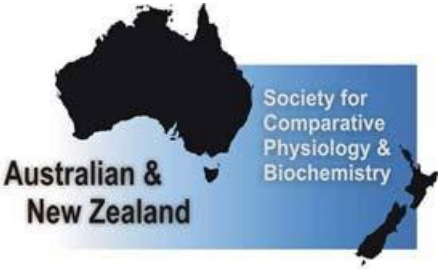


Australian and New Zealand Society for Comparative Physiology and Biochemistry

38th Annual Meeting

The University of Queensland
Gatton QLD

9-10th December 2023

Acknowledgement of Country

The University of Queensland (UQ) acknowledges the Traditional Owners and their custodianship of the lands on which we meet.

We pay our respects to their Ancestors and their descendants, who continue cultural and spiritual connections to Country.

We recognise their valuable contributions to Australian and global society.

The Brisbane River pattern from
A Guidance Through Time
by Casey Coolwell and Kyra Mancktelow.

Organizing Committee
Dr. Edward Narayan (Conference Chair)
Mr. Suresh Krishnasamy
Stress Lab Student Members

2023 Logo Design
Dr Adam Downie

Sponsors

The University of Queensland, Faculty of Science,
School of Agriculture and Food Sustainability (AGFS)

ADInstruments

Conference Venue
Animal Studies Building, Learning Theatre (8150-153)
Registration: 08:30am - 8:50am Saturday 9th December

Conference Dinner
Campus Dining Hall
Saturday 9th December

Self-serve buffet dinner service
(1 beverage coupon, cash bar will be available for self-service)


UQ Veterinary Medical Centre
LT (8150-153)
Recommended Carpark (Carpark 1)
Campus Dining Hall
Riddell Hall
Thynne Hall
Pitt Hall
Shelton Hall
Central Walkway
COMMUNITY GARDENS
Lake Galletly
Lake Lenor
Bird hide
Bushland Park
Mac's Pond
ARMY RESERVE UNIT
QASP
TOM GRAHAM CRICKET OVAL
RAY McNAMARA SPORTS OVAL
HUGH COURTNEY RUGBY OVAL
LOCKIE RULE TENNIS COMPLEX
INNER RING ROAD
OUTER RING ROAD
DIRECTORS LANE
GALLETLY ROAD
SOUTH RIDGE ROAD
HOMESTEAD LANE
HAY LANE
CAUSEWAY
CHAPEL HILL ROAD
MAIN DRIVE
SERVICE ROAD
HALL ROAD
RESERVE LANE
OAKLEY ROAD

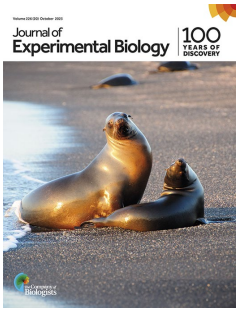
Discover Animals is an open access journal publishing research across the full range of animal sciences, including the intersection of human and animal interactions.

Collection: Selected Papers from the 2023 ANZSCPB Conference

Submission deadline: **15 June 2024**

This Topical Collection is in cooperation with the 2023 ANZSCPB Conference, from the 9th-10th December 2023. We welcome submissions from the participants of the conference.

Editor: Dr Edward Narayan, The University of Queensland



Journal of Experimental Biology is the leading primary research journal in comparative physiology and publishes papers on the form and function of living organisms at all levels of biological organisation, from the molecular and subcellular to the integrated whole animal.

Editor-in-Chief: Professor Craig Franklin, The University of Queensland

Snapshots of UQ Gatton

UQ Gatton combines the rural traditions of its Queensland Agricultural College heritage with innovative research and teaching facilities in agriculture, animal science, veterinary science, and the environment.

UQ's Gatton Farms is spread across two locations and covers 1064 hectares. The farms include:

- a dairy
- poultry unit
- sheep and goat herd
- horticultural fields
- plant nursery
- post-harvest facilities
- research laboratories and greenhouses.

Taurudicus the bull statue has been located at the front of the Animal Industries Building since 1967.

Taurudicus symbolises the past, present, and future scientific advances in the Queensland Beef Industry.

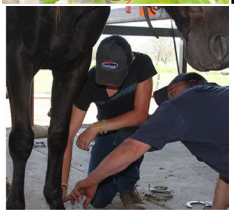
Taurudicus represents a hybrid beef bull with characteristics from different breeds to create a new breed modified by technology and scientific progress.

In 1987, acclaimed artist Rlhyl Hinwood was commissioned to design and carve a sculpture to recognise the bicentary and the campuses 90th anniversary.

It is called ‘The Adaptation of Agriculture in Queensland’ and the sculpture uses finely crafted imagery to tell the story of the important role this campus has played in the development of agriculture, animals studies and horticulture in Queensland as an educational institution.

The Queensland Animal Science Precinct (QASP) is a unique world-class research facility that accommodates training, teaching, validation, and commercialisation of animal research focusing on the research and development requirements of state, national and international animal industries.

QASP facilitates national and international collaboration and serves to strengthen the interaction between researchers and industry to ensure that research outcomes can be implemented at industry level.



The Gatton campus is home to the School of Agriculture and Food Sustainability, the School of Veterinary Science and UQ Skills, UQ's registered training organisation.

Programs on offer include:

- Bachelor of Agricultural Science
- Bachelor of Agribusiness
- Bachelor of Veterinary Technology
- Bachelor of Veterinary Science

Conference Programme

Saturday 9th December (Day 1)
Chair: Dr Edward Narayan
Venue: Animal Studies Building, Learning Theatre (8150-153)

0830am – 0900am	Registration
0900am – 0910am	Conference Welcome
0910am – 0930am	Opening Address: **Professor Melissa Brown** Executive Dean, Faculty of Science, The University of Queensland
0930am – 1000am	Keynote 1: **Professor John Cockrem** School of Veterinary Science Massey University
1000am – 1030am	Keynote 2: **Dr Christine Cooper** School of Molecular and Life Sciences Curtin University
1030am – 1130am	Conference Photo Session Morning Tea
1130am – 1300pm	HDR Student Talks Series 1
	Harsh Pahuja The University of Queensland
	Barbara Nuic Vidigal The University of Queensland
	Dylan Baloun University of Saskatchewan

	Ruvinda de Mel University of New England
	Sanjeev Baniya University of New England
	Joshua Gaschk University of the Sunshine Coast
1300pm – 1430pm	Lunch Poster Exhibition
1430pm – 1500pm	Keynote 3: **Dr Lesley Alton** School of Biological Sciences (Centre for Geometric Biology) Monash University
1500pm – 1530pm	Keynote 4: **Professor Michael Kearney** School of BioSciences The University of Melbourne
1535pm – 1650pm	HDR Student Talks Series 2
	Georgia-Constantina Hantzopoulou The University of Queensland
	Jasmin Annett University of the Sunshine Coast
	Isabella Reboul The University of Queensland
	Lauren Thornton University of the Sunshine Coast
	Coen Hird The University of Queensland

1650pm – 1700pm	Break
1700pm – 1815pm	**Pablo Recio Santiago** The Australian National University
	Yang Yifei The University of Queensland
	Robin Maag University of the Sunshine Coast
	Angela Simms La Trobe University
	Renae Charalambous The University of Queensland
1815pm – 1845pm	AGM
1845pm – 2030pm	Conference Dinner

Conference Programme

Sunday 10th December (Day 2)
Chair: Mr Suresh Krishnasamy
Venue: Animal Studies Building, Learning Theatre (8150-153)

0830am – 0850am	Registration
0850am – 0900am	Conference Welcome
0900am – 0920am	Opening Address: **Professor Craig Franklin** President, Academic Board The University of Queensland
0920am – 0930am	Student Prizes
0930am – 1000am	Keynote 5: **Dr Rebecca Cramp** School of the Environment The University of Queensland
1000am – 1030am	Keynote 6: **Professor Philip Withers** School of Biological Sciences The University of Western Australia
1030am – 1100am	Morning Tea
1100am – 1245pm	Day 2 Session Talks (AM)
	Dr Edward Narayan School of Agriculture and Food Sustainability The University of Queensland
	Dr Zenon Czenze School of Environmental and Rural Science University of New England

