THREATENED SPECIES? THE EFFECT OF MAREMMA SHEEPDOGS ON DISTRIBUTION AND BEHAVIOUR OF FOXES

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Invasive mesopredators, the red fox and feral cat, are a pervasive threat to Australian wildlife. Without exclusion fencing, control of these predators is difficult or infeasible with current techniques. There is an increase in the use of livestock guardian dogs (LGDs) by Australian farmers to protect stock from fox predation. When guarding livestock, LGDs could potentially provide indirect protection to wildlife threatened by fox predation, if they exclude foxes or suppress their hunting behaviour. We monitored fox activity on sheep farms through a camera survey, comparing areas with and without LGDs, and found that fox activity was reduced within LGD territories. Foxes also appeared to change their hunting behaviour; the closer foxes were to the core of the LGD range, the less likely they were to attempt to recover a buried food item, and the less time they were prepared to spend on this endeavour. We are extending these results to a trial reintroduction of eastern barred bandicoots to test whether the presence of LGDs allows them to persist in open landscapes. Our results thus far suggest that LGDs have great potential to support wildlife conservation, especially in fragmented landscapes used for livestock production and where foxes are otherwise abundant.



## WHAT DO WE KNOW ABOUT THE STATUS AND DISTRIBUTION OF THE NGUDLUKANTA (*CALOPRYMNUS CAMPESTRIS*)?

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The desert rat-kangaroo or 'ngudlukanta' (*Caloprymnus campestris*) was once sparsely distributed in the Lake Eyre Basin of north-eastern South Australia and adjacent parts of Queensland, but it has not been collected since the 1930s. However, numerous reported sightings, including some as recent as 2013 provide faint hope that it may still be extant. In 2018 and 2019, we used camera trapping, spotlighting and predator scat analysis to search for evidence of the animal at sites where it had been collected in the past and places where possible sightings were reported more recently. Our work comprised the most extensive field surveys ever undertaken for the ngudlukanta. Although we did not find evidence of the animal's continued existence, we did gather new records for other threatened species, including a significant range extension for the kowari (*Dasyuroides byrnei*). We also uncovered a new historic collection locality for the ngudlukanta and historic details about the collection locality of the type specimen. Because of the vastness of its supposed distribution, we do not see our null result as definitive for this poorly surveyed animal; we instead hope it provides a starting point for future surveys aimed at resolving the ngudlukanta's status.

# GEOMETRIC MORPHOMETRICS OUT-PERFORMS LINEAR-BASED METHODS IN THE TAXONOMIC RESOLUTION OF A MAMMALIAN SPECIES COMPLEX

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Taxonomic research has predominantly used linear morphometrics (LMM) to measure quantitatively skulls for species distinction. The choice of which measurements to collect generally relies on the expertise of the investigators, but this practice may ignore less obvious discriminatory characters. Additionally, taxonomic analyses often ignore allometry and thus the potential for groups to differ in shape purely due to size differences. 3D geometric morphometrics (GMM) can offer a more holistic characterization of shape and a rigorous way to assess allometry. In this study, I compared the performance of LMM and GMM for discriminating three morphologically similar clades of antechinus. I used four LMM protocols and a 3D GMM protocol to investigate the discriminatory performance with the raw data, after removal of isometry, and after allometric correction. I found that the steps of isometry extraction and allometric correction enhanced group discrimination in GMM. In addition, I detected a probable case of measurement redundancy in LMM, which reflected superficially high relative allometry but resulted in low discriminatory performance. These findings suggest that GMM offers the option of detecting crucial allometric and non-allometric shape differences between species, which can then benefit LMM protocols in a broader scale study including the discriminatory linear distances.

## Speed talk

### CURRENT POPULATION STRUCTURE OF *PETROGALE PENICILLATA* FOLLOWING THE 2019/20 AUSTRALIAN BUSH FIRES

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The 2019/20 Australian bush fires impacted known localities of brush-tailed rock-wallabies. It is currently uncertain as to how these localities were affected, whether they were completely decimated or whether they have been isolated from neighbouring groups. If populations are experiencing fragmentation, a possible loss of gene flow between neighbouring sites may occur, and depending on whether they are source or sink populations could have drastic consequences to surrounding groups. The reduction of gene flow within populations can lead to reduced fitness from loss of genetic diversity, which in turn could lead to inbreeding depression. The aim of this research is to determine the current population structure of wild brush-tailed rock-wallabies, including whether distribution has been restricted due to fragmentation following the fires, and whether populations are source or sink contributors. As this species was listed as vulnerable on the IUCN Red List in 2016, prior to the bush fires, the results from this study will provide important information about population structure for a vulnerable species, and potentially aid in current and future management decisions for the brush-tailed rock-wallabies.

