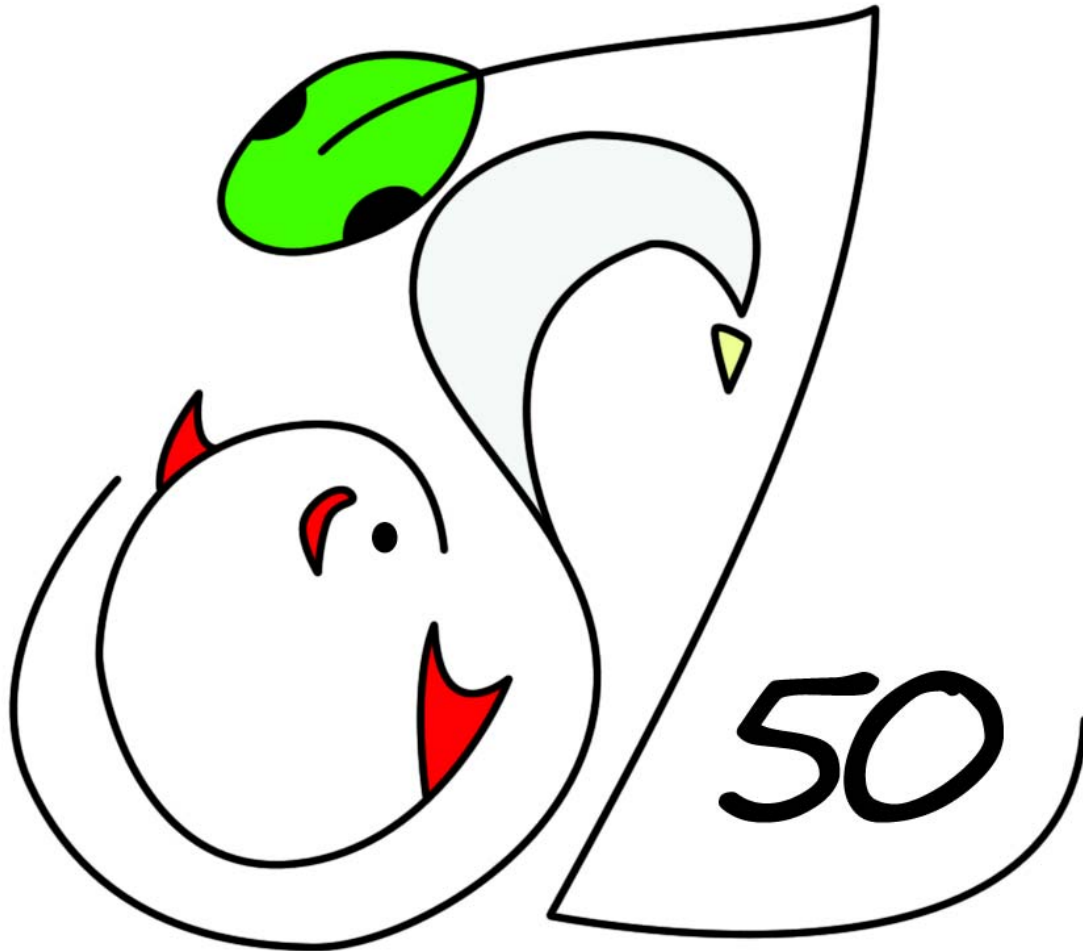


BULLETIN



CSZ - SCZ 2011
UNIVERSITY OF OTTAWA



Canadian Society of Zoologists

Advancing the study of animals and their environment

Société Canadienne de Zoologie

Favoriser l'étude des animaux et de leur environnement

Spring 2011
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BULLETIN OF THE CANADIAN
SOCIETY OF ZOOLOGISTS

The Bulletin is published three times a year (winter, spring, and autumn) by the Canadian Society of Zoologists. Members are invited to contribute short articles in either English or French and any information that might be of interest to Canadian zoologists. Send an electronic file. Figures, line drawings and photographs may be included. All manuscripts submitted are subject to review and approval by the Editors before publication. The views and comments expressed by contributors do not necessarily reflect the official policy of the Society.

BULLETIN DE LA SOCIÉTÉ
CANADIENNE DE ZOOLOGIE

Le Bulletin est publié trois fois par année (hiver, printemps et automne) par la Société canadienne de zoologie. Les membres sont invités à collaborer en envoyant au rédacteur en chef de courts articles en français ou en anglais, ainsi que toute information ou anecdote susceptibles d'intéresser les zoologistes canadiens. Les auteurs devront soumettre une copie sur traitement de texte. Les textes peuvent être accompagnés de dessins originaux ou de photographies. Avant d'être publiés, ils seront révisés et devront être approuvés par le rédacteur. Les opinions et commentaires qui apparaissent dans le Bulletin ne reflètent pas nécessairement les politiques de la SCZ.

Deadline for the next issue:

Date limite pour le prochain
numéro:

August 15, 2011 / 15 août 2011

**50th annual meeting
of the Canadian Society of Zoologists**

**50^{ième} reunion annuelle
de la Société Canadienne de Zoologie**



uOttawa

May 16-20, 2011

16-20 mai, 2011

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Cover: Logo created by Laurence LeMoine



50th annual meeting / 50^{ième} reunion annuelle
May 16-20 / 16-20 mai 2011
uOttawa

Organizing committee / Comité organisateur

Vance Trudeau (Chair)

Marie-Andrée Akimenko, Paul Craig, Charles Darveau, Marc Ekker,
Katie Gilmour, Michael Jonz, Colin Montpetit, Tom Moon, Steve Perry,
Patrick Walsh, Peter Zachar

We wish to thank the following for their contributions:
Nous remercions pour leur contribution:

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- Enclos à vélo sécurisé
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- Stationnement accessible
Accessible Parking
- Navette
Shuttle
- OC Transpo
- Taxi - point d'embarquement
Taxi Pick-up Point



2011 CSZ AWARDS / PRIX SCZ 2011

Fry Medal / Médaille Fry

Dr. Ken Storey, Carleton University

Exploring biochemical adaptations: synthetic intuition on a family farm

L'exploration des adaptations biochimiques: une « intuition synthétique » sur une ferme familiale

Ken Storey is a Professor of Biochemistry and holds the Canada Research Chair in Molecular Physiology at Carleton University. He received his B.Sc. from the University of Calgary and his Ph.D. Zoology from the University of British Columbia. Anyone's career relies on 'the turn of a friendly card' and for Ken the key event was an accidental landing in the lab of Peter Hochachka that both set him loose on a grand ride for life through the wide-open field of biochemical adaptation and added a key stabilizer (wife Janet). Since then Ken has studied how animals work at the molecular level exploring metabolic, enzyme and gene adaptations that support survival at environmental extremes. With nearly 600 publications to date his lab has tackled metabolic regulation in many forms ranging from aerobic muscle metabolism in fast-flying insects and fast-swimming squid to anoxia tolerance and antioxidant defense in turtles, fish and marine mollusks, from estivation by toads and snails under hot arid conditions to winter hibernation by ground squirrels and bats, and to perhaps his best-known work on whole body freezing survival by Canadian frogs, turtles and insects. Much of his research has followed the creed of “synthetic intuition” and has been unified by the identification of common principles of metabolic control that are used across phylogeny to coordinate strong metabolic rate depression as an energy-saving strategy under harsh environmental conditions. Ken's research has been enriched by generous mentors, by intriguing collaborators around the world, and by the hard work of more than 150 postdocs, graduate and undergraduate students that have enlivened his lab. Ken has received multiple awards for his research including recently the 2007 Distinguished Alumni Award from the University of Calgary and the 2010 Flavelle medal in biological science from the Royal Society of Canada.

Ken Storey est professeur de biochimie et occupe la Chaire en Physiologie moléculaire à l'Université Carleton. Il a reçu son B. Sc. de l'Université de Calgary et son Ph. D. en zoologie de l'Université de Colombie Britannique. Le hasard fait bien les choses et pour Ken, le premier coup du hasard fut de le faire aboutir au laboratoire de Peter Hochachka. C'est là qu'il a commencé la ligne de recherche qu'il a poursuivi toute sa vie dans le large domaine de l'adaptation biochimique et qu'il a trouvé un stabilisateur clé (sa femme Janet). Depuis lors, Ken a étudié le fonctionnement des animaux au niveau moléculaire, explorant des adaptations métaboliques, enzymatiques et génétiques qui permettent la survie dans des environnements extrêmes. Avec près de 600 publications, son laboratoire a examiné la régulation métabolique sous plusieurs formes partant du métabolisme musculaire aérobie chez des insectes à vol rapide et des calmars à nage rapide à la tolérance à l'anoxie et aux défenses antioxydantes chez les tortues, poissons et mollusques marins, de l'estivation chez les crapauds et les escargots vivant en conditions arides

à l'hivernation chez les écureuils et les chauves-souris jusqu'à ses travaux les probablement mieux connus sur la survie au gel corporel chez les grenouilles, tortues et insectes canadiens. Une large part de son travail s'est fait selon le principe de « l'intuition synthétique », mais se retrouve unifié par l'identification de principes communs du contrôle métabolique utilisés à travers le spectre phylogénétique et qui coordonnent la dépression métabolique prononcée qui permet de conserver l'énergie sous des conditions environnementales extrêmes. La recherche de Ken a été enrichie par des mentors généreux, par des collaborateurs internationaux stimulants et par le gros travail de plus de 150 étudiants des trois cycles ainsi que des stagiaires post-doctoraux qui ont animé son laboratoire. Ken a reçu de multiples prix pour sa recherche dont les plus récents sont le Prix d'ancien distingué de l'Université de Calgary en 2007 et le Médaille Flavelle en sciences biologiques de la Société royale du Canada en 2010.



Bob Boutilier New Investigator Award / Prix Boutilier

Dr. Ryan Norris, University of Guelph

Linking periods of the annual cycle in migratory animals
Comment relier les périodes du cycle annuel chez les animaux
migratoires

Ryan is an ecologist interested in the behaviour, population dynamics, conservation, and evolution of migratory animals. He obtained an MSc from York University in 2000, a PhD from Queen's University in 2004 and was an NSERC-Killam Memorial Postdoctoral Fellow at the University of British Columbia from 2004-2006. Ryan was appointed to a faculty position at the University of Guelph in 2006 and is currently Associated Editor for the Journal of Animal Ecology and Ibis. Ryan's research seeks to understand the factors that influence variation in population abundance of migratory animals and species living in seasonal environments by integrating behavioural and demographic field research with landscape ecology, theoretical and empirical modeling, and biogeochemistry. His recent research has addressed a variety of topics including effects of climate change and habitat loss throughout the annual cycle of seabirds and songbirds, the role of migration networks and seasonal interactions in predicting changes in population size, the development of quantitative conservation plans for migratory species, the costs and benefits of migration, and life-history trade-offs between different periods of the annual cycle. His fieldwork has taken him to the east and west coast of Canada, throughout the Caribbean and Central America, and the Canadian Arctic. As part of his research on population dynamics, he recently inherited two long-term marked populations: Savannah sparrows on Kent Island, Bay of Fundy, NS that began in 1987, and Tree swallows at Long Point that began in 1969. He also works closely with Dan Strickland on Gray jays in Algonquin Park, a study that began in 1965.

Ryan est un écologiste qui s'intéresse au comportement, à la dynamique des populations, à la conservation et à l'évolution des animaux migratoires. Il a obtenu une maîtrise de l'Université

York en 2000, un Ph. D. de l'Université Queen's en 2004 et a obtenu une bourse post-doctorale CRSNG-Killam à l'Université de Colombie Britannique de 2004 à 2006. Ryan a été engagé comme professeur adjoint à l'Université de Guelph en 2006 et il est éditeur associé au « Journal of Animal Ecology » et à « Ibis ». Les recherches menées par Ryan portent sur les facteurs qui influencent la variation dans l'abondance des animaux migrateurs et des espèces vivant dans des environnements à fortes variations saisonnières en intégrant des études comportementales et démographiques sur le terrain à l'écologie des paysages, la modélisation théorique et empirique et la biogéochimie. Ses études récentes ont porté sur des sujets variés, incluant les effets des changements climatiques et de la perte d'habitat durant le cycle annuel des oiseaux marins et des oiseaux chanteurs, le rôle des réseaux de migration et des interactions saisonnières dans la prédiction des changements de taille de population, le développement de plans de conservation quantitatifs pour les espèces migratoires, les coûts et bénéfices de la migration et les compromis d'histoire de vie entre différentes périodes du cycle annuel. Son travail de terrain l'a amené de la côte est à la côte ouest du Canada, aux Caraïbes et en Amérique centrale et dans l'Arctique canadien. Dans le cadre de ses recherches sur la dynamique des populations, il a récemment hérité de deux populations baguées depuis longtemps : les bruants des prés à l'île de Kent dans la baie de Fundy, Nouvelle Écosse, et bagués depuis 1987, et les hirondelles bicolores de Longue Point, bagués depuis 1969. Il travaille étroitement avec Dan Strickland sur les geais gris du Parc Algonquin, une étude débutée en 1965.



TWM Cameron Outstanding PhD Thesis Award
Prix TWM Cameron pour la meilleure thèse de doctorat

Dr. Kessen Patten, University of Alberta

*Mechanism underlying the maturation of synaptic
 AMPA receptors in zebrafish*
*Mécanismes de la maturation des récepteurs synaptiques
 AMPA chez le poisson zebra*

Dr. Kessen Patten recently graduated from Dr. Declan Ali's lab at the University of Alberta and is now doing a post-doc at Sainte-Justine Hospital Research Centre in Montreal. His thesis focuses on the mechanisms underlying the maturation of synaptic AMPA receptors in zebrafish. Synaptic maturation requires receptors to be trafficked to and from cell membranes, but the signaling links that underlie AMPA receptors cycling during development remain largely unknown. Using imaging, protein biochemistry, molecular biology, gene knockdown approaches and electrophysiological techniques, Kessen identified key molecular players that are required for the trafficking and maturation of AMPA receptors at developing synapses in zebrafish. In particular, his results revealed that PKC γ is an essential molecular link triggering the developmental changes in the properties of AMPA receptors. Loss of function of PKC γ severely affected the fish's ability to hatch or exhibit an escape response. His work moved the understanding of the synaptic development one step forward by identifying molecular players required for

maturation of AMPA receptors and by showing how this is a key developmental step to increase the efficiency of information transfer between neurons to refine the functioning of neural networks. Currently, his research focuses on neural processes of the vestibular system that control body balance and posture; and how neural and genetic factors contribute to balance deficits associated with the development of idiopathic scoliosis.

Le Dr Kessen Patten a récemment terminé son doctorat au laboratoire du Dr Declan Ali de l'université d'Alberta et réalise maintenant un stage postdoctoral au Centre de recherche de l'Hôpital Sainte Justine de Montréal. Sa thèse porte sur les mécanismes contrôlant la maturation des récepteurs AMPA chez le poisson zèbre. La maturation synaptique requiert un va et viens des ces récepteurs des membranes cellulaires, mais la signalisation qui supporte le recyclage des récepteurs AMPA durant le développement reste très peu connue. Utilisant l'imagerie, la biochimie des protéines, la biologie moléculaire, des approches de « knock-down » génétique et des techniques d'électrophysiologie, Kessen a identifié des éléments moléculaires jouant un rôle clé dans la signalisation et la maturation des récepteurs AMPA dans les synapses en développement chez le poisson zèbre. En particulier, ses résultats démontrent que PKC γ est un lien moléculaire essentiel qui déclenche les changements développementaux des propriétés des récepteurs AMPA. La perte de fonction du PKC γ affecte sévèrement la capacité du poisson à éclore ou à montrer une réponse de fuite. Son travail a permis des avancées dans la compréhension du développement synaptique en identifiant des éléments moléculaires requis pour la maturation des récepteurs AMPA et en montrant comment cette maturation joue un rôle clé dans l'augmentation de l'efficacité de transfert de l'information entre des neurones pour raffiner le fonctionnement des réseaux neuronaux. Actuellement sa recherche porte sur les processus neuronaux du système vestibulaire qui contrôlent l'équilibre et la posture et comment des facteurs neuronaux et génétiques contribuent à équilibrer des déficits associés au développement de la scoliose idiopathique.



**Distinguished Service Award
Médaille de distinction pour services rendus à
la Société canadienne de zoologie**

Jocelyne Pellerin, Université du Québec à Rimouski

This Award recognizes members of the CSZ who have contributed enormously to the well being of zoology in Canada by working hard for the CSZ, often well beyond the call of duty, but in ways that are not currently recognized by other Society awards.

Au cours des années d'existence de la Société, plusieurs de ses membres ont énormément contribué au devenir de la zoologie au Canada en travaillant très fort au sein de la Société canadienne de zoologie, souvent beaucoup plus que ce que l'on était en droit d'attendre d'eux. C'est ce que nous pourrons faire désormais avec cette médaille.

Wardle Lecture for Outstanding Contributions in Parasitology
Conférence Wardle pour Contribution Remarquable
dans le domaine de la Parasitologie

Dr. Dan McLaughlin, Concordia University

Dan received his Bachelor's (1967) and his PhD (1970) degrees from the University of New Brunswick, the latter under the direction of M. D.B. Burt. This was followed by two years of postdoctoral work with Harold Welch, Department of Zoology, University of Manitoba and the Delta Waterfowl Research Station, Manitoba, where he continues to do field work. He joined the Biology Department of Loyola College, now Concordia University, in 1972 and is now Professor Emeritus. During his career, he taught Introductory Biology, Invertebrate Zoology and Parasitology. His research has focused on the systematics and ecology of helminth parasites of aquatic birds, particularly those of waterfowl. Recent studies have dealt with the molecular systematics of cestodes and flukes, anthropogenic effects on parasite communities, and molecular approaches to studying diversity and ecology of larval flukes in fish. He has supervised 29 undergraduate Honours students, 12 Master's students and three Doctoral students. Among these students are four Fallis Prize winners, two Henry Baldwin Ward Medalists and two Wardle Medalists. He is a long time member of the Canadian Society of Zoologists and the Parasitology Section of the Society. He was Secretary of the Parasitology Section from 1998 to 2003 and Secretary of the Scientific Organizing Committee for the 10th International Congress of Parasitology held in Vancouver in 2002.

Dan a reçu son baccalauréat (1967) et son PhD (1970) de l'université du Nouveau Brunswick; son directeur de thèse était M.D.B. Burt. Il fit par la suite deux ans de formation postdoctorale avec Harold Welch, département de zoologie, université du Manitoba et à la « Delta Waterfowl Research Station », au Manitoba où il continua son travail sur le terrain. Il s'est joint au département de biologie du collège Loyola, aujourd'hui l'université Concordia, en 1972 et est maintenant professeur émérite. Au cours de sa carrière, il a enseigné le cours d'introduction à la biologie, la zoologie des invertébrés et la parasitologie. Ses recherches portent sur la systématique et l'écologie des parasites helminthes des oiseaux aquatiques. Ses travaux récents ont porté sur la systématique moléculaire des cestodes et trématodes, les effets anthropogènes sur les communautés de parasites, et sur les approches moléculaires visant à étudier la diversité et l'écologie des trématodes larvaires chez les poissons. Il a dirigé les travaux de 29 étudiants de premier cycle, 12 étudiants à la maîtrise et 3 étudiants au doctorat. Parmi ces étudiants, on retrouve trois récipiendaires du prix Fallis, deux récipiendaires de la médaille Henry Baldwin Ward et deux de la médaille Wardle. Il fait partie depuis longtemps de la société royale des zoologistes et de la section parasitologie de la société. Il fut secrétaire de la section parasitologie de 1998 à 2003 et secrétaire du comité d'organisation du 10^{ème} congrès international de parasitologie tenu à Vancouver en 2002.

Society Awards

Hoar Award: The Hoar Award (named in honour of William S. Hoar, founding member) is given for the best student paper presented orally at the Annual Conference of the Society, and is intended to encourage research and communication by students.

Prix Hoar : Le prix est remis à l'étudiant qui donne la meilleure présentation orale lors du congrès annuel de la Société. Le prix Hoar a pour but d'encourager l'excellence dans les travaux de recherche des étudiants et la présentation de leurs résultats.

Helen Battle Award: The Helen Battle Award (named in honour of Helen I. Battle; founding member and President, 1962-1963) is given for the best student poster at the Annual Conference of the CSZ and is intended to encourage and acknowledge excellence in scientific research and communication.

Prix Helen Battle : Le prix Helen Battle est remis à l'étudiant qui présente la meilleure affiche lors du congrès annuel de la Société canadienne de zoologie. Le prix Helen Battle a pour but d'encourager les étudiants à exceller dans leurs travaux de recherche ainsi que lors de la présentation de leurs résultats.

Section Awards

George F. Holeton Award: The Holeton Award is given for the most outstanding student poster presentation in Comparative Physiology and Biochemistry.

Prix George F. Holeton : Prix donné pour la meilleure affiche d'un étudiant de la Section Physiologie et Biochimie Comparée.

Brian K. Hall CMD Award: The Hall Award is given for the best oral presentation by a student on a topic in Comparative Morphology and Development.

Prix Brian K. Hall MDC : Prix donné à la meilleure présentation orale donnée par un étudiant sur un sujet touchant à la Morphologie et Développement Comparés lors du congrès annuel.

Cas Lindsey Award: The Cas Lindsey Book Prize is awarded for the best student presentation (oral or poster) within the fields of behaviour, ecology or evolution.

Prix Cas Lidsay : Le Prix Cas Lindsey de la section d'écologie, d'éthologie et d'évolution est destiné à l'étudiant qui a présenté la meilleure communication ou la meilleure affiche dans l'un des domaines suivants: comportement, écologie ou évolution.

Murray Fallis Award: The Fallis Award is given for the best student oral presentation in Parasitology.

Prix Murray Fallis : Prix pour la meilleure présentation orale donnée par un étudiant-chercheur dans le domaine de la parasitologie au cours de l'Assemblée générale annuelle.

Leo Margolis Scholarship: This scholarship has been established as a memorial to Dr. Leo Margolis, an internationally preeminent parasitologist and a staunch supporter of the Canadian Society of Zoologists since its inception in 1961.

La Bourse Leo Margolis : Cette bourse a été instituée à la mémoire de Leo Margolis, éminent parasitologiste de réputation internationale et militant fidèle de la Société canadienne de zoologie depuis sa création en 1961.

Student Travel Research Grant: This award will assist students and post-doctoral fellows from Canadian universities with expenses incurred during collaborative visits to other laboratories, research facilities, field stations or sites to conduct zoological research. The intention is to support ancillary research activities that will supplement and enhance the applicant's core research program, and not to fund the core research itself, which is the responsibility of the applicant's supervisor.

Subvention de recherche Étudiants/Chercheurs post-doctoraux : Ce prix vise à aider des étudiants ou chercheurs post-doctoraux à défrayer les coûts inhérents à des visites de collaboration scientifique effectuées dans des laboratoires d'accueil, instituts de recherche, stations ou sites d'études de terrain afin d'y poursuivre des recherches en zoologie. L'objectif de cette subvention est d'accroître les opportunités de recherche au delà de celles qui peuvent être offertes au sein du programme de recherche initial du récipiendaire.

For information on CSZ and CSZ Section Awards, visit the Society's web site <http://www.csz-scz.ca/>

Pour obtenir de plus amples renseignements sur la SCZ et les prix de la SCZ, veuillez visiter le site web de la société <http://www.csz-scz.ca/>.

THE T. W. M. CAMERON OUTSTANDING Ph.D. THESIS AWARD

This is an annual award, established by the Canadian Society of Zoologists to recognize the author of an outstanding Ph. D. Thesis in Zoology submitted to a Canadian University.

1. The recipient of the award will be invited to present a lecture on the subject of the dissertation to the Annual General Meeting. He/she will be presented with a commemorative scroll at the time. In order to facilitate attendance of the recipient at the meeting, reasonable expenses for air travel at minimum rates and all accommodation and meals at the meeting will be paid by the Society, up to a maximum of one thousand dollars (\$1,000).

2 (a) For nomination, a thesis must have been accepted at a Canadian University within the year preceding the nomination deadline.

(b) Only one thesis may be nominated by a department, though more than one department in a university may nominate a thesis.

(c) A nominated thesis should be accompanied by a joint letter from the Chair of the Department and the Supervisor indicating their reasons for the nomination.

3. Nominated theses will be examined by three judges chosen from among members of the Society. Theses will be judged on the quality of the science and the quality of the presentation.

4. Please provide three bound copies (hardbound or softbound) of the nominated thesis and supporting letters before **15 August 2011**. Contact the Secretary of the Society or visit the CSZ web site for complete terms of the award.

LE PRIX T. W. M. CAMERON POUR UNE THÈSE DE Ph.D. EXCEPTIONNELLE

Ce concours annuel a été institué par la Société canadienne de zoologie pour récompenser l'auteur d'une thèse de doctorat en zoologie jugée exceptionnelle et soumise dans une université canadienne.

1. Le gagnant du prix sera invité à donner une conférence sur le sujet de sa thèse lors de la réunion annuelle de la Société. Il recevra alors un parchemin commémoratif. Afin de permettre au récipiendaire d'être présent à la réunion annuelle, une somme maximale de 1000\$ sera allouée par la SCZ pour défrayer les frais de déplacement (billet d'avion, classe économique), les frais de séjour et les repas.

2. (a) Pour être admissible au concours, la thèse doit avoir été acceptée par une université canadienne durant l'année précédant la date limite de mise en candidature.

(b) Un département ne peut présenter qu'une seule thèse au concours, mais plusieurs départements d'une même université peuvent soumettre une thèse.

(c) Chaque thèse présentée doit être accompagnée d'une lettre signée par le directeur de département et le directeur de thèse de l'étudiant expliquant pourquoi la thèse a été sélectionnée.

3. Les thèses seront examinées par trois juges choisis parmi les membres de la Société. Les thèses seront jugées d'après deux critères: la qualité scientifique et la qualité de la présentation.

4. Veuillez fournir trois copies reliées de la thèse (reliure rigide ou cartonnée) et des lettres d'accompagnement **au plus tard le 15 août 2011** au président du comité pour le prix Cameron. Informations supplémentaires relatives à ce prix: contacter le secrétaire de la Société ou consulter notre site Web.

CSZ 2011 / SCZ 2011
50th Annual Meeting / 50^{ième} réunion annuelle

PROGRAMME OVERVIEW / VUE D'ENSEMBLE DE PROGRAMME

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Monday, May 16th / lundi, 16 mai

Summary of events / Le résumé d'événements

	Events / les événements	Location / endroit
08h30-14h00	Council meeting / réunion du conseil	GNN 080
08h30-17h00	Registration / inscription	90 U lobby
12h00-14h00	<i>Can J Zool</i> workshop / atelier du <i>Can J Zool</i>	BIOSCI 140
14h00-16h00	LOC Symposium / symposium COL	UCU AUD
16h00-16h30	Coffee / café	UCU Promenade A
16h30-17h30	AGM / AGA	UCU AUD
17h30-18h30	Welcome reception / réception de bienvenue	Tabaret 112
18h30-20h00	Fry lecture / conférence du prix Fry	Marion AUD
20h00-	Mixer (open mic) / rencontre sociale (micro ouvert)	The Draft

Can J Zool workshop / atelier du Can J Zool**Gateways to Scholarly Publication / Le Processus de Publication Scientifique****Location / endroit:** BIOSCI 140**Chair / président:** Saber Saleuddin & Brock Fenton

	Speaker / conférencier
12h00-14h00	<p>Representatives from all levels of scholarly publication (an author, a reviewer, a Can. J. Zool. Editor, a publisher, and a university science librarian) will discuss the process of scholarly publication. Participants will include: Drs. Bill Milsom (UBC), Liam McGuire (University of Western Ontario) and Jack Miller (Western), representing authors and reviewers; Dr. Ken Davey (York University) representing the publisher; Cynthia Bail (uOttawa) representing the library; and Bruce Dancik (University of Alberta) on behalf of editors.</p> <p><i>Des représentants de chaque étape du processus de publication érudite (auteur, évaluateur, éditeur, et bibliothécaire universitaire) discuteront des aspects du processus. Participants : Drs. Bill Milsom (UBC), Liam McGuire (University of Western Ontario), et Jack Miller (Western), en tant que représentants des auteurs et évaluateurs; Cynthia Bail (uOttawa) comme représentante de la bibliothèque; et Bruce Dancik (Université de l'Alberta) au nom des éditeurs.</i></p>

LOC Symposium / symposium COL**CSZ Pioneers and their legacy / Les pionniers de la SCZ et leur héritage****Location / endroit:** UCU AUD**Chair / président:** Charles Darveau

	Speaker / conférencier
14h00-14h30	<p>Cameron and Fallis: Two pioneers with different legacies <i>Cameron et Fallis : Deux pionniers aux héritages distincts</i> Ken Davey, York University</p>
14h30-15h00	<p>Fred Fry & George Holeton: Their accomplishments and the men behind them <i>Fred Fry et George Holeton : Leurs réalisations et les hommes qui les ont permis</i> Don Stevens, UPEI</p>
15h00-15h30	<p>Reflections on the academic heritage of comparative morphology & development <i>Réflexions sur l'héritage des études en morphologie comparée et développement</i> Brian Hall, Dalhousie University & Louise Page, University of Victoria</p>
15h30-16h00	Joe Rasmussen , University of Lethbridge

Welcome address / mots de bienvenue**Location / endroit:** Marion AUD

18h30-18h50	<p>Welcome address <i>Mots de bienvenue</i> Vance Trudeau, LOC Chair / Président du COL, uOttawa Greg Goss, CSZ President / Président de la SCZ, University of Alberta</p>
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Fry lecture / conférence du prix Fry

Location / endroit: Marion AUD

Chair / président: Greg Goss, President

18h50- 19h50	Exploring biochemical adaptations: synthetic intuition on a family farm <i>L'exploration des adaptations biochimiques: une « intuition synthétique » sur une ferme familiale</i> Ken Storey , Carleton University
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Past Fry Medalists / Prix Fry - gagnants des années passées

2010 – Joe Nelson, University of Alberta
 2009 – Anthony Farrell, University of British Columbia
 2008 - Jeremy McNeil, University of Western Ontario
 2007 - Nancy Sherwood, University of Victoria
 2006- Richard Peter, University of Alberta
 2005 - John Youson, University of Toronto Scarborough
 2004 - Thomas W. Moon, University of Ottawa
 2003 - William Milsom, University of British Columbia
 2002 – Robert Boutilier, Cambridge University
 2001 - F.W.H. Beamish, Burapha University
 2000 - John Philips, University of British Columbia
 1999 - Chris Wood, McMaster University
 1998 - Geoffrey J. Eales, University of Manitoba
 1997 - Harold Atwood, University of Toronto
 1996 - Charles Krebs, University of British Columbia
 1995 - Peter Hochachka, University of British Columbia
 1994 - Brian Hall, Dalhousie University
 1993 - David Randall, University of British Columbia
 1992 - David Jones, University of British Columbia
 1991 - Roger Downer, Waterloo
 1990 - William Leggett, McGill
 1989 - G.O. Mackie, Victoria
 1988 - Denis Chitty, University of British Columbia
 1987 - Ken Davey, York University
 1986 - David Idler, Memorial
 1985 - J.R Brett, Pacific Biological Station
 1984 - No award
 1983 - W.E. Ricker, Pacific Biological Station
 1982 - F.J. Rigler, University of Toronto
 1981 - K. Ronald, University of Guelph
 1980 - D.M. Ross
 1979 - M.J. Dunbar, McGill University
 1978 - P.A. Larkin, University of British Columbia
 1977 - H.I. Battle, Western Ontario
 1976 - I. McTaggart-Cowan, University of British Columbia
 1975 - F.R Hayes, Dalhousie University
 1974 - W.S. Hoar, University of British Columbia

Tuesday, May 17th / mardi, 17 mai

Summary of events / Le résumé d'événements

	Events / les événements	Location / endroit
08h30-16h30	Registration / inscription	SITE Rotunda
08h30-10h30	CMD symposium / symposium MDC Contributed papers / présentations orales	SITE
10h30-11h00	Coffee / café	SITE Rotunda
11h00-12h30	Contributed papers / présentations orales	SITE
12h30-14h00	Student lunch and workshop / dîner et atelier des étudiants <i>Can J Zool</i> lunch / dîner du <i>Can J Zool</i>	UCU Cafeteria CAREG 107
13h00-14h00	NSERC presentation / présentation CRSNG	SITE B0138
14h00-16h00	Contributed papers / présentations orales	SITE
16h00-16h30	Coffee / café	SITE Rotunda
16h30-17h30	Boutilier lecture / conférence Boutilier	Marion AUD
17h30-18h30	President's workshop / atelier du président	Marion AUD
18h30-21h00	Poster session / session d'affiches	Sports Complex
20h00-21h00	Hockey game / partie de hockey	Sports Complex
21h00-	Mixer / rencontre sociale	The Draft

CMD Symposium / symposium MDC

Regeneration: Developmental and Evolutionary Perspectives / Régénération : Perspectives développementales et évolutives

Location / endroit: SITE B0138

Chair / président: Matt Vickaryous

	Speaker / conférencier
08h30-09h00	Regeneration - One of nature's enduring mysteries <i>La régénération – Un des mystères persistants de la nature</i> Bruce Carlson
09h00-09h30	Functional recovery following regeneration of the damaged retina in the newt, <i>Notophthalmus viridescens</i> <i>Rétablissement fonctionnel suivant la régénération de la rétine endommagée chez le triton vert, Notophthalmus viridescens</i> Catherine Tsilfidis, M Beddaoui and SG Coupland
09h30-10h00	Evolutionary loss of regeneration in annelid worms <i>Perte évolutionnaire de la régénération chez les annélides</i> Alexa Bely
10h00-10h15	Morphogen-based model of ray growth and segment formation during fin development and regeneration <i>Modèle morphogénique de croissance des rayons et de formation de segments pendant le développement et la régénération des nageoires</i> Anne-Gaëlle Rolland-Lagan and M-A Akimenko
10h15-10h30	<i>Amphioxus</i> provides insight into the evolution of regeneration mechanisms at the invertebrate-vertebrate transition <i>Amphioxus comme modèle de l'évolution des mécanismes de régénération à la transition invertébrés-vertébrés</i> Ildiko ML Somorjai, RL Somorjai, J Garcia-Fernandez and H Escriva

Contributed talks / Présentations orales

CPB 1 Toxicology – heavy metals / *Toxicologie - métaux lourds*

Location / endroit: SITE H0104

Chair / président: Tyson McCormack

	Speaker / conférencier
09h15-09h30	Cadmium and calcium selectively inhibit electron transport chain complexes and ATP production in rainbow trout hepatic mitochondria <i>Inhibition sélective par le cadmium et le calcium des complexes de la chaîne de transport des électrons et de la production d'ATP dans les mitochondries hépatiques de la truite arc-en-ciel</i> Reginald C Adiele, C Kamunde and D Stevens
09h30-09h45	The effects of Cd exposure on performance and capacity to recover from repeat swimming in rainbow trout (<i>Oncorhynchus mykiss</i>) <i>Effets de l'exposition au Cd sur la performance et la capacité de récupération de nage récurrente chez la truite arc-en-ciel (Oncorhynchus mykiss)</i> Jessie Cunningham and J McGeer
09h45-10h00	Copper and nickel toxicity in the larvae of the yellow fever mosquito <i>Aedes aegypti</i> <i>Toxicité du cuivre et du nickel chez la larve du moustique de la fièvre jaune, Aedes aegypti</i> Lilia Kotzeva, K Kilkus, JL Loeppky, R O'Brien and MR Rheault
10h00-10h15	Bioaccumulation and ionoregulatory disruption in four freshwater invertebrate species following acute (48 and 96-h) waterborne exposures to nickel in soft and hard water <i>Bioaccumulation et perturbation de l'ionorégulation chez quatre invertébrés d'eau douce suivant une exposition aquatique aigue (48 et 96h) au nickel dans de l'eau dure et douce</i> Erin M Leonard and CM Wood
10h15-10h30	Characterization of TiO ₂ aqueous metal nanoparticles and assessment of RBL-2H3 immunotoxicity using <i>in-vitro</i> cell models <i>Caractérisation de particules métalliques aqueuses de TiO₂ et évaluation de l'immunotoxicité de RBL-2H3 en utilisant des modèles cellulaires in-vitro</i> Van A Ortega, L Felix, H Cortes, J Stafford and GG Goss

Contributed talks / Présentations orales

CPB 2 Chemosensing and chemosensory cells / *Chémodétection et cellules chémosensibles*

Location / endroit: SITE H0104

Chair / président: Suzie Currie

	Speaker / conférencier
09h30-09h45	Is this why Tiktaalik stayed on land? Terrestrially induced gill remodelling reduces the aquatic respiratory function of an amphibious fish <i>Pourquoi Tiktaalik est-il resté sur la terre ferme ? La remodelisation branchiale induite sur terre réduit la fonction respiratoire aquatique d'un poisson amphibie</i> Andy Turko, C Cooper and PA Wright
09h45-10h00	The interactive effects of hypoxemia, hyperoxia and temperature on the gill morphology of goldfish (<i>Carassius auratus</i>) <i>Effets interactifs de l'hypoxémie, l'hyperoxie et de la température sur la morphologie branchiale du cyprin doré (Carassius auratus)</i> Velislava Tzaneva, S Bailey and SF Perry
10h00-10h15	You take my breath away: the effect of prolonged hypoxia exposure on the cardio-ventilatory response of bowfin (<i>Amia calva</i>) with and without access to air <i>Tu me coupes le souffle : les effets d'une hypoxie prolongée sur la réponse cardio-ventilatoire du poisson-castor (Amia calva) avec et sans accès à l'air</i> Cosima Porteus, PA Wright and WK Milsom
10h15-10h30	CO ₂ sensing in developing zebrafish, <i>Danio rerio</i> <i>Détection du CO₂ durant le développement du poisson zèbre, Danio rerio</i> Scott F Miller and SF Perry

Contributed talks / Présentations orales

CPB 3 Metabolism I / *Métabolisme I*

Location / endroit: SITE B0138

Chair / président: Chris Moyes

	Speaker / conférencier
11h00-11h15	The thermal breadth of aerobic scope in a eurythermal fish, <i>Fundulus heteroclitus</i> <i>L'étendue thermique des capacités aérobie chez un poisson eurythermique, Fundulus heteroclitus</i> Timothy M Healy and PM Schulte
11h15-11h30	Juvenile migrant songbirds have higher basal metabolic rates than adults <i>Les passerins migrants juvéniles ont un taux métabolique basal plus élevé que celui des adultes</i> Brendan J McCabe and CG Guglielmo
11h30-11h45	Increased homeothermy during pregnancy in a heterothermic mammal, the greater hedgehog tenrec, <i>Setifer setosus</i> <i>Homéothermie accrue durant la grossesse chez un mammifère hétéotherme, le grand hérisson, Setifer setosus</i> Danielle L Levesque and BG Lovegrove
11h45-12h00	Real-time measurements of metabolism during freezing and thawing in wood frogs, <i>Rana sylvatica</i> <i>Mesures en temps réel du métabolisme lors du gel et du dégel chez la grenouille des bois, Rana sylvatica</i> Brent J Sinclair, CM Williams, HA MacMillan and KB Storey
12h00-12h15	Specific dynamic action in the sunflower star, <i>Pycnopodia helianthoides</i> <i>Action dynamique spécifique chez l'étoile de mer tournesol, Pycnopodia helianthoides</i> Iain J McGaw

Contributed talks / Présentations orales

CPB 4 Toxicology II - Heavy metals and nanoparticles / *Toxicologie II – Métaux lourds et nanoparticules*

Location / endroit: SITE H0104

Chair / président: Fernando Galvez

	Speaker / conférencier
11h00-11h15	Selenium toxicity in an eel brain cell line as applied to eel population decline <i>Toxicité au sélénium dans une lignée cellulaire de cerveau d'anguille corrélés au déclin de la population</i> Sophia R Bloch, LEJ Lee, PV Hodson and NC Bols
11h15-11h30	Carbohydrate metabolism in coelomic cells from tunicates with different degrees of vanadium accumulation <i>Le métabolisme des glucides dans les cellules coelomiques des tuniciers sous différents degrés d'accumulation de vanadium</i> Jason R Treberg, JE Stacey and WR Driedzie
11h30-11h45	Silver nanoparticles inhibit gill sodium transport in juvenile rainbow trout (<i>Oncorhynchus mykiss</i>) <i>Les nanoparticules d'argent inhibent le transport du sodium dans les branchies de truites arc-en-ciel juvéniles (Oncorhynchus mykiss)</i> Aaron G Schultz, T MacCormack, KJ Ong, M Guibin, J Veinot and GG Goss
11h45-12h00	Silver (nano and ionic) toxicity in rainbow trout hepatocytes <i>Toxicité des nano et ionoparticules d'argent dans les cellules hépatiques chez la truite arc-en-ciel</i> Andrey Massarsky, VL Trudeau and TW Moon
12h00-12h15	Sodium loss is the acute toxic mechanism of diverse contaminants in zebrafish: implications for additive toxicity <i>La perte de sodium est le mécanisme toxique aigu de divers contaminants chez le poisson-zèbre : implications pour la toxicité additive</i> Derek Alsop and CM Wood
12h15-12h30	Inhibition of zebrafish hatch by nanoparticles <i>Inhibition de l'éclosion chez le poisson-zèbre via des nanoparticules</i> Kimberly J Ong, X Zhao, M Thistle, R Clark, G Ma, J Veinot and GG Goss

Contributed talks / Présentations orales

CPB 5 Chemosensing and chemosensory cells cont'd / *Chémodétection et cellules chémosensibles (suite)*

Location / endroit: SITE G0103

Chair / président: Colin Brauner

	Speaker / conférencier
11h00-11h15	Purinergic regulation of breathing in amphibians <i>Régulation purinergique de la respiration chez les amphibiens</i> Andrew Peters and S Reid
11h15-11h30	The effect of temperature on the chronic hypoxia-induced changes to pH/CO ₂ -sensitive fictive breathing in the cane toads <i>L'effet de la température sur les changements de respiration fictive sensibles au pH/CO₂ induits par l'hypoxie chronique chez le crapaud géant</i> Stephen Reid and S Jenkin
11h30-11h45	Control of breathing in the in vitro brainstem preparation from goldfish (<i>Carassius auratus</i>) <i>Contrôle de la respiration in vitro dans le tronc cérébral du cyprin doré (Carassius auratus)</i> Eric Côté and R Kinkead*
11h45-12h00	Live imaging and functional analysis of NECs in teleost gills <i>Imagerie en direct et analyse fonctionnelle des CNE chez les téléostéens</i> Dee Brink, C Porteus, A Fong and WK Milsom
12h00-12h15	Effects of hypercapnia on intracellular pH and Ca ²⁺ in isolated gill neuroepithelial cells of zebrafish, <i>Danio rerio</i> <i>Les effets de l'hypercapnie sur le pH et le Ca²⁺ dans les cellules neuroépithéliales isolées de branchies chez le poisson zèbre, Danio rerio</i> Sara Abdallah, MG Jonz and SF Perry
12h15-12h30	Ion channels of neuroepithelial cells in zebrafish and goldfish <i>Les canaux ioniques des cellules neuroépithéliales chez le poisson-zèbre et le cyprin doré</i> Peter C Zachar and MG Jonz

Contributed talks / Présentations orales

CMD 1 Regeneration and development / *Régénération et développement*

Location / endroit: SITE A0105

Chair / président: Ryan Kerney

	Speaker / conférencier
11h00-11h15	A comparison of wound healing following voluntary (autotomy) and involuntary (amputation) tail loss using the leopard gecko, <i>Eublepharis macularius</i> <i>Comparaison entre la guérison de blessure provoquée volontairement (autotomie) et involontairement (amputation) chez le gecko léopard, Eublepharis macularius</i> Stephanie Delorme^H and MK Vickaryous
11h15-11h30	Histone modification in polychaete embryos - a link with phenotypic divergence? <i>Modification d'histone dans les embryons de polychètes – un lien avec la divergence phénotypique</i> Glenys Gibson, H Corban and V Lloyd
11h30-11h45	Cerebellar development in a precocial species with comments on heterochrony in neurodevelopment <i>Développement cérébelleux dans une espèce nidifuge et commentaires sur l'hétérochronie du neurodéveloppement</i> Emily A Gilbert^H, D Lim, MK Vickaryous and CL Armstrong
11h45-12h00	Influence of different levels of dissolved oxygen (DO) on the survival rate, the embryonic development (ED) and hatching success of Greenland halibut eggs <i>Influence des différents niveaux d'oxygène dissous (OD) sur le taux de survie, le développement embryonnaire (DE) et le succès d'éclosion des œufs chez le flétan du Groenland</i> Sahar Mejri^H, R Tremblay, C Audet and Y Lambert
12h00-12h15	Intracellular invasion of green algae in a salamander host <i>Invasion intracellulaire des algues vertes chez une salamandre hôte</i> Ryan Kerney, E Kim, RP Hangarter, AA Heiss, CD Bishop and BK Hall

Contributed talks / Présentations orales

CPB 6 Invertebrate Physiology : Regulation and homeostasis / *Physiologie des invertébrés : régulation et homéostasie*

Location / endroit: SITE C0136

Chair / président: Mark Rheault

	Speaker / conférencier
11h00-11h15	Circadian organization in an adult insect: rhythmicity of prothoracicotropic hormone from the brain and ecdysteroids from the hemolymph and ovaries during egg development in adult <i>Rhodnius prolixus</i> <i>Organisation circadienne chez un insecte adulte : rhythmicité de l'hormone prothoracicotrope du cerveau et des ecdystéroïdes de l'hémolymph et des ovaires durant le développement des œufs chez Rhodnius prolixus adulte</i> Michael Cardinal-Aucoin, X Vafopoulou, CGH Steel
11h15-11h30	Molecular identification and characterization of a gene encoding the kinin peptide(s) in <i>Rhodnius prolixus</i> <i>Identification moléculaire et caractérisation du gène codant le(s) peptide(s) de kinine chez Rhodnius prolixus</i> Garima Bhatt and I Orchard
11h30-11h45	Effect of serotonin on mitochondrial membrane potential in primary cultures of embryonic cells from the pond snail, <i>Helisoma trivolvis</i> <i>L'effet de la sérotonine sur le potentiel membranaire mitochondrial dans des cultures primaires de cellules embryonnaires chez l'escargot Helisoma trivolvis</i> Jeffrey I Goldberg, DR Rich, J Haddad, EC Boychuk and R Tam
11h45-12h00	The crustacean cardioactive peptide and its receptor in the blood-gorging bug, <i>Rhodnius prolixus</i> <i>Le peptide cardiotonique crustacéen et son récepteur chez l'insecte hématophage Rhodnius prolixus</i> Do Hee Lee and AB Lange
12h00-12h15	Pyrokinin-related peptides and their receptors in the haematophagous insect, <i>Rhodnius prolixus</i> - a vector of Chagas' disease <i>Peptides associés à la pyrokinine et leurs récepteurs chez l'insecte hématophage, Rhodnius prolixus – un vecteur de la maladie de Chagas</i> Jean-Paul V Paluzzi and MJ O'Donnell
12h15-12h30	Potential role of the neuropeptide Rhopr-DH31 in reproduction in the kissing bug, <i>Rhodnius prolixus</i> <i>Rôle potentiel du neuropeptide Rhopr-DH31 dans la reproduction chez l'insecte hématophage, Rhodnius prolixus</i> Meet Zandawala and I Orchard

Contributed talks / Présentations orales

PAR 1 Protozoa, ecology and control / *Protozoaires, écologie et contrôle*

Location / endroit: SITE J0106

Chair / président: Lena Measures

	Speaker / conférencier
11h00-11h15	Influence of <i>Hepatozoon</i> spp. (phylum Apicomplexa) on host-seeking and host-choice behaviour of two <i>Culex</i> species <i>Influence de Hepatozoon (embranchement Apicomplexa) sur le comportement de recherche et de choix d'hôte chez deux espèces du genre Culex</i> Laura Ferguson^F, NK Hillier and TG Smith
11h15-11h30	Optimizing detection and recovery methods for <i>Cryptosporidium parvum</i> and <i>Giardia duodenalis</i> in oysters <i>Optimisation des méthodes de détection et de récupération pour Cryptosporidium parvum et Giardia duodenalis chez l'huître</i> Jessica E Willis^F, S Greenwood, JT McClure, J Davidson and C McClure
11h30-11h45	No longer a one-trick pony: <i>Trichomonas gallinae</i> in maritime wild bird populations <i>Il a plus d'une corde à son arc : Trichomonas gallinae chez des populations sauvages d'oiseaux marins</i> Whitney K Kelly-Clark^F, S McBurney, S Greenwood, M Forzán and R Vanderstichel
11h45-12h00	Host distribution and parasitism in a damselfly-gregarine system <i>Distribution et parasitisme d'hôte dans un système agrion-grégaires</i> Julia J Mlynarek^F and MR Forbes
12h00-12h15	Are invasive species a parasite free lunch? <i>Est-ce que les espèces invasives sont un repas gratuit pour les parasites ?</i> Gregory Bulté, MR Forbes, SE Locke and DJ Marcogliese
12h15-12h30	Effect of sodium percarbonate on monogeneans infecting mummichogs (<i>Fundulus heteroclitus</i>) <i>Effet du percarbonate de sodium sur les monogènes infectant Fundulus heteroclitus</i> Michael DB Burt, K Crain, M Posselt, DK Cone, V Savoie-Swan, RH Easy and K Buchmann

NSERC presentation / présentation CRSNG

Location / endroit: SITE B0138

Chair / président: Vance Trudeau

13h00-14h00	<p>NSERC Program News and 2011 Discovery Grants Competition Results <i>Nouvelles des programmes du CRSNG et résultats du concours de subventions à la découverte de 2011</i></p> <p>Staff from NSERC's Research Grants and Scholarships Directorate will provide an overview of program news and results of the 2011 Discovery Grants competition. There will be an opportunity for questions following the presentation. <i>Le personnel de la Direction des subventions de recherche et bourses du CRSNG présentera un survol des nouvelles des programmes ainsi que des résultats du concours de subventions à la découverte de 2011. La présentation sera suivie d'une période de questions.</i></p>
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Contributed talks / Présentations orales

CPB 7 Anoxia and hypoxia responses and tolerance / *Réponses et tolérance à l'anoxie et hypoxie*

Location / endroit: SITE B0138

Chair / président: Jeff Richards

	Speaker / conférencier
14h00-14h15	Anoxia survival in turtles: possible roles of microRNAs in regulating metabolic rate depression <i>Survie à l'anoxie chez les tortues : rôles possibles des microARN dans la régulation de la dépression métabolique</i> Kyle K Biggar and KB Storey
14h15-14h30	Exceptional cardiac anoxia tolerance in tilapia (<i>Oreochromis hybrid</i>) <i>Résistance cardiaque exceptionnelle à l'anoxie chez tilapia (Oreochromis hybrid)</i> Sabine Lague, B Speers-Roesch, JG Richards and AP Farrell
14h30-14h45	Anoxia-sensitive GABA release by stellate neurons reduces pyramidal neuron activity through increases in GABA-A receptor currents in anoxia-tolerance turtle cortex <i>Le relâchement de GABA sensibles à l'anoxie par les neurones stellaires réduit l'activité des cellules pyramidales par l'augmentation de courants dans les récepteurs GABA-A dans le cortex tolérant à l'anoxie chez la tortue</i> Leslie T Buck and DWR Hogg
14h45-15h00	Mechanisms of hypoxia tolerance in carp <i>Mécanismes de la résistance à l'hypoxie chez la carpe</i> Rashpal S Dhillon, L Yao, V Matey, BJ Chen, SJ Fu, ZD Cao, CJ Brauner, YX Wang and JG Richards
15h00-15h15	Effects of starvation on the metabolic depression and hypoxia tolerance of rainbow trout (<i>Oncorhynchus mykiss</i>) <i>Les effets du jeûne sur la dépression métabolique et la tolérance à l'hypoxie chez la truite arc-en-ciel (Oncorhynchus mykiss)</i> Scott MacIntyre, Y Luo, YX Wang
15h15-15h30	Lactate flux in rainbow trout: hypoxia vs. exercise <i>Le flux de lactate chez la truite arc-en-ciel : comparaison entre l'hypoxie et l'exercice</i> Teye Omlin and J-M Weber
15h30-15h45	Hypoxia tolerance of Danios and Devarios <i>Tolérance à l'hypoxie chez Danio et Devario</i> Lili Yao and JG Richards

Contributed talks / Présentations orales

CPB 8 Toxicology III - Pollutants and pharmaceuticals / *Toxicologie III – Polluants et produits pharmaceutiques*

Location / endroit: SITE H0104 **Chair / président:** Jason Treberg

	Speaker / conférencier
14h00-14h15	Examining the physico-chemical properties and toxicological effects of manufactured polymer-coated nanoparticles using zebrafish (<i>Danio rerio</i>) <i>Propriétés physico-chimiques et effets toxicologiques de nanoparticules manufacturées recouvertes de polymères chez le poisson-zèbre (Danio rerio)</i> Lindsey C Felix, VA Ortega and GG Goss
14h15-14h30	Quantitative proteomic analysis of gills from zebrafish exposed to naphthenic acids and oil sands process water <i>Analyse protéomique quantitative des branchies chez les poissons-zèbre exposés aux acides naphthéniques et à l'eau contaminée par le traitement des sables bitumineux</i> Tyson J MacCormack, AG De Souza, L Li and GG Goss
14h30-14h45	Environmental influences on the accumulation of ethynylestradiol in the euryhaline killifish <i>Influences environnementales de l'accumulation d'éthinylestradiol chez les cyprinodontes euryhalins</i> Tamzin Blewett, DM MacLatchy and CM Wood
14h45-15h00	Cellular and physiological stress responses to EE2 during fluctuations in environmental temperature in the mummichog (<i>Fundulus heteroclitus</i>) <i>Réponses cellulaire et physiologique au stress à l'EE2 pendant les fluctuations de température environnementale chez Fundulus heteroclitus</i> Kavish P Chandra, A Lister, T Bosker, DL MacLatchy and S Currie
15h00-15h15	The effects of fluoxetine on head kidney steroidogenesis in rainbow trout (<i>Oncorhynchus mykiss</i>) <i>Les effets de la fluoxétine sur la stéroïdogénèse du rein chez la truite arc-en-ciel (Oncorhynchus mykiss)</i> Pamela A Stroud, GM Cooke and TW Moon
15h15-15h30	Molecular tools for early life stage salmonid bio-monitoring in polluted environments <i>Outils moléculaires pour la biosurveillance en milieu pollué des salmonidés dans les premières étapes de leur cycle de vie</i> Chris J Martyniuk, JR Elphick, R Sherrard and VL Marlatt
15h30-15h45	Energetic costs of aryl hydrocarbon receptor activation by beta-naphthoflavone in rainbow trout hepatocytes <i>Coûts énergétiques de l'activation du récepteur des aryl-hydrocarbures par la beta-naphthoflavone dans les cellules hépatiques chez la truite arc-en-ciel</i> Rance Nault and TW Moon
15h45-16h00	PCBs induce homeoviscous response in goldfish gills <i>Les BPC induisent la réponse homéovisqueuse dans les branchies du cyprin doré</i> Alexander Gonzalez and J-M Weber

Contributed talks / Présentations oralesCPB 9 Ion transport mechanisms / *Mécanismes de transport ionique***Location / endroit:** SITE G0103**Chair / président:** Pat Wright

	Speaker / conférencier
14h00-14h15	Comparing calcium and cadmium uptake along the gastro-intestinal tract of freshwater and seawater acclimated steelhead <i>Comparaison du captage de calcium et cadmium dans le tractus gastro-intestinal de la truite steelhead acclimatée à l'eau douce et à l'eau de mer</i> Joel S Klinck and CM Wood
14h15-14h30	Cadmium transport in rainbow trout enterocytes - which pathways are involved? <i>Transport du cadmium dans les entérocytes chez la truite arc-en-ciel – quelles voies sont impliquées ?</i> Raymond WM Kwong and S Niyogi
14h30-14h45	A novel proposed mechanism for Na ⁺ transport in rainbow trout gills <i>Un nouveau mécanisme pour le transport du Na⁺ dans les branchies de la truite arc-en-ciel</i> Agnieszka Dymowska, A Schultz, S Parks, J Brisebois, GG Goss
14h45-15h00	The effects of gill remodeling on branchial Na ⁺ transport in goldfish, <i>Carassius auratus</i> <i>Les effets du remodelage de la branchie sur le transport branchial du Na⁺ chez le cyprin doré, Carassius auratus</i> Julia Bradshaw and SF Perry
15h00-15h15	The influence of natural organic matter (NOM) on sodium transport in freshwater organisms <i>L'influence de la matière organique naturelle (MON) sur le transport du sodium chez les organismes d'eau douce</i> Hassan A Al-Reasi, DS Smith and CM Wood
15h15-15h30	Calcium-mediated mucin deployment in the slime of hagfishes <i>Déploiement de mucine facilité par le calcium dans le mucus des myxines</i> Julia E Herr, GG Goss and DS Fudge
15h30-15h45	Sulfate transport in hagfish: applying modern approaches to ancient fishes <i>Transport de sulfate chez la mixine : application d'approches modernes à d'anciens poissons</i> Alexander M Clifford, BL Goss, AG Schultz and GG Goss
15h45-16h00	Localization and expression of Na ⁺ ,K ⁺ -ATPase, Na ⁺ ,K ⁺ ,2Cl ⁻ cotransporter and CFTR during an osmotic challenge of <i>Fundulus heteroclitus</i> <i>Localisation et expression des Na⁺, K⁺-ATPase, des cotransporteurs de Na⁺, K⁺, 2Cl⁻ et de la CFTR pendant un défi osmotique chez Fundulus heteroclitus</i> Charlotte Bodinier, Y Meng and F Galvez

Contributed talks / Présentations orales

CMD 2 Student Satellite Symposium: New perspectives on adaptation to environmental variation via epigenetic mechanisms / *Symposium satellite d'étudiants : Nouvelles perspectives sur l'adaptation à la variation environnementale via des mécanismes épigénétiques*

Location / endroit: SITE A0150

Chair / président: Jan Lim

	Speaker / conférencier
14h00-14h30	Life Imprints: Living in a contaminated world <i>Les empreintes de la vie : Vivre dans un monde contaminé</i> David Crews
14h30-14h45	How cytosine methylation acquired its gene regulation function <i>Comment la méthylation de la cytosine a acquis sa fonction régulatrice du gène</i> Sanoji Wijenayake^H and R Gorelick
14h45-15h00	Are monozygotic twins identical in genetic and epigenetic features? <i>Est-ce que les jumeaux monozygotes sont identiques dans leurs caractéristiques épigénétiques ?</i> Christina A Castellani^H, RL O'Reilly and SM Singh
15h00-15h15	An epigenetic mechanism involved in temperature-induced sex ratio shifts in fish populations <i>Un mécanisme épigénétique impliqué dans le réarrangement du sex-ratio induit par la température dans des populations de poissons</i> Laia Navarro-Martin and F Piferrer

Contributed talks / Présentations orales

EEE-CPB joint session Behavioural and ecological physiology / *Physiologie comportementale et écologique*

Location / endroit: SITE C0136

Chair / président: Jean-Michel Weber

	Speaker / conférencier
14h00-14h15	Can Silastic implants be used to mimic chronic stress? Insights from the painted turtle <i>Est-ce que les implants Silastic peuvent être utilisés pour imiter un stress chronique ? Le cas de la tortue peinte</i> Véronique Juneau and G Blouin-Demers
14h15-14h30	Natural variation in the stress molecular network underlying a behavioural syndrome <i>Variation naturelle dans le réseau moléculaire du stress sous-tendant un syndrome comportemental</i> Nadia Aubin-Horth, M Deschênes and S Cloutier
14h30-14h45	The stress response, fitness, and behaviour in Pacific salmon <i>La réponse au stress, fitness et comportement du saumon du Pacifique</i> Katrina V Cook, SH McConnachie, GT Crossin, KM Gilmour and SJ Cooke
14h45-15h00	Sediment alters the swimming performance of individual and schooling salmonids <i>La performance de nage chez les individus et les bancs de salmonidés est altérée par les sédiments</i> Keith B Tierney, BI Berli and P Burkhardt-Holm
15h00-15h15	The effect of different predators on the escape response of <i>Placopecten magellanicus</i> <i>L'effet de différents prédateurs sur la réponse de fuite chez Placopecten magellanicus</i> Helga Guderley, JH Himmelman, M Nadeau and X Janssoone
15h15-15h30	Mother knows best: the costs and benefits of maternal antibody transfer in tree swallows <i>Coûts et bénéfices du transfert d'anticorps maternels chez l'hirondelle bicolor</i> Gary Burness, D Moher, RJ Kelly and EH Chin
15h30-15h45	Phenotypic flexibility of migrating hoary bats, <i>Lasiurus cinereus</i> <i>Flexibilité phénotypique chez la chauve-souris migratrice Lasiurus cinereus</i> Liam P McGuire, MB Fenton and CG Guglielmo
15h45-16h00	Graphs: Simpler methods for multivariate physiology <i>Des méthodes graphiques plus simples pour la physiologie multivariée</i> Dimitri A Skandalis

Contributed talks / Présentations orales

PAR 2 Microsporidians, trematodes and nematodes / *Microsporidies, trématode et nématodes*

Location / endroit: SITE J0106

Chair / président: Michael Duffy

	Speaker / conférencier
14h00-14h15	New method for detecting <i>Nosema ceranae</i> and <i>N. apis</i> in European honeybees <i>Une nouvelle méthode pour la détection de Nosema ceranae et N. apis chez l'abeille européenne</i> Tanya Copley^F, P Giovenazzo and S Jabaji
14h15-14h30	Observations on the epidemiology of <i>Loma morhua</i> during aquaculture of Atlantic cod <i>Remarques sur l'épidémiologie de Loma morhua chez la morue de l'Atlantique en aquaculture</i> Maeghan P O'Neill^F, AP Frenette and MS Duffy
14h30-14h45	Quantitative PCR assessment of <i>Loma morhua</i> infections in Atlantic cod <i>Évaluation des infections de Loma morhua par PCR quantitatif chez la morue de l'Atlantique</i> Aaron P Frenette^F, MDB Burt and MS Duffy
14h45-15h00	Characterizing determinants of snail resistance to digenetic trematode infection <i>Caractérisation des déterminants de la résistance à l'infection par Digena chez l'escargot</i> Patrick C Hanington and ES Loker
15h00-15h15	Molecular phylogeny of the trematode families Diplostomidae and Strigeidae <i>Phylogénie moléculaire des familles de trématodes Diplostomidae et Strigeidae</i> Angela Rose Lapierre^F, D McLaughlin, S Dayanandan, S Locke and D Marcogliese
15h15-15h30	Fortuitous re-identification of secretory cells with undefined roles in parasitism <i>Ré-identification fortuite de cellules sécrétrices au rôle parasitique indéterminé</i> Jennifer Fitzpatrick^F, S Belfry and MS Duffy
15h30-15h45	Observations on the incidence and interrelationships of <i>Parelaphostrongylus tenuis</i> in moose and deer in New Brunswick <i>Observations sur l'incidence et les rapports de Parelaphostrongylus tenuis chez l'orignal et le cerf au Nouveau-Brunswick</i> Katie M Leger^F, GJ Forbes, MD Burt and MS Duffy

