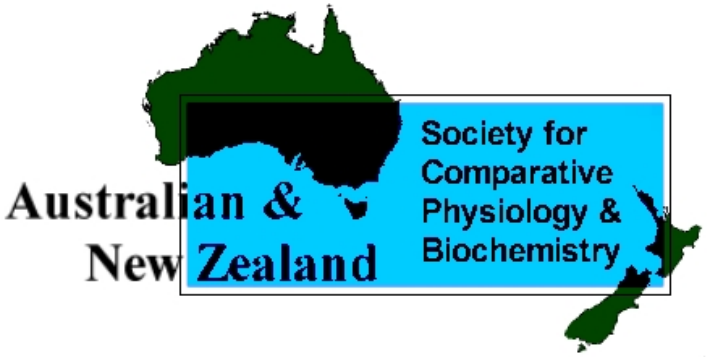
# AUSTRALIAN AND NEW ZEALAND SOCIETY FOR COMPARATIVE PHYSIOLOGY AND BIOCHEMISTRY


Silver Jubilee

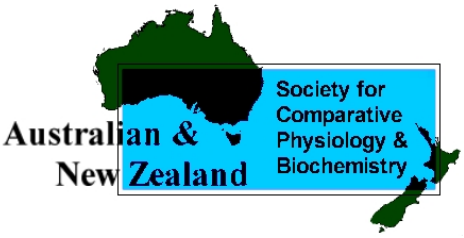
25TH ANNIVERSARY
GENERAL MEETING

December 5-8, 2008

University of Sydney

# AUSTRALIAN AND NEW ZEALAND SOCIETY FOR COMPARATIVE PHYSIOLOGY AND BIOCHEMISTRY

University of Sydney, December 5-8, 2008


## Organising Committee:

Mike Thompson, Frank Seebacher, Bronwyn McAllan, Adam Munn, Scott Parker

# Sponsors:

- **School of Biological Sciences, University of Sydney**
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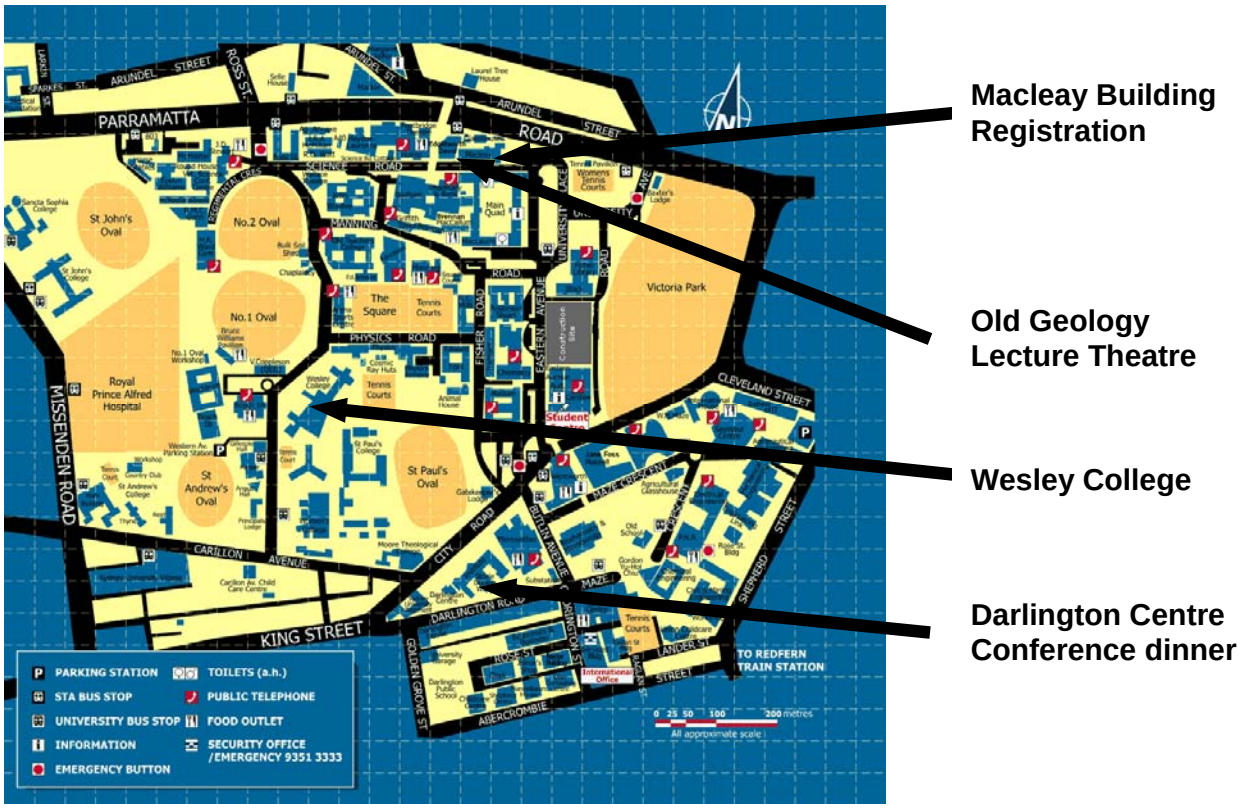

# ANZCPB 2008 – Silver Jubilee Meeting, University of Sydney

| Time | Friday 5 Dec | Saturday 6 Dec | Sunday 7 Dec | Monday 8 Dec |
|---|---|---|---|---|
| 8-9 | | 8:45 announcements | 8:45 announcements | 8:45 announcements |
| 9-10 | | **Symposium 1**<br>Evolutionary physiology<br>Plenary Lecture<br>Ary Hoffmann<br><br>10-10:30 symposium papers | **Symposium 2**<br>Molecular physiology<br>Plenary Lecture<br>Ken Storey<br><br>10-10:30 symposium papers | **Plenary Lecture**<br>A Fatty Tail<br>Tony Hulbert<br><br>10-10:30 Digestion |
| **10-11** | | **10:30-11 Morning tea** | **10:30-11 Morning tea** | **10:30-11 Morning tea (includes group photo)** |
| 11-12 | | Symposium papers | Symposium papers | Behaviour and ecology |
| 12-13 | | | | |
| **13-14** | | **Lunch** | **Lunch** | **Lunch** |
| 14-15 | | Thermal Biology | Respiration and metabolism | Reproduction |
| 15-16 | Public Lecture<br>Ken Storey | | **15:15:30 afternoon tea** | **Student Prizes** |
| 16-17 | Registration + Drinks | Posters + drinks and snacks | Respiration and metabolism | Business meeting |
| 17-18 | | | | |
| 18+ | | | 19+ conference dinner<br>Dinner speaker: Gordon Grigg | |

# CONFERENCE PROGRAM

| Friday 5 December | |
|---|---|
| | |
| **3:00** | **Professor Ken Storey – University of Sydney Seminar, Eastern Avenue Lecture Theatre** |
| **4:00 – 7:00** | **Registration desk open** |
| Pre-conference registration will be held in the foyer of the Macleay Building A12.<br>Registration pack will be available for collection, light refreshments (finger food, beer, wine, soft drinks) will be provided | |

# CONFERENCE PROGRAM

Presenter in bold: * indicates student presentation eligible for prize

| Saturday 6 December | |
|---|---|
| **Symposium: Evolutionary physiology – Chair: Mike Thompson** | |
| **8:45** | **Announcements** |
| **9:00** | **Plenary Lecture**<br>**Identifying physiological limits to evolutionary adaptation**<br>**Ary Hoffmann** |
| **10:00** | Genetic divergence in the thermal dependence of performance among populations of the native fruit fly, *Drosophila serrata*<br>**Camille Latimer***, Robbie S Wilson and Steve Chenoweth |
| **10:15** | Mixed signals: thermal performance of zebrafish (*Danio rerio*) in uncertain environments.<br>**Catriona H Condon***, Stephen F Chenoweth and Robbie S Wilson |
| **10:30-11:00** | **Morning tea** |
| | **Symposium: Evolutionary physiology – Chair: Ary Hoffmann** |
| **11:00** | Physiological responses of marine gastropod species to the highly variable thermal regimes of the intertidal region of temperate New South Wales<br>**Sam D. Clayman***, Frank Seebacher, Michael B. Thompson |
| **11:15** | Intestinal enzyme activity in the tropical agamid lizard, *Lophognathus temporalis*<br>**Sebastian Iglesias***, Christopher T. Tracy, Keith A. Christian |
| **11:30** | Comparison of physiological responses of a native and an introduced herbivore to the scent of predators<br>**Valentina Mella***, Christine Cooper |
| **11:45** | Migratory locusts increase aerobic capacity<br>**Edward P. Snelling***, Roger S. Seymour |
| **12:00** | Temperature-induced variation in phallus size reliably indicates male physical performance and gamete quality in eastern mosquito fish (*Gambusia holbrooki*)<br>**Robbie S Wilson** |
| **12:15** | Geographic variation in weapon size and maximum strength among populations of the two-toned fiddler crab (*Uca vomeris*).<br>**Candice L. Bywater***, Robbie S Wilson |
| **12:30** | Costs and benefits of a sexually selected trait in the threadfin rainbowfish *Iriatherina werneri*<br>**Andrew G. Trappett***, Craig R. White, Robbie S. Wilson |
| **12:45** | Putting physiology on the map<br>**Michael Kearney** |
| **1:00-2:00** | **Lunch** |

# CONFERENCE PROGRAM

Presenter in bold: * indicates student presentation eligible for prize

| Saturday 6 December | |
|---|---|
| **Thermal biology – Chair: Mike Kearney** | |
| **2:00** | The effect of latitude on body temperature and metabolic capacity in a native rat (*Rattus fuscipes assimilis*).<br>**Elsa Glanville***, Frank Seebacher |
| **2:15** | Thermoregulation in the little penguin (*Eudyptula minor*)<br>**Lyndal R. Horne***, Jonathan A. Green, Peter B. Frappell |
| **2:30** | Selected body temperature, metabolic rate and activity pattern of the Australian fossorial skink, *Saiphos equalis*<br>**Qiong Wu***, Scott L. Parker, Michael B. Thompson |
| **2:45** | Does thermal ecology constrain species distributions?<br>**Scott van Barneveld*** |
| **3:00** | Summer torpor in a subtropical insectivorous bat<br>**Clare Stawski***, Christopher Turbill, Fritz Geiser |
| **3:15** | Nonshivering thermogenesis in a small marsupial?<br>**Elias Polymeropoulos***, Peter B. Frappell |
| **3:30** | Hot & Bothered: does temperature affect the territorial behaviour and costs of fighting in males of the highly aggressive crayfish *Cherax destructor*?<br>**Ben Barth***, Vincent Van Uitregt, Catriona Condon, Candice Bywater, Daniel Hancox, Robbie Wilson |
| **3:45** | The effect of rapid cold hardening on ion homeostasis, mortality, chill-coma recovery and sexual behaviour of *Locusta migratoria*<br>Sofia Calderon, **Johannes Overgaard** |
| | |
| **4:00-6:00** | **Posters and drinks – Macleay Foyer** |
| | **Own arrangements for dinner** |

# Posters

## Foyer of Macleay Building – drinks included

| |
|---|
| Rat skeletal muscle membrane fatty acid composition is most responsive to the balance of dietary n-3 and n-6 polyunsaturated fatty acids<br>**Sarah K. Abbott***, Paul L. Else, A.J. Hulbert |
| The secret sex life of echidnas, the ¡Button and stump cam story<br>**Niels A Andersen**, Gemma Morrow, Jemma Chaplin, Stewart Nicol |
| Presenting Vascular endothelial growth factor C (VEGF-C) of the gecko *Christinus marmoratus* – Sequence and model<br>**Helen A. Blacker***, Sandra Orgeig, Gary W. Booker |
| Effect of the tapeworm, *Hymenolepis diminuta*, on nutritional indices and morphology of the digestive tract of Wistar rats<br>Budhima Nanayakkara , Carolyn Behm, **Paul D. Cooper** |
| Surviving the feast: Protection of intestinal function during prolonged fasting is the key to re-feeding success in a burrowing frog<br>**Rebecca L Cramp**, Edward A Meyer, Craig E Franklin |
| Sexual Selection and Visual Physiology: Maintenance of a rare colour morph in the Ornate Rainbowfish, *Rhadinocentrus ornatus*<br>**Daniel Hancox***, Conrad Hoskins, Craig White, Robbie S Wilson |
| The Effect of Intrauterine Growth Restriction on Pulmonary Surfactant Protein mRNA Levels in the Ovine Fetus<br>**Sandra Orgeig**, Tamara A. Crittenden, I. Caroline McMillen, Janna L. Morrison |
| Dynamics of organic contaminant burdens in the Southern Ocean humpback whale (*Megaptera novaeangliae*)<br>**Courtney Waugh***, Michael Noad, A'edah Abu Bakar, Susan Bengtson Nash |
| Is the Ancient Bunya Tree (*Araucaria bidwillii Hook*)- Sustainable at Remnant Sites?<br>Ian R. Smith, **Kerry W. Withers**, Simon Blomberg, John Billingsley |
| Do hot frogs waste away?<br>**Karen M Young***, Dr Rebecca L Cramp, Dr Craig White, Prof Craig E Franklin |

# CONFERENCE PROGRAM

Presenter in bold: * indicates student presentation eligible for prize

| Sunday 7 December | |
|---|---|
| **Symposium: Molecular physiology- Chair: Frank Seebacher** | |
| **8:45** | **Announcements** |
| **9:00** | **Plenary Lecture**<br>**Mammals on Ice: Molecular Secrets of Winter Hibernation**<br>**K.B. Storey** |
| **10:00** | Does AMP induce torpor?<br>**Steven J. Swoap** |
| **10:15** | Molecular mechanism which underlie the development of endothermy in birds (*Gallus gallus*)<br>**Isabel Walter***, Frank Seebacher |
| **10:30-11:00** | **Morning tea** |
| | **Symposium: Molecular physiology- Chair: Ken Storey** |
| **11:00** | Uterine angiogenesis in reproductive skinks: Characterisation and uterine expression of vascular endothelial growth factor (VEGF)<br>**Bridget F. Murphy***, Katherine Belov, Michael B. Thompson |
| **11:15** | Metabolic gating of fecundity and previtellogenic follicle expression of growth differentiation factor 9 and bone morphogenetic protein 15 in the short-finned zebrafish (*Danio rerio*)<br>**Erin L. Forbes***, P. Mark Lokman |
| **11:30** | Effects of pituitary hormones on GDF-9, BMP-15 and StAR mRNA expression in the previtellogenic ovary of the New Zealand short-finned eel *Anguilla australis*<br>**Peter M. Reid***, Sean L. Divers, P. Mark Lokman |
| **11:45** | Insulin like growth factor–I gene expression in previtellogenic ovary of eel, *Anguilla australis*.<br>**Alireza Shoae***, Alvin N. Setiawan, P. Mark Lokman |
| **12:00** | Molecular bases of the seasonal migration of *Gecarcoidea natalis*<br>Ute Postel, Fiona Thompson, Mark Viney, Gary Barker, Simon Webster, **Steve Morris** |
| **12:15** | Functional Diversity of Fish Heart Mitochondria<br>Sarah Rynbeck, Michael Oellermann, **Anthony Hickey** |
| **12:30** | Non-invasive monitoring of stress hormones in the endangered Fijian Ground Frog (*Platymantis vitianus*)<br>**Edward J. Narayan***, Frank C. Molinia, John F. Cockrem, Ketan S. Christi, Craig G. Morley |
| **12:45** | Detecting environmental change: transient receptor potential ion channels control thermoregulatory behaviour in reptiles<br>**Frank Seebacher**, Shauna A. Murray |
| **1:00-2:00** | **Lunch** |

# CONFERENCE PROGRAM

Presenter in bold: * indicates student presentation eligible for prize

| Sunday 7 December | |
|---|---|
| **Respiration and metabolism – Chair: Rufus Wells** | |
| **2:00** | Surviving the drought: Burrowing frogs save energy by increasing metabolic efficiency<br>**Sara M. Kayes***, Rebecca L. Cramp, Nicholas J. Hudson and Craig E. Franklin |
| **2:15** | Hypoxia tolerance in Antarctic fish<br>**Bill Davison** |
| **2:30** | Metabolic and ventilatory changes upon exposure to hypoxia and hypercapnia in neonatal fat-tailed dunnarts *(Sminthopsis crassicaudata)*<br>**Shannon J. Simpson***, Peter B. Frappell |
| **2:45** | Oxygen consumption in embryos and larvae: examining the critical point<br>**Casey Mueller*** |
| **3:00-3:30** | **Afternoon Tea** |
| **3:30** | Effects of measurement duration on the determination of basal metabolic rate and evaporative water loss of small marsupials: How long is long enough?<br>**Christine E. Cooper**, Philip C. Withers |
| **3:45** | Metabolic physiology and relative water economy in the brushtail bettong (*Bettongia penicillata*)<br>**Sylvie Schmidt***, Ariovaldo Cruz-Neto, Christine Cooper, Philip Withers |
| **4:00** | Oxygen delivery in reptiles: effects of body temperature<br>**Sarah J. Andrewartha***, Suzanne L. Munns and Peter B. Frappell |
| **4:15** | Are all discontinuous gas exchange cycles the same?<br>**Philip G. D. Matthews** |
| **4:30** | Insects breathe discontinuously to reduce respiratory water loss<br>**Natalie G. Schimpf***, Philip G. D. Matthews, Robbie S. Wilson, and Craig R. White |
| **4:45** | The sauropod's long neck<br>**Roger S. Seymour** |
| | |
| **7:00** | **Conference dinner – Darlington Centre** |

# CONFERENCE PROGRAM

Presenter in bold: * indicates student presentation eligible for prize

| Monday 8 December | |
|---|---|
| **8:45** | **Announcements** |
| **9:00** | **Plenary Lecture- Chair: Adam Munn**<br>**A Fatty Tale**<br>**A.J. Hulbert** |
| | **Digestion** |
| **10:00** | Post ingestive regulation of nutritional uptake: differential release of gut enzymes enables nutritional needs to be met on unbalanced diets<br>**Fiona J. Clissold**, Stephen J. Simpson, Benjamin J. Tedder and Arthur Conigrave |
| **10:15** | Dilatations, Diverticulae and Distal Digesta: an exploration of motility and hydrodynamics in avian and mammalian caecae.<br>**Roger G Lentle**, Patrick WM Jannsen |
| **10:30-11:00** | **Morning tea** |
| | **Behaviour and ecology – Chair: Ashley Edwards** |
| **11:00** | Costs and benefits of predator induced behaviour in larvae of the urban mosquito (*Aedes notoscriptus*)<br>**Vincent O. van Uitregt***, Craig R. White, Robbie S. Wilson |
| **11:15** | Predicting climatic constraints on the Dengue mosquito, *Aedes aegypti*, in Australia<br>**Kelly Richardson***, Michael Kearney, Ary Hoffmann |
| **11:30** | The importance of physiology and microenvironmental information in predicting climate change impacts<br>**Andres Merino-Viteri***, Stephen E. Williams, Luke Shoo, Andrew Krockenberger |
| **11:45** | Risk of predation enhances the lethal effects of UV-B in amphibians<br>**Lesley A. Alton***, Robbie S. Wilson, Craig E. Franklin |
| **12:00** | The impact of habitat fragmentation on measurable indicators of physiological stress in the small Australian marsupial *Antechinus agilis*<br>**Christopher Johnstone***, Alan Lill, Richard Reina |
| **12:15** | Does body condition account for variation in plasma corticosterone in cane toads?<br>**Megan A. Kelly***, Lee B. Astheimer, William A. Buttemer |
| **12:30** | Can faecal glucocorticoids be used as an indicator of stress in captive koalas?<br>**Koa N. Webster**, Sarah McKenzie, Elizabeth M. Deane |
| **12:45** | Effect of relative humidity on evaporative water loss in marsupials<br>**Philip C. Withers**, Christine E. Cooper |
| **1:00-2:00** | **Lunch** |

# CONFERENCE PROGRAM

Presenter in bold: * indicates student presentation eligible for prize

| Monday 8 December | |
|---|---|
| **Reproduction – Chair: Rebecca Cramp** | |
| **2:00** | The thermal properties of birds' nests<br>**Caragh Heenan*** |
| **2:15** | Temperature-dependent sex-biased embryo mortality in a bird<br>**Yvonne A. Eiby***, Jessica Worthington Wilmer, David T. Booth |
| **2:30** | Control of early oogenesis by methyl farnesoate in the Christmas Island red crab, *Gecarcoidea natalis*<br>**Stuart Linton**, Lauren Barrow, Claire Davies, Laura Harman |
| **2:45** | Hibernation and reproduction overlap in the echidna (*Tachyglossus aculeatus*)<br>**Stewart C. Nicol**, Gemma Morrow, Niels A. Andersen |
| **3:00** | **Student and staff prize announcements** |
| | **Annual General Meeting** |
| | Next meeting |
| | Other business |

## Identifying physiological limits to evolutionary adaptation

**Ary Hoffmann**

Department of Genetics & Department of Zoology, Bio21 Institute, Room 263, Level 2, 30 Flemington Road, Parkville, Victoria

Models of evolutionary change typically assume that physiological traits are controlled by variation at a substantial number of polymorphic loci and therefore capable of responding readily to natural selection. This is backed up by empirical data from model animals that indicate substantial changes in physiological traits are possible under artificial selection. However this notion is at odds with the phylogenetic conservatism evident in many species comparisons. Perhaps genetic diversity available for selection is much more constrained than previously appreciated, and patterns established in model species are unrepresentative of animals that make up the bulk of biodiversity. A few comparisons of genetic variation in physiological traits across groups of related species support this conjecture. The ability of specialist species to respond to selection might be limited due to DNA decay or to strong genetic interactions among traits. Resolving these issues could contribute to an understanding of the genetic basis of evolutionary limits and biodiversity.

