

ANZSCP



15th ANNUAL MEETING

December 4 to 6
1998

The University of Western Australia, Perth

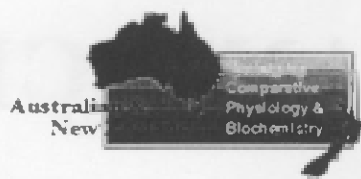
Programme & Abstracts

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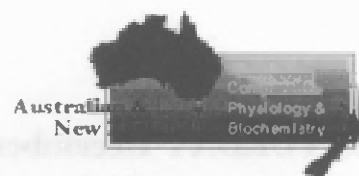
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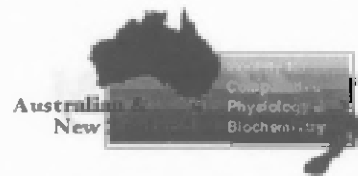
ANZSCP Proceedings,
15th Annual Meeting, December 4-6, 1998
The University of Western Australia, Nedlands WA 6907
Organised by Philip C. Withers
ISBN 0 86422 880 5

PROGRAM



FRIDAY December 4

12:00	REGISTRATION and BARBEQUE		University House
14:10	WELCOME		Zoology Lecture Theatre
	SESSION I Metabolic Plasticity	Chair: Mike Guppy	Zoology Lecture Theatre
14:20	<u>Philip Withers</u>	Overview of metabolic depression in ectotherms and endotherms	
14:40	<u>Fritz Geiser, G. Körtner & I. Schmidt</u>	Effects of murine leptin on energetics and torpor of the dasyurid marsupial <i>Sminthopsis macroura</i>	
15:00	<u>P. Hope, R. Baudinette, H. Turnbull, J. Kumaratilake & Gary Wittert</u>	Thermogenesis in marsupials: Uncoupling the evidence.	
15:20	<u>Graham Thompson</u>	Comparing the metabolism of reptiles with varying body mass	
15:40	AFTERNOON TEA		Zoology quadrangle
	SESSION 2 Metabolic Plasticity	Chair: Fritz Geiser	Zoology Lecture Theatre
16:00	<u>Philip Bethge & S. Nicol</u>	Energy requirements for different activities, including the cost of foraging, in the platypus (<i>Ornithorhynchus anatinus</i>)	
16:20	<u>Julian Pakay, A. Hobbs, P. Withers & M. Guppy</u>	The down-regulation of protein synthesis during metabolic depression in the land snail <i>Helix aspersa</i>	
16:40	<u>Mark Chappell & K. Hammond</u>	Organ system correlates with variation in aerobic performance in red junglefowl	
17:00	POSTERS — CHEESE & WINE SOCIAL		Zoology 1 st floor balcony
	<u>D. Adams, J. Cockrem & M. Potter</u>	Corticosterone response of captive northern brown kiwi (<i>Apteryx australis mantelli</i>) to an acute stressor.	
	<u>P. Bethge, H. Otley, S. Munks, & S. Nicol</u>	The use of dataloggers to determine behavioural activity in the platypus (<i>Ornithorhynchus anatinus</i>)	
	<u>P. Celi, D. Blache, G. Martin, P. Vercoe, R. Dynes & R. Tellam</u>	Intracerebral infusion of recombinant leptin inhibits LH secretion in male sheep by decreasing feed intake	
	<u>L. Cutler & A. Patak</u>	Myofibrillar protein composition of regenerating and pristine claw closer muscle of the yabby, <i>Cherax albidus</i>	
	<u>J. Elias & J. Baldwin</u>	Anaerobic metabolism in the intertidal elephant snail, <i>Scutus antipodes</i> (Fissurellidae)	
	<u>B. Gartrell, S. Jones, R. Brereton & L. Astheimer</u>	An investigation of the factors causing the population decline of the swift parrot (<i>Lathamus discolor</i>)	
	<u>F. Geiser & D. Coburn</u>	Energy expenditure and water uptake in free-ranging and captive blossom-bats, <i>Syconycteris australis</i> (Megachiroptera)	
	<u>L. Holm, I. Malecki & G. Martin</u>	Effect of temperature and pH on motility and velocity of emu spermatozoa	
	<u>T. Lamey & A. Patak</u>	The effects of moulting on muscle fibre characteristics of the yabby, <i>Cherax albidus</i>	
	<u>N. Leelapiyanart & H. Taylor</u>	Respiratory responses of intertidal crab eggs to changes in oxygen tension	
	<u>O. Lopatko, P. Wood, J. Joss, A. Smits & C. Daniels</u>	Acetylcholine controls surfactant secretion by Type II pneumocytes isolated from Australian lungfish and American bullfrogs	
	<u>S. Orgeig, S. Johnston, O. Lopatko & C. Daniels</u>	Development of the pulmonary surfactant system in a bird and reptile	
	<u>J. Van Cleeff, M. Blackberry & G. Martin</u>	Hyperlipaemic emu serum is clarified for radioimmunoassay by polyethyleneglycol (PEG) precipitation	
	<u>J. Wilde & P. Greenaway</u>	Diet and assimilation in the robber crab, <i>Birgus latro</i> (L.)	