Boutilier lecture / conférence du prix Boutilier

Location / endroit: Marion AUD

Chair / président: Greg Goss, President

16h30-17h30	<p>Linking periods of the annual cycle in migratory animals <i>Comment relier les périodes du cycle annuel chez les animaux migratoires</i> Ryan Norris, University of Guelph</p>
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President's workshop / atelier du président

Location / endroit: Marion AUD

Chair / président: Greg Goss, President

17h30-18h30	<p>The Canadian Society of Zoologists - what will the next 50 years bring? <i>La Société Canadienne de Zoologie- que nous réservent les 50 prochaines années?</i></p> <p>Members of the Canadian Society of Zoologists have a long history of innovative research, outstanding training for students and PDFs, and providing relevant basic and applied research to understand and solve today's scientific challenges. While we look forward to the next 50 years, they will almost certainly pose challenges for the Society with reduced and targeting funding for basic research and an increased pressure for sponsored research. The President's symposium bring together three former Presidents of the Society, Bill Milsom, Mike Belosevic and Doug Morris, to challenge the Society and present their ideas on what we have tried, what we are doing and what we need to do to ensure a strong and healthy next 50 years. A lively debate and discussion will follow on these ideas and this will help sculpt today's policies for tomorrow's Society.</p> <p><i>Les membres de la société canadienne de zoologie démontrent depuis nombre d'années leur talent à conduire des recherches innovatrices, à former de manière exceptionnelle les étudiants et stagiaires postdoctoraux et à générer des connaissances fondamentales et appliquées pour mieux comprendre et résoudre les défis scientifiques d'aujourd'hui. Nous envisageons avec enthousiasme les prochaines 50 années, qui poseront sans doute des défis à la société de zoologie suite aux baisses de financement qui affectent la recherche fondamentale et à une pression accrue pour trouver de nouvelles sources de financement dans le privé. Le symposium du président réunira 3 anciens présidents de la société, Bill Milsom, Mike Belosevic et Doug Morris, qui stimuleront la discussion en présentant leurs idées sur ce qui a été tenté, ce qui est fait présentement, et ce qui devra être fait pour que s'assurer que la société de zoologie passe les prochaines 50 années solidement et en santé. Un débat animé et une discussion suivront, basés sur ces idées et contribueront à former les politiques pour la société de zoologie de demain.</i></p>
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Wednesday, May 18th / mercredi, 18 mai**Summary of events / Le résumé d'événements**

	Events / les événements	Location / endroit
08h30-16h30	Registration / inscription	SITE Rotunda
08h30-10h30	CPB symposium / symposium PBC	SITE B0138
10h30-11h00	Coffee / café	SITE Rotunda
11h00-12h30	Andy Spencer Memorial symposium / symposium commémoratif Andy Spencer Contributed papers / présentations orales	SITE G0103 SITE
12h30-14h00	CPB lunch / dîner PBC CMD lunch / dîner MDC	Tabaret 112 CAREG 107
14h00-15h30	Andy Spencer Memorial symposium / symposium commémoratif Andy Spencer Contributed papers / présentations orales	SITE G0103 SITE
15h30-16h30	Coffee / café	SITE Rotunda
16h30-17h30	Cameron lecture / conférence Cameron	Marion AUD
17h30-18h30	Women in science workshop / atelier femmes en science	DRO lounges
18h30-20h00	ZET event / conférence ZET	UCU AUD
21h00-	Student mixer / rencontre sociale des étudiants	Heart and Crown (Byward market)

CPB Symposium / symposium PBC

**Waste Management and recycling: diverse approaches to nitrogen handling in animals /
Gestion des déchets et recyclage : différentes approches de prise en charge de l'azote chez les animaux**

Location / endroit: SITE B0138

Chair / président: Gary Anderson

	Speaker / conférencier
08h30-09h00	Ammonia excretion in the non-parasitic freshwater planarian <i>Schmidtea mediterranea</i> <i>Excrétion d'ammoniac chez le planaire non-parasitique d'eau douce Schmidtea mediterranea</i> Dirk Weihrauch, A Chan and MM Sourial
09h00-09h30	Small nitrogenous solutes in deep-sea animals: counteracting hydrostatic pressure and detoxifying hydrogen sulphide <i>Petits solutés azotés chez les animaux des grands fonds : contrer la pression hydrostatique et détoxifier le sulfure d'hydrogène</i> Paul Yancey
09h30-10h00	Ammonia excretion and Rh protein function in fish <i>Excrétion d'ammoniac et fonction de la protéine Rh chez les poissons</i> Chris M Wood, P Wright and CM Nawata
10h00-10h30	Nitrogen excretion by fruit eating bats fed contrasting sugar-density diets <i>Excrétion d'azote chez les chauves-souris mangeuses de fruits nourries de diètes contenant différentes densités de sucre</i> L Gerardo Herrera, J Osorio and C Mancina

Contributed talks / Présentations orales

CPB 10 Waste management and recycling: diverse approaches to nitrogen handling in animals
cont'd / *Gestion des déchets et recyclage : différentes approches de prise en charge de l'azote chez les animaux (suite)*

Location / endroit: SITE B0138

Chair / président: Gary Anderson

	Speaker / conférencier
11h00-11h15	Differential expression of Rh glycoproteins in the sea lamprey, <i>Petromyzon marinus</i> <i>Expression différentielle des glycoprotéines Rh chez la lamproie marine, Petromyzon marinus</i> Salvatore Blair, MP Wilkie and SL Edwards
11h15-11h30	The mechanisms of cutaneous ammonia transport in amphibious mangrove rivulus, <i>Kryptolebias marmoratus</i> , acclimated to different salinities <i>Les mécanismes de transport cutané d'ammoniac chez le killi des mangroves, Kryptolebias marmoratus, acclimaté à différentes salinités</i> Chris A Cooper and PA Wright
11h30-11h45	Ammonia transport in the skin of the African clawed frog, <i>Xenopus laevis</i> <i>Transport d'ammoniac dans la peau du xénope du Cap, Xenopus laevis</i> Melissa Cruz, A Chan, MM Sourial, D Weihrauch
11h45-12h00	Ontogeny of the urea cycle enzymes gene expression in zebrafish (<i>Danio rerio</i>) <i>Ontogénie de l'expression génétique des enzymes du cycle de l'urée chez le poisson-zèbre (Danio rerio)</i> Christophe MR LeMoine^P and PJ Walsh
12h00-12h15	Hierarchical formation in rainbow trout under the influence of high external ammonia <i>Formation de hiérarchie chez la truite arc-en-ciel exposée à une forte source externe d'ammoniac</i> Josias MB Grobler and CM Wood
12h15-12h30	The toadfish serotonin 2A receptor: its role in the regulation of pulsatile urea excretion <i>Le récepteur 2A de sérotonine chez les poisons-crapauds: son rôle dans la régulation de l'excrétion pulsatile de l'urée</i> M Danielle McDonald, LR Medeiros and EM Mager

Contributed talks / Présentations orales

CPB 11 Cellular/molecular regulatory mechanisms / *Mécanismes de régulation cellulaire et moléculaire*

Location / endroit: SITE H0104

Chair / président: Trish Schulte

	Speaker / conférencier
11h00-11h15	Regulation of foot muscle glutamate dehydrogenase from an estivating land snail <i>Régulation du glutamate déshydrogénase chez un escargot terrestre estivant</i> Ryan Bell and KB Storey
11h15-11h30	The evolution of the regulatory control of the vertebrate heart: the role of protein phosphorylation <i>L'évolution du contrôle régulateur du coeur des vertébrés et le rôle de la phosphorylation des protéines</i> Todd E Gillis
11h30-11h45	Regulation of glycerol-3-phosphate dehydrogenase during hibernation in the Richardson ground squirrel (<i>Spermophilus richardsonii</i>) by reversible protein phosphorylation <i>Régulation de la glycérol-3-phosphate déshydrogénase pendant l'hibernation chez le spermophile de Richardson (Spermophilus richardsonii) par phosphorylation réversible de protéine</i> Allan Letourneau and KB Storey
11h45-12h00	Control of cytochrome c oxidase (COX) gene expression in goldfish in response to temperature <i>Contrôle de l'expression génétique du cytochrome c oxydase (COX) en réponse au changement de température chez le cyprin doré</i> Katharina Bremer, CT Monk and CD Moyes
12h00-12h15	Hypometabolism In mammals: role of translational regulation in torpor survival <i>L'hypométabolisme chez les mammifères: le rôle de la régulation de la traduction dans la survie à la léthargie</i> Cheng-Wei Wu and KB Storey

Contributed talks / Présentations orales

Andy Spencer Memorial Symposium Insights from invertebrates on the origins of electrical excitability / *Symposium commémoratif Andy Spencer Contribution des invertébrés à notre compréhension des origines de l'excitabilité électrique*

Location / endroit: SITE G0103

Chair / président: David Spafford

	Speaker / conférencier
11h00-11h30	From jellyfish to biophysics: comparative approaches to understanding K ⁺ channel protein function <i>Des méduses jusqu'à la biophysique: approches comparatives pour comprendre les fonctions des canaux potassiques</i> Warren Gallin
11h30-12h00	Control of swimming in medusae: Beyond diffuse nerve nets <i>Le contrôle de la nage chez les méduses: au-delà des filets nerveux sensitifs</i> Richard Satterlie
12h00-12h30	A new inhibitory pathway in the jellyfish <i>Polyorchis</i> <i>Une nouvelle voie d'inhibition chez la méduse Polyorchis</i> George O Mackie, RW Meech and AN Spencer

Contributed talks / Présentations orales

CPB 12 Stress / *Stress*

Location / endroit: SITE A0105

Chair / président: Derek Alsop

	Speaker / conférencier
11h00-11h15	Serotonin directly stimulates cortisol secretion in goldfish <i>La sérotonine stimule directement la sécrétion du cortisol chez le cyprin doré</i> Jan E Lim and NJ Bernier
11h15-11h30	Social status affects cortisol responsiveness to acute stress in rainbow trout <i>Le statut social affecte la sensibilité au cortisol lors d'un stress aigu chez la truite arc-en-ciel</i> Jennifer D Jeffrey, M Gollock and KM Gilmour
11h30-11h45	Fish in hot water: What triggers catecholamine mobilization? <i>Les poissons dans l'eau chaude: Qu'est-ce qui déclenche la mobilisation des catécholamines?</i> Kathleen M Gilmour, SF Perry and S Currie
11h45-12h00	The organic osmolyte, trimethylamine oxide (TMAO), protects dogfish red blood cells from acute heat stress <i>L'oxyde de triméthylamine (TMAO), un osmolyte organique, protège les érythrocytes des changements aigus de températures chez l'aiguillat</i> Suzanne Currie, A Kolhatkar, C Robertson and K Gamperl
12h00-12h15	Over-expression of corticotropin-releasing factor reduces heat shock-induced caspase-3/7 activity in zebrafish embryos <i>La surexpression de corticolibérine réduit l'activité des caspases-3/7 contrôlées par les protéines de choc thermique chez les embryons de poisson zèbre</i> Sarah L Alderman, MLM Fuzzen, EF Sandiford and NJ Bernier
12h15-12h30	Oxidative stress and senescence throughout migration of pink salmon (<i>Oncorhynchus gorbuscha</i>) <i>Stress oxydant et sénescence tout au long de la migration du saumon rose (Oncorhynchus gorbuscha)</i> Samantha Wilson, T Mackie, WG Willmore and SJ Cooke

Contributed talks / Présentations orales

EEE 1 Selection / *Sélection*

Location / endroit: SITE C0136

Chair / président: Ora Johannsson

	Speaker / conférencier
11h00-11h15	<p>Feasibility of genomic selection in a Canadian aquacultural strain of Atlantic salmon using 4000 mapped SNP markers <i>Faisabilité d'une sélection génomique en utilisant 4000 marqueurs polymorphes mononucléotidiques répertoriés dans une lignée de saumon de l'Atlantique issue de l'aquaculture canadienne</i> Elizabeth G Boulding, K Ang, A Burton, L Damphousse, JAK Elliott, B Glebe, M Kent, S Lien, L Schaeffer and J Tosh</p>
11h15-11h30	<p>Selection on amphibian development rate across latitude: Evidence for diversifying selection at high latitudes <i>Vitesse de développement des amphibiens selon la latitude: Preuve pour une sélection diversifiée à haute latitude</i> Christopher B Edge^L, DG Thompson and JE Houlahan</p>
11h30-11h45	<p>Warmer climates weaken latitudinal gradients <i>Les réchauffements climatiques affaiblissent les répartitions latitudinales</i> Danielle Fraser^L, R Gorelick and N Rybczynski</p>
11h45-12h00	<p>An elaborate female trait varies with reproductive skew in the pukeko (<i>P. porphyrio melanotus</i>) <i>Un trait femelle complexe varie avec le biais reproductif chez le pukeko (P. porphyrio melanotus)</i> Cody J Dey, IG Jamieson and JS Quinn</p>

Contributed talks / Présentations orales

CPB 13 Biomechanics / *Biomécanique*

Location / endroit: SITE J0106

Chair / président: Doug Fudge

	Speaker / conférencier
11h00-11h15	Hummingbirds and insects use convergent mechanisms for flight control <i>Les les colibris et les insectes utilisent des mécanismes comparables pour le contrôle en vol</i> Douglas L Altshuler, EM Quicazain, PS Segre, KM Middleton
11h15-11h30	Time-varying motor control of autotomized gecko tails <i>Contrôle moteur de la queue du gecko suite à l'autotomie</i> Timothy E Higham and AP Russell
11h30-11h45	Effect of thermal acclimation on isometric force generation of isolated trout cardiac trabeculae <i>Effet de l'acclimatation thermique sur la génération de forces isométriques dans des cellules primaires de travées cardiaques chez la truite</i> Jordan M Klaiman and TE Gillis
11h45-12h00	Hyperbaric CT, a novel and useful tool for diving studies <i>CT hyperbare, un nouvel outil pour les études sous-marines</i> Andreas Fahlman and MJ Moore

Contributed talks / Présentations orales

CPB 14 Waste management and recycling: diverse approaches to nitrogen handling in animals
cont'd / *Gestion des déchets et recyclage : diverses approches pour l'acheminement de l'azote chez les animaux (suite)*

Location / endroit: SITE B0138 **Chair / président:** Danielle McDonald

	Speaker / conférencier
14h00-14h15	Evidence for transcriptional regulation of the urea transporter in the gill of the Gulf toadfish, <i>Opsanus beta</i> <i>Preuve de la régulation transcriptionnelle du transporteur de l'urée dans les branchies du batrachoidiforme Opsanus beta</i> Tammy Rodela, A Esbaugh, MD McDonald, KM Gilmour and PJ Walsh
14h15-14h30	Development of an in vitro model to study the neurotoxic effects of ammonia in the anoxia-tolerant goldfish (<i>Carassius auratus</i>) and ammonia-sensitive rainbow trout (<i>Oncorhynchus mykiss</i>) <i>Mise au point d'un modèle in vitro pour étudier les effets neurotoxiques de l'ammoniac chez un poisson tolérant à l'anoxie (Cyprin doré, Carassius auratus) et un poisson sensible à l'ammoniac (truite arc-en-ciel, Oncorhynchus mykiss)</i> Sanya Sidhu, LEJ Lee and MP Wilkie
14h30-14h45	Impact of hypoxia and ammonia on nutrient uptake by the gill, gut and skin of Pacific hagfish <i>Effet de l'hypoxie et de l'ammoniac sur la capture de nutriments par les branchies, les intestins et la peau de la myxine du Pacifique</i> Carol Bucking^P, CN Glover and CM Wood
14h45-15h00	Tolerance to brain swelling contributes to the high ammonia resistance of the anoxia-tolerance Crucian carp (<i>Carassius carassius</i>) <i>La tolérance au gonflement cérébral contribue à la forte résistance à l'ammoniac chez la carpe à la lune (Carassius carassius), un poisson tolérant l'anoxie</i> Michael P Wilkie, JAW Stecyk, C Couturier and GE Nilsson
15h00-15h15	The role of the colon in nitrogen balance in two chondrichthyan fishes, the ratfish, <i>Hydrolagus colliei</i> , and spiny dogfish, <i>Squalus acanthias</i> <i>Le rôle du côlon dans la régulation de l'azote chez deux poissons chondrichthyens, la chimère (Hydrolagus colliei) et l'aiguillat (Squalus acanthias)</i> W Gary Anderson, M Nawata, CM Wood, M Piercey-Normore and D Weihrauch
15h15-15h30	Diffusive gradients in the embryonic jelly mass of symbiotic <i>Ambystoma maculatum</i> are impacted by light and water pH during embryonic development <i>Gradients de diffusion dans la masse gélatineuse embryonnaire de l'Ambystoma maculatum symbiotique sont affectés par lumière et le pH de l'eau durant le développement de l'embryon</i> Kristin Bianchini, G Tattersall, C Porteus and PA Wright

Contributed talks / Présentations orales

CPB 15 Cellular/molecular regulatory mechanisms cont'd / *Mécanismes cellulaires/moléculaires régulateurs (suite)*

Location / endroit: SITE H0104

Chair / président: Todd Gillis

	Speaker / conférencier
14h00-14h15	Involvement of microRNA in the activation of Akt/PKB signaling in wood frog liver during freezing <i>Implication des micro-ARN lors de l'activation de la voie de signalisation Akt/PKB dans le foie de la grenouille des bois au moment de la congélation</i> Jing Zhang and KB Storey
14h15-14h30	Cross-species comparison of gene expression profiles in response to hypoxia in sculpins <i>Comparaison interspèce du profil d'expression génique en réponse à l'hypoxie chez le cottidé</i> Milica Mandic, ML Ramon, AY Gracey and JG Richards
14h30-14h45	Regulation of cellular and mitochondrial lipid uptake during hypoxia <i>Régulation de la prise de lipides par les cellules et les mitochondries lors de l'hypoxie</i> Andrea J Morash and AJ Murray
14h45-15h00	Evolution of metabolic responsiveness of cytochrome c oxidase genes <i>Évolution de la sensibilité métabolique du gène de l'oxydase du cytochrome c</i> Katrinka M Kocha, RM Mozes and CD Moyes
15h00-15h15	Inhibition of cellular cytotoxicity by channel catfish (<i>Ictalurus punctatus</i>) leukocyte immune-type receptors (IpLITRs) <i>Inhibition de la cytotoxicité par les récepteurs immunitaires des leucocytes chez la barbotte de rivière (Ictalurus punctatus)</i> Benjamin CS Montgomery, DN Burshtyn and JL Stafford
15h15-15h30	Induction of cellular signaling and immune effector functions by teleost immunoregulatory receptors <i>Induction de la signalisation cellulaire et des fonctions immunitaires par les récepteurs immunorégulateurs chez les téléostéens</i> James L Stafford, HD Cortes, BCS Montgomery and K Verheijen

Contributed talks / Présentations orales

Andy Spencer Memorial Symposium cont'd / *Symposium commémoratif Andy Spencer (suite)*

Location / endroit: SITE G0103

Chair / président: Warren Gallin

	Speaker / conférencier
14h00-14h30	Molecular evolution of HCN channels <i>Évolution moléculaire des canaux HCN</i> Eric Accili and H Jackson
14h30-15h00	The evolution and molecular physiology of voltage-gated calcium channels <i>Évolution et physiologie moléculaire des canaux calciques potentiel-dépendants</i> J David Spafford and A Senatore
15h00-15h30	Neurotransmitters in nudibranch statocysts: balancing reductionism <i>Les neurotransmetteurs dans les statocystes des nudibranches: réduction-nisme équilibré</i> Russell Wyeth

Contributed talks / Présentations orales

EEE 2 Climate change and biological interactions / *Changements climatiques et interactions biologiques*

Location / endroit: SITE A0150

Chair / président: Doug Morris

	Speaker / conférencier
14h00-14h15	Impact of hypoxia on the Greenland halibut (<i>Reinhardtius hippoglossoides</i>) <i>Impact de l'hypoxie chez le flétan du Groenland (Reinhardtius hippoglossoides)</i> Aurélien Prinnet-Dupont, M Vagner, D Chabot, Y Lambert and C Audet
14h15-14h30	Behaviour as biomarker? Contamination and movement in an invasive fish <i>Le comportement comme biomarqueur? Contamination et mouvement chez un poisson invasif</i> Julie R Marentette^L and S Balshine
14h30-14h45	Cold comfort: threshold temperatures mediate the impact of reduced snow cover on overwintering freeze tolerant caterpillars <i>Piètre consolation: les températures limites sont responsables des impacts d'une réduction de l'épaisseur de la neige sur les chenilles résistantes à la congélation hivernale</i> Katie E Marshall^L and BJ Sinclair
14h45-15h00	Studies on chemoreception in exotic rusty crayfish (<i>Orconectes rusticus</i>): learning and adaptation in novel aquatic ecosystems of Northwestern Ontario <i>Étude des chémorécepteurs chez l'écrevisse (Orconectes rusticus) : apprentissage et adaptation dans des nouveaux écosystèmes aquatiques au nord-ouest de l'Ontario</i> Cassidy Weisbord^L, DT Callaghan and GG Pyle
15h00-15h15	Invasive species (<i>Dreissena</i> , <i>Bythotrephes</i> , <i>Cercopagis</i>) depress major food source of fish in Lake Ontario: <i>Mysis diluviana</i> (the opossum shrimp) <i>Les espèces invasives (Dreissena, Bythotrephes, Cercopagis) diminuent les principales sources de nourritures dans le lac Ontario : Mysis diluviana (lacrevette opossum)</i> Ora E Johannsson, KL Bown, KT Holeck and MG Walsh
15h15-15h30	Global warming and competition for habitat by Arctic lemmings <i>Réchauffement climatique et compétition pour les habitats par les lemmings de l'Arctique</i> Douglas Morris and A Dupuch
15h30-15h45	Patch depletion behaviour differs between sympatric folivorous primates <i>Le comportement de la consommation de nourriture par parcelle diffère selon l'espèce de primates sympatriques folivores</i> Kaia J Tombak, AJ Reid, CA Chapman, JM Rothman, CA Johnson and R Reyna-Hurtado

Contributed talks / Présentations orales

CMD 3 Development and evolution / *Développement et évolution*

Location / endroit: SITE C0136

Chair / président: Louise Page

	Speaker / conférencier
14h00-14h15	Larval shell morphology and larval ecology in molluscs of the Gulf of St. Lawrence: is there evidence of change during the ocean warming of the last 10,000 yrs? <i>Morphologie des coquilles larvaires et écologie larvaire chez les mollusques dans le golfe du Saint-Laurent: les réchauffements océaniques des 10 000 dernières années ont-ils provoqué des changements importants?</i> Andre L Martel and P Bernatchez
14h15-14h30	How to rescue early vertebrate evolution from long-dead ancestors <i>Comment sauver l'évolution des vertébrés précoces à partir des ancêtres morts depuis longtemps</i> Tetsuto Miyashita^H
14h30-14h45	Modularity and evolvability among predatory gastropods with a biphasic life history <i>Capacité d'évolution et de résilience chez les gastéropodes carnassiers ayant un historique de vie biphasique</i> Louise Page
14h45-15h00	New information on the anatomy of the Triassic therapsid <i>Tetracynodon darti</i> , and the interrelationships of therocephalians <i>Nouvelle information sur l'anatomie du thérapside triasique (Tetracynodon darti), et les relations entre les Therocephalia</i> Trond Sigurdson, A Huttenlocker, T Rowe and S Modesto

Contributed talks / Présentations orales

CPB 16 Comparative endocrinology / *Endocrinologie comparative*

Location / endroit: SITE J0106

Chair / président: Nick Bernier

	Speaker / conférencier
14h00-14h15	Do ghrelin and nesfatin-1 interact to regulate feeding in goldfish? <i>La ghréline et la nesfatine-1 interagissent-elles pour contrôler la prise alimentaire chez le cyprin doré?</i> Brent Kerbel and S Unniappan
14h15-14h30	Nesfatin-1 regulates whole body energy homeostasis in rats <i>La nesfatine-1 contrôle l'homéostasie énergétique du corps entier chez le rat</i> Ronald Gonzalez, R Perry, R Tsushima, R Ceddia and S Unniappan
14h30-14h45	Gene expression profiles during natural metamorphosis in wild wood frog (<i>Lithobates sylvaticus</i>) tadpoles are similar to their laboratory counterparts <i>Les profils d'expression génique durant la métamorphose naturelle des têtards de grenouilles des bois sauvages (Lithobates sylvaticus) sont similaires à ceux observés en laboratoire</i> Laia Navarro-Martin, C Lanctot, C Edge, J Houlihan and V Trudeau
14h45-15h00	Regulation of the GH/IGF-I/IGFBP growth axis by the freshwater parasite (<i>Cryptobia salmositica</i>) in rainbow trout <i>Contrôle de l'axe de croissance GH/IGF-I/IGFBP par un parasite d'eau douce (Cryptobia salmositica) chez la truite arc-en-ciel</i> Barry Madison and NJ Bernier
15h00-15h15	The regulation of insulin-like growth factor 3 in the ovary of zebrafish <i>La régulation du facteur de croissance semblable à l'insuline 3 dans l'ovaire des poissons zèbres</i> David A Irwin and G Van Der Kraak
15h15-15h30	Molecular cloning, promoter activity analysis and discovery of a novel gonadotropin-releasing hormone transcript in the orange-spotted grouper (<i>Epinephelus coioides</i>) <i>Clonage moléculaire, analyse de l'activité du promoteur et découverte d'un nouveau produit de la transcription de la gonadolibérine chez le mérou brun (Epinephelus coioides)</i> Y-S Luo, X-C Liu, Y-Q Yang, H-R Lin, Z-Y Zhu and Wei Hu*

Cameron lecture / conférence du prix Cameron

Location / endroit: Marion AUD

Chair / président: Greg Goss, President

16h30-17h30	<p>Mechanism underlying the maturation of synaptic AMPA receptors in zebrafish</p> <p><i>Mécanismes de la maturation des récepteurs synaptiques AMPA chez le poisson zèbre</i></p> <p>Kessen Patten, University of Alberta</p>
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Women in science workshop / atelier des femmes en science

Location / endroit: DRO lounges

Chair / président: Katie Gilmour

17h30-18h30	<p>This workshop will feature a “speed-dating” session in which small groups of attendees will have the opportunity to chat briefly (10 min per date) with women in a variety of careers in science and at a variety of levels. The time available will allow for 4-5 dates per attendee. Confirmed “dates” include women in the upper administration of universities and of NSERC, journal editors, government researchers, women in science in government who are not researchers, teaching-oriented faculty, and university faculty juggling the demands of career and family.</p> <p><i>Cet atelier comportera une session de type ‘Rendez-vous Éclairs’ (speed dating) au cours de laquelle des petits groupes de congressistes auront l’opportunité de causer brièvement (10 minutes par rencontre) avec des femmes poursuivant divers types de carrière en sciences, à différents niveaux. Chaque congressiste aura suffisamment de temps pour 4-5 rencontres. Les « rendez-vous » confirmés incluent des femmes occupant des postes dans la haute administration des universités et du CRSNG, des éditrices de revues, des chercheurs gouvernementaux, des femmes de science dans les ministères qui ne sont pas en recherche, des membres du corps académique spécialisées en enseignement, et des membres du corps académique qui doivent conjuguer carrière et famille.</i></p>
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ZET event / conférence ZET

Biodiversity in the face of global climate change / La biodiversité face aux changements climatiques

Location / endroit: UCU AUD

Chair / président: Vance Trudeau

18h30-20h00	<p>Effects of climate change on amphibian populations</p> <p><i>Effets des changements climatiques sur les populations d’amphibiens</i></p> <p>Andrew Blaustein</p>
	<p>Biodiversity and bats</p> <p><i>Biodiversité et chauves-souris</i></p> <p>Brock Fenton</p>

Thursday, May 19th / jeudi, 19 mai**Summary of events / Le résumé d'événements**

	Events / les événements	Location / endroit
08h30-10h30	EEE symposium / symposium EEE PAR symposium / symposium PAR Contributed papers / présentations orales	SITE B0138 SITE A0150 SITE
10h30-11h00	Coffee / café	SITE Rotunda
11h00-12h30	Hoar award presentations / présentations du prix Hoar	Marion AUD
12h30-14h00	EEE lunch / dîner EEE PAR lunch / dîner PAR	CAREG 107 GNN 080
14h00-16h00	Contributed papers / présentations orales	SITE
16h00-16h30	Coffee / café	SITE Rotunda
16h30-17h30	Wardle lecture / conférence Wardle Teaching workshop / atelier d'enseignement	SITE B0138 MCD 146
18h30-	Banquet & awards / banquet et remise des prix	Canadian Museum of Nature

EEE Symposium / symposium EEE

Caribou conservation in Canada / La Conservation du Caribou au Canada

Location / endroit: SITE B0138

Chair / président: John Fryxell

	Speaker / conférencier
08h30-09h00	A perfect storm - conservation threats facing woodland caribou in Ontario <i>Une tempête parfaite – Les dangers qui menacent la conservation des caribous dans la forêt ontarienne</i> John Fryxell
09h00-09h30	The rise and fall of Newfoundland caribou at the turn of the 21st century <i>La montée et la chute des caribous de Terre-Neuve au tournant du 21^e siècle</i> Shane P Mahoney and James A Schaefer
09h30-10h00	Population dynamics of migratory caribou in a changing north <i>Les dynamiques des populations migratoires de caribous dans un nord changeant</i> Steeve Côté
10h00-10h30	A triage approach to caribou conservation <i>Une approche de triage pour la préservation des caribous</i> Stan Boutin

PAR Symposium / symposium PAR

Comparative aquatic parasitology and immunology / Parasitologie et Immunologie Aquatiques Comparatives

Location / endroit: SITE A0150

Chair / président: Todd Smith

	Speaker / conférencier
08h30-09h00	Immune responses to pathogens and parasites in ectothermic vertebrates <i>Réponse immunitaire aux pathogènes et aux parasites chez les vertébrés ectothermes</i> Brian Dixon
09h00-09h30	Pattern recognition receptors of rainbow trout <i>Récepteurs de reconnaissance des formes chez la truite arc-en-ciel</i> John S Lumsden, S Russell, K Young, M Edwards, A Peterson, A Reid
09h30-10h00	The secret life of lobsters: unravelling host-parasite interactions in our favourite crustacean <i>La vie cachée des homards: mise à nue des interactions entre les hôtes et les parasites chez notre crustacé préféré</i> Spencer Greenwood

Contributed talks / Présentations orales

CPB 17 Acid-base regulation / *Régulation acido-basique*

Location / endroit: SITE C0136

Chair / président: Steve Perry

	Speaker / conférencier
09h30-09h45	Physiological sensing of carbon dioxide, pH and bicarbonate <i>Détection physiologique du dioxyde de carbone, du pH et du bicarbonate</i> Martin Tresguerres
09h45-10h00	The physiological response of predicted future levels of atmospheric carbon dioxide on respiratory gas exchange and acid-base balance in the gulf toad-fish <i>Réponse physiologique aux niveaux estimés de dioxyde de carbone atmosphérique sur le système respiratoire d'échange de gaz et sur l'équilibre acido-basique chez le batrachodiforme</i> Andrew Esbaugh^P, R Heuer and M Grosell
10h00-10h15	Acid-base regulation in lamprey during hypercarbia; are all agnathans CO ₂ tolerant? <i>Régulation acido-basique chez la lamproie pendant l'hypercapnie; tous les agnathes sont-ils tolérants au CO₂?</i> Ryan B Shartau, D Baker, L Gaffney, D Close and CJ Brauner
10h15-10h30	Bicarbonate transport in tumour cell pH regulation and survival <i>Transport du bicarbonate pour le contrôle du pH et de la survie chez les cellules tumorales</i> Scott K Parks, J Chiche and J Pouyssegur

Contributed talks / Présentations oralesCPB 18 Translational studies / *Études traductionnelles***Location / endroit:** SITE J0106**Chair / président:** Mike Wilkie

	Speaker / conférencier
09h15-09h30	Dose-response curves of morphine in rainbow trout (<i>Oncorhynchus mykiss</i>) <i>Courbes dose-réponse de la morphine chez la truite arc-en-ciel</i> (<i>Oncorhynchus mykiss</i>) Sarah Jones and D Stevens
09h30-09h45	A comparison of holding environments for facilitating physiological recovery from capture stress in sockeye salmon <i>Comparaison d'environnements permettant de faciliter le rétablissement physiologique après le stress engendré par la capture chez le saumon rouge</i> Graham D Raby, S Wilson, MR Donaldson, SG Hinch and SJ Cooke
09h45-10h00	Physiological performance and environmental tolerance of four strains of diploid and triploid rainbow trout (<i>Oncorhynchus mykiss</i>) <i>Performance physiologique et tolérance environnementale chez quatre lignées de truites arc-en-ciel diploïdes et triploïdes</i> Mark A Scott, R Dhillon and JG Richards
10h00-10h15	The use of salmonid gut cell lines in the evaluation of plant derived materials and feed additives for aquaculture feed formulations <i>Utilisation de lignées cellulaires d'intestin de saumons pour évaluer des substances végétales et des agents additifs pour des formulations de nourriture utilisés par l'aquaculture</i> Robbie J Smith, NC Bols and LEJ Lee
10h15-10h30	Are you committed? Using oligonucleotide microarrays for gene expression profiling of American lobsters (<i>Homarus americanus</i>) <i>Êtes-vous engagé? Utilisation de puces à oligonucléotides pour analyser l'expression génique chez le homard américain</i> (<i>Homarus americanus</i>) Mitchell Moore, F Clark, A Acorn, M Comeau and S Greenwood

Contributed talks / Présentations orales

Hoar Award presentations / *présentations des prix Hoar*

Location / endroit: Marion AUD

Chair / président: Louise Milligan

	Speaker / conférencier
11h00-11h15	Free flying Swainsons thrushes (<i>Catharus ustulatus</i>) catabolize protein as a source of endogenous water <i>Les grives à dos olive catabolisent les protéines comme source endogène d'eau durant le vol</i> Alexander Gerson and CG Guglielmo
11h15-11h30	Surviving freezing: impacts on the immune system <i>Survivre à la congélation: les impacts sur le système immunitaire</i> Helen Holden and KB Storey
11h30-11h45	Distribution and expression analysis of transcription factors in tissues and progenitor cell populations of the goldfish (<i>Carassius auratus</i> L.) in response to growth factors and pathogens <i>Analyse de la distribution et de l'expression des facteurs de transcription dans des cellules et des tissus progéniteurs chez le cyprin doré (Carassius auratus L.) en réponse aux facteurs de croissance et aux pathogènes</i> Barbara A Katzenback, M Karpman and M Belosevic
11h45-12h00	The role of the ammonia transporter Rhcg1 in facilitating Na ⁺ uptake by zebrafish, <i>Danio rerio</i> , in acidic water <i>Rôle du transporteur de l'ammoniac Rhcg1 dans la facilitation de la prise de Na⁺ par le poisson zèbre (Danio rerio) en eau acide</i> Yusuke Kumai and SF Perry
12h00-12h15	Increased use of carbohydrates in Andean mice: a phylogenetic approach <i>Augmentation de la consommation d'hydrates de carbone chez les souris des Andes: une approche phylogénique</i> Marie-Pierre Schippers, O Ramirez, M Arana and GB McLelland
12h15-12h30	Patterns and consequences of metabolic suppression in a skipper butterfly in response to high daily thermal variability <i>Conséquences de l'inhibition métabolique en réponse à la grande variabilité de température journalière chez un Hesperidae</i> Caroline Williams, JJ Hellmann and BJ Sinclair

Contributed talks / Présentations oralesCPB 19 Metabolism II / *Métabolisme II***Location / endroit:** SITE B0138**Chair / président:** Yuxiang Wang

	Speaker / conférencier
14h00-14h15	The allosteric regulation of glutathione reductase in the freezing frog, <i>Rana sylvatica</i> <i>Régulation allostérique de la réductase du glutathion chez la grenouille congelée, Rana sylvatica</i> Neal J Dawson and KB Storey
14h15-14h30	Genomic and metabolic responses to methionine restriction: A comparison of carnivorous and omnivorous species <i>Réponse métabolique et génomique suite à la limitation de la méthionine : Une comparaison entre des espèces carnivores et omnivores</i> Paul M Craig and TW Moon
14h30-14h45	Does dietary fatty acid composition affect some classes of mitochondrial phospholipids more than others? <i>La composition des acides gras ingérés affecte-t-elle certaines classes de phospholipides mitochondriens plus que d'autres?</i> Nicolas Martin
14h45-15h00	The roles of succinate dehydrogenase and membrane remodeling during entrance into hibernation bouts <i>Rôle de la déshydrogénase du succinate sur le remodelage des membranes pendant l'entrée en hibernation</i> Dillon J Chung, GP Lloyd, RH Thomas, CC Guglielmo and JF Staples
15h00-15h15	The role of dietary PUFAs in white nose syndrome <i>Rôle de la prise alimentaire de PUFAs dans le syndrome du nez blanc</i> Craig L Frank, RM Brigham and TM Kunz
15h15-15h30	Changes in reactive oxygen species (ROS) production in liver and skeletal muscle during hibernation in thirteen-lined ground squirrels (<i>Ictidomys tridecemlineatus</i>) <i>Changement de la production d'espèces réactives de l'oxygène (ROS) dans le foie et les muscles squelettiques pendant l'hibernation de l'écureuil (Ictidomys tridecemlineatus)</i> Jason CL Brown, DJ Chung, KR Belgrave and JF Staples
15h30-15h45	Lessons in antioxidant defense from the anoxia tolerant crayfish <i>Défense antioxydante chez la langouste tolérante à l'anoxie</i> Benjamin Lant
15h45-16h00	Alternative strategies for exercise fuel use in mice selected for high locomotor activity <i>Stratégies alternatives pour l'utilisation du carburant pendant l'exercice chez des souris sélectionnées pour leur grande activité locomotrice</i> Nicole Templeman, H Schutz, T Garland and GB McClelland

Contributed talks / Présentations orales

CPB 20 Salinity tolerance, osmoregulation and regulation of salt/water balance / *Tolérance à la salinité, osmorégulation et régulation de l'équilibre sel/eau*

Location / endroit: SITE G0103

Chair / président: Carol Bucking

	Speaker / conférencier
14h00-14h15	A role for occludin in the regulation of paracellular permeability across fish gills <i>Rôle de l'occludine dans la régulation de la perméabilité paracellulaire dans les branchies de poisson</i> Helen Chasiotis and SP Kelly
14h15-14h30	Regulation of intestinal NaCl transport by bicarbonate and adenyl cyclases in killifish <i>Régulation du transport intestinal du NaCl par les bicarbonate et adénylate cyclases chez les cyprinodontiformes</i> Fernando Galvez, C Bodinier and M Tresguerres
14h30-14h45	Acclimation to ion-poor water alters the molecular physiology of tight junctions in pavement cells and mitochondria rich cells of the fish gill <i>L'accoutumance à de l'eau faible en ions altère la physiologie moléculaire des jonctions serrées des cellules riches en mitochondries chez les branchies de poisson</i> Dennis Kolosov, H Chasiotis, P Bui and SP Kelly
14h45-15h00	Do pink salmon possess a window of salinity tolerance associated with seawater entry? <i>Les saumons roses possèdent-ils une fenêtre de tolérance à la salinité associée à l'entrée d'eau de mer?</i> Zoe Gallagher, JS Bystriansky, AP Farrell and CJ Brauner
15h00-15h15	Seawater exposure differentially alters gill paracellular permeability and claudin mRNA abundance <i>in vitro</i> and <i>in vivo</i> <i>L'exposition à l'eau de mer altère la perméabilité paracellulaire des branchies et la quantité d'ARNm de claudine in vitro et in vivo</i> Bui Phuong and SP Kelly
15h15-15h30	The effect of dietary salt loading on the renin angiotensin and adrenergic systems of rainbow trout (<i>Oncorhynchus mykiss</i>) <i>Effet de la prise alimentaire de sel sur le système rénine-angiotensine et le système adrénergique chez la truite arc-en-ciel (Oncorhynchus mykiss)</i> Steve Perry, J Russell and NJ Bernier
15h30-15h45	Estrogen and osmoregulation in the goldfish (<i>Carassius auratus</i> L) <i>Estrogènes et osmorégulation chez le cyprin doré (Carassius auratus L)</i> Carolyn Arbanas, H Chasiotis and SP Kelly
15h45-16h00	The effects of senescence on adult sockeye blood plasma and gene expression <i>Effets de la sénescence sur le plasma sanguin et l'expression génique chez les saumons rouges adultes</i> Ken M Jeffries, SG Hinch and KM Miller

Contributed talks / Présentations oralesTeaching / *Enseignement***Location / endroit:** SITE A0150**Chair / président:** Tamara Kelly

	Speaker / conférencier
14h00-14h15	Ammonia excretion across the crab gill epithelium: A novel physiology teaching laboratory exercise <i>Excrétion de l'ammoniac à travers l'épithélium des branchies de crabe : Un nouvel exercice d'enseignement de la physiologie en laboratoire</i> Kevin Scott and D Weihrauch
14h15-14h30	Resuscitating the corpse: Transforming the laboratory experience in comparative vertebrate anatomy <i>Réussuciter les cadavres: Transformer l'expérience de laboratoire sur l'anatomie comparative des vertébrés</i> Anthony P Russell and HA Jamniczky
14h30-14h45	Teaching packages for undergraduate laboratory education <i>Trousse d'enseignement pour l'éducation en laboratoire chez les étudiants non-diplômés</i> Stephen Hunt
14h45-15h00	Promoting student engagement in large classes using Think-Pair-Share <i>Promouvoir l'implication des étudiants dans les classes nombreuses en utilisant le système Penser-Collaborer-Partager</i> Julie Clark
15h00-15h15	Ontario Consortium of Undergraduate Biology Educators (oCUBE): Using the unconference model for a community of practise <i>Consortium ontarien des éducateurs en biologie pour étudiants non-diplômés : Utiliser la conférence pluriparticipative comme modèle pour les communautés de pratique</i> Tamara LJ Kelly
15h15-15h30	Ontario Consortium of Undergraduate Biology Educators: Advancing the quality of undergraduate education in Ontario universities <i>Consortium ontarien des éducateurs en biologie pour étudiants non-diplômés: Accroître la qualité de l'éducation pour les étudiants non-diplômés dans les universités ontariennes</i> Colin J Montpetit

Contributed talks / Présentations orales

CPB 21 Invertebrate Physiology : Environmental adaptation / *Physiologie des invertébrés : Adaptation environnementale*

Location / endroit: SITE C0136

Chair / président: Mike O'Donnell

	Speaker / conférencier
14h00-14h15	Maintaining ion balance is crucial in the cold: physiological mechanisms setting the lower thermal limit of an insect <i>Maintenir un équilibre ionique est essentiel lorsqu'il fait froid: Mécanismes physiologiques déterminant la limite thermique la plus basse chez un insecte</i> Heath A MacMillan, CM Williams, JF Staples and BJ Sinclair
14h15-14h30	Cloning and expression of insect organic cation transporters (orct and orct2) from the fruit fly, <i>Drosophila melanogaster</i> Meigen <i>Clonage et expression des transporteurs de cations organiques des insectes (orct et orct2) chez la drosophile, Drosophila melanogaster Meigen</i> Brianne J Matier, N Sokal, D Theilmann and MR Rheault
14h30-14h45	Organic ion transport across the blood brain barrier in <i>Drosophila melanogaster</i> <i>Transport des ions organiques à travers la barrière hémato-encéphalique chez Drosophila melanogaster</i> Sara Seabrooke and M O'Donnell
14h45-15h00	Septate junction genes in transporting epithelia of larval <i>Aedes aegypti</i> : Effect of rearing salinity <i>Gène de jonctions cloisonnées dans le transport épithélial des larves de Aedes aegypti: Effets de l'élévation de la salinité</i> Sima Jonusaite, E Clelland, SP Kelly and A Donini
15h00-15h15	The cold tolerance strategy of the acorn weevil, <i>Curculio glandium</i> <i>La stratégie de résistance au froid chez le charançon des glands, Curculio glandium</i> Hiroko Udaka and BJ Sinclair
15h15-15h30	Iodine uptake mechanisms in the purple sea urchin <i>Mécanismes de la prise d'iode chez l'oursin violet</i> Ashley EM Miller and A Heyland

Contributed talks / Présentations orales

EEE 3 Social interactions / *Relations sociales*

Location / endroit: SITE J0106

Chair / président: Liz Boulding

	Speaker / conférencier
14h00-14h15	Social interactions, relatedness and population structure in a social cervid: implications for pathogen transmission <i>Relations sociales, contiguïté et structure populationnelle chez un cervidé social: implications dans la transmission de pathogènes</i> Jose A Andres, E Vander Wal and P Paquet
14h15-14h30	Jump-starting the dawn chorus: Male black-capped chickadees begin dawn singing earlier in response to song playback <i>Relance des concerts matinaux des oiseaux : Les mésanges à tête noire mâles commencent à chanter plus tôt en réponse à l'écoute d'un enregistrement du chant</i> Jennifer Foote, LP Fitzsimmons, DJ Mennill and LM Ratcliffe
14h30-14h45	Not-so-cooperative breeders make poor parents <i>Les éleveurs peu coopératifs font de mauvais parents</i> Constance M O'Connor^L, CJ Dey, J Dale and JS Quinn
14h45-15h00	Sex differences in group joining decisions in social fish <i>Différences sexuelles du comportement d'association chez les poissons sociaux</i> Adam R Reddon^L, D Balk and S Balshine
15h00-15h15	Electrocommunication playbacks and signal characterizations in a species of weakly electric fish, <i>Apteronotus leptorhynchus</i> <i>Enregistrement de la communication électrique et caractérisation des signaux chez une espèce de poissons faiblement électriques, Apteronotus leptorhynchus</i> Ginette Hupé and JE Lewis
15h15-15h30	Titration the effects of social familiarity and kinship on shoal-mate choice in young convict cichlids <i>Mesure des effets de la familiarité sociale et de la parenté sur le choix d'un partenaire chez de jeunes bagnards</i> Stacey SY Lee-Jenkins^L and J-GJ Godin

Wardle lecture / conférence Wardle

Location / endroit: SITE B0138

Chair / président: Todd Smith

16h30- 17h30	Digenea, Diversity and DNA <i>Digenea, diversité et ADN</i> J Daniel McLaughlin , Concordia University
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Teaching workshop / atelier d'enseignement

Location / endroit: MCD 146

Chair / président: Colin Montpetit

16h30- 17h30	Improving achievement, retention and equity in undergraduate biology courses <i>Accroître la réussite, la persévérance et l'équité chez les étudiants non-diplômés en biologie</i> Craig E Nelson
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Friday, May 20th / vendredi, 20 mai**Summary of events / Le résumé d'événements**

	Events / les événements	Location / endroit
08h30-12h30	<p>Teaching workshop (CSZ event in partnership with the Centre for University Teaching) / atelier pédagogique (SCZ en collaboration avec le Centre de pédagogie universitaire)</p> <p>Improving Achievement, Retention and Equity in Undergraduate Biology Courses / Améliorer le rendement, la rétention, et l'équité dans l'enseignement de la biologie pour les cours de première année</p> <p>Craig Nelson</p> <p>(note – this event is free of charge but registration by e-mail to centre@uOttawa.ca is required / Veuillez noter que l'inscription est gratuite et nous vous prions de confirmer votre présence en vous inscrivant par courriel à centre@uOttawa.ca)</p>	Jazzy Restaurant (UCU)
09h30-14h30	Guided visit to the scientific collections of the Canadian Museum of Nature / Une visite guidée du Musée canadien de la nature	CMN – Gatineau, Québec
10h00-12h30	Council meeting / réunion du conseil	GNN 080

Posters / Affiches

Posters with even numbers will be presented from 18h30 to 19h30 / *Les affiches avec des nombres pairs seront présentées entre 18h30 et 19h30.* Posters with odd numbers will be presented from 19h30 to 20h30 / *Les affiches avec des nombres impairs seront présentées entre 19h30 et 20h30.*

Please note / Veuillez prendre note:

* indicates the poster presenter if not the first author / * indique le présentateur d'affiche s'il n'est pas le premier auteur

[n] indicates the poster board number / [n] indique le numéro d'affiche

B indicates a competitor for the Battle award / B indique un compétiteur pour le prix Battle

L indicates a competitor for the Lindsey award / L indique un compétiteur pour le prix Lindsey

H indicates a competitor for the Holeton award / H indique un compétiteur pour le prix Holeton

CMD

1. **MORPHOLOGICAL INDICATES OF CRYPTIC FEMALE CHOICE AS REVEALED BY COMPARING THE REPRODUCTIVE GLANDS OF EIGHT PREVIOUSLY UNDESCRIBED SPECIES OF BLOOD-FEEDING HEMIPTERA [1]**

INDICATEURS MORPHOLOGIQUES DU CHOIX CRYPTIQUE FEMELLE TEL QUE RÉVÉLÉ PAR LA COMPARAISON DES GLANDES REPRODUCTRICES DE HUIT ESPÈCES D'HÉMIPTÈRES HÉMATOPHAGES ENCORE NON-CARACTÉRISÉE

Gary Chiang and JA Chiang

2. **INTERSPECIFIC SCALING OF LIMB BONES IN EXTANT REPTILES WITH IMPLICATIONS FOR BODY-MASS ESTIMATION [2]**

ÉCHELONNAGE INTERSPÉCIFIQUE DES OS DES MEMBRES CHEZ DES REPTILES AVEC DES IMPLICATIONS POUR UNE ESTIMATION DE LA MASSE CORPORELLE

Nicolas E Campione and DC Evans

3. **FORELIMB MORPHOLOGY OF A FOSSIL STEM PINNIPED, PUIJILA DARWINI, FROM THE CANADIAN HIGH ARCTIC [3]**

MORPHOLOGIE DES PATTES ANTÉRIEURES D'UN PINNIPÈDE FOSSILE (PUIJILA DARWINI) DE L'EXTRÊME ARTIQUE CANADIEN

Joanna M Northover, NR Rychynski* and C Schröder-Adams

4. **DESCRIPTION OF A FEMALE ENALIARCTOS EMLONGI (CARNIVORA, PINNIPEDIA) FROM THE MIOCENE OF WESTERN OREGON AND IMPLICATIONS FOR THE EVOLUTION OF PINNIPED MATING SYSTEMS [4]B**

DESCRIPTION D'UNE FEMELLE ENALIARCTOS EMLONGI (CARNIVORA, PINNIPEDA) DU MIOCÈNE DE L'OUEST DE L'OREGON ET LES IMPLICATIONS CONSÉQUENTES DANS L'ÉVOLUTION DES SYSTÈMES DE REPRODUCTION DES PINNIPÈDES

Thomas Cullen, N Rybczynski and C Schröder-Adams

5. **HMGCR PATHWAY IS NECESSARY FOR CEREBRAL-VASCULAR STABILITY AND ANGIOGENESIS DURING VERTEBRATE DEVELOPMENT [5]B**

LA VOIE HMGCR, UNE NÉCESSITÉ POUR LA STABILITÉ CÉRÉBRO-VASCULAIRE ET L'ANGIOGÉNÈSE LORS DU DÉVELOPPEMENT DES VERTÉBRÉS

Shahram Eisa-Beygi, G Hatch, M Ekker and TW Moon

6. **INVESTIGATING THE INDUCTION OF THE CONJUNCTIVAL PAPILLAE IN CHICKEN EMBRYOS WILL SHED LIGHT ON PATTERNING OF DERMAL BONES [6]B**
L'ÉTUDE DE L'INDUCTION DE LA PAPILLE CONJONCTIVALE CHEZ DES EMBRYONS DE POULET PERMETTRA DE CLARIFIER LES PATRONS DES OS DERMiques
 Karyn Jourdeuil, T Franz-Odenaal

7. **INFLUENCE OF DIFFERENTIAL DIETS ON THE GROWTH OF JUVENILE LEOPARD GECKOS (EUBLEPHARIS MACULARIUS) [7]**
L'INFLUENCE DE DIÈTES DIFFÉRENTIELLES SUR LA CROISSANCE DE GECKOS LÉOPARDS JUVÉNILES (EUBLEPHARIS MACULARIUS)
 Anthony P Russell and SE Hynes

8. **BETA-PARVIN FACILITATES CONVERGENT EXTENSION IN XENOPUS EMBRYOS [8]**
LA BÊTA-PARVINE FACILITE L'EXTENSION CONVERGENTE CHEZ DES EMBRYONS DE XENOPUS
 Catherine Studholme and M Marsden

9. **MODEL OF SEGMENT FORMATION AND RAY BRANCHING IN ZEBRAFISH CAUDAL FINS [9]**
MODÈLES DE FORMATION DE SEGMENTS ET DE RAMIFICATIONS DES RAYONS DANS LES NAGEOIRES CAUDALES DE POISSON ZÈBRE
 Valerie Tweedle, V Lefebvre, M-A Akimenko and A-G Rolland-Lagan

10. **EXPLORING HAGFISH SLIME THREAD PRODUCTION: ANCIENT SOLUTIONS TO MODERN PROBLEMS [10]B**
L'EXPLORATION DE LA PRODUCTION DE FILAMENTS DE MUCUS CHEZ LA MYXINE: D'ANCIENNES SOLUTIONS POUR DES PROBLÈMES MODERNES
 Timothy M Winegard and DS Fudge

PAR

11. **DEVELOPMENT OF AN IN VITRO INFECTION MODEL FOR LOMA MORHUA, A MICROSPORIDIAN PARASITE OF THE ATLANTIC COD, GADUS MORHUA [11]**
DÉVELOPPEMENT D'UN MODÈLE D'INFECTION IN VITRO POUR LOMA MORHUA, UN PARASITE MICROSPORIDIEN DE LA MORUE DE L'ATLANTIQUE, GADUS MORHUA
 Mike J MacLeod, R Rumney, SR Monaghan, A Frenette, M Duffy and LEJ Lee

12. **DO PARASITES MIX? WATER MITE AND GREGARINE COINFECTION IN LESTID DAMSELFLIES [12]B**
LES PARASITES SE MÉLANGENT-ILS? COINFECTION D'HYDRACHNES ET DE GRÉGARIENS CHEZ LES DEMOISELLES LESTIDES
 André W Morrill, MR Forbes and JJ Mlynarke

13. **PARASITISM, MERCURY CONTAMINATION AND STABLE ISOTOPES IN CORMORANTS [13]**
PARASITISME, CONTAMINATION AU MERCURE ET ISOTOPES STABLES CHEZ LES CORMORANS
 Stacey A Robinson, MR Forbes and CE Hebert

14. **ROLE OF TEMPERATURE ON THE TRANSMISSION AND IMPACT OF A PARASITE TO ITS HOST [14]B**
LE RÔLE DE LA TEMPÉRATURE SUR LA TRANSMISSION ET L'IMPACT D'UN PARASITE SUR SON HÔTE
 Kum C Shim and M Forbes

EEE

15. QUANTIFYING INDIVIDUAL VARIATION IN AGGRESSION IN APTERONOTUS LEPTORHYNCHUS: A BEHAVIOURAL SYNDROME APPROACH [15]

QUANTIFIER LA VARIATION INDIVIDUELLE DE L'AGRESSION CHEZ APTERONOTUS LEPTORHYNCHUS: UNE APPROCHE BASÉE SUR LE SYNDROME COMPORTEMENTAL

Isabelle Shank, G Hupé and JE Lewis

16. LEARNING NOT TO FEAR: ACQUIRED RECOGNITION OF NON-RISK BY JUVENILE CONVICT CICHLIDS [16]L

APPRENDRE À NE PAS AVOIR PEUR: RECONNAISSANCE ACQUISE DU NON-RISQUE PAR DES CICHLIDÉS FORÇATS JUVÉNILES

Patrick M Barks and J-GJ Godin

17. EFFECT OF PREDATOR DIET ON PREDATOR-INDUCED CHANGES IN LIFE HISTORY AND PERFORMANCE OF ANURAN LARVAE [17]

EFFET DE LA DIÈTE DES PRÉDATEURS SUR LES CHANGEMENTS INDUITS PAR LES PRÉDATEURS DANS L'HISTOIRE DE LA VIE ET LA PERFORMANCE DES LARVES D'ANOURES

Rayan El Balaa and G Blouin-Demers

18. PHEROMONE RECOGNITION AND MATING SUCCESS IN HAWAIIAN AND THAI POPULATIONS OF DIPLOPTERA PUNCTATA [18]

RECONNAISSANCE DES PHÉROMONES ET SUCCÈS REPRODUCTEUR DANS LES POPULATIONS HAWAIIENNE ET THAÏLANDAISE DE DIPLOPTERA PUNCTATA

Jasmine Farhan and J McNeil

19. ROVER/SITTER VARIATION IN THE FORAGING GENE ALSO INFLUENCES OVIPOSITION IN DROSOPHILA MELANOGASTER [19]BL

LA VARIATION ROVER/SITTER DANS LE GÈNE DE RECHERCHE DE NOURRITURE INFLUENCE AUSSI L'OVIPOSITION CHEZ DROSOPHILA MELANOGASTER

Chris CW Chen, MW McConnell, MJ Fitzpatrick

20. DOES GENE FLOW IMPEDE ADAPTATION? AN ARTIFICIAL SELECTION DROSOPHILA MODEL [20]

EST-CE QUE LE FLUX GÉNÉTIQUE ENTRAVE L'ADAPTATION? UN MODÈLE DE SÉLECTION ARTIFICIELLE CHEZ LA DROSOPHILE

Justin P Saindon and BJ Sinclair

21. THE RELATIONSHIP BETWEEN LONG DISTANCE ATTRACTION CALLS AND COURTSHIP CALLS ON MATING SUCCESS IN A FIELD CAUGHT CRICKET, GRYLLUS PENNSYLVANICUS [21]

LA RELATION ENTRE LES APPELS D'ATTRACTION DE LONGUE DISTANCE ET DE COURTISANERIE SUR LE SUCCÈS REPRODUCTEUR CHEZ UN CRIQUET DES CHAMPS, GRYLLUS PENNSYLVANICUS

Caitlin M Grant, IR Thompson, SJ Harrison and SM Bertram

22. FLIGHT AND FATTY ACID UTILISATION: LIPID PROFILES OF THE TRUE ARMYWORM (PSEUDALETIA UNIPUNCTA) UNDER MIGRATION CONDITIONS [22]

VOL ET UTILISATION DES ACIDES GRAS: PROFILS LIPIDIQUES DE LA LÉGIONNAIRE UNIPONCTUÉE (PSEUDALETIA UNIPUNCTA) DANS DES CONDITIONS DE MIGRATION

Angela Marinas and J McNeil

23. VARIATION IN CRICKET ACOUSTIC MATE ATTRACTION SIGNALING EXPLAINED BY BODY MORPHOLOGY AND METABOLIC DIFFERENCES [23]

LA VARIATION DES SIGNAUX ACOUSTIQUES D'ATTRACTION CHEZ LE CRIQUET PEUT ÊTRE EXPLIQUÉE PAR LA MORPHOLOGIE DU CORPS AINSI QUE DES DIFFÉRENCES MÉTABOLIQUES

Ian R Thomson, SM Bertram, C-A Darveau, JW Dawson and B Auguste

24. USING EIGENSHAPE ANALYSIS OF LOWER CHEEK TEETH IN ORDER TO INVESTIGATE THE TAXONOMY OF PLIOCENE FOSSIL RABBITS [24]B

UTILISATION DE L'ANALYSE EIGENSHAPE DES DENTS JUGALES INFÉRIEURES AFIN DE FAIRE L'ÉTUDE DE LA TAXONOMIE DES LAPINS FOSSILES DU PLIOCÈNE

Danielle Dionne and WT Mitchell

CPB

25. COST OF BREATHING IN TURTLES: AN INVESTIGATION OF THE METHODS, THEIR ESTIMATES AND CALCULATING THE TRUE COSTS [25]BH

LE COÛT DE LA RESPIRATION CHEZ LES TORTUES: UNE ÉTUDE DES MÉTHODES, LEURS ESTIMÉS ET LES CALCULS DES COÛTS RÉELS

Stella Y Lee and WK Milsom

26. CONTROL AND DEVELOPMENT OF AQUATIC SURFACE RESPIRATION BEHAVIOUR IN ZEBRAFISH, DANIO RERIO [26]

CONTRÔLE ET DÉVELOPPEMENT DU COMPORTEMENT DE RESPIRATION AQUATIQUE EN SURFACE CHEZ LE POISSON ZÈBRE, DANIO RERIO

Sara Abdallah, E Hristova and MG Jonz

27. OXYGEN-DEPENDENT CHANGES IN SKIN NEUROEPITHELIAL CELLS AND THE HYPOXIC VENTILATORY RESPONSE IN DEVELOPING ZEBRAFISH, DANIO RERIO [27]BH

CHANGEMENTS DÉPENDANTS DE L'OXYGÈNE DANS LES CELLULES NEUROÉPITHÉLIALES DE LA PEAU ET RÉPONSE VENTILATOIRE HYPOXIQUE CHEZ LE POISSON ZÈBRE EN DÉVELOPPEMENT, DANIO RERIO

Maria L Coccimiglio and MG Jonz

28. DOPAMINERGIC NEURON REGENERATION IN THE GOLDFISH BRAIN: A MODEL FOR PARKINSON'S DISEASE [28]BH

REGÉNÉRATION DES NEURONES DOPAMINERGIQUES DANS LE CERVEAU DES POISSONS ROUGES: UN MODÈLE POUR LA MALADIE DE PARKINSON'S

Maddie Waddell, VL Trudeau, A Basak and P Wagh

29. EFFECTS OF SEROTONIN ON PREOPTIC NEURONS IMPLICATED IN THE CONTROL OF MALE GOLDFISH REPRODUCTION [29]

EFFETS DE LA SÉROTONINE SUR LES NEURONES PRÉOPTIQUES IMPLIQUÉS DANS LE CONTRÔLE DE LA REPRODUCTION DES POISSONS ROUGES MÂLES

Agnes Crnic, W Lado, J Mennigen, JE Lewis and V Trudeau

30. GENE EXPRESSION PROFILES OF MALE GOLDFISH EXPOSED TO THE PRIMING SEX PHEROMONE, 17-ALPHA,20-BETA-DIHYDROXY-4-PREGNEN-3-ONE [30]BH

PROFILS D'EXPRESSION GÉNÉTIQUE DE POISSONS ROUGES MÂLES EXPOSÉS À LA PHÉROMONE D'AMORCE SEXUELLE 17-ALPHA, 20-BÊTA-DIHYDROXY-4-PREGNEN-3-ONE