*Notes:*

## Mammals on Ice: Molecular Secrets of Winter Hibernation

K.B. Storey

Institute of Biochemistry, Carleton University, Ottawa, Canada

Although alien to the physiology of man, many small mammals spend up to 8 months of the winter in deep torpor. Their metabolic rate drops to <5% of normal resting rate, core body temperature falls to near 0°C, breathing and heart rate are greatly reduced, and skeletal muscles go unused for weeks at a time. Current studies in my lab are focused on the signal transduction and gene expression responses that underlie hibernation. Against a background of strong suppression of transcription and translation during torpor, selected genes are up-regulated to facilitate the transitions to/from dormancy and aid long term viability during cold torpor. Hibernation is not only an amazing biological phenomenon but the molecular mechanisms that impart long term survival of mammalian organs in cold torpor have a variety of potential applications in medicine including the improvement of hypothermic preservation of excised organs for transplant, ischemia resistance, and prevention of muscle atrophy. For more information go to: www.carleton.ca/~kbstorey

*Notes:*

## A Fatty Tale

A.J. Hulbert

School of Biological Sciences
University of Wollongong
Wollongong, NSW 2522

Comparison of the large variation in metabolic rates of higher vertebrates revealed that cellular metabolic rates of (i) mammals compared to similar-sized reptiles, and (ii) mammals of different body size differed in a systematic manner. Furthermore, species with high rates of cellular metabolism had leaky membranes and fast membrane pumping processes. They also had more polyunsaturated membrane lipids and “species-crossover” studies experimentally verified that more polyunsaturated membrane lipids resulted in faster molecular activity of membrane pumps. This connection between membrane composition and metabolic rate was described as the “membrane pacemaker” theory of metabolism. More recently, membrane composition has been related to the maximum lifespan of species of higher vertebrates. The membrane pacemaker theory of aging has been used to explain the variation in maximum longevity (i) between mammal species, (ii) between strains of mice, (iii) between mammals and birds, (iv) between worker and queen honeybees, and (v) extended longevity due to calorie-restriction. Forty years of scientific research into metabolism and aging emphasise the importance of the “fatty tails” of membrane lipids.

*Notes:*

## Risk of predation enhances the lethal effects of UV-B in amphibians

**Lesley A. Alton**, Robbie S. Wilson and Craig E. Franklin

School of Integrative Biology, The University of Queensland, Brisbane, QLD, Australia

Amphibian declines are a prominent part of the global biodiversity crisis and have received special consideration because they have occurred relatively recently, on a global scale, and in seemingly pristine habitats where no obvious anthropogenic cause is apparent. Although several causes for declines have been implicated, the isolation of a singular cause has proven elusive. Consequently, it has been hypothesised that complex interactions between multiple environmental stressors, particularly those associated with global change, may be responsible. Increasing UV-B radiation associated with stratospheric ozone depletion is one such stressor that has received considerable attention. UV-B causes enhanced lethal effects when combined with other factors such as aquatic pH, contaminants, temperature and pathogens, but little is known of how UV-B interacts with pervasive biological stressors, such as predation. We exposed *Limnodynastes peronii* tadpoles to UV-B and predatory cues in a controlled laboratory experiment to determine their independent and interactive effects on survival and morphology. We show that UV-B and predation risk interact synergistically to enhance mortality above the additive effects of the independent stressors, and that exposure to UV-B affects the ability of tadpoles to morphologically respond to predatory cues, which has implications for their survival in a predator environment.

Notes:

## Oxygen delivery in reptiles: effects of body temperature

**Sarah J. Andrewartha**[1], Suzanne L. Munns[2], Peter B. Frappell[3]

[1] Adaptational and Evolutionary Respiratory Physiology Laboratory, La Trobe University, Melbourne, Vic, Australia
[2] School of Veterinary and Biomedical Sciences, James Cook University, Townsville, QLD, Australia
[3] School of Zoology, University of Tasmania, Hobart, Tas, Australia

Changes in body temperature (Tb) occur temporally and seasonally in most reptiles and can have large effects on activity levels and consequent oxygen ($O_2$) requirements, due largely to the $Q_{10}$ effect of temperature on biological rates. There is, therefore, a need to meet the increased $O_2$ demands at higher Tb's with greater $O_2$ supply at each step in the $O_2$ cascade (e.g. a proportional increase in $\dot{V}_E$ to $\dot{V}_{O_2}$). In direct conflict, a relative hypoventilation (decrease in $\dot{V}_E/\dot{V}_{O_2}$, or more relevantly $\dot{V}_E/\dot{V}_{CO_2}$) at higher Tb's is required to regulate arterial pH (pH*a*) in accordance with the α-stat hypothesis (ΔpH*a*/ΔTb ~ -0.016 U/°C). This poses possible limitations to $O_2$ supply at higher Tb's; a situation which may constrain the activity levels of aerobic predatory reptiles. As physiology at rest is basal to that achieved when active, this paper aims to examine the respiratory, metabolic and cardiovascular parameters directly involved in $O_2$ transport and pH*a* homeostasis at rest in two ectothermic vertebrates: Rosenberg's goanna (*Varanus rosenbergi*), an active predator, and the more sedentary estuarine crocodile (*Crocodylus porosus*).

*Notes:*

## Hot & Bothered: does temperature affect the territorial behaviour and costs of fighting in males of the highly aggressive crayfish *Cherax destructor*?

**Ben Barth**, Vincent Van Uitregt, Catriona Condon, Candice Bywater, Daniel Hancox, Robbie Wilson

Integrative Ecology Lab, School of Integrative Biology, The University of Queensland St Lucia, Queenslamd 4072 Australia

The role of temperature in shaping the social and behavioural dynamics of organisms and their populations is a fundamental question in ecological physiology. However, few studies have examined these ecological consequences of temperature-induced variation in physiological performance. One important aspect of the ecology of many organisms is territorial and fighting behaviour. We used freshwater crayfish as a model system to examine the influence of temperature on aggressive and social behaviour. As low temperature can directly decrease the claw strength of crayfish, temperature could affect aggressive interactions via two independent pathways. Firstly, crayfish may be less willing to engage in aggressive disputes at lower temperatures due to a decrease in claw strength and thus fighting ability. Alternatively, crayfish may be more willing to engage in aggressive disputes at lower temperatures due to the decreased strength of their opponents and subsequent reduced chances of receiving costly wounds during fights. We tested among these two hypotheses by examining the influence of temperature on the weapon strength (primary claw) and fighting behaviour of males of the aggressive crayfish *Cherax destructor*.

*Notes:*

## Geographic variation in weapon size and maximum strength among populations of the two-toned fiddler crab (*Uca vomeris*)

**Candice L. Bywater**, Robbie S Wilson

Integrative Ecology Lab (www.uq.edu.au/integrative-ecology), School of Integrative Biology, The University of Queensland, St Lucia 4072 Australia

Males of many species possess specialized weapons that are often displayed to resolve territorial disputes without direct physical contact. Theory predicts that the evolution of increased weapon size should be associated with increased competition for resources and weapon strength should increase simultaneously with size (reliable signals). In this study, we tested this association by examining inter-population variation in the size and maximum strength of the enlarged claw of the two-toned fiddler crab (*Uca vomeris*) and examined its association with population density and habitat variation. Fiddler crabs represent an ideal group for studying the evolution of weapon strength as males possess one enlarged and brightly coloured claw that is used both as a weapon during disputes with other males and to attract females during courtship. We examined six populations of *U. vomeris* in the creeks and bays along the south-east coast of Queensland between the Gold Coast and Bribie Island. We predicted that the increased competition that results from high population densities would be associated with larger relative claw sizes and greater weapon performance. For each population, we estimated population density and quantified habitat type. We also collected approximately 100 males from each population and measured the body size, claw size and maximum claw closing strength for each individual using a custom built force transducer. We will discuss the variation observed among populations in relative and absolute size of their weaponry and its association with maximum strength and population density.

*Notes:*

## Physiological responses of marine gastropod species to the highly variable thermal regimes of the intertidal region of temperate New South Wales

**Sam D. Clayman**[1], Frank Seebacher[1], Michael B. Thompson[1]

[1] Integrative Physiology Research Group, School of Biological Sciences, The University of Sydney, Sydney, NSW, Australia

The intertidal region experiences a high degree of thermal variability at daily and seasonal scales. The capacity of marine gastropods, which occur from subtidal to supratidal habitats, for aerobic and anaerobic metabolism may differ with increasing shore height. The aim of this study was to compare five gastropod species from a rock platform near Sydney to quantify physiological responses to varying thermal regimes along the shore gradient. Whole-animal rate of oxygen consumption ($\dot{V}O_2$) was measured in summer- and winter-acclimatised snails in both air and water, across a test temperature range of 10-35°C. Aerobic and anaerobic enzyme activity was measured at 10°, 20° and 30°C. $\dot{V}O_2$ in intertidal species was up to three times higher than sub- or supra-tidal species at most temperatures in water in both seasons, with the same pattern occurring in aerial $\dot{V}O_2$during winter but not in summer. Aerobic and anaerobic enzymes show compensation of activity in low shore species, but not high shore species at 20°C in summer compared to 10°C in winter. Differences in $\dot{V}O_2$ and enzyme activities are related to position on the shore, which likely represent changes caused by the selective pressures of variation in temperature regimes.

*Notes:*

## Post ingestive regulation of nutritional uptake: differential release of gut enzymes enables nutritional needs to be met on unbalanced diets

**Fiona J. Clissold**[1], Stephen J. Simpson[1], Benjamin J. Tedder[2], Arthur Conigrave[2]
[1]School of Biological Sciences, The University of Sydney, NSW, 2041
[2]School of Molecular and Microbial Biosciences, The University of Sydney

All animals are faced with the challenge of matching nutrient supply with demand in a variable environment. Behavioural mechanisms have been identified that enable animals to regulate their intake of multiple nutrients, however, how animals differentially utilise ingested nutrients to achieve nutrient balancing has been less well studied. One possible means of regulating the balance of nutrients assimilated would be through the differential release of digestive enzymes. We confined *Locusta migratoria* to synthetic diets unbalanced in the ratio of protein to carbohydrate and determined if gut proteinases (trypsin and α-chymotrypsin) and carbohydrases (α-glucosidase and amylase) where differentially released to balance nutrient assimilation. We found that digestive enzymes were up or down regulated in response to protein but not carbohydrate-imbalance. The nutritional and ecological implications of the results will be discussed.

Notes:

## Mixed signals: thermal performance of zebrafish (*Danio rerio*) in uncertain environments

**Catriona H Condon**, Stephen F Chenoweth, Robbie S Wilson

School of Integrative Biology, The University of Queensland

Thermal performance curves (TPC) represent the performance of an individual across a temperature range. Thermal acclimation can alter the thermal performance of a plastic trait via changes in the height (vertical shift), the thermal optimum (horizontal shift), or in a trade-off between the height and width (generalist-specialist shift) of a TPC. Here we investigate variation in TPC of two traits in the zebrafish, *Danio rerio* by examining the effect of environmental cue reliability on thermal performance. The TPC of a reversible plastic trait is predicted to be narrow and specialised when an individual receives highly reliable cues, while less reliable cues should induce a broad, generalist phenotype to cope with uncertain conditions. We acclimated *D. rerio* to matching and mis-matching seasonal temperature (16 and 30°C) and day-length (10:14, 12:12, 14:10 L:D) cues and examined the thermal performance of burst swimming and feeding rate between 8-38°C. Acclimation temperature had a significant effect on TPC shape for both traits via a horizontal shift in the thermal optimum. Horizontal and generalist-specialist variation together captured 66% of the total variation in swimming TPCs and 95% for feeding rate. Our results suggest that TPCs for reversible performance traits in *D. rerio* typically vary within the bounds of these two directions.

Notes:

# Effects of measurement duration on the determination of basal metabolic rate and evaporative water loss of small marsupials: How long is long enough?

**Christine E. Cooper**[1,2] and Philip C. Withers[1,2]

[1]Department of Environmental Biology, Curtin University of Technology
[2]Animal Biology, University of Western Australia

We examined the time-course for measurement of basal metabolic rate (BMR; measured as oxygen consumption and carbon dioxide production) and standard evaporative water loss (EWL) for six species of small marsupial, to determine the minimum time required to achieve basal/standard values. There was a highly significant effect of measurement duration on measured physiological variables with values for $O_2$ consumption, $CO_2$ production and EWL decreasing with time for all species. The time required to attain values statistically indistinguishable from minimal differed significantly between species, but in general $O_2$ consumption rate reached basal values after 4.3 hrs, $CO_2$ production after 4.5 hrs, and evaporative water loss after 5.2 hrs. For 16 BMR measurements of small marsupial species in the literature, with experimental duration provided, 10 were for less than 4 hrs, suggesting that their BMR values might be overestimates. For evaporative water loss, three of the four published values for small marsupials may be overestimates. It is clear that appropriate experimental duration is an important component of the measurement protocol for both BMR and standardised water loss, which needs to be rigorously observed in future studies.

*Notes:*

## Hypoxia tolerance in Antarctic fish

**Bill Davison**

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Antarctic fish are notable for their unique cardiovascular systems where the heart is controlled almost entirely by the parasympathetic system. Thus resting heart rates are achieved by increased parasympathetic activity, while increased rates are achieved by release of this cholinergic inhibition. Antarctic fish do not show an hypoxic reflex bradycardia, which is assumed to be a consequence of the dominance of the cholinergic control.

*Pagothenia borchgrevinki* tolerates hypoxia well, maintaining a constant $VO_2$ down to a water oxygen $PO_2$ of about 30 mmHg. However, they are not insensitive to changes in oxygen levels with increases in ventilation at high $PO_2$ (100 mm Hg). Heart rate is kept constant down to around 75 mm Hg, but then decreases to a low of 5 beats per minute at 25 mm Hg. This is a controlled (cholinergic) decrease in heart rate as it can be abolished by treatment with atropine.

Antarctic animals do not tolerate increases to water temperature, and it is assumed that this is linked to tissue hypoxia. Increasing the water temperature increases metabolic rate in *P. borchgrevinki* and decreases tolerance to hypoxia. However, acclimation of the fish to this new temperature resets everything and tolerance is restored.

Notes:

## Temperature-dependent sex-biased embryo mortality in a bird

**Yvonne A. Eiby**[1], Jessica Worthington Wilmer[2], David T. Booth[1]

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The effects of temperature on sex ratios have been well demonstrated in numerous species across a diverse range of taxa, but not in birds. However, recent evidence of temperature affecting the sex ratio of Australian Brush-turkey (*Alectura lathami*) chicks has prompted our investigation of the mechanism underlying this phenomenon. As with all megapode birds, brush-turkeys are exceptional in their use of environmental heat sources in incubate their eggs hence, their embryos experience and tolerate large changes in temperature. Because birds have genetic sex determination the suggested mechanism behind the skewed sex ratios is differential mortality. Using molecular techniques to, for the first time in brush-turkeys, sex both failed embryos and chicks, we confirmed that temperature dependent sex-biased embryo mortality is the mechanism causing the disparity observed in the sex ratio of chicks. Male embryo mortality was greater at high temperatures while female mortality is greater at low temperatures, with mortality in both sexes similar at intermediate incubation temperatures. This study provides the first strong evidence of this phenomenon in a higher vertebrate. A mechanistic knowledge of sex ratio manipulation, combined with brush-turkeys' lack of parental care and males' sole control over incubation conditions, creates a valuable avian model for investigating sex allocation theory.

Notes:

## Metabolic gating of fecundity and previtellogenic follicle expression of growth differentiation factor 9 and bone morphogenetic protein 15 in the short-finned zebrafish (*Danio rerio*)

**Erin L. Forbes**, P. Mark Lokman

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Growth differentiation factor 9 (GDF-9) and bone morphogenetic protein 15 (BMP-15) are oocyte specific factors implicated in follicular growth and ovulation in mammals. In order to investigate whether GDF-9 and/or BMP-15 were correlated with ration-dependent changes in fecundity in fish, zebrafish (*Danio rerio*) were subjected to four different feeding regimes. Counts of vitellogenic follicles were used as a proxy for fecundity, whereas q-PCR analyses were done to determine GDF-9 and BMP-15 mRNA levels in response to changes in ration size. Furthermore, the effects of growth hormone (GH), leptin and triiodothyronine ($T_3$) on GDF-9 and BMP-15 transcript abundance were determined. Both relative fecundity and gonadosomatic index (GSI) increased significantly with increased ration size. There was no difference in GDF-9 or BMP-15 transcript abundance between feeding regimes *in vivo*; however, notwithstanding small sample sizes, GH, leptin and $T_3$ all significantly down-regulated mRNA for both growth factors *in vitro*. These *in vitro* findings support the hypothesis that the early gonadotrophin-independent stages of folliculogenesis are regulated, at least in part, by the nutrition of the individual.

Notes:

## The effect of latitude on body temperature and metabolic capacity in a native rat (*Rattus fuscipes assimilis*)

**Elsa Glanville**[1], Frank Seebacher[1]

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The energetic cost of maintaining the relatively high and stable body temperatures ($T_b$) of endotherms increases with decreasing environmental temperatures ($T_e$). Small mammals that remain active during winter in cold climates may offset this cost by decreasing $T_b$, and may also increase metabolic capacities to facilitate internal heat production. The aim of this project was to determine whether latitudinally induced variation in climate influences body temperature and metabolic regulation in bush rats (*Rattus fuscipes assimilis*). In the wild, mean $T_b$ of rats from southern NSW (35.74°C±0.17) was significantly lower than the $T_b$ of rats from northern NSW (36.73°C±0.13), and $T_b$ amplitude ($T_{bmax}$ - $T_{bmin}$) was significantly greater in southern rats (4.02±0.15) compared to northern rats (3.08±0.14). State 3 (SIII) and state 4 ($SIV_{ol}$) rates of mitochondrial oxygen consumption varied significantly with latitude. The effect of latitude on tissue specific enzyme activity and gene expression was also investigated. The results indicate that rather than regulating to a fixed body temperature, mammals can maintain performance and reduce energetic cost in cooler thermal environments by regulating to a lower body temperature and concurrently fine tuning metabolic heat production capacity and shifting thermal sensitivities of metabolic pathways.