SATURDAY December 5

SESSION 3		Chair: Jamie O'Shea	Zoology Lecture Theatre
09:00	<u>John Donald</u> , B. Davis & K. Minerds	The effect of total water deprivation on the natriuretic peptide system of the hopping mouse, <i>Notomys alexis</i>	
09:20	K. Bell & <u>Sue Jones</u>	Changes in plasma concentrations of corticosterone and testosterone in response to capture stress in the lizard <i>Egernia whitii</i>	
09:40	<u>W. Callahan</u> & <u>Tes Toop</u>	Fishing for mechanisms: the natriuretic peptide system and the gills of the hagfish	
10:00	<u>Julie Roberts</u>	Aldosterone and renal function in avian species	
10:20	<u>Dennyse Newbound</u> , J. O'Shea & P. Withers	Osmoregulation and ionoregulation in the Port Jackson shark, <i>Heterodontus portusjacksoni</i>	
10:40	MORNING TEA		Zoology quadrangle
SESSION 4		Chair: Tess Toop	Zoology Lecture Theatre
11:00	<u>Judith Van Cleeff</u> , D. Blache, I. Malecki, and G. B. Martin	Gonadal hormones are proximate factors controlling seasonal fat metabolism in adult male emus	
11:20	<u>Perdita Hope</u> , W. Breed, H. Turnbull, J. Morley, M. Horowitz & G. Wittert	Gonadal steroids and alterations in photoperiod affect metabolic efficiency in female <i>S. crassicaudata</i>	
11:40	<u>Colleen Veitch</u> , C. Sernia & R. Gemmell	Prostaglandin F _{2α} Receptors in the brushtail possum, <i>Trichosurus vulpecula</i> and the short-nosed handicoot, <i>Isodon macrourus</i> at birth	
12:00	<u>Bronwyn McAllan</u> & J. Joss	Effects of oral administration of melatonin on the reproductive cycle of a small marsupial, <i>Antechinus stuartii</i>	
12:20	<u>Agung Riono</u> , D. Blache, A. Dharmarajan & G. Martin	Ingestion of extract of leaves of mangosteen (<i>Garcinia mangostana</i> Linn) induces germ cell apoptosis in rat testis	
12:40	LUNCH		Zoology quadrangle
SESSION 5		Chair: Peter Greenaway	Zoology Lecture Theatre
14:00	<u>Robert Gemmell</u> & B. Harmon	The function of the vaginal caecae of the marsupial bandicoot, <i>Isodon macrourus</i>	
14:20	<u>Michel Beal</u> & N. Scott	Plasma concentrations of calcium, magnesium and phosphate during development of tammar pouch-young (PY)	
14:40	<u>Ashley Edwards</u> & S M Jones	Steroid biosynthesis in a viviparous reptile, <i>Tiliqua nigrolutea</i> (Scincidae)	
15:00	<u>Peta Edwards</u> , B. Tuch & M. Beal	Abundance of endocrine cells in the pancreatic islets of macropods	
15:20	K. McClelland & <u>Ian Hume</u>	Selective retention of digesta in the caecum of bandicoots	
15:40	AFTERNOON TEA		Zoology quadrangle
SESSION 6		Chair: Ian Hume	Zoology Lecture Theatre
16:00	<u>Jamie O'Shea</u>	The innervation of the heart of the fat-tailed dunnart, <i>Sminthopsis crassicaudata</i>	
16:20	<u>Suzanne Munns</u> & B. Evans	Hypercapnia induced depression of ventilation in the Gippsland water dragon	
16:40	<u>Anton Thompson</u> & J. O'Shea	A cholinergically mediated adrenergic response in the heart of the horned shark, <i>Heterodontus portusjacksoni</i>	
17:00	<u>Alan Roberts</u>	Ecological correlates of locomotor performance in geckos	
18:30	Pre-dinner drinks		University House
19:00	1998 ANNUAL MEETING DINNER		University House