WE Lado, JA Mennigen, J Zamora, JP Popesku, E Pranckeviciene, X Xia, JE Lewis and VL Trudeau

31. PARTIAL CLONING OF CARDIAC PACEMAKER PROTEINS FROM THE MOST ANCESTRAL EXTANT CHORDATE, THE HAGFISH [31]BH

CLONAGE PARTIEL DES PROTÉINES CARDIAQUE "PACEMAKER" DE LA FORME LA PLUS ANCESTRALE DE CHORDÉ ENCORE EXISTANTE, LA MYXINE

Christopher M Wilson, JAW Stecyk, CS Couturier, GE Nilsson and AP Farrell

32. MOTION PARALLAX BEHAVIOUR IN WEAKLY ELECTRIC FISH [32]BH

COMPORTEMENT DE LA PARALLAXE DE MOUVEMENT CHEZ LES POISSONS FAIBLEMENT ÉLECTRIQUES

Colleen Young and JE Lewis

33. INNERVATION OF MITOCHONDRIA RICH CELLS IN THE GOLDFISH (CARASSIUS AURATUS) EXPERIENCING GILL REMODELLING [33]

INNERVATION DES CELLULES RICHES EN MITOCHONDRIES CHEZ LE POISSON ROUGE (CARASSIUS AURATUS) PENDANT LE REMODELAGE DES BRANCHIES

Velislava Tzaneva, C Vadeboncoeur and SF Perry

34. THERMOREGULATION IN THE BEARDED DRAGON (POGONA VITTICEPS): THE ROLE OF TRPM8 IN TEMPERATURE SENSATION [34]BH

THERMORÉGULATION CHEZ LE DRAGON BARBU (POGONA VITTICEPS): LE RÔLE DE TRPM8 DANS LA SENSATION DE LA TEMPÉRATURE

Jacob M Berman and GJ Tattersall

35. NEUROANATOMY OF THE HERMISSENDA CENTRAL NERVOUS SYSTEM: GABA, HISTAMINE, AND FMRFAMIDE IMMUNOREACTIVITY [35]BH

NEUROANATOMIE DU SYSTÈME NERVEUX CENTRAL D'HERMISSENDA: IMMUNORÉACTIVITÉ DE GABA, HISTAMINE ET FMRFAMIDE

Marissa P Webber and RC Wyeth

36. AMMONIUM SECRETION BY INSECT MALPIGHIAN TUBULES: APPLICATION OF A NOVEL AMMONIUM-SELECTIVE MICROELECTRODE [36]H

SÉCRÉTION D'AMMONIUM PAR LES TUBULES DE MALPIGHI DES INSECTES : APPLICATION D'UNE NOUVELLE MICROÉLECTRODE SÉLECTIVE À L'AMMONIUM

Austin A Browne and MJ O'Donnell

37. INSIGHTS INTO THE MECHANISM OF REGULATION OF T-TYPE CALCIUM CHANNELS USING THE IN-VERTEBRATE GENE LCAV3, FROM THE POND SNAIL, LYMNAEA STAGNALIS [37]BH

APERÇUS DES MÉCANISMES DE RÉGULATION DES CANAUX CALCIQUES DE TYPE T AVEC L'UTILISATION DU GÈNE D'INVERTÉBRÉ LCAV3, CHEZ L'ESCARGOT D'EAU DOUCE, LYMNAEA STAGNALIS

Adriano Senatore and JD Spafford

38. NEUROCHEMICAL CHARACTERIZATION OF A CIRCADIAN TIMING NETWORK: PUTATIVE COMMUNICATION PATHWAYS BETWEEN THE CIRCADIAN AND NEUROENDOCRINE SYSTEMS IN THE BRAIN OF RHODNIUS PROLIXUS (HEMIPTERA) [38]

CARACTÉRISATION NEUROCHIMIQUE D'UN RÉSEAU CIRCADIEN: VOIES DE COMMUNICATION PUTATIVES ENTRE LES SYSTÈMES CIRCADIENS ET NEUROENDOCRINIENS DANS LE CERVEAU DE RHODNIUS PROLIXUS (HEMIPTERA)

Martha Hindley-Smith

39. Na⁺/K⁺-ATPASE TRAFFICKING IN CONTROL AND HEAT SHOCKED LOCUSTS [39]BH

TRAFIC DE Na⁺/K⁺-ATPASE SOUS CONTRÔLE ET LOCUSTES EN CHOC THERMIQUE

Nicholas Y Hou, GAB Armstrong, and RM Robertson

- 40. OXYGEN EXCHANGE IN THE GOLDENROD BALL GALL IS FACILITATED BY PITH DRYING [40]**
L'ÉCHANGE D'OXYGÈNE CHEZ LA GALE DE LA VERGE D'OR EST FACILITÉ PAR LA DÉSHYDRATATION DE LA RÉSINE
 Qian Long and GJ Tattersall
- 41. PERFORMANCE TRADE-OFFS AND ENERGY UTILIZATION IN NEURAL CIRCUITS FOLLOWING METABOLIC STRESS [41]**
COMPROMIS DE PERFORMANCE ET UTILISATION DE L'ÉNERGIE DANS LES CIRCUITS NEURAUX SUITE À UN STRESS MÉTABOLIQUE
 Tomas GA Money, EJ Pollock, K Inozemtsev and RM Robertson
- 42. HYPOTHERMIA PROTECTS THE NERVOUS SYSTEM FROM REPETITIVE SPREADING DEPRESSION IN DROSOPHILA [42]BH**
L'HYPOTHERMIE PROTÈGE LE SYSTÈME NERVEUX CONTRE LA PROPAGATION RÉCURRENTÉ DE LA DÉPRESSION CHEZ LA DROSOPHILE
 EC Rodriguez and RM Robertson
- 43. A STICKY SITUATION: HOW DO ALPINE PHASMIDS SURVIVE COLD AND DESICCATION [43]BH**
AVOIR DES ENNUIS: COMMENT LES PHASMIDES ALPINS SURVIVENT-ILS LE FROID ET LA DESSICATION?
 Litza E Coello and BJ Sinclair
- 44. BLOCKADE OF GAP JUNCTIONS INDUCES REPETITIVE SPREADING DEPRESSION-LIKE EVENTS IN THE LOCUST CNS [44]BH**
LE BLOCAGE DES JONCTIONS GAP INDUIT LA PROPAGATION RÉCURRENTÉ D'ÉVÉNEMENTS DE TYPE DÉPRESSIF CHEZ LE LOCUSTE CNS
 Kristin E Spong, CI Rodgers-Garlick and RM Robertson
- 45. OVERWINTERING PHYSIOLOGY THROUGH THE DIFFERENT LIFE STAGES OF A MONTANE WILLOW LEAF BEETLE, CHRYSOMELA AENEICOLLIS [45]BH**
PHYSIOLOGIE DE L'HIVERNAGE AU COURS DES DIFFÉRENTS STADES DE VIE CHEZ UN CALLIGRAPHE DU SAULE MONTAGNAIS, CHRYSOMELA AENEICOLLIS
 Evelyn C Boychuk and BJ Sinclair
- 46. OCTOPAMINE ATTENUATES HYPOXIA-INDUCED REDUCTION OF AXONAL CONDUCTION VELOCITY IN A VISUAL INTERNEURON [46]BH**
L'OCTOPAMINE ATTÉNUÉ LA RÉDUCTION DE VITESSE DE CONDUCTION AXONALE INDUITE PAR L'HYPOXIE DANS UN INTERNEURONE VISUEL
 Michael KJ Sproule, TGA Money and RM Robertson
- 47. NUCLEOBINDIN-2 IN NON-MAMMALIAN VERTEBRATES: MOLECULAR, CELLULAR AND PHYSIOLOGICAL EVIDENCE FOR THE ANOREXIGENIC ACTIONS OF AN ENDOGENOUS FORM OF NESFATIN-1 IN GOLDFISH, CARASSIUS AURATUS [47]**
LA NUCLÉOBINDINE-2 CHEZ LES VERTÉBRÉS NON-MAMMIFÈRES: INDICES MOLÉCULAIRES, CELLULAIRES ET PHYSIOLOGIQUE DE L'ACTION ANOREXIGÈNE DE LA NESFATINE-1 ENDOGÈNE CHEZ LE POISSON ROUGE (CARASSIUS AURATUS)
 Ronald Gonzalez, B Kerbe, A Chun and S Unniappan
- 48. LEPTIN AND HSP70 IN GREY SEALS: THE EFFECTS OF FEEDING AND FASTING [48]BH**
LA LEPTINE ET HSP70 CHEZ LES PHOQUES GRIS: L'IMPACT DE L'ALIMENTATION ET DU JEÛNE
 Ian MacMillan, KA Bennett and S Currie

- 49. NESFATIN-1 CO-LOCALIZES APPETITE REGULATORY GASTROINTESTINAL HORMONES IN RATS [49]**
 BH
LA NESFATINE-1 CO-LOCALISE DES HORMONES GASTRO-INTESTINALES IMPLIQUÉES DANS LA RÉGULATION DE L'APPÉTIT CHEZ LES RATS
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- 50. PEPTIDE YY INHIBITS ENERGY INTAKE AND PROMOTES FAT UTILIZATION IN RATS [50]BH**
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- 121. ESTABLISHMENT OF LONG-TERM HEMATOPOIETIC CULTURES FROM HEPATIC TISSUES OF JUVENILE WALLEYE, SANDER VITREUS [121]BH**
ÉTABLISSEMENT DE CULTURES HÉMATOPOÏÉTIQUES À LONG TERME À PARTIR DE TISSUS DE DORÉS JAUNES JUVÉNILES, SANDER VITREUS
 Nguyen TK Vo, JS Lumsden, B Dixon, LEJ Lee and NC Bols

TALKS / PRÉSENTATIONS ORALES

Please note / Veuillez prendre note:

* indicates the presenter if not the first author / *indique le présentateur s'il n'est pas le premier auteur
[ABCn] indicates the session in which the talk will occur / [ABCn] indique la séance à laquelle la présentation aura lieu

F indicates a competitor for the Fallis award / *F* indique un compétiteur pour le prix Fallis

H indicates a competitor for the Hall award / *H* indique un compétiteur pour le prix Hall

L indicates a competitor for the Lindsey award / *L* indique un compétiteur pour le prix Lindsey

P indicates a competitor for the PDF award / *P* indique un compétiteur pour le prix PDF

Symposia, workshops and contributed sessions / Symposium, ateliers et séance spéciale

- CMD S CMD symposium – Regeneration: Developmental and Evolutionary Perspectives / *Régénération : Perspectives développementales et évolutives* (8h30 Tues in SITE B0138)
- CMD1 Regeneration and development / *Regénération et développement* (11h00 Tues in SITE A0150)
- CMD2 Student Satellite Symposium – New perspectives on adaptation to environmental variation via epigenetic mechanisms / *Symposium satellite d'étudiants : Nouvelles perspectives sur l'adaptation à la variation environnementale via des mécanismes épigénétiques* (14h00 Tues in SITE A0150)
- CMD3 Development and evolution / *Développement et évolution* (14h00 Wed in SITE C0136)
-
- CPB S CPB symposium – Waste management and recycling: diverse approaches to nitrogen handling in animals / *Gestion des déchets et recyclage : différentes approches de prise en charge de l'azote chez les animaux* (8h30 Wed in SITE B0138)
- CPB1 Toxicology I – Heavy metals / *Toxicologie - métaux lourds* (9h00 Tues in SITE H0104)
- CPB2 Chemosensing and chemosensory cells / *Chémodétection et cellules chémosensibles* (9h30 Tues in SITE G01033)
- CPB3 Metabolism I / *Métabolisme I* (11h00 Tues in SITE B0138)
- CPB4 Toxicology II – Heavy metals and nanoparticles / *Toxicologie II – Métaux lourds et nanoparticules* (11h00 Tues in SITE H0104)
- CPB5 Chemosensing and chemosensory cells cont'd / *Chémodétection et cellules chémosensibles (suite)* (11h00 Tues in SITE G01033)
- CPB6 Invertebrate physiology: Regulation and homeostasis / *Physiologie des invertébrés : régulation et homéostasie* (11h00 Tues in SITE C0136)
- CPB7 Anoxia and hypoxia responses and tolerance / *Réponses et tolérance à l'anoxie et hypoxie* (14h00 Tues in SITE B0138)
- CPB8 Toxicology III – Pollutants and pharmaceuticals / *Toxicologie III – Polluants et produits pharmaceutiques* (14h00 Tues in SITE H0104)
- CPB9 Ion transport mechanisms / *Mécanismes de transport ionique* (14h00 Tues in SITE G0103)
- CPB10 Waste management and recycling: diverse approaches to nitrogen handling in animals cont'd / *Gestion des déchets et recyclage : différentes approches de prise en charge de l'azote chez les animaux (suite)* (11h00 Wed in SITE B0138)
- CPB11 Cellular/molecular regulatory mechanisms / *Mécanismes de régulation cellulaire et moléculaire* (11h00 Wed in SITE H0104)
- CPB12 Stress / *Stress* (11h00 Wed in SITE A0150)
- CPB13 Biomechanics / *Biomécanique* (11h00 Wed in SITE J0106)
- CPB14 Waste management and recycling: diverse approaches to nitrogen handling in animals cont'd / *Gestion des déchets et recyclage : différentes approches de prise en charge de l'azote chez les animaux (suite)* (14h00 Wed in SITE B0138)
- CPB15 Cellular/molecular regulatory mechanisms cont'd / *Mécanismes cellulaires/moléculaires régulateurs (suite)* (14h00 Wed in SITE H0104)
- CPB16 Comparative endocrinology / *Endocrinologie comparative* (14h00 Wed in SITE J0106)
- CPB17 Acid-base regulation / *Régulation acido-basique* (9h30 Thurs in SITE C0136)
- CPB18 Translational studies / *Études traductionnelles* (9h15 Thurs in SITE J0106)
- CPB19 Metabolism II / *Métabolisme II* (14h00 Thurs in SITE B0138)
- CPB20 Salinity tolerance, osmoregulation and regulation of salt/water balance / *Tolérance à la salinité, osmoré-*

- gulation et régulation de l'équilibre sel/eau* (14h00 Thurs in SITE G0103)
- CPB21 Invertebrate physiology: Environmental adaptation / *Physiologie des invertébrés : Adaptation environnementale* (14h00 Thurs in SITE C0136)
- EEE-CPB joint session – Behavioural and ecological physiology / *Physiologie comportementale et écologique* (14h00 Tues in SITE C0136)
- EEE S EEE symposium – Caribou conservation in Canada / *La Conservation du Caribou au Canada* (8h30 Thurs in SITE B0138)
- EEE1 Selection / *Sélection* (11h00 Wed in SITE C0136)
- EEE2 Climate change and biological interactions / *Changements climatiques et interactions biologiques* (14h00 Wed in SITE A0150)
- EEE3 Social interactions / *Relations sociales* (14h00 Wed in SITE J0106)
- Hoar Hoar award talks / *présentations des prix Hoar* (11h00 Thurs in MRN AUD)
- LOC LOC symposium – CSZ pioneers and their legacy / *Les pionniers de la SCZ et leur héritage* (14h00 Mon in UCU AUD)
- PAR S PAR symposium – Comparative aquatic parasitology and immunology (8h30 Thurs in SITE A0150)
- PAR1 Protozoa, ecology and control / *Protozoaires, écologie et contrôle* (11h00 Tues in SITE J0106)
- PAR2 Microsporidians, trematodes and nematodes / *Microsporidies, trématode et nématodes* (14h00 Tues in SITE J0106)
- Spencer Andy Spencer Memorial Symposium / symposium commémoratif Andy Spencer (11h00 Wed in SITE G0103; continues at 14h00)
- TEA Teaching talks / *Enseignement* (14h00 Thurs in SITE A0150)
- TEA WS Teaching workshop / *atelier d'enseignement* (16h30 Thurs in MCD 146)
- Wardle Wardle lecture / *conférence Wardle* (16h30 Thurs in SITE B0138)
- ZET ZET event / *conférence ZET* (18h30 Wed in UCU AUD)

EFFECTS OF HYPERCAPNIA ON INTRACELLULAR pH AND Ca^{2+} IN ISOLATED GILL NEUROEPITHELIAL CELLS OF ZEBRAFISH, DANIO RERIO [CPB5]

LES EFFETS DE L'HYPERCAPNIE SUR LE pH ET LE Ca^{2+} DANS LES CELLULES NEUROÉPITHÉLIALES ISOLÉES DE BRANCHIES CHEZ LE POISSON ZÈBRE, DANIO RERIO

Sara Abdallah, MG Jonz and SF Perry

University of Ottawa

Adult zebrafish exhibit hyperventilatory responses to absolute environmental CO_2 levels as low as 1.0 mmHg. The ability of zebrafish to detect and respond to low ambient CO_2 appears to be mediated by neuroepithelial cells (NECs) of the gill filaments. Recent electrophysiological characterization of this response revealed that the partial pressure dependent depolarization of NECs in response to a hypercapnic stimulus is dependent on the rate of acidification associated with the hydration of CO_2 and the inhibition of a background K^+ channel. In order to further elucidate the signaling pathway underlying CO_2 chemotransduction in NECs we used microfluorimetric techniques to study intracellular changes in pH (pHi) and calcium ($[\text{Ca}^{2+}]_i$) in enzymatically dispersed NECs from zebrafish gill filaments. Using the ratiometric indicators BCECF and fura-2-AM we found that a hypercapnic stimulus evoked a decrease in pHi and an increase in $[\text{Ca}^{2+}]_i$, respectively, in a dose-dependent manner.

MOLECULAR EVOLUTION OF HCN CHANNELS [Spencer]

ÉVOLUTION MOLÉCULAIRE DES CANAUX HCN

Eric Accili¹ and H Jackson²

¹*University of British Columbia;* ²*University of Victoria*

Hyperpolarization-activated Cyclic Nucleotide (HCN) channels are voltage-gated cation channels, critical for regulation of membrane potential in electrically active cells. To understand the evolution of these channels at the molecular level, we cloned and examined two HCN homologs in *Ciona intestinalis* (designated CiHCNa and CiHCNb), a member of the tunicate family and putatively the closest extant ancestors of the vertebrate lineage. The core functional regions of CiHCNa and CiHCNb share approximately 50% sequence identity with those of the four mammalian homologs, and show broad conservation of function with mammalian and invertebrate forms. CiHCNa is functionally most similar to the mammalian forms. This isoform also undergoes N-glycosylation at a sequon near the pore, which is otherwise found and utilized only in vertebrate isoforms and is conspicuously absent from the one HCN gene we found in amphioxus. In contrast, ciHCNb does not undergo N-glycosylation, consistent with the absence of the N-glycosylation sequon, and possesses a distinct phenotype, distinguished by an unusually large resting conductance across all voltages tested. These data support urochordates, not amphioxus, as the closest ancestor to vertebrates and suggest that duplication of a vertebrate-like ancestral gene yielded two genes in *ciona*, which are roughly equidistant from vertebrate homologs; one with minimally evolved functions, and another having a dramatically altered ability to gate and lacking the pore-associated N-glycosylation sequon.

CADMIUM AND CALCIUM SELECTIVELY INHIBIT ELECTRON TRANSPORT CHAIN COMPLEXES AND ATP PRODUCTION IN RAINBOW TROUT HEPATIC MITOCHONDRIA [CPB1]

INHIBITION SÉLECTIVE PAR LE CADMIUM ET LE CALCIUM DES COMPLEXES DE LA CHAÎNE DE TRANSPORT DES ÉLECTRONS ET DE LA PRODUCTION D'ATP DANS LES MITOCHONDRIES HÉPATIQUES DE LA TRUITE ARC-EN-CIEL

Reginald C Adiele, C Kamunde and D Stevens

University of Prince Edward Island

We recently demonstrated that cadmium (Cd) and calcium (Ca) cooperate to impair rainbow trout liver mitochondria (RTLTM). To localize the sites of the impairment, sequential inhibition of mitochondrial electron transport complexes using rotenone (Complex I), malonate (Complex II) and antimycin A (Complex III) with measurements of rates of oxidation of the respective complex-specific substrates, malate-glutamate, succinate, duroquinone and ascorbate-tetramethyl-p-phenylenediamine were done. ATP production was measured using Firefly luciferase assay. Additionally, oxidative stress was assessed by quantifying thiobarbituric acid reactive substances (TBARS), specifically malondialdehyde (MDA), following incubation of RTLTM with Cd and Ca, singly and in combination. While cytochrome-c-oxidase was highly recalcitrant to Cd and Ca exposures, dose-dependent inhibition of NADH-dehydrogenase and succinate dehydrogenase were observed. Synthesis of ATP was reduced by 74, 60 and 83% in

the Cd, Ca and combined exposures indicating cooperative impairment of oxidative phosphorylation. Malondialdehyde concentrations increased in all of the exposures suggesting mitochondrial membrane peroxidation.

OVER-EXPRESSION OF CORTICOTROPIN-RELEASING FACTOR REDUCES HEAT SHOCK-INDUCED CASPASE-3/7 ACTIVITY IN ZEBRAFISH EMBRYOS [CPB12]

LA SUREXPRESSION DE CORTICOLIBÉRINE RÉDUIT L'ACTIVITÉ DES CASPASES-3/7 CONTRÔLÉES PAR LES PROTÉINES DE CHOC THERMIQUE CHEZ LES EMBRYONS DE POISSON ZÈBRE

Sarah L Alderman, MLM Fuzzen, EF Sandiford and NJ Bernier

University of Guelph

In zebrafish, the corticotropin-releasing factor (CRF) system is expressed from early stages of embryogenesis, yet its function during this time is unknown. We tested the hypothesis that CRF is cytoprotective during ontogeny by assessing whether or not CRF could suppress heat shock-induced apoptosis during embryogenesis. Heat shock increased caspase 3/7 activity at 7 and 10 h post stress, a key effector of apoptosis. The response to heat shock was also characterized by increases in the mRNA levels of CRF at 4 h post stress and CRF-binding protein at 4 and 7 h post stress. Embryos microinjected with CRF mRNA prior to heat shock had reduced caspase 3/7 activity relative to control-injected embryos; however there was no effect on mortality rates. This study provides original evidence of CRF cytoprotection *in vivo*, and supports a role for the CRF system in preventing stressor-induced programmed cell death during embryogenesis.

THE INFLUENCE OF NATURAL ORGANIC MATTER (NOM) ON SODIUM TRANSPORT IN FRESH-WATER ORGANISMS [CPB9]

L'INFLUENCE DE LA MATIÈRE ORGANIQUE NATURELLE (MON) SUR LE TRANSPORT DU SODIUM CHEZ LES ORGANISMES D'EAU DOUCE

Hassan A Al-Reasi¹, DS Smith² and CM Wood¹

¹McMaster University; ²Wilfrid Laurier University

This study examined sodium transport in the water flea (*Daphnia magna*) and zebrafish (*Danio rerio*) in the presence of chemically-distinct natural organic matter (NOM) isolates from three different freshwater sources and commercially available Aldrich humic acid (AHA). At experimental pH 5, adult *D. magna* with no added NOM experienced substantial reduction in the whole body Na content compared to the control (no NOM added) at pH ≥ 7 . In the presence of the naturally occurring NOMs at 12 mg l⁻¹ C, the whole body Na concentration was restored to levels found in adults of control at pH ≥ 7 . However, when exposed to 12 mg l⁻¹ C of AHA, *D. magna* adults exhibited similar reduction in Na content to that caused by pH 5 alone. For *D. rerio*, a radio-tracer experimental approach with ²²Na is being used to investigate unidirectional fluxes of Na ion in the presence of NOMs (NSERC Discovery).

SODIUM LOSS IS THE ACUTE TOXIC MECHANISM OF DIVERSE CONTAMINANTS IN ZEBRAFISH: IMPLICATIONS FOR ADDITIVE TOXICITY [CPB4]

LA PERTE DE SODIUM EST LE MÉCANISME TOXIQUE AIGU DE DIVERS CONTAMINANTS CHEZ LE POISSON-ZÈBRE : IMPLICATIONS POUR LA TOXICITÉ ADDITIVE

Derek Alsop and CM Wood

McMaster University

Larval zebrafish (*Danio rerio*) were used to examine the mechanisms of action and acute toxicities of a variety of contaminants, with a focus on metals. Mortalities associated with metal exposure were effectively related to loss of whole body [Na⁺], which decreased up to 39%. Additive toxicity was observed between metals. For example, exposure to sublethal levels of nickel (15% of the nickel LC₅₀) decreased the copper 96 h LC₅₀ by 58%. In addition, exposure to fluoxetine and other contaminants decreased whole body Na⁺. Fluoxetine also showed additive toxicity with copper. We have demonstrated that the acute toxicity of a number of contaminants is effectively related to Na⁺ loss, possibly stemming from stress hormone signaling. This common impact on Na⁺ may underlie additive toxicity. Understanding mechanisms will help predict the toxicities of mixtures for water quality criteria, a necessity

given that most polluted environments are impacted by multiple contaminants (NSERC PDF,Discovery).

HUMMINGBIRDS AND INSECTS USE CONVERGENT MECHANISMS FOR FLIGHT CONTROL
[CPB13]

LES LES COLIBRIS ET LES INSECTES UTILISENT DES MÉCANISMES COMPARABLES POUR LE CONTRÔLE EN VOL

Douglas L Altshuler¹, EM Quicazain², PS Segre², KM Middleton³

¹University of British Columbia; ²University of California Riverside; ³California State University San Bernardino

Animal locomotion may be specialized for high mechanical power or for fine motor control, but flying animals capable of sustained hovering require both. Insects exhibit functional segregation between power and control muscles for flight whereas vertebrate muscles typically perform both tasks. We tested the hypothesis that hummingbirds, which are unique among vertebrates in the ability to perform sustained hovering, would exhibit insect-like flight control. We challenged hummingbirds to produce maximum power during load lifting, and to maneuver while feeder tracking. Measurements of wingbeat kinematics revealed that hummingbirds regulate power output by varying wingtip velocity, but make only small adjustments to wing position angles during maneuvers. Electromyographic measurements demonstrated that pectoral muscles were regulated in response to changing power requirements, and that wing muscles were regulated during maneuvers. Thus, despite vast differences in anatomy, physiology, and evolutionary history, hovering insects and hummingbirds exhibit surprising convergence in motor control and wingbeat kinematics.

THE ROLE OF THE COLON IN NITROGEN BALANCE IN TWO CHONDRICHTHYAN FISHES, THE RATFISH, *HYDROLAGUS COLLIEI*, AND SPINY DOGFISH, *SQUALUS ACANTHIAS* [CPB14]

*LE RÔLE DU CÔLON DANS LA RÉGULATION DE L'AZOTE CHEZ DEUX POISSONS CHONDRICHTYENS, LA CHIMÈRE (*HYDROLAGUS COLLIEI*) ET L'AIGUILLAT (*SQUALUS ACANTHIAS*)*

W Gary Anderson¹, M Nawata², CM Wood², M Piercey-Normore¹ and D Weihrauch¹

¹University of Manitoba; ²McMaster University

The present study examined the role of the colon in regulating ammonia and urea nitrogen balance in two species of chondrichthyans, the ratfish, *Hydrolagus colliei* (a holocephalan) and the spiny dogfish, *Squalus acanthias* (an elasmobranch). Urea flux across stripped colonic tissue was found to be negligible. However, urea accumulation of ¹⁴C-urea was determined to be 2.8 and 6.2 fold greater in the mucosa of the dogfish compared to the serosa of the dogfish and the mucosa of the ratfish respectively. Through the addition of 2 mM NH₄Cl to the mucosal side of the isolated colon, ammonia flux was measured, but was found to be negligible in both species. Finally molecular analysis revealed expression of 3 isoforms of the urea transport protein (UT) and an ammonia transport protein (Rhbg) in the gill, intestine, kidney and colon of the ratfish. All of the transporters had high levels of identity to previously published sequences in both the elephantfish and the dogfish.

SOCIAL INTERACTIONS, RELATEDNESS AND POPULATION STRUCTURE IN A SOCIAL CERVID: IMPLICATIONS FOR PATHOGEN TRANSMISSION [EEE3]

RELATIONS SOCIALES, CONTIGUÏTÉ ET STRUCTURE POPULATIONNELLE CHEZ UN CERVIDÉ SOCIAL: IMPLICATIONS DANS LA TRANSMISSION DE PATHOGÈNES

Jose A Andres¹, E Vander Wal¹ and P Paquet²

¹University of Saskatchewan; ²University of Calgary

Social behaviours, such as close-contact interactions, are a mechanism for direct transmission of pathogens among hosts. Host populations, however, exist in patchy often isolated environments, which may create a continuum of genetic and social familiarity. Such variability can have an important effect on pathogen spread locally and at the landscape scale. Using a population of elk (*Cervus elaphus*) infected with bovine tuberculosis (*Mycobacterium bovis*) in south-western Manitoba, we tested whether interaction rates and durations were affected by degree of genetic relatedness. Furthermore, we tested whether this was a sociobiological phenomena (i.e., animals who interact are more closely related) or a function of hidden population structure (i.e., animals interactions are a just function of their distribution). Relatedness rarely influenced interaction rate, and in the isolated cases where significant dif-

ferences existed they could be explained as an artefact of hidden population structure. Connectivity between demes and social interactions seem to explain the distribution of infected individuals.

ESTROGEN AND OSMOREGULATION IN THE GOLDFISH (*CARASSIUS AURATUS* L) [CPB20]

*ESTROGÈNES ET OSMORÉGLULATION CHEZ LE CYPRIN DORÉ (*CARASSIUS AURATUS* L)*

Carolyn Arbanas, H Chasiotis and SP Kelly

York University

Estrogen is traditionally regarded as a reproductive hormone, but it is clear that its effects are wide ranging. The influence of 17 β -estradiol (E2) on salt and water balance in goldfish was considered by examining the effects of E2 on transcellular and paracellular ion transport 'machinery' in gill and kidney tissue as well as overall hydromineral status. Estrogen receptor subtype mRNA was found in the gill and kidney, and exogenous E2 administration reduced gill V-type H⁺-ATPase and kidney Na⁺-K⁺-ATPase activity. Despite this, overall changes in hydromineral status were modest, but in both the gills and kidney, mRNA expression of tight junction proteins, which are involved in the regulation of paracellular permeability, tended to increase in response to low levels of exogenous E2. Results suggest that in goldfish, E2 exposure has moderate effects on hydromineral status and changes in the transcellular and paracellular machinery of osmoregulatory epithelia may be partly responsible.

NATURAL VARIATION IN THE STRESS MOLECULAR NETWORK UNDERLYING A BEHAVIOURAL SYNDROME [EEE-CPB]

VARIATION NATURELLE DANS LE RÉSEAU MOLÉCULAIRE DU STRESS SOUS-TENDANT UN SYNDROME COMORTEMENTAL

Nadia Aubin-Horth^{1,2}, M Deschênes^{1,2} and S Cloutier²

¹Université Laval; ²Université de Montréal

Personality traits that co-vary in a population form a behavioural syndrome. Personality traits such as boldness are also correlated with stress reactivity. This suggests an influence of components of the stress axis on behaviour and a pleiotropic effect resulting in behavioural syndromes. We determined which components of the stress axis vary with personality in a wild population. We measured four personality traits, cortisol level and brain expression of CRH, CRHR2, POMC, GR1, GR2 and MR in non-stressed threespine sticklebacks (*Gasterosteus aculeatus*). Bolder individuals were more aggressive towards a conspecific intruder. Bolder and more aggressive individuals had higher brain glucocorticoid receptor expression. Our results show that natural variation in boldness and aggressive behaviours within a population is associated with differences in components of the stress axis. This also suggests that the behavioural syndrome found in this population could be the result of a pleiotropic effect of components of the stress axis.

REGULATION OF FOOT MUSCLE GLUTAMATE DEHYDROGENASE FROM AN ESTIVATING LAND SNAIL [CPB11]

RÉGULATION DU GLUTAMATE DÉSHYDROGENASE CHEZ UN ESCARGOT TERRESTRE ESTIVANT

Ryan Bell and KB Storey

Carleton University

Land snails, *Otala lactea*, survive in seasonally hot and dry environments by entering a state of aerobic torpor called estivation. During estivation, snails must prevent excessive dehydration and reorganize metabolic fuel use so as to endure prolonged periods without food. Glutamate dehydrogenase (GDH) was hypothesized to play a key role during estivation as it shuttles amino acid carbon skeletons into the Krebs cycle for energy production, and is very important to urea biosynthesis (a key molecule used for water retention). Analysis of foot muscle GDH between control and estivating conditions revealed significant differences in GDH kinetic properties. This may be regulated by reversible protein phosphorylation, as indicated by ProQ Diamond phosphoprotein staining, ion exchange chromatography and phospho-serine detection by immunoblotting. The behavior of differently phosphorylated forms correlates well with the increased use of amino acids for energy and increased synthesis of urea for water retention during prolonged estivation.

EVOLUTIONARY LOSS OF REGENERATION IN ANNELID WORMS [CMD S]

PERTE ÉVOLUTIONNAIRE DE LA RÉGÉNÉRATION CHEZ LES ANNÉLIDES

Alexa Bely

University of Maryland

Although the ability to regenerate lost body structures provides obvious benefits to injured animals, many animal lineages have experienced dramatic reductions in regeneration abilities. It remains unclear how and why these losses occur. Multiple independent losses of head regeneration ability are evident among annelids (segmented worms), making this phylum a particularly useful group in which to investigate regeneration loss. Among the Naididae, a group of primarily freshwater annelids, head regeneration has been lost multiple times and different lineages have lost regeneration to different degrees. Current studies are aimed at identifying the correlates of regeneration loss in this group and uncovering the developmental basis of regeneration failure.

MOLECULAR IDENTIFICATION AND CHARACTERIZATION OF A GENE ENCODING THE KININ PEPTIDE(S) IN RHODNIUS PROLIXUS [CPB6]

IDENTIFICATION MOLÉCULAIRE ET CARACTÉRISATION DU GÈNE CODANT LE(S) PEPTIDE(S) DE KININE CHEZ RHODNIUS PROLIXUS

Garima Bhatt and I Orchard

University of Toronto Mississauga

The digestive and diuretic activities in the haematophagous insect *Rhodnius prolixus* are under neuropeptide regulation. In *R. prolixus*, the kinin-like peptides, first isolated from *Leucophaea maderae* (i.e. leucokinins), have been shown to co-localize with the corticotrophin-releasing factor (CRF)-like diuretic hormone in some neurosecretory cell bodies and their abdominal neurohaemal sites. In addition, kinins are present in endocrine cells of the midgut of 5th instar *R. prolixus*. Leucokinin I stimulates hindgut contractions and midgut contractions in *R. prolixus*. In this study, we have isolated a 1198bp cDNA encoding a 398 amino acid prepropeptide, that predicts the processing of 12 Rhopr-kinins. Selected members of these Rhopr-kinins stimulate midgut and hindgut contractions. Northern blot analysis reveals a 1.9kb RNA transcript, suggesting that 700bp of the transcript is still missing. Reverse transcriptase-PCR reveals that the kinin transcript is expressed in the CNS and a variety of peripheral tissues, including anterior and posterior midgut and testes.

DIFFUSIVE GRADIENTS IN THE EMBRYONIC JELLY MASS OF SYMBIOTIC AMBYSTOMA MACULATUM ARE IMPACTED BY LIGHT AND WATER PH DURING EMBRYONIC DEVELOPMENT [CPB14]

GRADIENTS DE DIFFUSION DANS LA MASSE GÉLATINEUSE EMBRYONNAIRE DE L'AMBYSTOMA MACULATUM SYMBIOTIQUE SONT AFFECTÉS PAR LUMIÈRE ET LE PH DE L'EAU DURANT LE DÉVELOPPEMENT DE L'EMBRYON

Kristin Bianchini¹, G Tattersall², C Porteus¹ and PA Wright¹

¹*University of Guelph*; ²*Brock University*

Embryos of the yellow-spotted salamander, *Ambystoma maculatum*, are typically colonized by green algae that supply O₂ in the presence of light and may consume nitrogenous wastes. Given that *A. maculatum* inhabit acidic (pH < 5) and neutral lakes, we hypothesized that light conditions and water pH would affect the metabolism of these symbiotic organisms and alter the diffusive gradients within the jelly mass. Embryo jelly masses reared at pH 4.5 had lower PO₂ and higher ammonia levels, while embryonic tissues had higher ammonia and lactate concentrations relative to embryos at pH 8.0. Light conditions and embryonic position in the jelly mass affected PO₂ but not ammonia gradients, suggesting that algal symbionts generate O₂ but do not significantly impact local ammonia concentrations. We conclude that chronic exposure to acidic lake water has a profound effect on the microenvironment of developing *A. maculatum* embryos.

ANOXIA SURVIVAL IN TURTLES: POSSIBLE ROLES OF MICRORNAS IN REGULATING METABOLIC RATE DEPRESSION [CPB7]

SURVIE À L'ANOXIE CHEZ LES TORTUES : RÔLES POSSIBLES DES MICROARN DANS LA RÉGULATION

DE LA DÉPRESSION MÉTABOLIQUE

Kyle K Biggar and KB Storey

Carleton University

Mammalian tissues are highly sensitive to anoxia, but some freshwater turtles are champion facultative anaerobes. Natural anoxia tolerance depends on biochemical adaptations including those that preserve cell viability by suppressing energy-expensive functions to facilitate entry into a hypometabolic state. Current microRNA studies have identified prominent groups of up-regulated microRNAs during hypometabolism. Small non-coding microRNAs may provide a new mechanism of rapid-acting biological control that can help to suppress non-essential protein translation. We hypothesized that microRNAs could aid in suppressing cell proliferation under anoxia. Selected microRNA species (miR-16-1 and miR-15a) known to bind at evolutionarily conserved regions in Cyclin D1 (a key cell cycle regulator) were evaluated using RT-PCR in organs of normoxic and anoxic (5 and 24 h exposures) turtles, *Trachemys scripta elegans*. To determine the capacity of selected microRNAs to bind Cyclin D1 mRNA, 3' RACE was used to determine the 3' UTR sequence and web-based bioinformatic software was used to determine the likelihood of binding *in vivo*.

DIFFERENTIAL EXPRESSION OF Rh GLYCOPROTEINS IN THE SEA LAMPREY, PETROMYZON MARINUS [CPB10]

EXPRESSION DIFFÉRENTIELLE DES GLYCOPROTÉINES RH CHEZ LA LAMPROIE MARINE, PETROMYZON MARINUS

Salvatore Blair¹, MP Wilkie² and SL Edwards¹

¹*Appalachian State University*; ²*Wilfrid Laurier University*

Ammonia is generated as a result of amino acid catabolism in all animals; however, ammonia is highly toxic and must be excreted or converted to less toxic nitrogenous waste products such as urea. Multiple strategies are employed by different groups of aquatic invertebrates and vertebrates to excrete ammonia across the gills, skin and/or via renal routes. Most recently Rhesus glycoproteins have been shown to play a critical role in ammonia transport in both invertebrates and vertebrates. The little data we currently have suggests that in later life-stages lamprey excrete ammonia predominately through branchial routes. Anadromous lampreys are found in a wide range of environmental salinities and as a group share the same osmotic stresses as those faced by the teleost (bony) fishes. This study examined Rh glycoprotein expression in epithelial tissues from various life stages of sea lamprey.

EFFECTS OF CLIMATE CHANGE ON AMPHIBIAN POPULATIONS [ZET]

EFFETS DES CHANGEMENTS CLIMATIQUES SUR LES POPULATIONS D'AMPHIBIENS

Andrew Blaustein

Oregon State University

Numerous factors are affecting amphibian populations including direct and indirect effects of climate change. Climate change may cause shifts in amphibian ranges. Changes in climate may affect survival, growth, reproduction and dispersal capabilities of amphibians. Moreover, climate change can alter amphibian habitats including vegetation, soil, and hydrology. Climate change can influence food availability, predator-prey relationships and competitive interactions which can alter community structure. Climate change can also alter pathogen-host dynamics. Changes in climate can interact with other stressors such as UV-B radiation and contaminants. The interactions among all these factors are complex and are probably driving some amphibian population declines and extinctions. Because natural selection has favored traits that have persisted for millions of years, it is unlikely that amphibian behaviors and life history characteristics will change in ecological time even though these characteristics may be harmful to amphibians under present conditions.

ENVIRONMENTAL INFLUENCES ON THE ACCUMULATION OF ETHYNYLESTRADIOL IN THE EURYHALINE KILLIFISH [CPB8]

INFLUENCES ENVIRONNEMENTALES DE L'ACCUMULATION D'ÉTHYNYLESTRADIOL CHEZ LES CYPRI-NODONTES EURYHALINS

Tamzin Blewett¹, DM MacLatchy² and CM Wood¹

¹McMaster University; ²Wilfrid Laurier University

We examined the impact of temperature and salinity on the uptake of radiolabeled 17- α ethynylestradiol (EE2, 100 ng l⁻¹, hormone used in birth control) in male killifish. Oxygen consumption rates (MO₂), EE2 uptake rates, and tissue-specific EE2 distribution were monitored. In killifish acclimated to 18°C at 16 ppt (50% SW), both MO₂ and EE2 uptake were lower after 24-h exposure to 10°C and 4°C, and only EE2 uptake was higher after exposure to 26°C. Killifish acclimated to FW had 60% lower rates of EE2 uptake, whereas those acclimated to 32 ppt (100% SW) had the highest uptake measured. Drinking made a negligible contribution. EE2 accumulation was the highest (> 60%) in the liver (including gallbladder), carcass (20%), and gastrointestinal tract (10%), with < 10% in gills and spleen. Strong positive relationships between EE2 uptake and MO₂ suggest a similar pathway for uptake across the gills. (NSERC Strategic, D. MacLachy, P.I).

SELENIUM TOXICITY IN AN EEL BRAIN CELL LINE AS APPLIED TO EEL POPULATION DECLINE [CPB4]

TOXICITÉ AU SÉLÉNIUM DANS UNE LIGNÉE CELLULAIRE DE CERVEAU D'ANGUILLE CORRÉLÉE AU DÉCLIN DE LA POPULATION

Sophia R Bloch¹, LEJ Lee², PV Hodson³ and NC Bols¹

¹University of Waterloo; ²Wilfrid Laurier University; ³Queen's University

American eel (*Anguilla rostrata*) populations in the Great Lakes have experienced a dramatic decline in the last decades. The reasons are mostly unknown and are expected to be multiple. Selenium pollution might play a role in the decline of eel populations. Selenium has become an element of concern because of its bioaccumulative nature in food webs. Toxicity studies with selenium compounds were performed on an eel brain cell line to study the cellular mechanism and to try to collect species-specific toxicity data related to selenium. In short-term tests done at room temperature Na₂SeO₃, was more cytotoxic than Na₂O₄Se and Selenomethionine was not cytotoxic. However, in long-term tests SeMet at 125 μ M and higher did impair cell proliferation but only at temperatures of 26°C and 30°C and not at 14°C. These results suggest that changes in temperature should be considered in evaluating the toxic potential of Se.

LOCALIZATION AND EXPRESSION OF Na⁺,K⁺-ATPASE, Na⁺,K⁺,2Cl⁻ COTRANSPORTER AND CFTR DURING AN OSMOTIC CHALLENGE OF FUNDULUS HETEROCLITUS [CPB9]

LOCALISATION ET EXPRESSION DES Na⁺, K⁺-ATPASE, DES COTRANSPORTEURS DE Na⁺, K⁺, 2Cl⁻ ET DE LA CFTR PENDANT UN DÉFI OSMOTIQUE CHEZ FUNDULUS HETEROCLITUS

Charlotte Bodinier, Y Meng and F Galvez

Louisiana State University

Immunohistochemistry was used to describe the cellular distribution of Na⁺/K⁺ ATPase (NKA), Na⁺/K⁺/2Cl⁻ co-transporter (NKCC), and the chloride channel, cystic fibrosis transmembrane conductance regulator (CFTR), in ion-transporting epithelia of *Fundulus grandis*, during osmotic challenges. Although NKA was always expressed on basolateral membranes of epithelia, the cellular distributions of NKCC and CFTR were salinity-dependent. During seawater acclimation, NKCC and CFTR were typically co-localized to the apical membrane of intestines, but were distributed to the basolateral and apical membranes of gills, respectively. Freshwater transfer resulted predominantly in apical NKCC and basolateral CFTR cellular distributions in the intestines and gills, although cells with basolateral NKCC and apical CFTR localization were also abundant in the crypts of intestines. This presentation will describe the potential roles of these proteins in osmoregulation and acid-base regulation during osmotic challenges.

FEASIBILITY OF GENOMIC SELECTION IN A CANADIAN AQUACULTURAL STRAIN OF ATLANTIC SALMON USING 4000 MAPPED SNP MARKERS [EEE1]

FAISABILITÉ D'UNE SÉLECTION GÉNOMIQUE EN UTILISANT 4000 MARQUEURS POLYMORPHES MONONUCLÉOTIDIQUES RÉPERTORIÉS DANS UNE LIGNÉE DE SAUMON DE L'ATLANTIQUE ISSUE DE L'AQUACULTURE CANADIENNE

Elizabeth G Boulding¹, K Ang², A Burton², L Damphousse¹, JAK Elliott², B Glebe³, M Kent⁴, S Lien⁴, L Schaeffer¹

and J Tosh¹

¹University of Guelph; ²Cooke Aquaculture Inc; ³DFO St. Andrews; ⁴CIGENE at Norwegian University of Life Sciences

Disease is a major constraint affecting the sustainability and profitability of the Atlantic salmon industry. We are testing the feasibility of using genomic selection to improve traits that can not be directly measured on broodstock such as disease and parasite resistance. We are using DNA samples from the parents and grandparents of each family for 4000 SNPs as well as estimates of their breeding values (EBVs) based on their siblings' growth rates in sea-water farm cages and their siblings' survival when challenged by ISA or by the salmon louse. Allele effects at SNPs associated with disease resistance as well as SNPs associated with growth can be used to obtain genomic EBVs for the next generation of candidate broodstock. We can use simulation to predict genetic changes in economically important traits that would accrue from the use of genomic selection and compare this to current selection programs.

A TRIAGE APPROACH TO CARIBOU CONSERVATION [EEE S]

UNE APPROCHE DE TRIAGE POUR LA PRÉSERVATION DES CARIBOUS

Stan Boutin

University of Alberta

I will present a case for a triage approach to caribou conservation. Using information from Alberta herds I will show how considering the real cost of conservation measures leads to picking certain herds to receive the majority of our conservation efforts. The herds chosen are not the ones that would receive priority under SARA regulations. The triage approach may be the only realistic option in areas where effective conservation requires large tracts of land be set aside from further industrial activity and this comes at considerable economic cost to society.

THE EFFECTS OF GILL REMODELING ON BRANCHIAL Na^+ TRANSPORT IN GOLDFISH, *CARASSIUS AURATUS* [CPB9]

*LES EFFETS DU REMODELAGE DE LA BRANCHIE SUR LE TRANSPORT BRANCHIAL DU Na^+ CHEZ LE CYPRIN DORÉ, *CARASSIUS AURATUS**

Julia Bradshaw and SF Perry

University of Ottawa

Goldfish undergo a reversible gill remodeling involving the growth and loss of an interlamellar cell mass (ILCM). This transformation is triggered by the O_2 demand of the individual and/or the O_2 availability to balance the opposing requirements of the gill for O_2 uptake and osmoregulation. Using this model, we tested the hypothesis that an increased blood-to-water diffusion distance and/or decreased surface area reduce passive efflux of Na^+ . Using hypoxia and temperature acclimation to induce a remodeling of the gill, unidirectional branchial Na^+ fluxes were lower in goldfish with an ILCM following thermal remodeling. There was no effect of hypoxia or subsequent recovery on unidirectional Na^+ fluxes despite a significant difference in branchial surface area. The implications of gill remodeling on Na^+ uptake as well as expression of mRNA transcripts coding for genes implicated in Na^+ uptake (NHE3, NHE2, H^+ ATPase, Na^+/K^+ -ATPase) and the redistribution of Na^+ -transporting cells will be discussed.

CONTROL OF CYTOCHROME C OXIDASE (COX) GENE EXPRESSION IN GOLDFISH IN RESPONSE TO TEMPERATURE [CPB11]

CONTRÔLE DE L'EXPRESSION GÉNÉTIQUE DU CYTOCHROME C OXYDASE (COX) EN RÉPONSE AU CHANGEMENT DE TEMPÉRATURE CHEZ LE CYPRIN DORÉ

Katharina Bremer, CT Monk and CD Moyes

Queen's University

We explored the mechanisms behind muscle mitochondrial biogenesis in goldfish in response to cold acclimation. Central to mammalian mitochondrial biogenesis is the transcriptional master regulator PPAR γ co-activator-1 α (PGC1 α) and a network of transcription factors it co-activates. Focusing on the PGC1 axis, we looked at (i) the

transcriptional response of PGC1 paralogs, (ii) the effects on protein kinases regulating PGC1 activity, and (iii) the pattern of transcription factors that interact with PGC1. We observed cold-induced increases in COX activity and mRNA for some COX subunits, NRF1 and PGC1 β . However, cold induced a marked decrease in PGC1 α mRNA, and either no change or decreases in other transcription factors known to bind PGC1 including TRs, PPARs, ERRs, and RXRs. Amongst the transcription factors regulating COX genes, only NRF1 appears to play a significant role, and it seems to exert its effects in combination with PGC1 β , rather than PGC1 α , most important in mammals.

LIVE IMAGING AND FUNCTIONAL ANALYSIS OF NECS IN TELEOST GILLS [CPB5]

IMAGERIE EN DIRECT ET ANALYSE FONCTIONNELLE DES CNE CHEZ LES TÉLÉOSTÉENS

Dee Brink¹, C Porteus¹, A Fong² and WK Milsom¹

¹University of British Columbia; ²Macquarie University

Teleost gills use specialized neuroepithelial cells (NECs) to detect changes in [O₂] in blood and ambient water. Energetic investigation of gill NECs has raised a number of questions. 1. What is the relationship between serotonergic NECs and cholinergic cells in the gill? 2. What are the neural circuits associated with each, and how do they respond to hypoxia? 3. Does hypoxia trigger NEC and/or cholinergic cell migration? 4. To what extent are the innervations of NECs malleable? We are using multi-photon microscopy and immunofluorescence to identify serotonergic and cholinergic cells, and their synaptic interactions, in intact live and fixed gills of the teleosts *Carassius auratus* and *Oncorhynchus mykiss*. We are assessing both NEC and neuronal [O₂] sensing with electrophysiology, and FM dyes in live gill preparations.

CHANGES IN REACTIVE OXYGEN SPECIES (ROS) PRODUCTION IN LIVER AND SKELETAL MUSCLE DURING HIBERNATION IN THIRTEEN-LINED GROUND SQUIRRELS (ICTIDOMYS TRIDECIMLINEATUS) [CPB19]

CHANGEMENT DE LA PRODUCTION D'ESPÈCES RÉACTIVES DE L'OXYGÈNE (ROS) DANS LE FOIE ET LES MUSCLES SQUELETTIQUES PENDANT L'HIBERNATION DE L'ÉCUREUIL (ICTIDOMYS TRIDECIMLINEATUS)

Jason CL Brown, DJ Chung, KR Belgrave and JF Staples

University of Western Ontario

We measured ROS production at 10 and 37°C in mitochondria from liver and skeletal muscle of hibernating ground squirrels during torpor and interbout euthermia (IBE). At 37°C, basal ROS production and/or free radical leak (FRL; proportion of electrons leading to ROS production) were significantly lower during IBE compared to torpor, particularly in liver. Therefore, mitochondria may be modified during arousal and IBE (when body temperature and metabolic rate are dramatically increased) in order to limit ROS formation and oxidative damage. At 10°C, compared to 37°C, mitochondrial ROS production was reduced by 66-95% in both tissues. In addition, FRL was 45-61% lower, suggesting that mitochondria are more efficient at avoiding ROS production at low temperatures by limiting electron leak. Reduced FRL at low temperatures appears to reflect greater temperature sensitivity of ROS production ($Q_{10} = 2.3$) compared to oxygen consumption ($Q_{10} = 1.8$). Together, our data suggest that hibernation reduces mitochondrial ROS production and alleviates oxidative stress.

ANOXIA-SENSITIVE GABA RELEASE BY STELLATE NEURONS REDUCES PYRAMIDAL NEURON ACTIVITY THROUGH INCREASES IN GABA-A RECEPTOR CURRENTS IN ANOXIA-TOLERANCE TURTLE CORTEX [CPB7]

LE RELÂCHEMENT DE GABA SENSIBLES À L'ANOXIE PAR LES NEURONES STELLAIRES RÉDUIT L'ACTIVITÉ DES CELLULES PYRAMIDALES PAR L'AUGMENTATION DE COURANTS DANS LES RÉCEPTEURS GABA-A DANS LE CORTEX TOLÉRANT À L'ANOXIE CHEZ LA TORTUE

Leslie T Buck and DWR Hogg

University of Toronto

Anoxia induces hyper-excitability and cell death in mammalian brain; however, in the anoxia-tolerant western painted turtle neuronal activity is depressed and cell death absent. In anoxic turtle brain [GABA] is rapidly elevated

and we previously determined that during anoxia GABA-AR currents mediate an inhibitory postsynaptic shunt. The objective of this investigation was to further characterize the anoxic GABAergic response. Using perforated patch techniques we identified phasic GABA-mediated post-synaptic potentials (GABAergic PSPs) that occur at a frequency of 0.1 Hz. Anoxia did not increase PSP frequency but amplitude doubled from 41 to 82 pA. GABA uptake blockers increased anoxic PSP amplitude to 120 pA indicating that GABA release is synaptic and oxygen-sensitive. Recordings from stellate interneurons revealed that these neurons fire 3-10 APs per/burst, occurring with an inter-burst frequency of approximately 10 secs. Anoxia increased AP burst frequency to 15-20 APs/burst, suggesting an oxygen sensitive mechanism. We conclude that in anoxia-tolerant turtle brain stellate interneurons increase: APs in response to anoxia, presynaptic GABA release, and post-synaptic GABAergic PSPs; together resulting in a shunting current that decreases excitability.

IMPACT OF HYPOXIA AND AMMONIA ON NUTRIENT UPTAKE BY THE GILL, GUT AND SKIN OF PACIFIC HAGFISH [CPB14]P

EFFET DE L'HYPOXIE ET DE L'AMMONIAC SUR LA CAPTURE DE NUTRIMENTS PAR LES BRANCHIES, LES INTESTINS ET LA PEAU DE LA MYXINE DU PACIFIQUE

Carol Bucking¹, CN Glover² and CM Wood³

¹University of Ottawa; ²University of Canterbury; ³McMaster University

The feeding strategy of the Pacific hagfish (*E. stoutii*), where they immerse in the body cavities of animals to feed, creates a rich external nutrient source that may promote nutrient acquisition by branchial and epidermal epithelia. However, this strategy could also subject hagfish to reduced oxygen and elevated ammonia. Hence, we examined the transport of nutrients across the skin and gills of hagfish and the impact of hypoxia and ammonia on nutrient assimilation and metabolism. Alanine and glycine were absorbed via specific transport pathways by the skin and gills. Hypoxia pre-exposure altered glycine transport by the skin, gill and gut as well as glycine tissue distribution. Pre-exposure to waterborne ammonia did not impact gut or skin glycine uptake. Alanine transport by the gut and gill was unaffected by hypoxia. These results indicate hagfish possess novel nutrient transport pathways and are adapted to maintain nutrient assimilation in light of environmental stressors.

ARE INVASIVE SPECIES A PARASITE FREE LUNCH? [PAR1]

EST-CE QUE LES ESPÈCES INVASIVES SONT UN REPAS GRATUIT POUR LES PARASITES ?

Gregory Bulté¹, MR Forbes¹, SE Locke² and DJ Marcogliese²

¹Carleton University; ²St-Lawrence Center

As the number of invasive species increases, more and more native predators are reported to shift their diet toward invasive prey. Such diet shifts are expected to have important parasitological and immunological consequences, which will ultimately affect the health and fitness of native predators. Many different groups of parasites use prey as intermediate or paratenic hosts to infect predators and the abundance and diversity of trophically transmitted parasites are directly related to a predator's diet. Invasive species typically have fewer parasites than native species. Thus individual, feeding on invasive species are expected to be exposed to a fewer diversity of trophically transmitted parasites. We tested this prediction using pumpkinseed sunfish feeding on invasive zebra mussels. Our results generally support the prediction that invasive species are relatively parasite free food source.

MOTHER KNOWS BEST: THE COSTS AND BENEFITS OF MATERNAL ANTIBODY TRANSFER IN TREE SWALLOWS [EEE-CPB]

COÛTS ET BÉNÉFICES DU TRANSFERT D'ANTICORPS MATERNELS CHEZ L'HIRONDELLE BICOLORE

Gary Burness, D Moher, RJ Kelly and EH Chin

Trent University

Female birds transfer maternal antibodies (matAb) to their young. To explore the costs of receiving matAb, we challenged female tree swallows (*Tachycineta bicolor*) prior to egg laying with lipopolysaccharide (LPS) or saline (Control). Following hatching, one half a female's nestlings were immunized with LPS and the other half injected with saline (Control), and for 4 h post injection nestling metabolic rate (MR) was measured. Nestlings from LPS-mothers had a higher MR following treatment with LPS than did nestlings from Control-mothers, suggesting an

energetic cost to antibody transfer. Near fledging, we challenged all nestlings with phytohaemagglutinin (PHA) to test the impact of matAb when encountering a different "pathogen". LPS-nestlings from LPS-mothers had a stronger response to PHA than did LPS-nestlings from Control-mothers. These data suggest that during the nestling phase matAb have an energetic cost, but aid in responding to subsequent novel challenges.

EFFECT OF SODIUM PERCARBONATE ON MONOGENEANS INFECTING MUMMICHOGS (FUNDULUS HETEROCLITUS) [PAR1]

EFFET DU PERCARBONATE DE SODIUM SUR LES MONOGÈNES INFECTANT FUNDULUS HETEROCLITUS

Michael DB Burt, K Crain, M Posselt, DK cone, V Savoie-Swan, RH Easy and K Buchmann
University of New Brunswick, Fredericton

Fundulus heteroclitus (mummichogs), naturally infected with four Monogenea (three *Fundulotrem* spp; one *Gyrodactylus* sp), were exposed to different concentrations of sodium percarbonate over an 18 hour period in a static saltwater system. At concentrations of 80 mg l⁻¹ and 160 mg l⁻¹ there were significant reductions in numbers of worms still attached to their fish host. At concentrations of 320 mg l⁻¹ no worms were found and there was no apparent effect on the fish host. This preliminary study indicates that this 'environmentally-friendly' chemotherapeutant functions in salt water and may be useful in the treatment of other ectoparasites.

CIRCADIAN ORGANIZATION IN AN ADULT INSECT: RHYTHMICITY OF PROTHORACICOTROPIC HORMONE FROM THE BRAIN AND ECDYSTEROIDS FROM THE HEMOLYMPH AND OVARIES DURING EGG DEVELOPMENT IN ADULT RHODNIUS PROLIXUS [CPB6]

ORGANISATION CIRCADIENTE CHEZ UN INSECTE ADULTE : RHYTHMICITÉ DE L'HORMONE PROTHORACICOTROPIQUE DU CERVEAU ET DES ECDYSTÉROÏDES DE L'HÉMOLYPHE ET DES OVAIRES DURANT LE DÉVELOPPEMENT DES ŒUFS CHEZ RHODNIUS PROLIXUS ADULTE

Michael Cardinal-Aucoin, X Vafopoulou, CGH Steel
York University

The neuropeptide prothoracicotropic hormone (PTTH) is usually considered a larval hormone since its only known targets, the prothoracic glands, degenerate in adults. Using a sensitive *in vitro* bioassay, PTTH was shown to be both present and released in female adults during egg development. PTTH content increased after a blood meal and its content and release cycled with a daily rhythm. Tissue incubation techniques and ecdysteroid radioimmunoassay revealed that a blood meal triggers an increase in ecdysteroids in the hemolymph and ovaries. The ecdysteroid hemolymph titres and content and release from ovaries cycled with a daily rhythm. These daily rhythms were established to be under endogenous circadian control. Furthermore, PTTH appears to affect ovary ecdysteroids. It therefore seems that the larval PTTH-ecdysteroid axis of circadian organization persists in adult *Rhodnius* and regulates egg development, thus providing the first evidence of the PTTH-ecdysteroid axis and its rhythmicity in an adult insect. Supported by NSERC Discovery Grant 6669.

REGENERATION - ONE OF NATURE'S ENDURING MYSTERIES [CMD S]

LA RÉGÉNÉRATION – UN DES MYSTÈRES PERSISTANTS DE LA NATURE

Bruce M Carlson
University of Michigan

Regeneration occurs in many forms and patterns throughout the animal and plant kingdoms. Phylogenetically, it is seen in animals ranging from protozoa to humans. This talk will review the spectrum of regenerative phenomena, with an emphasis on both known mechanisms and questions yet to be answered. Asexual reproduction and morphallaxis, processes only known to occur in invertebrates, will also be discussed in the broader context of regeneration.

ARE MONOZYGOTIC TWINS IDENTICAL IN GENETIC AND EPIGENETIC FEATURES? [CMD2]H
EST-CE QUE LES JUMEAUX MONOZYGOTES SONT IDENTIQUES DANS LEURS CARACTÉRISTIQUES ÉPI-

GÉNÉTIQUES ?

Christina A Castellani, RL O'Reilly and SM Singh
University of Western Ontario

Monozygotic (MZ) twins have played a major part in our understanding of the role of genes and the environment (Fisher 1918). The foundation of this insight lies in the assumption that MZ twins are genetically identical and any discordance between them is a result of environmental factors, either directly or indirectly. Advances in genetic and epigenetic methods and approaches have allowed for the direct assessment of the similarities and differences across monozygotic twins. The results argue that MZ twins may differ in epigenetic (DNA Methylation, Histone Acetylation, Gene Expression, etc) and genetic (SNPs, Copy Number Variations, Indels, etc) features. Not surprisingly, the novel results challenge conclusions that are based on the assumption that MZ twins are identical. These may include concepts such as 'nature vs nurture' and estimation of heritability, among others.