Notes:

## The thermal properties of birds' nests

**Caragh Heenan**

Ecology and Evolutionary Biology, The University of Adelaide, Adelaide, SA, Australia

Birds' nests have evolved into many shapes and sizes, but all are designed for the same general function: to protect the eggs and hatchlings and help moderate their microenvironment. In addition to attenuating changes in egg temperature, well insulated nests also conserve the energy reserves of the parent at low ambient temperatures. Such energy savings have the ability to influence the lifetime reproductive success of an individual. Nest insulation is therefore important and may be related to the size of the parent and the incubation climate. This study measures thermal conductance through the nests of 35 species of South Australian birds, with the data analysed allometrically according to parental body mass (M). Scaling of nest dimensions (internal diameter $\alpha M^{0.36}$, depth $\alpha M^{0.24}$, surface area $\alpha M^{0.72}$ and nest mass $\alpha M^{1.24}$), indicates that nest size is directly related to bird size. However, nest conductance scales with $M^{0.24}$, indicating that larger nests are relatively better insulated than smaller ones. This is reflected in negative scaling of surface-specific conductance ($M^{-0.47}$), and positive scaling of nest wall thickness ($M^{0.48}$). Material conductivity is independent of parent mass ($M^{0.02}$). The design and construction of birds' nests may be a trade-off between nest insulation and structural support.

*Notes:*

## Functional Diversity of Fish Heart Mitochondria

Sarah Rynbeck[1], Michael Oellermann[1] and **Anthony Hickey**[1]

[1]School Biological Sciences, University of Auckland, New Zealand

Mitochondria are essential intracellular organelles, particularly in the heart where they produce 90% of cellular energy. The discovery of the mitochondrion's role in numerous cellular processes, including the production of reactive oxygen species, cellular signalling and apoptosis (cell death), has lead to renewed interest in functional studies of mitochondria. However, most studies have focused on model organisms, comparisons of vastly different species, or those from extraordinary habitats. The aim of this study was to compare respirational properties of heart ventricle fibres in five common New Zealand fish species with varying levels of activity, using high resolution respirometry. Cardiac tissue has been chosen due to its central physiological role and susceptibility to stress. A substrate inhibitor titration protocol was used to determine differences in electron transport system complex ratios between species. We predicted that more active species would have more active heart mitochondria, but found that the less active yellowbelly flounder has the highest respirational capacities per unit mass. However, more active fish such as yellow eye mullet and jack mackerel may compensate by having greater relative ventricle masses. This study has revealed fundamental species differences in fish heart mitochondria, and has developed methodologies for future research into these important powerhouses.

*Notes:*

## Thermoregulation in the little penguin (*Eudyptula minor*)

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Penguins are primarily adapted to cope with thermal challenges associated with foraging at sea. As for all birds, penguins are constrained to breed and moult on land, so are faced with the challenge of maintaining body temperature (Tb) under contrasting environments. Most previous studies on penguin thermoregulation have focussed on responses to cold exposure and/or water immersion. Penguins can, however, also experience high temperatures on land, particularly those that breed in tropical and temperate regions. The aim of this study was to investigate the thermoregulatory responses of the temperate little penguin (*Eudyptula minor*), by measuring changes in Tb, metabolism, ventilation, heart rate ($f_H$) and behaviour when exposed to a 'heating-cooling' protocol (heated from 22°C to 35°C, then cooled to 5°C). As temperatures warmed, the birds tolerated some heat storage. Ultimately, to prevent over heating at high ambient temperatures the penguins panted and increased $f_H$, both uncoupling from $O_2$ delivery and assisting in elimination of excess heat.

Notes:

## Intestinal enzyme activity in the tropical agamid lizard, *Lophognathus temporalis*

**Sebastian Iglesias**, Christopher T. Tracy, Keith A. Christian

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*Lophognathus temporalis*, has higher metabolic and feeding rates during in the wet season compared to the dry season. Also, *L. temporalis* from urban sites tend to be larger than those from natural sites, partly due to site differences in food availability. Therefore, we hypothesized that activity of membrane-bound intestinal enzymes and masses of organs related to digestion would differ both seasonally and between urban and natural sites. To test this, we measured activities of aminopeptidase-N (APN), maltase, and sucrase, as well as organ masses. APN activity was highest in the middle portion of the intestine (section 2), followed by the proximal portion (section 1) and then the distal portion (section 3). Maltase activity was highest in section 1 and decreased distally. We detected some sucrase activity in section 1 but none in sections 2 or 3. We found similar enzyme activities within each section irrespective of site or season. However, total enzyme activities were higher during the wet season compared to the dry season for both urban and bush *L. temporalis*. Total wet season enzyme activity in urban and bush *L. temporalis* was greatest for APN (25.4; 15.8 $\mu$mol $min^{-1}$; respectively), then maltase (3.9; 3.6 $\mu$mol $min^{-1}$; respectively) and then sucrase (0.3; 0.2 $\mu$mol $min^{-1}$; respectively). The higher total enzyme activities were the result of an increase in intestinal mass during the wet season.

Notes:

# The impact of habitat fragmentation on measurable indicators of physiological stress in the small Australian marsupial *Antechinus agilis*

**Christopher Johnstone**, Alan Lill, Richard Reina

Monash University

Habitat fragmentation remains a threat to biodiversity worldwide, yet the future of many vertebrate species may depend entirely on their ability to persist in restricted 'islands' of habitat within an altered matrix. For conservation management of such species to be effective, there is a need to further our understanding of the mechanisms that underlie species decline following habitat fragmentation.

In vertebrates, overt threats to survivorship elicit a stress response, leading to changes in behaviour (e.g. sheltering, escape) and physiology (e.g. increased heart rate, mobilisation of metabolic energy stores) that improve an individual's chances of immediate survival at the expense of long-term survival and reproduction. Prolonged or frequent acute stress responses can lead to a pathological state of physiological exhaustion termed chronic stress. This disease state has been associated with decreases in reproductive output and rate of growth, immunosuppression, and an increased rate of molecular aging.

This study examines whether free-living populations of agile antechinus (Antechinus agilis) living in fragmented habitats show higher measurable indicators of physiological stress when compared to populations living in a relatively similar continuous habitat. If so, then it may be that for some vertebrates, chronic physiological stress is contributing to population decline in fragmented habitats.

Notes:

## Surviving the drought: Burrowing frogs save energy by increasing metabolic efficiency

**Sara M. Kayes**[1], Rebecca L. Cramp[1], Nicholas J. Hudson[2] and Craig E. Franklin[1]

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Energy conservation is a key priority in any animal that undergoes extended periods in the absence of food. This is exemplified in animals that undergo periods of dormancy. During dormancy animals undergo a major metabolic depression to conserve their limited endogenous fuel supplies. Mitochondrial function underlies aerobic metabolism and can be divided into two major processes: ATP synthesis and proton leak. The proportion of oxygen consumed to drive ATP synthesis compared to proton leak is called metabolic efficiency. To maximise energy savings it has been hypothesised that metabolic efficiency should be increased during dormancy; however this has not been previously shown. In this study we measured mitochondrial respiration in the muscle of the burrowing frog, *Cyclorana alboguttata* to estimate how rates of proton leak changed during extended periods of dormancy. After seven months in aestivation, *C. alboguttata* significantly reduced mitochondrial oxygen consumption on average by 83% and, unlike other dormant animals, decreased rates of proton leak to a greater extent than ATP synthesis, increasing metabolic efficiency. *C. alboguttata* can survive in a dormant state for several years and we propose that increased metabolic efficiency is a key survival mechanism during prolonged dormancy.

*Notes:*

## Putting physiology on the map

**Michael Kearney**[1]

[1]Department of Zoology, The University of Melbourne

There is an urgent need to predict the impacts of human-induced changes in climate and land use on biodiversity. The development of Geographic Information Systems (GIS) datasets on climate, terrain, vegetation, soil and other variables has revolutionized the way we tackle these questions but very often such studies are done in a correlative manner without explicit consideration of known physiological links between the GIS data and the organism. This presentation will illustrate how the principles of biophysical ecology can be used to make the links between physiological knowledge and spatial environmental data. This enables us to understand and predict how climate and habitat features interact with the key traits of organisms to affect their ability to persist across real landscapes. Such an approach provides spatially explicit assessments of habitat quality from a physiological perspective, allowing more robust predictions of how threatened species, diseases and pests will respond to concurrent changes in climate and habitat alteration. It also provides a means to investigate species' fundamental and realized niches.

*Notes:*

## Does body condition account for variation in plasma corticosterone in cane toads?

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We examined the relation between plasma corticosterone and body condition in free-living cane toads (*Bufo marinus*). Blood was collected from animals within 3 min of capture and 1 and 2 h afterwards. Body mass ($M_b$) and 4 morphological measures were taken before animals were euthanased. Carcasses were oven dried to determine dry mass and fat content was determined gravimetrically following Soxhlett fat extraction. Body condition (BC) was estimated from 3 models: BC1 was based on size predictions from principal components analysis; BC2 used residuals analysis of cube-root $M_b$ vs. snout-vent length (SVL) regressions; and BC3 used residuals analysis of log-transformed SVL vs. log transformed $M_b$ regressions. All BC indices were directly correlated with body fat in males, but not in females. Male baseline corticosterone was directly related to BC2 and BC3, but the 1 and 2 h corticosterone levels were inversely related to BC1, BC2, and BC3. Body condition did not account for corticosterone variation in females, nor was there any correspondence between body fat content and corticosterone levels in either gender. Overall, BC1 best accounted for body fat and post-stress glucocorticoid potential in males, but BC indices were poor at explaining variation of these measures in females.

*Notes:*

## Genetic divergence in the thermal dependence of performance among populations of the native fruit fly, *Drosophila serrata*

**Camille Latimer**, Robbie S Wilson, Steve Chenoweth

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Fluctuating temperatures can induce thermal stress and may lead to adaptation in traits that improve performance at particular temperatures. In species occurring in environments with different thermal environments, adaptive divergence in performance at different temperatures may also occur among populations. Organisms' performance over a wide range of temperature can be investigated using thermal dependence curves – non linear functions that capture the relationship between performance and temperature. Here, using the native Australian fly *Drosophila serrata*, I conducted quantitative genetic analyses of thermal dependence curves for locomotor activity in three natural populations spanning a latitudinal gradient. There were three key findings. First, significant genetic variation within populations indicated that different parts of the *D. serrata* thermal dependence can respond to selection independently of others. Second, thermal dependence curves exhibited significant genetic divergence among natural populations suggestive of local adaptation to the thermal climate. Finally, thermal dependence curves were sexually dimorphic, suggesting independent phenotypic optima for the two sexes in the way in which they respond to rapid changes in their thermal environment.

Notes:

## Dilatations, Diverticulae and Distal Digesta: an exploration of motility and hydrodynamics in avian and mammalian caecae

**Roger G Lentle**[1 2] and Patrick WM Jannsen[1]

[1] Institute of Food Nutrition and Human health Massey University New Zealand
[2] Riddett Institute Massey University New Zealand

The development of dilatations and bind ended sacs that store and prolong the residence time of digesta requires the development of specific patterns of motility to coordinate flow and prevent undue distension. Surprisingly little information is available regarding the motility of these structures. We present the results of recent work using high resolution spatiotemporal and image mapping techniques developed by our group examining patterns of motility in the isolated chicken and rabbit caecum.

*Notes:*

## Control of early oogenesis by methyl farnesoate in the Christmas Island red crab, *Gecarcoidea natalis*

**Stuart Linton**[1], Lauren Barrow[2], Claire Davies[3], Laura Harman[1]

1. School of Life and Environmental Sciences, Deakin University.
2. King Island Natural Resource Management Group
3. CSIRO – Marine and Atmospheric Research, Cleveland, Brisbane

Methyl farnesoate is a hormone present in crustaceans that is chemically related to juvenile hormone of insects. Its function in decapods is unknown but it may be involved in controlling early oogenesis. This study examined the endocrine role of methyl farnesoate in oogenesis in the Gecarcinid land crab, *Gecarcoidea natalis.* An endocrine disruption approach was utilised whereby Pyriproxyfen, a mimic of methyl farnesoate, was administered to the crabs. Methyl farnesoate stimulated vitellogen synthesis given the ovaries from crabs fed pyriproxyfen had a higher total nitrogen content and dry mass than ovaries from control crabs fed the placebo. It also stimulated division of the oogonia and induced early ovary development since ovaries from crabs fed pyriproxyfen were more mature, containing more previtellogenic and vitellogenic oocytes of a larger diameter, than that of control animals. Methyl farnesoate is not likely to be involved in maturation of the ovaries given the ovaries from all animals in this experiment were less mature than ovaries from wild animals sampled from the forest at the end of the experiment. The histology, total nitrogen, and dry mass of the ovaries from the various control groups were similar despite crabs in the higher doses assimilating more dry matter. Thus the rate of ovary development is not correlated to nutrient intake and hence it is under tight hormonal control.

*Notes:*

## Are all discontinuous gas exchange cycles the same?

**Philip G. D. Matthews**

School of Integrative Biology, The University of Queensland, QLD, Australia

Diapausing moth pupae are the standard preparation for studying discontinuous gas exchange cycles (DGCs) in insects due to the ease with which they can be manipulated. Thus several hypotheses regarding the adaptive function of discontinuous respiration in insects have been based on data from pupae alone. But how well their pattern of gas exchange represents the DGCs displayed by other insects is largely unknown. DGCs in the speckled cockroach *Nauphoeta cinerea* were examined using a decapitated preparation which pacified the insect while allowing oxygen probes to be placed directly within the longitudinal trunks of their tracheal system. Cockroaches were ventilated with hypoxic, normoxic and hyperoxic gas mixes while recording $CO_2$ emission, intertracheal $PO_2$ and abdominal movements. Cockroaches began breathing discontinuously within 1-2 h of decapitation and continued throughout the experiments (~7 h). The durations of the open and closed respiratory phases were not affected by ambient $PO_2$. Intertracheal $PO_2$ increased to within 5 kPa of ambient levels during the open phase of the DGC, associated with abdominal pumping, while during the closed phase the intratracheal $PO_2$ declined linearly. Variable intertracheal $PO_2$ and convective ventilation do not occur in pupae, suggesting that DGCs may have multiple adaptive functions across insect taxa.

*Notes:*

## Comparison of physiological responses of a native and an introduced herbivore to the scent of predators

**Valentina Mella**[1], Christine Cooper[1]

[1]Department of Environmental Biology - Curtin University of Technology

This study investigated if the intensity of the physiological reaction of rabbits (*Oryctolagus cuniculus)* and tammar wallabies (*Macropus eugenii*) to the odour of potential predators (snake, quoll, fox and cat) differed from that observed to non-threatening scents (distilled water and horse). In general, no metabolic response was observed in both rabbits and wallabies after introduction of any of the treatments, with values of oxygen consumption and carbon dioxide production not significantly different before and after exposure to the scents. However, both control and predator odours elicited a significant a response in ventilatory variables, with all the animals showing significantly higher respiratory frequencies and significantly lower tidal volumes after submission of all the scents. Rabbits responded significantly more to cat and quoll than to the other treatments, while wallabies showed a greater response to fox and cat. For rabbits, there was no significant effect of duration of exposure to the scents, but the reaction of the wallabies showed to diminish over time.

*Notes:*

## The importance of physiology and microenvironmental information in predicting climate change impacts

**Andres Merino-Viteri**[1], Stephen E. Williams[1], Luke Shoo[1] and Andrew Krockenberger[2]

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At present, most attempts to predict climate change impacts on biodiversity have relied on correlative methods. This approach uses environmental information based on the macroenvironment and species presence data to predict species distribution under different climate change scenarios. However, we know that not all species are directly exposed to macroenvironmental conditions. Additionally, these models do not include information about species specific physiological requirements and tolerances. The Microhylid frogs have been predicted to be one of the most threatened groups of vertebrates by climate change in the rainforest of the Wet Tropics Bioregion, Northern Queensland. The predicted susceptibility is primarily inferred from restricted geographic distribution to cool, wet and aseasonal upland environments. Previously, correlative models have predicted changes in the extent and location of microhylid distributions, even with minimal increases in temperature. During the day, these frogs take refuge under logs, rocks or epiphytes fallen from trees. These refuges provide a buffer from external daytime environmental conditions. Here, we quantify differences between macroenvironmental information used in previous models and information on real conditions experienced by microhylid frogs in the rainforest. We also present preliminarily physiological information for different species of microhylid frogs and discuss implications for future scenarios of climate change.

*Notes:*

## Molecular bases of the seasonal migration of *Gecarcoidea natalis*

Ute Postel, Fiona Thompson, Mark Viney, Gary Barker, Simon Webster*, **Steve Morris**

School of Biological Sciences, University of Bristol, Woodland Road, Bristol, BS8 1UG, UK; *School of Biological Sciences, Bangor University, Deiniol Road, Bangor, LL57 2UW, UK

The terrestrial crab *Gecarcoidea natalis* retains a marine larval stage and on Christmas Island undertakes an annual breeding migration. The monsoon rainfalls stimulate a near instantaneous switch from hypo- to hyperactivity. How this switch is accomplished is unknown. We examined changes in gene transcription in leg muscle. Total RNA from migrating and non-migrating males was used to construct two cDNA libraries. First recombinant clones were isolated and insert fragments amplified and sequenced. About 73 % of the ESTs were assigned to known sequences using BLAST and contig analysis. Approximately 57 % of the ESTs match proteins related to muscle function. Comparison of the libraries revealed differential expression of genes. For example, actin was less transcribed in migrating crabs, which could either indicate generally increased gene expression during migration and/or might be related to changes in the muscle structure. Further indications for migration related structural changes in muscle tissue are the increased transcription of a muscle LIM protein and of tropomyosin-like protein. Ongoing sequencing and RT-PCR work should reveal differential expression of genes in addition to those for muscle structural proteins. This approach appears to be appropriate for screening for transcription based changes supporting the seasonal physiology of this crustacean.

Notes:

## Oxygen consumption in embryos and larvae: examining the critical point

**Casey Mueller**

Ecology and Evolutionary Biology, University of Adelaide

The term 'critical oxygen pressure' ($P_C$) was introduced to characterise the environmental oxygen level at which an oxyregulator is no longer able to regulate and therefore becomes an oxyconformer. This has misled attempts to describe data as either showing oxyconformity or oxyregulation when in most instances the relationship lies somewhere in between. The relationship between $\dot{V}O_2$ and environmental $PO_2$ was examined throughout development in the frog *Pseudophryne bibronii* and the $P_C$ determined using two methods. The decline in $\dot{V}O_2$ in *P. bibronii* embryos is best described as a curve while in early larvae the relationship has a more abrupt transition between regulation and conformity. This difference indicates that the extra steps of the embryonic gas exchange pathway, created by the egg capsule, strongly influence $\dot{V}O_2$. While the $P_C$ can be determined from a curved relationship its ability to describe tolerance to low oxygen is uncertain. The $\dot{V}O_2$ of embryos may be better understood by examining the various resistances to gas exchange in the oxygen cascade. Following diffusion through the capsule, factors such as convection with the perivitelline fluid and morphology of the embryo, including skin thickness and cardiovascular attributes, may influence oxygen uptake by varying magnitudes.