SUNDAY December 6

SESSION 3		Chair: Don Bradshaw	Zoology Lecture Theatre
09:00	<u>Willie van Aardt</u>	The MO_2 and metabolic release of CO_2 from labeled glucose and lactate in the exercising ghost crab, <i>Ocypode ceratophthalmus</i>	
09:20	<u>Philip Withers, G. Thompson & R. Seymour</u>	Metabolic physiology of the marsupial mole (<i>Notoryctes caurinus</i>)	
09:40	<u>John Baldwin, A. Gupta & X. Inglesias</u>	Scaling of anaerobic energy metabolism during tail flipping behaviour in the freshwater crayfish, <i>Cherax destructor</i>	
10:00	<u>Michael Guppy</u>	A comparative study of fuel choices by cells	
10:20	<u>Joseph Hoh, Y. Kim, L. Sieber & C. Lucas</u>	Macropodids express alpha cardiac myosin in their jaw-closing muscles	
10:40	MORNING TEA		Zoology quadrangle
SESSION 4		Chair: Phil Withers	Zoology Lecture Theatre
11:00	<u>Trevor Anderson & S. Smith</u>	The relationship between histidase activity and trophic habit in surgeon fishes	
11:20	<u>Don Bradshaw & F. Bradshaw</u>	Measurement of nectar and pollen intake of free-ranging marsupial Honey possums (<i>Tarsipes rostratus</i>)	
11:40	<u>Patrick Spanoghe, G. Davidson & B. Paterson</u>	Effect of aerial exposure on the western rock lobster, <i>Panulirus cygnus</i>	
12:00	<u>Stewart Nicol & N. Andersen</u>	Using dataloggers to investigate hibernation in echidnas	
12:20	<u>James Pearson</u>	Physiological precocity in an altricial parrot	
12:40	Award of Student Prizes		Zoology Lecture Theatre
13:00	DISCUSSION SESSION - 1999 Meeting		Zoology Lecture Theatre

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THE UNIVERSITY OF WESTERN AUSTRALIA

ABSTRACTS OF TALKS

The relationship between histidase activity and trophic habit in surgeon fishes

Trevor A. Anderson and Shawn Smith

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Herbivorous animals survive on a diet which is relatively poor in protein and essential amino acids (EAA) and may therefore possess mechanisms that protect the EAA from degradation by modifications in the K_m and V_{max} of the key degradative enzymes. We expected that the initial enzyme in the degradative pathway of an essential amino acid would have a lower K_m and a higher V_{max} in animals that receive an adequate supply of essential amino acids (carnivores). Our initial test of this hypothesis focussed on histidase, the primary enzyme in histidine degradation, as histidine levels are generally tightly regulated in fish. Individuals of five closely related species of tropical surgeon fish with a range of trophic habits were captured by spear, dissected and liver and muscle tissue stored in liquid nitrogen until assay. Homogenates of tissue were prepared and assayed for histidase using the method of Chiu *et al.* (1984).

The carnivorous *Naso hexacanthus* and *N. vlamingii* and the fermenting herbivore *N. unicornus* had lower K_m and V_{max} for liver histidase than the detritivorous *Ctenochaetus striatus* which had lower values than the non-fermenting herbivore *Acanthurus lineatus*. These data support the hypothesis with regard to K_m but not with regard to V_{max} .

Chiu, Y.N., Austic, R.E. & Rumsay, G.L. (1984) *Comp. Biochem. Physiol.* 78B, 777-783.

Scaling of anaerobic energy metabolism during tail flipping behaviour in the freshwater crayfish, *Cherax destructor*

J. Baldwin, A. Gupta and X. Inglesias

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Yabbies (*Cherax destructor*) display an escape behaviour in which rapid bursts of tail flipping propel the animal backwards. This is a classic example of anaerobic muscle work, initially powered by phosphagen hydrolysis then switching to anaerobic glycolysis once arginine phosphate reserves are depleted. We have investigated the effect of animal size on anaerobic scope (maximum rate of energy production) and anaerobic capacity (total energy used to reach exhaustion) during this escape behaviour.