CELLULAR AND PHYSIOLOGICAL STRESS RESPONSES TO EE2 DURING FLUCTUATIONS IN ENVIRONMENTAL TEMPERATURE IN THE MUMMICHOG (*FUNDULUS HETEROCLOTUS*) [CPB8] *RÉPONSES CELLULAIRE ET PHYSIOLOGIQUE AU STRESS À L'EE2 PENDANT LES FLUCTUATIONS DE TEMPÉRATURE ENVIRONNEMENTALE CHEZ FUNDULUS HETEROCLOTUS*

Kavish P Chandra¹, A Lister², T Bosker³, DL MacLachy² and S Currie¹

¹Mount Allison University; ²Wilfrid Laurier University; ³University of New Brunswick, Saint John

17 α -ethynylestradiol (EE2) is a potent endocrine disruptor in fish. We hypothesized that fish exposed to EE2 1) at high temperatures or 2) an additional acute heat stress will be more susceptible to endocrine disruption and that heat shock proteins (HSPs) may be involved given their role in chaperoning the estrogen receptor. Mummichog, acclimated to 10 or 26°C, were exposed to 0 and 250 ng EE2 l⁻¹ for two weeks. Separate mummichog were exposed to EE2 similarly at 18°C and were heat shocked at 30°C for 1 h. HSP90 levels were higher in 10°C acclimated fish compared to 26°C; however, HSP70 increased in 10°C female fish exposed to EE2. Following heat shock, nuclear HSP70 increased but decreased with EE2, suggesting that EE2 affects the heat shock response and/or movement of HSPs into the nucleus. Currently, we are measuring vitellogenin mRNA expression to link changes in HSPs to EE2 susceptibility.

A ROLE FOR OCCLUDIN IN THE REGULATION OF PARACELLULAR PERMEABILITY ACROSS FISH GILLS [CPB20]

RÔLE DE L'OCCLUDINE DANS LA RÉGULATION DE LA PERMÉABILITÉ PARACELLULAIRE DANS LES BRANCHIES DE POISSON

Helen Chasiotis and SP Kelly
York University

Tight junctions (TJs) are composed of transmembrane and cytosolic protein networks that form a semi-permeable 'seal' which regulates the paracellular movement of solutes across vertebrate epithelia. Recent studies have investigated a role for occludin, a transmembrane TJ protein, in contributing to paracellular permeability across the gill epithelium of fishes. In these *in vivo* and *in vitro* studies, occludin abundance was assessed following manipulation of gill permeability by environmental challenge (e.g. ion-poor water exposure) or hormone treatment (e.g. cortisol). Preliminary data utilizing siRNA to 'knockdown' occludin in a cultured gill model are discussed. Studies to date suggest that when the paracellular pathway across the gill epithelium is 'tightened', occludin most likely contributes, however the extent of this contribution may differ between species and likely depends upon other TJ proteins (e.g. claudins).

THE ROLES OF SUCCINATE DEHYDROGENASE AND MEMBRANE REMODELING DURING ENTRANCE INTO HIBERNATION BOUTS [CPB19]

RÔLE DE LA DÉSHYDROGÉNASE DU SUCCINATE SUR LE REMODELAGE DES MEMBRANES PENDANT L'ENTRÉE EN HIBERNATION

Dillon J Chung, GP Lloyd, RH Thomas, CC Guglielmo and JF Staples
University of Western Ontario

Between interbout euthermia (body temperature, T(b); 37°C) and early entrance into a torpor bout (T(b) 30°C), respiration of liver mitochondria purified from *Ictidomys tridecemlineatus* fell over 50%. Respiration did not decline further in the late entrance and torpor stages (T(b) 15 and 5°C, respectively). Succinate dehydrogenase (SDH) activity followed a similar trend and correlated with state 3 respiration. Unlike arousal, oxaloacetate did not inhibit SDH. Relative content of phospholipid classes changed little during entrance except for a transient decrease in phosphatidylethanolamine. Some saturated phospholipid fatty acids (16:0, 18:0) increased in early arousal while some unsaturates (18:2, 20:4) decreased. These changes did not persist into late entrance or torpor, and did not correlate with mitochondrial respiration. We conclude that suppression of mitochondrial metabolism occurs early during entrance into torpor and is likely due to acute regulation of mitochondrial enzymes.

PROMOTING STUDENT ENGAGEMENT IN LARGE CLASSES USING THINK-PAIR-SHARE [TEA]
PROMOUVOIR L'IMPLICATION DES ÉTUDIANTS DANS LES CLASSES NOMBREUSES EN UTILISANT LE
SYSTÈME PENSER-COLLABORER-PARTAGER

Julie Clark
 York University

Think-pair-share is a valuable cooperative learning teaching strategy that can be used with any class size, discipline, and academic level (primary school to university). It promotes active learning by encouraging thinking, problem solving and in-class discussion. During a think-pair-share activity, students are presented with a question/problem/scenario, each student thinks silently about it for a moment and then joins one or two other students to exchange ideas and derive a group decision/answer. This technique can be used in concert with student response systems (e.g. clickers). Previous work has demonstrated that this activity, and others that promote student engagement, enhance student learning when compared to classic lecture deliveries. The benefits of using this teaching strategy in a large class (e.g. 200-500 students) will be discussed and the technique demonstrated.

SULFATE TRANSPORT IN HAGFISH: APPLYING MODERN APPROACHES TO ANCIENT FISHES
 [CPB9]
TRANSPORT DE SULFATE CHEZ LA MIXINE : APPLICATION D'APPROCHES MODERNES À D'ANCIENS
POISSONS

Alexander M Clifford, BL Goss, AG Schultz and GG Goss
 University of Alberta

Hagfish represent a unique phylogenetic position between the urochordates and jawed vertebrates. While hagfish are known as osmoconformers in regards to Na⁺ and Cl⁻, they do regulate plasma concentrations of Ca²⁺, Mg²⁺ and SO₄²⁻ to ~1/3rd to 1/2 of seawater levels. Recent evidence suggests that the putative ancestral mineralocorticoid in lamprey is 11-deoxycortisol. We investigated if hagfish possess active sulfate handling mechanisms using ³H-inulin and ³⁵S (as SO₄²⁻) injections into the blood and measured both disappearance from the blood and appearance in the water of both isotopes. To evaluate the potential mechanisms of active ³⁵SO₄²⁻ excretion, we measured the levels of 11-deoxycortisol, plasma glucose, and ATPase activity over time following injection of an additional ~3mM NaSO₄. Using a recently obtained hagfish gill transcriptome, we have identified a putative sulfate transporter (SLC26a1) and will examine its expression following SO₄²⁻ injection.

THE STRESS RESPONSE, FITNESS, AND BEHAVIOUR IN PACIFIC SALMON [EEE-CPB]
LA RÉPONSE AU STRESS, FITNESS ET COMPORTEMENT DU SAUMON DU PACIFIQUE

Katrina V Cook¹, SH McConnachie¹, GT Crossin², KM Gilmour³ and SJ Cooke¹
¹Carleton University; ²Simon Fraser University; ³University of Ottawa

The acute stress response is thought to mediate life history trade-offs and behavioural syndromes. However, links with direct fitness metrics remain inconclusive. We present two case studies examining the relationship between individual variability in cortisol, the primary stress hormone in fish, fitness and performance metrics in Pacific salmon (*Oncorhynchus* spp.). Semelparous species provide a unique opportunity to quantify fitness as individuals failing to spawn have zero fitness. We describe characteristics of baseline and stress-induced cortisol in river-entry

sockeye salmon (*O. nerka*) and mature pink salmon (*O. gorbuscha*) in light of migratory and reproductive success and spawning behaviours. In both cases we observe negative fitness consequences of elevated stress-induced cortisol in relatively few, poor quality individuals. However, in river-entry sockeye salmon immediate post-release swimming behaviour is related to the stress response whereas in fully mature pink salmon, reproductive behaviours are mediated by baseline cortisol.

THE MECHANISMS OF CUTANEOUS AMMONIA TRANSPORT IN AMPHIBIOUS MANGROVE RIVULUS, KRYPTOLEBIAS MARMORATUS, ACCLIMATED TO DIFFERENT SALINITIES [CPB10]
LES MÉCANISMES DE TRANSPORT CUTANÉ D'AMMONIAC CHEZ LE KILLI DES MANGROVES, KRYPTOLEBIAS MARMORATUS, ACCLIMATÉ À DIFFÉRENTES SALINITÉS

Chris A Cooper and PA Wright
University of Guelph

In the euryhaline, amphibious mangrove rivulus (*Kryptolebias marmoratus*) the skin is an important site for ammonia excretion. The aim of the present study was to determine the mechanisms of ammonia excretion across the skin, taking into account the recently discovered ammonia transporting Rhesus (Rh) glycoproteins. Using the *in vitro* Ussing chamber approach, we showed that in freshwater (FW), cutaneous ammonia excretion was inhibited when 'proton-ATPase', 'sodium/proton exchange' and 'sodium channels' were targeted, whereas a decrease in mucosal pH increased excretion. In seawater (SW), the same transporters appear to play a smaller role, and inhibition of the chloride channel also decreased ammonia excretion. Unexpectedly, a decrease in mucosal pH reduced ammonia excretion in SW. Therefore, we infer that ammonia (gaseous) is the primary route of excretion in FW, whereas ammonium (ionised) is more important in SW. Mechanisms behind ammonia volatilisation across the skin of air-exposed fish will also be presented.

NEW METHOD FOR DETECTING NOSEMA CERANAE AND N. APIS IN EUROPEAN HONEYBEES [PAR2]F
UNE NOUVELLE MÉTHODE POUR LA DÉTECTION DE NOSEMA CERANAE ET N. APIS CHEZ L'ABEILLE EUROPÉENNE

Tanya Copley¹, P Giovenazzo² and S Jabaji¹
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Nosemosis of honeybees, *Apis mellifera* L., is caused by two Microsporidia species, *Nosema ceranae* and *N. apis*, and current methods for detection involve killing adult bees, which can be detrimental to dwindling hives. The following study aimed at developing a method for detection of both species that does not involve killing bees. Infection rates of *N. ceranae* and *N. apis* were quantified using duplex qPCR in adult bees, debris at the bottom of the hive, and frass over a one year period. Infection levels were then correlated to those in the bees and analyzed using PCA. Results demonstrate that the debris at the bottom of the hive is a good indicator of infection levels for both species, while frass can be collected to determine *N. ceranae* infection levels demonstrating that adult bees do not need to be killed in order to detect Nosemosis resulting in less losses to dwindling hives.

CONTROL OF BREATHING IN THE IN VITRO BRAINSTEM PREPARATION FROM GOLDFISH (CARASSIUS AURATUS) [CPB5]
CONTRÔLE DE LA RESPIRATION IN VITRO DANS LE TRONC CÉRÉBRAL DU CYPRIN DORÉ (CARASSIUS AURATUS)

Eric Côté and R Kinkad*
Université Laval

We used an *in vitro* preparation to investigate central mechanisms that generate and regulate breathing in a teleost fish. We determined whether 1) respiratory rhythm generation requires Cl⁻-dependent neurotransmission and 2) changes in O₂ or CO₂/H⁺ affect fictive breathing *in vitro*. Following anesthesia, brainstems were isolated and placed in a chamber containing a solution bubbled with 98% O₂, 2% CO₂. Fictive breathing was recorded extracellularly from cranial nerve VII. Exposing brainstems to Cl⁻-free solution abolished fictive breathing; however, respiratory related activity resumed upon return to control conditions. Reducing medium O₂ from 98% to 40% augmented fic-

tive breathing frequency. Augmenting CO₂ from 2% to 4% had no effect. We conclude that, in goldfish, respiratory rhythm is generated by networks involving inhibitory neurotransmission. Though we provide no evidence of central CO₂ chemoreceptors in goldfish, their brainstem contains O₂-sensitive elements capable of stimulating breathing. This research was supported by NSERC.

POPULATION DYNAMICS OF MIGRATORY CARIBOU IN A CHANGING NORTH [EEE S]
LES DYNAMIQUES DES POPULATIONS MIGRATOIRES DE CARIBOUS DANS UN NORD CHANGEANT
Steeve D Côté
Université Laval and Centre for Northern Studies

Caribou (*Rangifer tarandus*) are a key species in Arctic ecosystems. They play a central role in the ecology of predators and the structure of Arctic plant communities. In addition, caribou provide socioeconomic and cultural benefits from subsistence and sport hunting activities. Most migratory caribou populations are currently declining with serious biological, societal, and economic implications. In addition, direct and indirect consequences of climate change on migratory caribou herds may include alteration in habitat use, migration patterns, and demography. For example, caribou may experience a further northerly shift in distribution due to several factors including longer ice-free periods, increases in snowfall, and changes in the distribution of insects and predators. Research by Caribou Ungava, a research group interested in the ecology of migratory caribou of northern Quebec and Labrador in the context of climate change, addresses the factors outlining variations in the population dynamics of caribou, implications for survival and reproduction, as well as the response of caribou habitat to different climate change scenarios.

GENOMIC AND METABOLIC RESPONSES TO METHIONINE RESTRICTION: A COMPARISON OF CARNIVOROUS AND OMNIVOROUS SPECIES [CPB19]
RÉPONSE MÉTABOLIQUE ET GÉNOMIQUE SUITE À LA LIMITATION DE LA MÉTHIONINE : UNE COMPARAISON ENTRE DES ESPÈCES CARNIVORES ET OMNIVORES
Paul M Craig and TW Moon
University of Ottawa

Mammalian studies report that methionine restriction (MR) as a dietary regime extends life-span, delays the onset of age related diseases, and enhances fat oxidation in obese subjects plagued by metabolic syndrome. However, the underlying cellular signaling pathways and how nutrient receptors are involved is poorly understood. Rainbow trout (*Oncorhynchus mykiss*), a carnivorous glucose-intolerant species, and goldfish (*Carassius auratus*), an omnivorous glucose-tolerant species, were used to examine fuel use, including markers of beta-oxidation, glycolysis, gluconeogenesis, lipogenesis and protein metabolism, in addition to key nutrient receptors (AMPK, mTOR, SREBP and CREBH) to determine the dominant genomic and metabolic pathways activated during nominal and high carbohydrate intake with and without MR. Comparison between these two species may shed light on the validity of using fish as a model for hyperglycemia and to elucidate new targets of therapy for human metabolic syndromes. Studies supported by a NSERC-DG.

LIFE IMPRINTS: LIVING IN A CONTAMINATED WORLD [CMD2]
LES EMPREINTES DE LA VIE : VIVRE DANS UN MONDE CONTAMINÉ
David Crews
University of Texas at Austin

The phenotype is determined by inherited and experienced factors. Traditionally, the former are a result of evolution by selection acting on the genotype while the latter encompasses events in the individuals' life history. Recently epigenetic studies have modified this perspective. 'Context-dependent' epigenetic change occurs when the causative environmental factors persist in the environment. 'Germline-dependent' epigenetic change is incorporated into the germline and manifests in each generation in the absence of the causative agent. Such distinctions are important given the ubiquity of anthropogenic chemical contamination. Greater effort must be placed on integrative and interdisciplinary studies that explicitly illuminate how the phenotype is affected at all levels of biological organization. Only when this is done will we begin to understand how ancestral environmental exposures act both at

the level of the individual and their descendants to influence all aspects of life history.

AMMONIA TRANSPORT IN THE SKIN OF THE AFRICAN CLAWED FROG, XENOPUS LAEVIS
[CPB10]

TRANSPORT D'AMMONIAC DANS LA PEAU DU XÉNOPE DU CAP, XENOPUS LAEVIS

Melissa Cruz, A Chan, MM Sourial, D Weihrauch

University of Manitoba

Skin tissues of *Xenopus laevis* were investigated for their ammonia transport properties using an Ussing chamber and *in vivo*-like transepithelial osmotic gradients. Metabolic ammonia generated by the skin accounted to $0.022 \pm 0.003 \mu\text{mol l}^{-1} \text{cm}^2 \text{h}^{-1}$ (belly) and $0.025 \pm 0.003 \mu\text{mol l}^{-1} \text{cm}^2 \text{h}^{-1}$ (back) of which 57% and 60% were released towards the apical bath, respectively. Both skins prepared from the belly and back exhibited a net ammonia efflux when activated by 10 mM theophylline. Interestingly, reasonable ammonia net-effluxes only occurred when the applied ammonia gradients in these experiments were clearly above ammonia levels measured in the plasma ($346 \pm 31 \mu\text{M}$). Quantitative mRNA-expression analysis revealed that Rhbg is highly expressed in kidney and skin tissues, but showed low expression levels in liver, nerve and muscle tissues. When compared to Rhbg, Rhcg showed 10 times lower relative expression levels in the skin, but 2.5 times higher expression levels in the kidney. In liver, nerve and muscle tissues Rhcg was barely detectable.

THE EFFECTS OF CD EXPOSURE ON PERFORMANCE AND CAPACITY TO RECOVER FROM REPEAT SWIMMING IN RAINBOW TROUT (ONCORHYNCHUS MYKISS) [CPB1]

EFFETS DE L'EXPOSITION AU CD SUR LA PERFORMANCE ET LA CAPACITÉ DE RÉCUPÉRATION DE NAGE RÉCURRENTÉ CHEZ LA TRUITE ARC-EN-CIEL (ONCORHYNCHUS MYKISS)

Jessie Cunningham and J McGeer

Wilfrid Laurier University

Swimming ability is frequently used to characterize the integrated metabolic costs associated with exposure to contaminants, including Cd. More specifically, the use of repeat swimming challenges acts as a more sensitive indicator, identifying impairment that was not observed in a singular swim challenge alone. This study employs two consecutive swimming challenges, separated by a recovery period of varying duration in order to investigate the effects of Cd on repeated swimming ability in juvenile salmonids. Swim trials consisted of two consecutive swim challenges separated by a recovery period (30 min-6 h). Blood, organ and muscle samples were taken before and after each of the swim trials and rest periods and tissue Cd burden, plasma ion composition and metabolic fluctuations were measured. The goal of this research is to form linkages between exposure, bioaccumulation, physiological disruption and impairment to whole animal performance. This research is supported through the NSERC Discovery Program.

THE ORGANIC OSMOLYTE, TRIMETHYLAMINE OXIDE (TMAO), PROTECTS DOGFISH RED BLOOD CELLS FROM ACUTE HEAT STRESS [CPB12]

L'OXYDE DE TRIMÉTHYLAMINE (TMAO), UN OSMOLYTE ORGANIQUE, PROTÈGE LES ÉRYTHROCYTES DES CHANGEMENTS AIGÛS DE TEMPÉRATURES CHEZ L'AIGUILLAT

Suzanne Currie¹, A Kolhatkar¹, C Robertson¹ and K Gamperl²

¹Mount Allison University; ²Memorial University of Newfoundland

The spiny dogfish shark (*Squalus acanthias*) like most elasmobranchs, uses the organic osmolytes urea and TMAO to osmoconform to their environment. TMAO is also a chemical chaperone, stabilizing proteins and preventing denaturation. Using dogfish red blood cells as our model, we hypothesized that cells experiencing an acute heat stress would be protected from protein damage by TMAO, and would therefore not induce the highly conserved molecular chaperone HSP70. HSP70 was not induced following an acute 1 h heat shock in red blood cells incubated with physiological concentrations of TMAO. Despite a lack of HSP induction, these cells showed no indication of apoptosis, membrane damage, excess protein oxidation or ubiquitination. Further, haemoglobin-oxygen affinity was not affected by either acute heat or the presence of TMAO. Thus, TMAO appears to sufficiently protect dogfish cells from the potentially damaging effects of heat stress.

CAMERON AND FALLIS: TWO PIONEERS WITH DIFFERENT LEGACIES [LOC]

CAMERON ET FALLIS : DEUX PIONNIERS AUX HERITAGES DISTINCTS

KG Davey

York University

The principal legacy of most academic scientists is situated in people: their students and other workers who passed through their laboratories. TWM Cameron and AM Fallis were two very different men: one an imperious professor of the traditional British school, the other a modest son of rural Ontario. Each in their own way influenced generations of parasitological research not only in Canada, but internationally. This presentation documents some aspects of their legacies as revealed in their influence on students, acolytes and colleagues. For Fallis, this influence is direct, flowing from his mentoring of parasitologists who spread throughout Canada and internationally. For Cameron the influence is indirect: the establishment and growth of the Institute of Parasitology provided an infrastructure within which the subject flourished and from which workers moved to other centres.

THE ALLOSTERIC REGULATION OF GLUTATHIONE REDUCTASE IN THE FREEZING FROG, RANA SYLVATICA [CPB19]

RÉGULATION ALLOSTÉRIQUE DE LA RÉDUCTASE DU GLUTATHION CHEZ LA GRENOUILLE CONGELÉE, RANA SYLVATICA

Neal J Dawson and KB Storey

Carleton University

Wood frogs have the remarkable ability to survive whole body freezing during the winter. One aspect of survival is a profound suppression of physiological and metabolic processes that leaves cells in a state of low activity. Over freeze/thaw cycles, generation of reactive oxygen species is expected to be high, especially during reperfusion. Glutathione reductase (GR) (E.C. 1.6.4.2) is a ubiquitous flavoenzyme, considered a secondary antioxidant enzyme. GR is charged with the regeneration of reduced GSH from the oxidized (GSSG) form via a NADPH-dependent reaction; this replenishes the GSH pool and the cellular free radical buffering ability. The reduced glutathione supplied by this reaction has several fates including maintaining the thiol groups of soluble and structural proteins in their proper redox state, directly scavenging oxygen radicals and acting as substrates for antioxidant enzymes such as GPox and GST. In this study, the mechanism of control of GR during freezing is explored.

A COMPARISON OF WOUND HEALING FOLLOWING VOLUNTARY (AUTOTOMY) AND INVOLUNTARY (AMPUTATION) TAIL LOSS USING THE LEOPARD GECKO, EUBLEPHARIS MACULARIUS [CMD1]H

COMPARAISON ENTRE LA GUÉRISON DE BLESSURE PROVOQUÉE VOLONTAIREMENT (AUTOTOMIE) ET INVOLONTAIREMENT (AMPUTATION) CHEZ LE GECKO LÉOPARD, EUBLEPHARIS MACULARIUS

Stephanie Delorme and MK Vickaryous

University of Guelph

Tail loss in lizards occurs at pre-existing planes of weakness using a voluntary process known as autotomy. For most lizards, tail loss is followed by scar-free wound healing and regeneration. Previous work suggests that lizards will also regenerate their tails following involuntary amputation, although few details are available. Using the leopard gecko (*Eublepharis macularius*) we compared the sequence of anatomical and histological events that begins following tail autotomy versus tail amputation. Changes in histology of the regenerating tail were examined at multiple time points using histochemistry and immunohistochemistry. Scar-free wound healing and regeneration followed both forms of tail loss. After wounding the cells of the epithelium proliferate, sealing off the wound site. Wound closure is further facilitated by the contractile actions of myofibroblasts. The wound epithelium is immunoreactive for WE6, a wound keratin first found in urodeles. Deep to the epithelium mesenchymal-like cells aggregate and differentiate to form new tissues.

AN ELABORATE FEMALE TRAIT VARIES WITH REPRODUCTIVE SKEW IN THE PUKEKO (P. PORPHYRIO MELANOTUS) [EEE1]

UN TRAIT FEMELLE COMPLEXE VARIE AVEC LE BIAIS REPRODUCTIF CHEZ LE PUKEKO (P. PORPHY-

RIO MELANOTUS)

Cody J Dey¹, IG Jamieson² and JS Quinn¹

¹McMaster University; ²University of Otago

Despite a comprehensive understanding of secondary sexual traits in males, the mechanisms underlying elaborate trait evolution in females remain elusive. Comparative cross-species analyses suggest that the degree of reproductive skew (i.e. reproductive sharing) among females in a social group can influence the degree of intrasexual competition and select for female elaboration. Using two New Zealand populations of pukeko that vary in the degree of skew, we provide the first within species test of this hypothesis. In contrast to our theoretical predictions, our results showed that females had more elaborate ornaments under conditions of low reproductive skew. We discuss why reproductive skew may not provide an accurate estimator of the scope for sexual selection and how life-history can influence trait elaboration independent of reproductive skew.

MECHANISMS OF HYPOXIA TOLERANCE IN CARP [CPB7]

MÉCANISMES DE LA RÉSISTANCE À L'HYPOXIE CHEZ LA CARPE

Rashpal S Dhillon¹, L Yao¹, V Matey², BJ Chen³, SJ Fu³, ZD Cao³, CJ Brauner¹, YX Wang^{3,4} and JG Richards¹

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Low oxygen environments can be an important driving force for adaptation and result in remarkable modifications of metabolic pathways and mechanisms for oxygen uptake. Previous studies have shown that in response to hypoxia exposure, crucian carp (*Carassius carassius*) and goldfish (*Carassius auratus*) are capable of producing ethanol as a means of reducing acidosis and undergo gill remodeling to maximize oxygen uptake. In this study, we compare anaerobic metabolism and gill structure in ten species of carp exposed to a hypoxic condition over 48 h. Changes in gill structure were significant in seven of the ten species, and the time required for remodeling was variable between species. Plasma ethanol and lactate content were measured, and alcohol dehydrogenase, pyruvate kinase and lactate dehydrogenase activities in the muscle and liver were compared in all species.

IMMUNE RESPONSES TO PATHOGENS AND PARASITES IN ECTOTHERMIC VERTEBRATES

[PAR S]

RÉPONSE IMMUNITAIRE AUX PATHOGENES ET AUX PARASITES CHEZ LES VERTÉBRÉS ECTOTHERMES

Brain Dixon

University of Waterloo

Knowledge of ectothermic vertebrate, particularly teleost fish, immune systems has advanced a lot in the past two decades. However, even with the list of genes produced by EST and genome projects, knowledge of the function of the encoded proteins and the system as a whole is limited. This presentation will show that fish immune systems are very different from mammalian and tetrapod immune systems and that simply designing assays based on knowledge of immunological processes in those groups of animals can be misleading. More knowledge of fish immunity, down to the level of different genera of cultured fish in some cases, will be needed to develop effective methods. The information and diagnostic tools required to develop effective assays will be discussed.

A NOVEL PROPOSED MECHANISM FOR Na⁺ TRANSPORT IN RAINBOW TROUT GILLS [CPB9]

UN NOUVEAU MÉCANISME POUR LE TRANSPORT DU Na⁺ DANS LES BRANCHIES DE LA TRUITE ARC-EN-CIEL

Agnieszka Dymowska, A Schultz, S Parks, J Brisebois, GG Goss

University of Alberta

The molecular identity of the Na⁺ uptake mechanism across the gills of freshwater fish remains the subject of lively debate. Extensive evidence for NHE mediated Na⁺ uptake exists, especially for zebrafish. However, thermodynamic constraints on the function of NHEs at low ion concentrations (Na⁺ < 0.5 mM) and low environmental pHs suggest alternate mechanisms may need to exist in those species exploiting these environments. Efforts to identify ENaC homologues in teleost fishes have not been successful. We investigated if alternative sodium channels could play a role in Na⁺ uptake in rainbow trout. Here we demonstrate the presence of an acid sensing ion channel

(ASIC), a member of the ENaC/DEG superfamily of Na⁺ channels that is expressed in MR cells. We report the inhibition of Na⁺ uptake in very soft water using ASIC specific pharmacological blockade and suggest that this channel may be responsible for Na⁺ uptake in freshwater fish in very soft water.

SELECTION ON AMPHIBIAN DEVELOPMENT RATE ACROSS LATITUDE: EVIDENCE FOR DIVERSIFYING SELECTION AT HIGH LATITUDES [EEE1]L

VITESSE DE DÉVELOPPEMENT DES AMPHIBIENS SELON LA LATITUDE: PREUVE POUR UNE SÉLECTION DIVERSIFIÉE À HAUTE LATITUDE

Christopher B Edge¹, DG Thompson² and JE Houlahan¹

¹University of New Brunswick Saint John; ²Canadian Forest Service

As latitude increases mean temperature decreases; natural selection has acted on traits that are physiologically linked to temperature in the opposite direction of the gradient (Countergradient selection). For example, amphibian development rate is positively correlated to temperature but animals from high latitudes develop faster than conspecifics from low latitudes when reared in a common environment. Development rate is variable, and if directional selection has favoured animals with short development times at high latitudes then there should be a negative relationship between the variability in development rate and latitude. Using a meta-analysis (>200 studies) we investigated the patterns in mean development rate and the variability in development rate between and within species across latitude. In support of our hypothesis between and within species mean development rate is negatively correlated with latitude and there is a negative correlation across all species between variation and latitude. However, within species variability and latitude were positively correlated, implying that at high latitudes natural selection has favoured increased variation in development rate.

THE PHYSIOLOGICAL RESPONSE OF PREDICTED FUTURE LEVELS OF ATMOSPHERIC CARBON DIOXIDE ON RESPIRATORY GAS EXCHANGE AND ACID-BASE BALANCE IN THE GULF TOADFISH [CPB17]P

RÉPONSE PHYSIOLOGIQUE AUX NIVEAUX ESTIMÉS DE DIOXYDE DE CARBONE ATMOSPHÉRIQUE SUR LE SYSTÈME RESPIRATOIRE D'ÉCHANGE DE GAZ ET SUR L'ÉQUILIBRE ACIDO-BASIQUE CHEZ LE BATRACHOÏDIFORME

Andrew Esbaugh, R Heuer and M Grosell

University of Miami

The oceanic carbonate system is changing rapidly due to increased uptake of atmospheric anthropogenic CO₂. Current levels of 380 ppm are expected to rise to 1000 ppm by 2100 and over 1900 ppm by 2300. The present study was undertaken to investigate the impacts these increases will have on a marine teleost, the gulf toadfish. Using a paired experimental design, evidence for a compensated blood acidosis after 24 h of exposure to 560, 750, 1000 and 1900 ppm CO₂ was observed. A more detailed time course at 1000 and 1900 ppm CO₂ revealed a significant respiratory acidosis after 15 min of exposure with full compensation by 8 h and 2 h, respectively. Exposure to 1900 ppm CO₂ for 72 h caused a significant increase in intestinal base secretion. Exposure to bicarbonate free seawater and elevated CO₂ revealed that compensation is achieved by bicarbonate uptake rather than proton extrusion. The dynamic regulation of proteins involved in branchial acid-base regulation will be discussed.

HYPERBARIC CT, A NOVEL AND USEFUL TOOL FOR DIVING STUDIES [CPB13]

CT HYPERBARE, UN NOUVEL OUTIL POUR LES ÉTUDES SOUS-MARINES

Andreas Fahlman and MJ Moore

Woods Hole Oceanographic Institution

It has been proposed that the structure of the respiratory system of marine mammals is a trait that prevents inert gas uptake and thereby decreases the risk of decompression sickness (DCS). It was therefore surprising when recent necropsy reports of mass stranded deep diving whales reported profuse bubble phenomena as well as other symptoms similar to DCS. To improve our understanding of how marine mammals manage gases during diving we investigated the elastic properties of the respiratory system using Computerized Tomography (CT) employing a specially designed fiberglass tube system that reduces potential artifacts from steel chambers. In addition, we com-

pared our chamber results with compliance curves (pressure-volume loops) from excised lungs. Our results suggest that the elastic properties vary in phocids as compared with odontocetes. These differences affect the depth where the alveoli collapse and gas exchange cease, and influence gas management and physiological limitations to diving.

EXAMINING THE PHYSICO-CHEMICAL PROPERTIES AND TOXICOLOGICAL EFFECTS OF MANUFACTURED POLYMER-COATED NANOPARTICLES USING ZEBRAFISH (DANIO RERIO) [CPB8]

PROPRIÉTÉS PHYSICO-CHIMIQUES ET EFFETS TOXICOLOGIQUES DE NANOPARTICULES MANUFACTURÉES RECOUVERTES DE POLYMÈRES CHEZ LE POISSON-ZÈBRE (DANIO RERIO)

Lindsey C Felix, VA Ortega and GG Goss

University of Alberta

The toxicological response of aquatic animals resulting from exposure to manufactured nanoparticles (NPs) is a major issue in environmental risk assessment. We tested aqueous polymer-coated 5-6 nm metal-oxide TiO₂, ZnO, Fe₃O₄ and CeO₂ NPs manufactured by Vive Nano Inc to determine the metal core effect. Additionally, we tested nanocapsules, hollow polymer shells with the metal core removed by acid digestion, to determine the effect of the polymer coating. Physico-chemical properties including dissolution were measured in order to quantify the amount of free metal and metal released from the core over time. To determine the toxicological effect we exposed zebrafish embryos over a 72 hour period to a range (1, 10, 50, 100 and 200 mg l⁻¹) of each NP type following Organization for Economic Co-Operation and Development (OECD) guidelines. Our results indicate that free metal is a contaminant and there is no apparent effect of metal core or polymer coating on toxicity.

BIODIVERSITY AND BATS [ZET]

BIODIVERSITÉ ET CHAUVES-SOURIS

Brock Fenton

University of Western Ontario

The threat to biodiversity posed by invasive species such as pathogenic fungi, also extends to bats. Since March 2006 literally millions of little brown bats have died from White Nose Syndrome in the northeastern United States. WNS arrived in Canada (Ontario and Quebec) by March 2010 and we predicted large dieoffs of these bats in March 2011. This situation allows us to assess our conservation responsiveness. Bats also fall victim to "green" energy projects such as wind turbines, but the threat is not deemed large enough to curb the spread of these industrial installations. But bats also are affected in a different way by disease - persecuted as carriers of diseases that affect people (e.g., rabies, SARS, Ebola, histoplasmosis). Bats are said to be beneficial to humans because they spread seeds, pollinate plants and eat insects. But can this putative positive side outweigh the risks they supposedly represent? In the end, habitat loss, often because of urban sprawl and conversion to agricultural landscapes may pose a greater threat to the future of the biodiversity of bats (and amphibians)!

INFLUENCE OF HEPATOZOON SPP. (PHYLUM APICOMPLEXA) ON HOST-SEEKING AND HOST-CHOICE BEHAVIOUR OF TWO CULEX SPECIES [PAR1]F

INFLUENCE DE HEPATOZOON (EMBRANCHEMENT APICOMPLEXA) SUR LE COMPORTEMENT DE RECHERCHE ET DE CHOIX D'HÔTE CHEZ DEUX ESPÈCES DU GENRE CULEX

Laura Ferguson, NK Hillier and TG Smith

Acadia University

Host-seeking behaviour of *Culex territans* infected with *Hepatozoon clamatae*, and *Culex pipiens* infected with *Hepatozoon sipedon*, on an infected frog or snake, respectively, was recorded at 15 and 30 d post-feeding to determine if these parasites manipulated host-seeking behaviour. We found that host-seeking behaviour did not change over the course of the infection in either species of mosquito, although results for *C. territans* were confounded by egg retention. In addition, paired choice trials were designed to allow *C. territans* to choose between green frogs infected with *H. clamatae* and uninfected green frogs, as well as between frogs with varying levels of infection. Results indicate that mosquitoes do not readily distinguish between uninfected frogs and frogs with low or moderate infections (0.1-2.0% RBCs infected); however, although not statistically significant, a slight trend suggests that

mosquitoes may discriminate and preferentially choose frogs with high infections (>2.0%).

FORTUITOUS RE-IDENTIFICATION OF SECRETORY CELLS WITH UNDEFINED ROLES IN PARASITISM [PAR2]F

RÉ-IDENTIFICATION FORTUITE DE CELLULES SÉCRÉTRICES AU RÔLE PARASITIQUE INDÉTERMINÉ

Jennifer Fitzpatrick, S Belfry and MS Duffy

University of New Brunswick

While there is plenty of research devoted to secretory glands of plant-parasitic nematodes, remarkably little is known of these cells in nematodes infecting animals. The role of these secretory cells seems obvious with secretion of proteins into host tissues facilitating nematode survival and longevity. Secreted glycans from *Parelaphostrongylus tenuis* were being investigated when these cells were re-discovered. Originally identified by Anderson (1956), these two cells occupy up to 10% of worm length, each cell full of secretory vesicles. Proteins secreted from the excretory glands of *P. tenuis* are being investigated to help determine a functional role for these unique gland cells. Light microscopy, electron microscopy, and immunogold labeling were used to identify cellular and sub-cellular structures, and for epitope localization, respectively. Improved understanding of nematode immune evasion and modulation depends on characterization of products secreted from these unique cells.

JUMP-STARTING THE DAWN CHORUS: MALE BLACK-CAPPED CHICKADEES BEGIN DAWN SINGING EARLIER IN RESPONSE TO SONG PLAYBACK [EEE3]

RELANCE DES CONCERTS MATINAUX DES OISEAUX : LES MÊSANGES À TÊTE NOIRE MÂLES COMMENCENT À CHANTER PLUS TÔT EN RÉPONSE À L'ÉCOUTE D'UN ENREGISTREMENT DU CHANT

Jennifer Foote¹, LP Fitzsimmons², DJ Mennill³ and LM Ratcliffe⁴

¹Algoma University; ²Carleton University; ³University of Windsor; ⁴Queen's University

Variation in the level of competition for mates and territories is likely to influence the behaviour of competitors. The start of the dawn chorus in songbirds is influenced by a variety of internal factors (circadian rhythms) and external factors (light levels, social cues). Here we investigate whether the start time of the dawn chorus is influenced by the singing behaviour of conspecific competitors. We used playback to simulate an unfamiliar male performing a dawn song bout within an existing (focal) male's territory. Playback began 15 min before the earliest song sung by any male on the preceding (control) day. Focal males and neighbours began singing significantly earlier on the day of playback compared to the control day. Changes in dawn chorus timing were thus detected at both the individual and communication network level. Our results show that animals adjust the timing of their sexual communication in response to increased levels of competition.

THE ROLE OF DIETARY PUFAS IN WHITE NOSE SYNDROME [CPB19]

RÔLE DE LA PRISE ALIMENTAIRE DE PUFAS DANS LE SYNDROME DU NEZ BLANC

Craig L Frank¹, RM Brigham² and TM Kunz³

¹Fordham University; ²University of Regina; ³Boston University

The torpor bouts of bats affected by White Nose Syndrome (WNS) are reduced in length, but the cause of this is unknown. Studies on other mammals revealed that moderately high levels of polyunsaturated fatty acids (PUFAs) are required in the diet for torpor. We predicted that the diets of bat species not susceptible to WNS have higher levels of PUFAs than those of species that are susceptible to WNS, and, that the fall diets of bat populations where WNS does not occur have relatively higher PUFA contents than those of populations where WNS occurs. We analyzed white adipose tissues from: *Myotis lucifugus* at different sites, and, *Eptesicus fuscus*. The fall diets of *E. fuscus* contain more linoleic acid than those of *M. lucifugus* collected from the same mine with WNS, and, *M. lucifugus* populations prone to WNS have less alpha-linolenic acid in their diets than those without WNS.

WARMER CLIMATES WEAKEN LATITUDINAL GRADIENTS [EEE1]L

LES RÉCHAUFFEMENTS CLIMATIQUES AFFAIBLISSENT LES RÉPARTITIONS LATITUDINALES

Danielle Fraser, R Gorelick and N Rybczynski

The strength of latitudinal diversity gradients has varied through time within several non-vertebrate lineages. We tested the hypothesis that the degree of differentiation between northern and southern faunas decreases during global warming and increases during global cooling by investigating the diversity patterns of Cenozoic hoofed mammals and proboscideans. We created occurrence matrices (genera and species) and tested for a correlation between diversity and latitude during the mid (~15 Ma) and late Miocene (~7 Ma) using correspondence analysis. We did not find a significant relationship during mid Miocene global warming. However, we found a significant relationship between latitude and both species and genus diversity during late Miocene global cooling. The warm conditions of the former apparently extended the tolerance zones of hoofed mammals and proboscideans, reducing diversity differences between northern and southern faunas. In contrast, the cool conditions of the late Miocene apparently resulted in a reduction of those tolerance zones.

QUANTITATIVE PCR ASSESSMENT OF LOMA MORHUA INFECTIONS IN ATLANTIC COD [PAR2]F
ÉVALUATION DES INFECTIONS DE LOMA MORHUA PAR PCR QUANTITATIF CHEZ LA MORUE DE L'ATLANTIQUE

Aaron P Frenette, MDB Burt and MS Duffy
University of New Brunswick

Infections caused by the intracellular parasite *Loma morhua* pose an immediate threat to the production level of the developing cod aquaculture industry in Atlantic Canada. The current research focus aims to identify cod family lines that show natural resistance to *L. morhua* infections. Morphological examination of infected fish has identified the spleen as the most reliable organ for detection of infection. Spleens from 1696 cod, representing 49 different family lines, were collected following three years of aquaculture in sea cages. Gross examination revealed 44% with putative *L. morhua* infections and the remaining 56% were apparently uninfected. Since not all parasite life stages result in visible lesions, qPCR will be employed to detect *L. morhua* reliably and to quantify the level of infection for indication of genetic resistance.

A PERFECT STORM - CONSERVATION THREATS FACING WOODLAND CARIBOU IN ONTARIO

[EEE S]

UNE TEMPÊTE PARFAITE – LES DANGERS QUI MENACENT LA CONSERVATION DES CARIBOUS DANS LA FORÊT ONTARIENNE

John Fryxell
University of Guelph

Woodland caribou in Ontario have experienced substantial range retraction across large parts of Ontario. Vital rates analysis suggests that range retraction has been accompanied by unsustainable levels of mortality, largely due to predation. Using simulation models, I explore the possible role played by several contributory processes, including caribou movement, habitat change, apparent competition, and predator population dynamics. As a first step toward reversing these trends, I also outline an adaptive management framework designed to identify the most beneficial conservation interventions.

DO PINK SALMON POSSESS A WINDOW OF SALINITY TOLERANCE ASSOCIATED WITH SEA-WATER ENTRY? [CPB20]

LES SAUMONS ROSES POSSÈDENT-ILS UNE FENÊTRE DE TOLÉRANCE À LA SALINITÉ ASSOCIÉE À L'ENTRÉE D'EAU DE MER?

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Pink salmon (*Oncorhynchus gorbuscha*) migrate to seawater (SW) at (0.2 g) immediately following gravel emergence. Most salmon spend 1 or more years in freshwater (FW), and become physiologically prepared for SW entry while in FW (smolt). Whether a window of salinity tolerance similar to that of a smolt exists for pink salmon is unknown. To characterize the development of SW tolerance in pink salmon, fish were sampled in FW every two weeks

for six months post-hatch and transferred every two weeks to SW and sampled at 24 h, 5 d, 2 wk, 4 wk, and 8 wk post-transfer. SW-induced-morbidity, whole body water and ion content, and gill Na⁺K⁺ ATPase mRNA a1 FW and SW isoform expression were examined. A window of salinity tolerance was found to exist corresponding with the time of natural out-migration. Within this window fish in FW decreased gill Na⁺K⁺ ATPase mRNA a1 FW isoform expression, and increased the expression of the SW isoform providing evidence that pink salmon do have a smolt-like phase.

FROM JELLYFISH TO BIOPHYSICS: COMPARATIVE APPROACHES TO UNDERSTANDING K⁺ CHANNEL PROTEIN FUNCTION [Spencer]

DES MÉDUSES JUSQU'À LA BIOPHYSIQUE: APPROCHES COMPARATIVES POUR COMPRENDRE LES FONCTIONS DES CANAUX POTASSIQUES

Warren J Gallin

University of Alberta

Over 600 million years of evolution has generated variants of ion channel proteins by mutation and winnowed these variants for functionality by natural selection. The nervous system of every animal differs in function, so ion channels from any organisms have the potential to yield novel information about the basic mechanisms of the channel structure-function relationship when viewed in a comparative perspective. We have been collecting an extensive sample of voltage-gated potassium channels from phylogenetically diverse organisms, using comparative approaches to identify functional intra-channel interactions, and formulating a generalized model how intra-molecular interactions set kinetic and steady-state behaviors of these channels. I will discuss two lines of inquiry; analysis of the interplay between inter-helix loop length and steric packing within the voltage sensor domain of Kv1 family channels from *Polyorchis penicillatus* and *Mus musculus*, and the discovery of a naturally occurring omega current in a Kv3 channel from *Notoplana atomata*.

REGULATION OF INTESTINAL NaCl TRANSPORT BY BICARBONATE AND ADENYLYL CYCLASES IN KILLIFISH [CPB20]

RÉGULATION DU TRANSPORT INTESTINAL DU NaCl PAR LES BICARBONATE ET ADÉNYLATE CYCLASES CHEZ LES CYPRINODONTIFORMES

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Osmoregulation in marine fish depends on water absorption across the intestinal epithelium, which is driven by NaCl absorption and facilitated by bicarbonate secretion into the lumen. We investigated the regulation of intestinal NaCl transport by bicarbonate and adenylyl cyclases (AC) in the anterior intestine of seawater-acclimated killifish, *F. heteroclitus*. Addition of bicarbonate to the bath stimulated NaCl absorption in a dose-dependent manner, estimated from increases in the serosal-negative short-circuit current (I_{sc}). This stimulation was blocked by 4-catechol estrogen, an inhibitor of soluble AC (sAC), but it was insensitive to 2', 5'-dideoxyadenosine, an inhibitor of transmembrane AC (tmAC). On the other hand, the tmAC activator forskolin induced a reduction in I_{sc}, indicating inhibition of NaCl absorption or stimulation of NaCl secretion. We hypothesize sAC- and tmAC-dependent intracellular signaling in fish intestine occurs in distinct intracellular microdomains, which differentially regulate ion-transporting proteins such as NKCC, NKA and CFTR.

FREE FLYING SWAINSONS THRUSHES (CATHARUS USTULATUS) CATABOLIZE PROTEIN AS A SOURCE OF ENDOGENOUS WATER [Hoar]

LES GRIVES À DOS OLIVE CATABOLISENT LES PROTÉINES COMME SOURCE ENDOGÈNE D'EAU DURANT LE VOL

Alexander Gerson and CG Guglielmo

University of Western Ontario

Migrant birds catabolize both lipids and protein during flight, but the factors determining protein catabolism in flight have not been thoroughly investigated. Protein catabolism yields five times more endogenous water than the

catabolism of lipids, and may act as a source of water in flight. To test this hypothesis, Swainsons thrushes (*Catharus ustulatus*) were flown in a climatic wind tunnel at 18°C under conditions of high evaporative water loss and low evaporative water loss. Fuel mixture was determined using plasma metabolite analysis, and by measuring changes in fat and lean mass using quantitative magnetic resonance. Under high evaporative water loss conditions birds catabolized more lean mass resulting in a 20% increase in endogenous water production over low evaporative water loss flights. These results demonstrate that humidity affects fuel mixture in flying birds, and suggests that protein storage during migration may in part be a metabolic strategy to provision water.

HISTONE MODIFICATION IN POLYCHAETE EMBRYOS- A LINK WITH PHENOTYPIC DIVERGENCE? [CMD1]

MODIFICATION D'HISTONE DANS LES EMBRYONS DE POLYCHÈTES – UN LIEN AVEC LA DIVERGENCE PHÉNOTYPIQUE

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Our objective was to determine if epigenetic mechanisms such as histone modifications are linked to larval development mode in polychaetes. Some species of spionid polychaete exhibit variation in development resulting in the production of dimorphic young. We used immunohistochemistry to examine histone modifications in embryos of both morphs. Preliminary results suggest that histone modifications occur in spionid embryos. Both histone acetylation (H3K14ac) and methylation (H3K9 monomethylation) were detected. Differences between morphs were found in the cell lineages in which histone modifications occurred (H3K14ac) as well as the developmental stage at which the modifications could be detected (H3K9me1). Additionally, some histone modifications appeared to be influenced by maternal diet. Although preliminary, these results suggest a potential mechanism by which phenotypic divergence can occur in larval development.

CEREBELLAR DEVELOPMENT IN A PRECOICIAL SPECIES WITH COMMENTS ON HETEROCHRONY IN NEURODEVELOPMENT [CMD1]H

DÉVELOPPEMENT CÉRÉBELLEUX DANS UNE ESPÈCE NIDIFUGE ET COMMENTAIRES SUR L'HÉTÉROCHRONIE DU NEURODÉVELOPPEMENT

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The cerebellum is a complex region of the brain associated with the coordination of motor skills. In altricial rodents various antigens have been used to describe the morphology of the cerebellum throughout development. In contrast, little is known about the cerebellar development in precocial species. We investigated cerebellar development of the embryonic chick using western blot analysis and immunohistochemistry focusing on three antigens: Calbindin, Calretinin and Zebrin II. To examine whether cerebellar development is accelerated in precocial species we compared our chick data to previous results obtained from mice, a species with a matching embryonic period (~21 days) and determined that the initial onset and expression of all three antigens is consistently 5 to 7 days earlier in (precocial) chicks than (altricial) mice. We hypothesize that the advanced level of motor coordination observed in precocial species is linked to the accelerated maturation of the cerebellum.

THE EVOLUTION OF THE REGULATORY CONTROL OF THE VERTEBRATE HEART; THE ROLE OF PROTEIN PHOSPHORYLATION [CPB11]

L'ÉVOLUTION DU CONTRÔLE RÉGULATOIRE DU COEUR DES VERTÉBRÉS ET LE RÔLE DE LA PHOSPHORYLATION DES PROTÉINES

Todd E Gillis

University of Guelph

Beta-adrenergic stimulation is a critical pathway for increasing the output of the vertebrate heart. The activation of Beta-receptors increases the activity of protein kinase A (PKA) that then targets specific regulatory proteins for phosphorylation. We have been working to characterize the role that the phosphorylation of cardiac troponin I (cTnI) and myosin binding protein C (MyBP-C) by PKA plays in regulating contractile function and how this re-

sponse has evolved within the vertebrate heart. This work includes examining the influence of PKA on the function of recombinant troponin complexes and the contractile function of skinned trout cardiac trabeculae. We have also completed phylogenetic analysis to model how cTnI and MyBP-C have evolved within vertebrate striated muscle. Together these studies demonstrate that as the anatomy and function of the vertebrate heart has become more complex the ability of the contractile proteins to modulate contractile function has also increased.

FISH IN HOT WATER: WHAT TRIGGERS CATECHOLAMINE MOBILIZATION? [CPB12]

LES POISSONS DANS L'EAU CHAUDE: QU'EST-CE QUI DÉCLENCHÉ LA MOBILISATION DES CATÉCHOLAMINES?

Kathleen M Gilmour¹, SF Perry¹ and S Currie²

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Rainbow trout exposed to a heat shock (1 h at 25°C after raising water temperature from 13°C to 25°C over 1 h) mount a significant catecholamine response. This study aimed to investigate the proximate mechanisms underlying catecholamine mobilization. Use of warmed saline in an *in situ* saline-perfused posterior cardinal vein preparation ruled out heat itself as a trigger for catecholamine secretion at the level of the chromaffin cells. Trout exposed to heat shock *in vivo* exhibited a significant reduction in arterial O₂ tension but not O₂ content, and catecholamine release was not prevented by exposure to heat shock during hyperoxia. Thus, catecholamine mobilization probably was not triggered by impaired blood O₂ transport. Heat-shocked trout also exhibited a respiratory acidosis, an elevation of arterial CO₂ tension coupled with a fall in arterial pH. Catecholamine mobilization during heat shock in rainbow trout may be triggered by activation of central thermoreceptors.

EFFECT OF SEROTONIN ON MITOCHONDRIAL MEMBRANE POTENTIAL IN PRIMARY CULTURES OF EMBRYONIC CELLS FROM THE POND SNAIL, *HELISOMA TRIVOLVIS* [CPB6]

*L'EFFET DE LA SÉROTONINE SUR LE POTENTIEL MEMBRANNAIRE MITOCHONDRIAL DANS DES CULTURES PRIMAIRES DE CELLULES EMBRYONNAIRES CHEZ L'ESCARGOT *HELISOMA TRIVOLVIS**

Jeffrey I Goldberg, DR Rich, J Haddad, EC Boychuk and R Tam

University of Calgary

Helisoma trivolvis embryos contain serotonergic neurons that mediate both behavioral and metabolic responses to hypoxia. Initial experiments on whole embryos suggested that the metabolic response involves widespread increases in mitochondrial membrane potential (MMP). To validate the whole embryo experiments and determine whether serotonin directly affects MMP in most cells, CMXRos Mitotracker Red (CMR) was used to assess MMP in primary cultures of dissociated embryonic cells. Cultures were loaded with CMR before or after the treatments. In both cases, the mitochondrial uncoupler carbonyl cyanide m-chlorophenyl hydrazone (10 µM) and serotonin (100 µM) caused a significant decrease and increase in CMR fluorescence, respectively. These responses were observed in nearly all cells examined. These data suggest a global neurohormonal role for serotonin, whereby it prevents hypoxia-induced cell death by increasing MMP.

PCBS INDUCE HOMEOVISCIOUS RESPONSE IN GOLDFISH GILLS [CPB8]

LES BPC INDUISENT LA RÉPONSE HOMÉOVISQUEUSE DANS LES BRANCHIES DU CYPRIN DORÉ

Alexander Gonzalez and J-M Weber

University of Ottawa

The fluidizing effect that ensues when ortho-substituted polychlorinated biphenyls, a well-known class of industrial pollutant, intercalate into plasma membranes has received little attention. We hypothesized that PCB-153 would fluidize the cell membranes of exposed goldfish, and that this, in turn, would induce homeoviscous adjustments of the membranes' phospholipid composition. Goldfish were assigned into four treatment groups to assess the relative and combined effects of exposure to PCB-153 and temperature (20°C or 5°C for 30 days). Gills were then harvested to analyze the fatty acid composition of their membrane phospholipids. Results show a compensatory, homeoviscous response to PCB exposure, in the form of a 6% decrease in the average number of double bonds per fatty acid. This strongly suggests that homeoviscous adjustments are not mediated solely by temperature.

NESFATIN-1 REGULATES WHOLE BODY ENERGY HOMEOSTASIS IN RATS [CPB16]

LA NESFATINE-1 CONTRÔLE L'HOMÉOSTASIE ÉNERGÉTIQUE DU CORPS ENTIER CHEZ LE RAT

Ronald Gonzalez, R Perry, R Tsushima, R Ceddia and S Unniappan

York University

Nesfatin-1 is a recently discovered anorexigen produced in pancreatic beta cells and other tissues. The aim of this study was to characterize the effects of nesfatin-1 on whole-body energy homeostasis, insulin secretion and glycemia in male Fischer 344 rats. The *in vivo* physiological effects of continuous peripheral infusion of nesfatin-1 using sub-cutaneously implanted osmotic mini-pumps were examined in ad libitum-fed rats. The effects of nesfatin-1 on glucose-stimulated insulin secretion (GSIS) from islets and insulin-mediated glucose uptake in adipocytes were examined. Nesfatin-1 increased physical activity and fat oxidation, while cumulative food intake was reduced. While nesfatin-1 enhanced GSIS *in vivo* during an oral glucose tolerance test, glycemia was unaffected. Basal and insulin-mediated glucose uptake in adipocytes was stimulated in nesfatin-1 treated rats. Collectively, our data indicates that nesfatin-1 regulates insulin secretion, glucose homeostasis and whole-body energy balance in rats.

THE SECRET LIFE OF LOBSTERS: UNRAVELLING HOST-PARASITE INTERACTIONS IN OUR FAVOURITE CRUSTACEAN [PAR S]

LA VIE CACHÉE DES HOMARDS: MISE À NUE DES INTERACTIONS ENTRE LES HÔTES ET LES PARASITES CHEZ NOTRE CRUSTACÉ PRÉFÉRÉ

Spencer J Greenwood

Atlantic Veterinary College, University of Prince Edward Island

The Canadian lobster fishery annually adds ~\$1 billion to Atlantic Canada's economy and represents the country's most economically significant fishery. Our research concentrates on improving the understanding of host-pathogen-environment interactions and the impact this has on the wild fishery as well as during post-harvest storage. I will introduce the 'emerging' (*Neoparamoeba*) or 'perceived' (*Hematodinium*) protistan parasite threats to the lobster fishery but concentrate on the impact of post-harvest losses associated with the ciliated parasite, *Anophryoides haemophila*, the causative agent of bumper car disease. Details of the lobster's immune response are being discovered using our lobster DNA microarray while the parasites arsenal is being revealed through transcriptomic profiling. The presentation focus will be to explore the history of bumper car disease in the lobster fishery and to present our recent molecular approaches to unravel this host-parasite interaction.

HIERARCHICAL FORMATION IN RAINBOW TROUT UNDER THE INFLUENCE OF HIGH EXTERNAL AMMONIA [CPB10]

FORMATION DE HIÉRARCHIE CHEZ LA TRUITE ARC-EN-CIEL EXPOSÉE À UNE FORTE SOURCE EXTERNE D'AMMONIAC

Josias MB Grobler and CM Wood

McMaster University

A new technique, involving training fish to feed inside a darkened container and then capturing the fish using an identical dummy container to record physiological parameters, was used to establish social hierarchies in juvenile rainbow trout. Hierarchies were established within 10 days, with dominant individuals displaying higher growth rates, higher feeding rates, higher ammonia excretion, and higher instantaneous percent protein utilization compared to subordinates. Oxygen consumption did not vary significantly with respect to social rank, though subordinates tended to have higher values. We are now investigating the effect of high external ammonia on the formation of hierarchies and the resulting physiology of dominant and subordinate individuals. Environmentally relevant concentrations of total ammonia (100, 200, and 700 $\mu\text{mol l}^{-1}$ at pH 7.5) are being used to investigate this question. It is hypothesized that high external ammonia will reduce appetite and cause a reduction in aggression.

THE EFFECT OF DIFFERENT PREDATORS ON THE ESCAPE RESPONSE OF *PLACOPECTEN MAGELLANICUS* [EEE-CPB]

*L'EFFET DE DIFFÉRENTS PRÉDATEURS SUR LA RÉPONSE DE FUITE CHEZ *PLACOPECTEN MAGELLANICUS**

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We used force recordings during escape responses to compare how *Placopecten magellanicus* responds to starfish and crustacean predators. We predicted that scallops would respond more intensely to contact with predatory than with non-predatory starfish and crabs. We used a glass rod as a control. Total phasic contractions, maximal and mean phasic force, maximal tonic force and reliance on tonic contractions did not vary with the stimulus. However, the stimulus had a strong impact on the initial response. The number of phasic contractions in the first 10, 30 and 60 s differed between stimuli, with the mechanical control having the lowest intensity, followed by crabs, non-predatory starfish and then predatory starfish. Similarly, the minimal interval between phasic contractions showed that scallops react most strongly to the predatory starfish. Non-predatory starfish lead to stronger reactions than crabs, but the most vigorous escape response is reserved for predatory starfish.

REFLECTIONS ON THE ACADEMIC HERITAGE OF COMPARATIVE MORPHOLOGY & DEVELOPMENT [LOC]

RÉFLEXIONS SUR L'HÉRITAGE DES ÉTUDES EN MORPHOLOGIE COMPARÉE ET DÉVELOPPEMENT

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The legacy of giants within the community of Canadian zoologists is invariably a life's work of research excellence together with mentorship, inspiration, and opportunities provided to a brood of academic progeny. Most of the individuals who helped organize the Comparative Morphology and Development section of CSZ can trace their academic ancestry directly through one or more of three such giants: George O. Mackie, Fu-Shiang Chia, and Brian K. Hall. George Mackie pioneered groundbreaking (and often breath-taking) research on the structure and function of invertebrate neural and cellular communication systems; Fu-Shiang Chia inspired a generation of marine invertebrate larval biologists from a home base in land-locked Edmonton; and Brian Hall led us into the exciting world of Evo-Devo from his core research on vertebrate neural crest and skeletogenesis. F. Ronald Hayes, Helen Battle and John Youson (all Fry Medalists) pioneered embryological studies of salmon and lampreys. Ian McLaren gave us the "McLaren effect."

CHARACTERIZING DETERMINANTS OF SNAIL RESISTANCE TO DIGENTIC TREMATODE INFECTION [PAR2]

CARACTÉRISATION DES DÉTERMINANTS DE LA RÉSISTANCE À L'INFECTION PAR DIGENEA CHEZ L'ES-CARGOT

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Compatibility between snails and digenetic trematodes is determined by multiple factors. The planorbid snail *Biomphalaria glabrata* serves as the intermediate host for a number of trematodes including the human parasite *Schistosoma mansoni*. Transcriptional studies have identified factors that display differential expression profiles between resistant and susceptible snails, and some of these factors have been functionally linked to defense. FREP3 displays increased expression in resistant *B. glabrata* snails following challenge with *S. mansoni* and *Echinostoma paraensei*. It plays a role in the generation of a successful defense response by inducing phagocytosis and acting as an opsonin. Specific suppression of FREP3 expression by RNAi in resistant snails results in a loss of the resistance phenotype. Moreover, successful parasitism of *B. glabrata* by *E. paraensei* naturally suppresses FREP3 expression, allowing the snail to be infected by parasites it would otherwise be resistant to.

THE THERMAL BREADTH OF AEROBIC SCOPE IN A EURYTHERMAL FISH, FUNDULUS HETEROCLITUS [CPB3]

L'ÉTENDUE THERMIQUE DES CAPACITÉS AÉROBIQUE CHEZ UN POISSON EURYTHERMIQUE, FUNDULUS HETEROCLITUS

Timothy M Healy and PM Schulte

University of British Columbia

Decreases in aerobic scope at high and low temperatures have been suggested to limit organismal thermal performance and tolerance. Eurythermal species, by definition, have both wide thermal tolerance windows and wide thermal breadths of performance, but because most previous studies have been performed on acclimated fish, it is not clear whether eurythermality is a result of generally wide thermal breadth, or a large capacity for acclimation. To address this question, we measured the aerobic scope of a eurythermal fish, *Fundulus heteroclitus*, after acclimation or acute exposure to temperatures from 5 to 33°C. Our data suggest that the thermal breadth of aerobic scope in *Fundulus heteroclitus* is large even when they are acutely challenged with temperature change, and that, although acclimation has significant effects on aerobic scope, the effects lead to only a relatively small increase in thermal breadth.

CALCIUM-MEDIATED MUCIN DEPLOYMENT IN THE SLIME OF HAGFISHES [CPB9]

DÉPLOIEMENT DE MUCINE FACILITÉ PAR LE CALCIUM DANS LE MUCUS DES MYXINES

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The defensive slime produced by hagfishes is composed of mucins, intermediate filament threads, and seawater. The mucins are packaged into membrane-bound vesicles that are delivered from slime glands to the external environment by holocrine secretion. Vesicles rupture when they come into contact with seawater. We hypothesized that rupture is due to an influx of inorganic ions and water molecules from seawater into the vesicle via channels in the vesicle membrane, resulting in the rapid expansion of the mucin network. Isolated mucin vesicles were exposed to a variety of salt solutions and ion channel inhibitors. Approximately 60% of vesicles ruptured only when calcium ions were present at a concentration of 4 mM or higher, and at a faster rate than free media calcium-independent vesicles. This suggests that there are two separate classes of hagfish slime mucin vesicles; one exhibiting calcium-triggered rupture, and the other exhibiting rupture that is not ion-specific.

NITROGEN EXCRETION BY FRUIT EATING BATS FED CONTRASTING SUGAR-DENSITY DIETS [CPB S]

EXCRÉTION D'AZOTE CHEZ LES CHAUVES-SOURIS MANGEUSES DE FRUITS NOURRIES DE DIÈTES CONTENANT DIFFÉRENTES DENSITÉS DE SUCRE

L Gerardo Herrera¹, J Osorio² and C Mancina³

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We compared N excretion in two groups of Great Fruit-eating bats *Artibeus lituratus* (Phyllostomidae) fed energy-poor or energy-rich diets. We predicted that N excreted as ammonia would increase in bats on the energy-poor diet. Most bats on the energy-rich diet were ureotelic whereas on the energy-poor diet an equal proportion of bats were ureotelic, ammonotelic or ureo-ammonotelic. Bats fed the energy-poor diet had a higher production of ammonia and a higher percent of nitrogen excreted as ammonia. Percent N ammonia was inversely related to energy intake and directly related to volumetric food intake. Ammonia production was inversely related to energy intake. By favoring ammonia production over urea, bats on the energy-poor diet can save up to 1% of their basal metabolic rate. Consumption of energy-dilute fruits in the wild by fruit bats might favor the production of ammonia when it is accompanied by the ingestion of large volumes of water.