## CONTINENTAL-SCALE ADAPTIVE RADIATION REFLECTED IN CRANIAL SHAPE IN PERAMELEMORPHIAN MARSUPIALS

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The processes involved in evolutionary radiations often reflect morphological evolution into new adaptive zones, facilitated by ecological opportunity, and resulting in species that differ in adaptive phenotypic traits. The evolutionary history of peramelemorphians is rather patchy, with the oldest fossils being around 25 million years old, recovered from central Australia. These are small insectivorous perameloids, with no clear relationship to modern families. While most modern peramelemorphian are scratch-digging omnivores (except for the Chaeropodidae, which were mainly herbivorous and did not dig), it is unclear if this ecological niche evolved once or multiple times within this group. Here we seek to characterise diversity in cranial morphology within the Peramelemorphia and to investigate to what extent this variation might be related to ecological adaptations. Further, whether the evolution of cranial shape reflects an adaptive radiation across the geographic range of Sahul (Australia + New Guinea) within the timeframe of peramelemorphian evolution. We use 3D geometric morphometric tools to describe and compare skull shape across 30 species of bandicoots and bilbies, which represent all the major clades within the marsupial Order Peramelemorphia. Divergent evolution in skull shape between these clades appears to reflect interesting patterns of adaptation for diets across different environmental conditions.

# ONE SIZE, ONE SHAPE? A PRELIMINARY STUDY OF SHAPE DIFFERENCES IN THE SKULL OF MICE FROM DIFFERENT HABITATS

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Most shape variation in the rodent skull occurs with changes in size within and between species, with little evidence that the skull adapts to specific dietary regimes beyond changing in size. This contrasts with diverse habitats occupied by invasive rodents, making them an ideal non-laboratory system for assessing the scope of adaptation or phenotypic plasticity within the constraints of the rodent masticatory system. We present a pilot study of geometric morphometric comparisons of skull shape between feral house mice from the arid Simpson desert (n = 10), the Adelaide CBD (n = 10), and the wetter South-East of South Australia (n = 8). Unexpectedly, non-size related differences between Adelaide and Simpson desert populations were visible in the main variation of the dataset as well as in an ANOVA, which is striking given our very low sample sizes. Adelaide CBD and Simpson desert individuals differed in having shorter and more downturned snouts and a slightly different masseter region. Integration of the well-established phylogenetic relationships between populations, and larger samples, are required to assess whether these shape differences result from plastic re-modelling of the skull or represent heritable adaptation; either result has implications for understanding the importance of masticatory adaptation in invasion success. Funded by ARC FT180100634.

## CUTANEOUS AND RESPIRATORY CONTROL OF EVAPORATIVE WATER LOSS

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It is well known that mammals (and birds) augment their evaporative water loss when heat stressed, but it has only recently been shown that they also have acute physiological control of their evaporative water loss at lower ambient temperatures (within and below their thermoneutral zone). For example, ambient relative humidity affects evaporative water loss less than expected from the physics of evaporation. It is not clear whether this capacity to control evaporative water loss is due to modification of cutaneous evaporation, respiratory evaporation, or a combination of both. Cutaneous evaporative water loss of a small dasyurid *Sminthopsis dolichura* (measured directly using a Tewameter probe) increases with increasing ambient temperature from 20 °C to 30 °C as expected from physical principles. However, cutaneous evaporative water loss increases with ambient relative humidity within the thermoneutral zone (30 °C), which is opposite to physical predictions of Fick's Law and suggests that modification of cutaneous evaporation is an important mechanism for control of total evaporative water loss. The effect of humidity on respiratory evaporative water loss, determined by measuring expired air temperature using a FLIR infrared camera, appears to have a lesser role in the control of total evaporative water loss.

## Speed talk

### BODY SIZE AND POUCH ASSOCIATION IN MARSUPIALS

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The pouch is a variable feature of marsupials but few studies tackled its evolution. In Didelphimorphia it is hypothesised that the pouch might be related with size, being present only in larger species, but in Marsupialia as whole the factors that may be related to its presence have not yet been evaluated. Here we test the association between pouch presence and body mass in marsupials, to verify how the two variables interact in a phylogenetic context. “Pouch absence” was assigned to species that do not present pouch or do so only seasonally. Size was estimated through “body mass” and female data was preferred when available. We conducted a phylogenetic logistic regression analysis between the two variables, and compared the AIC score of this model to that of a null model including only the intercept. The first model, including mass as an independent variable, provided a better fit to our data ( $AIC_{diff} = 10.8$ ,  $AIC_w = 0.99$ ), indicating an association between the presence of pouch and body mass in marsupials. The presence of the pouch is highly influenced by larger sizes, as can be easily seen in Didelphimorphia, while in Australasian clades a phylogenetic component may be influencing its presence.

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