The positive allometry of anaerobic scope, reflected in the activities of rate limiting glycolytic enzymes, scales with the increased power required by larger animals to overcome drag during locomotion through water. Exercise time and number of tail flips required to reach exhaustion showed positive allometry, as did anaerobic glycolytic capacity. However, the contribution of phosphagen hydrolysis to anaerobic capacity was independent of body mass. Limits to anaerobic capacity are not set by fuel stores, but may involve inhibition of glycolytic enzyme activity at the low pH values reached in tail muscle of exhausted animals. It is suggested that this positive allometry of anaerobic capacity observed during enforced exercise may not be utilised routinely in nature because of metabolic constraints imposed during recovery of large animals.

Plasma concentrations of calcium, magnesium and phosphate during development of Tammar pouch-young (PY)

A. M. Beal and N. A. Scott

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At birth, marsupial neonates lack calcified bones. Whether they are born with some capacity to regulate calcium and phosphorus or when this develops during pouch-life is unknown. We have measured plasma and milk concentrations of Ca, Mg, PO₄ and other ions from mothers and PY starting at 25 d post-birth. PY plasma [Ca] increased progressively from 25 to 150 d post-natum but remained lower than maternal plasma Ca ($P < 0.001$) up to 100 d. In contrast, PY plasma was hypermagnesian to maternal plasma being near constant up to 100 d post-birth but rising between 100 and 200 d. Despite milk having substantially higher levels of both elements than either maternal or PY plasma, the concentrations of Ca and Mg in milk were not correlated with plasma levels of mothers ($P = 0.4$ and 0.93) or PY ($P = 0.18$ and 0.54). PY were hyperphosphataemic relative to the mothers throughout pouch-life with PY plasma concentrations increasing over the 100-250 d post-birth. Milk [PO₄] were much higher than that in plasma from the mothers or PY and was negatively correlated with maternal plasma ($P = 0.023$) and positively correlated with PY plasma ($P = 0.005$) throughout pouch life. The data suggest that PY gain control of Ca homeostasis earlier than that of Mg or PO₄.

Changes in plasma concentrations of corticosterone and testosterone in response to capture stress in the lizard *Egernia whitii*

K. Bell and S. M. Jones

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In vertebrates, exposure to a stressor generally stimulates the secretion of corticosteroids by the adrenal cortex. Often, an increase in plasma corticosteroids is followed by a decrease in plasma sex steroid concentrations; however, in reptiles, these generalisations do not apply to all species. Males of the lizard *Egernia whitii* were captured in the field and bled at 0, 10, 60 or 240 minutes after capture, each animal being sampled once only. The response to acute capture stress was reflected a rapid increase in plasma corticosterone concentrations, with a significant variation after ten minutes, and concentrations remaining high at 240 min. Plasma testosterone concentrations also changed dramatically, but at a slower rate. Gonadal interactions in *E. whitii* were also investigated during long term captivity, and through the reproductive cycle. There were no significant differences between males and females in plasma concentrations of corticosterone through the season, with lowest values occurring during the postpartum period. These results were unexpected; the lack of sex-related differences in plasma corticosteroid concentrations may reflect the social nature of this species.

**Energy requirements for different activities, including
the cost of foraging, in the platypus
(*Ornithorhynchus anatinus*)**

Phillip Bethge and Stewart Nicol

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We measured the energy requirements of freely-swimming platypuses in a 11 m³ swim tank using respirometry. In the tank animals foraged voluntarily while all activities and gaseous exchange were closely monitored. In addition we used a conventional treadmill to determine energy requirements for walking. Energy requirements of the active platypus were found to be higher than maximal metabolic rates for the animal reported in the past. Energy requirements for foraging averaged 8.6 W/kg (n=6) for dives lasting the normal dive duration of 20 to 40 s observed in the wild and increased slightly with decreasing dive duration. The metabolic rate for walking was found to be 8.7 W/kg (speed 0.2 m/s, n=8). Resting rates of the platypus were found to increase with decreasing air and water temperature respectively. Minimal energy requirements for resting under the water surface (wedging) amounted to 3.6 W/kg (water temp 14°C). Minimal metabolic rate of platypuses resting on the water surface was found to be 3.9 W/kg (water temp 20°C) while minimal resting rate on land was 2.1 W/kg (air temp 26°C).