TIME-VARYING MOTOR CONTROL OF AUTOTOMIZED GECKO TAILS [CPB13]

CONTRÔLE MOTEUR DE LA QUEUE DU GECKO SUITE À L'AUTOTOMIE

Timothy E Higham¹ and AP Russell²

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Autotomy (voluntary loss of an appendage) is widespread among diverse groups of vertebrates and invertebrates, and much attention has been given to ecological and developmental aspects of tail autotomy in lizards. Although most studies have focused on the ramifications for the lizard (behavior, biomechanics, energetics, etc.), the tail itself can exhibit interesting behaviors once segregated from the body. Little is known, however, about the control mechanisms underlying these movements. Using electromyography, we examined the time-varying motor patterns at four sites (two proximal and two distal) in the tail of the leopard gecko following autotomy. For rhythmic swings

we found that burst duration, but not cycle duration, reached a plateau at approximately 150 seconds following autotomy. For flips/jumps the coefficient of variation in motor patterns was significantly greater than for rhythmic swings. These findings support the conclusion that the different tail behaviors do not stem from overlapping pattern generators, but instead are the outcome of independent types of signal.

SURVIVING FREEZING: IMPACTS ON THE IMMUNE SYSTEM [Hoar]

SURVIVRE À LA CONGÉLATION: LES IMPACTS SUR LE SYSTÈME IMMUNITAIRE

Helen Holden and KB Storey

Carleton University

The wood frog, *Rana sylvatica*, belongs to a small, unique group of amphibians that survives whole body freezing over the winter. Wood frogs may be frozen for weeks at a time during which their vulnerability to pathogens was questioned. Antimicrobial peptides (AMPs), effector molecules of innate immunity commonly found in frog skin, provide the first line of defense against environmental microbes. RT-PCR was used to analyze the gene expression of wood frog AMP (brevinin-1SY) in response to freezing or its associated stresses (dehydration, anoxia). Freezing (24 h) caused brevinin-1SY mRNA levels to decrease significantly in dorsal skin and large intestine compared to controls (5°C acclimated), whereas dehydration (40% of total body water lost) produced significant increases in AMP mRNA in ventral skin, dorsal skin and lung. Anoxia exposure (24 h) significantly decreased small intestine AMP mRNA levels. Furthermore, during tadpole development, brevinin-1SY expression correlated strongly with the end stages of metamorphosis.

TEACHING PACKAGES FOR UNDERGRADUATE LABORATORY EDUCATION [TEA]

TROUSSE D'ENSEIGNEMENT POUR L'ÉDUCATION EN LABORATOIRE CHEZ LES ÉTUDIANTS NON-DIPLÔMÉS

Stephen Hunt

Qubit Systems Inc.

Qubit Systems Inc. (Queen's University Biological Instrumentation and Technology) designs and manufactures a wide range of teaching packages for undergraduate laboratory education. The range and scope of these packages will be discussed, and examples presented of standard experiments from the laboratory manuals, as well as experiments devised by students for hypothesis testing. The data acquisition software is intuitive, so that students can use this as a platform for conducting very diverse experiments, such as studies of mitochondrial respiration in aqueous suspension, fish respirometry, insect and animal respirometry in the gas phase, and human exercise physiology. The software includes numerous analytical features, most of which can be automated to allow for rapid data evaluation. The teaching packages are modular, so components can be shared across different laboratories and departments (e.g. animal and plant science) for cost-effective use of limited teaching funds.

ELECTROCOMMUNICATION PLAYBACKS AND SIGNAL CHARACTERIZATIONS IN A SPECIES OF WEAKLY ELECTRIC FISH, *APTERONOTUS LEPTORHYNCHUS* [EEE3]

*ENREGISTREMENT DE LA COMMUNICATION ÉLECTRIQUE ET CARACTÉRISATION DES SIGNAUX CHEZ UNE ESPÈCE DE POISSONS FAIBLEMENT ÉLECTRIQUES, *APTERONOTUS LEPTORHYNCHUS**

Ginette Hupé and JE Lewis

University of Ottawa

Weakly electric fish produce communication signals called chirps during social interaction. We examine chirping behaviours using a novel playback paradigm to explore the chirping behaviour of male *Apteronotus leptorhynchus* in response to intruder mimics with variable chirp patterning styles. In the first scenario, chirps were delivered through the simulated intruder interactively, echoing chirps produced by the real fish; in the second chirps were delivered in a random sequence. In the third simulated intruder scenario, the mimic signal contained no chirps. In response to the playbacks, chirps were produced in bursts, with the longest preferred ICIs tending to occur in response to the interactively chirping mimics. Interactive chirp delivery induced an echo response in the majority of trials, whereas random chirp delivery inhibited the echo response in approximately half of the fish tested. The stimulus dependent differences in chirp patterns change over the course of the simulated interaction.

THE REGULATION OF INSULIN-LIKE GROWTH FACTOR 3 IN THE OVARY OF ZEBRAFISH [CPB16]

LA RÉGULATION DU FACTEUR DE CROISSANCE SEMBLABLE À L'INSULINE 3 DANS L'OVAIRE DES POISSONS ZÈBRES

David A Irwin and G Van Der Kraak

University of Guelph

The insulin-like growth factor (IGF) system has garnered attention for its potential role in ovarian development in fish with the recent discovery of the gonad specific IGF-3. The current studies use real-time PCR to examine the regulation of IGF-3 gene expression in the ovary of zebrafish. Growth hormone, a regulator of the IGF system, had no effect on IGF-3 expression. Whereas, the gonadotropin analog human chorionic gonadotropin (hCG) and the adenylate cyclase activator forskolin stimulated IGF-3 gene expression in full grown and mid-vitellogenic follicles. H-89, a protein kinase A inhibitor, blocked the actions of hCG on IGF-3 expression. IGF-3 gene expression is dramatically reduced in follicles treated with the protein kinase C activators PMA and A23187. A smaller reduction in gene expression was seen in full grown follicles treated with prostaglandins. These results demonstrate hCG through a cAMP-dependant pathway up-regulates IGF-3 while prostaglandins down-regulate IGF-3; possibly through a PKC-dependant pathway.

SOCIAL STATUS AFFECTS CORTISOL RESPONSIVENESS TO ACUTE STRESS IN RAINBOW TROUT [CPB12]

LE STATUT SOCIAL AFFECTE LA SENSIBILITÉ AU CORTISOL LORS D'UN STRESS AIGÛ CHEZ LA TRUITE ARC-EN-CIEL

Jennifer D Jeffrey¹, M Gollock² and KM Gilmour¹

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Social hierarchies form in pairs of juvenile rainbow trout (*Oncorhynchus mykiss*) through competition over limited resources. Dominant fish establish and maintain their high social status through acts of aggression, causing sustained, high cortisol levels in subordinate fish. The chronic stress experienced by subordinate fish begs the question of how these fish are able to deal with additional, acute stressors. Analysis of plasma cortisol concentrations *in vivo* showed that the cortisol response of subordinate fish to an acute netting stress was attenuated compared to that of dominant fish. *In vitro* studies indicated that attenuation occurs at the level of the interrenal cells, which exhibited an attenuated cortisol response to ACTH. We investigated the underlying causes of this attenuated cortisol response through gene expression analysis of key players in cortisol synthesis at the level of the interrenal cells.

THE EFFECTS OF SENESCENCE ON ADULT SOCKEYE BLOOD PLASMA AND GENE EXPRESSION [CPB20]

EFFETS DE LA SÉNESCENCE SUR LE PLASMA SANGUIN ET L'EXPRESSION GÉNÉRIQUE CHEZ LES SAUMONS ROUGES ADULTES

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Sockeye salmon are semelparous, which means they die shortly after spawning. The rapid senescence that occurs post-spawning in adult sockeye salmon is characterised by immunosuppression and organ deterioration, but at present the physiological mechanisms involved in final senescence and mortality remain unknown. We collected wild sockeye salmon and held them in a laboratory environment to evaluate the effects of final senescence on blood plasma and gill tissue gene expression. As fish died, they were characterised by a 20-40% decrease in plasma osmolality and chloride, likely representing a complete loss of osmoregulatory ability. Plasma chloride was a strong predictor of longevity and plasma levels began to decline 2-10 days before the fish became moribund. We compared changes in gene expression profiles using 16K gene cDNA microarrays to examine cellular processes affected by final senescence. These results will provide insight into the physiological mechanisms involved in mortality in adult sockeye salmon.

INVASIVE SPECIES (DREISSENA, BYTHOTREPES, CERCOPAGIS) DEPRESS MAJOR FOOD

SOURCE OF FISH IN LAKE ONTARIO: MYSIS DILUVIANA (THE OPOSSUM SHRIMP) [EEE2]

LES ESPÈCES INVASIVES (DREISSENA, BYTHOTREPHES, CERCOPAGIS) DIMINUENT LES PRINCIPALES SOURCES DE NOURRITURES DANS LE LAC ONTARIO : MYSIS DILUVIANA (LACREVETTE OPOSSUM)

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Most impacts of invading species are indirect, mediated through alterations in food resources, predator attention, and habitat. These invading species were expected to alter mysid food supplies either directly or through impacts on competitors. A comparison between 1990-1995 (invaders essentially absent in deep waters) and 2002-2007 (invaders present) found roughly a 50% decline in density and biomass of *M. diluviana*. Simultaneously, mysid food resources declined; i.e., lower algal biomass, fewer zooplankton. In addition, the near loss of the August cohort correlated with high abundance of *Cercopagis* + *Bythotrephes* in mid-summer. Cohort mortality rates indicated that the population was now controlled predominantly by food resources. Prior to the invasions, production was negatively related to alewife predation. Thus control of the population has shifted away from top-down forces which were unrelated to invader impacts, and the recent change in cohort structure and decrease in total biomass are likely due to invader impacts.

DOSE-RESPONSE CURVES OF MORPHINE IN RAINBOW TROUT (ONCORHYNCHUS MYKISS) [CPB18]

COURBES DOSE-RÉPONSE DE LA MORPHINE CHEZ LA TRUITE ARC-EN-CIEL (ONCORHYNCHUS MYKISS)

Sarah Jones and D Stevens

University of Prince Edward Island

The CCAC has acknowledged that fish "may have the capacity to experience adverse states usually associated with pain in mammals". Currently there are not specific guidelines regulating pain control in fish. Fish are becoming more common in research and it is important to define a protocol to ensure proper health and welfare in fish. Morphine is the analgesic of choice for pain reduction in humans and has also been used in fish. Rainbow trout were challenged with an electrical stimulus-response test both before and after an intraperitoneal dose of morphine. Blood and brain samples were analyzed using LC-MS to measure the quantity of morphine in fish plasma and 3 parts of the brain. Our objective is to relate the change in stimulus threshold to the dose of morphine and to its concentration in the plasma and the brain.

SEPTATE JUNCTION GENES IN TRANSPORTING EPITHELIA OF LARVAL AEDES AEGYPTI: EFFECT OF REARING SALINITY [CPB21]

GÈNE DE JONCTIONS CLOISONNÉES DANS LE TRANSPORT ÉPITHÉLIAL DES LARVES DE AEDES AEGYPTI: EFFETS DE L'ÉLEVATION DE LA SALINITÉ

Sima Jonusaite, E Clelland, SP Kelly and A Donini

York University

Habitats of freshwater (FW) mosquito larvae can become salinated due to evaporation or winter road salting. Salinity-induced changes in transcellular transport activities have been suggested in the rectum, Malpighian tubules and anal papillae of larval *A. aegypti*; however, no data are available on the effects of salinity on paracellular transport. This study examined the presence of septate junction (SJ) genes and effects of brackish water (BW) acclimation on their expression levels in the osmoregulatory organs of *A. aegypti* larvae. The mRNA transcripts of seven SJ genes (mega, sinu, cor, srib, dlg, nrxIV, lgl) were detected in all osmoregulatory tissues examined in FW-reared larvae. Furthermore, long-term BW exposure was accompanied by a significant reduction in srib expression in the anal papillae. This is the first study to identify SJ genes in osmoregulatory epithelia of FW *A. aegypti* and data suggest that BW exposure may lead to changes in permeability of anal papillae.

CAN SILASTIC IMPLANTS BE USED TO MIMIC CHRONIC STRESS? INSIGHTS FROM THE PAINTED TURTLE [EEE-CPB]

EST-CE QUE LES IMPLANTS SILASTIC PEUVENT ÊTRE UTILISÉS POUR IMITER UN STRESS CHRONI-

QUE ? LE CAS DE LA TORTUE PEINTE

Véronique Juneau and G Blouin-Demers

University of Ottawa

Chronic stressors typically elevate circulating levels of the glucocorticoid (GC) stress hormones in vertebrates, and often negatively impact their fitness. The relationship between chronic stress and fitness, however, is equivocal in ecological studies, and poorly understood in oviparous reptiles. We want to determine how elevated GC levels affect the acute stress response, immune function, and reproductive success in a long-lived free-ranging reptile: the painted turtle. We conducted a validation study in controlled laboratory conditions to assess the effectiveness of Silastic implants at elevating levels of corticosterone. We made implants using medical-grade Silastic tubing filled with crystalline corticosterone. Wild-caught adult turtles were assigned to a treatment: control, sham, sealed implant or implant with holes. We inserted the implants subcutaneously then collected blood samples periodically over 28 days to monitor circulating corticosterone levels. Satisfactory results will allow us to mimic chronic stress and carry the project in the field this summer.

DISTRIBUTION AND EXPRESSION ANALYSIS OF TRANSCRIPTION FACTORS IN TISSUES AND PROGENITOR CELL POPULATIONS OF THE GOLDFISH (*CARASSIUS AURATUS* L.) IN RESPONSE TO GROWTH FACTORS AND PATHOGENS [Hoar]

*ANALYSE DE LA DISTRIBUTION ET DE L'EXPRESSION DES FACTEURS DE TRANSCRIPTION DANS DES CELLULES ET DES TISSUS PROGÉNITEURS CHEZ LE CYPRIN DORÉ (*CARASSIUS AURATUS* L.) EN RÉPONSE AUX FACTEURS DE CROISSANCE ET AUX PATHOGÈNES*

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University of Alberta

The differentiation of hematopoietic progenitor cells into functional mature cells is a tightly regulated process influenced by growth factors and orchestrated by the modulation of transcription factors (TFs), which then act to regulate gene expression. We report on the identification and distribution of TFs *runx1*, *cebp-alpha*, *cjun*, *cmyb*, *egr1*, *gata1*, *gata2*, *gata3*, *mafb*, *lmo2*, *pax5*, and *pu.1* in hematopoietic tissues and cell populations in the goldfish. Progenitor cells isolated from the goldfish kidney show increased levels of TFs known to be markers of hematopoietic stem cells and demonstrate dynamic changes in TF mRNA levels during cultivation. Furthermore, treatment of progenitor cells with recombinant goldfish kit ligand or colony-stimulating factor-1, caused increased mRNA levels of myeloid TFs. We also observed differential expressions of the TFs in progenitor cells following *in vivo* exposure of the goldfish to heat-killed *Aeromonas salmonicida* or live *Trypanosoma carassii*.

ONTARIO CONSORTIUM OF UNDERGRADUATE BIOLOGY EDUCATORS (OCUBE): USING THE UNCONFERENCE MODEL FOR A COMMUNITY OF PRACTISE [TEA]

CONSORTIUM ONTARIEN DES ÉDUCATEURS EN BIOLOGIE POUR ÉTUDIANTS NON-DIPLÔMÉS : UTILISER LA CONFÉRENCE PLURIPARTICIPATIVE COMME MODÈLE POUR LES COMMUNAUTÉS DE PRATIQUE

Tamara LJKelly

York University

oCUBE brings together dedicated Biology educators in a community of practise, sharing expertise and enthusiasm for teaching and learning in undergraduate biology education. Members of oCUBE provide peer support and feedback, working to improve student and instructor engagement, experience and learning. The annual oCUBE UnConference is built on sharing/disseminating challenges, successes, and proven techniques in Biology post-secondary education. The UnConference model provides a just-in-time method allowing members of the oCUBE community to explore topics of mutual interest. Topics range from helping to define scholarly practises within a teaching context, to using limited laboratory resources more effectively. There is no predetermined agenda to meetings; topics are decided during the first meeting using the dotmocracy method. While the UnConference model appears less formal than a traditional conference (requiring minimal overhead), several end-products are generated. This helps place our conversations into a larger context and provides valuable information within and beyond our community. Here we explore the oCUBE UnConference/Dotmocracy model, including lessons learned and key factors for success (e.g., Rules of UnConference Enabling Constraints).

NO LONGER A ONE-TRICH PONY: TRICHOMONAS GALLINAE IN MARITIME WILD BIRD POPULATIONS [PAR1]F

IL A PLUS D'UNE CORDE À SON ARC : TRICHOMONAS GALLINAE CHEZ DES POPULATIONS SAUVAGES D'OISEAUX MARINS

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In the summer and fall of 2007-2009, mortalities due to trichomonosis occurred in the Maritime provinces' purple finch (*Carpodacus purpureus*) and American goldfinch (*Carduelis tristis*) populations. The disease, caused by *Trichomonas gallinae*, is often reported at backyard feeding and watering stations, raising questions about disease transmission. Columbiformes are well known reservoir hosts for the parasite and are fed by the general public. Therefore, columbiformes were sampled at local birdfeeding sites to determine if isolates recovered were genetically similar to that causing mortality in sympatric finch species. *T. gallinae* was isolated from 9/40 wild columbiformes and from one of two wild bald eagles (*Haliaeetus leucocephalus*) held for a short time in a rehabilitation facility. Isolates were cultured and then genotyped by polymerase chain reaction and DNA sequencing revealing that at least two genotypes of *T. gallinae* presently endemic in Maritime bird populations.

DO GHRELIN AND NESFATIN-1 INTERACT TO REGULATE FEEDING IN GOLDFISH? [CPB16]

LA GHRÉLINE ET LA NESFATINE-1 INTERAGISSENT-ELLES POUR CONTRÔLER LA PRISE ALIMENTAIRE CHEZ LE CYPRIN DORÉ?

Brent Kerbel and S Unniappan

York University

Ghrelin and nesfatin-1 are two endocrine factors that regulate food intake in vertebrates. Ghrelin (orexigen) increases, while nesfatin-1 (anorexigen) reduces food intake in goldfish. Recently, these peptides were found co-localized in gastric oxyntic cells of rats, suggesting they are functionally related in mammals. We studied whether ghrelin and nesfatin-1 interact to regulate feeding in goldfish. Co-localization of ghrelin-like and nesfatin-1-like immunoreactivity was detected in the hypothalamus and gut of goldfish. Intracerebroventricular administration of nesfatin-1 reduces ghrelin mRNA expression, while ghrelin injection via the same route reduces nesfatin-1 mRNA expression in the goldfish forebrain. Nesfatin-1 suppression of ghrelin (to inhibit feeding), and ghrelin suppression of nesfatin-1 (to stimulate feeding) are possible pathways that contribute to the endocrine control of feeding in goldfish.

INTRACELLULAR INVASION OF GREEN ALGAE IN A SALAMANDER HOST [CMD1]

INVASION INTRACELLULAIRE DES ALGUES VERTES CHEZ UNE SALAMANDRE HÔTE

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The egg capsules of spotted salamanders (*Ambystoma maculatum*) often appear green, due to a green alga, *Oophila amblystomatis*. Previous research has shown that this relationship is a true symbiotic mutualism where both partners benefit. However, few studies have focused on the morphological basis of this symbiosis. Our study combines time lapse, fluorescent, and electron microscopy with molecular techniques to track the algae during development. We have found an intra-tissue invasion of algal cells into the host, which results in both extracellular and intracellular algal localization in all three embryonic germ layers and persists through early larval stages. Tissue-specific PCR reveals the same species of algae in several adult female oviducts, as well as male Müllerian and Wolffian ducts, consistent with a process of vertical transmission of algae from one salamander generation to the next. The existing literature on algal-invertebrate symbioses provides many directions for further research on this unique algal-vertebrate association.

EFFECT OF THERMAL ACCLIMATION ON ISOMETRIC FORCE GENERATION OF ISOLATED TROUT CARDIAC TRABECULAE [CPB13]

EFFET DE L'ACCLIMATATION THERMIQUE SUR LA GÉNÉRATION DE FORCES ISOMÉTRIQUES DANS DES CELLULES PRIMAIRES DE TRAVÉES CARDIAQUES CHEZ LA TRUITE

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Cold acclimation of rainbow trout can cause cardiac hypertrophy. We have recently demonstrated that this hypertrophic response involves an increase in muscle mass and connective tissue within the ventricle. Furthermore, cold acclimation caused a 50% increase in the maximal rate of the actomyosin ATPase. The aims of the current study were to examine if the hypertrophic response of the trout heart is reversible and to investigate if the observed changes in actomyosin ATPase activity translate into an enhanced ability to generate force in response to calcium. To do this we first acclimated a group of trout to 4°C and then to 17°C. The heart size of the same individuals was measured at each acclimation point using an ultrasound. Additionally, trabeculae were dissected from the hearts of individuals at each acclimation temperature. The force generating capabilities of these preparations were measured over a range of calcium concentrations.

COMPARING CALCIUM AND CADMIUM UPTAKE ALONG THE GASTRO-INTESTINAL TRACT OF FRESHWATER AND SEAWATER ACCLIMATED STEELHEAD [CPB9]

COMPARAISON DU CAPTAGE DE CALCIUM ET CADMIUM DANS LE TRACTUS GASTRO-INTESTINAL DE LA TRUITE STEELHEAD ACCLIMATÉE À L'EAU DOUCE ET À L'EAU DE MER

Joel S Klinck and CM Wood
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Calcium and cadmium are taken up in part by a common pathway along the gastro-intestinal tract (GIT) of freshwater rainbow trout. *Oncorhynchus mykiss irideus* (steelhead) are euryhaline rainbow trout which undergo vast physiological changes to their GIT when acclimated to seawater from freshwater, which likely affects Ca and Cd transport. To further understand these changes, a 'gut-to-gut' comparison of seawater and freshwater steelhead was done employing *in vitro* gut sac techniques and an *in vivo* feeding experiment. Concentration-kinetics of Ca and Cd, and their interactions, were examined. Seawater trout had much lower rates of Ca uptake in all GIT segments (stomach, anterior-, mid-, and posterior- intestines), but differences in Cd transport were much more subtle. Three different Ca channel blockers had no effect on reducing Ca or Cd transport. Bicarbonate excretion was greater in seawater trout, and interestingly, more influenced by 100 µM Cd than 10 mM Ca. (NSERC Discovery).

EVOLUTION OF METABOLIC RESPONSIVENESS OF CYTOCHROME C OXIDASE GENES [CPB15]

ÉVOLUTION DE LA SENSIBILITÉ MÉTABOLIQUE DU GÈNE DE L'OXYDASE DU CYTOCHROME C

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In mammals, nuclear-encoded cytochrome c oxidase (COX) genes are known to be regulated by factors that directly and indirectly sense metabolic conditions. COX4 displays increased transcription during energy stressors, as well as an isoform switch from COX4-1 to COX4-2 under hypoxia. COX4 paralogs in fish appear orthologous with the corresponding mammalian genes; however fish COX4 genes do not appear to be regulated in the same manner as their mammalian counterparts. Hypoxic conditions do not stimulate transcription of COX4-2 in whole fish or fish cells. AMP kinase activation in zebrafish alters mRNA levels of COX4-1 and transcription factors known to be mammalian COX gene regulators in patterns that are distinct from mammals. Further studies into the differing response to energy fluctuations in fish compared to mammals give insight into the evolutionary origins of metabolic regulation.

ACCLIMATION TO ION-POOR WATER ALTERS THE MOLECULAR PHYSIOLOGY OF TIGHT JUNCTIONS IN PAVEMENT CELLS AND MITOCHONDRIA RICH CELLS OF THE FISH GILL [CPB20]

L'ACCOUSTOMANCE À DE L'EAU FAIBLE EN IONS ALTÈRE LA PHYSIOLOGIE MOLÉCULAIRE DES JONCTIONS SERRÉES DES CELLULES RICHES EN MITOCHONDRIES CHEZ LES BRANCHIES DE POISSON

Dennis Kolosov, H Chasiotis, P Bui and SP Kelly
York University

Tight junction (TJ) proteins of the TJ complex play a fundamental role in determining the paracellular permeability of vertebrate epithelia. Goldfish (*Carassius auratus*, L.) were acclimated to ion-poor water and the morphology and molecular physiology of the TJ complex was examined in pavement cells (PVCs) and mitochondria-rich cells (MRCs) of the gill epithelium. Transcript abundance of twelve TJ proteins (claudin-7, -8, -12, -B, -C, -D, -E and -H, as well as occludin and ZO-1) was quantified in whole gill tissue, as well as PVCs and MRCs separated by discontinuous density gradient centrifugation. Molecular and morphological data support the notion that even in the apparent absence of TJ complex heterogeneity in the freshwater fish gill epithelium, TJ protein abundance may vary distinctly between complexes formed by adjacent PVCs versus those formed by MRCs and PVCs.

COPPER AND NICKEL TOXICITY IN THE LARVAE OF THE YELLOW FEVER MOSQUITO Aedes Aegypti [CPB1]

TOXICITÉ DU CUIVRE ET DU NICKEL CHEZ LA LARVE DU MOUSTIQUE DE LA FIÈVRE JAUNE, Aedes Aegypti

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Currently, the mechanism of toxicity for nickel; a non-essential metal, and copper; an essential metal remains to be elucidated in larval *Aedes aegypti*. The acute and chronic toxic effects of nickel and copper on fourth instar *A. aegypti* were examined. Fourth instar *A. aegypti* larvae were exposed to known concentrations of nickel and copper treatments in both chronic and acute exposures. Haemolymph samples were collected to determine the amount of each metal present in larval haemolymph using a novel laser ablation-ICPMS method developed for the analysis of metals in small biological samples. During acute exposures to copper and nickel, copper was actively taken up into the haemolymph at low concentrations, while nickel is not actively accumulated in the haemolymph. Exposure to chronic sub lethal levels of copper showed active up-take into the haemolymph over 36 hours followed by elimination of copper from the haemolymph 48 hours post exposure. Chronic exposure to sub lethal nickel concentrations did not show a significant difference from control values, indicating that nickel does not accumulate in the haemolymph or is actively defended against.

THE ROLE OF THE AMMONIA TRANSPORTER Rhcg1 IN FACILITATING Na⁺ UPTAKE BY ZEBRAFISH, DANIO RERIO, IN ACIDIC WATER [Hoar]

RÔLE DU TRANSPORTEUR DE L'AMMONIAC Rhcg1 DANS LA FACILITATION DE LA PRISE DE Na⁺ PAR LE POISSON ZÈBRE (DANIO RERIO) EN EAU ACIDE

Yusuke Kumai and SF Perry
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The recent discovery of ammonia-conducting channels (Rh proteins) in fish has provided new insight on the long-debated interaction between ammonia excretion and Na⁺ uptake occurring at the gill. In the present study, the role of Rhcg1 in Na⁺ uptake by zebrafish in acidic water (pH 4.0) was investigated using translational knockdown of Rhcg1 protein. Rearing sham-injected larvae in acidic water significantly stimulated the Na⁺ uptake, and when the larvae were transferred to circumneutral pH water, the uptake rate decreased rapidly. However, Na⁺ uptake was significantly lower in Rhcg1 morphants reared in acidic water and no clear reduction in Na⁺ uptake was observed following their transfer to circumneutral water. When fish were transferred from neutral to acidic water, Na⁺ uptake was stimulated in sham larvae but not in Rhcg1 morphants. These observations indicate that Rhcg1 plays a critical role in facilitating Na⁺ uptake in zebrafish larvae when exposed to acidic water.

CADMIUM TRANSPORT IN RAINBOW TROUT ENTEROCYTES – WHICH PATHWAYS ARE INVOLVED? [CPB9]

TRANSPORT DU CADMIUM DANS LES ENTÉROCYTES CHEZ LA TRUITE ARC-EN-CIEL – QUELLES VOIES SONT IMPLIQUÉES ?

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We investigated the mechanism(s) by which cadmium (Cd) crosses the intestinal epithelium of freshwater fish,

using isolated enterocytes of rainbow trout (*Oncorhynchus mykiss*) as the experimental model. The apical uptake of free Cd^{2+} in the enterocytes was a saturable and high-affinity transport process. Our findings suggested that the uptake of Cd^{2+} occurs through divalent metal transporter-1 (DMT1) and ZIP family of zinc transporters. It appeared that calcium dependent pathways were not involved in apical Cd^{2+} uptake. Interestingly, cadmium-cysteine conjugate, $\text{Cd}(\text{Cys})$, was readily bioavailable to enterocytes. Our results suggested that the uptake of $\text{Cd}(\text{Cys})$ is kinetically different from that of free Cd^{2+} , indicating $\text{Cd}(\text{Cys})$ is absorbed through a specific transport system. We also found that Cd efflux from the enterocytes occurs primarily through an ATPase-driven process. Overall, our study provides new mechanistic insights into the intestinal Cd transport in freshwater fish.

EXCEPTIONAL CARDIAC ANOXIA TOLERANCE IN TILAPIA (OREOCHROMIS HYBRID) [CPB7]

RÉSISTANCE CARDIAQUE EXCEPTIONNELLE À L'ANOXIE CHEZ TILAPIA (OREOCHROMIS HYBRID)

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The hypoxia-tolerant tilapia (*Oreochromis hybrid*) downregulates *in vivo* cardiac performance during hypoxia exposure, possibly to balance cardiac energy demand with reduced energy supply. We developed an *in situ* perfused heart preparation for tilapia and explored the effects of N_2 -induced severe hypoxia, NaCN -induced anoxia, and acidosis (pH 7.25) on cardiac function at 22°C. Maximum cardiac power output (PO_{max}) was 4.56 mW g^{-1} in normoxia and decreased by <30% (3.34 mW g^{-1}) in severe hypoxia (~1 Torr). 1 mM NaCN greatly reduced PO_{max} (1.77 mW g^{-1}) without compromising routine cardiac function. Acidosis with severe hypoxia also reduced PO_{max} (1.92 mW g^{-1}), again without compromising routine function. These data show that the tilapia heart tolerates severe hypoxia and, to a lesser extent, chemical anoxia and acidosis. Although down-regulation of routine cardiac energy demand may be unnecessary in hypoxia, anoxia and acidosis place significant limitations on maximum cardiac function in tilapia.

LESSONS IN ANTIOXIDANT DEFENSE FROM THE ANOXIA TOLERANT CRAYFISH [CPB19]

DÉFENSE ANTIOXYDANTE CHEZ LA LANGOUSSE TOLÉRANTE À L'ANOXIE

Benjamin Lant

Carleton University

The freshwater crayfish (*Orconectes virilis*) is able to survive prolonged periods of deep hypoxia or anoxia arising due to oxygen depletion in ice-covered overwintering sites or low/no flow conditions in stream/river beds during the summer. Survival is aided by metabolic rate depression, but management of reactive oxygen species (ROS) is a major challenge when transitioning between periods of low and high oxygen conditions. Return to higher oxygen levels at the end of periods of hypometabolism often overwhelms the electron transport chain, drastically increasing ROS production; threatening cell survival. Analysis of genes/proteins involved in the production of reducing molecules and the pathways controlling antioxidant gene expression (FoxO transcription factors), showed that crayfish tissues have robust molecular responses that are activated to prevent significant cellular damage by ROS production. Hence, the crayfish model can further our understanding of how aquatic invertebrates mediate oxidative stress, both natural and arising due to aquatic pollution.

MOLECULAR PHYLOGENY OF THE TREMATODE FAMILIES DIPLOSTOMIDAE AND STRIGEIDAE [PAR2]F

PHYLOGÉNIE MOLÉCULAIRE DES FAMILLES DE TRÉMATODES DIPLOSTOMIDAE ET STRIGEIDAE

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Phylogenetic relationships between and within the families Strigeidae and Diplostomidae (Digenea) remain unresolved. Earlier studies based on adult morphophology and/or larval type and host specificity have led to conflicting hypotheses on the monophyly of the Diplostomidae. We obtained sequences from small and large subunits of ribosomal DNA from 9/41 diplostomid genera and 5/13 strigeid genera to independently assess systematic relationships proposed by earlier authors. Initial results do not support the monophyly of either family. Instead, a single monophyletic clade with four major subclades are strongly supported, including one comprising both strigeid and dip-

lostomid genera. Future analyses using total evidence, including internal transcribed spacer regions, the barcode region of the cytochrome oxidase 1 region of mitochondrial DNA and character mapping of the morphological and life cycle data will be used to interpret the evolutionary history of these two families.

THE CRUSTACEAN CARDIOACTIVE PEPTIDE AND ITS RECEPTOR IN THE BLOOD-GORGING BUG, RHODNIUS PROLIXUS [CPB6]

LE PEPTIDE CARDIOTONIQUE CRUSTACÉEN ET SON RÉCEPTEUR CHEZ L'INSECTE HÉMATOPHAGE RHODNIUS PROLIXUS

Do Hee Lee and AB Lange

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Crustacean cardioactive peptide (CCAP) has multifunctional roles in insects including the stimulation of visceral and cardiac muscle contraction, and the regulation of ecdysis. Previously we have cloned the cDNA sequence of the CCAP gene from *R. prolixus* central nervous system (CNS), and shown its expression in the CNS. The presence of CCAP in the CNS has now been verified by MALDI-TOF MS/MS. We have a partial cDNA sequence of the CCAP G-protein coupled receptor (GPCR) and its expression has been observed in the CNS as well as peripheral tissues of *R. prolixus*. CCAP dose-dependently stimulates *R. prolixus* hindgut contractions, with threshold at 5×10^{-9} M and maximum response at 10^{-7} M CCAP. Also, CCAP increases the frequency of heartbeat in a reversible, dose-dependent manner, with threshold close to 10^{-11} M and maximum response at 10^{-10} M CCAP. CCAP is therefore present in *R. prolixus*, and acts via GPCRs to modify visceral and cardiac muscle contraction.

TITRATING THE EFFECTS OF SOCIAL FAMILIARITY AND KINSHIP ON SHOAL-MATE CHOICE IN YOUNG CONVICT CICHLIDS [EEE3]L

MESURE DES EFFETS DE LA FAMILIARITÉ SOCIALE ET DE LA PARENTÉ SUR LE CHOIX D'UN PARTENAIRE CHEZ DE JEUNES BAGNARDS

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Carleton University

We investigated the role of social familiarity and kinship on shoal-mate choice in free-swimming convict cichlid young or fry (*Amatitlania siquia*). Cues predicting social familiarity and kinship were titrated against each other in a balanced design. Individual focal fish were given a simultaneous 4-way choice to associate (shoal) with conspecifics that were either socially familiar and kin, socially unfamiliar and kin, socially familiar and not kin, or socially unfamiliar and not kin. Stimulus shoal preference differed depending on the body length of the focal fry; smaller fry exhibited no preference, whereas larger fry preferred to associate with familiar kin. In the convict cichlid system, where brood mixing occurs in the wild, a preference to associate with familiar kin may confer fitness benefits to individuals. Our results have implications for understanding the mechanisms of brood mixing events in the wild and potentially inbreeding avoidance in the convict cichlid fish.

OBSERVATIONS ON THE INCIDENCE AND INTERRELATIONSHIPS OF PARELAPHOSTRONGYLUS TENUIS IN MOOSE AND DEER IN NEW BRUNSWICK [PAR2]F

OBSERVATIONS SUR L'INCIDENCE ET LES RAPPORTS DE PARELAPHOSTRONGYLUS TENUIS CHEZ L'ORIGNAL ET LE CERF AU NOUVEAU-BRUNSWICK

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University of New Brunswick

The nematode *Parelaphostrongylus tenuis* is common in white-tailed deer in eastern North America. Parasite transmission to moose occurs in areas where they co-exist with deer. Definitive evidence for moose population declines due to *P. tenuis* is lacking but correlations have been hotly debated in the literature. Conclusions regarding the impact of *P. tenuis* on moose are complicated by the fact that some infections result in severe neurologic disease and death whereas moose have been shown to survive low intensity infections. Temporal and spatial differences in parasitological data from deer and moose used in prior analyses likely contributed to the challenges in understanding associations. Accordingly, we examined concurrently the incidence of *P. tenuis* infection in both deer and moose from a region of New Brunswick with high deer density and from another region with low deer density.

Accurate baseline data should help to facilitate understanding of these complex parasitic interrelationships.

ONTOGENY OF THE UREA CYCLE ENZYMES GENE EXPRESSION IN ZEBRAFISH (DANIO RERIO) [CPB10]P

ONTOGÉNIE DE L'EXPRESSION GÉNÉTIQUE DES ENZYMES DU CYCLE DE L'URÉE CHEZ LE POISSON-ZÈBRE (DANIO RERIO)

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Although the majority of adult teleosts excrete most of their nitrogenous wastes as ammonia, several fish species are capable of producing urea early in their development. In zebrafish, it is unclear if it results from a functional ornithine urea cycle (OUC) and how it might be regulated. This study explored the spatiotemporal patterns of gene expression of major OUC enzymes in developing zebrafish using real time PCR and *in situ* hybridization. In addition, we hypothesized that the gene expression of the OUC enzyme carbamoyl phosphate synthase III (CPSIII) was epigenetically regulated through methylation of its promoter. Our results suggest a colocalization of the OUC enzyme transcripts in developing zebrafish providing further support for a functional OUC in these animals. In addition, the methylation status of CPSIII promoter is not consistent with the patterns of expression observed in these animals, suggesting other means of transcriptional regulation of this enzyme.

BIOACCUMULATION AND IONOREGULATORY DISRUPTION IN FOUR FRESHWATER INVERTEBRATE SPECIES FOLLOWING ACUTE (48 AND 96-H) WATERBORNE EXPOSURES TO NICKEL IN SOFT AND HARD WATER [CPB1]

BIOACCUMULATION ET PERTURBATION DE L'IONORÉGULATION CHEZ QUATRE INVERTÉBRÉS D'EAU DOUCE SUIVANT UNE EXPOSITION AQUATIQUE AIGUE (48 ET 96H) AU NICKEL DANS DE L'EAU DURE ET DOUCE

Erin M Leonard and CM Wood

McMaster University

We investigated the bioaccumulation and acute toxicity of Ni in four freshwater invertebrate species: *Chironomus riparius*, *Lymnaea stagnalis*, *Lumbriculus variegatus* and *Daphnia pulex* in two water hardnesses environmentally relevant for Canada: 40 and 140 mg l⁻¹ as CaCO₃. In all cases water hardness was protective against acute Ni toxicity with LC₅₀ values 2-10 times higher in the harder water. In addition, higher Ca and Mg in the exposure water significantly reduced Ni bioaccumulation in these organisms suggesting that competition for uptake at the biotic ligand may contribute to higher metal resistance. Whole body Na and Mg levels were depleted in the higher exposure concentrations suggesting ionoregulatory disruption as a mechanism of acute Ni toxicity. Ni speciation within the two exposure mediums will be also be discussed (NSERC Strategic Grant, Rio Tinto Alcan and Environment Canada).

REGULATION OF GLYCEROL-3-PHOSPHATE DEHYDROGENASE DURING HIBERNATION IN THE RICHARDSON GROUND SQUIRREL (SPERMOPHILUS RICHARDSONII) BY REVERSIBLE PROTEIN PHOSPHORYLATION [CPB11]

RÉGULATION DE LA GLYCÉROL-3-PHOSPHATE DÉSHYDROGÉNASE PENDANT L'HIBERNATION CHEZ LE SPERMOPHILE DE RICHARDSON (SPERMOPHILUS RICHARDSONII) PAR PHOSPHORYLATION RÉVERSIBLE DE PROTÉINE

Allan Letourneau and KB Storey

Carleton University

Hibernation is a strategy employed by several vertebrates in order to conserve energy during lowered temperatures and in times of low food availability. During torpor, cellular energy charge is maintained but adenylate concentrations are reduced preventing all but critical cellular processes. As a result, enzymatic systems must be suppressed during torpor and quickly up-regulated during recovery. One mechanism is reversible protein phosphorylation. *Spermophilus richardsonii* is a hibernator that reorganizes its metabolic machinery to primarily oxidize fatty acids during torpor which suggests that certain pathways in the metabolism of fatty acids are regulated. Glycerol-3-

phosphate dehydrogenase bridges glycolysis to fatty acid metabolism and is a possible target for regulatory reversible phosphorylation. Examination of liver and muscle G3PDH between euthermic and hibernator RGS revealed the hibernator has higher phosphate content, higher affinity for G3P substrate and lower activation energies, especially at lower temperatures suggesting that this enzyme is critical during the arousal phase.

INCREASED HOMEOTHERMY DURING PREGNANCY IN A HETEROOTHERMIC MAMMAL, THE GREATER HEDGEHOG TENREC, SETIFER SETOSUS [CPB3]

HOMÉOTHERMIE ACCRUE DURANT LA GROSSESSE CHEZ UN MAMMIFÈRE HÉTÉROTHERME, LE GRAND HÉRISSON, SETIFER SETOSUS

Danielle L Levesque and BG Lovegrove

University of KwaZulu-Natal

There is increasing evidence that the level of homeothermy observed in most modern endotherms was derived from an ancestral heterothermic state. One of the hypotheses for why this occurred is that homeothermy allows for greater energetic output during reproduction (gestation and lactation) which has direct benefits to fitness. We tested this hypothesis by recording resting metabolic rate over a range of ambient temperatures in both reproductive and non-reproductive free-ranging Greater hedgehog tenrecs (*Setifer setosus*, Tenrecidae), a physiologically primitive mammal from Madagascar. During pregnancy there was an increase in metabolic rate and body temperature, accompanied by a decrease in body temperature variability. This indicates that homeothermy indeed assists reproduction, and that benefits to parental care may have contributed to the evolution of endothermy in mammals.

SEROTONIN DIRECTLY STIMULATES CORTISOL SECRETION IN GOLDFISH [CPB12]

LA SÉROTONINE STIMULE DIRECTEMENT LA SÉCRÉTION DU CORTISOL CHEZ LE CYPRIN DORÉ

Jan E Lim and NJ Bernier

University of Guelph

While serotonin (5-HT) can stimulate the hypothalamic-pituitary-interrenal stress axis in fish, the specific sites of action are unresolved. In this study, goldfish were injected intraperitoneally with either saline or the 5-HT 1A/7 receptor agonist 8-OH-DPAT. Relative to unhandled controls, while the saline- and 8-OH-DPAT-injected fish were characterized by a transient and sustained increase in cortisol levels, respectively, all treatments had similar plasma ACTH as well as preoptic area CRF and pituitary POMC mRNA levels. To assess the direct action of 5-HT on cortisol secretion *in vitro*, head kidney tissue were superfused with 10^{-7} M ACTH, 5-HT, 8-OH-DPAT and cisapride (a 5-HT 4 receptor agonist). All agonists elicited a similar 3.5-fold increase in cortisol secretion rate but the total amount of cortisol secreted in response to ACTH was greater than with 5-HT, 8-OH-DPAT and cisapride. These results suggest that 5-HT can directly stimulate cortisol secretion from the interrenals via multiple 5-HT receptor subtypes.

PATTERN RECOGNITION RECEPTORS OF RAINBOW TROUT [PAR 5]

RÉCEPTEURS DE RECONNAISSANCE DES FORMES CHEZ LA TRUITE ARC-EN-CIEL

John S Lumsden, S Russell, K Young, M Edwards, A Peterson, A Reid

University of Guelph

Two plasma lectins were isolated by their ability to bind to various infectious agents that cause disease in rainbow trout. Intelectin, isolated for the first time from a fish, exhibited calcium-dependent binding to N-acetylglucosamine- and mannose-conjugated matrices. Ladderlectin was found to have two isoforms and the genomic sequence encompassed six exons and five introns, with exon 2 encoding 14 amino acids that were exclusive to one isoform. Two-dimensional PAGE and western blots demonstrated multiple electrophoretic forms of both lectins. Enzyme immunoassays showed that there was significant group and individual variation in plasma lectin concentrations. Neither lectin was an acute phase reactant nor were the concentrations substantially altered during bacterial infection, however both lectins were localized by immunohistochemistry in intimate association with microbes *in vivo*. Both lectins were also identified on the cell surface of leukocytes and cell lines.

MOLECULAR CLONING, PROMOTER ACTIVITY ANALYSIS AND DISCOVERY OF A NOVEL GONADOTROPIN-RELEASING HORMONE TRANSCRIPT IN THE ORANGE-SPOTTED GROUPE (EPINEPHELUS COIOIDES) [CPB16]

CLONAGE MOLÉCULAIRE, ANALYSE DE L'ACTIVITÉ DU PROMOTEUR ET DÉCOUVERTE D'UN NOUVEAU PRODUIT DE LA TRANSCRIPTION DE LA GONADOLIBÉRINE CHEZ LE MÉROU BRUN (EPINEPHELUS COIOIDES)

Y-S Luo¹, X-C Liu², Y-Q Yang¹, H-R Lin², Z-Y Zhu¹ and Wei Hu^{1*}

¹Chinese Academy of Sciences; ²Sun Yat-Sen University

The orange spotted grouper is a good model for studying sex differentiation and sex reversal because it is a protogynous hermaphrodite. We first cloned the cDNA and genomic DNA sequences for gonadotropin-releasing hormone (GnRH-II). We also cloned the promoter sequence of GnRH-II. Our study showed that the region responsible for the cell-specific expression of GnRH-II gene is located between -2005 to -956 bp. GnRH-II promoter driven EGFP expression in transgenic zebrafish showed that GnRH-II neurons are mainly located near the midbrain and in the eyes. In addition, a novel GnRH-II transcript which retains intron 2 was discovered in the intersexual gonad and the mature testicle but not in the ovary and the brain. Overall, our study provides useful information to understand the regulatory mechanism and function of GnRH-II and the role of GnRH-II in sex reversal in grouper.

QUANTITATIVE PROTEOMIC ANALYSIS OF GILLS FROM ZEBRAFISH EXPOSED TO NAPHTHENIC ACIDS AND OIL SANDS PROCESS WATER [CPB8]

ANALYSE PROTÉOMIQUE QUANTITATIVE DES BRANCHIES CHEZ LES POISSONS-ZÈBRE EXPOSÉS AUX ACIDES NAPHTÉNIQUES ET À L'EAU CONTAMINÉE PAR LE TRAITEMENT DES SABLES BITUMINEUX

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¹Mount Allison University; ²University of Alberta

The recovery of bitumen from oil sands involves hot water extraction and the production of oil sands process-affected water (OSPW). The toxicity of OSPW to fish is primarily attributed to naphthenic acids (NAs) but it is not clear how other OSPW components may contribute. Zebrafish were exposed to refined NAs and unrefined OSPW. Gills were subsequently perfused to remove blood, processed, and analyzed for relative peptide quantification and protein identification. In fish exposed to NAs, only a few proteins showed consistent changes in abundance, the most notable being a decrease in vitellogenin-related proteins. OSPW-exposed fish exhibited extensive variations in protein abundance with many related to the maintenance of gill structure and function. Relative abundance changes for select proteins are now being validated by western blot analysis. This study sheds new light on the mechanisms of OSPW toxicity and will aid in identifying new biomarkers of OSPW exposure.

EFFECTS OF STARVATION ON THE METABOLIC DEPRESSION AND HYPOXIA TOLERANCE OF RAINBOW TROUT (ONCORHYNCHUS MYKISS) [CPB7]

LES EFFETS DU JEÛNE SUR LA DEPRESSION MÉTABOLIQUE ET LA TOLÉRANCE À L'HYPOXIE CHEZ LA TRUITE ARC-EN-CIEL (ONCORHYNCHUS MYKISS)

Scott MacIntyre¹, Y Luo², YX Wang¹

¹Queen's University; ²Southwest University (China)

Juvenile rainbow trout were starved for 5 weeks at 15°C to determine the effect of chronic food deprivation induced metabolic depression on hypoxia tolerance. At each week, routine metabolic rate (RMR) and critical oxygen tension (Pcrit) were measured. Concomitantly, resting and post-hypoxia fish (8 h 50% air saturation) were sampled to measure metabolites in blood, liver and muscle and metabolic enzyme activities in selective tissues. RMR significantly decreased following 4 weeks of starvation, however, no significant change in Pcrit was observed. The metabolic response pattern to hypoxia, however, did change over the starvation period from an intermediate pattern (between regulator and conformer) at week 0 to regulator pattern at week 5. The metabolites and enzymes activities experienced significant alterations over the 5 week period. Our results suggest that the prolonged starvation could induce metabolic depression and enhance hypoxia tolerance in rainbow trout.

A NEW INHIBITORY PATHWAY IN THE JELLYFISH POLYORCHIS [Spencer]

UNE NOUVELLE VOIE D'INHIBITION CHEZ LA MÉDUSE POLYORCHIS

GO Mackie¹, RW Meech² and AN Spencer³

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Contact of food with the manubrial lips in *Polyorchis* evokes trains of electrical impulses (E potentials) that propagate to the margin where they cause arrest of swimming. This may make it easier for the animal to get the food into its mouth. The conduction pathway for E potentials is located in the endodermal canals. A nerve plexus is present in the endodermal wall of the stomach and in the four radial canals and the ring canal. Neurites belonging to this system run close to the inner nerve ring where the swimming pacemaker neurons are located. Intracellular recordings from the latter show inhibitory postsynaptic potentials (ipsp) on arrival of E potentials. The reversal potential for the ipsp is at least -65mV. Swimming inhibition mediated by this endodermal pathway is distinct from swimming arrests associated with contractions of the radial muscles that cause involution of the bell margin (Spencer 1981, J.Exp.Biol.93, 33). However it is possible that both responses use the same set of inhibitory interneurons as a final common pathway.

MAINTAINING ION BALANCE IS CRUCIAL IN THE COLD: PHYSIOLOGICAL MECHANISMS SETTING THE LOWER THERMAL LIMIT OF AN INSECT [CPB21]

MAINTENIR UN ÉQUILIBRE IONIQUE EST ESSENTIEL LORSQU'IL FAIT FROID: MÉCANISMES PHYSIOLOGIQUES DÉTERMINANT LA LIMITE THERMIQUE LA PLUS BASSE CHEZ UN INSECTE

Heath A MacMillan, CM Williams, JF Staples and BJ Sinclair

University of Western Ontario

At their critical thermal minimum (CT_{min}), insects enter chill coma, a state of complete immobilization, and begin to accumulate injuries (chilling injury). Both chill coma and chilling injury have been associated with a failure to maintain ion equilibrium potentials, though the principal causes of such failure are unknown. We quantified whole animal metabolic rate, muscle ATP, lactate and alanine concentrations as well as hemolymph, muscle and gut cation and water content in the fall field cricket during the onset of chill coma and progression of chilling injury. Cold exposure did not affect the energy status or ion and water content of the muscle itself, but dissipated muscle ion equilibrium potentials through a massive movement of ions and water into the gut. The direct and indirect effects of this loss of osmotic homeostasis are thus likely mechanisms driving chilling injury in chill-susceptible insect species.

REGULATION OF THE GH/IGF-I/IGFBP GROWTH AXIS BY THE FRESHWATER PARASITE (CRYPTOBIA SALMOSITICA) IN RAINBOW TROUT [CPB16]

CONTRÔLE DE L'AXE DE CROISSANCE GH/IGF-I/IGFBP PAR UN PARASITE D'EAU DOUCE (CRYPTOBIA SALMOSITICA) CHEZ LA TRUITE ARC-EN-CIEL

Barry Madison and NJ Bernier

University of Guelph

Rainbow trout (200 g) were infected with a haemoflagellate naturally occurring in freshwaters of Western Canada, *Cryptobia salmositica*. Though not typically lethal, symptoms of infection include: severe anaemia, ascites, anorexia and emaciation. Peak infection generally occur 3-4 weeks post-injection, though symptoms may persist weeks later. Control fish and those infected with parasite were fed to satiation daily for 14 weeks. Pair-fed fish were given an identical ration to the parasite-infected fish to isolate the effects of reduced feeding on the growth axis. Growth indices, plasma growth hormone (GH) and insulin-like growth factor I (IGF-I), as well as tissue-specific mRNA expression of GH, IGF-I, IGF-I receptors and IGF-binding proteins were assessed throughout the course of infection. *Cryptobia* infection significantly reduced the growth rate of trout and our results show that peak parasitemia and anorexia are associated with significant alterations to the endocrine growth axis.

THE RISE AND FALL OF NEWFOUNDLAND CARIBOU AT THE TURN OF THE 21ST CENTURY [EEE S]

LA MONTÉE ET LA CHUTE DES CARIBOUS DE TERRE-NEUVE AU TOURNANT DU 21^E SCIÈCLE

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The caribou of insular Newfoundland (*Rangifer tarandus caribou*) represent the only woodland caribou population in Canada not listed as threatened or endangered. This island population increased dramatically in the late 20th century – as much as 20-fold in 40 years – but has declined by more than 60% in the past decade. During (or nearing) the decline phase, adult survival remained high and stable; body size of both sexes diminished. In at least one herd, spring migration has been delayed while fall migration advanced. Recruitment is substantially lower, stemming from low calf survival; the proximate cause of calf mortality is predation from black bears, coyotes, lynx and bald eagles. Accordingly, the mean age of adults has increased. We hypothesize that female caribou, under food limitation, may be seeking foods in riskier habitats where predators are more frequent. An intensive, 5-year program is underway to increase our understanding of predator-caribou-habitat interactions and their link to the decline.

CROSS-SPECIES COMPARISON OF GENE EXPRESSION PROFILES IN RESPONSE TO HYPOXIA IN SCULPINS [CPB15]

COMPARAISON INTERESPÈCE DU PROFIL D'EXPRESSION GÉNÉRIQUE EN RÉPONSE À L'HYPOXIE CHEZ LE COTTIDÉ

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¹University of British Columbia; ²University of Southern California

An organism's defence against hypoxia involves changes in a number of complex traits, some of which are determined by the coordinated activities of hundreds of genes. Phenotypic responses to changes in environment vary among species and to understand the evolutionary or ecological implications of this variation it is critical to elucidate the differences in large scale patterns of gene expression across the species. Sculpins, a group of closely related benthic fishes, differ dramatically in their tolerance to hypoxia. We examined broad-scale patterns of gene expression using heterologous microarrays among six species of sculpin that were exposed to O₂ tensions at 65% of their respective Pcrit for 72 hours. Results suggest that there is little change in transcription levels in the tolerant species until at least 24 hours of hypoxia, whereas the sensitive species exhibit very early transient changes in gene expression followed by return to baseline in the late stages of hypoxia.

BEHAVIOUR AS BIOMARKER? CONTAMINATION AND MOVEMENT IN AN INVASIVE FISH

[EEE2]L

LE COMPORTEMENT COMME BIOMARQUEUR? CONTAMINATION ET MOUVEMENT CHEZ UN POISSON INVASIF

Julie R Marentette and S Balshine

McMaster University

Most studies of behaviour and toxicology are performed in laboratory settings with acute, controlled, single contaminant exposures. Contaminant exposure in natural settings is more complex. To explore how natural behaviour might be influenced by habitats contamination, I have been conducting studies on the round goby in a highly polluted part of Lake Ontario. This is a fish invasive to the Great Lakes. I first review evidence for contaminant exposure in our study sites. I then reveal that round gobies collected from cleaner sites were more active than fish from highly contaminated sites in the laboratory, but moved similar distances in the field. Although changes in activity level are the most frequently used behavioural measure of contaminant exposure, the ecological relevance of change was not apparent in this study. These results challenge the utility of behaviour as an integrated biomarker of contaminant exposure beyond the laboratory.

COLD COMFORT: THRESHOLD TEMPERATURES MEDIATE THE IMPACT OF REDUCED SNOW COVER ON OVERWINTERING FREEZE TOLERANT CATERPILLARS [EEE2]L

PIÈTRE CONSOLATION: LES TEMPÉRATURES LIMITES SONT RESPONSABLES DES IMPACTS D'UNE RÉDUCTION DE L'ÉPAISSEUR DE LA NEIGE SUR LES CHENILLES RÉSISTANTES À LA CONGÉLATION HIVERNALE

Katie E Marshall and BJ Sinclair

Along with changes in mean temperatures, temperate latitude winter habitats are predicted to substantially alter as snow cover declines precipitously. For ectothermic animals that overwinter underneath the snow layer, these snow cover decreases could alter overwintering energetics and physiology as temperature regimes change. We investigated the effects of snow cover on the freeze tolerant Arctiid caterpillar *Pyrrharctia isabella* and found that overwintering with snow cover led to decreased pupal and triglyceride mass. A numerical energetics model found this result was due to the nonlinear reduction in metabolic rate due to freezing, as the reduced temperatures above the snow layer did not themselves account for the difference in post-winter triglyceride stores. This result, coupled with the current decline in snow cover in temperate latitudes, implies that critical physiological thresholds such as freezing point can greatly affect the fitness of an organism in its environment.

LARVAL SHELL MORPHOLOGY AND LARVAL ECOLOGY IN MOLLUSCS OF THE GULF OF ST. LAWRENCE: IS THERE EVIDENCE OF CHANGE DURING THE OCEAN WARMING OF THE LAST 10,000 YRS? [CMD3]

MORPHOLOGIE DES COQUILLES LARVAIRES ET ÉCOLOGIE LARVAIRE CHEZ LES MOLLUSQUES DANS LE GOLFE DU SAINT-LAURENT: LES RÉCHAUFFEMENTS OCÉANIQUES DES 10 000 DERNIÈRES ANNÉES ONT-ILS PROVOQUÉ DES CHANGEMENTS IMPORTANTS?

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The larval and early juvenile shell of marine gastropods and bivalves contains a skeletal record of the growth and developmental history of the animal. Using well-preserved juvenile stages, we examine the morphology and morphometry of the larval shell of gastropods (protoconch) and bivalves (prodissococonch) from the gulf and estuary region of the St. Lawrence. For any given species, this examination allows the study of modes of larval development and larval ecology, including life history traits such egg size, size at larval settlement and metamorphosis (species with planktotrophic larval development) as well as hatching size (species with direct development). Within single species, we compare these early life history traits between modern specimens deposited in museums (or recent research collections) and specimens that inhabited the same area ~10,000 yrs ago. The latter are collected from unique holocene shell deposits found along the north shore of the St. Lawrence maritime estuary. This research also brings new insights into the impact of ocean warming on the life history of marine benthic invertebrates.

DOES DIETARY FATTY ACID COMPOSITION AFFECT SOME CLASSES OF MITOCHONDRIAL PHOSPHOLIPIDS MORE THAN OTHERS? [CPB19]

LA COMPOSITION DES ACIDES GRAS INGÉRÉS AFFECTE-T-ELLE CERTAINES CLASSES DE PHOSPHOLIPIDES MITOCHONDRIENS PLUS QUE D'AUTRES?

Nicolas Martin

Université Laval

Two diets differing only in fatty acid (FA) composition were fed to two groups of trout for a minimum of 8 weeks. Among the main FA provided by these diets, 22:6n-3 accounted for 0.4% and 14% while 18:2n-6 accounted for 18% and 10.5% in diets 1 and 2, respectively. Total mitochondrial phospholipids differed markedly in FA composition after the feeding treatment whereas mitochondrial functional properties were more stable. Dietary treatment differentially affected the FA composition of three major phospholipid classes, cardiolipin, phosphatidylethanolamine and phosphatidylcholine. While the three classes accumulated 22:6n-3 when fed diet 2, they maintained stable levels of 18:1n-9. Under the 22:6n-3 deficient diet, CL preferentially accumulated 18:2n-6 and 20:3n-6, while PE and PC showed increased levels of 20:4n-6 and 22:5n-6. Our results suggest that trout can control the impact of diet on the FA composition of phospholipid classes potentially necessary for the respiratory chain.

MOLECULAR TOOLS FOR EARLY LIFE STAGE SALMONID BIO-MONITORING IN POLLUTED ENVIRONMENTS [CPB8]

OUTILS MOLÉCULAIRES POUR LA BIOSURVEILLANCE EN MILIEU POLLUÉ DES SALMONIDÉS DANS LES PREMIÈRES ÉTAPES DE LEUR CYCLE DE VIE

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Molecular bioindicators were developed to enhance an existing *in situ* early life stage cutthroat trout (embryos to swim-up) bioassay for use in diagnostic assessment of chemical stressors in the aquatic environment. This field study was conducted using cutthroat trout embryos to evaluate water quality associated with three urban streams in British Columbia. Endpoints included survival, deformities, size, vitellogenin, metallothionein (Mt) protein, and gene assays for well characterized transcripts that are responsive to metals Mt A/B), endocrine disruptors (vitellogenin) and stress. Vitellogenin levels in the head/tail protein extracts from the 3 field sites was not detectable, however low levels of vitellogenin mRNA were detectable in the liver. Dose-response studies with E2 are necessary to confirm the sensitivity of this life-stage in response to estrogens. We combine measures of reproductive success with both biochemical and molecular endpoints to assess the potential of a holistic approach in bio-monitoring using early life staged embryos.

SILVER (NANO AND IONIC) TOXICITY IN RAINBOW TROUT HEPATOCYTES [CPB4]
TOXICITÉ DES NANO ET IONOPARTICULES D'ARGENT DANS LES CELLULES HÉPATIQUES CHEZ LA TRUITE ARC-EN-CIEL
Andrey Massarky, VL Trudeau and TW Moon
University of Ottawa

Nanomaterials (NMs) including nanosilver (nAg) continue to be incorporated into an increasing number of consumer and medical products. Much remains unknown regarding the toxicity of nAg but oxidative stress is suggested as one toxic mechanism. Thus, this research examined the effects of nAg and silver ions (Ag⁺) on levels of reactive oxygen species (ROS) and antioxidants in rainbow trout (*Oncorhynchus mykiss*) hepatocytes. Both silver types showed a concentration-dependent cytotoxicity and reduced both glutathione (GSH) and oxidized glutathione (GSSG) levels. The activities of (i) superoxide dismutase (SOD) increased in a dose-dependent manner for both silver types, (ii) glutathione reductase (GR) showed a dose-dependent reduction with ionic but not nano silver, while (iii) catalase (CAT) and (iv) glutathione peroxidase (GPx) increased insignificantly. There was also evidence for an increase in lipid, DNA, and protein oxidation in response to silver exposure. Supported by NSERC.