	Professor Craig White Head, School of Biological Sciences Monash University
	Associate Professor Christofer Clemente School of Science, Technology and Engineering University of the Sunshine Coast
	Dr Jacinta Kong Department of Biology Carleton University
	Professor Gordon Grigg School of the Environment The University of Queensland
1245pm – 1345pm	Lunch
1330pm – 1430pm	HDR Student Special Session: **Associate Professor Louise Kuchel** Deputy Associate Dean Academic, Faculty of Science The University of Queensland
1430pm – 1500pm	Keynote 7: Professor Timothy Mahony Centre for Animal Science Queensland Alliance for Agriculture and Food Innovation (QAAFI)
1500pm – 1530pm	Afternoon Tea

	Day 2 Session Talks (PM)
1530pm – 1645pm	**Dr Nicholas Hudson** School of Agriculture and Food Sustainability The University of Queensland
	Dr Nicholas Wu Hawkesbury Institute for the Environment Western Sydney University
	Dr Todd McWhorter School of Animal and Veterinary Science The University of Adelaide
	Dr Alyssa Bowden School of the Environment The University of Queensland
	Dr Adam Downie Franklin Eco-Laboratory The University of Queensland
1645pm – 1700pm	Conference End

Poster List

P01	Koala stress throughout decades of environmental change: analysing spatial-temporal physiological stress trends in southeast Australia post-European arrival. **Alex Meyer, The University of Queensland**
P02	Bringing science to the stable during equine assisted services in Australia. **Amanda Hancock, The University of Queensland**
P03	Torpid bats cuddle for survival **Clare Stawski, University of the Sunshine Coast**
P04	Maternal investment has transient - not programmatic - effects on lampropholis metabolism. **Dalton Leibold, The Australian National University**
P05	Wool profiles of testosterone and cortisol in merino rams. **Dylan Fox, The University of Queensland**
P06	Liver mitochondrial content is modified following dietary crude protein and phosphorus deficiencies in wethers. **Elmer Fernandez, The University of Queensland**
P07	Adrenal histology of koalas. **Harsh Pahuja, The University of Queensland**
P08	Comparative analysis of behavioural repertoires for mahogany glider and brushtail possum using accelerometer loggers and machine learning algorithms. **Jasmin Annett, University of the Sunshine Coast**
P09	Quantitative assessment of activity levels and behavioural patterns in long-nosed potoroos and rufous bettongs: a pilot study at hidden vale wildlife centre, Queensland. **Jiwoo Jeon, The University of Queensland**

P10	The attitudes and motivation of dairy farm owners and stock-handlers to training that targets their attitudes and behaviours towards handling and working with dairy cows. **Mandi McLeod, The University of Queensland**
P11	Untangling the role of sex-steroid hormones in sex-reversed lizards. **Naomi Laven, The Australian National University**
P12	Stress quantification of small mammals housed in a breeding facility, by measuring faecal cortisol metabolites. **Nishit Rao, The University of Queensland**
P13	Koala commute: quantifying koala ground-movement with accelerometery. **Oakleigh Wilson, University of the Sunshine Coast**
P14	Impacts of urban living on insectivorous bats. **Robin Rowland, University of the Sunshine Coast**
P15	Fleas from the silk road in central Asia: identification of ctenocephalides canis and ctenocephalides orientis on owned dogs in Uzbekistan using molecular identification and geometric morphometrics. **Runting Wang, The University of Queensland**
P16	Assessing the behaviour of Asiatic black bears from the records of Vietnam bear rescue centre. **Sharvari Avinash Sherekar, The University of Queensland**

Opening Address (Day 1)

Professor Melissa Brown

Executive Dean, Faculty of Science
The University of Queensland

Biography:

Professor Melissa Brown is the Executive Dean of the Faculty of Science at The University of Queensland (UQ), President of the Australian Council of Deans of Science, and member of several Boards or Advisory Boards. Melissa completed her Bachelor of Science (Hons) and PhD at The University of Melbourne and is a Graduate of The Australian Institute of Company Directors. She has held research, academic or visiting academic positions at the Imperial Cancer Research Fund, King's College London, The University of Melbourne, The University of Queensland, and The University of Oxford.

During her career, Melissa has taught molecular biology to more than ten thousand coursework students and graduated 39 research students. Her research in cancer genetics has been supported by over $20 million in competitive research fellowships and grants and has resulted in over 100 research papers and reviews that have been cited more than 4500 times.

Melissa has held a number of academic leadership roles, including Head of School, Deputy, or Acting Director of two Research centres, and Deputy Executive Dean and Associate Dean (Research). In these and her current role as Executive Dean, she has introduced multiple processes and schemes to enable early career researchers to reach their potential, and to bring new teams of researchers together with each other or industry to address important research questions in Science and Medicine.

Opening Address (Day 2)

Professor Craig Franklin

President of Academic Board
The University of Queensland

Biography:

Professor Craig Franklin is an animal ecophysiologist whose research program investigates how fish; frogs & reptiles can survive and function under extreme and changing environmental conditions. He is recognised as one of the leading proponents of the emerging field of conservation physiology. His research is supported by the Australian Research Council, the National Environmental Science Program, a Cooperative Research Centre, industry partnerships, and through philanthropic donations. He oversees a large and productive research group, currently composed of 3 postdocs, 8 Ph.D. and 5 Honours' students.

Craig has published over 300 scientific articles, including articles in Nature, Nature Climate Change, Nature Ecology & Evolution, Global Change Biology, and The Journal of Experimental Biology, where he is a regular contributor. He jointly won the Whitley Book Award for a proceeding on "Crocodilian Biology and Evolution" and has co-written an enthusiast's field guide to Antarctica; "Antarctica Cruising Guide" published by AWA Press, now in its 4th edition.

Craig is a passionate and enthusiastic teacher, educator, and mentor. His teaching experience ranges from coordinating large 1st year biology classes to focused third year courses in zoology/animal ecophysiology and conservation biology. He has taught more than 20,000 students during his academic career at UQ. He has been awarded a number of awards/prizes including being appointed as an ARC Professorial Fellow; receiving an Honorary Doctorate from the University of Göteborg, Sweden; and receiving the President's Medal from the Society for Experimental Biology, UK. Craig has also been recognised for his contributions to teaching and learning, including being twice a finalist in the Australian Awards for University Teaching (for team teaching) and was the recipient of a UQ teaching excellence award.

Craig serves on a number of external professional bodies, committees, and editorial boards. He is the Editor in Chief for the Journal of Experimental Biology (Company of Biologists, Cambridge UK) and past President of the Society for Experimental Biology (2019-2021). He is the Director of Research for the Steve Irwin Wildlife Reserve.

Craig actively champions diversity and inclusion within all aspects of his life - at work, in his communities, and within society more broadly. He is a 'UQ ALLY' in support of the LGBTQAI+ community and upholds the fundamental values of mutual respect, tolerance, and honesty. He always aims to maintain a sense of humour in facing life's challenges.

Outside of work he is a cook, gardener, lover of the oceans, bush & wildlife, and gets enjoyment sharing good food & wine with family and friends, and from being a grandfather.

Keynote 1

Title: Individual Variation, Personality, and the Ability of Animals to Cope with Climate Change.

Presenter: Professor John Cockrem
School of Veterinary Science, Massey University

Abstract:

Animal species are increasingly experiencing more frequent and extreme weather in comparison with conditions in which the species evolved. Individual variation in behavioural and physiological responses of animals to stimuli from the environment is ubiquitous across all species. Populations with relatively high levels of individual variation are more likely to survive in a range of environmental conditions and cope with climate change than populations with low levels of variation. Behavioural and physiological responses are linked in animals, and personality can be defined as consistent individual behavioural and physiological responses of animals to changes in their immediate environment. Glucocorticoids are released when the neuroendocrine stress system is activated in response to stimuli from the environment perceived to be threatening. The size of a glucocorticoid response of an animal is an indication of the animal's personality. Animals with reactive personalities have relatively high glucocorticoid responses, are relatively slow and thorough to explore new situations, and are more flexible and able to cope with changing or unpredictable conditions than animals with proactive personalities. Animals with reactive personalities are likely to be better able to cope with environmental changes due to climate change than animals with proactive personalities. A reaction norm shows the relationship between phenotype and environmental conditions. Populations with relatively high individual variation in plasticity of reaction norms will have more animals that can adjust to a new situation than populations with little variation in plasticity. Future studies of individual variation in plasticity of responses to changing environments will help understanding of how populations of animals may be able to cope with climate change.