*Notes:*

# Uterine angiogenesis in reproductive skinks: Characterisation and uterine expression of vascular endothelial growth factor (VEGF)

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While most skinks are oviparous, laying eggs that continue to develop in the nest, some are viviparous (live-bearing), retaining embryos *in utero* until completely developed. Uterine tissue surrounding embryos becomes increasingly vascular as embryos develop, and vascular proliferation (angiogenesis) is fastest during the period of prolonged embryo retention in viviparous species. To investigate the molecular mechanisms of uterine angiogenesis, we characterised VEGF in oviparous and viviparous skinks and used RT-PCR to examine VEGF mRNA expression in the uterus. Vascular endothelial growth factor (VEGF) is one of the most potent of a suite of growth factors up-regulated during the initiation of angiogenesis. Several splice variants transcribed from the single-copy VEGF gene are translated into different VEGF protein isoforms, each with different angiogenic properties. Differential expression of these isoforms is associated with uterine angiogenesis in both mammals and birds. Preliminary results indicated VEGF mRNA splice variants are differentially expressed in skink uterus during reproduction. We also demonstrated mRNA expression of a very short, diffusible VEGF splice variant ($VEGF_{111}$) during late pregnancy. Such a diffusible VEGF protein may have an embryonic origin, stimulating vascular proliferation in surrounding uterine tissue to support an increasing embryonic oxygen demand.

Notes:

## Non-invasive monitoring of stress hormones in the endangered Fijian Ground Frog (*Platymantis vitianus*)

**Edward J. Narayan[1],** Frank C. Molinia[2], John F. Cockrem[3], Ketan S. Christi[1], Craig G. Morley[4]

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[3]Massey University, Palmeston North, New Zealand
[4]Department of Conservation, New Zealand

The Fijian ground frog *Platymantis vitianus* is the larger of Fiji's two threatened endemic frogs. It is listed as endangered under the IUCN standards. Captive breeding has been unsuccessful, and it was not known if stress might affect breeding in captivity. We developed enzyme immunoassays (EIAs) to non-invasively measure stress hormones in frog urine. A frog urine pool showed parallelism with corticosterone but not cortisol standards, and a corticosterone EIA was then used to examine stress in frogs. Immunoreactive corticosterone increased in frog urine 6 hours, 1 and 2 days after injection of frogs with adrenocorticotropic hormone (at 2.5µl/g Body mass), indicating that the corticosterone EIA could detect physiological changes in circulating corticosterone in frogs. Seasonal profiles of corticosterone were measured in wild vitellogenic females, non-vitellogenic females and adult male frogs on Viwa Island over a 12 month period. Preliminary results showed that corticosterone level was higher in vitellogenic females than in non-vitellogenic females, indicating the energetic costs associated with breeding. In a second experiment, urinary corticosterone concentrations were measured after capture of wild (n=19) Fijian ground frogs. Corticosterone significantly increased within an hour of capture, indicating that frogs, like other vertebrates, have an acute corticosterone response to capture.

Notes:

## Hibernation and reproduction overlap in the echidna (*Tachyglossus aculeatus*)

**Stewart C.Nicol**[1], Gemma Morrow[1], Niels A. Andersen[2]

[1]School of Zoology, University of Tasmania
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During hibernation and torpor there is a slowing of metabolic activity, and thus these processes have been considered to be incompatible with reproduction, which is energetically expensive. Several dasyurid species have now been shown to enter daily torpor during pregnancy (Geiser et al. 2005), but the only mammal which has been demonstrated to enter deep torpor when pregnant is the Canadian hoary bat (Willis et al. 2006). During our long-term study of hibernation in free-ranging echidnas, on several occasions we observed males with hibernating females, while data from body temperature loggers indicated that some pregnancies must occur very shortly after arousal from hibernation. Using a combination of techniques we have now demonstrated that male echidnas will mate with females before they have completed their hibernation, and that pregnant females may re-enter hibernation.

Geiser, F., McAllan, B.M., Brigham, R.M., 2005. Daily torpor in a pregnant dunnart (Sminthopsis macroura Dasyuridae: Marsupialia). Mammalian Biology - Zeitschrift fur Saugetierkunde 70, 117-121.
Willis, C., Brigham, R., Geiser, F., 2006. Deep, prolonged torpor by pregnant, free-ranging bats. Naturwissenschaften 93, 80-83.

Notes:

## The effect of rapid cold hardening on ion homeostasis, mortality, chill-coma recovery and sexual behaviour of *Locusta migratoria*

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The rapid cold hardening (RCH) response is a naturally occurring phenomenon in insects that increases cold tolerance during diurnal variations in temperature. While the benefits of RCH are well established, the underlying physiological mechanisms still remain unresolved. In the present study we investigated the relationship between RCH, ion homeostasis and cold performance in the migratory locust *Locusta migratoria*. We found that a 2 hour RCH exposure to 0ºC increased survival after a subsequent exposure to cold shock (2h at -6ºC). RCH also benefitted chill coma recovery and reproductive behaviour after milder cold shocks (2h at -4ºC) demonstrating an important ecological role of RCH. RCH and cold shock both affected the intra and extracellular distribution of particularly potassium. Thus, the RCH treatment alone caused an increase in extracellular [$K^+$] but this treatment also seemed to reduce the ionic disturbance after a subsequent cold shock. Further evidence of an ameliorating effect of RCH was found in the faster recovery of ion homeostasis in RCH treated animals following a cold shock. Although the cause of improved ion homeostasis following RCH is still unresolved, these results points to either reduced membrane permeability or increased ion pump activity as key elements of the RCH response in insects.

Notes:

## Nonshivering thermogenesis in a small marsupial?

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Uncoupling protein 1 (UCP1) mediated adaptive nonshivering thermogenesis (NST) gives small eutherian mammals a crucial advantage to survive periods of cold stress. However, the existence of adaptive NST in marsupial mammals is still a matter of debate Here, we investigated the effect of cold acclimation on basal metabolic rate (BMR) and artificially induced NST by estimating the thermogenic response to an optimal dosage of noradrenaline (NA) by measuring oxygen consumption and body temperature (Tb). While the BMR was slightly elevated in cold acclimated animals, the amplitude of the NA response (maximal metabolic rate) was more pronounced in warm acclimated (WA) animals reaching similar levels in both groups (WA: 69% CA:53%, increase relative to BMR). Due to a prolonged thermogenic effect of NA in CA dunnarts, the overall response here, is greater. In contrast, a marginal elevation in body temperature (WA:1,3°C and CA:1,2°C) was observed after NA injection in all animals, indicating a low thermogenic effect. Although NA significantly increases thermogenesis in cold acclimated dunnarts which could be attributed to a higher expression of UCP1, the minor increase in body temperature does not suggest a pronounced NST capacity in this marsupial species.

*Notes:*

## Effects of pituitary hormones on GDF-9, BMP-15 and StAR mRNA expression in the previtellogenic ovary of the New Zealand short-finned eel *Anguilla australis*

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The factors that regulate early oogenesis such as growth differentiation factor-9 (GDF-9) and bone morphogenetic protein-15 (BMP-15) and other factors such as steroidogenic acute regulatory protein (StAR) have been well studied in mammals, but little is known in oviparous vertebrates. To investigate temporal changes in expression of GDF-9, BMP-15 and StAR during oogenesis, eels were matured artificially and ovarian samples collected for analysis by quantitative polymerase chain reaction (qPCR). Furthermore, an in vitro experiment of ovarian fragments cultured in the presence of recombinant follicle stimulating hormone (FSH), luteinising hormone (LH) or growth hormone (GH) was conducted for both 24 hour and four day periods to better understand regulation of GDF-9, BMP-15 and StAR. The expression of BMP-15 during induced oogenesis was found to closely resemble that of GDF-9 with highest expression during early vitellogenesis. The expression of StAR during induced oogenesis did not change except for a four-fold increase before final maturation. The expression of both GDF-9 and BMP-15 was unchanged in both incubation periods. Expression of StAR increased four-fold after FSH administration but only after 24 hours of incubation. These results imply key roles for GDF-9 and BMP-15 during early oogenesis and a role for StAR in final maturation in the eel.

Notes:

## Predicting climatic constraints on the Dengue mosquito, *Aedes aegypti*, in Australia

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Arthropod-borne diseases such as Dengue Fever are major contributors to the global burden of disease and climate change is predicted to alter their distribution and prevalence. The magnitude of this climatic effect will be influenced by the physiological responses of vectors such as mosquitoes. It is now possible to predict species' ranges by integrating geographic information systems (GIS) data on climate with physiological data, but accurate predictions require knowledge about geographic variation in climate sensitivity. We studied the climatic constraints on the Dengue Fever vector, the mosquito *Aedes aegypti*, in Australia by collecting site-specific physiological data on the thermal sensitivity of mainland populations and combining it with biophysical models of breeding sites. While there was no geographic variation in the thermal sensitivity of the immature phase within mainland Australia, it was more tolerant of high temperature than Thursday Island populations and developed more slowly overall than non-Australian lineages. We combine this data with empirical and simulated data on temperatures in mosquito breeding containers to establish the suitability of different containers for mosquito proliferation across Australia. This information will be valuable in developing policy on water storage practices that will minimise Dengue Fever risk in Australia.

Notes:

# Insects breathe discontinuously to reduce respiratory water loss

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Many insects breathe discontinuously when at rest, for reasons that are poorly understood and hotly debated. Three adaptive hypotheses attempt to explain the significance of these discontinuous gas exchange cycles (DGCs), whether it be to save water, to facilitate gas exchange in underground environments, or to limit oxidative damage. Comparative studies favour the water saving hypothesis and mechanistic studies are equivocal, but no study has examined the acclimation responses of insects chronically exposed to a range of respiratory environments. The present research is the first mechanistic study of chronic exposure to take a strong-inference approach to evaluating the competing hypotheses according to the explicit predictions stemming from them. Adult cockroaches (*Nauphoeta cinerea*) were chronically exposed to various treatments of different respiratory gas compositions ($O_2$, $CO_2$, and humidity) and the DGC responses were interpreted in light of the *a priori* predictions of the competing hypotheses. The results refute the theories of oxidative damage and underground gas exchange, and provide evidence supporting the hypothesis that DGCs serve to reduce respiratory water loss: cockroaches exposed to low humidity exchange respiratory gases for shorter durations during each DGC than cockroaches exposed to high humidity conditions.

Notes:

# Metabolic physiology and relative water economy in the brushtail bettong (*Bettongia penicillata*)

**Sylvie Schmidt[1],** Ariovaldo Cruz-Neto[1,2,3], Christine Cooper[1,3], Philip Withers[1,3]

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We measured the thermal, metabolic and hygric physiology of the brushtail bettong, a small macropod marsupial from Western Australia, and calculated the first estimate of relative water economy (RWE) for macropod marsupials to compare it to the limited data currently available for marsupials. Measurements were made at ambient temperatures ($T_a$) between 10 and 35°C using flow-through respirometry. Body temperature increased with $T_a$. Metabolic rate (oxygen consumption and carbon dioxide production) was basal at $T_a$ = 32°C, being 111% of that predicted for marsupials based on mass, and increased below the thermoneutral zone (TNZ). Evaporative water loss at the lower end of the TNZ ($T_a$ = 26°C) was 65% of that predicted for marsupials. Wet and dry thermal conductance increased at high $T_a$. RWE decreased with $T_a$, reaching the theoretical point of RWE (PRWE) at $T_a$ = 9.8°C. This is higher than PRWEs that we have measured for other small macropods (Banded hare- wallaby, Rufous hare-wallaby) and that predicted for dasyurids, but there are methodological problems with these calculations. The PRWE for the brushtail bettong of 9.8 °C is lower than that measured for small dasyurids and mouse-opossums, presumably reflecting their higher body mass.

Notes:

## Detecting environmental change: transient receptor potential ion channels control thermoregulatory behaviour in reptiles

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All organismal functions are governed by thermodynamics, and animals regulate their body temperature to optimise cellular performance, and to avoid harmful extremes[1]. The capacity to sense environmental and internal temperatures is a physiological prerequisite for the evolution of thermoregulation[2]. However, the mechanisms which enable ectothermic vertebrates to sense hot or cold environments remain unknown. Here we show that transient receptor potential ion channels (TRP) control thermoregulatory behaviour in a reptile, *Crocodylus porosus*. In this first report of TRPs in ectothermic reptiles, we sequenced genes from cDNA encoding a hot sensing ion channel (TRPV1) from heart tissue of a crocodile, two lizards, and two birds, and also a cool sensing ion channel (TRPM8) from the crocodile. At least in the crocodile, the TRPV1 and TRPM8 genes are also expressed in brain, liver, and peripheral muscle tissues. Pharmacological blockade of TRPV1 and TRPM8 in *C. porosus* abolishes the typically reptilian shuttling behaviour between cooling and heating environments, leading to significantly altered body temperature patterns. Our results provide the proximate mechanism of thermal selection in terrestrial ectotherms, and identify a new research direction in the thermal biology of ectotherms with a focus on the role of sensory neurons, and their interaction with cellular responses to temperature.

Notes:

## The sauropod's long neck

**Roger S. Seymour**

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The sauropods were arguably the most important ecologically dominant group of dinosaurs, not only because of their endurance for over most of the 50 million years of the Mesozoic, but also because of their enormous size. Aside from body bulks estimated to approach 100 tonnes, they sported long necks, sometimes in excess of 9 m. A debate continues on the function of the neck, with many palaeontologists proposing that it was used vertically, for high browsing in conifers. However, it is easy to demonstrate that arterial blood pressure in such stances would reach perhaps 8 times the mammalian norm. This presentation quantifies the effects of high blood pressure on cardiac size and function, according to physiological principles derived from living animals. It also considers proposed solutions to the problem, namely the siphon principle, multiple hearts, raised hydrostatic indifferent points, neck posture and probable aquatic behaviour.

*Notes:*

## Insulin like growth factor–I gene expression in previtellogenic ovary of eel, *Anguilla australis*

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Numerous studies have focused on the intraovarian insulin-like growth factor (IGF) system in late stages of oogenesis (mostly vitellogenesis and final maturation) in the fish ovary. However, only few studies have investigated the functionality of this system during early stages of oocyte growth known as previtellogenesis. This growth phase is analogous to the preantral stage of follicle growth in the mammalian ovary. Previtellogenesis is thought to be GTH independent and requires growth factor inputs. In the present study we examined the gene expression of IGF-I in liver and ovary of immature wild eel using real-time PCR. Thirty fish were divided between four groups on the basis of body size (BS<40cm, 40cm<BS<60cm, 60<BS<80cm, BS>80cm). Histological assessments of the ovary revealed that most oocytes were in the perinucleolus or oil droplet stage. Gonadosomatic and hepatosomatic indices varied between groups and ranged between 0.05%-1.8% and 0.73%-1.89% respectively. IGF-I mRNA, quantified as the sum of two splice variants, was detected in the ovary albeit at lower levels than in liver, suggesting a functional IGF system may exist in the previtellogenic ovary.

Notes:

## Metabolic and ventilatory changes upon exposure to hypoxia and hypercapnia in neonatal fat-tailed dunnarts *(Sminthopsis crassicaudata)*

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The fat-tailed dunnart is born small and developmentally immature (mass 13 mg, gestation 13.5 days). At birth, the lungs contain only a few air sacs, and the skin is the only organ of gas exchange until the onset of continuous ventilation and a functional residual capacity (FRC) is established. We examined ventilation and metabolism during normoxia/normocapnia in neonatal dunnarts ranging from postnatal day (P) 0 to P23. Rhythmic ventilation, with the characteristic post-inspiratory pause, was not detected until several days after birth. We also investigated the effects of hypercapnia (5%CO2) and hypoxia (10% O2) on ventilation and metabolism. The newborn dunnart responded to acute hypoxia by hyperventilation, which was achieved mostly by a decrease in metabolic rate (hypometabolism). This hypometabolism led to marked decrease in minute ventilation ($V_E$) after several minutes of exposure and resulted in prolonged periods of apnoea. As the pouch young age, both metabolic and ventilatory components contribute to the hypoxic hyperventilation. Upon exposure to hypercapnia, the non-breathing P0 dunnarts appear to have a similar hypometabolic response. The expected response of hyperventilation via an increase in $V_E$, predominantly associated with an increase in tidal volume, was observed in the P5 and older neonates. Exposure to hypercapnia also led to an increased stability in the breathing pattern and frequency of augmented breaths or sighs.

Notes:

## Migratory locusts increase aerobic capacity

**Edward P. Snelling**[1], Roger S. Seymour[1]

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Insects increase metabolic rate up to 200-fold above resting levels during strenuous activity. This study examined the change in resting and maximum metabolic rate throughout the lifecycle of an insect. Open-flow respirometry was used to measure oxygen consumption during rest and hopping exercise in 1st, 3rd, and 5th instar migratory locusts. Rest and flight measurements were also taken on winged adult locusts. Resting oxygen consumption rate in juvenile hoppers increased with body mass to the power of 0.77, whereas maximum oxygen consumption rate increased with an exponent of 0.94. This represents a 2.5–4.5-fold increase in oxygen consumption from rest to maximum activity in juveniles. Adults on the other hand, increase metabolic activity 40-fold during flight with oxygen consumption rates in excess of 1000 $\mu$mol $O_2$ $g^{-1}$ $h^{-1}$. Although the increase in maximum aerobic capacity from juvenile hopper to flighted adult is impressive, flight oxygen consumption is less than expected for an insect of equivalent mass. Flight behaviour and smaller wing-loadings in the locust could explain this phenomenon.

*Notes:*

## Summer torpor in a subtropical insectivorous bat

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It is widely believed that mammalian torpor is restricted to cold climates. However, recent studies have found that several mammals inhabiting warm regions, such as arid or tropical habitats, frequently use daily torpor or even prolonged torpor in winter. We used radio-telemetry to measure skin temperatures ($T_{skin}$) to determine whether free-ranging long-eared bats (*Nyctophilus bifax* ~10 g) in a coastal subtropical habitat employ torpor during summer. Bats used torpor on 85% of observation days, with torpor bouts ranging from 0.3 to 21.2 h and the average torpor bout duration was 3.1±1.4 h (*n*=13 bats, *N*=121 observations). Torpor bout duration significantly increased with decreasing $T_a$ and $T_{skin}$ ($P<0.001$; $R^2=0.06$ and 0.18, respectively), with most bats (60%) showing two or more bouts/day. Daily minimum $T_{skin}$ was positively correlated with corresponding $T_a$ ($P<0.001$, $R^2=0.43$), as torpid $T_{skin}$ fluctuations passively followed daily $T_a$ trends. The average daily minimum $T_{skin}$ was 23.6±2.9°C (*n*=13, *N*=74) and the lowest $T_{skin}$ recorded was 16.0°C. Our study contributes to the emerging body of data that torpor is used regularly by microbats in subtropical regions, even during summer when conditions are mild, and suggests that even in warm climates small insectivorous bats have to deal with energetic constraints.

Notes:

## Does AMP induce torpor?

**Steven J. Swoap**

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The nucleotide AMP has recently been purported to be a primary regulator of torpor in mice, as circulating AMP is elevated in the fasted state and administration of AMP causes severe hypothermia. We compared the physiological characteristics (metabolic, body temperature, cardiovascular) that occur during a true bout of torpor with those that occur with the exogenous administration of AMP in mice, and found these states are quite dissimilar. While administration of AMP into mice induced hypothermia similar to the depth of fasting-induced torpor, ADP and ATP were equally effective in lowering $T_b$. The maximum rate of $T_b$ fall into hypothermia was significantly faster with injection of adenine nucleotides than during fasting-induced torpor. Heart rate decreased from 755 ± 15 to 268 ± 17 bpm within one minute of AMP administration, unlike that observed during torpor (from 646 ± 21 to 294 ± 19 bpm over 35 minutes). Finally, the hypothermic effect of AMP was blunted with pre-administration of an adenosine receptor blocker, suggesting that AMP action on $T_b$ is mediated via the adenosine receptor. These data suggest that injection of adenine nucleotides into mice induces a reversible hypothermic state that is unrelated to fasting-induced torpor.