CLONING AND EXPRESSION OF INSECT ORGANIC CATION TRANSPORTERS (ORCT AND ORCT2) FROM THE FRUIT FLY, DROSOPHILA MELANOGASTER MEIGEN [CPB21]
CLONAGE ET EXPRESSION DES TRANSPORTEURS DE CATIONS ORGANIQUES DES INSECTES (ORCT ET ORCT2) CHEZ LA DROSOPHILE, DROSOPHILA MELANOGASTER MEIGEN
Brienne J Matier¹, N Sokal², D Theilmann² and MR Rheault¹
¹University of British Columbia; ²Pacific Agri-Food and Agricultural Research Center

Organic cations include endogenous metabolites, and xenobiotics (drugs, pesticides, environmental toxins), that must be effectively eliminated in order for organisms to survive. The midgut and Malpighian tubules of insects have been shown to play a role in the active transport of organic cations. Two putative organic cation transporters (OCTs) were cloned from adult *Drosophila melanogaster*. Phylogenetic analysis indicates that these OCTs exist in an insect specific clade separate and equally divergent from cloned vertebrate OCT isoforms. Gene expression patterns for these *Drosophila* transporters have been elucidated using quantitative PCR which support previous *in vitro* physiological evidence. Physiological characterization of these isolated insect transporters is currently in progress using transient expression in Sf9 insect cell lines. A complete understanding of the molecular structure, tissue expression, and physiological characterization of these organic cation transporters may hold promise for the formulation of more effective and environmentally benign insecticides, and may provide insights into the evolutionary origin of OCTs themselves.

JUVENILE MIGRANT SONGBIRDS HAVE HIGHER BASAL METABOLIC RATES THAN ADULTS [CPB3]
LES PASSERINS MIGRANTS JUVÉNILES ONT UN TAUX MÉTABOLIQUE BASAL PLUS ÉLEVÉ QUE CELUI DES ADULTES

Brendan J McCabe and CG Guglielmo
University of Western Ontario

Juvenile songbirds have to complete long distance migrations within weeks of fledging while behavioral and physiological differences from adults still exist. Limited evidence suggests juveniles refuel more slowly at stopover locations and as a result, overall migration speed can be slower than adults. It was predicted that slower refueling rates might be because juveniles have greater energetic costs during stopover due to higher basal metabolism. To test this prediction, adult and juvenile Swainson's Thrushes (*Catharus ustulatus*) and White-throated Sparrows (*Zonotrichia albicollis*) were captured during a fall migration stopover at Long Point, Ontario. Using open flow respirometry, basal metabolic rates of adult and juvenile birds were measured from each species. Once corrected for mass and ordinal date, juveniles had higher basal metabolic rates than adults, which may reflect maturation processes still occurring in juveniles. Juveniles face higher inherent energetic costs than adults during fall migration. These higher costs may contribute to longer refueling and migration times observed in juvenile migrants.

THE TOADFISH SEROTONIN 2A RECEPTOR: ITS ROLE IN THE REGULATION OF PULSATILE UREA EXCRETION [CPB10]

LE RÉCEPTEUR 2A DE SÉROTONINE CHEZ LES POISONS-CRAPAUDS: SON RÔLE DANS LA REGULATION DE L'EXCRÉTION PULSATILE DE L'URÉE

M Danielle McDonald, LR Medeiros and EM Mager
University of Miami

High circulating concentrations of the stress hormone, cortisol, appear to inhibit pulsatile urea excretion in Gulf toadfish, *Opsanus beta*, while high levels of the neurotransmitter, serotonin (5-HT) are stimulatory. Based on pharmacological evidence, we believe that the action of 5-HT is mediated by the 5-HT_{2A} receptor. We have now sequenced the full-length 5-HT_{2A} receptor from toadfish brain, which shows >70% sequence homology to mammalian 5-HT_{2A} receptors on the amino acid level. Injection of toadfish 5-HT_{2A} cRNA into *Xenopus* oocytes results in a 3.5-fold increase in the binding of [³H]-5-HT compared to water-injected controls and current work is investigating the specificity of the mammalian pharmacological compounds, alpha-methyl 5-HT and ketanserin, for the toadfish 5-HT_{2A} receptor. The mRNA expression of the 5-HT_{2A} receptor is highest in the swim bladder, gonad, hindbrain and gill - the particular relevance of this expression pattern to intraspecific communication will be discussed.

SPECIFIC DYNAMIC ACTION IN THE SUNFLOWER STAR, PYCNOPODIA HELIANTHOIDES [CPB3]

ACTION DYNAMIQUE SPÉCIFIQUE CHEZ L'ÉTOILE DE MER TOURNESOL, PYCNOPODIA HELIANTHOIDES

Iain J McGaw

Memorial University of Newfoundland

The specific dynamic action (SDA) was investigated in the sunflower star, *Pycnopodia helianthoides*. Seastars fed clams of 5%, 10%, or 20% BW showed a stepwise increase in time to peak oxygen consumption, duration and the total SDA. When seastars consumed a whole clam versus the shucked flesh, the time to peak oxygen consumption and duration were greater, leading to an overall higher SDA. A smaller initial peak comprising 2.8% of the total SDA represented the energy required to open the clam. When the seastars were fed butter clam, purple urchin or herring the time to peak, peak oxygen uptake and total SDA were similar despite the fact the meals differed in protein, lipid and caloric content. Seastars consuming urchins exhibited a second peak in oxygen uptake; this likely represented energy required to eject the test. The data are discussed in relation to SDA patterns recorded in other organisms.

PHENOTYPIC FLEXIBILITY OF MIGRATING HOARY BATS, LASIURUS CINEREUS [EEE-CPB]

FLEXIBILITÉ PHÉNOTYPIQUE CHEZ LA CHAUVE-SOURIS MIGRATRICE LASIURUS CINEREUS

Liam P McGuire, MB Fenton and CG Guglielmo
University of Western Ontario

Some bats migrate hundreds or thousands of kilometers between winter and summer grounds. We investigated the energetic consequences of migration for bats and resulting phenotypic flexibility. We collected hoary bats (*Lasiurus cinereus*) during spring migration and non-migrating hoary bats in summer. We measured muscle and organ masses,

compared body composition (fat and lean mass) and measured flight muscle aerobic enzyme capacity (carnitine palmitoyl transferase, citrate synthase, and 3-hydroxyacyl-CoA dehydrogenase). Digestive organs (stomach, intestines, kidneys, and liver) were smaller during migration, though lungs were larger. Females increased fat stores during migration, while males did not. Aerobic enzyme activities were all greater during migration. Increased lungs and aerobic enzyme activities reflect an increased capacity of aerobic exercise. However, smaller digestive organs suggest migration has selected for lower mass, minimizing energetic demands during flight. Differences in thermoregulatory strategies (torpor) during spring migration may have resulted in different body composition between sexes.

DIGENEA, DIVERSITY AND DNA [Wardle]

DIGENEA, DIVERSITÉ ET ADN

J Daniel McLaughlin

Concordia University

Species-level identification of adult digenetic trematodes using morphological methods is difficult; identification of metacercariae to species level can be virtually impossible. DNA-based methods can link larval stages to adult parasites and have become an important tool in studies of parasite ecology in recent years. Application of molecular methods to studies of the larval parasite communities in freshwater fishes from the St. Lawrence River near Montreal, Quebec permitted a number of unique and novel insights into the diversity, specificity and host-parasite relations of larval digenetics infecting fish. We detected a four-fold increase larval diversity over that reported previously from Canadian fishes, and a greater degree of host specificity than previously believed to occur. These novel and important observations, which were not possible using traditional morphological and life history approaches, fundamentally change how we view the larval parasite communities in fish and illustrate the value of DNA methods in parasite ecology.

INFLUENCE OF DIFFERENT LEVELS OF DISSOLVED OXYGEN (DO) ON THE SURVIVAL RATE, THE EMBRYONIC DEVELOPMENT (ED) AND HATCHING SUCCESS OF GREENLAND HALIBUT EGGS [CMD1]H

INFLUENCE DES DIFFÉRENTS NIVEAUX D'OXYGÈNE DISSOUS (OD) SUR LE TAUX DE SURVIE, LE DÉVELOPPEMENT EMBRYONNAIRE (DE) ET LE SUCCÈS D'ÉCLOSION DES ŒUFS CHEZ LE FLÉTAN DU GROENLAND

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Université du Québec à Rimouski

The bathypelagic eggs of Greenland halibut are subjected to the low oxygen levels observed in the deep waters of the Estuary and Gulf of St. Lawrence during their development. The aim of the present study was to determine the influence of different levels of dissolved oxygen (DO) on the survival rate, the embryonic development (ED) and hatching success of Greenland halibut eggs. In a laboratory experiment, fertilized eggs from six individual females were exposed to five levels of DO classified as: severe (10% and 20%, ~0.7 and 1.4 mg l⁻¹), moderate (35% and 50%, ~2.4 and 3.5 mg l⁻¹) and normoxic conditions of DO (100%, ~6.9 mg l⁻¹). Embryonic development and lipid composition were assessed every 2 and 7 days, respectively to investigate the effect of DO levels and female origin on the changes in the biochemical composition and the development of the eggs until hatching. Significant differences were observed in hatching success and development time between females and DO levels. In severe hypoxic conditions (10% saturation) no hatching occurred and at higher DO levels, ED was impaired in some females. Among developmental stages, triacylglycerols and polar lipids were the dominant lipid classes and both DO levels and female origin influenced lipid class dynamics. This study demonstrates the detrimental effect of severe hypoxia on the early development of Greenland halibut, which could reduce the recruitment success of this population.

IODINE UPTAKE MECHANISMS IN THE PURPLE SEA URCHIN [CPB21]

MÉCANISMES DE LA PRISE D'IODE CHEZ L'OURSIN VIOLET

Ashley EM Miller and A Heyland

University of Guelph

Thyroid hormones (THs) accelerate larval development in several echinoids and preliminary evidence indicates that several species can synthesize THs from exogenous iodine, an essential component. However, little is known about iodine uptake in echinoids and other marine invertebrates. Using combinations of ^{125}I radioisotope and pharmacology experiments, we found that iodine uptake in sea urchin larvae is largely diffusional; it is augmented by exogenous hydrogen peroxide (H_2O_2) and is inhibited by H_2O_2 scavenging agents. Tests of a sodium iodide symporter (NIS) inhibitor did not reduce iodine uptake. Our data suggest that echinoid embryos/larvae use H_2O_2 assisted diffusion of iodine. This mechanism has so far only been characterized in marine bacteria and brown algae, in contrast to vertebrates, where iodine is incorporated and concentrated via NIS dependent mechanisms. We suggest that H_2O_2 facilitated diffusion could be an ancestral mechanism of iodine uptake in marine organisms.

CO₂ SENSING IN DEVELOPING ZEBRAFISH, DANIO RERIO [CPB2]

DÉTECTION DU CO₂ DURANT LE DÉVELOPPEMENT DU POISSON ZÈBRE, DANIO RERIO

Scott F Miller and SF Perry

University of Ottawa

The goal of this study was to characterize the ontogeny of CO₂ sensing in developing zebrafish (*Danio rerio*) larvae. An increase in heart rate was used to indicate a physiological response to CO₂. CO₂ is thought to be sensed by gill neuroepithelial cells (NECs), which are homologous to the Type I cells of the carotid body of mammals. Owing to its role in facilitating intracellular acidification during exposure to hypercapnia, it was hypothesized that carbonic anhydrase (CA) is a major contributor to CO₂ sensing and that inhibition of CA would blunt the downstream cardiac response. Indeed, the increase in heart rate following exposure to hypercapnia (0.75% CO₂) was reduced after exposing fish to acetazolamide, a CA inhibitor. Based on data obtained using β -adrenergic receptor antagonists, the efferent limb of the reflex tachycardia accompanying hypercapnia is apparently mediated by sympathetic adrenergic neurons interacting with β_1 receptors.

HOW TO RESCUE EARLY VERTEBRATE EVOLUTION FROM LONG-DEAD ANCESTORS [CMD3]H

COMMENT SAUVER L'ÉVOLUTION DES VERTÉBRÉS PRÉCOCES À PARTIR DES ANCÊTRES MORTS DEPUIS LONGTEMPS

Tetsuto Miyashita

University of Alberta

Cyclostomes and gnathostomes represent the two surviving lineages of the first great radiation of vertebrates. Between them lies a diverse array of extinct fishes. Major innovations during this stage include jaws, paired fins, and mineralized skeletons. However, the origin of each of these novelties defies resolution. Firstly, the fossil record is patchy. Secondly, no consensus exists on interrelationships of basal vertebrates. Thirdly, little understanding of hagfish embryology leaves the ancestral state of vertebrates unconstrained. I introduce comparative morphological approaches to identify homologous cranial muscles between hagfish and lamprey. The homologous muscles were likely present in their common ancestor. Morphological correlates of the homologues allow identifying these muscles in extinct jawless fishes. I also report on the initial success of a hagfish hatchery project. Embryos to be recovered in this project will constrain the ancestral state of vertebrate development.

HOST DISTRIBUTION AND PARASITISM IN A DAMSELFLY-GREGARINE SYSTEM [PAR1]F

DISTRIBUTION ET PARASITISME D'HÔTE DANS UN SYSTÈME AGRION-GRÉGARINES

Julia J Mlynarek and MR Forbes

Carleton University

The distribution of a species can affect the prevalence of interspecific interactions. Because parasites rely on hosts to survive, host-parasite interactions can be affected by the distribution of the host. Many studies have focused on a single host-parasite system across the host's geographic range. My goal was to determine whether a host's geographic range characteristics plays a role on parasitism between several related host species if they are collected in a single region. The damselfly-gregarine host-parasite system was used to answer these questions. Gregarine parasitism was assessed in seven species pairs from the suborder Zygoptera. Based on a linear regression, there is no relationship between geographic range size and gregarine prevalence. There is a slightly positive relationship be-

tween the distance to the Northern range edge and gregarine prevalence. This pressure could have implications on the role of range shifts in host-parasite systems.

INHIBITION OF CELLULAR CYTOTOXICITY BY CHANNEL CATFISH (*ICTALURUS PUNCTATUS*) LEUKOCYTE IMMUNE-TYPE RECEPTORS (IPLITRS) [CPB15]

*INHIBITION DE LA CYTOTOXICITÉ PAR LES RÉCEPTEURS IMMUNITAIRES DES LEUCOCYTES CHEZ LA BARBUE DE RIVIÈRE (*ICTALURUS PUNCTATUS*)*

Benjamin CS Montgomery, DN Burshtyn and JL Stafford

University of Alberta

Inhibitory immune receptors tightly control cellular activation and protect tissues from excessive damage caused by inflammation. Channel catfish leukocyte immune-type receptors (IpLITRs) are a family of proteins with some members containing immunoreceptor tyrosine-based inhibitory motifs (ITIMs) within their cytoplasmic tails; a key feature of inhibitory receptors in mammals. To investigate the function of ITIM-containing IpLITRs, I generated a series of chimeric proteins encoding the cytoplasmic region of various wild-type and truncated ITIM-bearing IpLITRs and expressed the receptors in mouse NK cells. IpLITR chimeras caused specific inhibition of NK cell-mediated cytotoxicity towards their target cells. This inhibition was demonstrated to be receptor-mediated and ITIM-dependent as cytotoxicity was regained in the presence of blocking antibodies and ITIM-binding dominant-negative phosphatases, respectively. Biochemically, the IpLITR chimeras co-immunoprecipitated key phosphatases known to mediate immune cell inhibition in other vertebrates. These results provide direct evidence that ITIM-bearing IpLITRs utilize a conserved phosphatase-dependent pathway for regulating cellular activation.

ONTARIO CONSORTIUM OF UNDERGRADUATE BIOLOGY EDUCATORS: ADVANCING THE QUALITY OF UNDERGRADUATE EDUCATION IN ONTARIO UNIVERSITIES [TEA]

CONSORTIUM ONTARIEN DES ÉDUCATEURS EN BIOLOGIE POUR ÉTUDIANTS NON-DIPLÔMÉS: ACCROÎTRE LA QUALITÉ DE L'ÉDUCATION POUR LES ÉTUDIANTS NON-DIPLÔMÉS DANS LES UNIVERSITÉS ONTARIENNES

Colin J Montpetit

University of Ottawa

oCUBE is a new Community of Practice bringing together Ontario Life Science educators, serving as a nexus of expertise, enthusiasm for and innovation in teaching. oCUBE was founded on the need to sustain a vibrant community of practice among people determined to improve the quality of experience of undergraduate biology education for both students and educators. Overall, oCUBE is dedicated to enhancing faculty engagement, providing peer support and mentoring to new and future faculty, sharing and disseminating best practices in Biology teaching, and, ultimately improving student engagement, experience and learning. The Consortium provides opportunities for building supportive community that, in turn, fosters professional development, curriculum innovation, research collaboration, scholarship of teaching and learning as well as interaction with other groups with complementary interests. The goal of this presentation is to discuss the oCUBE structure, and the goals and activities of the community of practice.

ARE YOU COMMITTED? USING OLIGONUCLEOTIDE MICROARRAYS FOR GENE EXPRESSION PROFILING OF AMERICAN LOBSTERS (*HOMARUS AMERICANUS*) [CPB18]

*ÊTES-VOUS ENGAGÉ? UTILISATION DE PUCES À OLIGONUCLÉOTIDES POUR ANALYSER L'EXPRESSION GÉNIQUE CHEZ LE HOMARD AMÉRICAIN (*HOMARUS AMERICANUS*)*

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American lobster (*Homarus americanus*) fishing is Canada's most valuable seafood export. Currently, methods for determining the minimum legal catch size by Fisheries and Oceans scientists is based on a 'size at maturity' model, which is not uniform across all lobster fishing areas. This method requires the slaughter of thousands of lobster, to examine the gonads as the exoskeleton prevents external examination. Ovary staging is currently subjective employing several methods, including colour and oocyte size. Using a novel lobster microarray, tissues from female

lobsters were analyzed to determine gene expression changes between ovary stages. The research focuses around lobsters with an ovary stage of 4a/b, which is the physiological commitment point for ovary/oocyte development. Identifying novel ovary stage associated biomarkers may lead to the development of a non-biased method of determining sexual maturity in females.

REGULATION OF CELLULAR AND MITOCHONDRIAL LIPID UPTAKE DURING HYPOXIA

[CPB15]

RÉGULATION DE LA PRISE DE LIPIDES PAR LES CELLULES ET LES MITOCHONDRIES LORS DE L'HYPOXIE

Andrea J Morash and AJ Murray

University of Cambridge

Highly oxidative tissues such as cardiac and skeletal muscles must sustain high ATP production to match their energetic demands. This requires a continual supply of both oxygen and metabolic substrates. Under hypoxic conditions, these tissues must adapt in order to maintain cellular energy homeostasis while preventing oxidative damage. Physiological adaptations to enhance oxygen delivery have been very well characterized, whilst adaptations at the cellular and mitochondrial level remain relatively unexplored. Much of the focus has now been pinned on the efficiency of ATP production through substrate selection, (ie. glucose or ketone bodies vs. fatty acids), however, the mechanisms through which this selection is mediated are unknown. Using hypoxic exposed mice and humans, we investigated the role of PPAR α and several of its target genes in regulating lipid metabolism in cardiac and skeletal muscle during acute and chronic hypoxia. Preliminary results indicate that PPAR α may mediate tissue specific responses which may alter fatty acid oxidation.

GLOBAL WARMING AND COMPETITION FOR HABITAT BY ARCTIC LEMMINGS [EEE2]

RÉCHAUFFEMENT CLIMATIQUE ET COMPÉTITION POUR LES HABITATS PAR LES LEMMINGS DE L'ARCTIQUE

Douglas Morris and A Dupuch

Lakehead University

Effects of global warming such as permafrost degradation, altered phenologies, and increased plant growth portend major impacts on Arctic ecosystems. Many of these impacts will be associated with changes in habitat. If habitat change is predictable, then we should be able to use patterns of habitat selection to forecast future distribution and abundance of Arctic species. In order to do so, we must account for both the direct and indirect effects of habitat change. Comparison of lemming habitat selection across a 15 year interval demonstrates that changes in the local distribution of brown lemmings were caused mainly by intra-specific competition for habitat rather than habitat change. Changes in the distribution of collared lemmings were caused primarily by inter-specific competition and secondarily by habitat change. It thus appears that the major impacts of global warming on these prototypical Arctic mammals are modulated by indirect routes that influence density-dependent competition for habitat.

ENERGETIC COSTS OF ARYL HYDROCARBON RECEPTOR ACTIVATION BY BETA-NAPHTHOFLAVONE IN RAINBOW TROUT HEPATOCYTES [CPB8]

COÛTS ÉNERGÉTIQUES DE L'ACTIVATION DU RÉCEPTEUR DES ARYL-HYDROCARBURES PAR LA BETA-NAPHTHOFLAVONE DANS LES CELLULES HÉPATIQUES CHEZ LA TRUITE ARC-EN-CIEL

Rance Nault and TW Moon

University of Ottawa

Environmental pollutants including polyaromatic hydrocarbons (PAHs) are continuously added to the aquatic environment. In response to these toxic insults, aquatic organisms activate defence systems in an attempt to metabolize and excrete these toxicants and their metabolites. Of particular interest for PAHs are those that activate the aryl hydrocarbon receptor (AhR) pathway which plays an important role in inducing transcription of cytochrome P4501A, a key enzyme in metabolizing many of these contaminants. In this study I hypothesize that the activation of the AhR by beta-naphthoflavone (B-NF), a model AhR agonist, results in increased energetic costs requiring

metabolic reorganization in trout hepatocytes as the liver is the principle site of xenobiotic and whole animal metabolism. A stoichiometry based mathematical model will assess whether hepatic metabolism is re-organised to cope with AhR activation. This study will provide insights into the costs and the metabolic responses of AhR activation in hepatocytes.

AN EPIGENETIC MECHANISM INVOLVED IN TEMPERATURE-INDUCED SEX RATIO SHIFTS IN FISH POPULATIONS [CMD2]

UN MÉCANISME ÉPIGÉNÉTIQUE IMPLIQUÉ DANS LE RÉARRANGEMENT DU SEX-RATIO INDUIT PAR LA TEMPÉRATURE DANS DES POPULATIONS DE POISSONS

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Sex ratio shifts in response to temperature are common in fish and reptiles. However, the mechanism linking temperature during early development and sex ratios has remained elusive. We show in the European sea bass, a fish in which temperature effects on sex ratios are maximal before the gonads form, that males have double DNA methylation levels than females in the promoter of *cyp19a*, the gene coding for aromatase, the enzyme that converts androgens into estrogens. Exposure to high temperature increased the *cyp19a* promoter methylation levels of females, meaning that induced masculinization involves DNA methylation-mediated control of aromatase gene expression, with an observed inverse relationship between methylation levels and expression. Although different CpGs within the *cyp19a* promoter exhibited different sensitivity to temperature, we show that the increased methylation of the *cyp19a* promoter, which occurs in the gonads but not in the brain, is not a generalized effect of temperature.

GENE EXPRESSION PROFILES DURING NATURAL METAMORPHOSIS IN WILD WOOD FROG (LITHOBATES SYLVATICUS) TADPOLES ARE SIMILAR TO THEIR LABORATORY COUNTER-PARTS [CPB16]

LES PROFILS D'EXPRESSION GÉNÉTIQUE DURANT LA MÉTAMORPHOSE NATURELLE DES TÉTARDS DE GRENOUILLES DES BOIS SAUVAGES (LITHOBATES SYLVATICUS) SONT SIMILAIRES À CEUX OBSERVÉS EN LABORATOIRE

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¹University of Ottawa; ²University of New Brunswick

Numerous studies conducted with tadpoles grown under standard laboratory conditions have shown the fundamental importance of thyroid hormones (TH), thyroid receptors (TR) and diiodinases (Dio) enzymes during anuran metamorphosis. However, these studies often use laboratory-reared species (e.g., *Xenopus laevis*) that may not be representative of natural populations. For this reason, the present study focused on gene expression profiles in wild wood frog (*Lithobates sylvaticus*) tadpoles. The present study shows for the first time that expression profiles of thyroid-related genes in anuran tadpoles undergoing metamorphosis in the wild are remarkably similar to those found in laboratory-reared tadpoles of the same and other species. These data are an important first step to analyze if extrapolation of laboratory results on the effects of endocrine disrupting chemicals can be applied to natural systems.

IMPROVING ACHIEVEMENT, RETENTION AND EQUITY IN UNDERGRADUATE BIOLOGY COURSES [TEA WS]

ACCROÎTRE LA RÉUSSITE, LA PERSÉVÉRANCE ET L'ÉQUITÉ CHEZ LES ÉTUDIANTS NON-DIPLÔMÉS EN BIOLOGIE

Craig E Nelson

Indiana University

Key pedagogical changes can make major differences in achievement and retention in almost any college or university biology classroom without lowering the standards for achievement. Specific topics will include: 1. How can I radically reduce or (sometimes) eliminate low grades in lecture courses without lowering standards? 2. How can I make my students brighter and harder working using only 1 hour of class time (in ways that level the playing field for all groups)? 3. But what about covering the content? Participants will be asked to consider and discuss how

these approaches might apply in their own teaching.

NOT-SO-COOPERATIVE BREEDERS MAKE POOR PARENTS [EEE3]L

LES ÉLEVEURS PEU COOPÉRATIFS FONT DE MAUVAIS PARENTS

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For cooperatively breeding species, increased group size is associated with group-living benefits such as increased offspring provisioning and increased territory defence. However, increased group size can also intensify competition among group members for reproductive opportunities or resources. We investigated benefits and costs associated with group size in a cooperatively breeding rail, the pukeko (*Porphyrio porphyrio melanotus*). We found that very large groups displayed increased aggression. In particular, aggression increased in groups containing high numbers of similarly sized males. Importantly, increased aggression was strongly related to decreases in chick survival to fledging, overriding other important factors such as a territory quality. Our results demonstrate that not only do large cooperatively breeding groups face a cost in terms of increased aggression, this conflict can lead to a breakdown in overall group function, and dissolution of offspring care benefits.

LACTATE FLUX IN RAINBOW TROUT: HYPOXIA VS. EXERCISE [CPB7]

LE FLUX DE LACTATE CHEZ LA TRUITE ARC-EN-CIEL : COMPARAISON ENTRE L'HYPOXIE ET L'EXERCICE

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University of Ottawa

The rates of lactate appearance (Ra) and disposal (Rd) in the circulation of rainbow trout were measured *in vivo* by continuous infusion of [U-¹⁴C] lactate during exposure to acute hypoxia and during exercise. We aimed at determining how Ra and Rd account for the observed changes in blood lactate. Hypoxic fish (25% O₂ for 90 min) showed progressive increase in blood lactate from 1.0 to 8.9 mM, and Ra lactate was strongly stimulated from 18.4 to 36.5 $\mu\text{mol kg}^{-1} \text{min}^{-1}$. Surprisingly, Rd lactate was also increased from 19.9 to 30.3 $\mu\text{mol kg}^{-1} \text{min}^{-1}$. In exercising fish (1.7 BL s⁻¹, 100% O₂ for 100 min), Ra and Rd lactate showed transient but identical increase from 13 to 22 $\mu\text{mol kg}^{-1} \text{min}^{-1}$, thereby maintaining a low, baseline blood lactate concentration of 0.9 mM. This study shows: 1) that the hypoxia-induced increase in blood lactate is due to a stronger stimulation of Ra than Rd lactate, and 2) that submaximal exercise can cause a large increase in lactate production without affecting blood lactate concentration.

OBSERVATIONS ON THE EPIDEMIOLOGY OF LOMA MORHUA DURING AQUACULTURE OF ATLANTIC COD [PAR2]F

REMARQUES SUR L'ÉPIDÉMIOLOGIE DE LOMA MORHUA CHEZ LA MORUE DE L'ATLANTIQUE EN AQUACULTURE

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University of New Brunswick

Loma morhua has impeded development of the Atlantic cod aquaculture industry. Infections cause mortalities and reduced growth rates in both juvenile and adult cod. We observed adult cod at an aquaculture site in Atlantic Canada and documented 100% prevalence of infection (2010-2011). Average infection intensity was 69 (1-300) xenomas per fish and the spleen was the most reliable indicator of infection (98%). Intensity of gill xenomas was correlated with water temperature at cage sites, with highest infection intensities observed following decrease from 12 to 10°C. Biofouling by blue mussels was abundant on sea cages. 76.5% of cod contained blue mussels and 32.1% contained copepods in their intestinal tract, evidence that Atlantic cod are opportunistic feeders that supplement their diet where possible. Macro- and micro-invertebrates were collected to identify reservoirs of significance and seawater was filtered to determine correlation between water temperature and peak periods of parasite transmission at sea cages.

INHIBITION OF ZEBRAFISH HATCH BY NANOPARTICLES [CPB4]

INHIBITION DE L'ÉCLOSION CHEZ LE POISSON-ZÈBRE VIA DES NANOPARTICULES

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Hatching success in zebrafish is an indicator of embryonic health, and various toxicants or environmental conditions can promote or inhibit hatch. For fish hatch to occur, there must be both a release of hatching enzyme from the hatching gland and physical breaching of the chorion by movement of the embryo. Inhibition of hatch can be related to a delay in development, a reduction of embryo movement, or an interaction between a toxicant and hatching enzymes. In our lab, certain nanoparticles have been found to delay hatch. We examined a range of nanoparticles, including silver, zinc oxide, silicon, cadmium selenide, and hydroxyapatite to determine effects on zebrafish hatching. Using microscopy, we monitored for both morphological delays in development and movement of embryonic fish. Additionally, using protease assays, we established that NPs can inhibit the hatching proteases necessary for breakdown of the chorion.

CHARACTERIZATION OF TiO₂ AQUEOUS METAL NANOPARTICLES AND ASSESSMENT OF RBL-2H3 IMMUNOTOXICITY USING IN-VITRO CELL MODELS [CPB1]

CARACTÉRISATION DE PARTICULES MÉTALLIQUES AQUEUSES DE TiO₂ ET ÉVALUATION DE L'IMMUNOTOXICITÉ DE RBL-2H3 EN UTILISANT DES MODÈLES CELLULAIRES IN-VITRO

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University of Alberta

Nanotechnology is an emerging multidisciplinary field that involves the synthesis of molecules in the nanoscale (<100 nm). The small size of nanoparticles (NP) produces unique physico-chemical properties that are different from their larger bulk forms. Although impressive from a physico-chemical perspective, there is growing concern over the potential and unknown toxicity of these particles on biological systems. Dynamic Light Scattering was used to characterize polyacrylic encapsulated TiO₂ NPs in our solutions. RBL-2H3 immune cell line (RBL) was exposed to Nano-TiO₂ concentrations ranging from 0, 1, 10, 50, 100 and 200 mg l⁻¹ over 48 hours. Using light microscopy and flow cytometry, cells were analyzed for appearance, viability and proliferation. Results indicated dose-dependent and changes in viability, proliferation and morphology. We then examined the effects of Nano-TiO₂ exposures on immune cell effector functions (phagocytosis, degranulation, cytokine secretion, and modulation of immune gene and protein expression.) by dosing RBLs with sub-lethal doses.

MODULARITY AND EVOLVABILITY AMONG PREDATORY GASTROPODS WITH A BIPHASIC LIFE HISTORY [CMD3]

CAPACITÉ D'ÉVOLUTION ET DE RÉSILIENCE CHEZ LES GASTÉROPODES CARNASSIERS AYANT UN HISTORIQUE DE VIE BIPHASIQUE

Louise Page

University of Victoria

Explosive diversification of predatory gastropods after their Cretaceous origin has been attributed to competitive interactions among taxa exploiting a novel food. However, the selective challenge of carnivory must have acted through a developmental system capable of generating phenotypic variability as raw material for selection. Previous studies of development by predatory gastropods identified a key innovation to a developmental module for adult foregut structures, which allowed pre-metamorphic construction of the specialized adult feeding system without compromising larval feeding structures. Results of a recent developmental analysis of a cone snail with a feeding larval stage are consistent with this hypothesis and revealed how a markedly different type of predatory feeding system has arisen through different modification of the same developmental module identified in the other gastropods. Diversification within the context of a biphasic life cycle, where boundaries between developmental modules are obvious, makes predatory gastropods ideal for addressing questions about the link between development and evolution.

PYROKININ-RELATED PEPTIDES AND THEIR RECEPTORS IN THE HAEMATOPHAGOUS INSECT, RHODNIUS PROLIXUS - A VECTOR OF CHAGAS' DISEASE [CPB6]

PEPTIDES ASSOCIÉS À LA PYROKININE ET LEURS RÉCEPTEURS CHEZ L'INSECTE HÉMATOPHAGE, RHODNIUS PROLIXUS – UN VECTEUR DE LA MALADIE DE CHAGAS

Jean-Paul V Paluzzi and MJ O'Donnell

McMaster University

Pyrokinin-related peptides are normally produced from multiple genes in insects. One such gene, referred to as the capability or CAPA gene, encodes a single pyrokinin-related peptide and two CAPA-related peptides. The CAPA related peptides are known to be modulators of fluid secretion rates of insect Malpighian tubules. For example, CAPA peptides stimulate fluid secretion in dipteran insects, however in hemipteran insects, they inhibit fluid secretion. Unfortunately, little information is known regarding the effects of the pyrokinin-related peptides. Thus, in order to elucidate the roles of the pyrokinin-related peptides in *R. prolixus*, we have isolated and functionally characterized receptors for these peptides. We demonstrate receptor expression is associated with a number of tissues not previously recognized as targets of this peptide family. This research establishes novel possibilities for physiological roles of pyrokinin-related peptides in this medically relevant disease-vector.

BICARBONATE TRANSPORT IN TUMOUR CELL pH REGULATION AND SURVIVAL [CPB17]

TRANSPORT DU BICARBONATE POUR LE CONTRÔLE DU PH ET DE LA SURVIE CHEZ LES CELLULES TUMORALES

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University of Nice

Rapidly growing tumours develop faster than the complementary vasculature resulting in regions of hypoxia and alterations in gene expression directed by the Hypoxia Inducible Factor-1 (HIF1). As a consequence of increased metabolic acid production, the tumour microenvironment is acidified. However, tumour cells maintain an alkaline intracellular pH (pHi) despite the marked acidification of the extracellular fluid. Therefore the altered pH dynamics in tumours provide a unique opportunity to target pH disruption for the development of effective anti-cancer strategies. Recent studies have implicated the HIF1 regulated extracellular facing carbonic anhydrase IX in tumour pHi regulation and survival by allowing CO₂/HCO₃⁻ cycling. However, other components of the HCO₃⁻ re-uptake mechanism remain unknown. This presentation will discuss recent findings on hypoxia induced bicarbonate transporters and advances in the overall tumour cell pHi regulating mechanism.

THE EFFECT OF DIETARY SALT LOADING ON THE RENIN ANGIOTENSIN AND ADRENERGIC SYSTEMS OF RAINBOW TROUT (ONCORHYNCHUS MYKISS) [CPB20]

EFFET DE LA PRISE ALIMENTAIRE DE SEL SUR LE SYSTÈME RÉNINE-ANGIOTENSINE ET LE SYSTÈME ADRENERGIQUE CHEZ LA TRUITE ARC-EN-CIEL (ONCORHYNCHUS MYKISS)

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Chronic dietary salt loading causes hypertension and a decreased sensitivity of the systemic vasculature to α -adrenergic stimulation in rainbow trout. This reduced sensitivity is consistent with a blunting of responses normally aimed at raising blood pressure. To test this idea, we examined the consequences of long-term hypertension on the interactive capacities of the renin angiotensin system (RAS) and adrenergic systems to elevate blood pressure. Secretion of catecholamines in response to angiotensin II (ANG II) *in vivo* and *in situ* was reduced in salt fed fish. The reduced sensitivity to ANG II could not be explained by alterations in stored catecholamine levels or the general responsiveness of the chromaffin cells to depolarizing stimuli (KCl). Paradoxically, the pressor effects of ANG II were heightened in the salt fed fish and during acute hypoxia (a condition which activates the RAS), plasma catecholamines were increased to a greater extent in the salt-fed fish.

PURINERGIC REGULATION OF BREATHING IN AMPHIBIANS [CPB5]

RÉGULATION PURINERGIQUE DE LA RESPIRATION CHEZ LES AMPHIBIENS

Andrew Peters and S Reid

University of Toronto Scarborough

Amphibians can survive long bouts of hypoxia by entering a state of metabolic arrest. Adenosine (ADO), which, during hypoxia, can increase up to 100X in the extracellular fluid, has been implicated in initiating hypoxia-induced metabolic arrest. This study examined the effects of ADO on respiratory regulation in cane toads. Using an *in vitro* brainstem preparation and recording respiratory motor output from the vagus nerve, ADO was acutely applied at multiple concentrations and pH levels and recordings continued for a further 12 h. At pH 7.8, 1 μ M ADO decreased total fictive ventilation (TFV), 10 μ M increased TFV while 0.1 μ M and 100 μ M had no effect. At pH 7.4, both 1 μ M and 10 μ M decreased TFV, 100 μ M increased TFV while 0.1 μ M had no effect. At pH 8.0, 1, 10 and 100 μ M all increased TFV. The data suggest that exogenous ADO elicits a concentration-dependent modulation of respiratory motor output which is pH-dependent.

SEAWATER EXPOSURE DIFFERENTIALLY ALTERS GILL PARACELLULAR PERMEABILITY AND CLAUDIN MRNA ABUNDANCE IN VITRO AND IN VIVO [CPB20]

L'EXPOSITION À L'EAU DE MER ALTÈRE LA PERMÉABILITÉ PARACELLULAIRE DES BRANCHIES ET LA QUANTITÉ D'ARNM DE CLAUDINE IN VITRO ET IN VIVO

Bui Phuong and SP Kelly

York University

Effect of seawater (SW) on gill permeability characteristics was investigated *in vivo* and *in vitro* by exposing either puffer fish (*Tetraodon nigroviridis*) or a cultured puffer fish gill epithelium (composed of pavement cells) to SW for 6 or 12 h. Changes in transepithelial resistance (TER) and paracellular [3 H]PEG-4000 flux were examined *in vitro* while alterations in the mRNA abundance of claudin tight junction proteins were measured *in vivo* and *in vitro*. SW significantly reduced TER across cultured gill epithelia from 2 h onwards. However, paracellular permeability did not change for at least 6 h, and then increased between 6 - 12 h. Changes in permeability occurred in conjunction with altered mRNA abundance of select claudin proteins. This was also apparent in whole gill tissue, albeit a different trend. Differences between *in vitro* and *in vivo* likely reflect the cellular heterogeneity of the gill and/or the influence of the endocrine system.

YOU TAKE MY BREATH AWAY: THE EFFECT OF PROLONGED HYPOXIA EXPOSURE ON THE CARDIO-VENTILATORY RESPONSE OF BOWFIN (AMIA CALVA) WITH AND WITHOUT ACCESS TO AIR [CPB2]

TU ME COUPES LE SOUFFLE : LES EFFETS D'UNE HYPOXIE PROLONGÉE SUR LA RÉPONSE CARDIO-VENTILATOIRE DU POISSON-CASTOR (AMIA CALVA) AVEC ET SANS ACCÈS À L'AIR

Cosima Porteus¹, PA Wright² and WK Milsom¹

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We investigated the effect of exposure to prolonged hypoxia on the cardio-ventilatory response of bowfin with and without access to the surface to breathe air. Animals without access to air during acute progressive hypoxia showed a 2.5 fold increase in gill breathing frequency and a 30% reduction in heart rate. After exposure to prolonged hypoxia, fish without access to air during prolonged hypoxia had higher resting heart rates, increased heart rate sensitivity to acute hypoxia, and a decrease in gill breathing sensitivity to acute hypoxia relative to fish that had access to air during chronic hypoxia exposure. Surprisingly haemoglobin oxygen binding affinity decreased after chronic exposure to hypoxia in both fish with and without access to air. Taken together these results indicate that bowfin utilize different strategies for matching oxygen supply and demand during prolonged hypoxia than other more derived teleosts such as trout.

IMPACT OF HYPOXIA ON THE GREENLAND HALIBUT (REINHARDTIUS HIPPOGLOSSOIDES) [EEE2]

IMPACT DE L'HYPOXIE CHEZ LE FLÉTAN DU GROENLAND (REINHARDTIUS HIPPOGLOSSOIDES)

Aurélien Prinet-Dupont¹, M Vagner¹, D Chabot², Y Lambert² and C Audet¹

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In the Estuary and the Gulf of St. Lawrence, the Greenland halibut, an important commercial species, is frequently caught in severely hypoxic areas (20-25% air sat.) suggesting that it is hypoxia tolerant. Dissolved oxygen is known

to influence fish physiology and performance in limiting aerobic scope (AS) of metabolism. We found that adult Greenland halibut were more hypoxia tolerant than juveniles (Critical oxygen level = 11.1 ± 2.7 vs $14.9 \pm 3.2\%$ sat.), suggesting that AS could be limited in juveniles. The reduction in AS with decreasing oxygen level was confirmed at different levels of dissolved oxygen. We also studied the impact of hypoxia digestion metabolism. It is expected that severe hypoxia (20% sat.) slows digestion, which should decrease food intake and growth in the field.

A COMPARISON OF HOLDING ENVIRONMENTS FOR FACILITATING PHYSIOLOGICAL RECOVERY FROM CAPTURE STRESS IN SOCKEYE SALMON [CPB18]

COMPARAISON D'ENVIRONNEMENTS PERMETTANT DE FACILITER LE RÉTABLISSEMENT PHYSIOLOGIQUE APRÈS LE STRESS ENGENDRÉ PAR LA CAPTURE CHEZ LE SAUMON ROUGE

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¹Carleton University; ²University of British Columbia

We evaluated the role of recovery environment for sockeye salmon physiology following fisheries capture stress. We compared a specially designed revival box, the Fraser box, which uses a pump to ram ventilate fish, to an in-river flow-through recovery bag. Sockeye were beach seined in the Harrison River (British Columbia), air exposed for 3 minutes to induce severe capture stress and immediately sampled, or placed in a low-flow (0.2 l s^{-1}) or high-flow (0.9 l s^{-1}) Fraser box, or a recovery bag for either 15, 30, 60, or 120 minutes. Following the recovery period, we assessed reflex actions and sampled blood and white muscle. In the laboratory we analyzed physiological indices of stress, exhaustion, and energetic state in plasma and white muscle, and used those metrics to compare the three recovery environments over a 2 hour time course. This study demonstrates that environment plays a role in the physiological recovery of sockeye salmon from exercise and air exposure.

SEX DIFFERENCES IN GROUP JOINING DECISIONS IN SOCIAL FISH [EEE3]L

DIFFÉRENCES SEXUELLES DU COMPORTEMENT D'ASSOCIATION CHEZ LES POISSONS SOCIAUX

Adam R Reddon, D Balk and S Balshine

McMaster University

In social animals, group joining decisions can have important fitness consequences especially when individuals exist in a dominance hierarchy that relates to reproductive success. Choosing to join a large group may maximize safety but a small group can minimize the delay to dominant status. We explored this trade-off using *Neolamprologus pulcher*, a cooperatively breeding cichlid fish in which individuals conform to a rigid dominance hierarchy and females are philopatric. We predicted that because females have less opportunity to switch groups, they would place higher value on social rank than safety. We found that males prefer larger groups regardless of the rank they must assume when they join while females preferred larger groups only when joining did not compromise social rank. Our results help to elucidate factors underlying social decision making and suggest that females value both rank and safety while males are primarily concerned with safety.

THE EFFECT OF TEMPERATURE ON THE CHRONIC HYPOXIA-INDUCED CHANGES TO pH/CO₂-SENSITIVE FICTIVE BREATHING IN THE CANE TOADS [CPB5]

L'EFFET DE LA TEMPERATURE SUR LES CHANGEMENTS DE RESPIRATION FICTIVE SENSIBLES AU pH/CO₂ INDUITS PAR L'HYPOXIE CHRONIQUE CHEZ LE CRAPAUD GÉANT

Stephen Reid and S Jenkin

University of Toronto Scarborough

This study examined the effects of temperature and chronic hypoxia (CH) on pH/CO₂-sensitive fictive breathing, and central pH/CO₂ chemosensitivity, in cane toads. Toads were exposed to CH (10% or 15% O₂) or control conditions (21% O₂) for 10 days at either room temperature (controls), 10°C or 30°C following which *in vitro* brainstem-spinal cord preparations were used to examine central pH/CO₂-sensitive fictive breathing (i.e., motor output from respiratory nerves which is the neural correlate of breathing). A reduction in artificial cerebral spinal fluid (aCSF) pH increased fictive breathing frequency (fR) and total fictive ventilation (TFV). Cold temperature reduced and hot temperature increased fR and TFV under control conditions. CH attenuated fictive breathing independently of temperature. Additional experiments in which the aCSF temperature was varied indicate that the effects of temperature acclimation result from neural plastic changes within respiratory control centres in the brain.

EVIDENCE FOR TRANSCRIPTIONAL REGULATION OF THE UREA TRANSPORTER IN THE GILL OF THE GULF TOADFISH, OPSANUS BETA [CPB14]

PREUVE DE LA RÉGULATION TRANSCRIPTIONNELLE DU TRANSPORTEUR DE L'URÉE DANS LES BRANCHIES DU BATRACHOÏDIFORME OPSANUS BETA

Tammy Rodela¹, A Esbaugh², MD McDonald², KM Gilmour³ and PJ Walsh³

¹University of British Columbia; ²University of Miami; ³University of Ottawa

Ureotelic Gulf toadfish (*Opsanus beta*) accumulate urea internally until a branchial urea transport mechanism is activated to facilitate the excretion of urea in distinct pulses. This unusual urea excretion pattern is regulated, in part, by permissive declines in circulating cortisol concentrations. The current study examined toadfish urea transporter (tUT) transcript levels in toadfish. Measurement of tUT mRNA showed a 6.2-fold upregulation 12 to 18 h following a pulse event. *In silico* analysis of an isolated 1.2 kb fragment upstream of the tUT gene revealed 6 putative glucocorticoid response element (GRE) half sites. *In vivo* reporter assays of the tUT promoter fragment demonstrated relative luciferase activity was enhanced 3.4- and 9.8-fold following exposure to moderate (via crowding stress) and high (via infusion) cortisol. We conclude GRE-mediated upregulation of mRNA may be required to maintain tUT activity for subsequent pulse events. (Funded by NSERC to KMG and PJW, NSF to MDM)

MORPHOGEN-BASED MODEL OF RAY GROWTH AND SEGMENT FORMATION DURING FIN DEVELOPMENT AND REGENERATION [CMD S]

MODÈLE MORPHOGENIQUE DE CROISSANCE DES RAYONS ET DE FORMATION DE SEGMENTS PENDANT LE DÉVELOPPEMENT ET LA RÉGÉNÉRATION DES NAGEOIRES

Anne-Gaëlle Rolland-Lagan and M-A Akimenko

University of Ottawa

The segmented dermal bony rays of zebrafish (*Danio rerio*) caudal fins can regenerate following amputation, and have emerged as a convenient model system to study bone development and regeneration. Descriptive studies indicate that rays grow along the proximo-distal axis of the fin through distal addition of bone matrix, and distal joint formation gives rise to bony segments. However, mechanisms controlling patterns of bone growth and joint formation remain elusive. We propose a morphogen-based simulation model which accounts for multiple qualitative observations described in the literature regarding fin ray growth during development and regeneration. The model can recreate realistic patterns of fin ray growth and joint formation across whole fins as they develop and/or regenerate following amputation. We therefore propose that fin ray growth and joint formation is under the control of three interacting morphogens, one produced at the proximal end of the fin and two produced at the distal end.

RESUSCITATING THE CORPSE: TRANSFORMING THE LABORATORY EXPERIENCE IN COMPARATIVE VERTEBRATE ANATOMY [TEA]

RÉSSUCITER LES CADAVRES: TRANSFORMER L'EXPÉRIENCE DE LABORATOIRE SUR L'ANATOMIE COMPARATIVE DES VERTÉBRÉS

Anthony P Russell and HA Jamniczky

University of Calgary

Anatomy is generally thought of as a fact-rich discipline that lends itself primarily to rote learning. Over the past six years we have worked on ways of enhancing student engagement in vertebrate anatomy by changing the way content is presented, tasks are set, and expectations are defined. We participated in this process through involvement with the Inquiry Through Blended Learning (ITBL) initiative at the University of Calgary. Through this engagement and partnership we developed a sequence of inquiry-based, sequential and interconnected laboratories. In association with this we generated a workbook and a set of web-based course materials, including instructional videos and tutorials. Laboratories are clustered into modular sets, and integration between modules is required. Workbook exercises serve as a study resource. Despite the challenges inherent in a large course (144 enrollees per year) the approach has been largely well-received and has resulted in positive changes in student attitudes and the approach of students to learning this subject matter.

CONTROL OF SWIMMING IN MEDUSAE: BEYOND DIFFUSE NERVE NETS [Spencer]

LE CONTRÔLE DE LA NAGE CHEZ LES MÉDUSES: AU-DELÀ DES FILETS NERVEUX SENSITIFS

Richard Satterlie

University of North Carolina at Wilmington

The neuronal organization of swim systems in medusae of three cnidarian classes (Hydrozoa, Scyphozoa, Cubozoa) show a clear dichotomy that was described by Romanes in the late 1800s. Since that time, both structural and physiological data have confirmed this dichotomy, providing an excellent example of behavioral convergence. Two of the classes, Scyphozoa and Cubozoa, show the same basic neural organization of the swim systems while the hydrozoan swim systems exhibit drastic differences. In all three groups, nerve nets are used for some aspects of neural conduction, but there are also varying degrees of nerve net compression and neural condensation that suggest centralized nervous systems are present in each group of medusae.

INCREASED USE OF CARBOHYDRATES IN ANDEAN MICE: A PHYLOGENETIC APPROACH

[Hoar]

AUGMENTATION DE LA CONSOMMATION D'HYDRATES DE CARBONE CHEZ LES SOURIS DES ANDES:
UNE APPROCHE PHYLOGÉNIQUE

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¹McMaster University; ²Universidad Peruana Cayetano Heredia

For decades, it has been hypothesized that one adaptation to maintain performance at high altitude is the preferred use of carbohydrates (CHO) as fuel because of its oxygen-saving advantage (15-18% more ATP per mole of O₂) over fatty acids. To test this hypothesis, we measured whole-body fuel selection patterns and biochemical aspects of cardiac and skeletal muscle metabolism in four closely related species of Andean mice (*Phyllotis*) native to high (4000-4500m) and low (close to sea level) altitudes. More specifically, we measured aerobic capacities, time to fatigue and fuel selection at rest and at submaximal exercise intensities under both normoxic and hypoxic (12% O₂) conditions. Taking into account the phylogenetic relationships of the species studied, our results show an increased use of CHO at submaximal relative exercise intensities in the high altitude *Phyllotis* species compared to their low altitude counterparts, and thus provide the first compelling evidence of CHO preference as an adaptation in high altitude mammals. (Funded by NSERC, authorized by INRENA)

SILVER NANOPARTICLES INHIBIT GILL SODIUM TRANSPORT IN JUVENILE RAINBOW TROUT (ONCORHYNCHUS MYKISS) [CPB4]

LES NANOPARTICULES D'ARGENT INHIBENT LE TRANSPORT DU SODIUM DANS LES BRANCHIES DE TRUITES ARC-EN-CIEL JUVENILES (ONCORHYNCHUS MYKISS)

Aaron G Schultz¹, T MacCormack², KJ Ong¹, M Guibin¹, J Veinot¹ and GG Goss¹

¹University of Alberta; ²Mount Allison University

Silver is a potent inhibitor of Na⁺ transport in fish and is suggested to elicit its effects at the gill by inhibiting Na⁺,K⁺-ATPase and/or carbonic anhydrase activity. This study sought to investigate if silver nanoparticles (NPs) or free dissociating Ag⁺ from the NP's affect Na⁺ transport in rainbow trout (*Oncorhynchus mykiss*). Silver NPs were dialyzed in water to examine the dissolution rate and calculate background of free Ag⁺ released from the NPs. Fish were exposed to 1.0 mg l⁻¹ citrate-capped silver NPs, dialyzed citrate-capped NPs, PVP and BSA-capped silver NP, or 10 µg l⁻¹ and 0.02 µg l⁻¹ silver (as AgNO₃). Silver NPs significantly inhibited Na⁺ influx by over 50%, but had no effect on Na⁺ efflux. Na⁺,K⁺-ATPase and carbonic anhydrase activity were measured to determine if the reduction in Na⁺ uptake is associated with an inhibition of these branchial enzymes. This study is the first to show that ion regulation is disrupted by silver NPs.

AMMONIA EXCRETION ACROSS THE CRAB GILL EPITHELIUM: A NOVEL PHYSIOLOGY TEACHING LABORATORY EXERCISE [TEA]

EXCRÉTION DE L'AMMONIAC À TRAVERS L'ÉPITHÉLIUM DES BRANCHIES DE CRABE : UN NOUVEL EXERCISE D'ENSEIGNEMENT DE LA PHYSIOLOGIE EN LABORATOIRE

Kevin Scott and D Weihrauch

University of Manitoba

This novel teaching lab is designed to demonstrate the fundamentals of nitrogenous waste removal in an aquatic species, while using modern scientific research techniques. While the mechanisms of ammonia excretion are well characterized in the green shore crab, they are currently unknown in *Cancer magister*. However, it is the Dungeness crab used due to its more manageable gill size. Using live crabs, students measure the whole body excretion rate. On a cannulated gill preparation they setup themselves, students also perform experiments to determine 1) whether ammonia excretion is active or passive, and 2) the mechanisms of ammonia excretion in these crabs. The development of new teaching labs plays an important role in the education of students in physiology programs. Teaching fundamentals in the context of current research, while using modern equipment, provides students with a solid background and better prepares them for today's research environment.

PHYSIOLOGICAL PERFORMANCE AND ENVIRONMENTAL TOLERANCE OF FOUR STRAINS OF DIPLOID AND TRIPLOID RAINBOW TROUT (ONCORHYNCHUS MYKISS) [CPB18]

PERFORMANCE PHYSIOLOGIQUE ET TOLÉRANCE ENVIRONNEMENTALE CHEZ QUATRE LIGNÉES DE TRUITES ARC-EN-CIEL DIPLOÏDES ET TRIPLOÏDES

Mark A Scott, R Dhillon and JG Richards

University of British Columbia

The goal of this project is to determine why 3n rainbow trout exhibit higher mortalities in the wild compared with their 2n counterparts. To accomplish this goal, we measured critical swimming speed (Ucrit), standard metabolic rate (oxygen consumption rates; MO_2), critical oxygen tensions (Pcrit), critical thermal maximum (CTmax), and time to loss of equilibrium from hypoxia exposure. These parameters were measured in 2n and 3n varieties of wild and domesticated strains of rainbow trout. Of all the analyses, only time to loss of equilibrium has consistently shown impaired 3n performance amongst all strains tested. For possible explanations we are currently measuring the activities of key metabolic enzymes of aerobic and anaerobic energy production and the metabolites associated with them in muscle, heart, and brain in hypoxia exposed trout.

ORGANIC ION TRANSPORT ACROSS THE BLOOD BRAIN BARRIER IN DROSOPHILA MELANOGASTER [CPB21]

TRANSPORT DES IONS ORGANIQUES À TRAVERS LA BARRIÈRE HÉMATO-ENCÉPHALIQUE CHEZ DROSOPHILA MELANOGASTER

Sara Seabrooke and M O'Donnell

McMaster University

Optimal brain function is highly dependent upon the body's ability to regulate the chemical microenvironment around brain cells. The blood brain barrier (BBB) isolates the brain from the blood and thus plays a cardinal role in brain homeostasis. My research utilizes *Drosophila* to understand how the BBB maintains a homeostatic environment for the brain. Integral to this is to understand the role of ion transporters in the BBB. Using genetic manipulation and fluorescent imaging, I have determined that expression of the organic anion transporter, P58Dc, but not the multidrug efflux transporter, MET, is necessary to expel the organic anion, fluorescein, from the brain. These findings will further our understanding of how the BBB maintains a microenvironment for the brain and how manipulating ion transporters can impact neuropharmacology. *Drosophila* has been a powerful tool in neurobiology and will certainly be important in developing methods for enhancing transport of beneficial drugs across the BBB.

ACID-BASE REGULATION IN LAMPREY DURING HYPERCARBIA; ARE ALL AGNATHANS CO_2 TOLERANT? [CPB17]

RÉGULATION ACIDO-BASIQUE CHEZ LA LAMPROIE PENDANT L'HYPERCAPNIE; TOUS LES AGNATHES SONT-ILS TOLÉRANTS AU CO_2 ?

Ryan B Shartau, D Baker, L Gaffney, D Close and CJ Brauner

University of British Columbia

Hagfish are one of the most CO_2 tolerant fishes and compensate for a CO_2 induced respiratory acidosis during exposure to 6% CO_2 through net uptake of HCO_3^- in the blood that is 3-fold greater than other fish investigated to date. To determine whether this is a general trait among agnathans, the response of Pacific lamprey (*Lampetra tri-*

dentate) to elevated CO₂ was investigated. Lamprey in freshwater were not able to tolerate exposure to 6 or 3% CO₂ for 48 h indicating that they do not possess the CO₂ tolerance of hagfish. However, they were able to tolerate 1.5% CO₂ and blood pH recovered to control values within 6 h which is rapid relative to most fish investigated to date. Preliminary findings indicate that pH compensation occurred in the absence of net uptake of HCO₃⁻ in the blood. Given that lamprey have existed in their present form for 360 million years, the unique pattern of blood pH compensation in lamprey may shed insight into the evolution of acid-base regulation in vertebrates.

DEVELOPMENT OF AN IN VITRO MODEL TO STUDY THE NEUROTOXIC EFFECTS OF AMMONIA IN THE ANOXIA-TOLERANT GOLDFISH (CARRASIIUS AURATUS) AND AMMONIA-SENSITIVE RAINBOW TROUT (ONCORHYNCHUS MYKISS) [CPB14]

MISE AU POINT D'UN MODÈLE IN VITRO POUR ÉTUDIER LES EFFETS NEUROTOXIQUES DE L'AMMONIAC CHEZ UN POISSON TOLÉRANT À L'ANOXIE (CYPRIN DORÉ, CARASSIUS AURATUS) ET UN POISSON SENSIBLE À L'AMMONIAC (TRUITE ARC-EN-CIEL, ONCORHYNCHUS MYKISS)

Sanya Sidhu, LEJ Lee and MP Wilkie

Wilfrid Laurier University

Hyperammonemia causes potentially fatal brain swelling due to fluid shifts into astrocytes. *In vitro* and *in vivo* approaches were used to test the hypothesis that ammonia-tolerant goldfish brains are more resistant to ammonia-induced swelling compared to ammonia-sensitive trout. Established cell-lines stained positively for glial fibrillary acidic protein (GFAP) suggesting the cells had astrocyte-like characteristics. Subsequent viability tests using Alamar Blue indicated that goldfish cells were two-fold more tolerant to high external ammonia (HEA) than trout cells exposed to similar ammonia concentrations (10-100 mM). Trout cells also exhibited greater vacuolization than goldfish cells, suggesting greater susceptibility to cell swelling. However, HEA exposure in the presence of methionine sulfoximine, which is thought to prevent cell swelling, did not affect cell viability. *In vivo* exposure of goldfish to HEA (5mM) also caused 50% increases in brain tissue water. We suggest that resistance to astrocyte swelling does not explain the higher ammonia tolerance of goldfish.

NEW INFORMATION ON THE ANATOMY OF THE TRIASSIC THERAPSID *TETRACYNODON DARTI*, AND THE INTERRELATIONSHIPS OF THEROCEPHALIANS [CMD3]

NOUVELLE INFORMATION SUR L'ANATOMIE DU THÉRAPSIDA TRIASSIQUE (TETRACYNODON DARTI), ET LES RELATIONS ENTRE LES THEROCEPHALIA

Trond Sigurdson¹, A Huttenlocker², T Rowe³ and S Modesto⁴

¹Université de Montréal; ²University of Washington; ³University of Texas at Austin; ⁴Cape Breton University

Within Synapsida (i.e. mammals and 'mammal-like reptiles'), the therocephalians constitute an important group of ecologically diverse therapsids from the Upper Permian and Lower Triassic. Although therocephalians have more mammalian features than earlier therapsids, they are not as closely related to true mammals as are the non-mammalian cynodonts. Previous studies indicate that primitive therocephalians may have had maxilloturbinals in the nasal cavity, which could be linked to the presence of endothermic metabolic rates. This study redescribes the baurioid therocephalian *Tetracynodon darti*, partially with the use of CT-scanning. No conclusive evidence for the presence of maxilloturbinals was found, but a number of elongate ridges on the ventral side of the nasal bone may indicate the presence of nasoturbinals which appear to be both respiratory and sensory in modern mammals. Previous inaccuracies in the original description of *Tetracynodon darti* are corrected, and this study also presents a new phylogenetic analysis of therocephalian interrelationships.

REAL-TIME MEASUREMENTS OF METABOLISM DURING FREEZING AND THAWING IN WOOD FROGS, RANA SYLVATICA [CPB3]

MESURES EN TEMPS REEL DU MÉTABOLISME LORS DU GEL ET DU DÉGEL CHEZ LA GRENOUILLE DES BOIS, RANA SYLVATICA

Brent J Sinclair¹, CM Williams¹, HA MacMillan¹ and KB Storey²

¹The University of Western Ontario; ²Carleton University

The wood frog, *Rana sylvatica*, survives freezing because of a dynamic process of mobilization of glucose from

glycogen in response to ice formation. This glucose is restored to glycogen after freezing, but repeated freezing leads to depletion of glycogen, which suggests that freezing and thawing have a metabolic cost. Here, we measure oxygen consumption and carbon dioxide production in *R. sylvatica* during complete freeze-thaw cycles in real time using flow-through respirometry. Initiation of freezing results in a very large increase in metabolic rate. While frozen, metabolic rate is significantly depressed, and there is a spike in metabolic rate upon thawing, although it is unclear whether this reflects a cost of thawing, or the cost of metabolizing anaerobic byproducts accumulated while frozen. The ecological implications of these costs will be discussed in the context of ongoing climate change which modifies the frequency and duration of freeze-thaw cycles.

GRAPHS: SIMPLER METHODS FOR MULTIVARIATE PHYSIOLOGY [EEE-CPB]
DES METHODES GRAPHIQUES PLUS SIMPLES POUR LA PHYSIOLOGIE MULTIVARIÉE
Dimitri A Skandalis
Universität Ulm

High-throughput data collection may transform comparative physiology through studies of many individuals or species over many variables, but not without appropriate analytic and statistical methods. Principal components analysis is simple and efficient, but the constructed variables may not be easily interpretable. Technically powerful methods, such as path analysis and factor analysis, may be costly to implement and are prone to methodological subjectivity. An intermediate method draws graphs (networks) of the associations between variables based on their partial correlations, providing intuitive and visual insight into their relationships. The method is attractive for its technical simplicity, its broad applicability, and its apparent ability to perform well even with missing data. I will demonstrate the method with examples from previous studies on bumble bee flight physiology, and mouse and fruit fly metabolism.