Keynote 2

Title: Regulation of Insensible Evaporative Water Loss.

Presenter: Dr Christine Cooper*
School of Molecular and Life Sciences, Curtin University

Abstract:

Maintaining water, energy and thermal balance are core functions for terrestrial endotherms. Water and thermal balance are of more immediate concern than energy balance, so a species' hygric physiology is of particular adaptive significance. Non-thermoregulatory "insensible" evaporation is an important component of water balance. It has long been a physiological paradigm that this insensible evaporative water loss (EWL) is a passive consequence of the physics of evaporation in and below thermoneutrality and therefore EWL is proportional to the water vapour pressure deficit between the animal and the ambient air. However, attempts to account for the effects of ambient water vapour pressure on measurements of marsupial EWL failed to reduce variability in the data. To understand this, we experimentally investigated the effect of the evaporative environment on insensible evaporative water loss for endothermic birds and mammals and found that EWL can be maintained constant over a range of ambient water vapour pressures. We used helox as an alternate method to perturb the evaporative environment; helox should increase insensible EWL via greater respiratory and cutaneous water loss. However, rates of EWL in helox were indistinguishable from those in normal air, further evidence of physiological control of EWL. To understand the role of EWL control, we evaluated the efficacy of EWL regulation for birds and mammals and found no body mass or habitat effects, suggesting the role of insensible EWL regulation may be thermoregulatory, rather than for water conservation. Examining the EWL regulation of endothermic marsupials when both torpid and normothermic, and of ectothermic lizards when thermoconforming and thermoregulating, supports the hypothesis of a thermoregulatory role of EWL control.

* in collaboration with Professor Philip Withers, The University of Western Australia

Keynote 3

Title: Plastic and Evolved Metabolic Responses to Temperature and Nutrition.

Presenter: Dr Lesley Alton*
Centre for Geometric Biology, School of Biological Sciences, Monash University

Abstract:

Climate warming is expected to increase the energy demands of ectotherms by accelerating their metabolic rates exponentially. Ectotherms living in a warmer world may therefore require a greater energy supply to fuel their higher living costs. Unfortunately, nutritional resources in the future are expected to become less abundant and be of poorer quality. How ectotherms will survive in warmer environments with poorer nutrition will likely depend on their ability to adjust their metabolic rates through both phenotypic plasticity and genetic adaptation. My research using the fruit fly, Drosophila melanogaster, shows that metabolic rates have limited capacity to evolve in response to changes in temperature, but that phenotypic plasticity can reduce the energetic costs of climate warming. Surprisingly, metabolic rates do not evolve in response to poor nutrition, but poor nutrition modulates metabolic plasticity in response to climate warming. These results combined indicate that in the absence of evolutionary adaptation, poor nutrition will exacerbate the effect of climate warming on the energy demands of ectotherms. However, to better understand the evolutionary capacity of metabolic rates, I propose that future work should examine how human-induced environmental change will shift life history strategies, and whether these shifts will result in correlated changes in metabolic rate.

* **Lesley A. Alton**[1,2], Teresa Kutz[2], Candice L. Bywater[2], Emily Lombardi[2], Fiona E. Cockerell[2], Sean Layh[2], Hugh Winwood-Smith[2], Pieter A. Arnold[2], Julian E. Beaman[2], Greg M. Walter[2], Keyne Monro[1,2], Christen K. Mirth[2], Carla M. Sgrò[2] and Craig R. White[1,2]

[1]Centre for Geometric Biology, [2]School of Biological Sciences, Monash University

Keynote 4

Title: Functional Traits and The Future Of Comparative Physiology.

Presenter: Professor Michael Kearney
School of BioSciences, The University of Melbourne

Abstract:

Functional traits are a hot topic in biology. Large efforts are underway to build databases to store functional trait data and new methods are being developed to use functional traits in the study of how species are responding to global environmental change. Yet there are nontrivial challenges in defining functional traits, deciding which ones to prioritise, how to store them, and how to use them when making predictions. In this talk I will discuss a new framework for defining functional traits based on their role in dynamical systems models of organisms, focusing on physiologically based models of energy and mass exchange. I will show how the skills and knowledge of comparative physiologists are vital in this framework and argue that we need to take a more active role in the development of functional trait databases and in their application to predict the effects of future environmental change.

Keynote 5

Title: Ten Years On - Using the Physiological Toolbox to Understand Chytridiomycosis, an Emerging Infectious Disease of Amphibians.

Presenter: Dr Rebecca Cramp
School of the Environment, The University of Queensland

Abstract:

Chytridiomycosis, the fatal disease caused by the fungal pathogens Batrachochytrium dendrobatidisis and Batrachochytrium salamandrivorans, has been responsible for the decline or extinction of more than 500 amphibian species globally. A novel infectious disease, understanding why this particular disease emerged when it did, why it has had such a catastrophic impact on biodiversity, what predisposes animals to infection, how infections affect animal health and performance, and how we can manage infections in sensitive populations, has been critical both to amphibian conservation and to wildlife disease management. For over a decade, our research group has been studying the pathobiology of chytridiomycosis in amphibians, the environmental drivers influence disease susceptibility and, more recently, how we can manage the risks of chytridiomycosis to improve the success of captive release programs. This talk will briefly highlight how our integrative and diverse research program has contributed to a greater understanding of chytridiomycosis in Australian amphibians, where our chytridiomycosis work is heading and how our learnings from this program of research can be used to inform surveillance and study for other emerging infectious diseases of wildlife.

Keynote 6

Title: What is the Point of Relative Water Economy?

Presenter: Professor Philip Withers*
School of Biological Sciences, The University of Western Australia

Abstract:

For endotherms, the ratio of evaporative water loss (EWL, mg h-1) to metabolic rate (MR, ml O2 h-1), measured in controlled laboratory conditions, has been used as a comparative index of water economy (excluding urinary and faecal water loss which are often relatively small components of the water budget). Conversion of MR to metabolic water production (MWP, mg h-1) yields the relative water economy index (RWE = EWL/MWP, dimensionless). The air temperature at which RWE = 1 is the point of relative water economy (PRWE), at which the resting animal is in water balance. At lower temperatures, RWE >1 and the animal is in positive water balance. RWE and PRWE have been used as comparative indices of adaptation to aridity, reflecting adaptations to minimise evaporative EWL, maximise MWP, or both. A conceptually similar but more inclusive index of water economy for free-living animals is the ratio of field water turnover rate (FWTR, ml day-1) to field metabolic rate (FMR, kJ day-1), known as the water economy index (WEI = FWTR/FMR, ml kJ-1); this includes evaporative, urinary, and faecal water losses. Conversion of FMR to metabolic water production yields a dimensionless WEI. We provide examples for various species of both PRWE (folivorous marsupials and estrildid finches) and WEI (numbats, thorny devils, and zebra finches). Both PRWE and WEI are useful indices that integrate water and energy balance and reflect the extent of adaptation of species to environmental aridity under controlled and in natural conditions, respectively. We suggest that they are useful tools for the “conservation toolbox” to incorporate into climate models that predict the likely effects of environmental change (e.g., desertification and climate change) on species abundance and distribution.

* in collaboration with Dr Christine Cooper, Curtin University

Keynote 7

Title: The Role of microRNA in the Virulence of Bovine Herpesvirus.

Presenter: Professor Timothy Mahony*
Centre for Animal Science, Queensland Alliance for Agriculture and Food Innovation (QAAFI)

Abstract:

Bovine respiratory disease (BRD) is the major cause of morbidity and mortality in feedlot cattle globally. BRD is a major driver of the therapeutic use of antimicrobials in cattle. A multitude of factors contribute to the likelihood of an animal developing BRD. A well accepted model of BRD development is that cattle arrive at feedlots with compromised immune systems. At the same time, they are exposed to one or more viruses and as a consequence of poor immune function these infections are exacerbated. This combination renders the animals highly susceptible to severe secondary bacterial infections that are diagnosed and treated as BRD. One of the key viruses associated with BRD is bovine herpesvirus 1 (BoHV-1). Following the registration of a BoHV-1 specific modified live vaccine in Australia it was rapidly adopted by the feedlot sector. Several years after the vaccine became available anecdotal reports emerged from the field suggesting loss of vaccine efficacy. Molecular investigations of the BoHV-1 strains isolated after vaccine adoption, suggest there is minimal evidence for either antigenic drift or antigenic shift driving this reported loss of efficacy. Similarly, evaluation of known BoHV-1 virulence markers did not provide any insights. However, analyse of the expression patterns of small non-coding RNAs, microRNA (miRNA), of BoHV-1 strains suggest that these molecules could represent novel virulence determinants. The differential expression patterns of BoHV-1 encoded miRNA species isolated pre and post vaccine adoption will be presented. The possible mechanisms through which these virally encoded miRNAs could affect virulence will be discussed.