*Notes:*

## Costs and benefits of a sexually selected trait in the threadfin rainbowfish *Iriatherina werneri*

**Andrew G. Trappett**[1], Craig R. White[1], Robbie S. Wilson[1]

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Sexually selected traits are used as inter-specific signals of reproductive potential and mate quality. Frequently, females choose males that display elaborate sexually selected traits as they are considered to be reliable indicators of male quality. The exaggeration of male ornamentation is thought to be constrained by the costs of producing and maintaining these traits. Here we investigate the costs and benefits of an exaggerated ornament in male threadfin rainbowfish. We examined the relationship between the size of ornamentation and attractiveness to females. We also examined the costs of fin ornamentation for both metabolic and locomotor performance traits. We predicted that when standardized for body size, males with larger ornaments would appear more attractive to females at the cost of decreased escape performance and increased metabolic expenditure due to parasitic drag. We used linear regression and path analysis to determine the effect of body size, body depth and size of ornament on total seconds of attention gained from females, metabolic cost of activity and maximum escape response. We found that length of ornamentation was the best predictor of attractiveness, resting metabolic rate and negatively correlated with maximum escape velocity. This study found both costs and benefits of ornamentation.

Notes:

## Does thermal ecology constrain species distributions?

**Scott van Barneveld**

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I used two morphologically similar and closely related lizard species, *Lampropholis delicata* and *L. guichenoti* to address the question: Does thermal ecology constrain species' distributions? Both species are widely distributed with overlapping distributions, except that *L. delicata* occurs further north into warmer latitudes than does *L. guichenoti*. I acclimated both species to cool, warm and hot (15, 25 and 30 °C) thermal environments for 60 days before measuring their sprint speeds as an index of performance at a range of temperatures between 12 -35°C. It was expected that *L. delicata* with a greater latitudinal distribution would outperform *L. guichenoti* over a breadth of temperatures. Both species demonstrated similar acclimation responses to 15 and 25 °C, but when acclimated to 30 °C *L. delicata* was able to outperform *L. guichenoti* at temperatures over 25 °C. Each had a similar running speed when tested at 12 to 25 °C (0.7 and 0.6 m/s at 25 °C), but the performance of *L. guichenoti* fell to 0.5 and 0.45 m/s at 30 and 35 °C respectively; in contrast, performance of *L. delicata* improved to 0.88 and 0.75 m/s respectively. It is likely that suboptimal performance of *L. guichenoti* in warmer climates is a significant factor limiting its distribution.

Notes:

## Costs and benefits of predator induced behaviour in larvae of the urban mosquito (*Aedes notoscriptus*)

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Prey often exhibit behavioural and morphological responses that convey greater survival in the presence of predators. The evolution and maintenance of such responses requires a functional trade-off between alternate phenotypes. That is, predator-adapted phenotypes must be beneficial in the presence of predators but costly in their absence. While the cost/benefit trade-off of prey responses seem intuitive, they are often difficult to demonstrate empirically. In this study, we examine the costs and benefits of the behavioural response of larval mosquitoes *Aedes notoscriptus* to fish predators. Larval *Ae. notoscriptus* reduce activity in the presence of predator chemical cues from Firetail gudgeon, *Hypseleotris galii*. We will test the adaptive benefits of the behavioural response by entering predator exposed and naïve larvae into predation trials with *H. galii*. Fitness costs will be measured by comparing longevity and lifetime fecundity of predator exposed to predator naïve females. We predict that larvae exposed to predator chemical cues throughout development will avoid detection from *H. galii* for longer, but suffer a shorter adult life span and/or reduced lifetime fecundity. We will discuss the findings of these experiments and the potential use of aqueous predator chemical cues as control agents of pest mosquitoes.

Notes:

## Molecular mechanism which underlie the development of endothermy in birds (*Gallus gallus*)

**Isabel Walter**, Frank Seebacher

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The evolution of endothermy is associated with high metabolic rates and internal heat production. During embryogenesis endotherms cannot regulate their body temperature metabolically and are therefore similar to ectotherms. The transition from ectothermy to endothermy occurs by the development of metabolic capacity during embryogenesis. Internal heat production is facilitated by increased oxidative metabolic capacity accompanied by the uncoupling of aerobic metabolism from energy (ATP) production. Additionally, heat production in endotherms is facilitated by greater basal proton leak across the inner mitochondrial membrane compared to ectotherms. The aim of this study was to test whether the transition from an ectothermic to an endothermic metabolic state in developing chicken embryos occurs by the interaction between increased basal ATP demand ($Na^+$,$K^+$-ATPase activity and gene expression), increased oxidative capacity and increased uncoupling of mitochondria. We show that this process is controlled by thyroid hormone via its effect on PGC1α and adenine nucleotide translocase (ANT) gene expression. Additionally mitochondria become more uncoupled during development, but unlike in mammals the uncoupling protein of birds does not uncouple mitochondria and therefore plays no role in heat production. Our findings elucidate the interaction between different mechanisms that lead to the development of endothermy.

*Notes:*

## Can faecal glucocorticoids be used as an indicator of stress in captive koalas?

**Koa N. Webster**[1], Sarah McKenzie[1] and Elizabeth M. Deane[1,2]

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This study examined faecal glucocorticoid (GC) metabolite concentrations in a captive population of koalas at Taronga Zoo in Sydney, Australia. GC metabolites present in koala faeces were readily detected using a corticosterone enzyme immunoassay (EIA). Faecal sampling occurred during two seasons (Autumn and Winter) at three separate enclosures with varying exposure to human visitors. Analysis of variance identified a significant effect of season and enclosure on koala faecal GC metabolites, but no effect of zoo visitor numbers. Faecal GC concentrations were higher in Winter than Autumn, similar to earlier studies on plasma cortisol and suggesting a possible circannual rhythm in GC hormones. The koalas in the enclosure with the most consistent exposure to humans had the lowest faecal corticosterone levels, which may be a sign of habituation to the presence of humans. Koalas in an enclosure with more sporadic visitation by humans had the highest faecal corticosterone levels; this could indicate that pulses of visitors are more stressful than relatively constant exposure. Faecal GC metabolite analysis, a non-invasive approach for monitoring adrenocortical stress responses, may be a useful tool for managers of captive populations of marsupials, including the koala.

*Notes:*

## Temperature-induced variation in phallus size reliably indicates male physical performance and gamete quality in eastern mosquito fish (*Gambusia holbrooki*)

**Robbie S Wilson**

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Males of many organisms possess elaborated structures that are used to engage in fights with other males and/or to attract females during courtship. The size and elaboration of these secondary sexual traits can be affected by the environment via its influence on the condition of an individual male. This link between male condition and the elaboration of male sexual signals is one of the most important mechanisms maintaining the reliability of these traits as signals of male quality. The role temperature plays in mediating the condition of individual males and the size and elaboration of their sexually selected traits is currently unknown. Males of the eastern mosquito fish (*Gambusia holbrooki*) possess a modified anal-fin phallus (gonopodium) that is used as both a signal of dominance and a stabbing weapon during male-male competitive bouts. I examined the effect of temperature on the size of this putative sexual signal (phallus size) by chronically exposing males to either 20° or 30°C for four weeks. I also tested the influence of these thermal environments on various measures of male quality; including male territorial performance, swim speed and gamete function. Males chronically exposed to 30°C possessed longer phalluses greater ejaculate sizes, larger testes and faster sperm swimming speeds than those exposed to 20°C. This is the first study to show that environmental variation in phallus size can be a reliable indicator of male physical performance and gamete quality.

Notes:

# Effect of relative humidity on evaporative water loss in marsupials

**Philip C. Withers**[1,2], Christine E. Cooper[1,2]

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We found that correcting for ambient relative humidity (RH) significantly increased rather than decreased the variability of the allometric relationship for evaporative water loss (EWL) data for 27 species of marsupial. Consequently, we examined the effect of RH and ambient temperature ($T_a$) on EWL for the western pygmy possum (*Cercartetus concinnus*), brushtail possum (*Trichosurus vulpecula*) and little red kaluta (*Dasykaluta rosamondae*) and the implications of RH-correcting EWL data. For pygmy possums, EWL was not influenced by RH at $T_a$ = 30°C. For brushtail possums, EWL was independent of RH at $T_a$ = 25°C for RH ≤63 % but decreased linearly at higher RHs, whereas EWL was linearly related to RH from 26-92 % RH at $T_a$ = 30°C. For kalutas, EWL was independent of RH <60% at $T_a$ = 25, 30 and 35°C. Our results indicate that marsupials do not necessarily show the expected linear effect of ambient RH on EWL, possibly because of behavioural modification of their immediate microclimate or the dynamics of nasal counter-current water exchange. These effects of chamber RH on physiological variables differed from expected, and therefore care must be taken when considering the RH effect on EWL, and potentially other standard physiological variables such as body temperature, metabolic rate and thermal conductance.

*Notes:*

## Selected body temperature, metabolic rate and activity pattern of the Australian fossorial skink, *Saiphos equalis*

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Fossorial and nocturnal lizards have limited opportunities to thermoregulate because they do not have access to basking opportunities, which has implications for their thermal physiology and metabolism. We measured substrate temperatures ($T_s$) in the field, and selected body temperature ($T_b$) in the laboratory for adults and juveniles of the fossorial skink *S. equalis* to quantify basic aspects of its thermal biology. *Saiphos equalis* selects relatively cool temperatures over a broad range (approximately 17-24 ºC), suggesting that it does not thermoregulate precisely. Individuals of *S. equalis* are on the surface of the substrate more frequently at night (75%) than during the day (25%). Like many other fossorial lizards, *S. equalis* is nocturnal and selects relative low body temperatures compared to heliothermic lizard species. Rates of oxygen consumption, measured at 2° C intervals from 10-30 °C in adult lizards, increased as a function of temperature, although there was no significant difference over the preferred body temperature range.

Notes:

# Rat skeletal muscle membrane fatty acid composition is most responsive to the balance of dietary n-3 and n-6 polyunsaturated fatty acids

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[2]School of Health Sciences, University of Wollongong, Wollongong, NSW, Australia

The aim of this study was to quantify the relationship between fatty acid (FA) profiles of the diet and membrane composition of rat muscle. Rats were fed one of 12 diets differing only in lipid profile. Diet saturates (SFA) ranged from 8-88%, monounsaturates (MUFA) 6-65%, polyunsaturates (PUFA) 4-81% with n-6 PUFA 3-70% and n-3 PUFA 1-70%. PUFA Balance (= n-3 PUFA as % of total PUFA) ranged from 1-86%. Skeletal muscle phospholipids were separated and FA composition measured. Muscle phospholipids were plotted against diet composition and the slope of each relationship used to quantify the response of muscle to dietary fat profile. The resulting slopes in increasing order were SFA (0.01), PUFA (0.07), MUFA (0.12), n-3 PUFA (0.14), n-6 PUFA (0.20) and PUFA Balance (0.28). A dietary PUFA Balance <10% resulted in very high 20:4n-6 in muscle phospholipids and reduced levels of 22:6n-3. The balance of dietary n-3 and n-6 PUFA is very important in determining FA composition of membrane bilayers. If these results in rats also apply to humans, the observation that diets with PUFA Balance <10% result in very high levels of 20:4n-6 in membrane lipids likely has important medical and health implications.

*Notes:*

## The secret sex life of echidnas, the iButton and stump cam story

**Niels A. Andersen**, Gemma Morrow, Jemma Chaplin, Stewart Nicol

School of Zoology
Discipline of Anatomy and Physiology
University of Tasmania

The cryptic nature of echidnas makes good field-based physiological and behavioural observations hard to obtain. At our study site in the Tasmanian midlands we have followed a field population since 1996. In the first 11 years of the study we obtained information from a relatively small number of individuals using implanted temperature loggers. When combined with other physiological data and field observations this has given us a surprisingly comprehensive picture of echidna biology. However, there are drawbacks associated with the use of such invasive techniques. In this report we show that small external temperature loggers (iButtons) can provide nearly the same information as implanted temperature loggers, and in some cases provide information that could not be obtained from body temperature. This approach also has the great advantage that data can be downloaded in the field.

*Notes:*

## Presenting Vascular endothelial growth factor C (VEGF-C) of the gecko *Christinus marmoratus* – Sequence and model

**Helen A. Blacker**[1], Sandra Orgeig[2], Gary W. Booker[3]

[1] School of Earth and Environmental Sciences, The University of Adelaide, Adelaide, SA, Australia
[2] Sansom Institute, School of Pharmacy and Medical Sciences, University of South Australia, Adelaide, SA, Australia
[3] School of Molecular and Biomedical Science, The University of Adelaide, Adelaide, SA, Australia

The Australian marbled gecko *Christinus marmoratus*, like many gecko species, has the ability to drop its tail as a predator escape response. The regenerated tail is not lymphoedematous, and we have previously shown that fluid drainage pathways within the tail are restored during regeneration, presumably as a result of lymphangiogenesis (the growth of new lymph vessels). In mammals, a key lymphangiogenic stimulator is vascular endothelial growth factor C (VEGF-C) via signalling through the receptor, VEGFR-3. cDNA and amino acid sequences of gecko VEGF-C have been obtained from mRNA isolated from a regenerated gecko tail. The 1749bp nucleotide sequence encodes a glycoprotein containing 424 amino acids. An alignment of gecko VEGF-C with other vertebrate sequences shows that this lizard protein has 78% identity and 87% similarity with the human sequence (i.e. % of identical and similar amino acids, respectively). The strongest region of homology occurs within the VHD (vascular homology domain). A molecular model has been generated from the amino acid sequence based on homology to the known crystallised sequence of VEGF. This will enable us to make inferences on the protein's functionality and to determine whether it may be a factor responsible for lymphangiogenesis in the regenerating gecko tail.

Notes:

## Surviving the feast: Protection of intestinal function during prolonged fasting is the key to re-feeding success in a burrowing frog

**Rebecca L Cramp**, Edward A Meyer and Craig E Franklin

School of Integrative Biology, The University of Queensland, Brisbane, Australia 4072

Evolutionary theory suggests that the digestive capacity of a tissue be matched to the demands placed upon it to avoid energy wastage. But down-regulating the intestine potentially compromises the animals' re-feeding ability. We examined the functional capability of the small intestine of the green striped burrowing frog, *Cyclorana alboguttata* following 4-6 months aestivation and while active and feeding. The mass-specific metabolic rate of isolated intestinal slices increased (per unit of wet mass) during aestivation. When extrapolated to the whole intestine, its metabolic contribution (to whole animal metabolic rate) rose from about 6 % in active animals to over 20% in aestivating ones. Mass-specific intestinal proline transport increased during aestivation relative to that of active frogs, but total intestinal proline uptake capacity was reduced. Intestinal $Na^+K^+$ATPase activity was maintained despite a reduction in the number of transporters through an increased molecular activity of transporters. These results suggest that energy savings are made by reducing intestinal mass during aestivation, but despite this, a significant amount of functionality is maintained at a relatively high energetic cost to the animal. We hypothesise that the ability to re-feed immediately after aestivation outweighs the cost associated with 'maintaining' an unused tissue during periods of extreme energetic stress.

Notes:

## Sexual Selection and Visual Physiology: Maintenance of a rare colour morph in the Ornate Rainbowfish, *Rhadinocentrus ornatus*

**Daniel Hancox**, Conrad Hoskins, Craig White & Robbie S Wilson

Integrative Ecology Lab (www.uq.edu.au/integrative-ecology), School of Integrative Biology, The University of Queensland, St Lucia 4072 Australia

Geographic variation in colour ornamentation is a wide-spread phenomenon, occurring across many taxa with diverse life histories. Divergence in colour ornamentation can arise in response to changes in the visual environment, physiology of vision and colour expression, and through selection on communication channels such as competition and mate choice. In contrast, colour polymorphism (where more than one colour morph persists within discrete populations) is a rare occurrence in natural populations, requiring functional tradeoffs between colour morphs that are competing for survival under the same conditions. Due to the rarity of colour polymorphic populations, these processes remain largely unexamined. Fortunately, the Ornate Rainbowfish (*Rhadinocentrus ornatus*) of Fraser Island presents an ideal system for addressing these issues. Consisting of a common blue morph and rare red morph, colour polymorphism is expressed in both males and females and is known to vary among populations in response to the visual habitat. Our research on sexual selection in this species has uncovered conflicting patterns of non-random mating between males and females. Building on this result, we are investigating the visual physiology of the *R.ornatus* and the extent of variation in colour expression among Fraser Island populations in response to changes in the visual environment.

Notes:

## The Effect of Intrauterine Growth Restriction on Pulmonary Surfactant Protein mRNA Levels in the Ovine Fetus

**Sandra Orgeig,** Tamara A. Crittenden, I. Caroline McMillen, Janna L. Morrison

Sansom Institute, School of Pharmacy & Medical Sciences, University of South Australia, Adelaide, SA, Australia

Postnatal lung function is dependent on adequate lung growth and surfactant maturation during fetal development. Placental insufficiency is a major cause of intrauterine growth restriction (IUGR) and neonatal morbidity due to restricted fetal substrate supply. Chronic fetal hypoxemia in the ovine fetus alters surfactant protein (SP) expression. SP's are integral to surfactant function by promoting lipid adsorption to, and reducing surface tension, at the air-liquid interface of the lung. IUGR was induced by surgical removal of endometrial caruncles from ewes prior to mating. Post-mortem sampling of lung tissue was conducted on 20 pre-term fetuses at 130-135 days' gestation (control n=10, IUGR n=10) and 31 fetuses at 139-145 days' gestation (control n=15, IUGR n=16). Quantitative real-time PCR (qRT-PCR) detected the relative abundance of SP-A, -B and -C mRNA transcripts in fetal sheep lung using SYBR green. Older fetuses (139-145 days) demonstrated no significant difference in SP mRNA levels between control and IUGR groups. However, a significant ($P$<0.05) decrease in the level of SP-B and SP-C mRNA, but not SP-A, was observed in the IUGR compared with the control group at 130-135 days' gestation. This unexpected decrease in SP-B and SP-C mRNA levels contrasts with other studies investigating chronic hypoxemia.

Notes:

## Dynamics of organic contaminant burdens in the Southern Ocean humpback whale (*Megaptera novaeangliae*)

**Courtney Waugh**[1], Michael Noad[2], A'edah Abu Bakar[1], Susan Bengtson Nash[1]

[1] *National Research Centre for Environmental Toxicology (EnTOX), University of Queensland, Brisbane, QLD, Australia*
[2] *School of Veterinary Science, University of Queensland, Brisbane, QLD, Australia*

Marine mammals, particularly large, long-lived, cetaceans, accumulate considerable concentrations of man-made chemicals, organochlorine compounds (OCs), as a result of their position at the top of the food web and historical and current global production of the chemicals. Cetaceans are generally believed to have a reduced cytochrome P-450 mediated capacity for the detoxification of these chemicals and consequently are considered to be among the most vulnerable taxa to the adverse health effects of these chemicals. OCs accumulate in fat reserves and are significantly influenced by lipid dynamics. Southern Ocean populations of humpback whales undertake some of the longest migrations and periods of fasting known in any mammal. It is hypothesized that this seasonal migration-associated weight loss serves to redistribute and concentrate OC loads, representing an elevated risk of toxicity. A persistent and toxic OC compound has been detected by our team in the blubber of a Southern Ocean humpback whale at levels comparable to individuals in the Gulf of St. Lawrence- one of the most notoriously OC contaminated marine ecosystems in the world. Our team is currently expanding this effort by exploring the dynamics of OC burdens in the blubber of the Southern Ocean humpback whale during their migrational journey and characterising metabolizing enzymes in the dermal tissues.

Notes:

# Is the Ancient Bunya Tree (*Araucaria bidwillii Hook*)- Sustainable at Remnant Sites?

Ian R. Smith[1], **Kerry W. Withers**[2], Simon Blomberg[1], John Billingsley[3]

[1]School of Integrative Biology, University of Queensland, Brisbane, Qld, Australia
[2] Centre for Systems Biology, University of Southern Queensland, Toowoomba, Qld, Australia
[3]National Centre for Engineering in Agriculture, University of Southern Queensland, Toowoomba, Qld, Australia

The bunya pine (*Araucaria bidwillii*- Section *Bunya*) was worldwide during the Jurassic. Climate change (drying) and poor seed dispersal may have contributed to its present distribution in Australia, limited to the Bunya Mountains and remnant sites. The cones are large, soft shelled and nutritious and fall to the ground beneath the tree before dehiscing. Previously, we demonstrated that fauna ate *A.bidwillii* seeds only in situ at remnant sites and ate and dispersed them in the Bunya Mountains. Rodents ate the seeds in situ, but did not disperse them, while possums dispersed the seeds. Examination of seeds fed to captured possums and rodents facilitated identification of predators of seeds in the wild. We examined predation and dispersal of tagged *A. bidwillii* seeds at 3 replicates of each of 5 remnant sites of *A. bidwillii* in SE Qld. Most seeds that did not germinate were eaten, mainly by possums. Seed dispersal was less at small dry rainforest remnant areas at Wratten and Jimna than Gallangowan and Yarraman State Forests and highly variable within some sites. Propagation of *A. bidwillii* requires that seeds be dispersed beyond the canopy (8m). The results suggest that this ancient tree species is not sustainable at some remnant sites, especially in dry rainforest along firebreaks.