THE USE OF SALMONID GUT CELL LINES IN THE EVALUATION OF PLANT DERIVED MATERIALS AND FEED ADDITIVES FOR AQUACULTURE FEED FORMULATIONS [CPB18]
UTILISATION DE LIGNÉES CELLULAIRES D'INTESTIN DE SAUMONS POUR ÉVALUER DES SUBSTANCES VÉGÉTALES ET DES AGENTS ADDITIFS POUR DES FORMULATIONS DE NOURRITURE UTILISÉS PAR L'AQUACULTURE
Robbie J Smith¹, NC Bols² and LEJ Lee¹
¹*Wilfrid Laurier University*; ²*Waterloo University*

Plant derived materials (PDM) are increasingly being used in fish-feed formulations as alternative nutrient sources. However, the presence of antinutritional compounds including tannins and saponins in PDM are problematic to fish. Antinutrient effects in fish need to be evaluated using purified individual compounds or in mixtures, in proportions similar to those found within fish-feeds. *In vitro* techniques offer advantages in the testing of feed components as high throughput capacity, reduced costs, fewer animals tested and potential *in vivo* predictive values can be achieved. Two gut-derived salmonid cell lines were used to evaluate selected PDM. Quillaja saponin and tannic acid were highly toxic with EC₅₀ of ~5.7 and 1.8 µg ml⁻¹ respectively. The feed additives: vitamin C (10-100 µg ml⁻¹), sodium bentonite (10-200 µg ml⁻¹), and β-carotene (0.5-10 µg ml⁻¹) ameliorated the cytotoxicity of these compounds. This study provides data useful for designing optimum inclusion levels of PDM and treatment methods for neutralizing the negative effects of antinutrients.

AMPHIOXUS PROVIDES INSIGHT INTO THE EVOLUTION OF REGENERATION MECHANISMS AT THE INVERTEBRATE-VERTEBRATE TRANSITION [CMD S]
AMPHIOXUS COMME MODÈLE DE L'ÉVOLUTION DES MÉCANISMES DE RÉGÉNÉRATION À LA TRANSITION INVERTÉBRÉS-VERTÉBRÉS
Ildiko ML Somorjai¹, RL Somorjai², J Garcia-Fernandez¹ and H Escriva³
¹*University of Barcelona*; ²*IBD National Research Council*; ³*OOB Université Pierre et Marie Curie ParisVI*

The basal chordate amphioxus is uniquely positioned to address the evolution of regeneration in chordates. We report here the high regeneration potential of the European amphioxus, *Branchiostoma lanceolatum*. Remarkably, adults regenerate not only posterior, but also anterior structures, including spinal cord, notochord and muscle. Re-

generation proceeds via formation of an *msx*-expressing blastema and neurogenesis. The process is age and size dependent, with larger and older individuals regenerating less well. Development of a classifier based on tail regeneration rates predicts the assignment of young and old adults to their own class with >94% accuracy, indicating an underlying biological difference in regeneration potential. We demonstrate that regeneration is linked to the proliferation of a pool of satellite-like progenitor cells that express Pax3/7, the extent of which is inversely correlated with size and age. These results may have important implications for our understanding of the evolution and diversity of regeneration mechanisms.

THE EVOLUTION AND MOLECULAR PHYSIOLOGY OF VOLTAGE-GATED CALCIUM CHANNELS [Spencer]

ÉVOLUTION ET PHYSIOLOGIE MOLÉCULAIRE DES CANAUX CALCIQUES POTENTIEL-DÉPENDANTS

J David Spafford and A Senatore

University of Waterloo

I remember the first time that I met Andy (Spencer) 20 years ago. His research changed my life. I fell in love with Andy's research model, the *Polyorchis* jellyfish -- majestic, iridescent, floating medusae from the Canadian ocean. They captured the imagination of how brain neurons may have evolved to communicate. An attraction was Bamfield Marine Station, where one could go jellyfishing in the Inlet, and plant electrodes into the day's catch by the afternoon, into what were very curious looking and simple neurons. Andy taught me how to think broadly, and write and communicate in a concise manner. Andy also taught me never to play tennis with him, unless I wanted to lose badly. After my PhD, I went from jellyfish to snails, and running my own lab of students, in continued pursuit of the evolution and molecular physiology of ionic channels.

INDUCTION OF CELLULAR SIGNALING AND IMMUNE EFFECTOR FUNCTIONS BY TELEOST IMMUNOREGULATORY RECEPTORS [CPB15]

INDUCTION DE LA SIGNALISATION CELLULAIRE ET DES FONCTIONS IMMUNITAIRES PAR LES RÉCEPTEURS IMMUNORÉGULATEURS CHEZ LES TÉLÉOSTÉENS

James L Stafford, HD Cortes, BCS Montgomery and K Verheijen

University of Alberta

Innate immune responses such as phagocytosis and degranulation are vital for host defense from pathogenic invaders. It is well documented that these responses are executed by leukocytes in a range of different animals including fish and mammals. However, little is known about the receptor-mediated mechanisms and intracellular signaling pathways that influence innate cellular responses in ectothermic vertebrates. Our research focuses on understanding how teleost immune cells control and coordinate their innate cellular responses. Specifically, we are characterizing a family of proteins termed channel catfish leukocyte immune-type receptors (IpLITRs), which share many features with mammalian immunoregulatory receptors. For example, IpLITRs exist as putative inhibitory- and stimulatory-types based on their predicted ability to recruit cellular phosphatase and kinases, respectively. We have previously demonstrated that stimulatory IpLITR-types selectively associate with adaptor proteins as a preliminary requirement for surface expression and cellular activation. This presentation will focus on the functional consequences of this association, which suggests that stimulatory IpLITR-types activate conserved immune signaling pathways and are potent inducers of degranulation and phagocytosis.

FRED FRY & GEORGE HOLETON: THEIR ACCOMPLISHMENTS AND THE MEN BEHIND THEM [LOC]

FRED FRY ET GEORGE HOLETON : LEURS RÉALISATIONS ET LES HOMMES QUI LES ONT PERMIS

Don Stevens

University of Guelph

The highest award of our society is the Fry Award and Medal for The Outstanding Zoologist of the Year (named in honour of Fred Fry) and that of the CPB section is George F. Holeton award (named in memory of George). I had the honour and privilege of working with them and will say a few words about them and their accomplishments.

THE EFFECTS OF FLUOXETINE ON HEAD KIDNEY STEROIDOGENESIS IN RAINBOW TROUT (ONCORHYNCHUS MYKISS) [CPB8]

LES EFFETS DE LA FLUOXÉTINE SUR LA STÉROÏDOGÉNÈSE DU REIN CHEZ LA TRUITE ARC-EN-CIEL (ONCORHYNCHUS MYKISS)

Pamela A Stroud¹, GM Cooke² and TW Moon¹

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Fluoxetine (FLX), the active ingredient of Prozac, is a member of the selective serotonin reuptake inhibitor (SSRI) class of anti-depressants and is present in aquatic environments worldwide. Previous studies reported that FLX is an endocrine disruptor in fish, concentrating in tissues including the brain. Evidence supported serotonin influencing the activity of the hypothalamo-pituitary-interrenal (HPI) stress axis, thus exposure to FLX may disrupt the teleost stress response. This study examined *in vitro* cortisol production in rainbow trout (*Oncorhynchus mykiss*) interrenal cells exposed to FLX and ¹⁴C-pregnenolone metabolism in head kidney microsome preparations of FLX-exposed trout. Results indicate that cells exposed *in vitro* to moderate-high concentrations of FLX had lower cortisol production and cell viability (versus control) and microsomes isolated from trout exposed to 54 µg l⁻¹ FLX had higher pregnenolone metabolism versus those of control and low FLX exposed (540 ng l⁻¹) trout. Funded by NSERC, CWN and ON Best in Science.

ALTERNATIVE STRATEGIES FOR EXERCISE FUEL USE IN MICE SELECTED FOR HIGH LOCOMOTOR ACTIVITY [CPB19]

STRATÉGIES ALTERNATIVES POUR L'UTILISATION DU CARBURANT PENDANT L'EXERCICE CHEZ DES SOURIS SÉLECTIONNÉES POUR LEUR GRANDE ACTIVITÉ LOCOMOTRICE

Nicole Templeman¹, H Schutz², T Garland² and GB McClelland¹

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Patterns of exercise metabolic fuel use are remarkably similar in mammals, wherein absolute oxidation rates scale with aerobic capacity (VO₂max); underlying mechanisms remain unclear. We used artificial selection for high running (HR) activity in mice to evaluate: 1) VO₂max, 2) fuel use, 3) cardiac properties, and 4) metabolic machinery protein and mRNA expression. Emergence of a HRmini line with reduced muscle size suggests alternative response to selection. HRmini had a greater VO₂max possibly due to a larger relative heart size and metabolic remodeling. HR mice upregulated absolute exercise lipid oxidation rates, but groups did not differ in the proportional mix of fuels. HRmini muscles had elevated FAT/CD36 protein and mRNA, H-FABP protein, PPARα mRNA, and citrate synthase, B-hydroxyacyl-CoA dehydrogenase, and hexokinase. Therefore, mammals can utilize alternate strategies for enhancing fuel oxidation rates commensurate with an elevated VO₂max.

SEDIMENT ALTERS THE SWIMMING PERFORMANCE OF INDIVIDUAL AND SCHOOLING SALMONIDS [EEE-CPB]

LA PERFORMANCE DE NAGE CHEZ LES INDIVIDUS ET LES BANCS DE SALMONIDÉS EST ALTÉRÉE PAR LES SÉDIMENTS

Keith B Tierney¹, BI Berli² and P Burkhardt-Holm²

¹University of Alberta; ²University of Basel

Human activity in and around the world's river systems is altering sediment loading. A question is how sediment affects the performance of riverine fish. Here we tested the swimming abilities of two juvenile salmonids, rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*), in clear water and water loaded with powdered calcium carbonate, a common constituent of sediment. Individuals and small schools (5 fish) were tested for prolonged swimming ability and acceleration ability. Fish tested in groups performed 33% faster than as individuals. In spite of baseline performance differences between species, a low concentration of sediment was associated with increased performance. With increased sediment loading, no general pattern was apparent. These results indicate that activities that lead to sediment loading may affect fish swimming performance. Future research is planned to explore the mechanism(s) behind the unexpected performance alteration and to explore the effects of other common sediment components.

PATCH DEPLETION BEHAVIOR DIFFERS BETWEEN SYMPATRIC FOLIVOROUS PRIMATES

[EEE2]

LE COMPORTEMENT DE LA CONSOMMATION DE NOURRITURE PAR PARCELLE DIFFÈRE SELON L'ESPÈCE DE PRIMATES SYMPATRIQUES FOLIVORES

Kaia J Tombak¹, AJ Reid¹, CA Chapman^{1,2}, JM Rothman³, CA Johnson³ and R Reyna-Hurtado^{1,2}

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Food competition in group-living animals is accepted as a critical determinant of foraging strategies. Leaf-eating (folivorous) primates are thought to experience low food competition, but conflicting evidence in the literature has brought into question whether or not they are food-limited and deplete the food patches they use. We examine folivore patch depletion behavior in guerezas (*Colobus guereza*) in Kibale N.P., Uganda, using the same methods as a previous study on the sympatric red colobus (*Procolobus rufomitratus*). Red colobus were found to deplete food patches, while we found contrary evidence for guerezas. This fundamental difference in resource use may be linked to the large disparity in their group sizes or digestive physiologies. Our research highlights the problem in lumping all folivorous primates into a single category as is the convention in current socioecological models, a practice that may be at the root of the inconsistencies in the literature.

CARBOHYDRATE METABOLISM IN COELOMIC CELLS FROM TUNICATES WITH DIFFERENT DEGREES OF VANADIUM ACCUMULATION [CPB4]

LE MÉTABOLISME DES GLUCIDES DANS LES CELLULES COELOMIQUES DES TUNICIERS SOUS DIFFÉRENTS DEGRÉS D'ACCUMULATION DE VANADIUM

Jason R Treberg¹, JE Stacey² and WR Driedzic²

¹Buck Institute for Research on Aging; ²Memorial University of Newfoundland

Tunicates (sea squirts) from the suborder Phlebobranchia accumulate remarkable levels of the heavy metal vanadium while members of Stolidobranchia accumulate vanadium to a lesser degree and other tunicate suborders do not accumulate vanadium. The function of this vanadium is unclear, but enhanced pentose phosphate pathway (PPP) has been linked to vanadium levels. We compared aspects of carbohydrate metabolism in coelomic cells from tunicate species ranging from a high vanadium accumulator to non-accumulators. All species appear to have similar aerobic poise with no apparent link to vanadium accumulation. Based on lactate production induced by NaCN and low lactate dehydrogenase activity the species examined have a limited anaerobic poise. Phosphoglucose isomerase (PGI) and glucose-6 phosphate dehydrogenase (G6PDH) were measured to compare the relative capacity to metabolize glucose-6 phosphate via glycolysis and the PPP respectively. The G6PDH/PGI ratio was clearly elevated in the vanadium accumulators, supporting the notion that high PPP capacity is linked to vanadium accumulation in tunicates.

PHYSIOLOGICAL SENSING OF CARBON DIOXIDE, pH AND BICARBONATE [CPB17]

DÉTECTION PHYSIOLOGIQUE DU DIOXYDE DE CARBONE, DU pH ET DU BICARBONATE

Martin Tresguerres

Scripps Institution of Oceanography, UCSD

In biological systems, carbon dioxide exists in equilibrium with protons and bicarbonate. These three molecules must be sensed to be able to maintain cellular and blood pH, and they also function as signals to modulate multiple physiological functions. This presentation reviews recent progress in delineating molecular and cellular mechanisms for sensing carbon dioxide, pH and bicarbonate.

FUNCTIONAL RECOVERY FOLLOWING REGENERATION OF THE DAMAGED RETINA IN THE NEWT, NOTOPHTHALMUS VIRIDESCENS [CMD S]

RÉTABLISSEMENT FONCTIONNEL SUIVANT LA RÉGÉNÉRATION DE LA RÉTINE ENDOMMAGÉE CHEZ LE TRITON VERT, NOTOPHTHALMUS VIRIDESCENS

Catherin Tsilfidis¹, M Beddaoui² and SG Coupland²

¹Ottawa Hospital Research Institute; ²University of Ottawa

The adult red-spotted newt, *Notophthalmus viridescens*, possesses the remarkable ability to regenerate a complete retina following injury. Cells of the retinal pigment epithelium dedifferentiate and provide the source of progenitor cells for the regeneration of the new retina. We are interested in studying retina regeneration. As a first step, we determined whether we could follow the functional recovery of the regenerating retina *in vivo*. We developed full-field electroretinography in the newt and identified the parameters for its use to ensure reliable and reproducible recordings. We then used this technique to non-invasively follow retinal regeneration following retinectomy. Measures of retinal function with the electroretinography protocol showed that photoreceptor function is initially lost following retinectomy and subsequently restored during regeneration. These results serve as a starting point for further studies aimed at determining the molecular mechanisms involved in the regeneration process.

IS THIS WHY TIKTAALIK STAYED ON LAND? TERRESTRIALLY INDUCED GILL REMODELLING REDUCES THE AQUATIC RESPIRATORY FUNCTION OF AN AMPHIBIOUS FISH [CPB2]

POURQUOI TIKTAALIK EST-IL RESTÉ SUR LA TERRE FERME ? LA REMODÉLISATION BRANCHIALE INDUITE SUR TERRE RÉDUIT LA FONCTION RESPIRATOIRE AQUATIQUE D'UN POISSON AMPHIBIE

Andy Turko, C Cooper and PA Wright

University of Guelph

The amphibious mangrove rivulus, *Kryptolebias marmoratus*, may spend weeks at a time in terrestrial environments. During these periods of air breathing gills are remodelled, reducing surface area. I tested the hypothesis that this remodelling would negatively impact respiratory function upon returning to water breathing. Specifically, I predicted that air-acclimated fish would show a hypoxic ventilatory response at a higher level of dissolved oxygen than control fish. Custom-built chambers were used to non-invasively measure ventilatory frequency and amplitude as fish were exposed to stepwise decreases in dissolved oxygen. Air-acclimated fish increased ventilatory activity at a significantly higher oxygen concentration than control fish, and took longer to recover from hypoxic exposure. My results indicate that reversible gill remodelling has consequences for respiratory function upon switching respiratory media until subsequent remodelling suited to the new habitat can take place.

THE INTERACTIVE EFFECTS OF HYPOXEMIA, HYPEROXIA AND TEMPERATURE ON THE GILL MORPHOLOGY OF GOLDFISH (CARASSIUS AURATUS) [CPB2]

EFFETS INTERACTIFS DE L'HYPOXÉMIE, L'HYPEROXIE ET DE LA TEMPERATURE SUR LA MORPHOLOGIE BRANCHIALE DU CYPRIN DORÉ (CARASSIUS AURATUS)

Velislava Tzaneva, S Bailey and SF Perry

University of Ottawa

At temperatures below 15°C, goldfish lamellae are covered by an interlamellar cell mass (ILCM). Here we test the hypotheses that i) depletion of internal O₂ stores (hypoxemia) can trigger the removal of the ILCM in goldfish acclimated to 7°C, ii) exposing fish acclimated to 25°C to an abundance of O₂ (hyperoxia) can reverse the gill remodelling, and iii) neuroepithelial cells (NECs) are involved in signalling the shedding of the ILCM. Hypoxemia induction by phenylhydrazine (anaemia) and 5% CO exposure caused a decrease in the ILCM from 80 to 23 and 35%, respectively. Hyperoxia exposure at 25°C caused an increase to 67% of total ILCM and a smaller decrease in the size of the ILCM when fish were transferred from 7 to 25°C. Chronic sodium cyanide injections were used to induce chemical hypoxia and stimulate NECs; this treatment led to a significant decrease in the ILCM.

THE COLD TOLERANCE STRATEGY OF THE ACORN WEEVIL, CURCULIO GLANDIUM [CPB21]

LA STRATÉGIE DE RÉSISTANCE AU FROID CHEZ LE CHARANÇON DES GLANDS, CURCULIO GLANDIUM

Hiroko Udaka and BJ Sinclair

University of Western Ontario

The acorn weevil, *Curculio glandium*, is an important pest of oak acorns. Females lay their eggs inside oak acorns, where the larvae feed and grow until the acorn falls to the ground just before winter. After the acorn falls, the larvae burrow out and overwinter underground. To study cold tolerance of this species, several hundred individual larvae from oak acorn were collected from Pelee Island in the fall. Freezing points and lower lethal temperatures were measured in the overwintering stage of the larvae. Larvae did not survive internal ice formation, indicating that they

are freeze intolerant. Larvae also did not exhibit evidence of rapid cold-hardening after a short-term exposure to a sublethal low temperature or cryoprotective dehydration. These results indicate that *C. glandium* larvae are not particularly cold tolerant, and are probably dependent on a thermally-buffered soil microclimate to survive winter in Ontario.

AMMONIA EXCRETION IN THE NON-PARASITIC FRESHWATER PLANARIAN SCHMIDTEA [CPB S] MEDITERRANEA

EXCRÉTION D'AMMONIAC CHEZ LE PLANAIRE NON-PARASITIQUE D'EAU DOUCE SCHMIDTEA MEDITERRANEA

Dirk Weihrauch, A Chan and MM Sourial

University of Manitoba

In aquatic invertebrates metabolic nitrogenous waste is excreted predominately as ammonia. Little is known however, of the underlying mechanisms of excretion. Our results indicate that in *S. mediterranea* ammonia excretion depends on an acidification of the apical unstirred layer of the body surface. Our inhibitor experiments showed that the mechanism involves the participation of the Na/K-ATPase, V-ATPase, NHEs and carbonic anhydrase. Alkalization (pH 8.5, 2 days) of the environment led to an increase of body ammonia levels and to a down-regulation of V-ATPase and Rh protein mRNA. Further, 2 day exposure to a non lethal ammonia concentration (1 mM) caused a doubling of body ammonia levels and to an increase in Rh protein and Na/K-ATPase mRNA expression levels, while no changes were detected in V-ATPase expression levels. When *S. mediterranea* was acclimated (1 week) to an environmental salinity of 100 mM NaCl, mRNA expression levels of the Rh protein and V-ATPase increased.

STUDIES ON CHEMORECEPTION IN EXOTIC RUSTY CRAYFISH (ORCONECTES RUSTICUS): LEARNING AND ADAPTATION IN NOVEL AQUATIC ECOSYSTEMS OF NORTHWESTERN ONTARIO [EEE2]L

ÉTUDE DES CHÉMORECEPTEURS CHEZ L'ÉCREVISSE (ORCONECTES RUSTICUS) : APPRENTISSAGE ET ADAPTION DANS DES NOUVEAUX ÉCOSYSTÈMES AQUATIQUES AU NORD-OUEST DE L'ONTARIO

Cassidy Weisbord, DT Callaghan and GG Pyle

Lakehead University

Crayfish rely on chemosensory cues to mediate life processes. Exotic species, like rusty crayfish (*Orconectes rusticus*), are known to employ a broader range of chemosensory stimuli owing to superior adaptability and behavioural plasticity relative to native crayfish species. We report two behavioural studies designed to measure chemically mediated associative learning, and environment-specific chemical cue utilization, in rusty crayfish. We found that rusty crayfish could quickly and easily form a learned attraction to a walleye (*Sander vitreum*) egg cue when paired with a food stimulus using a single, two-hour exposure. We also found that rusty crayfish from two ecologically distinct provenances favoured injury cues from the population of conspecifics more likely to cannibalize with higher frequency, and no response to the same cue from the other study population. Our results describe how aquatic invasive species use chemical signals in adapting and surviving in novel ecosystems.

HOW CYTOSINE METHYLATION ACQUIRED ITS GENE REGULATION FUNCTION [CMD2]H *COMMENT LA MÉTHYLATION DE LA CYTOSINE A ACQUIS SA FONCTION RÉGULATRICE DU GÈNE*

Sanoji Wijenayake and R Gorelick

Carleton University

Cytosine methylation (5mC) regulates gene expression and provides genomic immunity against extracellular invaders in many extant organisms. I hypothesize that gene regulation via cytosine methylation originated in ancestral prokaryotes as a transposon-mediated countermeasure to endonuclease cleavage. I predict that transposon-coded proteins manipulated prokaryotic DNMTases into hypermethylating bacterial restriction endonuclease sites, decreasing endonuclease enzymes accessibility to the palindrome sequences and rendering r-m system II ineffective at removing transposable elements from the bacterial genome. I will use nucleotide BLAST analysis to quantify the methylated restriction sites in the r-m system II of prokaryotes by using two reference primers per a species, one for the methylated sequences and the other for the endonuclease restriction sites. Furthermore, I plan to use nucleotide

BLAST to test whether majority of transposon insertions happen near restriction sites.

TOLERANCE TO BRAIN SWELLING CONTRIBUTES TO THE HIGH AMMONIA RESISTANCE OF THE ANOXIA-TOLERANT CRUCIAN CARP (CARASSIUS CARASSIUS) [CPB14]

LA TOLÉRANCE AU GONFLEMENT CÉRÉBRAL CONTRIBUE À LA FORTE RÉSISTANCE À L'AMMONIAC CHEZ LA CARPE À LA LUNE (CARASSIUS CARASSIUS), UN POISSON TOLÉRANT L'ANOXIE

Michael P Wilkie^{1,2}, JAW Stecyk², C Couturier² and GE Nilsson²

¹Wilfrid Laurier University; ²University of Oslo

Features underlying the extreme anoxia tolerance of crucian carp may also give it greater resistance to high external ammonia (HEA). One such adaptation could be resistance to ammonia-induced brain swelling, which can be fatal. To test this hypothesis, brain swelling was examined in crucian carp acutely exposed to HEA (2-32 mM) for 96 h. No mortality was observed, but overturning and cessation of ventilation were noted at 16 and 32 mM ammonia. Notably, the overturned fish completely recovered following return to ammonia-free water. Unlike in anoxia-exposed fish, HEA caused brain swelling as indicated by 23% increases in the brain water content of overturning fish. The increase strongly correlated with external and internal ammonia concentrations and was completely reversible. Thus, crucian carp is not resistant to ammonia-induced brain swelling. Instead, we suggest the large cranium volume of crucian carp gives it the capacity to withstand increases in brain volume in response to ammonia, and perhaps other neurotoxic insults.

PATTERNS AND CONSEQUENCES OF METABOLIC SUPPRESSION IN A SKIPPER BUTTERFLY IN RESPONSE TO HIGH DAILY THERMAL VARIABILITY [Hoar]

CONSÉQUENCES DE L'INHIBITION MÉTABOLIQUE EN RÉPONSE À LA GRANDE VARIABILITÉ DE TEMPÉRATURE JOURNALIÈRE CHEZ UN HESPERIIDAE

Caroline Williams¹, JJ Hellmann² and BJ Sinclair¹

¹University of Western Ontario; ²University Of Notre Dame

Thermally variable environments are more energy demanding due to the non-linear nature of response curves, and physiological plasticity may mitigate these effects. For holometabolous insects, overwintering energy reserves must fuel metamorphosis, and influence adult fitness. A reduction in temperature sensitivity, and thus metabolic rate, will reduce consumption of reserves, and is expected in populations exposed to energy-demanding (e.g. highly variable) environments. To test this hypothesis we used skipper butterflies from stable (Vancouver Island [VI]) or variable thermal environments (Oregon [OR]), raised at VI or OR temperatures. We measured metabolic rate-temperature relationships and modeled overwinter energy use in both environments for the past 50 years using meteorological data. *E. propertius* show metabolic down-regulation through plasticity and local adaptation in response to variable environments, however this metabolic down-regulation does not fully compensate for increased energy costs of variable environments. We discuss the influence of phenology changes and how variability changes will impact populations.

OPTIMIZING DETECTION AND RECOVERY METHODS FOR CRYPTOSPORIDIUM PARVUM AND GIARDIA DUODENALIS IN OYSTERS [PAR1]F

OPITIMISATION DES MÉTHODES DE DÉTECTION ET DE RÉCUPÉRATION POUR CRYPTOSPORIDIUM PARVUM ET GIARDIA DUODENALIS CHEZ L'HUÎTRE

Jessica E Willis¹, S Greenwood¹, JT McClure¹, J Davidson¹ and C McClure²

¹University of Prince Edward Island; ²Department of Health and Wellness, Government of Canada

Bivalve shellfish thrive in coastal environments and are of great importance to the aquaculture industry in Atlantic Canada. Contamination of this resource is common due to agricultural run-off and sewage treatment facility overflows. Under such circumstances, Eastern oysters (*Crassostrea virginica*) are exposed to zoonotic parasites *Cryptosporidium parvum* and *Giardia duodenalis*, which are commonly shed in livestock feces. It is crucial to study these parasites in oysters to gain a better understanding of the potential transmission to human consumers. To date, these parasites have been detected in many shellfish destined for human consumption. However, detection methods used between studies vary and often utilize expensive isolation techniques that still result in low recovery efficiencies.

This study will attempt to optimize recovery methods from oysters using a developed pepsin digest and will explore the use of alternative methods for separation of concentrated parasites from debris.

OXIDATIVE STRESS AND SENESCENCE THROUGHOUT MIGRATION OF PINK SALMON (ONCORHYNCHUS GORBUSCHA) [CPB12]

STRESS OXIDANT ET SÉNESCENCE TOUT AU LONG DE LA MIGRATION DU SAUMON ROSE (ONCORHYNCHUS GORBUSCHA)

Samantha Wilson, T Mackie, WG Willmore and SJ Cooke
Carleton University

A previously unidentified cost of migration in Pacific salmon (*Oncorhynchus* spp.) may be oxidative stress. Oxidative stress is caused by an imbalance between free radical production and absorption, leading to irreparable cellular damage that accumulates over time and contributes to senescence. The objective of this study was to determine if oxidative stress represents a significant cost of migration between river entrance and spawning of maturing pink salmon (*Oncorhynchus gorbuscha*). Pink salmon tissues were collected from individuals at different stages of migration. Each tissue was assayed for resistance to oxidative stress using as well as for oxidative DNA damage. Results demonstrate that oxidative stress may be experienced differentially between tissues and may be dependent on antioxidant availability and mobility. A decrease in resistance to oxidative stress occurs across migration indicating oxidative stress may correlate with the rapid senescence associated with a semelparous reproductive strategy.

AMMONIA EXCRETION AND Rh PROTEIN FUNCTION IN FISH [CPB S]

EXCRÉTION D'AMMONIAC ET FONCTION DE LA PROTÉINE Rh CHEZ LES POISSONS

Chris M Wood¹, P Wright² and CM Nawata¹

¹McMaster University; ²University of Guelph

Our understanding of how ammonia is excreted in aquatic animals has been revolutionized by recent findings that Rh glycoproteins play a key role. In the gills of freshwater teleosts, our group has proposed a Na⁺/NH₄⁺ exchange metabolon, of which Rh proteins are an integral part (Wright and Wood, 2009, J. Exp. Biol. 212, 2302-2312). This system appears to be activated during high environmental ammonia exposure to excrete ammonia against gradients. This presentation will present evidence for this model, as well as recent data examining whether the same system applies in different ammonia loading scenarios (e.g. feeding, exercise) and whether it is operative in seawater fish, where the very different physical chemistry is an important factor affecting ammonia excretion. Finally, we will examine fish which normally excrete little or no ammonia, such as the elasmobranch dogfish and the Magadi tilapia, a unique ureotelic teleost which lives at pH 10 (NSERC Discovery).

HYPOMETABOLISM IN MAMMALS: ROLE OF TRANSLATIONAL REGULATION IN TORPOR SURVIVAL [CPB11]

L'HYPOMÉTABOLISME CHEZ LES MAMMIFÈRES: LE RÔLE DE LA RÉGULATION DE LA TRADUCTION DANS LA SURVIE À LA LÉTHARGIE

Cheng-Wei Wu and KB Storey
Carleton University

For many small mammals, winter survival is a serious challenge because of cold temperatures and limited food availability. The solution can be hibernation, an altered physiological state characterized by seasonal heterothermy and entry into torpor; metabolic rate may drop to just 1-5% of resting metabolic rate in euthermia. A key part of metabolic rate depression is suppression of nonessential ATP-expensive cell functions such as protein synthesis. The mTOR signaling pathway is a critical component of the insulin receptor network and the primary process that is responsible for regulating protein synthesis. Analysis of the mTOR signaling pathway in muscle of 13-lined ground squirrels showed a strong suppression during hibernation. Immunoblotting revealed significant reductions in relative phosphorylation of mTOR (Ser2448) by 87%, 4E-BP (Thr46) by 74%, and P70S6K (Thr389) by 45% during late torpor. Additionally, levels of the microRNA miR29b, a negative regulator of PI3-K, was upregulated by 1.2-fold during early torpor.

NEUROTRANSMITTERS IN NUDIBRANCH STATOCYSTS: BALANCING REDUCTIONISM [Spencer]
LES NEUROTRANSMETTEURS DANS LES STATOCYSTES DES NUDIBRANCHES: RÉDUCTIONNISME ÉQUILIBRÉ

Russell C Wyeth

St. Francis Xavier University

The reductionist study of invertebrates has generated remarkable generalities in how neurons function. Yet a complementary neuroethological approach is important for understanding the context specific adaptations of the nervous system that generate behaviours appropriate to a species' natural environment. For example, a great deal is known about the molecular and cellular basis of how the nudibranch *Hermisenda crassicornis* learns to associate light with turbulence, delaying phototactic crawling once conditioned. To date, studies of vestibular system hair cell connections with photoreceptors have focused on the neurotransmitter GABA. However, evidence from other opisthobranchs suggests additional neurotransmitters may also be present. Using standard immunohistochemistry, my lab has found histamine-immunoreactive and FMRFamide-immunoreactive hair cells. This added complexity, paired with the likelihood that the vestibular system is used for more than turbulence detection, suggests a broader neuroethological study of locomotion will lead to a better understanding of both sensory and central systems in *Hermisenda*.

SMALL NITROGENOUS SOLUTES IN DEEP-SEA ANIMALS: COUNTERACTING HYDROSTATIC PRESSURE AND DETOXIFYING HYDROGEN SULPHIDE [CPB S]

PETITS SOLUTÉS AZOTÉS CHEZ LES ANIMAUX DES GRANDS FONDS : CONTRER LA PRESSION HYDROSTATIQUE ET DÉTOXIFIER LE SULFURE D'HYDROGÈNE

Paul H Yancey

Whitman College

Shallow marine elasmobranchs use the nitrogenous wastes urea (a protein destabiliser) and trimethylamine N-oxide (TMAO; a protein stabiliser), at about a 2:1 cellular ratio for optimal counteraction of (de)stabilising effects (e.g., 350:175 mM). Shallow marine teleosts have TMAO at 40-70 mM (without urea). Recently we found that TMAO increases with depth in elasmobranchs, teleosts, and crustaceans (up to 300 mmol kg⁻¹ at 3000 m). *In vitro*, TMAO counteracts destabilizing effects of hydrostatic pressure on protein structure and function. In elasmobranchs, urea contents decline with depth as TMAO becomes the major osmolyte in deepest species. In many marine invertebrates, the sulphur amino acid taurine is a major osmolyte. However, clams and worms from hydrothermal vents and cold seeps have high levels of hypotaurine instead. Hypotaurine can bind toxic hydrogen sulphide, becoming the non-toxic thiotaurine; its levels in tissues correlate with environmental sulphide exposure. Funded by the National Science Foundation and Whitman College.

HYPOXIA TOLERANCE OF DANIOS AND DEVARIOS [CPB7]

TOLÉRANCE À L'HYPOXIE CHEZ DANIO ET DEVARIO

Lili Yao and JG Richards

University of British Columbia

Hypoxia is a common environmental stress for fish. This project aims to characterize variation in hypoxia tolerance among 11 different species of *Danios* and *Devarios*. Hypoxia tolerance was assessed by measuring critical oxygen tensions (Pcrit) and time to lose equilibrium (LOE) at 16 Torr. Pcrit was similar among species investigated, but LOE varied dramatically. The mechanisms underlying variation in hypoxia tolerance are investigated by assessing routine O₂ consumption rate, mass-specific gill surface area, whole blood haemoglobin (Hb)-O₂-binding affinity (P₅₀), metabolites concentration (glycogen and glucose) and enzymes activities (pyruvate kinase, lactate dehydrogenase, creatine phosphokinase and citrate synthase) indicating aerobic and/or anaerobic capacities in muscle, liver and brain.

ION CHANNELS OF NEUROEPITHELIAL CELLS IN ZEBRAFISH AND GOLDFISH [CPB5]

LES CANAUX IONIQUES DES CELLULES NEUROÉPITHÉLIALES CHEZ LE POISSON-ZÈBRE ET LE CYPRIN DORÉ

Peter C Zachar and MG Jonz
University of Ottawa

Neuroepithelial cells (NECs) of the zebrafish gill are prime candidates for peripheral oxygen chemoreceptors. These cells can be isolated and identified with the vital dye neutral red (NR), and exhibit a physiological response to hypoxia that is mediated by membrane ion channels. Goldfish retain gill NECs of identical morphology and distribution, yet these two species have different tolerances to low oxygen. We are, therefore, investigating the biophysical and chemical properties of ion channels in gill cells of goldfish as a comparative model. Cells dissociated from the gill and isolated with NR resembled zebrafish NECs. Preliminary evidence from patch-clamp experiments indicates that NR-positive cells of goldfish express a mixture of K^+ conductances across the membrane, while those of zebrafish express primarily background K^+ currents. Our goal is to characterize these membrane conductances and determine their potential contributions to oxygen sensing.

POTENTIAL ROLE OF THE NEUROPEPTIDE RHOPR-DH31 IN REPRODUCTION IN THE KISSING BUG, RHODNIUS PROLIXUS [CPB6]

RÔLE POTENTIEL DU NEUROPEPTIDE RHOPR-DH31 DANS LA REPRODUCTION CHEZ L'INSECTE HÉMATOPHAGE, RHODNIUS PROLIXUS

Meet Zandawala and I Orchard
University of Toronto Mississauga

Rhodnius prolixus undergoes a period of rapid diuresis after ingesting large blood meals. Neurohormones with either diuretic or anti-diuretic activity control the process of diuresis by acting on several tissues including the anterior midgut, hindgut and Malpighian tubules. One of the neurohormones that potentially plays a role in diuresis is diuretic hormone 31 (DH31) which belongs to the calcitonin-like family of diuretic hormones. Previously, we isolated complete cDNA sequences of three Rhopr-DH31 splice variants (Rhopr-DH31-A, Rhopr-DH31-B and Rhopr-DH31-C) and characterized their expression in fifth-instar *R. prolixus* central nervous system (CNS). Here, we isolate the complete cDNA sequence of a newly-discovered fourth splice variant of Rhopr-DH31 (Rhopr-DH31-D) from *R. prolixus* testes, and two Rhopr-DH31-like receptors (Rhopr-DH31-R1 and Rhopr-DH31-R2) from the CNS. Interestingly, reverse transcriptase-PCR demonstrates that Rhopr-DH31-R1 has its highest expression in testes suggesting a potential role for Rhopr-DH31 in male reproduction.

INVOLVEMENT OF MICRORNA IN THE ACTIVATION OF Akt/PKB SIGNALING IN WOOD FROG LIVER DURING FREEZING [CPB15]

IMPLICATION DES MICRO-ARN LORS DE L'ACTIVATION DE LA VOIE DE SIGNALISATION Akt/PKB DANS LE FOIE DE LA GRENOUILLE DES BOIS AU MOMENT DE LA CONGÉLATION

Jing Zhang and KB Storey
Carleton University

Wood frogs, *Rana sylvatica*, are one of a few vertebrates that can survive whole body freezing during the winter. Liver holds a key position in preparing frogs for freeze tolerance, producing and exporting the glucose cryoprotectant to all other organs (derived from catabolism of massive liver glycogen reserves). The multi-functional Akt/PKB signaling pathway is an important mediator of insulin signaling and carbohydrate metabolism. Immunoblot analysis showed that protein levels of both active phosphorylated forms of Akt were increased in wood frog liver after 24 h freezing and 8 h thawing. Regulation of Akt by small non-coding microRNAs has also been reported recently. Three miRNAs (miR-26a, miR-126, miR-217) that have been linked with silencing expression of Akt inhibitors were evaluated in wood frog liver with results showing up-regulation of expression levels. This suggests potential roles for microRNAs in Akt signaling in the control of wood frog metabolism during freezing.

POSTERS / AFFICHES

Posters with even numbers will be presented from 18h30 to 19h30 / Les affiches avec des nombres pairs seront présentées entre 18h30 et 19h30. Posters with odd numbers will be presented from 19h30 to 20h30 / Les affiches avec des nombres impairs seront présentées entre 19h30 et 20h30.

Please note / Veuillez prendre note:

* indicates the poster presenter if not the first author / *indique le présentateur d'affiche s'il n'est pas le premier auteur

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H indicates a competitor for the Holeton award / H indique un compétiteur pour le prix Holeton

CONTROL AND DEVELOPMENT OF AQUATIC SURFACE RESPIRATION BEHAVIOUR IN ZEBRAFISH, *DANIO RERIO* [26]

*CONTRÔLE ET DÉVELOPPEMENT DU COMPORTEMENT DE RESPIRATION AQUATIQUE EN SURFACE CHEZ LE POISSON ZÈBRE, *DANIO RERIO**

Sara Abdallah, E Hristova and MG Jonz

University of Ottawa

In fish, aquatic surface respiration (ASR) is a behavioural response to severe hypoxia characterized by movement to the air-water interface to enhance oxygen uptake. We characterized ASR in zebrafish during development and adulthood, and the potential contribution of gill chemoreceptors in mediating this behaviour. In 1 litre tanks, adult zebrafish began to perform ASR at a PO_2 of 40 mmHg and reached a maximal response at 15 mmHg. Acclimation to chronic hypoxia (30 mmHg) blunted the ASR response to acute hypoxia. In developing zebrafish, ASR behaviour began to appear at 17 days post-fertilization (dpf) and was fully developed at 20 dpf. Intraperitoneal injections of $2 \mu\text{g } \mu\text{l}^{-1}$ 5-HT or $10 \mu\text{g } \mu\text{l}^{-1}$ ACh significantly increased ASR response time to acute hypoxia 3-fold compared to sham-injected controls. These studies indicate a relatively late development of ASR behaviour in zebrafish and suggest that ASR is under the control of gill chemoreceptors.

THE MINERALOCORTICOID RECEPTOR IN ZEBRAFISH [117]

LE RÉCEPTEUR MINÉRALOCORTICOÏDE CHEZ LE POISSON ZÈBRE

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University of Waterloo

Aldosterone, the primary mineralocorticoid in tetrapods is absent in teleosts, yet a highly conserved mineralocorticoid receptor (MR) is present in fish. Beyond a role in maintaining sodium balance, very little is known about the functions of MR in teleosts. While cortisol is the presumed ligand for teleostean MR, co-expression of the cortisol de-activating enzyme 11 β -hydroxysteroid dehydrogenase (HSD2) could allow other ligands access to MR. To begin understanding the potential roles of MR in fish, knowledge of its tissue distribution and ontogenic expression pattern is needed. Towards this end, we have used in situ hybridization studies to map MR mRNA expression patterns throughout zebrafish development and in the adult brain. Interestingly, while HSD2 is pervasively expressed in zebrafish brains, MR is expressed only in a few discrete regions, adding support to the debate that cortisol is the principal MR ligand in fish.

THE EFFECT OF A STATIN AND A FIBRATE DRUG ON CHOLESTEROL METABOLISM AND STEROID PRODUCTION IN THE ZEBRAFISH *DANIO RERIO* [78]

*L'EFFET D'UNE STATINE ET D'UN MÉDICAMENT DE TYPE FIBRATE SUR LE MÉTABOLISME DU CHOLESTÉROL ET LA PRODUCTION STÉROÏDIENNE CHEZ LE POISSON ZÈBRE *DANIO RERIO**

Aziz Al-Habsi and TW Moon

University of Ottawa

Pharmaceuticals are emerging contaminants and their presence in the environment has raised concerns given their pseudopersistence, increased usage patterns and bioactivity. Atorvastatin (ATV) is a highly prescribed statin drug reported in surface waters at 15 ng l⁻¹ and 44 ng l⁻¹ in wastewater treatment plant (WWTP) effluents. Gemfibrozil (GEM) a lipid lowering fibrate drug is present at comparable or higher concentrations. Our objective was to determine the effects of ATV and GEM on zebrafish cholesterol metabolism and steroid production. Male and female zebrafish were fed a human equivalent dose of ATV, GEM, and the combination of ATV + GEM daily for 30 days. Results to date indicate that these two drugs affect cholesterol, testosterone, and estradiol levels in both sexes, implicating an effect on both the reproductive and stress axes in zebrafish. Presently transcript levels of a number of genes are being assessed to better understand the mechanistic bases of these changes.

ACTIVITY OF AMP KINASE, A BIOCHEMICAL PREDICTOR OF OPTIMUM TEMPERATURE OF FISH [108]

ACTIVITÉ DE L'AMP KINASE, UN PRÉDICTEUR BIOCHIMIQUE DE LA TEMPÉRATURE OPTIMALE DES POISSONS

Katja Anttila, M Casselman, PM Schulte and AP Farrell
University of British Columbia

This study evaluated whether increased activity of AMP kinase (AMPK) is a predictor of optimum temperature (T_{opt}) of fish. Intracardiac activity of AMPK of coho salmon was measured over range of temperatures and compared with resting and maximum metabolic rates at these temperatures. The aerobic scope (maximum minus resting metabolic rate) had a T_{opt} of 17°C, above which there was a pronounced increase in resting metabolic rate ($p < 0.05$). Correspondingly, the activity level of AMPK remained low and constant between 11°C and 15°C, but increased significantly at 17°C and continued to increase as function of temperature ($p < 0.05$). Thus, increased activity of cardiac AMPK, an enzyme that is known to regulate the energy metabolism of cells and become activated when intracellular AMP becomes elevated, could be used to biochemically determine the T_{opt} of fish.

LEARNING NOT TO FEAR: ACQUIRED RECOGNITION OF NON-RISK BY JUVENILE CONVICT CICHLIDS [16]L

APPRENDRE À NE PAS AVOIR PEUR: RECONNAISSANCE ACQUISE DU NON-RISQUE PAR DES CICHLIDES FORÇATS JUVÉNILES

Patrick M Barks and J-GJ Godin
Carleton University

Many animals can learn to 'fear' novel cues via an association between a novel cue and a familiar cue already known to represent risk (e.g. alarm behaviour in nearby conspecifics). Here we investigated whether animals can likewise learn to not fear a novel cue via the simultaneous presentation of a novel cue and a familiar cue indicative of non-risk. We simultaneously exposed juvenile convict cichlid (*Amatitlania siquia*) 'observers' to a novel visual cue and 'demonstrator' cichlids from one of three treatment groups. Demonstrators had either been previously trained to 'fear' the novel cue, had no prior experience with the novel cue, or had previously been habituated to the cue. We subsequently exposed observers to the novel cue alone, and found that fish conditioned with habituated demonstrators exhibited lower-intensity behavioural responses than observers from the other treatments, indicating a learned recognition of non-risk.

GLUCOSE-6-PHOSPHATASE GENE SEQUENCE AND PROTEIN EXPRESSION IN FED, FASTING AND STARVELING GREY SEALS, HALICHOERUS GRYPUS [96]

SÉQUENCE DE GÈNES ET L'EXPRESSION DE PROTÉINES DU GLUCOSE-6-PHOSPHATASE CHEZ DES PHOQUES GRIS (HALICHOERUS GRYPUS) NOURRIS, JEÛNANTS ET FAMÉLIQUES

KA Bennett
Mount Allison University

Seals undergo extended periods of fasting, accompanied by hyperglycemia, as occurs in diabetes. The reason is unclear, but may involve liver glucose-6-phosphatase (G6Pase), which catalyses the terminal step in gluconeogenesis and glycogenolysis and is primarily responsible for hepatic glucose output. I have sequenced the gene encoding

the catalytic subunit of G6Pase from grey seals (G6PC). It shows >90% identity with cat, dog, and human G6PC genes. None of the substitutions in the predicted protein change sites are critical for catalytic activity or stability. G6PC protein levels were highly variable between individuals and the difference between nutritional states approached significance. Fed pups had higher levels than fasting pups. This contrasts with other animals in which G6PC expression is suppressed by feeding and upregulated during fasting. Investigating how G6Pase is regulated in seals will aid our understanding of how they control blood glucose and co-ordinate fuel metabolism during fasting and feeding.

THERMOREGULATION IN THE BEARDED DRAGON (POGONA VITTICEPS): THE ROLE OF TRPM8 IN TEMPERATURE SENSATION [34]BH

THERMORÉGULATION CHEZ LE DRAGON BARBU (POGONA VITTIVEPS): LE ROLE DE TRPM8 DANS LA SENSATION DE LA TEMPÉRATURE

Jacob M Berman and GJ Tattersall

Brock University

Thermoregulation is a vital part of an animal's life. To regulate effectively organisms must sense temperature internally and from the environment. ThermoTRP channels, a subset of the TRP family, have been shown to be temperature sensitive and contribute a role in thermosensation. This research examines how TRPM8, a cold sensitive channel, contributes to thermoregulation in an ectotherm, the bearded dragon (*Pogona vitticeps*). Lizards are placed in a ramping shuttle box and administered intraperitoneal injections of capzasepine or AMTB, both of which are TRPM8 antagonists. The resulting changes in thermal preference will elaborate on the role of thermosensation in structuring thermoregulatory behavior. In addition, PCR and qPCR techniques will be used to establish expression patterns of TRPM8 throughout the bearded dragon body, and whether these co-vary with postural preferences for warm anterior regions and cool tail regions, helping to establish the role of peripheral thermosensation.

DEVELOPMENTAL CHANGES IN HEMOGLOBIN-OXYGEN AFFINITY IN RAINBOW TROUT (ONCORHYNCHUS MYKISS) [90]H

CHANGEMENTS DÉVELOPPEMENTAUX DE L'AFFINITÉ HÉMOGLOBINE-OXYGÈNE CHEZ LA TRUITE ARC-EN-CIEL

Kristin Bianchini and PA Wright

University of Guelph

Two trout hemoglobin isoforms, embryonic (HbE) and adult (HbA), are known to have dissimilar properties but an earlier study was performed under non-physiological conditions. We predicted that the Hb-O₂ affinity would be higher in HbE than in HbA due to the fact that encapsulated embryos develop in a hypoxic microenvironment. The objective of this study was to determine the Hb-O₂ affinity and the Bohr shift in rainbow trout before and after hatching at 10 °C. A method was developed to extract blood samples (0.5 µl) from individual trout embryos. In normoxia, blood from pre-hatch rainbow trout embryos shows a significantly higher oxygen affinity ($P_{50} = 5.47 \pm 0.19$ mmHg) and less of a Bohr shift compared to adult blood ($P_{50} = 15.30 \pm 0.68$ mmHg). During embryonic development, trout express HbE with properties that are optimally suited to respiration in a diffusive rather than a convective system.

REPEATABILITY OF FLIGHT ENERGETICS IN THE BUMBLEBEE BOMBUS IMPATIENS AND ITS METABOLIC CORRELATES [105]BH

RÉPÉTABILITÉ DE L'ÉNERGÉTIQUE DU VOL CHEZ LE BOURDON BOMBUS IMPATIENS ET SES ASSOCIATIONS MÉTABOLIQUES

Fannie Billardon, K Bélanger and C-A Darveau

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Differences in performance among individuals of the same species can be considerable and studying the bases of such differences is necessary to assess evolvable physiological traits. Our study aimed to test if flight energetics variability is repeatable over time in *Bombus impatiens* individuals (n=59). Large interindividual variation in flight energetics was found, where metabolic rate during flight varied up to 3-fold in similar size individuals. Repeatabil-

ity in flight metabolic rate and wing beat frequency was high, which demonstrates that these traits are characteristics of an individual. In addition, we studied morphological and biochemical characteristics that might explain such variation. It was shown that the variation in metabolic rate and wing beat frequency cannot be explained by wing morphology in our sample. Nonetheless, our results show that some enzymes involved in energy production pathways (glycogen phosphorylase, trehalase and hexokinase) are correlated with hovering flight metabolic rate variation.

THE PHYSIOLOGICAL EFFECTS OF RESIDENT GULF KILLIFISH IMPACTED BY CRUDE OIL FROM THE DEEPWATER HORIZON OIL SPILL [68]

LES CONSÉQUENCES PHYSIOLOGIQUES DU PÉTROLE BRUT PROVENANT DU DÉVERSEMENT PÉTROLIER "DEEP WATER HORIZON" SUR LES CYPRINODONTIDÉS DU GOLFE DU MEXIQUE

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The gulf killifish, *Fundulus grandis*, is one of the most abundant and ecologically important fish in coastal marsh habitats of the Gulf of Mexico; a region severely contaminated with crude oil from the BP Deepwater Horizon oil spill. We have initiated several projects to characterize the physiological effects of crude oil exposure in resident populations of killifish *in situ*, combining these data with detailed water chemistry analyses and satellite imagery to document the magnitude of exposure. Tissues from wild-caught fish are being analyzed for various indicators of oil exposure and effect, including the documentation of protein-level effects at the gills, intestines, livers, and kidneys. Results to date demonstrate severe tissue damage and dramatic up-regulation of cytochrome P4501A (CYP1A) protein expression in the gills, kidneys, and intestines of fish sampled from the most heavily-oiled sites. These results are consistent with previous studies describing the effects of polycyclic aromatic hydrocarbon exposure in teleost fish, including killifish.

OVERWINTERING PHYSIOLOGY THROUGH THE DIFFERENT LIFE STAGES OF A MONTANE WILLOW LEAF BEETLE, CHRYSOMELA AENEICOLLIS [45]BH

PHYSIOLOGIE DE L'HIVERNAGE AU COURS DES DIFFÉRENTS STADES DE VIE CHEZ UN CALLIGRAPHE DU SAULE MONTAGNAIS, CHRYSOMELA AENEICOLLIS

Evelyn C Boychuk and BJ Sinclair

University of Western Ontario

Insects living in alpine environments experience temperature extremes over both seasonal and daily scales. The willow leaf beetle, *Chrysomela aeneicollis*, from the Sierra Nevada, has been studied extensively for summer thermal tolerance, but its cold tolerance remains to be investigated. Since climate change is predicted to increase the frequency of extreme winter cold temperatures due to the loss of the buffering effect of snow cover, the plasticity of cold tolerance will have to be characterized to predict future survival trends. We will assess the physiological mechanisms and the developmental plasticity of cold tolerance by combining biochemical assays, determination of lower lethal temperature and measurements of metabolic rate. The objective of this study is to develop an understanding of the overwintering physiology of *C. aeneicollis* over all life stages, with the long-term goal of using these data to parameterize models predicting the future survival of this species in a changing climate.

AMMONIUM SECRETION BY INSECT MALPIGHIAN TUBULES: APPLICATION OF A NOVEL AMMONIUM-SELECTIVE MICROELECTRODE [36]H

SÉCRÉTION D'AMMONIUM PAR LES TUBULES DE MALPIGHI DES INSECTES : APPLICATION D'UNE NOUVELLE MICROÉLECTRODE SÉLECTIVE À L'AMMONIUM

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McMaster University

Although insects are generally considered to be uricotelic, several studies have demonstrated that ammonia is excreted by species such as locusts, cockroaches, flies and mosquitoes. Previous studies have examined transport of ammonia by the hindgut. We investigated the effects of ammonia on rates of secretion of fluid, Na⁺, K⁺ and NH₄⁺ by isolated Malpighian tubules of larval and adult *Drosophila melanogaster*. Fluid secretion by tubules of adults

was unaffected by ammonia levels as high as 50 mM. Rates of fluid secretion by larval tubules increase 25% in response to ammonia concentrations of 1 mM or greater. Ammonium concentrations in droplets of secreted fluid collected by the Ramsay assay were measured using a novel ammonium-selective microelectrode based on the 19-membered crown ring ionophore TD19C6, which exhibits a better ammonium ion selectivity than nonactin towards other alkali metal and alkaline earth metal ions. Tubules of larval *Drosophila* concentrated ammonia in the secreted fluid above the level in the bath. Possible mechanisms of transport will be discussed.

COLD-INDUCED ADAPTATIONS IN MITOCHONDRIA-RICH CELLS OF EURYTHERMAL TELEOST FISH FUNDULUS HETEROCLITUS [85]B

ADAPTATIONS INDUITES PAR LE FROID DANS LES CELLULES RICHES EN MITOCHONDRIES DES POISSONS TÉLÉOSTÉENS EURYTHERMES

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St. Francis Xavier University

Cystic fibrosis transmembrane conductance regulator (CFTR) anion channels in chloride cells of the gills and opercular epithelia of *Fundulus heteroclitus* control chloride secretion. The present study examined the effects of cold-shock vs. cold-acclimation on chloride secretion in seawater animals. Electrophysiology was used to monitor chloride secretion rate (I_{sc}), DASPEI fluorescence was used to estimate total chloride cell density, scanning electron microscopy estimated exposed chloride cell density, and immunocytochemistry monitored CFTR localization. Cold-shock disrupted chloride transport regulation. Cold-acclimation induced supernormal chloride secretion after warming but did not affect the density of chloride cells or exposed chloride cells. Cold-shock decreased I_{sc} and exposed chloride cell density. Chloride cells in cold-acclimated animals had CFTR immunofluorescence in sub-apical vesicles. In summary, CFTR is under complex control and proper ion transport regulation at cold temperatures requires cold-acclimation. Results imply homeoviscous adaptation in the cold preserves complex CFTR regulation.

SEASONAL CHANGES IN GILL ATPASE EXPRESSION IN PREPARATION FOR SPAWNING MIGRATION OF PINK SALMON (ONCORHYNCHUS GORBUSCHA) [88]

CHANGEMENTS SAISONNIERS DE L'EXPRESSION DE L'ATPASE DANS LES BRANCHIES EN PRÉPARATION À LA MIGRATION POUR LE FRAI CHEZ LE SAUMON ROSE (ONCORHYNCHUS GORBUSCHA)

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Despite decades of research on smoltification of salmon during their seaward migration, very little is understood about whether salmon undergo a similar physiological preparation for freshwater re-entry during their spawning migration. Pink salmon reach maturity and return to freshwater at two years of age. Exceptions to this rule are very rare making pinks the ideal species to study seasonal changes in osmoregulatory capacity. This study examined the expression and activity of gill H^+ -ATPase and several isoforms of Na^+K^+ -ATPase in lab-reared pink salmon held in seawater over an 18 week period coinciding with the period prior to, during and after the timing of their natural freshwater migration. Muscle water content and plasma sodium and chloride concentrations were determined to assess the osmoregulatory status of pink salmon throughout the study period and discussed in relation to observed changes in gill ion transporter expression and activity.

INTERSPECIFIC SCALING OF LIMB BONES IN EXTANT REPTILES WITH IMPLICATIONS FOR BODY-MASS ESTIMATION [2]

ÉCHELONNAGE INTERSPÉCIFIQUE DES OS DES MEMBRES CHEZ DES REPTILES AVEC DES IMPLICATIONS POUR UNE ESTIMATION DE LA MASSE CORPORELLE

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The interspecific scaling patterns of limb bones and body mass in mammals have been rigorously examined to test theoretical scaling models, compare limb scaling patterns between groups, and provide equations to predict body mass in extinct animals. Interspecific limb scaling in reptiles, however, has received less attention. Here we examine the scaling differences between various limb measures and body mass in reptiles. We test the hypothesis that

phylogenetic, body size, and lifestyle differences are represented by variation in limb scaling. Results reveal scaling differences related to the length of the humerus, femur, radius, and tibia, but circumference measurements show little variation between reptile groups. This suggests that body size and lifestyle affects limb length, whereas circumference measures are constrained by body mass and relatively independent of other factors. This measure likely provides a good proxy to predict body mass in extinct sprawling taxa.

THE POSSIBILITY OF A HIGH-THROUGHPUT ASSAY FOR THE DETERMINATION OF OPTIMAL TEMPERATURE IN SALMON [109]B

UN DOSAGE ENZYMATIQUE À HAUT DÉBIT POURRAIT PERMETTRE LA DÉTERMINATION DE LA TEMPÉRATURE OPTIMALE CHEZ LE SAUMON

Matthew T Casselman, K Anttila, and AP Farrell

University of British Columbia

Pacific salmon populations display an optimal temperature (T_{opt}) for aerobic scope with temperatures above T_{opt} linked to reduced fitness. As a result, predicting the effects of climate change on salmon populations requires timely and reliable characterization of T_{opt} values. Our research goal was to develop a technique to expedite the measurement of T_{opt} , building from previous knowledge that adult salmon maximum heart rate (f_H) is achieved around T_{opt} . Using juvenile coho salmon, an exhaustive-exercise protocol defined T_{opt} for aerobic scope and confirmed that maximum f_H was reached. Next, ECG measurements were made on anaesthetized coho that were acutely warmed, with and without pharmacological stimulation of f_H . Arrhenius breakpoint analysis of the relationship between temperature and f_H revealed a breakpoint that corresponded with the T_{opt} for aerobic scope. This assay is proposed as a rapid determination of T_{opt} that can be applied broadly to the conservation of Pacific salmon.

THE EFFECTS OF 17 α -ETHYNYLESTRADIOL (EE2) ON GONADAL DEVELOPMENT AND DIFFERENTIATION IN THE ESTUARINE KILLIFISH (FUNDULUS HETEROCLITUS) [69]BH

LES EFFETS DU 17 α -ÉTHYNYLESTRADIOL (EE2) SUR LE DÉVELOPPEMENT ET LA DIFFÉRENCIATION GONADIQUE CHEZ LES CYPRINODONTIDÉS DE L'ESTUAIRE (FUNDULUS HETEROCLITUS)

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Wilfrid Laurier University

This study aims to confirm the period of gonadal differentiation in the estuarine killifish or mummichog (*Fundulus heteroclitus*) and to determine the sensitivity of gonadal development to EE2 (17 α -ethynylestradiol; a model estrogen). Early life stage exposure of fish, including mummichog, to estrogenic endocrine disruptors causes effects such as intersex and feminization; however, the critical period of exposure that leads to altered differentiation has not been identified in mummichog. Artificially regressed mummichog were spawned, and fertilized eggs were collected and exposed to EE2 (0, 10, 50 and 250 ngL⁻¹) within 8h of spawning. Embryos and larvae were continually exposed in petri dishes and beakers (26°C) and sampled weekly from hatch date to 10 weeks post-hatch to histologically determine the sensitivity of gonadal development to EE2. Preliminary results provide strong evidence that initial signs of primordial gonadal development appear at two weeks post-hatch, followed by a clear distinction of the gonads in the following weeks.

TEMPERATURE EFFECT ON P_{crit} AND GILL MORPHOLOGY IN CARPS OF UPPER YANGTZE RIVER, CHINA [112]

L'EFFET DE LA TEMPÉRATURE SUR P_{crit} ET LA MORPHOLOGIE DES BRANCHIES CHEZ LES CARPES DE LA RIVIÈRE YANGTZE SUPÉRIEURE EN CHINE

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Temperature is a dominating ecological factor that can profoundly affect physiological functions and result in changes in metabolic rate, hypoxia tolerance and mechanisms for oxygen acquisition. Previous studies have shown that there was a clear correlation between P_{crit} , the hypoxia tolerant indicator in fish, and gill surface area. The hypoxia induced gill remodeling in crucian carp (*Carassius carassius*) at low temperature could also occur at higher temperature. In this study, we compared routine metabolic rate, P_{crit} and gill structure in 6 species of carp of the

upper Yangtze River acclimated to 10, 15, 20, 25, and 30°C. The effect of temperature on P_{crit} in carps was significant and species-specifically different. The gill remodeling induced by temperature was significant in 3 of 6 carps. There was no correlation between P_{crit} and gill surface area in these carps.

ROVER/SITTER VARIATION IN THE FORAGING GENE ALSO INFLUENCES OVIPOSITION IN DROSOPHILA MELANOGASTER [19]BL

LA VARIATION ROVER/SITTER DANS LE GÈNE DE RECHERCHE DE NOURRITURE INFLUENCE AUSSI L'OVIPOSITION CHEZ DROSOPHILA MELANOGASTER

Chris CW Chen, MW McConnell, MJ Fitzpatrick

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The selection of a suitable location for the deposition of eggs can have significant fitness consequences for offspring survival. Female *Drosophila melanogaster* select oviposition substrates by tasting with their tarsi and proboscis and previous work suggest that high levels of nutrients are preferred. Naturally occurring allelic variation in the foraging gene, *for*, which encodes a cGMP-dependent protein kinase (PKG), underlies a polymorphism in foraging behaviour. Recent work has shown that this polymorphism also affects oviposition. Here we explore the specific factors influencing oviposition choices by using a factorial design to manipulate both carbohydrate and protein levels in the laying substrates. We find that rovers prefer to lay on substrates with low protein concentrations whereas sitters prefer substrates with high levels of carbohydrates. These results show that the inherent differences in *for*-PKG expression and activity between rovers and sitters leads to differential preferences for specific components of potential egg laying substrates.