*Tristan Wimpenny[1], Tatiana E. Briody[1], Elizabeth .V. Fowler[2], **Timothy J. Mahony[1]**
[1]Centre for Animal Science, Queensland Alliance for Agriculture and Food Innovation.
[2]Animal Science, AgriScience Queensland, Queensland Department of Agriculture and Fisheries.

Special Student Session (Day 2)

Title: Workshop for Postgrads About Learning Aspects of Writing or Speaking.

Associate Professor Louise Kuchel
Deputy Associate Dean Academic (Students)
Faculty of Science

Abstract:

Associate Professor Louise Kuchel contributes to improving the curricular and extracurricular student experience in the Faculty of Science. This work includes developing and delivering initiatives to increase student engagement with opportunities in the educational, community service and industry learning spaces. She works at both the St Lucia and Gatton campuses, online and in collaboration with UQ SEED, UQ Ventures, UQ International Development, the Faculty of Science staff and school staff.

Previously her research focussed on using physiological approaches and techniques to address questions in ecology, conservation, and aquaculture, especially in vertebrates living in extreme environments and continues to be involved in biological research through teaching, co-supervision, and examination of postgraduate students.

Louise's current research is all about finding ways to improve teaching and student learning, with a focus on biology and other sciences.

"This is a new and exciting direction for me to which I and my group are now dedicated. Of particular interest to me is finding ways to improve communication abilities of science students through the design, testing and implementation of effective curricula, class activities and assessment methods. Naturally, no learning occurs in isolation, so my current research also looks at learning scientific reasoning, information literacy, and how to improve the relevance and authenticity of practical/lab classes and assessment tasks."

Academic Presenters

Interplay between stress and reproduction: novel epigenetic markers to boost welfare and reproduction in Australian merino sheep (*Ovis aries*).

Dr Edward Narayan
School of Agriculture and Food Sustainability
The University of Queensland

Australia produces superfine Merino sheep (*Ovis aries*) for wool that is highly sorted in the clothing and fashion industries. Sheep can be exposed to unpredictable environmental conditions (e.g., Heat Stress), which can impact on reproductive outcomes. Shearing or removal of wool is a traditional industry practice that reduces heat load and diseases in sheep. In this study, we determined the effect(s) of early shearing on Australian Merino ewes and their lambs. To test this research question, we used a combination of field and laboratory methods including GPS collars, wool cortisol, and epigenetic changes measured using Illumina NovaSeq RRBS. Ewes were kept on full fleece or shorn early in the gestation period. Top-knot wool sample was taken from ewes during pre-joining, day 50 (mid-gestation), and day 90 (late gestation) for laboratory analysis. Ewes were pregnancy scanned at mid-gestation to determine whether they were early or late parturition (this confirmation is provided by the pregnancy scanner based on fetus size). Top-knot wool sample was also taken from the lambs at weaning for hormone and wool quality testing. Ear tissue was taken from ewes at day 50 (mid-gestation) and from lambs at lamb marking for DNA analysis. Results showed that twice or early shorn ewes grazed 10% higher and maintained stronger body condition than once shorn ewes. Wool cortisol levels were also significantly lower in the early shorn ewes between mid- and late gestation. Lambs bred from twice shorn ewes had on average better visual wool quality parameters in terms of micron, spin finesses, and curvature. For the DNA methylation results, we have discovered that 36 gene loci were significantly modulated either between different shearing treatments or late vs. early pregnancy status of ewes. Collectively, this research provides novel dataset combining physiological, molecular epigenetics, and digital tracking indices that advances our understanding of how Merino ewes respond to shearing frequency, and this information could guide further research on Merino sheep breeding and welfare.

Canada's hottest bats: pronounced evaporative cooling by big brown bats.

Dr Zenon Czenze
School of Environmental and Rural Science
University of New England

The effects of anthropogenic climate change and global heating have pervasive and deleterious effects, particularly for small endotherms. Species that inhabit anthropogenic structures may face the threat of hyperthermia and lethal dehydration to a greater extent than those that have access to natural roosting habitat, which are often cooler. Our knowledge of the effects of climate change is more developed for species south of the equator than species living at northern latitudes. Big brown bats are one of the most common bats across North America, and exploit variable roosting habitats, roost in buildings, and may, therefore, be a species of concern. If bats do not have access to variable microclimates, they may be forced to suffer acute hyperthermia and/or dehydration during heatwaves. To investigate the thermal tolerance of these bats we captured free ranging bats near Lillooet, BC, CAN a semi-arid area, where historic summer temperatures have reached 46.8°C. We captured female and male big brown bats and exposed them to a stepped-temperature regime. We found their heat tolerance limit to be approximately 48.0°C, their maximum body temperature exceeded 44.0°C, and they exhibited pronounced evaporative cooling capacity. Additionally, we used ibuttons to collect temperature of several roosts, and found micro-climates to vary. Under a projected climate model, our data suggest that if populations have access to free standing water, they should be buffered against heat waves reaching >48°C, however, in areas without access to free standing water, bats could be at an increased risk of mortality from heat waves.

Linking physiological data and life-history theory to predict the future of fish.

Professor Craig White
Head, School of Biological Sciences
Monash University

There is an urgent need to understand how animals will respond to ongoing anthropogenic change. Physiological data have been used to explore the proximate impacts of global change on organisms, which might be mediated through the impacts of abiotic stressors on traits such as growth, reproduction, foraging, immune competence, aerobic scope, and others. If such descriptions of how organisms work are reasonable, then they might also provide reasonable predictions of the proximate responses of animals to changes in their environment. But such approaches ignore how fitness (co)varies with evolutionary drivers that are unrelated to physiology, and we know life does not work that way – shifts in the selective milieu induce evolutionary change, and organisms adapt such that their physiologies and life histories are altered. Here we attempt to link proximate and ultimate drivers of climate change responses by incorporating the size-dependence of physiological tolerances into a life-history optimisation model to predict how physiology will impact life-history evolution in the Anthropocene. We parameterised the model using a new compilation of data for the hypoxia and maximum thermal tolerances of 400 species of fish, analysed using phylogenetic mixed models to separate the within- and among-species scaling of tolerance traits. We found that larger species generally have poorer hypoxia tolerance, but that hypoxia tolerance generally improves as size increases within a species. Thermal tolerance, on the other hand, decreases with size both within and among species. Optimisation of the life history under size-dependent mortality results in dramatic decreases in optimum body size, generating a pattern consistent with size-mortality relationships in nature and offering a potential explanation for the widespread size declines observed during the Anthropocene.

Locomotor joint moments in Varanid lizards and the limits to body size in sprawling tetrapods.

Associate Professor Christofer Clemente
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Geometric scaling predicts a major challenge to legged, terrestrial locomotion with increasing body size. Locomotor support requirements at dynamically equivalent speeds scale isometrically with body mass (M1), while force generation capacity should scale M2/3 as it depends on tissue cross-sectional area. Mammals compensate with more upright postures at larger sizes, but it remains unknown how sprawling tetrapods deal with this constraint. Varanid lizards are an ideal group to address this question because they span a large body size range with similar posture and body proportions. We report the scaling of joint moments from the hindlimb and forelimb from varanid species ranging from 7-37,000 g. Joint moments were calculated via inverse kinematics and inverse dynamics in forelimb and hindlimb musculoskeletal models with 23 and 26 muscles, respectively, and 12 dofs in OpenSim. Peak joint moments scaled generally with isometry (M1.30 isometry; M1.31 hindlimb mean; M1.26 forelimb mean) with the exception of hip adduction (M1.45). Impulses of joint moments scaled with positive allometry (M1.167 isometry; M1.55 hindlimb mean; M1.45 forelimb mean). Previous work found that muscle parameters (muscle mass, length, CSA) as well as duty factor scale with positive allometry, suggesting that varanid lizards use both anatomical and kinematic adjustments to produce sufficient joint impulses for locomotion without suffering high peak joint moments. These results suggest that hip adduction may provide a biomechanical limit to sprawling locomotion at large body size.