Notes:

## Do hot frogs waste away?

**Karen M Young**[1], Dr Rebecca L Cramp[1], Dr Craig White[1], Prof Craig E Franklin[1]

School of Integrative Biology, The University of Queensland, St Lucia, Queensland 4072, Australia

Muscle disuse atrophy (MDA) is a process of tissue degeneration that occurs when muscle is not in use. Prolonged disuse occurs in nature, exemplified by animals that undergo extended dormancy. In these disuse situations dormant animals show a remarkable resistance to muscle atrophy. The substantial metabolic depression that characterises dormancy is postulated to provide protection against disuse atrophy in dormant animals. This is because a recognised contributor to MDA is oxidative stress, where the formation and accumulation of reactive oxygen species (ROS) in muscle can cause the degenerative changes associated with atrophy. Furthermore, a fixed proportion of oxygen reduced in mitochondria results in ROS. The extent muscles atrophy may therefore be closely linked with an animal's metabolic rate. Previous research has indicated sensitivity of the depressed dormant metabolism to temperature in burrowing frogs and toads. Thus, the potential exists for increased muscle disuse atrophy to occur via elevation of the hypometabolic state by elevated dormancy temperature in ectotherms. I will use temperature as a tool to show a link between metabolic rate and MDA, investigate mobilisation of protective mechanisms and assess the manifestation of any effects in locomotor performance at the whole animal level, in *Cyclorana alboguttata*.

*Notes:*

## Effect of the tapeworm, *Hymenolepis diminuta*, on nutritional indices and morphology of the digestive tract of Wistar rats

Budhima Nanayakkara [1], Carolyn Behm[2], **Paul D. Cooper[1]**

[1] Botany & Zoology, School of Biology, Australian National University, Canberra, ACT, Australia
[2] Biochemistry & Molecular Biology, School of Biology, Australian National University, Canberra, ACT, Australia

Parasites are typically considered to be detrimental to their hosts, although many species have been shown to be either commensal or mutualistic. We investigated whether the tapeworm, *Hymenolepis diminuta*, which inhabits the small intestine of rats affects various parameters associated with digestion, as well as the gross morphology of the small and large intestine and caecum. Six six-week-old Wistar rats were infected with 10-11 cysticercoid larvae by gavage, with six rats treated in the same way, but without addition of cysticercoids. Growth rates, feeding rates, nitrogen balance, urine production and mean retention times in the guts were measured in the rats. At the end of the whole animal measurements, wet mass of small and large intestine and caecum were all determined, with and without contents. No significant difference for any digestive parameter or growth rate was found, although the small intestine and caecal tissue masses of infected animals did increase. The small intestine may increase to compensate for any nutrient removed by the parasite, but less clear is the reason for caecal increase. Future work will examine the possible mechanisms causing the observed responses.

Notes:

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BIOLOGICAL SCIENCES AOB

# AUSTRALIAN AND NEW ZEALAND SOCIETY

# FOR

# COMPARATIVE PHYSIOLOGY

# & BIOCHEMISTRY

# SILVER JUBILEE

# 2008

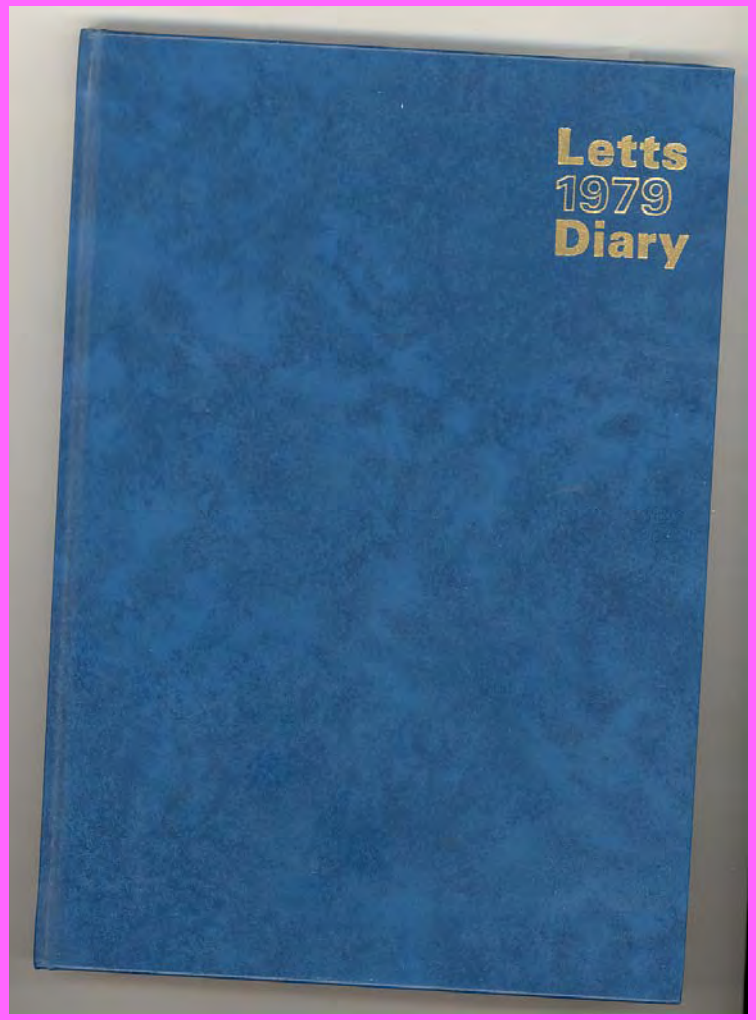
AFTER DINNER SPEECH BY GORDON GRIGG, DEC 7 2008.

Beginnings: Meetings at UNSW (Greenaway and Dawson) sitting around a large wooden table with a slab of beer in the middle.

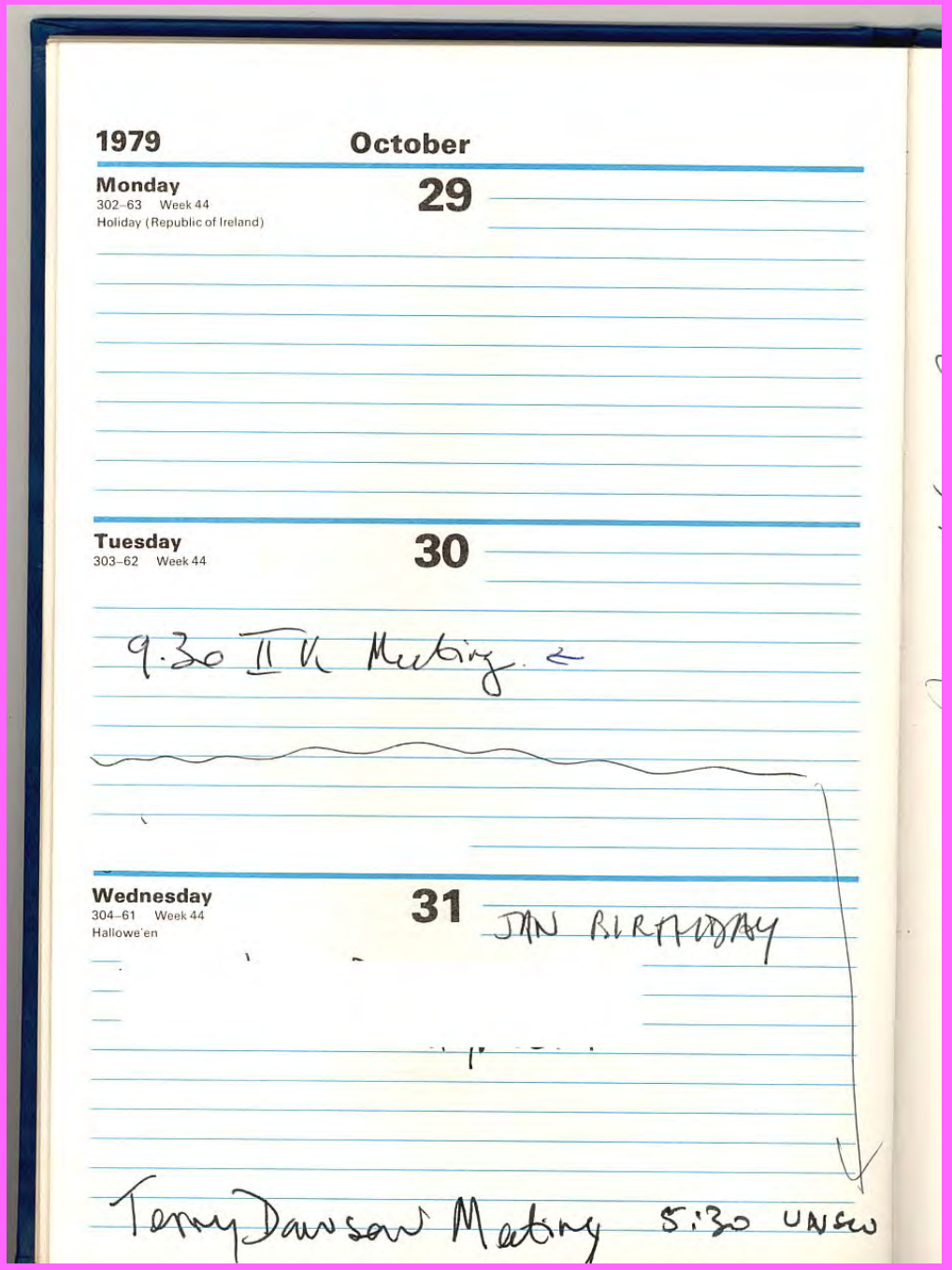
OHP at one end, sometimes.

Slide projector.

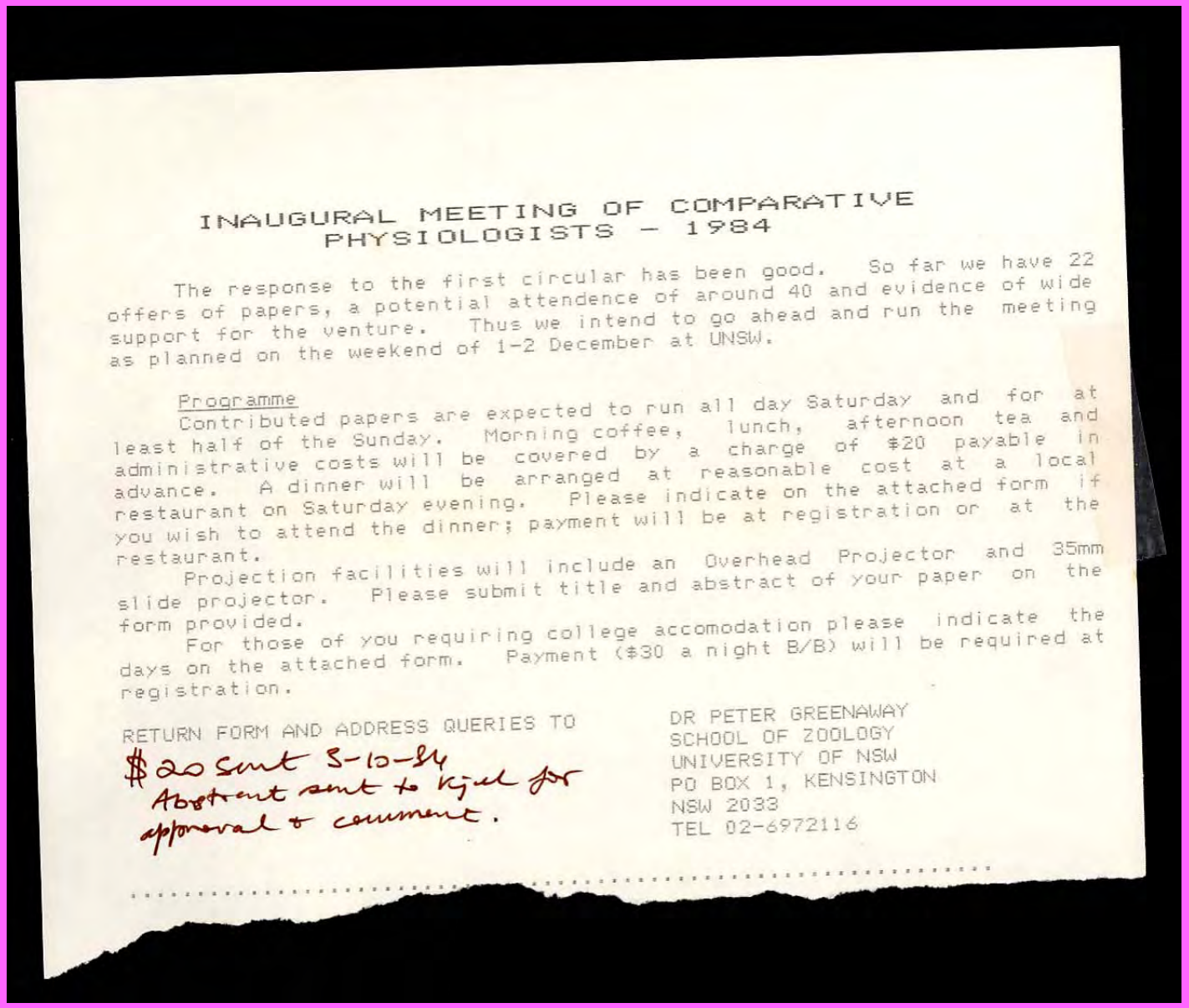
Circa 1980?




This entry in my Diary for 1979 may be for one of those events. (I presume it says Terry Dawson 'meeting', not 'mating'



A somewhat historic flyer.....



INAUGURAL MEETING OF COMPARATIVE PHYSIOLOGISTS – 1984

The response to the first circular has been good. So far we have 22 offers of papers, a potential attendence of around 40 and evidence of wide support for the venture. Thus we intend to go ahead and run the meeting as planned on the weekend of 1-2 December at UNSW.

Programme

Contributed papers are expected to run all day Saturday and for at least half of the Sunday. Morning coffee, lunch, afternoon tea and administrative costs will be covered by a charge of $20 payable in advance. A dinner will be arranged at reasonable cost at a local restaurant on Saturday evening. Please indicate on the attached form if you wish to attend the dinner; payment will be at registration or at the restaurant.

Projection facilities will include an Overhead Projector and 35mm slide projector. Please submit title and abstract of your paper on the form provided.

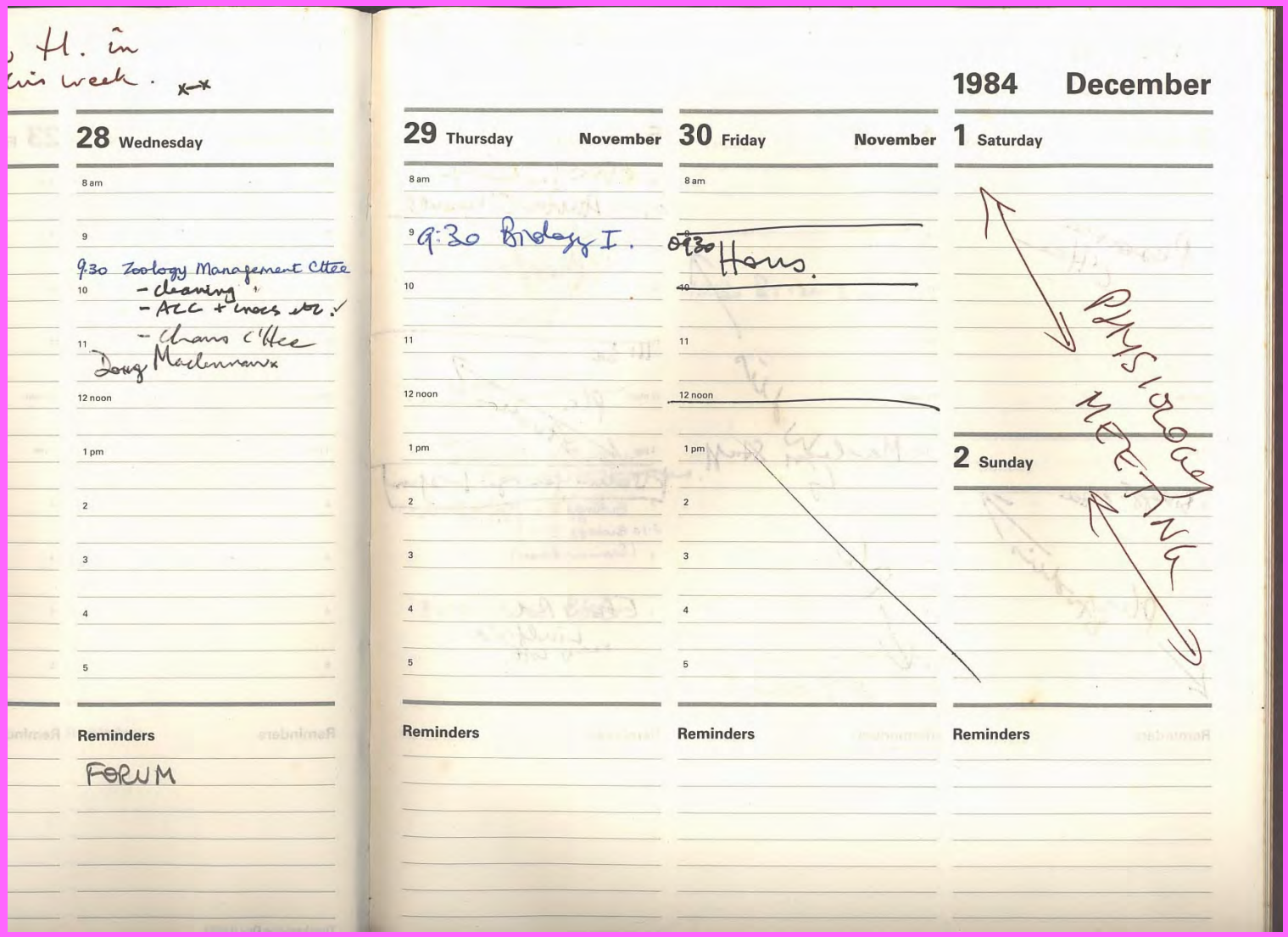
For those of you requiring college accomodation please indicate the days on the attached form. Payment ($30 a night B/B) will be required at registration.