**Measurement of nectar and pollen intake
of free-ranging marsupial honey possums
(*Tarsipes rostratus*)**

S. D. Bradshaw and F. J. Bradshaw

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Turnover rates of a combination of stable and radioactive isotopes (tritium, oxygen-18 and sodium-22) have been used to estimate daily intake of pollen and nectar in free-ranging honey possums in Scott National Park in the extreme southwest of Western Australia. The Field Metabolic Rate (FMR) is measured using doubly-labelled water and nectar intake is estimated independently from the turnover of both water and sodium. Nectar energy intake is then estimated from the sugar concentration of fresh nectar collected from the inflorescences on which the honey possums have been feeding. Pollen intake is finally estimated as the difference between the energy derived from nectar and the FMR. The method assumes that honey possums normally do not drink free-water in the field, that all the sodium in their diet is derived from nectar, and that individuals are in energetic balance over the measurement period. These assumptions have been tested and found to be reasonably robust, except during periods of heavy rain when some free-water intake may occur. Data from some 30 individuals show that nectar intake is reasonably constant at 6-7 ml.day⁻¹ for individuals with an average mass of 9 g. Daily pollen intake varies considerably between individuals, however, averaging 510 mg.day⁻¹ but ranging from 0 to as much as 2 g.day⁻¹. Laboratory studies with a captive colony of honey possums show that the minimum nitrogen requirement for the maintenance of balance in this species is approximately 115 mg.kg^{-0.75}.day⁻¹, well below that recorded for macropodid marsupials but very similar to that of the sugar glider, *Petaurus breviceps*, which also feeds on a high carbohydrate diet.

**Fishing for mechanisms:
the natriuretic peptide system
and the gills of the hagfish**

Will Callahan and Tes Toop

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Previous studies have identified a natriuretic peptide (NP) system in the hagfish. This earlier research focussed on the Atlantic hagfish, *Myxine glutinosa*. Recently, whole gill perfusion studies and myography of afferent and efferent branchial arteries have implicated NPs in the control of blood flow through the gills of the New Zealand hagfish, *Eptatretus cirrhatus* (Forster, Glover and Simpson, XIII Int. Congress Comp. Endocrinol. 1997). However, the NP receptors that would mediate this regulation have not been identified in this species. The current study demonstrates the presence of NP binding sites in the gills of *E. cirrhatus* and examines whether NP actions in the gills of this hagfish could be mediated by guanylate cyclase receptors, similar to those found in jawed vertebrates.

**Organ system correlates with variation
in aerobic performance in red junglefowl**

M. A. Chappell and K. Hammond

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Limits to whole-animal performance may be set by peripheral effectors, central organs, or by all components in synchrony ("symmorphosis"). We examined these concepts using aerobic performance in red junglefowl as a model system. We measured individual variation in the masses of peripheral (pectoralis and leg muscles) and central organs (heart, lungs, gonads, liver, spleen, and gut), and searched for correlations with minimal and maximal aerobic metabolism (BMR and VO_{2max}). We found substantial variance within and between sexes, but few consistent relationships between performance and organ size. On average, males had lower BMR and higher VO_{2max} than females, and had smaller visceral organs (gut, liver) and larger cardiovascular organs (heart, lung, haematocrit) and muscles. BMR was not correlated with any single organ mass in either sex (there was no relationship between female reproductive status and either BMR or VO_{2max} , although gonadal and oviduct mass varied more than 12-fold). In males only, BMR was correlated to combined gut mass. Male VO_{2max} residuals were correlated to heart and muscle mass; female VO_{2max} residuals were correlated to haematocrit. These results suggest that attaining high aerobic performance requires increased investment in muscles and in organs involved in oxygen delivery, but not in digestive organs.