Leveraging physiology for insect mass rearing: Effects of diet and temperature on cricket performance.

Dr Jacinta Kong*
Department of Biology
Carleton University

Insects are reared en masse for releases related to conservation or pest management, for food and feed production and waste processing, as well as important services like pollination, decomposition, and disease control. Physiological performance fundamentally underpins the quantities and qualities of insects necessary for success in mass rearing programs. Such characteristics include growth, development, and survival that, in turn, are modulated by extrinsic factors such as temperature and diet. However, the relationships between these factors and how they modulate performance deficits and gains at the scale of a mass rearing operation are poorly understood. Here, I showcase how rearing temperature and diet affects the performance of farmed crickets through trade-offs in growth, development, and survival. Higher rearing temperatures (30-38°C) resulted in rapidly maturing and larger crickets at the expense of lower survival and shorter lifespans compared with lower rearing temperatures (20-28°C). Group reared crickets reared on higher protein diets did not differ in growth and development metrics but had lower survival than control diets, and these patterns contrasted with individually reared crickets. I discuss how manipulating insect physiology through rearing conditions and context can ensure the continued success and optimisation of mass rearing programs and the services they provide.

***Jacinta Kong**, Matthew Muzzatti, Émile Vadboncoeur, Heath MacMillan and Sue Bertram, Department of Biology, Carleton University, Canada

Mammalian and avian endothermy, independent origins or common ancestry?

Professor Gordon Grigg
School of the Environment
The University of Queensland

Many papers on the evolution of whole-body endothermy open by stating the long-held tenet that it evolved independently in birds and mammals. In 2022 I was part of a paper challenging that. We put forward evidence suggesting that, despite 300 million years since the separation between mammalian and reptile/bird lines, their whole-body endothermy is very old and is homologous; https://doi.org/10.1111/brv.12822 (open access). We had suspected this when, in addition to BAT, a skeletal muscle source of non-shivering thermogenesis (NST) was becoming better recognised in eutherians. That was thought provoking because birds lack BAT and rely on NST from muscle. Analysing information then available we found considerable but not complete similarity between the two NSTs. Monotremes and marsupials also lack BAT, so they likely rely on NST from muscle. BAT-based NST seems to be a late-comer. Support for common ancestry was strengthened after we demonstrated that the fossil record of both lineages has loads of evidence of whole-body endothermy, even back to the Upper Carboniferous. After briefly summarising that background I will review the similarities in thermoregulatory biology across birds, monotremes, marsupials and eutherians. Though not providing direct evidence, the extensive similarities are impressively consistent with a common ancestry for endothermy. But the detailed extent of similarity at a molecular level between the NST in birds and the putative muscle based NST in all three mammalian groups remains to be clarified. Indeed, no source of NST has yet been demonstrated with certainty in non-eutherian mammals. I will mention one chance observation on an echidna that is provocative. It may even offer a way forward. The palaeontological data are very strong, endothermy is ancient. And the thermoregulatory biology across the four groups concurs with common ancestry. I wonder what influence future research on skeletal muscle NST at molecular and functional levels will have on our hypothesis, after taking into account 300 million years of separation between Sauropsida and Synapsida.

Dramatic genome-wide reprogramming of mRNA in hypometabolic muscle nutrients?

Dr Nicholas Hudson
School of Agriculture and Food Sustainability
The University of Queensland

In response to seasonal droughts, the green striped burrowing frog Cyclorana alboguttata enters a reversible hypometabolic state called aestivation. Oxygen consumption can be reduced in excess of 80% despite warm (>20 C°) ambient temperatures. Transcriptome profiling of aestivating versus control gastrocnemius muscle indicated an extensive metabolic reprogramming, with nearly a quarter of the entire muscle transcriptome (3,996 of 16,960 mRNA) exhibited a nominal > 2-fold change in expression. Consistent with a physiological adaptation to spare carbohydrate reserves various aspects of carbohydrate catabolism were systemically downregulated. This included release of glucose-1-phosphate from stored glycogen (18-fold downregulation of the glycogen phosphorylase enzyme encoded by PYGB), transformation of glucose-1-phosphate into glucose-6-phosphate for entry into glycolysis (PGM1, 9-fold downregulation), inhibition of glycolysis itself (36 and 32-fold downregulation of TPI1 and PGAM) with the penultimate glycolytic step catalysed by enolase (ENO3) dramatically reduced 630-fold. The 590 frog orthologs of mRNA encoding the mitoproteome were, viewed as a population, significantly downregulated during aestivation, although not to the same extent as for carbohydrate catabolism. Prominent examples here include members of the TCA cycle (IDH2), electron transport chain (NDUFA6), the ATP synthase complex (ATP5F1B) and ADP/ATP intracellular transport (SLC25A4), with fold reductions in the order of 3 to 6. Moreover, mRNA derived from the mt genome itself (e.g., mt-ND1) were downregulated 2-5 fold. This set of observations is quantitatively consistent with the observed ~80% (~4-fold) mitochondrial respiratory quiescence observed physiologically. Finally, we note the ~5-fold upregulation of the mRNA EIFG3 that encodes part of the EIF4F complex. This possesses global control of protein synthesis via transportation of mRNA to the ribosomal machinery. Given protein synthesis is repressed in aestivating frogs we propose this indicates muscle is poised for translation of mRNA upon emergence, supporting a molecular strategy to rapidly restore function when the summer rains come.

Does climate and phylogeny interact to explain population differences in torpor physiology for Australian bent-winged bats?

Dr Nicholas Wu
Hawkesbury Institute for the Environment
Western Sydney University

Many endotherms deploy energy-conserving survival strategies such as torpor to decrease their body temperature under unfavourable conditions. However, the expression and pattern of torpor can vary substantially between and within-species. Adaptation to the local environment is one potential driver for within-species variation in torpor patterns. For example, populations from a colder climate may have lower torpor body temperature, metabolic rate, and water loss to conserve energy during cold winters compared to populations from a warmer climate that are rarely exposed to cold winters when subjected acutely to the same cold temperatures. An important outstanding question is what extent does the interaction of environment and gene play in population differences in the thermal sensitivity of torpor physiology.

To test the local adaptation hypothesis in thermal sensitivity, we exposed Australian bent-winged bats (*Miniopterus orieane*) to different temperature regimes and measured torpor skin temperature (proxy for body temperature), oxygen consumption and carbon dioxide production (proxy for metabolic rate), and water loss from four distinct populations via open-flow respirometry. In this talk, I will present preliminary results on how torpor body temperature, metabolic rate, and water loss change under different cold temperature exposure in two populations of bent-winged bats, and I will discuss future plans for the remaining two populations.

Sucrose digestion capacity in birds shows convergent coevolution with nectar composition across continents.

Dr Todd McWhorter
School of Animal and Veterinary Science
The University of Adelaide

The major lineages of nectar-feeding birds (hummingbirds, sunbirds, honeyeaters, flowerpiercers, and lorikeets) are considered examples of convergent evolution. We compared sucrose digestion capacity and sucrase enzymatic activity per unit intestinal surface area among 50 avian species from the New World, Africa, and Australia, including 20 nectarivores. With some exceptions, nectarivores had smaller intestinal surfaces, higher sucrose hydrolysis capacity, and greater sucrase activity per unit intestinal area. Convergence analysis showed high values for sucrose hydrolysis and sucrase activity per unit intestinal surface area in specialist nectarivores, matching the high proportion of sucrose in the nectar of the plants they pollinate. Plants pollinated by generalist nectar-feeding birds in the Old and New Worlds secrete nectar in which glucose and fructose are the dominant sugars. Matching intestinal enzyme activity in birds and nectar composition in flowers appears to be an example of convergent coevolution between plants and pollinators on an intercontinental scale.

Cactus oil and 5-aminolevulinic acid improve performance of juvenile barramundi, Lates calcarifer, under chronic thermal stress.