RETURN FORM AND ADDRESS QUERIES TO

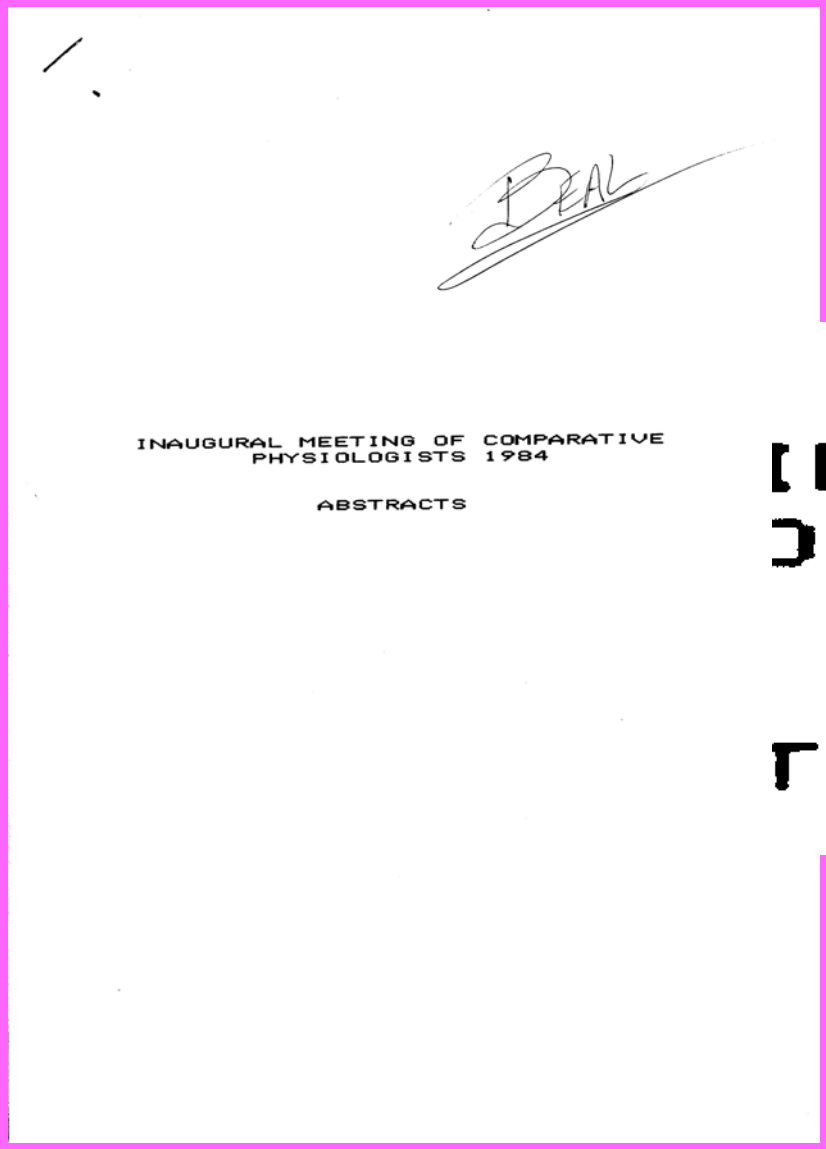
$20 sent 3-10-84
Abstract sent to Kjell for approval & comment.

DR PETER GREENAWAY
SCHOOL OF ZOOLOGY
UNIVERSITY OF NSW
PO BOX 1, KENSINGTON
NSW 2033
TEL 02-6972116

The entry in my Diary for the Inaugural Meeting of the Society.....



Cover page of the Programme and Abstracts for the Inaugural meeting.....



INAUGURAL MEETING OF COMPARATIVE
PHYSIOLOGISTS 1984

ABSTRACTS

Remember dot matrix printers?

[NG OF COMP
)GISTS 1984

TRACTS


…. And the old hardware?

**Apple Computer**

**Introduced**January 1983
**Discontinued**November 1993
**Price US$1298**

**CPU**6502 / 65C02, 1.023 MHz

**RAM**64 KB (up to 1 MB+)

**OS ProDOS**

….. and storage media?

## The meetings…… 1984-1995

| | | | |
|---|---|---|---|
| 1 | 1984 | University of New South Wales | Greenaway, Dawson |
| 2 | 1985 | University of New South Wales | Greenaway, Dawson |
| 3 | 1986 | University of Wollongong | Hulbert |
| 4 | 1987 | CSIRO Wildlife & Ecology | Brown, Cork |
| 5 | 1988 | University of New South Wales | Greenaway |
| 6 | 1989 | Flinders University | Baudinette, Frappell |
| 7 | 1990 | University of Melbourne | Evans, Baldwin |
| 8 | 1991 | University of New England | Roberts |
| 9 | 1992 | University of Sydney | Morris, Thomson |
| 10 | 1993 | University of Tasmania | Nicol |
| 11 | 1994 | University of Queensland | Grigg |
| 12 | 1995 | University of Canterbury | Taylor, Davison & Forster |

# Flyer for the 5th Meeting (at UNSW).....

Fifth

## COMPARATIVE PHYSIOLOGISTS MEETING

3rd-4th December 1988

It was agreed at the 1987 meeting in Canberra that the 1988 meeting should be at the University of NSW in Sydney. The details for the meeting are as follows:

VENUE: School of Biological Science, University of NSW

DATES: Sat. 3rd & Sun. 4th December, 1988.

PAPERS: The sessions will follow the format of previous meetings with 15 min. presentations and 5 min. allowed for discussion. Slide and overhead projection facilities will be available. Contributions may be in any field of comparative or environmental physiology/biochemistry. Research students are encouraged to attend and participate.

COST: Registration, lunch, tea and coffee. $30 payable by Nov. 7th 1987.

ACCOMMODATION: Accommodation is available in University Colleges a few minutes walk from the Biological Sciences Building where the sessions will be held. The cost for a Single room is $26 per person (Bed only, no breakfast available over the weekend). Accommodation costs are payable at registration.

CONFERENCE DINNER: On Saturday night there will be a dinner at a local restaurant. Estimated cost is $20-25 including drinks, payable at registration.

Please complete the attached form and return by November 7th. If you need more forms either photocopy the one attached or contact the organizers. Please make cheques payable to COMPARATIVE PHYSIOLOGY MEETING. Address all correspondence to:

Dr. Peter Greenaway
School of Biological Science
University of NSW
P.O. Box 1, Kensington
N.S.W. 2033

**For Telephone contacts**

**Peter Greenaway (02) 697 2190 or Mike Beal (02) 697 2116**

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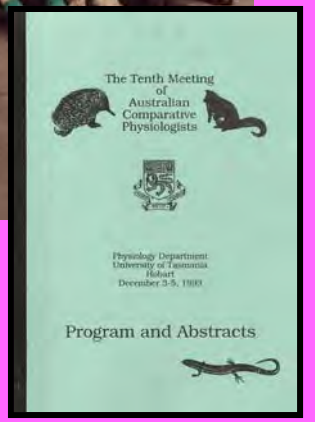



Hobart Dec 3-5 1993

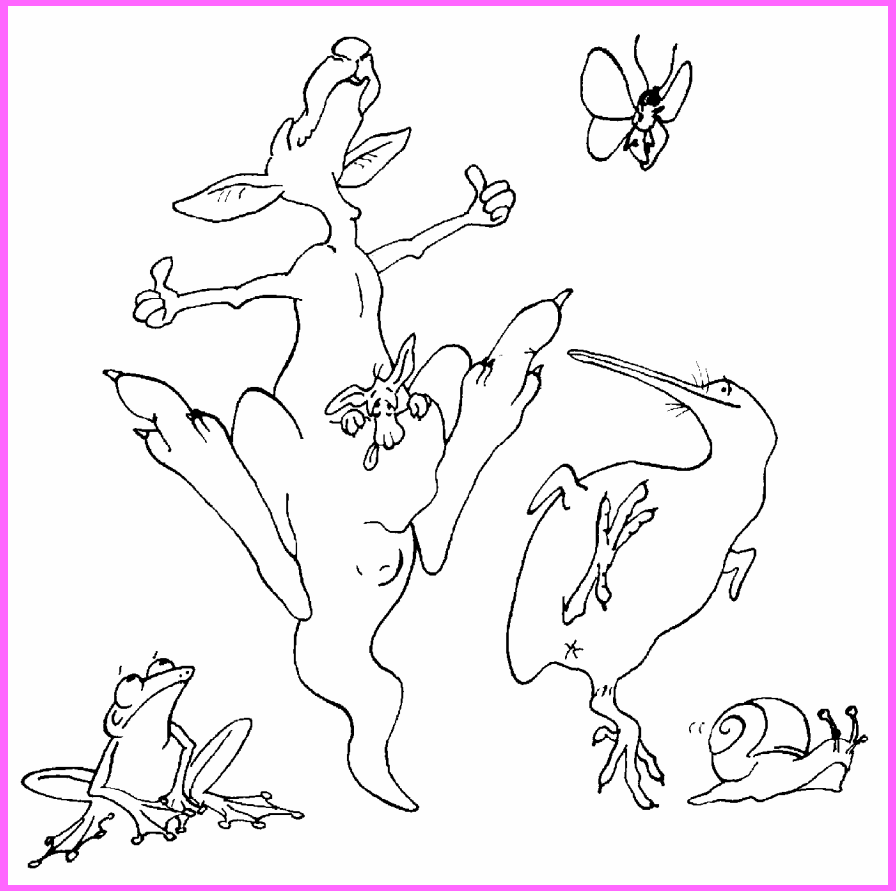
And we'd moved to a new storage medium.....

| | | | |
|---|---|---|---|
| 13 | 1996 | LaTrobe University | Frappell |
| 14 | 1997 | University of Wollongong | Hulbert, Else & Buttemer |
| 15 | 1998 | University of Western Australia | Withers, Guppy |
| 16 | 1999 | University of New England | Geiser, McAllan, Roberts |
| 17 | 2000 | Deakin University | Donald, Toop |
| 18 | 2001 | University of Adelaide | Orgeig |
| 19 | 2002 | ICCPB, Mt Buller 2003 | Frappell |
| 20 | 2003 | University of Tasmania | Nicol |
| 21 | 2004 | University of Wollongong | Buttemer, Else |
| 22 | 2005 | University of Otago | Cree, Wharton, Lokman, Marshall, Dearden, Donohoe |
| 23 | 2006 | Brisbane | Franklin |
| 24 | 2007 | Perth | Cooper, Maloney, O'Shea, Withers |
| 25 | 2008 | Sydney | Thompson, McAllen, Seebacher, Munn, Parker |




Wollongong 5-7 Dec 1997

Tee-shirt.....



# ANZSCPB '99

## The University of New England

Designed by Gerhardt Körtner

## JOINT MEETINGS

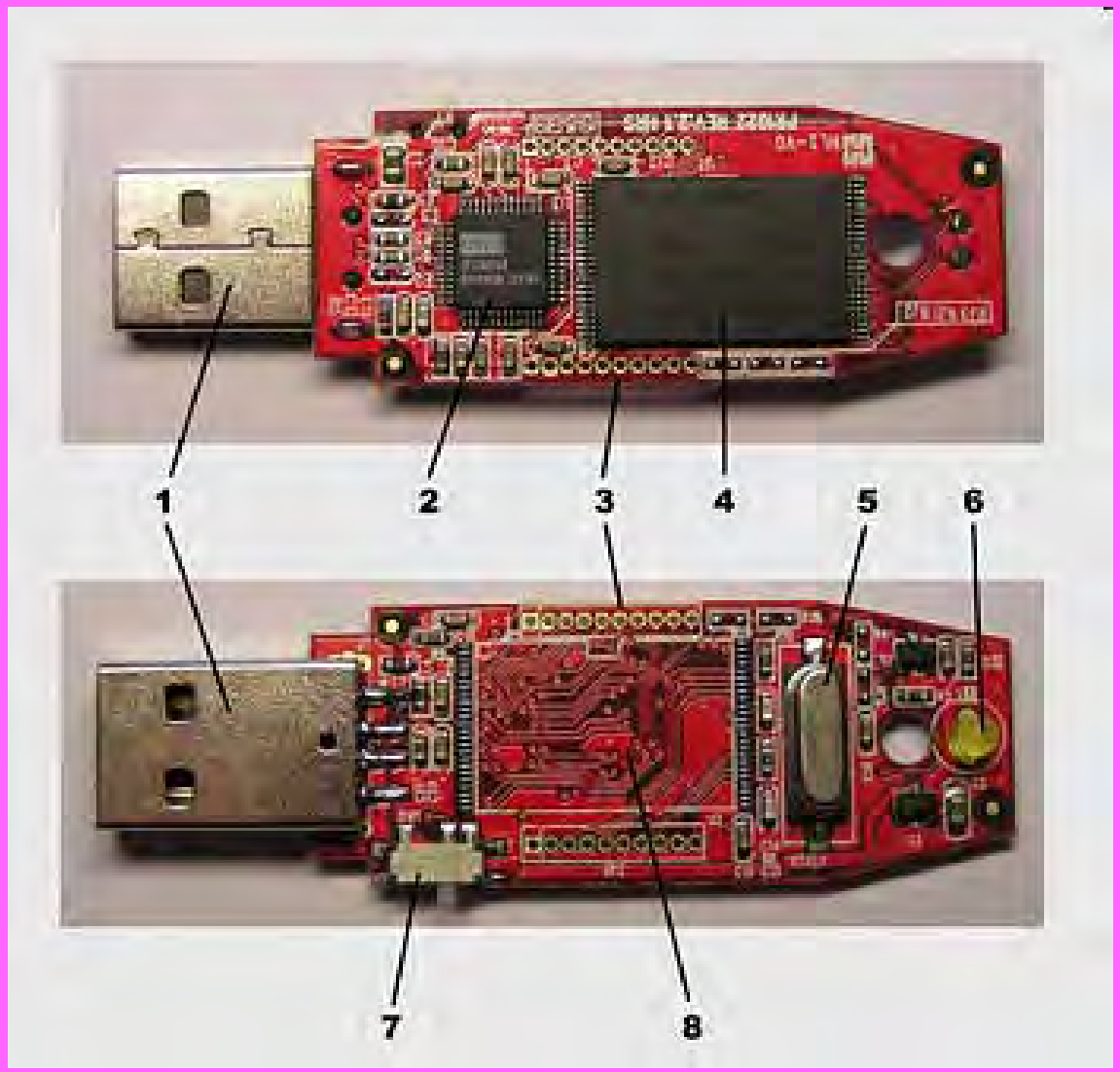
| Year | City | Organisers |
|---|---|---|
| 1992 | Cambridge, UK | SEB, APS, ASZ & CSZ |
| 1995 | Birmingham, UK | 4th International Congress of Comparative Physiology & Biochemistry |
| 2000 | Cambridge, UK | EXPERIMENTAL BIOLOGY 2000- Milestones and Goals |
| 2003 | Mt Buller, Victoria | ICCPB |
| 2007 | Brazil | ICCPB |

Further advances in the hardware.....

….and the storage media


Commercially available in 2000

Just in case you've ever wondered what they look like inside.....



There have been other positive changes too:

- Information availability; huge increase and ease
- Measurement & observation technologies
- Analytical capacities (molecular & statistical)
- Growth of knowledge/understanding

But lots of changes that have not been so beneficial.....

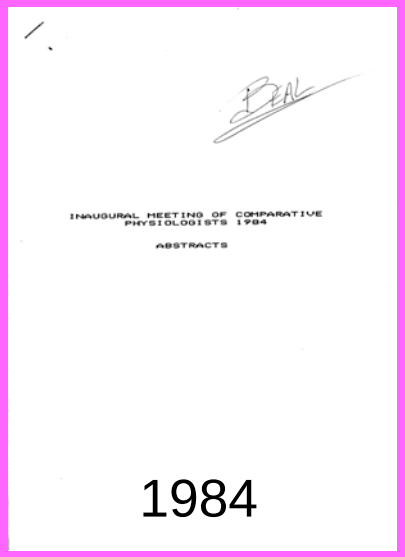
- Increased bureaucratization of universities, managerialism e.g. risk assessments. Extra admin work for academics
- Funding for research (applied vs. curiosity-driven)
- Ethics committees

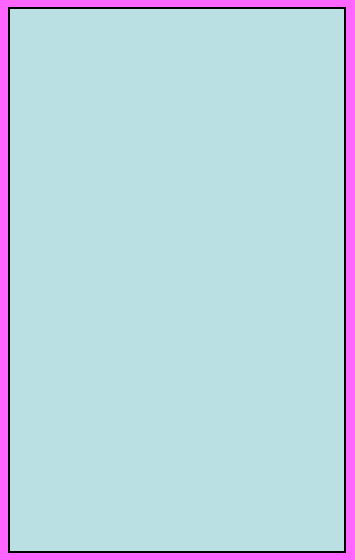
- Impact factors

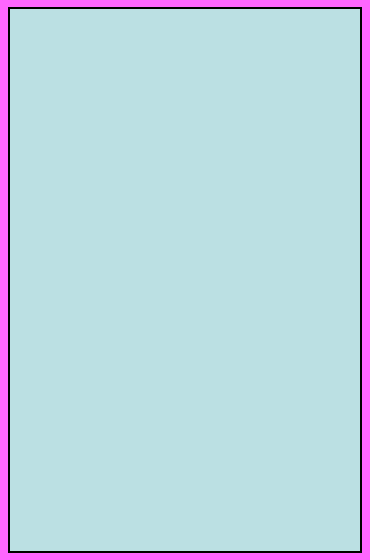
- Funding models (Performance Based Research Fund, Research Assessment Exercise)
- The “Business Model” university. Bad for postgrads

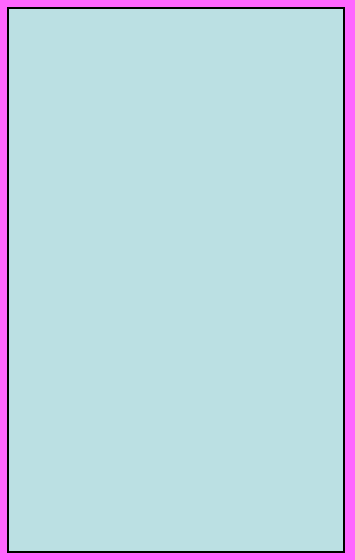
- Positions for scientists increasingly short term

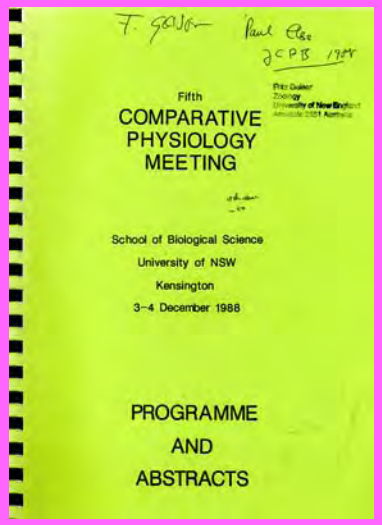
- Animal rightsists
- Religious fundamentalism

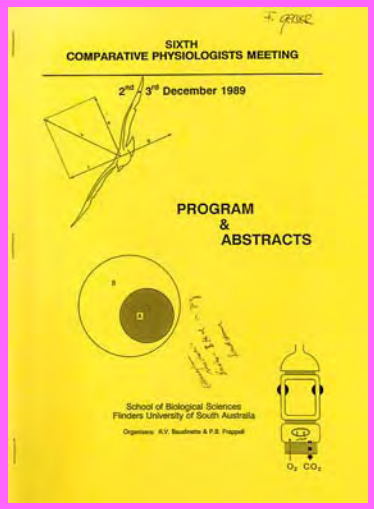

INAUGURAL MEETING OF COMPARATIVE PHYSIOLOGISTS 1984
ABSTRACTS
1984

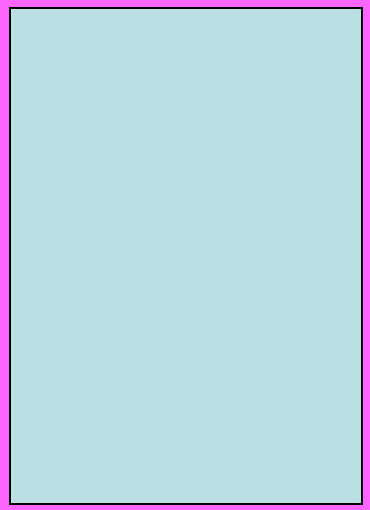


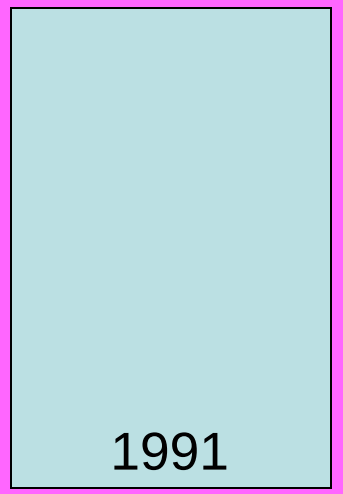


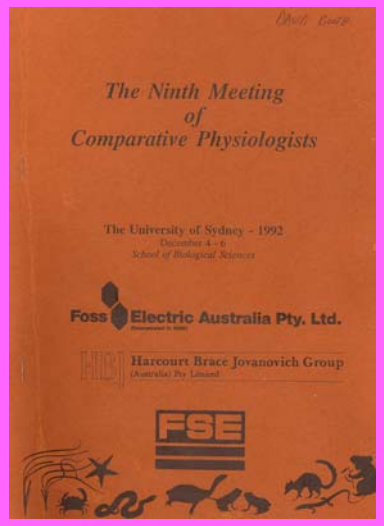


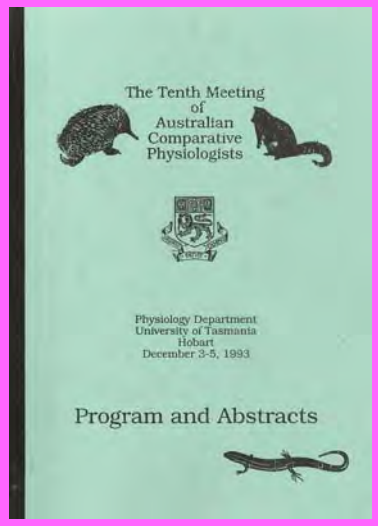

Fifth
COMPARATIVE PHYSIOLOGY MEETING
School of Biological Science
University of NSW
Kensington
3–4 December 1988
PROGRAMME AND ABSTRACTS