**The effect of total water deprivation
on the natriuretic peptide system of the hopping mouse,
*Notomys alexis***

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The natriuretic peptide system counters hypervolaemia and concomitant hypertension by renal diuresis and natriuresis, and vasodilation. However, the importance of hypervolaemic regulation in mammals has been questioned, and in particular, the role of natriuretic peptides in the maintenance of normal fluid balance. We are using the hopping mouse, *Notomys alexis*, to investigate the function of natriuretic peptides in a desert-adapted mammal that can survive without free access to water. Atrial natriuretic peptide (ANP) cDNA was cloned from *N. alexis*, and the sequence of ANP (1-28) was identical to rat ANP. This information enabled a radioimmunoassay for rat ANP to be used to quantify ANP levels in the heart and plasma of *N. alexis*. *N. alexis*, of either sex, were divided into an experimental group (n=12) subject to seventeen days of total water deprivation (TWD), and a control group (n=12) that had free access to water. No significant difference in haematocrit, skeletal muscle and liver water content, and cardiac ANP levels was observed between control and experimental groups. However, plasma ANP and the density of ANP binding on renal glomeruli were significantly lower in TWD animals. This data suggests that the ANP system is down-regulated during TWD, probably to conserve salt and water.

**Steroid biosynthesis in a viviparous reptile,
Tiliqua nigrolutea (Scincidae)**

A. Edwards, S. M. Jones and N. Davies

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Predominance of either the delta-4 or delta-5 pathway for gonadal steroid biosynthesis varies between vertebrate classes. More recent information suggests that variation between both sex and reproductive condition can also occur. We examined *in vitro* biosynthesis of progesterone (P4), androstendione (AD), dehydroepiandrosterone (DHA), testosterone (T) and 17 β -oestradiol (E2) from pregnenolone (P5). Late pre-ovulatory (Oct) and post-partum (Mar) ovaries and final-spermatogenesis (Sep) and quiescent (Feb) testes of a viviparous skink, *Tiliqua nigrolutea* were used. Steroids were identified using various thin layer chromatography (TLC) solvent systems and HPLC (attached to a radiometric detector) elution times. A strong preference for the delta-4 pathway was apparent in both sexes and at both reproductive and quiescent times of year. However, for several key steroids, the relative proportions synthesised during incubation differed between reproductive conditions. Interestingly, we have demonstrated that ovarian follicles do not produce E2 from P5 *in vitro* at either time of year. The end product of P5 metabolism is instead another, more polar steroid, which is currently unidentified.

Abundance of endocrine cells in the pancreatic islets of macropods

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For more than twenty years, it has been believed that the islets of Langerhans from the macropod pancreas were essentially similar to those from the sheep pancreas in having a preponderance of α cells (glucagon-secreting) and few β cells (insulin-secreting) in comparison with islets from monogastric animals. This was argued to be an adaptation to foregut fermentation. On finding that the islets of one tammur wallaby had high β and low α cell numbers we have reassessed the proportions of the 4 cell types in islets from red and eastern grey kangaroos, tammars and sheep using immunohistological techniques. The results confirm that sheep islets have high α cell (53.9 \pm 3.20 %) and low β cell numbers (29.1 \pm 1.61 %) with the remainder being somatostatin-secreting δ cells (6.2 \pm 1.96 %) and pancreatic polypeptide secreting ϕ cells (10.8 \pm 4.04 %). In contrast, reds, greys and tammars were similar in having nearly twice as many β cells as α cells averaging 52.4 \pm 4.36 % β -cells, 28.9 \pm 2.27 % α -cells, 9.2 \pm 1.33 % δ -cells and 10.5 \pm 2.58 % ϕ -cells. Apparently, high α cell numbers are not an essential adjunct to being a foregut.

Effects of murine leptin on energetics and torpor of the dasyurid marsupial *Sminthopsis macroura*

Fritz Geiser¹, Gerhard Körtner¹ and Ingrid Schmidt²

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Leptin plays an important role in regulating body fat stores of placental mammals, but the contribution of changes in energy uptake and expenditure to this adjustment remains controversial. We were interested in how recombinant murine leptin would affect metabolic rate and body temperature of a marsupial mammal (*Sminthopsis macroura*, 25 g) known to display daily torpor. In a group of 8 animals, food-deprived for 1 day at 18 °C, leptin treatment (5 μ g/g body mass in Tris buffer) halved the duration of torpor bouts, and raised the average daily minimum body temperature by 4.5 °C and the minimum metabolic rate by 2.2-fold in comparison to control treatment with Tris buffer. Leptin treatment thus increased daily energy expenditure by 9% although during the activity phase metabolic rates and body temperatures were not raised. Body mass was also not affected. These findings suggest that leptin affects the adjustment of thermoregulatory energy expenditure during the rest phase. They show that the hormone has strong physiological effects despite the lack of thermogenetically active brown fat in marsupials and some structural differences between murine and marsupial leptin.