Dr Alyssa Bowden
School of the Environment
The University of Queensland

Climate change is pushing aquaculture species to their physiological limits through elevated temperature pressures. These elevated temperatures impact feed intake, nutrient use, growth, health, and welfare. Therefore, dietary supplements are being investigated as easy to administer tools to alleviate the stress response and retain productivity in cultured species during an era of climate change. Emerging research shows that manipulating the diet can modulate the stress response and elevate thermal tolerance, which is pivotal in aquaculture species as the oceans continue to warm. In particular, two emerging additives, cactus oil and 5-aminolevulinic acid (5-ALA), have gained traction in research due to their roles in upregulating heat shock proteins and as the sole precursor to heme, respectively. Cactus oil stimulates heat shock protein formation which act as molecular chaperones to stabilise proteins, enhance protein folding, degrade abnormal proteins, and inhibit apoptosis. 5-ALA, on the other hand, is involved in heme biosynthesis. Heme is a very important molecule through the formation of hemoproteins which are involved in aerobic energy metabolism (hemoglobin, myoglobin, cytochrome c oxidase). Using juvenile barramundi as a model species, two trials were conducted to test the efficacy of cactus oil and 5-ALA supplementation in aquafeeds. Each trial consisted of 3 test diets (control and 2 levels of supplementation) and fish were fed the diets for a minimum of 6 weeks. Water temperature was ramped up from 30°C to 37°C over 4 weeks to determine the efficacy of the diets under chronic thermal stress conditions. Results indicate that both cactus oil and 5-ALA supplementation can help fish cope with chronic elevated temperatures, but more research is needed to determine the extent of the protection and the feasibility of industry adoption.

The impact of ultraviolet radiation on marine life physiology.

Dr Adam Downie
Franklin Eco-Laboratory
The University of Queensland

Sunlight is a critical factor supporting ecosystem function, as plants and corals utilize the sun's energy to produce oxygen and develop structure. However, short wavelengths of sunlight, primarily ultraviolet radiation (UVR) are a natural daytime stressor in both terrestrial and aquatic ecosystems. Indeed, UVR acts as a cellular stressor whose impacts can manifests up several levels of biological organization impacting whole animal performance and potentially ecosystem function. Understanding the sub-lethal and lethal effects of UVR on marine life will provide a mechanistic understanding of how different animals and life stages cope with this stressor, as well as what the ramifications are for different populations. My talk will provide an overview of three areas of research during my post-doc at the University of Queensland: I. broad physiological impacts of UVR on animals, II. interactive effects of UVR with other climate stressors on corals, and III. the physiological impacts of UVR on coral reef fish embryo development. My talk will discuss the different approaches to studying UVR'S impacts on marine life, different strategies marine life use to cope with UVR stress, and conservation strategies to mitigate the effects of UVR in marine systems.

Student Presenters

Physiological stress response of koala joeys to visitors.

Harsh Pahuja
The University of Queensland

Koala (*Phascolarctos cinereus*) joey rescues are increasing over the years, and rehabilitation of a joey requires extensive care, close proximity and handling by humans. These novel environments are likely to present a suite of biotic and abiotic stressors during rehabilitation. In this study, we longitudinally monitored the faecal cortisol metabolites (FCMs) of three koala joeys within the context of potential stressors at the Magnetic Island Koala Hospital, Queensland, Australia. A total of 92 faecal samples were analysed for FCMs using a polyclonal R4866 cortisol enzyme-immunoassay which has been previously validated in koalas. The iterative baseline method was used to establish FCM profiles of all individuals, and to identify significant peaks in FCM concentrations. Visitor events were identified and confirmed as an acute stressor based on the FCM profiles of the koala joeys. All three koala joeys elicited a significant rise in FCM concentrations after each visitor encounter. We recommend that visitor encounters be kept to a minimum, and perhaps avoided altogether especially for joeys that are being rehabilitated to be released back in the wild. To our knowledge, this is the first study to report on the acute stress response of koala joeys to visitors.

The effects of multiple stressors and amino acid balance on the energetics and digestion of Atlantic salmon Salmo salar L.

Barbara Nuic Vidigal, Alyssa Bowden, Craig Franklin, Rebecca Cramp
The University of Queensland

Australian Atlantic salmon (Salmo salar) are farmed in Tasmania, a global warming hotspot. Consequently, this species has experienced challenging conditions such as higher temperatures and low aquatic oxygen levels (hypoxia). These conditions usually result in decreased feed intake, growth, and mortality. Temperature and hypoxia affect fish metabolic rate, and it has been alluded to in the literature that this reduction in feed intake could be due to limited aerobic scope (AS) – the energy available for aerobic activities such as digestion. The cost of digestion, absorption and assimilating a meal – termed Specific Dynamic Action, SDA – can occupy a large proportion of the AS and compete for energy allocation to other oxygen-dependant activities. Thus, trade-offs are more likely to happen, and digestion may be de-prioritised under conditions in which the AS is restricted. We investigated the AS and SDA of Atlantic salmon at optimum (15°C) and elevated temperatures (21°C) and under acute hypoxia (at 50% air saturation). We found that both factors reduced Atlantic salmon's AS. Furthermore, it costs more to digest, and SDA occupies a higher proportion of the AS at higher temperatures. Thus, it is challenging for Atlantic salmon on Tasmanian farms to digest and grow under these conditions. However, digesting and assimilating a meal is an inescapable step for growth. Hence, refining diets to provide adequate nutritional requirements and facilitate digestion in challenging environmental conditions is an important approach to be investigated. We investigated the impact of amino acid balance with the supplementation of glutamine – an important amino acid in energy metabolism and gut health - on SDA at elevated temperatures (22°C) in Atlantic salmon parr. Fish were fed three experimental diets for seven to eleven weeks at 22°C, and growth, metabolic rate and critical thermal maximum were investigated.

Reproduction in Red Squirrels.

Dylan, Baloun
University of Saskatchewan

Variation in reproductive phenologies can affect the environment experienced during key life-history stages. Reproduction is commonly timed to occur when resources and weather conditions are optimal for reproductive-ready individuals and/or their new offspring. However, mismatches with less favorable conditions (i.e., increased ambient temperature or low food availability), can constrain maternal investment. Female red squirrels (*Tamiasciurus hudsonicus*) adjust their reproductive output in response to episodic white spruce seed fluctuations to favour either offspring “quantity” (litter size) or “quality” (juvenile growth rate). In years following high seed production, resource availability is high, and squirrels have small litters earlier in the spring when temperatures are low. In the breeding season immediately preceding a bumper crop of seed (when resources are extremely low), reproduction is delayed, litters are larger, and occurs multiple times throughout the warm summer months, creating an opportunity for overwhelming energy expenses, and thus shifts in the phenotypic expression of life-history traits (i.e., maternal investment). We hypothesize that maternal investment during early life-history stages is affected by phenological shifts in ambient temperatures. We used 30+ years of life-history data (litter size and juvenile growth rate) collected from a northern population of red squirrels, near Kluane National Park, YK in conjunction with local weather data to test for trade-offs between, and the effects of temperature and food availability on litter size and juvenile growth rate simultaneously. As our climate continues to change, with shifting phenologies and increasing summer ambient temperatures accelerated at high latitudes, it is imperative that we understand how these changes could constrain reproduction for wildlife and affect their capacity to respond to climatic change.

Not too hot to handle: Thermal physiology of an Australian desert dwelling bat.

Ruvinda de Mel
University of New England

Animals living in arid environments constantly face the threat of dehydration and hyperthermia. For species that do not drink during the hottest part of the day, high temperatures during summer may be lethal. Many bats are particularly vulnerable to overheating, yet our understanding of the physiological strategies used by arid zone bats is lacking. We studied the thermoregulation at high temperatures of the lesser long-eared bat (*Nyctophilus geoffroyii*) (Females=11, Males=6) in Sturt National Park, Australia. We used flow through respirometry, exposed bats to a ramped ambient temperature (Ta) regime, and recorded evaporative water loss (EWL), body temperature (Tb) and resting metabolic rate (RMR). There was an interaction between Sex and Ta in the RMR results, with females spending less energy at higher Ta than males. We found that, as Ta increases, females defend lower Tb than males and exhibit lower EWL than males. Females tolerated higher Ta before increasing their EWL (Inflection point F= 42.5°C, M=40.7°C) and before reaching their higher heat tolerance limit (F= 45.0 ± 1.44°C, M=43.3 ±1.65°C). These results may reflect stronger selection pressures on females to conserve water and tolerate the higher Ta associated with maternity colonies. Our results can help inform how bats in these extreme arid habitats are at risk due to climate change and heat waves.