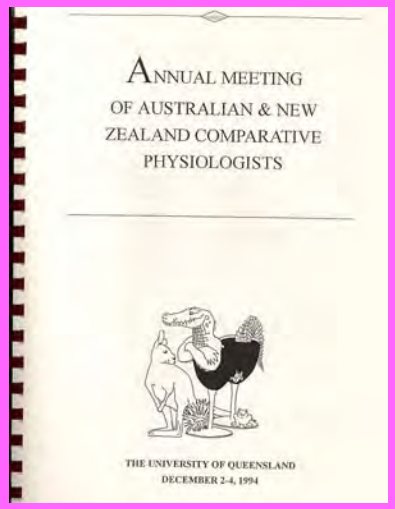

SIXTH
COMPARATIVE PHYSIOLOGISTS MEETING
2nd / 3rd December 1989
PROGRAM & ABSTRACTS
School of Biological Sciences
Flinders University of South Australia

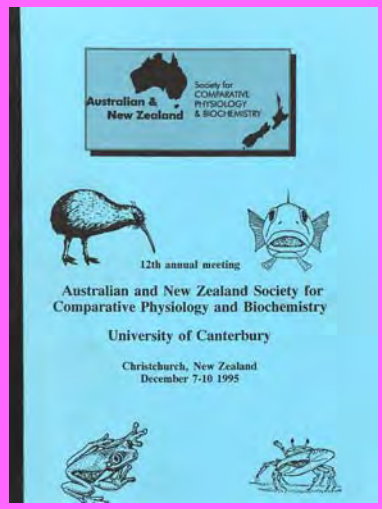



1991

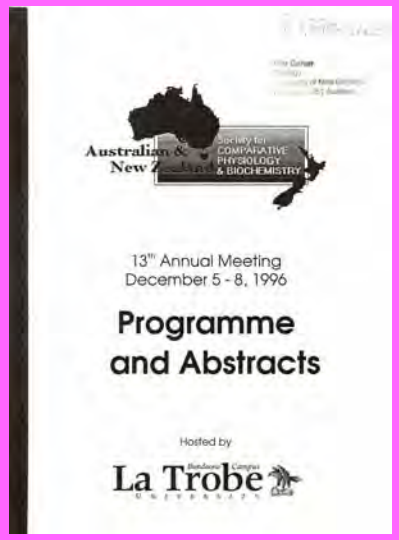

The Ninth Meeting
of
Comparative Physiologists
The University of Sydney - 1992
December 4 - 6
School of Biological Sciences
Foss Electric Australia Pty. Ltd.
Harcourt Brace Jovanovich Group
FSE

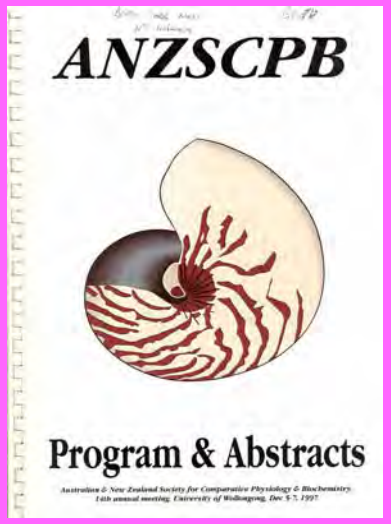

The Tenth Meeting
of
Australian
Comparative
Physiologists
Physiology Department
University of Tasmania
Hobart
December 3-5, 1993
Program and Abstracts

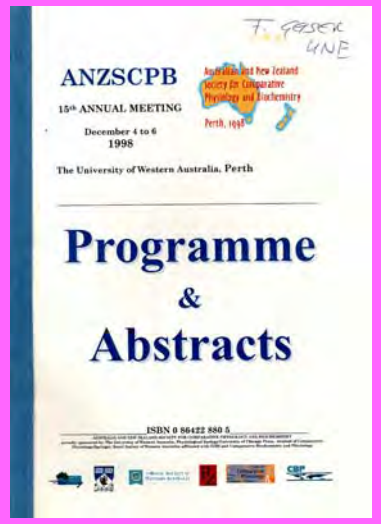

Annual Meeting
of Australian & New
Zealand Comparative
Physiologists
The University of Queensland
December 2-4, 1994

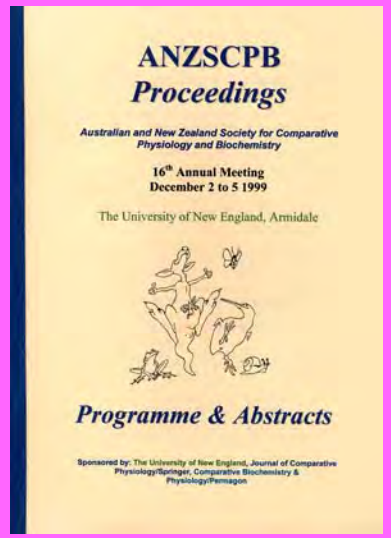

Australian &
New Zealand
Society for
Comparative
Physiology
& Biochemistry
12th annual meeting
Australian and New Zealand Society for
Comparative Physiology and Biochemistry
University of Canterbury
Christchurch, New Zealand
December 7-10 1995

1992

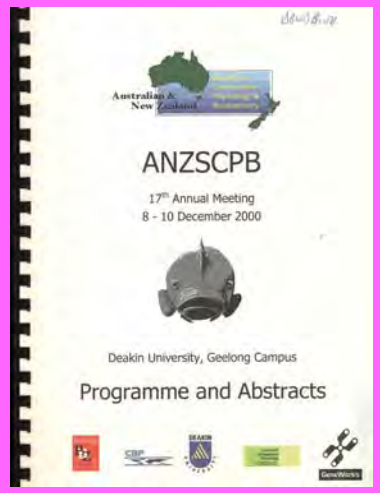

Australian &
New
Society for
Comparative
Physiology
& Biochemistry
13th Annual Meeting
December 5 - 8, 1996
Programme
and Abstracts
Hosted by
La Trobe

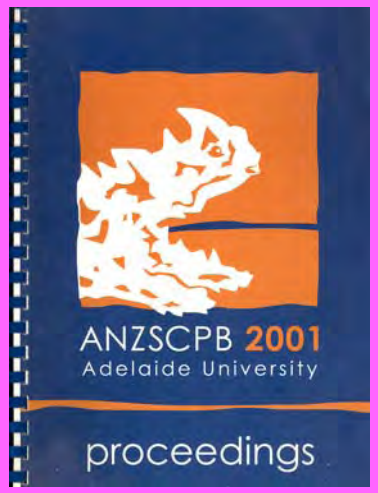

ANZSCPB
Program & Abstracts


ANZSCPB
15th ANNUAL MEETING
December 4 to 6
1998
The University of Western Australia, Perth
Programme
&
Abstracts

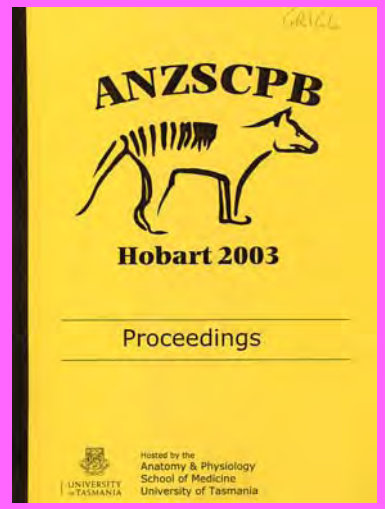

ANZSCPB
Proceedings
Australian and New Zealand Society for Comparative
Physiology and Biochemistry
16th Annual Meeting
December 2 to 5 1999
The University of New England, Armidale
Programme & Abstracts

1999

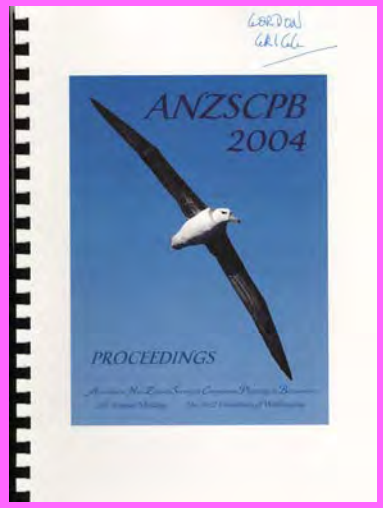

ANZSCPB
17th Annual Meeting
8 - 10 December 2000
Deakin University, Geelong Campus
Programme and Abstracts

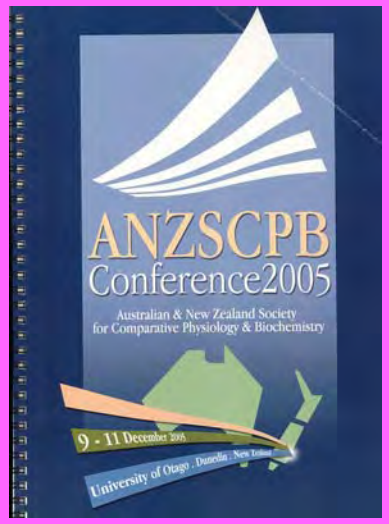

ANZSCPB 2001
Adelaide University
proceedings

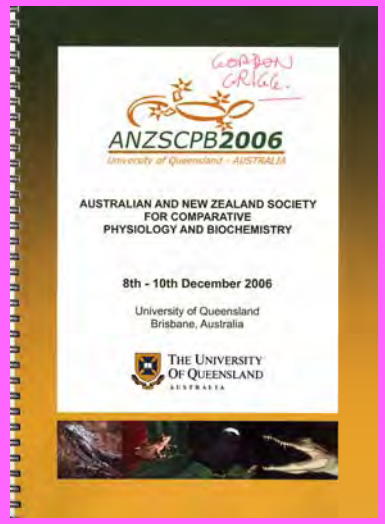

COMPARATIVE BIOCHEMISTRY AND PHYSIOLOGY
CBP
Supplement
ICCPB 2003
Elsevier


ANZSCPB
Hobart 2003
Proceedings
Hosted by the
Anatomy & Physiology
School of Medicine
University of Tasmania

2000


ANZSCPB
2004
PROCEEDINGS


ANZSCPB
Conference2005
Australian & New Zealand Society
for Comparative Physiology & Biochemistry
9 - 11 December 2005
University of Otago . Dunedin . New Zealand


ANZSCPB2006
University of Queensland - AUSTRALIA
AUSTRALIAN AND NEW ZEALAND SOCIETY
FOR COMPARATIVE
PHYSIOLOGY AND BIOCHEMISTRY
8th - 10th December 2006
University of Queensland
Brisbane, Australia
THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA


AUSTRALIAN AND NEW ZEALAND
SOCIETY FOR COMPARATIVE
PHYSIOLOGY AND BIOCHEMISTRY
24th ANNUAL
GENERAL MEETING
Australian &
New Zealand
Society for
Comparative
Physiology &
Biochemistry
Perth
Western Australia
December 1 and 2, 2007
Curtin

2007

After all this time, the Society still lacks a LOGO

I decided to give the matter some thought.....

Criteria for a good logo:

- A critter that is instantly recognisable, and well known
- It should be physiologically remarkable
- and robust, vigorous
- and captures the public's imagination
- as well as having a strong Australian and NZ flavour


QANTAS


Maybe the NZ members would not approve.....

I thought of echidnas and crocodiles, but decided that would be too self-serving……

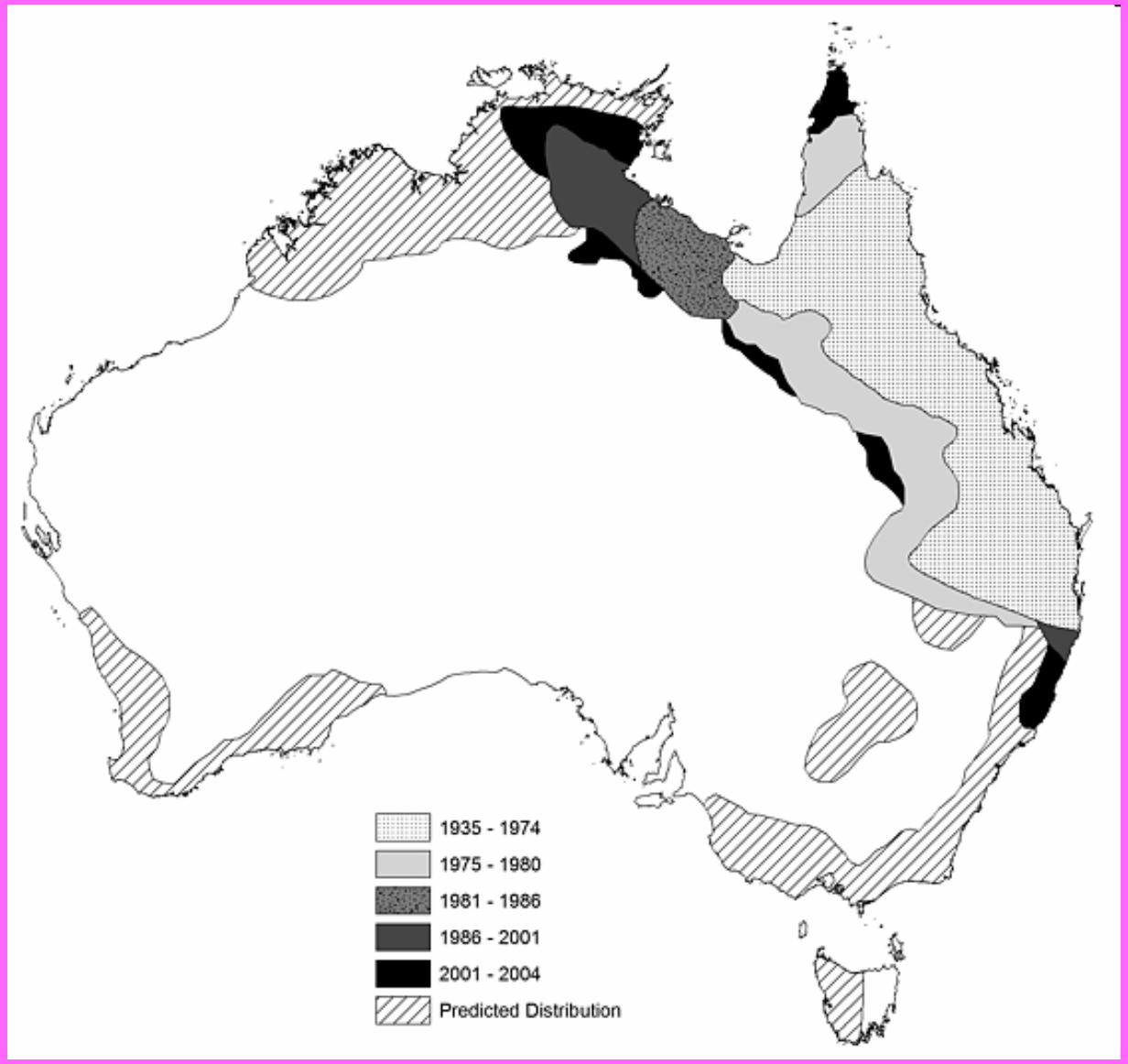
Remembering the criteria……

It should be……

- A critter that is instantly recognisable, and well known
- it should be physiologically remarkable
- and robust, vigorous
- and captures the public's imagination
- as well as having a strong Australian and NZ flavour


Obviously it has to be a Cane Toad.....

Coming soon to a backyard near you.....




Remember the cane Toad Movie?

Cane Toads 2 is being filmed right now!

A sexy little leather purse to keep your coins in. A 100% Australian gift from deep in far north Queensland. Soft on the outside, durable on the inside. Available with or without legs.


GENUINE RUSSIE TOAD
SOFO HARDINGS

# Cane Toad Toxicity: Can *Obama* Save Us?

By Steamboat McGoo


Toad
Races
Tonight 8-15 pm.


THE CANE TOAD
WHY TO VOTE NO
REPUBLIC
DAVID FLINT


I'm a proud supporter of
FREE TIBET!
FREE TIBET!
JUST SAY NO TO
SINOFASCISM!
the Cane Toads for a Free Tibet Action Committee


ROADBUSTERS
PROTECTING BIODIVERSITY


CANE TOAD CONTROL PROJECT
APPROVED & MONITORED TRAP


I reckon this would
make a great logo

But what about a New Zealand connection ??

Richard Macey
March 28, 2007

CANE toads are evolving so quickly they could soon be on Sydney's doorstep, scientists warn.

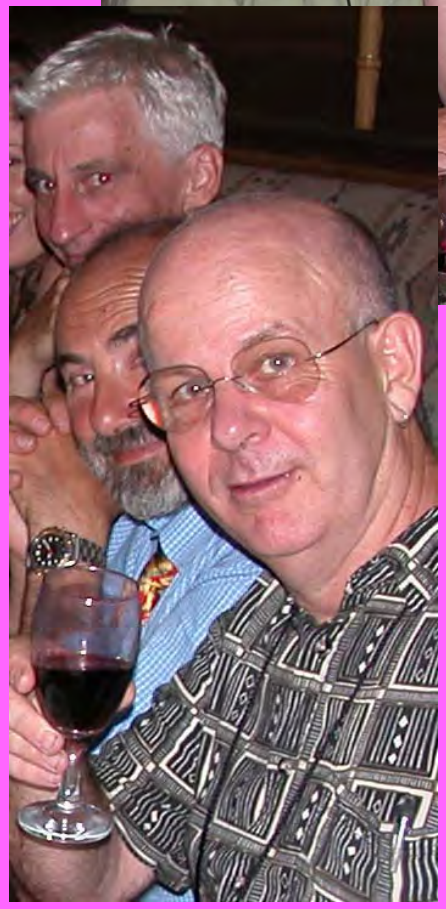
It was previously thought the cane toad's Australian invasion would be limited to climates similar to those of its original habitat, but work by an international team of researchers, including Rick Shine from the University of Sydney, is rapidly adapting to a wider range of climates.

As it happens, I was in New Zealand in September, so I took the opportunity and laid a few propagules in anticipation.

What with the double whammy of rapid cane toad evolution and global warming, they'll be giving their diesle engine calls from Whangarei to Whataroa in no time!

Stakeholder polling…….


Mike Thompson



The idea was greeted with enthusiasm and approval!

# AUSTRALIAN & NEW ZEALAND SOCIETY FOR COMPARATIVE PHYSIOLOGY & BIOCHEMISTRY

25 YRS