The dynamics of cave roost use by bats in the central Himalayas of Nepal.

Sanjeev Baniya
University of New England

Seasonal cave use by bats can be attributed to performing energetically expensive acts such as mating and reproduction or using prolonged energy saving torpor to avoid energetic shortfalls associated with winter. Although cave use by bats varies inter- and intra-specifically, roost site characteristics and microclimates have critical fitness consequences. Climate change is affecting cave microclimates globally and it is necessary to understand the current patterns of roost use, community composition, and activity inside caves to help quantify the effect of climate change on underground ecosystems. We recorded cave temperatures and examined species richness and abundance of bats in 41 caves in central Himalayas across a seasonal (mid-winter, late winter, and early spring) and an elevational (400 - 2700 m) gradient. We found that most caves were used as maternity sites in early spring rather than hibernacula during mid-winter, and that Hipposideros armiger, Rhinolophus affinis, Rhinolophus cf. pusillus used warmer microsites in early spring (H. armiger: 20.1±1.6 °C, R. affinis: 20±1.8 °C, R. cf. pusillus: 19.6±1.6 °C) as compared to mid-winter (H. armiger: 18±0.9 °C, R. affinis: 16.2±3.1 °C, R. cf. pusillus: 15.4±2.9 °C). Further, species richness and abundance changed seasonally, with more species and individuals present in early spring compared to mid-winter. In mid-winter, species richness was negatively correlated with elevation, with more species at low elevation. Our results indicate that small changes in microclimatic temperatures can have large impacts on the community structure of cave-roosting bats. We recommend that this work be replicated in other areas with high diversity of cave-roosting bats to help predict the effects of climate change on these species.

Inferring Predation and Locomotor Strategies of Extent and Extinct Carnivorous Marsupials from Locomotor Shape.

Joshua Gaschk
University of the Sunshine Coast.

Predation pressure shapes ecosystems through natural selection. In Australia, predators have evolved from marsupial lineages separate from other Carnivorans; Canids, Felids, and Viverroids. Where marsupial predators, Dasyurids and Thylacinus cynocephalus, fit within globally dominant predator clades, is important to understand the evolution of Australian ecosystems. Here, we used geometric morphometric and principal component analyses to compare the locomotor shape and spatiotemporal gait characteristics of locomotion within these different clades. To do this, side profile videos of various animals during symmetrical and asymmetrical locomotion were collated and a Procrustes alignment was performed to account for the size differences between species. Results demonstrated that the main distinction between locomotor shape and spatiotemporal characteristics (e.g., articulation over time) differentiated cursorial pursuers from ambush predators. Dasyurids were more like Felids with crouched postures and highly protracted forelimbs at footfall, however their posture was more crouched and spine more flexed which could be attributed to their scansorial lifestyle. The thylacine's only definitive relationship was with larger Viverroids (hyaena), where they show more gathered walking gaits, likely for efficiency and support of structures specialised for scavenging. If the thylacine's feeding ecology was predominantly scavenging, this could explain the naivete of Australian fauna to predation pressure from ambush and pursuit hunting specialists.

The relationship between the seasonal variation in wool quality and wool cortisol in merino ewes.

Georgia Hantzopoulou
The University of Queensland.

Higher cortisol levels are known to have a negative effect in wool production. In this experiment we attempted to measure the levels of cortisol through a reproductive season in merino ewes and match it with the wool quality traits of those ewes during the same time period, in an attempt to quantify the impact of cortisol on wool production. Long wool samples were collected post-parturition, the length was measured and then the wool was cut into multiple 1cm sub-samples which were used to see the differences in wool cortisol and quality traits though time, as wool is estimated to grow about 1 cm/month. The data analysis is ongoing, but it is expected that the samples that have highest cortisol levels will have lower wool quality traits during the periods of higher cortisol, and that the wool sub-samples with the better-quality wool traits will have lower cortisol levels. The environmental data for the wool growth period were also collected and matched with the equivalent wool centimetre, and through them we might be able to detect a relationship between climatic conditions, stress in sheep, and wool quality traits, which will be important with the climatic changes expected to occur in the near future. If our hypotheses are true, then this could lead to significant changes in the wool production industry, as wool farmers will be able to select for and breed animals with higher resistance to stress, which will lead to lower wool cortisol and higher wool quality. In addition, by choosing for more stress-resilient sheep, the animal welfare of the population will be improved.

Combining biomechanics and movement ecology to investigate habitat use and optimisation in free-ranging macropod species using accelerometry and machine learning algorithms.

Jasmin Annett
University of the Sunshine Coast

This ambitious project will quantify fine-scale movement data from free-ranging macropod species using accelerometry and machine learning algorithms. We will use cutting edge methodology to predict the behaviours of closely related macropod species such as Eastern Grey kangaroos (Macropud giganteus), Red kangaroos (Macropud rufus), Wallabies, Quokkas (Setonix bracyurus), Pademelons (Thylogale sp.) and the Musky Rat kangaroo (Hypsiprymnodon moschatus). The free-ranging movement data will infer species specific behavioural budgets relating to habitat type and structure. Coupled with macropod speed-energy landscape models we will be able to relate the habitat specific activity budgets with locomotion energetics, to understand the cost and benefit of hopping in varying habitats and species of different weight categories. This data will also allow us to infer species responses to urban infrastructure and provide a more refined evaluation on the use of habitat corridors and fencing, studies of which are few and far between.

Salivary cortisol in dolphins: challenges and possible applications for adrenal hormone monitoring for animals under human care.

Isabella Reboul
The University of Queensland

Non-invasive hormone analysis is a useful tool to assess adrenocortical activity, providing insight into the physiological state of an animal and how animals cope with environmental challenges. Routine endocrine monitoring is historically conducted using blood sampling, but this can be undesirable due to the invasive nature of venepuncture. This study biologically validated the use of saliva in bottlenose dolphins (Tursiops truncatus) as a reliable and less invasive alternative to blood sampling for evaluating acute changes in cortisol associated with an external physiological stressor. Paired blood and saliva samples were collected 24 h before, after and during a routine veterinary procedure, during which nine dolphins were held out of water for up to 30 min. Using enzyme immunoassays, we found a significant, positive correlation between blood and salivary cortisol concentrations. Both plasma and salivary cortisol concentrations increased significantly during the procedure, and returned to pre-procedure concentrations within 24 h. Diurnal variation in salivary cortisol levels was also evaluated in 12 bottlenose dolphins during 15 days of baseline management conditions. Voluntary saliva samples were collected five times during daylight hours (06:00h, 10:45h, 12:00h, 14:45h, 16:00h). Salivary cortisol concentrations were higher at 06:30h than at any other time of day, and decreased significantly by 10:45h, remaining stable until the last sample was taken at 16:00h. The methods used in this study demonstrate how serial saliva sampling can be implemented in animal care facilities as a monitoring tool to evaluate dolphin adrenal function including the effects of acute stressors. Depending on the timing of sample collection, normal diurnal variation may need to be considered. The benefits and challenges of collecting saliva samples for adrenal hormone analysis, and the broader implications of this study on cetacean welfare will be discussed.

Postural adaptations underpin increased tendon stress in hopping kangaroos: potential contributors to the energetic advantages of hopping.

Lauren Thornton
University of the Sunshine Coast

Hopping kangaroos exhibit remarkably little increase in metabolic energy expenditure with locomotor speed compared to other running animals. This phenomenon may be related to greater elastic energy savings due to increasing tendon stress, however, the underlying mechanisms contributing to the rise in tendon stress remain poorly understood. We created a three-dimensional (3D) kangaroo musculoskeletal model, integrating 3D motion capture and force plate data, to analyse the kinematics and kinetics of hopping red and grey kangaroos. Using our model, we evaluated how body mass and speed influence (i) hindlimb posture, (ii) effective mechanical advantage (EMA), and (iii) the associated tendon stress in the ankle extensors during hopping. We found that increasing ankle dorsiflexion and metatarsophalangeal plantarflexion likely played an important role in decreasing ankle EMA by altering both the muscle and external moment arms, which subsequently increased peak tendon stress. Surprisingly, kangaroo hindlimb posture appeared to contribute to heightened tendon stress rather than mitigate it to minimize the risk of tendon rupture, thereby elucidating a potential mechanism behind the increase in stress with speed. These posture-mediated increases in elastic energy savings could be a key factor enabling kangaroos to achieve energetic benefits at faster hopping speeds.

UV radiation and amphibian declines: a molecular investigation.

Coen, Hird
The University of Queensland

1) Global amphibian declines have often occurred at high altitudes, linked to complex interactions between stressors such as emerging diseases and abiotic factors. The interactions between drivers of amphibian declines are largely unknown, and multiple abiotic factors are implicated including increased levels of ultraviolet radiation (UVR) and temperature.
2) Some amphibian life-stages (embryo and larvae primarily) employ a variety of physiological strategies to mitigate against long term impacts of UVR exposure, including repairing UVR-induced DNA damage through the enzyme photolyase. Cool temperatures can slow the rate of photolyase activity after UVR exposure, but the ecological relevance of this in the whole organism and in relation to amphibian declines is not well understood.
3) Here, we used a range of laboratory experiments to investigate a) the thermal sensitivity of UV-induced DNA repair and photolyase expression in three species of amphibian larvae; and b) the capacity for cold acclimation to offset the depressive effects of temperature on UV-induced DNA damage accumulation in a model species of amphibian larvae.
4) We found that cool temperatures had a depressive effect on UV-induced DNA repair in two species. However, the magnitude of DNA damage and effect of temperature following the acute dose differed between species. We further discovered that cool-acclimated larvae had significantly reduced DNA damage compared with warm-acclimated larvae. Cold acclimation induced melanism, but this did not provide a photoprotective effect on UV-induced DNA damage accumulation. It is therefore likely that the cold acclimation can be attributed to thermal plasticity in the activity or constitutive abundance of CPD photolyase.
5) Taken together, these results revealed a complex interplay between environmental temperature and the repair of UV-induced DNA damage, highlighting the need to consider species-specific differences and acclimation capacities when forecasting the impact of increased UVR in amphibian habitats.

Effect of early environment on the response to a stressor in two sympatric lizards.

Pablo Recio Santiago
The Australian National University

The environment in which organisms develop can have sustained effects during later stages of life. Prenatal thermal environment and stress hormones are predicted to interact in reptiles to shape different aspects of their behavior and physiology. Here, we tested the interactive effects of prenatal Corticosterone (CORT) – the main stress-related hormone in reptiles – and incubation temperature on lizards response towards a stressor. Preliminary analyses show that exposition to CORT during early development affect the response of lizards towards a stressor later in life.

Effects of stocking density during simulated transport on physiology and behaviour of largemouth bass (Micropterus salmoides).

Yifei Yang
The University of Queensland

Live transport of farmed fish is common practice in the Chinese aquaculture industry. However, it is stressful to fish and can cause welfare issues. This study aimed to determine the effects of transport stocking density on the physiology and behaviour of largemouth bass (Micropterus salmoides). There were four experimental treatments in a two-factor design (N = 5 groups per treatment). Fish were distributed into stocking densities of either 39 (low density) or 78 (high density) g/L. Half of the fish groups were exposed to transport stress for 3 h simulated by a motion platform, and the other half were kept in static tanks for the same length of time. Baseline physiology and behaviour were measured from a subset of fish after acclimation but before selection into groups and application of transport. Experimental fish physiology and behaviour were measured immediately after transport to determine the effect of transport, stocking density, and their interaction. Water quality was measured before and after transport. Dissolved oxygen levels decreased in the high-density transported groups after transport. Water temperature increased for all experimental groups post-transport, as did total ammonia nitrogen levels, particularly in the high-density groups. Serum cortisol, catalase, and aspartate transaminase significantly increased in the transported groups compared to the control fish. We identified a positive correlation between serum and mucus samples for cortisol, glucose, and lactate in transported fish, providing information to develop less invasive methods to assess largemouth bass welfare. Fish ventilation rates elevated in the groups kept at a high stocking density regardless of whether they experienced transport stress. High-density transported fish showed more fear-related behaviours like freezing and thigmotaxis than non-transported groups. We conclude that both a 3-h simulated transport and higher stocking densities are stressful to largemouth bass as evidenced by physiological and behavioural indicators of stress, and water quality.

Lateral spinal undulation in lizards: Optimal body plans in theory, in vivo, and in robots.

Robin Maag
Biorobotics Lab
University of the Sunshine Coast

While mammals utilise flexion-extension motion of their spine to facilitate their locomotion on land, squamates utilise more archaic, fish-like lateral bending patterns. Particular for legged squamates, like most lizards, the advantages, and disadvantages of lateral spinal undulation (LSU) are subject of current discussion, predominantly on the basis of isolated experiments in vivo, in silico or using robots. Here, we aim at combining all three approaches for their mutual benefit: In vivo walking and climbing lizard data were collected and analysed, spinal and limb kinematics extracted, and a simple geometric model derived to predict resultant maximum stride length, which is in turn was used to validate a bio-inspired robot: SQUAMATAR. Subsequently, we use the robotic model to investigate the effect of LSU and limb kinematics on the efficiency and stability of walking and climbing. While increased LSU seemingly increases efficiency, the opposite holds for stability. We discuss the trade-offs and offer mechanistic rationales for the biological role of LSU.

From effluent to oestrogen, exploring the role of sewage in turtle reproductive physiology.

Angela Simms
La Trobe University

Endocrine-disrupting chemicals (EDCs) have been of concern for wildlife since the 1950s. For wildlife exposed, endocrine-disrupting chemicals are known to have reproductive and physiological effects that can impact embryonic development and survival, and affect thyroid function, the immune system, and the nervous systems. Turtles are considered one of the most threatened vertebrate groups in the world. In south-eastern Australia, freshwater turtles are common within settling ponds of wastewater treatment facilities. However, our understanding of effluent exposure to reptiles overall is extremely limited. Due to freshwater turtles long life spans and potential site fidelity to these settling ponds, this may increase their vulnerability to impacts from EDCs. The aim of our study is to see whether environmental oestrogens within wastewater settling ponds disrupt the natural oestrogen and testosterone cycle within Murray River turtles (Emydura macquarii) and Eastern long-necked turtles (Chelodina longicollis). To address our aim, we assess oestrogen and testosterone cycles in turtles in sewage settling ponds compared with nearby reference sites (natural wetlands), where we sampled blood from turtles at three time points (Autumn, Spring and Summer). We also did ultrasounds on female turtles to confirm the reproductive stages of individuals across the three seasons. The results from our study will provide insight as to whether turtle reproductive hormones may be impacted by EDCs found in sewage-settling ponds.

Conservation physiology of koalas using faecal glucocorticoid analysis.

Renae Charalambous
The University of Queensland

Prolonged exposure to stressful stimuli activates a stress response that is known to pose significant threats to animal health both in the wild and in captivity. In the face of escalating environmental challenges, and the recurrent need for rescue and rehabilitation, understanding and predicting how wildlife responds to stressful stimuli has become paramount for effective conservation management. Furthermore, the recently endangered koala provides a compelling model for investigating the homeostatic health parameters associated with the stress response.

Proposed by Michael Romero, the Reactive Scope Model conceptualises several physiological mediators associated with the stress response across four distinctive ranges of health. These are predictive and reactive homeostasis, which encompass a “normal reactive scope,” as well as homeostatic overload and homeostatic failure, which encompass disease and death. Using this model, we aim to quantify homeostatic health parameters of South-East Queensland koalas using faecal glucocorticoid metabolite concentrations.

Our study employs a non-invasive approach by analysing faecal glucocorticoid metabolite concentrations. This methodology provides an insight into the physiological status of a koala without causing undue disturbance. In fact, the benefits of faecal glucocorticoid metabolite analysis extend beyond ethical considerations, as they provide a means to study an elusive species such as the koala effectively. Ultimately, our study seeks to provide a robust foundation for adaptive management practices, facilitating the conservation of koalas in the wild and in captivity to safeguard their survival.

Stress Lab
University of Queensland

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