MORPHOLOGICAL INDICATES OF CRYPTIC FEMALE CHOICE AS REVEALED BY COMPARING THE REPRODUCTIVE GLANDS OF EIGHT PREVIOUSLY UNDESCRIBED SPECIES OF BLOOD-FEEDING HEMIPTERA [1]

INDICATEURS MORPHOLOGIQUES DU CHOIX CRIPTIQUE FEMELLE TEL QUE RÉVÉLÉ PAR LA COMPARAISON DES GLANDES REPRODUCTRICES DE HUIT ESPÈCES D'HÉMIPTÈRES HÉMATOPHAGES ENCORE NON-CARACTÉRISÉE

Gary Chiang and JA Chiang

Redeemer University College

The morphology of reproductive organs was documented for females and males in eight species of blood-feeding Hemiptera, all vectors of Chagas disease. These included three of *Rhodnius* (*R. brethesi*, *R. nasutus*, *R. pictipes*), three from *Triatoma* (*T. dimidiata*, *T. klugi*, *T. sordida*), and one from each of *Nesotriatoma* (*N. bruneri*) and *Panstrongylus* (*P. megistus*). Morphological differences were observed between species with the greatest variation among female accessory reproductive glands. Fertilization in these bugs is internal and spermatozoa are stored in the spermathecae, which are paired bilaterally symmetrical blind-ended tubes attached to the common oviduct. Females can be copulated by more than one male, and differences in their accessory glands may have evolved to permit females to select which sperm fertilize the eggs. The female's ability to discriminate between sperm is referred to as cryptic female choice, a postcopulatory evolutionary mechanism that helps to explain the diversity of insect species.

RAPID EVALUATION OF THE CYTOTOXIC AND GENOTOXIC POTENTIAL OF OIL SANDS PROCESS AFFECTED WATERS WITH FISH CELL LINES [70]

ÉVALUATION RAPIDE DU POTENTIEL CYTOTOXIQUE ET GÉNOTOXIQUE DES EAUX CONTAMINÉES PAR LE TRAITEMENT DES SABLES BITUMINEUX GRÂCE À DES LIGNÉES DE CELLULES DE POISSON

Alice Chun, U Adamcic-Bistrivoda, B Sanson and LEJ Lee

Wilfrid Laurier University

Rapid and reliable toxicity assessment of large numbers of oil sands process-affected waters (OSPW) are needed in order to reclaim oil sands mined lands and for predicting fish success in oil sands aquatic reclamation components, such as the End Pit Lakes. Conventional toxicity testing using whole fish is slow, tedious and extremely costly, thus alternatives are being sought. This study employed various fish cell lines in fluorometric (cytotoxicity) and electro-

phoretic (genotoxicity) assays to assess the safety of several OSPW samples. Cytotoxicity correlated with the naphthenic acid concentration present in the samples ($R^2 > 0.65$; $p < 0.0001$) when data comparisons were performed after blind bioassays. Polycyclic aromatic hydrocarbons and naphthenic acids are believed to be the chief toxicants in OSPW and *in vitro* evidence appears to corroborate these findings. The fish cell line bioassays provide strong reproducibility and good relative sensitivity compared to available *in vivo* data, thus are useful OSPW toxicity predictive assays.

OXYGEN-DEPENDENT CHANGES IN SKIN NEUROEPITHELIAL CELLS AND THE HYPOXIC VENTILATORY RESPONSE IN DEVELOPING ZEBRAFISH, DANIO RERIO [27]BH

CHANGEMENTS DÉPENDANTS DE L'OXYGÈNE DANS LES CELLULES NEUROÉPITHÉLIALES DE LA PEAU ET RÉPONSE VENTILATOIRE HYPOXIQUE CHEZ LE POISSON ZÈBRE EN DÉVELOPPEMENT, DANIO RERIO

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In zebrafish, the ventilatory response to hypoxia first develops at 3 days post-fertilization (d.p.f.) before O₂-chemoreceptive neuroepithelial cells (NECs) of the gill appear at 7 d.p.f.. This indicates the presence of extrabranchial chemoreceptors in embryos and a developmental transition to primarily gill O₂ sensing. We investigated NEC-like cells of the skin, which reach peak density in embryos but decline as gill NECs appear. Exposure of embryos and larvae to chronic hypoxia prevented the loss of skin NECs, shifted peak basal ventilation to a later developmental stage, and induced a hypoventilatory response to acute hypoxia. Chronic exposure to hyperoxia rapidly diminished skin NECs, shifted peak ventilation to earlier stages and eliminated the response to acute hypoxia. Administration of the neurotoxin, 6-hydroxydopamine, degraded nerve terminals that contact skin NECs and reduced both basal ventilation frequency and the hypoxic ventilatory response. Thus, skin NECs are candidates for extrabranchial O₂ chemoreceptors in developing zebrafish.

A STICKY SITUATION: HOW DO ALPINE PHASMIDS SURVIVE COLD AND DESICCATION [43]BH

AVOIR DES ENNUIS: COMMENT LES PHASMIDES ALPINS SURVIVENT-ILS LE FROID ET LA DESSICCATION?

Litza E Coello and BJ Sinclair

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Insects have repeatedly colonized alpine environments, which are characterized by low ambient temperature, low water availability and a short growing season. *Niveaphasma annulata* is a stick insect that is distributed from sea level to alpine zones in New Zealand, with repeated, independent, incursions into the alpine zone. I hypothesise that there are physiological differences between lowland and montane populations, and that common biochemical and genetic constraints mean that alpine populations will differ from lowland populations in the same way. To test these hypotheses I will characterize and compare the cold and desiccation tolerance of multiple lowland and alpine *N. annulata* populations by determining low thermal limits, cold tolerance strategy, water loss rates, and identifying and quantifying biological cryoprotectants and thermal hysteresis activity. I predict alpine populations will be more cold and desiccation tolerant than their lowland counterparts.

NANO-SILVER TOXICITY IN DAPHNIA PULEX: DETERMINING THE ROLE OF IONIC SILVER [71]H

TOXICITÉ DU NANOARGENT CHEZ DAPHNIA PULEX : DÉTERMINATION DU RÔLE DE L'ARGENT IONIQUE

Emily-Jane Costa and J McGeer

Wilfrid Laurier University

The objective of this research is to determine the effect of ionic (Ag⁺) and nanoparticle silver (nAg) on toxicity and uptake kinetics in *Daphnia pulex*. Toxicity tests, solution ultrafiltration (e.g. < 450nm, < 100nm, < 10nm, and < 1nm metal fractions) and dialysis techniques were applied to solutions of Ag⁺ and nAg (with positive and negative surface charges). Toxicity tests were standard 48 h exposures to determine 50% effect concentrations (EC₅₀s) and this was combined with uptake and accumulation as well as depuration (48 h) studies. *Daphnia* (n = 12) were sampled at time 0, 1, 3, 6, 12, 24, and 48 h in both phases to measure whole-body Ag, Na, and Cl. The EC₅₀ for Ag⁺ (0.78 µg l⁻¹ and nAg (0.83 µg l⁻¹) were similar but uptake kinetics differed. *Daphnia* accumulated Ag⁺ slower than nAg but depurated

Ag⁺ faster than nAg. This research was supported by the NNBNI.

EFFECTS OF SEROTONIN ON PREOPTIC NEURONS IMPLICATED IN THE CONTROL OF MALE GOLDFISH REPRODUCTION [29]

EFFETS DE LA SÉROTONINE SUR LES NEURONES PRÉOPTIQUES IMPLIQUÉS DANS LE CONTRÔLE DE LA REPRODUCTION DES POISSONS ROUGES MÂLES

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In vertebrates, including teleost fish, the neurotransmitter serotonin (5HT) is known to modulate reproduction. This project aims to determine this site of central action of 5HT. Neuroanatomical evidence indicated widespread 5HT projections including extensive 5HT-immunoreactive fibers in the goldfish preoptic area (POA). Patch-clamp electrophysiology of single ventral POA neurons in an *in vitro* whole brain preparation with olfactory bulbs (OB) attached was used. Preliminary results suggest that bath application of 5HT (40 µM) is able to alter neuronal firing patterns, inducing bursting. Electrical stimulation of the OB evokes depolarization in some POA neurons indicating some synaptic connectivity. We conclude that 5HT may be able to modulate the olfactory input to the POA. Selective serotonin reuptake inhibitors, such as fluoxetine are considered environmental pollutants and may inhibit reproduction in fish. By understanding how 5HT affects reproduction, we can better understand the possible consequences of such contaminations.

DESCRIPTION OF A FEMALE ENALIARCTOS EMLONGI (CARNIVORA, PINNIPEDIA) FROM THE MIOCENE OF WESTERN OREGON AND IMPLICATIONS FOR THE EVOLUTION OF PINNIPED MATING SYSTEMS [4]B

DESCRIPTION D'UNE FEMELLE ENALIARCTOS EMLONGI (CARNIVORA, PINNIPEDA) DU MIOCÈNE DE L'OUEST DE L'OREGON ET LES IMPLICATIONS CONSÉQUENTES DANS L'ÉVOLUTION DES SYSTÈMES DE REPRODUCTION DES PINNIPÈDES

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The land to sea transition of pinnipeds (seals, sea lions, walrus) is poorly understood when compared with other marine mammals, such as cetaceans. Fossils play a critical role in reconstructing the early stages of pinniped evolution. This study reports on a partial skull originally considered, based on dental evidence, to be a subadult of *Enaliarctos emlongi*. However, the lack of prominent sutures on this small specimen suggests the animal was an adult. Here we show that the small skull can be distinguished from the type of *E. emlongi* based on a number of important cranial differences, including the morphology of the snout and occiput. However, given the dental similarities with the type, we suggest that this skull may represent a female of *E. emlongi*. If this is correct, it would imply that *E. emlongi* was highly sexually dimorphic, and possibly polygamous, as seen in modern pinnipeds, especially otariids (sea lions).

AN EXAMINATION OF THE IMPACT OF MITO-NUCLEAR INTERACTIONS ON BIOENERGETICS IN BLUEGILL, PUMPKINSEED AND THEIR HYBRIDS [107]

ÉTUDE DE L'IMPACT DES INTERACTIONS MITO-NUCLÉAIRES SUR LA BIOÉNERGÉTIQUE CHEZ LE CRAPET ARLEQUIN, LE CRAPET SOLEIL ET LEURS HYBRIDES

Rhiannon Davies, A Hume, C Moyes and YX Wang

Queen's University

Bluegill (*Lepomis macrochirus*) and pumpkinseed (*L. gibbosus*) sunfish are commonly found in the same water bodies. As adults, each species has separate ecological niches and thus experiences different environmental influences leading to observed differences in bioenergetic pathways, but these species are still able to produce viable hybrid offspring. The mating strategies of bluegill ensure that the hybrid offspring are the result of a male bluegill and female pumpkinseed pairing. Since mitochondrial DNA is inherited maternally, and the nuclear DNA is inherited from both parents this provides a unique model to examine the effect of mito-nuclear interactions on mitochondrial function. Previously, these hybrids have been observed to have reduced pyruvate flux and capacity of OX-

PHOS enzymes, complex III and complex IV, in isolated mitochondria. We investigate the molecular mechanisms underlying mitochondrial function by examining regulatory elements and transcription factors to determine what is causing decreased hybrid mitochondrial function.

USING EIGENSHAPE ANALYSIS OF LOWER CHEEK TEETH IN ORDER TO INVESTIGATE THE TAXONOMY OF PLIOCENE FOSSIL RABBITS [24]B

UTILISATION DE L'ANALYSE EIGENSHAPE DES DENTS JUGALES INFÉRIEURES AFIN DE FAIRE L'ÉTUDE DE LA TAXONOMIE DES LAPINS FOSSILES DU PLIOCÈNE

Danielle Dionne and WT Mitchell

Carleton University

Traditionally, linear and angular measurements of the occlusal surface of the third lower premolar have been used to identify different species fossil rabbits, such as *Hypolagus*. Recent advances in computer technology have led to the development of new techniques and methods to evaluate variation in shape that may be useful in the taxonomic classification of fossil species such as *Hypolagus*. New fossil rabbits are still being found and it is a challenge trying to classify them in the traditional way, especially within a genus as diverse as *Hypolagus*. We show that although standard eigenshape analysis of the third premolar did not recover traditionally recognized *Hypolagus* species groupings, preliminary work with other *Hypolagus* teeth show that this method may be capable of recognizing species groupings. This could provide a framework for the inferred past biodiversity and could provide new insight for investigating the origin and evolution of *Lagomorpha* over time.

DOSE-RESPONSE CURVES OF MORPHINE USING A ZEBRAFISH MODEL [118]BH

COURBES DOSE-RÉPONSE DE LA MORPHINE UTILISANT LE POISSON ZÈBRE COMME MODÈLE

Angela Douglas

University of Prince Edward Island

Fish have recently become the most widely used research model, surpassing mice and rats. As a result fish are subject to a variety of potentially painful treatments and while animal welfare regulations have progressed in the last few years, there is little evidence-based data regarding the efficacy of analgesics in fish. Before any analgesic can be used, a dose-response relationship must be demonstrated and first needs to be shown with morphine, the gold standard analgesic. I tested a model using acid injection as the noxious stimulus and swimming behaviour as the response. Acid injection has been shown to decrease swimming frequency. To reduce this decrease associated with the noxious stimulus, I injected morphine at 1, 3, 10, 30, 100 mg kg⁻¹ in an attempt to show a dose-response relationship. Fish activity, before and after treatment, was recorded with a video camera and analyzed with Loligo software. Effective doses of morphine were then injected in conjunction with Naloxone, a known opioid antagonist, in an attempt to reverse the morphine-associated changes. The goals of these experiments are to discover a potential robust reliable model that can be used to define the dose-response relationship of morphine in fish. This model can then be applied to test the effect of other drugs as well as the effect of various environmental factors on the dose-response relation.

INTERACTIONS BETWEEN METABOLIC RATE AND SOCIAL STATUS IN ZEBRAFISH, DANIO RERIO [98]

INTÉRACTIONS ENTRE LE TAUX MÉTABOLIQUE ET LE STATUT SOCIAL CHEZ LE POISSON ZÈBRE, DANIO RERIO

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Fish held in small groups often form dominance hierarchies due to competition over limited resources (e.g. territories or mating opportunities). Distinctive behaviour is noticeable within ranks in these hierarchies, with dominant fish being more aggressive and active than subordinates. Physiological differences can also be linked to social status. Zebrafish exhibit social hierarchies in which dominance can be assessed by scoring aggressive and submissive behaviour. The rate of oxygen consumption of subordinate fish was significantly higher than that of dominant, sham (handled but not exposed to social interaction) or control fish (minimal handling) suggesting that low social

status is associated with a high metabolic cost. The goal of this study was to determine whether metabolic rate (measured as the rate of oxygen consumption in a closed respirometry system) can be used to predict the social status an individual zebrafish will attain in a social interaction.

THE EFFECT OF THYROID HORMONE ON THE REPRODUCTIVE AXIS: A COMPARATIVE STUDY IN VERTEBRATES [55]BH

EFFET DE L'HORMONE THYROÏDIENNE SUR L'AXE REPRODUCTEUR: UNE ÉTUDE COMPARATIVE CHEZ LES VERTÉBRÉS

Paula Duarte-Guterman and VL Trudeau

University of Ottawa

In vertebrates, the main role of thyroid hormones (THs) is to regulate metabolism, and in amphibians and some fish, metamorphosis. There is emerging evidence that THs also regulate the reproductive axis. We compared this non classical effect of TH in three frog species (*Silurana tropicalis*, *Physalaemus pustulosus*, *Rana pipiens*) and other vertebrates. In all studied organisms, TH increases the androgen:estrogen ratio, but the mechanism differs. In most species (*P. pustulosus*, *R. pipiens*, goldfish, rodents, and pig), TH decreases estrogen synthesis. Alternatively, in one species (*S. tropicalis*), TH increases the expression of androgen synthesis enzymes. We suggest that the link between THs and sex steroids is basal in vertebrates, but in some groups, there has been evolutionary divergence of the proximate mechanisms linking these endocrine axes. We propose that differences in mechanisms are related to the sex-determining system (female versus male heterogamety) of a given species.

HMGCR PATHWAY IS NECESSARY FOR CEREBRAL-VASCULAR STABILITY AND ANGIOGENESIS DURING VERTEBRATE DEVELOPMENT [5]B

LA VOIE HMGCR, UNE NÉCESSITÉ POUR LA STABILITÉ CÉRÉBRO-VASCULAIRE ET L'ANGIOGÈNESE LORS DU DÉVELOPPEMENT DES VERTÉBRÉS

Shahram Eisa-Beygi, G Hatch, M Ekker and TW Moon

University of Ottawa

HMGCR is the rate-limiting enzyme in the biosynthesis of cholesterol and other lipids. Statin drugs are HMGCR inhibitors and zebrafish embryos treated with statins demonstrated cranial hemorrhages at 2 dpf. This vascular-defect was rescued by mevalonate supplementation, the immediate metabolite of the HMGCR pathway. A splice-modifying antisense-morpholino-oligonucleotide designed against *hmgcrb* pre-mRNA and a translation-blocking morpholino oligonucleotide targeting the ATG initiation site of *hmgcrb* mRNA also resulted in hemorrhages. Moreover, these embryos had reduced hemoglobin in the pericardium and the sinus venosus. Fluorescent microscopy of *fli:eGFP;Gata:dsRED* embryos shows that hemorrhages arise due to vessel rupture at the base of lateral dorsal aortae (LDA). Furthermore, mRNA levels of VEGF and EPO-encoding genes were significantly elevated, suggesting transcriptional up-regulation of erythropoiesis and angiogenesis as mediating post-hemorrhagic recovery. The recovery from cerebral hemorrhages suggests a transient function for *hmgcrb* in cerebral-vascular development. We hypothesize that inhibition of HMGCR elicits cerebral hemorrhages by reducing the geranylgeranylation of Rho GTPases.

EFFECT OF PREDATOR DIET ON PREDATOR-INDUCED CHANGES IN LIFE HISTORY AND PERFORMANCE OF ANURAN LARVAE [17]

EFFET DE LA DIÈTE DES PRÉDATEURS SUR LES CHANGEMENTS INDUITS PAR LES PRÉDATEURS DANS L'HISTOIRE DE LA VIE ET LA PERFORMANCE DES LARVES D'ANOURES

Rayan El Balaa and G Blouin-Demers

University of Ottawa

Phenotypically plastic animals can induce changes in their life history and physiology upon detection of predation cues during development. These phenotypic inductions are usually restricted to risky environments as they involve costly trade-offs. I examined the effects of predator diet on the performance, life-history, and morphology of developing Northern Leopard frog (*Rana pipiens*) tadpoles. Tadpoles were exposed to cues either from fish free water, Brown bullhead (*Ameiurus nebulosus*) on a pellets diet [Pellet treatments], or *A. nebulosus* on a *R. pipiens* tadpoles

diet [Tadpole treatments]. Tadpoles exposed to Pellet treatments had faster hatching rates, slower growth rates, smaller body dimensions, faster burst speed, and reached metamorphosis before all other treatment groups. Tadpoles exposed to Tadpole treatments had slower growth rates, smaller body dimensions, and faster burst speed than fish free treatments. These results suggest that tadpoles can sense differences in predator diet, and induce morphological, life history, and performance changes based on levels of predation risk.

THE EFFECT OF CHRONIC NICKEL EXPOSURE ON THE SUSTAINED SWIMMING ABILITY OF RAINBOW TROUT (ONCORHYNCHUS MYKISS) [72]H

EFFETS DE L'EXPOSITION CHRONIQUE AU NICKEL SUR LA CAPACITÉ DE NAGE PROLONGÉE CHEZ LA TRUITE ARC-EN-CIEL (ONCORHYNCHUS MYKISS)

John Ellis and J McGeer

Wilfrid Laurier University

Swim performance is commonly used to assess the toxicological effects that contaminants have on fish. In this study, swim performance was measured to examine the effects of Ni on the swimming ability of rainbow trout. Fish were exposed to concentrations of 0, 0.75 and 2 mg l⁻¹ Ni resulting in mortalities of 2%, 14.6% and 15.9%, respectively. Liver, kidney, gill, muscle and plasma samples were collected before and after each swim trial. Tissue Ni burden, plasma ion composition and the metabolic impacts of exposed fish were examined. A four-fold increase in Ni accumulation was observed in the gill. At d 23, a significant decrease in swim performance was observed in fish exposed to 2 mg l⁻¹ Ni compared to the control. A reduced swimming capacity in fish could severely impair their survival in natural environments in terms of predator avoidance and prey capture. This research is supported through the NSERC Discovery Program.

PHEROMONE RECOGNITION AND MATING SUCCESS IN HAWAIIAN AND THAI POPULATIONS OF DIPLOPTERA PUNCTATA [18]

RECONNAISSANCE DES PHÉROMONES ET SUCCÈS REPRODUCTEUR DANS LES POPULATIONS HAWAIIENNE ET THAÏLANDAISE DE DIPLOPTERA PUNCTATA

Jasmine Farhan and J McNeil

University of Western Ontario

The Pacific beetle cockroach *Diploptera punctata* is a viviparous cockroach found in Asia and many Pacific islands, including Hawaii. The majority of studies on this species have focused on the reproductive physiology but little is known about its mating behaviour or if, as in other cockroaches, sex pheromones are important. In my study I used two allopatric populations, one from Hawaii and the other from Thailand, as preliminary laboratory evidence suggested that interbreeding between the two populations was limited. I tested the hypothesis that differences in sex pheromones provided an effective reproductive isolating mechanism. I first examined the mating success of females, either zero or five days after their final moult when held with a male from her original population or one from the other geographic population. I then examined the response of both males and females using a Y-tube olfactometer bioassay. Females regardless of their age preferred males from their own geographic population significantly more than males from the other population. In the Y-tube assays showed that Hawaiian individuals utilized volatiles to discriminate between potential mates while did not appear to be the case for those from Thailand.

EFFECTS OF 17 α -ETHINYLESTRADIOL (EE2) ON GONADAL STEROIDOGENESIS IN MUMMICHOG (FUNDULUS HETEROCLITUS) UNDER DIFFERING SALINE CONDITIONS [73]BH

EFFETS DU 17 α -ÉTHINYLESTRADIOL (EE2) SUR LA STÉROÏDOGÈNESE GONADIQUE CHEZ LE CHOQUEMORT (FUNDULUS HETEROCLITUS) SOUS DIFFÉRENTES CONDITIONS SALINES

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¹Wilfrid Laurier University; ²Canadian Rivers Institute; ³University of New Brunswick

Waterborne exposure to 17 α -ethinylestradiol (EE2), a synthetic estrogen, decreases gonadal steroidogenesis in the estuarine killifish or mummichog (*Fundulus heteroclitus*). Mummichog is a useful fish model to study how environmental conditions alter responses to EE2. Mummichog were exposed for 14 days to 0, 50 and 250 ng l⁻¹ EE2 in 0, 16 and 32 ppt salinity. In females, gonadal production of 17 β -estradiol was significantly decreased when exposed

to 250 ng l⁻¹ EE2 at 0 ppt and significantly increased when exposed to 50 ng l⁻¹ EE2 at 16 ppt. Use of steroidogenic precursors in the ovarian incubations indicated that at 0ppt estradiol production was decreased at various points in the pathway before, at and downstream of cholesterol conversion to pregnenolone in 250ng l⁻¹ EE2-exposed fish. At 16 ppt, increased estradiol production in 50 ng l⁻¹ EE2-exposed fish is potentially due to changes in cholesterol transport into the mitochondria and/or conversion to pregnenolone. No changes in steroidogenesis were detected in fish exposed to EE2 at 32 ppt.

NUCLEOBINDIN-2 IN NON-MAMMALIAN VERTEBRATES: MOLECULAR, CELLULAR AND PHYSIOLOGICAL EVIDENCE FOR THE ANOREXIGENIC ACTIONS OF AN ENDOGENOUS FORM OF NESFATIN-1 IN GOLDFISH, CARASSIUS AURATUS [47]

LA NUCLÉOBINDINE-2 CHEZ LES VERTÉBRÉS NON-MAMMIFÈRES: INDICES MOLÉCULAIRES, CELLULAIRES ET PHYSIOLOGIQUE DE L'ACTION ANOREXIGÈNE DE LA NESFATINE-1 ENDOGÈNE CHEZ LE POISSON ROUGE (CARASSIUS AURATUS)

Ronald Gonzalez, B Kerbe, A Chun and S Unniappan
York University

Nesfatin-1 is a recently discovered anorexigen encoded in the precursor peptide, nucleobindin-2 (NUCB2) in mammals. To date, nesfatin-1 has not been described in any non-mammalian species. Our objective was to characterize nesfatin-1 in fish. In the present study, we employed molecular, immunohistochemical, and physiological studies to characterize the structure, distribution, and appetite regulatory effects of nesfatin-1. A very high conservation in NUCB2 sequences, especially in the nesfatin-1 region was found in non-mammalian vertebrates. Nesfatin-1-like immunoreactive cells are present in the hypothalamus and in the gastrointestinal tract of goldfish. A 2-fold increase in NUCB2 mRNA was observed in the goldfish hypothalamus at 1 and 3 h post-feeding. *In vivo*, a single intraperitoneal (50 ng g⁻¹) or intracerebroventricular injection (5 ng g⁻¹) of the full-length native nesfatin-1 reduced food intake by 23% and 50%, respectively. Our results provide molecular, anatomical and functional evidence to support potential anorectic and metabolic roles for endogenous nesfatin-1 in goldfish.

THE RELATIONSHIP BETWEEN LONG DISTANCE ATTRACTION CALLS AND COURTSHIP CALLS ON MATING SUCCESS IN A FIELD CAUGHT CRICKET, GRYLLUS PENNSYLVANICUS [21]

LA RELATION ENTRE LES APPELS D'ATTRACTION DE LONGUE DISTANCE ET DE COURTISANERIE SUR LE SUCCÈS REPRODUCTEUR CHEZ UN CRIQUET DES CHAMPS, GRYLLUS PENNSYLVANICUS

Caitlin M Grant, IR Thompson, SJ Harrison and SM Bertram
Carleton University

Cricket acoustic mating behaviours allow us to explore the relationship between mate attraction and courtship displays. To attract females, males produce two distinct mating calls: a long distance attraction call and a courtship call. To date, most research has focused on determining how variation in either mate attraction or courtship calls influences fitness, but little research has focussed on the relationship between these call types. Here we explore the relationships between mate attraction, courtship calls, and mating success in field caught Fall Field crickets, *G. pennsylvanicus*. We quantified long distance and courtship calling effort to determine how they influence male attractiveness and mating success. We will also explore if high effort in one type of calling corresponds to high effort in the other, or if trade-offs exist between long distance and courtship calls with respect to male attractiveness. Our results provide insights into the evolution of multiple signals.

FUEL PREFERENCE IN THE SOUTH AMERICAN AESTIVATING FROG CERATOPHRYS ORNATA [97]

PRÉFÉRENCES DES SOURCES ÉNERGETIQUES CHEZ LA GRENOUILLE ESTIVANTE SUD-AMÉRICAINNE CERATOPHRYS ORNATA

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Aestivating anurans can remain dormant for extended periods of time to avoid desiccation. In order to survive prolonged inactivity, their endogenous fuel stores must be used to maintain energetic balance. Previously, it has been

shown that stored lipids are the primary oxidizable fuel used during aestivation and the activities of carbohydrate-related enzymes are reduced. This study explores the role of both carbohydrate and lipid oxidizing pathways during aestivation by analyzing pyruvate dehydrogenase, carnitine palmitoyl transferase, citrate synthase and 3-hydroxyacyl-CoA dehydrogenase of liver, heart and skeletal muscle of the ornate horned frog (*Ceratophrys ornata*). Furthermore, analysis of tissue metabolites, including carnitine, acetyl-CoA, glycogen and glucose, and plasma levels of non-esterified fatty acids and glucose will be presented.

ROLE OF ANTIAPOPTOTIC SIGNALING IN MAMMALIAN HIBERNATION [61]

ROLE DE LA SIGNALISATION ANTI-APOPTOTIQUE DANS L'HIBERNATION DES MAMMIFÈRES

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In the context of normal cell turnover, apoptosis is an essential natural phenomenon. Apoptosis depends on signals that promote cell death - proapoptotic pathways - and those that neutralize these signals - antiapoptotic pathways. We proposed that changes in antiapoptotic proteins would counteract stresses associated with hibernation (e.g. cold body temperatures, changes in metabolic requirements, ischemia-reperfusion) in thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*). Immunoblotting was used to analyze expression of proteins in three tissues. In brain, phospho-Bcl-2 (T56), phospho-Bcl-2(S70), Bcl-3, xIAP, Mcl-1, and BI-1 increased significantly during torpor (compared with euthermia) whereas cIAP was unaltered. In liver, all proteins were unchanged except for cIAP and Bcl-3 that decreased and BI-1 which increased during torpor. In kidney, the majority of proteins did not change except for a decrease in phospho-Bcl-2(T56) and an increase in BI-1 during torpor. The data show that antiapoptotic pathways have organ-specific responses in hibernators with a prominent potential role in brain.

NEUROCHEMICAL CHARACTERIZATION OF A CIRCADIAN TIMING NETWORK: PUTATIVE COMMUNICATION PATHWAYS BETWEEN THE CIRCADIAN AND NEUROENDOCRINE SYSTEMS IN THE BRAIN OF RHODNIUS PROLIXUS (HEMIPTERA) [38]

CARACTÉRISATION NEUROCHIMIQUE D'UN RÉSEAU CIRCADIEN: VOIES DE COMMUNICATION PUTATIVES ENTRE LES SYSTÈMES CIRCAIENS ET NEUROENDOCRINIENS DANS LE CERVEAU DE RHODNIUS PROLIXUS (HEMIPTERA)

Martha Hindley-Smith

York University

Clock cells are specialized types of cells which possess molecular oscillators that drive the endogenous rhythmicity observed in many organisms. Within the insect brain, there exist two distinct clusters of clock cells. Antibodies against a variety of neurochemicals were used to stain insect brains. Their association with the brain clock system, specifically LNs, can be inferred by way of double labelling with an antibody against the neuropeptide pigment-dispersing factor (PDF), which has been used extensively to trace the LNs and their axons. All double-labelling was done using standard immunohistochemistry procedure and tissue was observed using laser scanning confocal microscopy. All of these neurochemicals may potentially function as neurotransmitters and/or neuromodulators within a spatially distributed brain clock network. The apparent close association of these neurochemicals with the relatively large medial neurosecretory cells (MNCs) indicates another potential role for them as communicators of timing information between the neuroendocrine and brain clock systems.

Na⁺/K⁺-ATPASE TRAFFICKING IN CONTROL AND HEAT SHOCKED LOCUSTS [39]BH

TRAFIC DE Na⁺/K⁺-ATPASE SOUS CONTRÔLE ET LOCUSTES EN CHOC THERMIQUE

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During abiotic stress (e.g. hyperthermia or anoxia) locusts enter a reversible coma which is associated with a rapid and large surge of extracellular potassium ([K⁺]_o) in the central nervous system. Recovery from this coma is dependent on the clearance of [K⁺]_o to pre-stress levels. Heat shock (HS) pretreatment increases the rate of recovery from hyperthermic coma by unknown mechanisms. We found that prior HS also increased the rate of neural recovery from anoxic coma in dissected preparations and intact animals recovering from water immersion. We measured Na⁺/K⁺-ATPase activity before and after anoxic coma in metathoracic ganglia taken from control and HS prepa-

tions. We also localized Na⁺/K⁺-ATPase protein in 4-10 µm paraffin sections of the metathoracic ganglion using fluorescence immunocytochemistry. Our results indicate that an increased rate of [K⁺]_o clearance is correlated with trafficking of Na⁺/K⁺-ATPase to neuronal membranes without large changes of total Na⁺/K⁺-ATPase activity.

DO COMPLIANT TENDONS REDUCE THE COST OF LOCOMOTION? [114]H

LES TENDONS SOUPLES RÉDUISENT-ILS LE COÛT DE LA LOCOMOTION?

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Locomotion is an energetically demanding activity. Energy used by muscles during cyclical contractions, for example trotting or hopping, is suggested to be lessened when a compliant tendon connects muscle to the skeleton. To test the idea that tendons can reduce the cost of cyclic locomotion we repeatedly stimulated frog sartorius muscle that was connected to a load with either a compliant or non-compliant (stiff) tendon, causing the suspended load to rise and fall cyclically at equal amplitudes. Based on preliminary results, the muscle in series with a compliant tendon performed about half as much work while shortening, required approximately half the period of activation, had a tension-time-index about 50% less and an oscillation frequency about 60% faster than when in series with a non-compliant (stiff) tendon. This suggests compliant tendons may reduce the cost of cyclic movement, which will be further investigated using measures of oxygen consumption.

QUALITATIVE AND QUANTITATIVE APPROACH TO DESCRIBE BLUE MUSSEL'S (MYTILUS EDULIS) ANTIMICROBIAL PEPTIDES PRODUCTION [120]

APPROCHE QUALITATIVE ET QUANTITATIVE POUR LA DESCRIPTION DE LA PRODUCTION DE PEPTIDES ANTIMICROBIEN CHEZ LA MOULE BLEUE (MYTILUS EDULIS)

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Antimicrobial peptides, like Mytilins, are produced by the hemocytes of mussels and released into hemolymph where they act synergistically as powerful bactericides. This study's objective is to acquire quantification and qualitative observation of these peptides within immune cells from *Mytilus edulis*. Mussels were sampled in October, February and April to describe a seasonal pattern of peptide synthesis. Hemocyte organelle acid extracts were purified on Sep-pack C18 cartridges and the bactericidal 40% acetonitril fraction was isolated. Specific antibodies have been raised against Mytilins A, B and Mytimicins and quantification of peptides by ELISA in purified extracts is currently being developed. For the qualitative approach, immunohistochemical assay is in progress. We expect to visualize which cell types are producing the peptides and to observe variations of cell staining according to seasonal sampling period. Because of strong inter individual variations, a protocol using hemolymph based blocking solution was developed which minimized nonspecific labelling.

INVESTIGATING THE INDUCTION OF THE CONJUNCTIVAL PAPILLAE IN CHICKEN EMBRYOS WILL SHED LIGHT ON PATTERNING OF DERMAL BONES [6]B

L'ÉTUDE DE L'INDUCTION DE LA PAPILLE CONJONCTIVALE CHEZ DES EMBRYONS DE POULET PERMETTRA DE CLARIFIER LES PATRONS DES OS DERMALIQUES

Karyn Jourdeuil and T Franz-Odenaal

Mount St. Vincent University

Conjunctival papillae, epithelial thickenings on the surface of the eye, are responsible for the induction of the underlying scleral ossicles. While recent studies in our lab have focused on determining the factors that control the induction of the scleral ossicles, little has been done to understand the induction of conjunctival papillae. The purpose of this study is to determine the molecular and cellular factors that control the induction of the conjunctival papillae. Through embryonic manipulations, we have discovered that the presumptive eyelid epithelium and the otic vesicle epithelium play no role in the induction of the conjunctival papillae but the nasal region may be involved. Further analyses of the cellular mechanisms (cell-cell communication, diffusible signal, cell migration) will be conducted via surgery, dil injections and possibly barrier experiments. A candidate gene approach will be used to determine the genetic factors involved and the mechanisms of induction.

SOME LIKE IT HOT: TEMPERATURE BIOLOGY IN SHORTNOSE STURGEON [110]

CERTAINS L'AIMENT CHAUD: LA BIOLOGIE DE TEMPÉRATURE CHEZ L'ESTURGEON À MUSEAU COURT

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University of New Brunswick

This study focused on establishing a baseline of routine metabolism for juvenile shortnose sturgeon (~10 g fish) under their acclimation temperatures (10°C, 15°C, 20°C, 25°C) or exposed to acute temperature conditions (10°C->15°C->20°C->25°C). For acclimated fish, the metabolic rates, over the temperatures tested, showed a linear increase followed by a levelling off at temperatures above 15°C. The variability in the metabolic rates was lowest at the colder temperatures. For the acute exposures, the relationship between temperature and metabolic rate showed a slightly different pattern. In particular, metabolic rate continued to increase up to 20°C before levelling off. Additional experiments are currently underway to examine the critical thermal maximum of juvenile shortnose sturgeon. Funded by NSERC.

GONADAL EFFECTS OF KISSEPTIN IN ZEBRAFISH [60]BH

EFFETS GONADIQUES DE LA KISSEPTINE CHEZ LE POISSON ZÈBRE

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York University

Kisspeptin is a recently discovered reproductive hormone and appears to have many important regulatory roles in mammals and non-mammalian vertebrates. Kisspeptin and its receptor have been found to play a role in regulating reproduction by acting locally in the gonads of mammals. Kisspeptin has been identified in several fishes and it was found to regulate reproduction by influencing the hypothalamic and pituitary derived reproductive hormones. We found kisspeptin and its receptor expressed in zebrafish gonads. Zebrafish kisspeptin-10 (zfKP-10) acted directly on oocytes to induce oocyte maturation. In addition, zfKP-10 significantly increased luteinizing hormone receptor, follicle stimulating hormone receptor and 20 β -hydroxysteroid dehydrogenase mRNA expression. This suggests that zfKP-10 affects oocyte maturation by influencing the local effectors of ovarian functions.

SUPPRESSION OF MUSCLE DISUSE ATROPHY DURING MAMMALIAN HIBERNATION - MICRORNA REGULATION IN THE SKELETAL MUSCLE OF MYOTIS LUCIFIGUS [62]H

ÉLIMINATION DE L'ATROPHIE DUE À L'INACTION MUSCULAIRE LORS DE L'HIBERNATION DES MAMMIFÈRES – RÉGULATION DES MICRO-ARN DANS LE MUSCLE SQUELETTIQUE DE MYOTIS LUCIFIGUS

Samantha F Kornfeld, KK Biggar and KB Storey
Carleton University

Muscle wasting is common in mammals during extended periods of immobility. However, many hibernating mammals manage to avoid muscle atrophy after remaining stationary for long periods. Recent research has highlighted roles for short non-coding microRNAs in the regulation of stress tolerance and we proposed that they could also play an important role in muscle maintenance during hibernation. To explore this, a group of microRNAs known to influence cell proliferation, differentiation and apoptosis (all cellular parameters of muscle atrophy) were analyzed by RT-PCR in hibernating bats, *Myotis lucifugus*. Significant changes in transcript expression were observed in microRNAs 1, 29b, 181b, 15a, 20a, 206, 208 and 21 in skeletal muscle of hibernating bats when compared with euthermic aroused bats. These microRNAs are predicted to target multiple muscle-specific factors, including SMAD7 and MAFbx transcription factors, and are likely involved in the preservation of muscle size and function during bat hibernation.

EFFECTS OF ELEVATED DIETARY IRON ON THE GASTRO-INTESTINAL EXPRESSION OF DMT-1 AND IRON HOMEOSTASIS IN RAINBOW TROUT (ONCORHYNCHUS MYKISS) [83]H

EFFETS D'UNE DIÈTE RICHE EN FER SUR L'EXPRESSION GASTRO-INTESTINALE DE DMT-1 ET L'HOMÉOSTASIE DU FER CHEZ LA TRUITE ARC-EN-CIEL (ONCORHYNCHUS MYKISS)

Raymond WM Kwong, C Hamilton and S Niyogi
University of Saskatchewan

Diet is the primary source of iron in fish, and the absorption of dietary iron is believed to occur via the divalent metal transporter-1 (DMT-1). The present study was designed to examine the effects of elevated dietary iron on the gastro-intestinal mRNA expression of DMT-1 and systemic iron status in rainbow trout. Fish were treated with normal and high-iron diets for 14 days. The DMT-1 expression (both β - and γ -isoforms) in the intestine was higher than that in the stomach. Interestingly, DMT-1 expression increased significantly in the fish gut following treatment with elevated dietary iron for 7 days, followed by a decrease to the control level at day 14. The temporal variation in DMT-1 expression exhibited good correlation with the alteration in tissue-specific iron burden and plasma iron status. Overall, our study suggests that DMT-1 expression regulates gastro-intestinal iron absorption in fish during exposure to high iron diet.

GENE EXPRESSION PROFILES OF MALE GOLDFISH EXPOSED TO THE PRIMING SEX PHEROMONE, 17 α ,20 β -DIHYDROXY-4-PREGNEN-3-ONE [30]BH

PROFILS D'EXPRESSION GÉNÉTIQUE DE POISSONS ROUGES MÂLES EXPOSÉS À LA PHÉROMONE D'AMORCE SEXUELLE 17- α , 20- β -DIHYDROXY-4-PREGNEN-3-ONE

WE Lado, JA Mennigen, J Zamora, JP Popesku, E Pranckeviciene, X Xia, JE Lewis and VL Trudeau
University of Ottawa

Sex pheromones rapidly affect endocrine physiology, behaviour and sperm release but little is known about their effects on gene expression in the neuroendocrine tissues mediating olfactory input. Therefore, we exposed male goldfish to waterborne 17,20 β -P (4.3 nM) for 6 hrs, after which the telencephalon was dissected for microarray analysis. Thirty-one transcripts were differentially expressed (4 up, 27 down). For example, ependymin-II and p53 binding protein were up-regulated, while N-myc downstream regulated gene 4 (NDRG4), Calmodulin and Aldolase C were down-regulated. Some of these genes have been shown to play a role in neuronal plasticity, metabolism and may be involved in neuroendocrine regulation. (Supported by NSERC, OGS and uOttawa)

THERMOREGULATION IN THE ASIAN ELEPHANT, ELEPHAS MAXIMUS [113]

THERMORÉGULATION CHEZ L'ÉLÉPHANT ASIATIQUE, ELEPHAS MAXIMUS

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Asian elephants are large endothermic mammals with a low surface area to volume ratio that inhabit a variety of warm environments and face a variety of thermoregulatory challenges both in the wild and in captivity. A previous study at the Toronto zoo has demonstrated the ability of African elephants to employ adaptive heterothermy to combat heat stress. This strategy involves diurnal storage of heat in the body during warm days, followed by nocturnal heat loss back to the cooler environment. African elephants have been observed to fluctuate their core body temperature by as much as 8°F in a 24 hour period, and appear to increase the temperature of their ears overnight through vasodilation permitting increased loss of heat to the cooler night sky through longwave radiation. A similar function was hypothesized to be present in Asian elephants, and was investigated in the present study. Through a 10 night and one day observational period of the herd of five female Asian elephants at Busch Gardens, Tampa, Florida, it was determined that Asian elephants may also utilize adaptive heterothermy. Asian elephants exhibit clear differential surface body temperature distribution at night, but place much more emphasis on trunk vasodilation and heat loss, opposed to their ears, which are greatly reduced in surface area compared to the African elephant.

GLYPHOSATE-BASED FORMULATIONS ARE TOXIC AND DISRUPT WOOD FROG (*LITHOBATES SYLVATICUS*) DEVELOPMENT [74]

LES FORMULES À BASE DE GLYPHOSATE SONT TOXIQUES ET PERTURBENT LE DÉVELOPPEMENT DE LA GRENOUILLE DES BOIS (LITHOBATES SYLVATICUS)

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Glyphosate-based herbicides are used worldwide and have been shown to affect survival, development, and sexual differentiation of tadpoles under laboratory conditions. Recent evidence suggests that the POEA surfactant may be

a more important causative factor leading to these effects than the active herbicidal ingredient. In an effort to replicate real-world agricultural application to glyphosate formulations and to investigate the direct effects of the surfactant we used pulse exposures to WeatherMax®, Vision®, POEA and isopropylamine salt of glyphosate, as well as a chronic exposure to POEA. Complete mortality was observed after exposure to 2.89 mg a.e./L of WeatherMax® and chronic POEA (1.43 mg/L). We also found a disruption of genes involved in metamorphosis, including thyroid hormone receptor beta expression in tail tissue after exposure to WeatherMax®. Our results demonstrate varying degrees of toxicity amongst formulations and with different exposure regimes, and support evidence that the POEA surfactant is an important factor contributing to effects on developing tadpoles.

IS MALE PHENOTYPE CRITICALLY ENDANGERED? [75]

LE PHÉNOTYPE MÂLE EST-IL EN GRAVE DANGER D'EXTINCTION?

Valerie Langlois

Royal Military College of Canada

It is now recognized that certain contaminants (e.g., pesticides, pharmaceuticals, industrial and military by-products) have the ability to act on the endocrine system of vertebrates at very low concentrations. Among other actions, endocrine disrupting chemicals (EDCs) can modulate biosynthesis and hormonal actions that can lead to benign to severe health defects. Sex steroids are the main hormones that control normal sexual development in vertebrates and are a target of EDCs with estrogenic, anti-estrogenic, androgenic and anti-androgenic properties. The impairment of the androgen:estrogen ratio can result in reduced fertility in vertebrates. Recent studies have suggested that goitrogenic chemicals would also contribute to the alteration of sex ratio favouring the female phenotype. Therefore, a question remains: Is male phenotype critically endangered? This paper will review recent data on androgen biosynthesis disruption and will discuss next research priorities.

THE EFFECTS OF HEAT SHOCK ON RAINBOW TROUT (ONCORHYNCHUS MYKISS) SELECTED FOR DIVERGENT CORTISOL STRESS RESPONSES [111]BH

EFFETS DU CHOC THERMIQUE SUR LA TRUITE ARC-EN-CIEL (ONCORHYNCHUS MYKISS) SÉLECTIONNÉE POUR UNE DIVERGENCE DANS LES RÉPONSES DE STRESS ASSOCIÉES AU CORTISOL

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To investigate the roles of stress hormones in the heat shock response, I capitalized on two lines of rainbow trout bred for their high (HR) and low (LR) cortisol response to confinement stress. I predicted that LR fish, with a low cortisol but high catecholamine response to stress, would induce higher levels of heat shock proteins (HSPs) after heat stress than HR trout. However, significantly higher catecholamine and cortisol responses to heat stress occurred in HR compared to LR fish, and were accompanied by a more pronounced HSP response. LR fish, with a lower HSP response to heat stress, also showed evidence of greater oxidative protein damage. Despite their distinct physiological and cellular responses to heat shock, HR and LR fish did not differ in thermal tolerance. These findings suggest that cellular responses, like the catecholamine stress response have also been selected during selection for divergent cortisol stress responses.

COST OF BREATHING IN TURTLES: AN INVESTIGATION OF THE METHODS, THEIR ESTIMATES AND CALCULATING THE TRUE COSTS [25]BH

LE COÛT DE LA RESPIRATION CHEZ LES TORTUES: UNE ÉTUDE DES MÉTHODES, LEURS ESTIMÉS ET LES CALCULS DES COÛTS RÉELS

Stella Y Lee and WK Milsom

University of British Columbia

Past studies designed to measure the metabolic cost of breathing in turtles have used different methods and produced very different results. In an attempt to resolve this issue, the present study obtained data using three different methods in a single group of red-eared sliders. All three methods produced highly variable results (individual variability, differences between use of hypoxia and hypercapnia to stimulate breathing), when respiratory drive was

low. We obtained consistent results, however, (a low ventilatory cost of 1 ml oxygen l⁻¹ air ventilated) with two methods using different respiratory gases when respiratory drive was high. There was also evidence, however, suggesting that non-ventilatory metabolism is suppressed by hypercapnia and hypoxia, masking the true cost of breathing. The extent to which this is the case remains to be calculated. Supported by the NSERC of Canada.

OXYGEN EXCHANGE IN THE GOLDENROD BALL GALL IS FACILITATED BY PITH DRYING [40]
L'ÉCHANGE D'OXYGÈNE CHEZ LA GALE DE LA VERGE D'OR EST FACILITÉ PAR LA DÉSHYDRATATION DE LA RÉSINE

Qian Long and GJ Tattersall
Brock University

Gall-producing insects spend a significant part of their life cycle surrounded by plant tissue, which the insect stimulates the host plant to produce. We studied whether living tissue of the goldenrod ball gall (on *Solidago* spp.) may impose hypoxic stress on its inhabitant, the larval *Eurosta solidaginis*, by limiting gas diffusion and directly consuming oxygen. *E. solidaginis* larvae tolerated oxygen levels commonly found in living galls between July and October without showing significant metabolic rate depression. In the gall itself, the pith tissue which takes up much of the gall's volume started drying after the gall reached its full size. Compared to fresh gall tissue surrounding the larva, dry tissue is more permeable to gas exchange and consumes less oxygen. Therefore, we suggest that any potential hypoxic stress is more likely to occur at the beginning of the plant's growth season, and future studies will be conducted to confirm this.

THE INFLUENCE OF FASTING AND REPEAT EXHAUSTIVE EXERCISE ON THE METABOLIC PROFILE OF RAINBOW TROUT (ONCORHYNCHUS MYKISS) [99]
INFLUENCE DU JEÛNE ET DE L'ACTIVITÉ PHYSIQUE INTENSE ET RÉPÉTÉE SUR LE PROFIL MÉTABOLIQUE DE LA TRUITE ARC-EN-CIEL (ONCORHYNCHUS MYKISS)

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This study aimed to determine the effect fasting and the combination of starvation with daily exhaustive exercise would have on a rainbow trout's (*Oncorhynchus mykiss*) ability to mount and recover from a bout of burst exhaustive swimming. Trout were deprived of food and hand chased until exhaustion once a day for 7 days. The fish were then subjected to another bout of exhaustive exercise, and sacrificed immediately after exercise and at 1, 2, and 8 hours into recovery. Glucose, glycogen, lactate, pyruvate ATP, ADP, and AMP concentrations were determined in the white muscle and liver. In addition, plasma glucose and lactate, and white muscle pH_i were also measured. The combination of fasting and exhaustive exercise resulted in significant decreases of glycogen in liver and white muscle along with decreases in lactate production post exercise, and delayed metabolic recovery in white muscle.

ROLE OF MYOGENIC REGULATORY FACTORS IN RESISTANCE TO MUSCLE DISUSE ATROPHY IN ANOXIA TOLERANT TURTLES [63]H
LE RÔLE DES FACTEURS DE RÉGULATION MYOGÉNIQUES DANS LA RÉSISTANCE À L'ATROPHIE DUE À L'INACTIVITÉ MUSCULAIRE CHEZ LES TORTUES TOLÉRANTES À L'ANOXIE

Bryan Luu, KK Biggar and KB Storey
Carleton University

The red-eared slider turtle (*Trachemys scripta elegans*) is a model organism capable of withstanding extreme long-term oxygen deprivation (anoxia). During anoxia exposure, turtles impressively depress metabolic rate by 80-90%. To achieve this, physiological processes, such as muscle contraction, are suppressed to conserve energy. Previous studies have shown that anoxic turtles show significant resistance to hindlimb disuse atrophy during anoxia. To further explore atrophy resistance, this study examined the metabolic adaptations used by turtles to limit muscle catabolism during periods of inactivity. The nuclear localization and total cellular protein expression of myogenic transcription factors, MyoD and Myogenin, were studied as well as downstream structural proteins under their control including troponin I and C, tropomyosin, myosin heavy chain, myosin light chain, and desmin. These muscle-

specific structural proteins displayed differential regulation in red muscle, white muscle and cardiac muscle of turtles under anoxic conditions. This study sheds light on how the anoxic turtle may resist muscle atrophy.

DEVELOPMENT OF AN IN VITRO INFECTION MODEL FOR LOMA MORHUA, A MICROSPORIDIAN PARASITE OF THE ATLANTIC COD, GADUS MORHUA [11]

DÉVELOPPEMENT D'UN MODÈLE D'INFECTION IN VITRO POUR LOMA MORHUA, UN PARASITE MICROSPORIDIDIEN DE LA MORUE DE L'ATLANTIQUE, GADUS MORHUA

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With dwindling fisheries, aquaculture is taking an important role in the provision of fish to global markets. However, growth of aquaculture is constrained by disease outbreaks and high mortalities. Disease progression in commercially important aquacultured species may be better studied *in vitro* where pathogen-host interaction can be more easily dissected. This is especially true with intracellular parasites like the microsporidia which are becoming emerging pathogens of concern. Microsporidia of the genus *Loma* have been shown to inflict high mortalities in aquaculturally important species including the cod, *Gadus morhua*. Attempts to develop in vitro models to study *Loma* infection using salmonid and gadid (cod, haddock) derived cell lines will be presented. Culture conditions for enhancing *Loma morhua* and other microsporidian spores in vitro are presented, including physicochemical characteristics such as temperature, pH, hormonal and nutrient composition. By exploring *Loma* infection processes, the welfare of commercially important aquacultured livestock may be improved.

LEPTIN AND HSP70 IN GREY SEALS: THE EFFECTS OF FEEDING AND FASTING [48]BH

LA LEPTINE ET HSP70 CHEZ LES PHOQUES GRIS: L'IMPACT DE L'ALIMENTATION ET DU JEÛNE

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Mount Allison University

Phocid seals undergo intensive feeding followed by protracted fasting, but their regulation of fat stores and cellular tolerance to fasting are poorly understood. Thus, we investigated expression of leptin, a fat-derived hormone that controls energy expenditure in other animals, and heat shock protein 70 (HSP70) in relation to body size and nutritional state in grey seal tissues. Blubber leptin levels were significantly correlated with body condition, but plasma levels were not. This contrasts with the normally strong relationship between condition and circulating leptin in other mammals. However, plasma leptin was elevated in fed pups compared with fasting or starving animals, suggesting differences between seals and other animals in the role of leptin in fat regulation and appetite. HSP70 levels were also significantly higher in blubber from fed individuals compared with other nutritional states. Feeding seals may thus experience greater cellular stress than when fasting or even

NOVEL HIF-1 REGULATION BY NON-CODING RNA IN MAMMALIAN HIBERNATORS [64]

NOUVELLE RÉGULATION DE HIF-1 PAR DE L'ARN NON CODANT CHEZ LES MAMMIFÈRES HIBERNANTS

Yulia Maistrovski, KK Biggar and KB Storey

Carleton University

Hibernation is an animal adaptation to survive extreme winter cold temperatures. It is characterized by decreased metabolic rate and suppression of all physiological processes. Research has shown that transitions to/from the torpid state are regulated, in part, by the hypoxia inducible transcription factor-1 (HIF-1). A natural antisense transcript (aHIF), whose sequence is strictly complementary to HIF-1alpha subunit mRNA, has been identified in rodents and may potentially act as a regulator of HIF-1alpha translation during torpor. The present study investigated the role of aHIF in regulating hibernation-responsive HIF-1alpha in skeletal muscle and liver of 13-lined ground squirrels (*Spermophilus tridecemlineatus*) and little brown bats (*Myotis lucifugus*). Significant increases in HIF-1alpha mRNA transcript levels were found in bat muscle during torpor, along with increased protein levels. Oppositely, aHIF transcript levels decreased in the bat muscle tissue, suggesting release of its inhibitory function in HIF-1alpha translation during torpor.

THE CHRONIC EFFECTS OF TITANIUM DIOXIDE NANOPARTICLES ON HYALELLA AZTECA [76]H
LES EFFETS CHRONIQUES DES NANOPARTICULES DE DIOXYDE DE TITANE SUR HYALELLA AZTECA
Gurkirpal Malhi and J McGeer
Wilfrid Laurier University

The goal of this research is to contribute towards the understanding of the potential for nanoparticles (NPs) to cause environmental impacts by comparing the relationship between particle characteristics and chronic effects. Chronic (28 d) toxicity tests (water hardness of 40 mg l⁻¹CaCO₃) followed Environment Canada methods. Exposure concentrations ranged from 1 - 100 mg l⁻¹TiO₂ NPs that had been sonicated. *Hyalella azteca* were exposed to uncoated TiO₂ NPs that had average diameter of 7nm, 20nm, 22nm, 25nm, yielding IC₅₀ values for growth effects of 23.0 ± 2.6, 42.4 ± 6.9, 16.6 ± 4.4, and 24.9 ± 2.7 mg Ti l⁻¹ respectively. IC₅₀ values for 20nm particles with a hydrophobic surface coating was 44.8 ± 2.5 while those with a hydrophilic coat was 12.9 ± 1.1 mg Ti l⁻¹. The IC₅₀ for dissolved ionic forms of Ti was 1.9 ± 0.26 mg l⁻¹. This research is funded by the NRC-NSERC-BDC Nanotechnology Initiative.

PEPTIDE YY INHIBITS ENERGY INTAKE AND PROMOTES FAT UTILIZATION IN RATS [50]BH
LE PEPTIDE YY INHIBE L'APPORT ÉNERGÉTIQUE ET FAVORISE L'UTILISATION DES GRAISSES CHEZ LES RATS
Chishuvo Mandivenga and S Unniappan
York University

Peptide YY 3-36 (PYY3-36) is a gut hormone known to reduce food intake. Previous studies have shown that co-infusion of leptin extends the anorectic effects of PYY. We determined the metabolic effects of PYY3-36 alone or PYY3-36 and leptin in male Fisher 344 rats. Subcutaneous infusion of PYY3-36 (100 µg kg⁻¹ body wt day⁻¹) for one day using osmotic mini-pumps decreased respiratory exchange ratio and average volume of oxygen and carbon dioxide during the dark phase in *ad libitum* fed rats. Respiratory quotient was decreased. A marked increase in fat utilization and a decrease in carbohydrate usage were observed. These changes were accompanied by significantly lower cumulative food intake. However, infusion of sub-anorectic doses of leptin alone or co-infusion of leptin with PYY3-36 did not produce significant changes in whole-body metabolism. Currently, the mechanisms that mediate the metabolic effects of PYY3-36 are being investigated.

FLIGHT AND FATTY ACID UTILISATION: LIPID PROFILES OF THE TRUE ARMYWORM (PSEUDALETIA UNIPUNCTA) UNDER MIGRATION CONDITIONS [22]
VOL ET UTILISATION DES ACIDES GRAS: PROFILS LIPIDIQUES DE LA LÉGIONNAIRE UNIPONCTUÉE (PSEUDALETIA UNIPUNCTA) DANS DES CONDITIONS DE MIGRATION
Angela Marinas and J McNeil
University of Western Ontario

The true armyworm, *Pseudaletia unipuncta*, a sporadic agricultural pest is a migratory species in North America. Migration is initiated in response to short days and low temperatures that are cues of future habitat deterioration. Sustained migratory flight requires a substantial amount of energy, in the form of fatty acids (FAs), including the essential fatty acids that are only acquired during larval development. However, any essential FAs used during migratory flight will be at a cost to future reproductive success, as these are important for oogenesis. The current study, part of a longer project examining adaptations that may reduce costs of migration on reproduction, was designed to test the hypothesis that adults allocate and release lipids differentially when reared and flown under summer and fall conditions.

COLD SHOCK INHIBITION OF ION TRANSPORT REGULATION IN THE EURYHALINE TELEOST FISH, FUNDULUS HETEROCLITUS: EVIDENCE FOR CFTR ANION CHANNEL METABOLON [84]
INHIBITION DE LA RÉGULATION DU TRANSPORT IONIQUE DUE AU CHOC THERMIQUE FROID CHEZ LE POISSON TÉLÉOSTÉEN FUNDULUS HETEROCLITUS: UN INDICE POUR LE MÉTABOLON DU CANAL ANIONIQUE CFTR
WS Marshall, EM Osmond, GW Hosier and RRF Cozzi
St Francis Xavier University

Salt secretion by mitochondria rich (MR) cells of the gills and opercular epithelia of *Fundulus heteroclitus* is regulated by osmotic changes via a complex pathway involving Integrin alpha/beta as a volume sensor, Focal Adhesion Kinase (FAK) and CFTR anion channels in the apical membrane of MR cells. FAK and CFTR structurally colocalize in the apical membrane, but to determine if they are functionally linked, tissues were cold shocked to various extents and tested for sensitivity to hypotonic shock. Above 10°C hypotonic shock reversibly inhibited chloride secretion (as I_{sc}), accompanied by dephosphorylation of FAK pY407. Below 10°C (5.0 and 2.5°C), I_{sc} was totally insensitive to hypotonic shock and FAK pY407 remained phosphorylated. In the cold shocked tissue, without homeoviscous adaptation, lipid bilayers are in a gel state, which we imply uncouples the (remote) volume sensor from the closely linked FAK/CFTR metabolon. Supported by NSERC.

DEVELOPMENT IN HYPOXIA AND PLASTICITY IN LIZARDS [91]H

DÉVELOPPEMENT EN CONDITION D'HYPOXIE ET PLASTICITÉ CHEZ LES LÉZARDS

Diane E Massey and GJ Tattersall

Brock University

While it has been shown that incubation temperature affects both reptile morphology and physiology during development and post-hatching stages, the effects of hypoxia during incubation are not well known. Reptile eggs are often incubated in underground nests and are subject to the environment of the nest. With no new oxygen entering the underground nest, oxygen levels likely decrease throughout development due to the growing embryos increased metabolism. By incubating eggs in chronic hypoxia we have been able to study these effects on development, temperature preference, and sprint speed in the agamid lizard, *Pogona vitticeps*. We have found that incubation length in hypoxia increases as does hatchling size. Hatchlings incubated in hypoxia also show a cooler temperature preference and faster sprint speed. These results indicate that oxygen levels play an important role during development and demonstrates the plasticity of these traits.

NITRIC OXIDE SIGNALLING IS DIFFERENTIALLY INVOLVED IN THE GONADOTROPIN-RELEASING ACTIONS OF TWO NATIVE GONADOTROPIN-RELEASING HORMONES IN GOLDFISH [58]BH

LA SIGNALISATION DU MONOXYDE D'AZOTE EST IMPLIQUÉE DIFFÉRENTIELLEMENT DANS L'ACTION LIBÉRATRICE DE GONADOTROPINE DE DEUX HORMONES ENDOGÈNES DE GONADOLIBÉRINE CHEZ LE POISSON ROUGE

Amanda Meints and JP Chang

University of Alberta

Nitric oxide (NO) synthase (NOS) immunoreactivity has been detected in goldfish pituitary gonadotropes. This study examined whether the NOS/NO pathway mediates maturational gonadotropin (GTH-II) release responses to two native gonadotropin-releasing hormone isoforms in goldfish: sGnRH and cGnRH-II. Application of three NOS inhibitors, aminoguanidine hemisulfate, 1400W and 7-nitroindazole, as well as two NO scavengers, PTIO and rutin hydrate, reduced sGnRH-induced, but not cGnRH-II-elicited, GTH-II secretion from dispersed goldfish pituitary cells in column perfusion. Co-application of cGnRH-II with the NO donor, sodium nitroprusside (SNP), caused additive increases in GTH-II release but co-application of sGnRH and SNP did not. These results indicate that sGnRH, but not cGnRH-II, uses the NOS/NO pathway to stimulate GTH-II release. These findings also add to known differences in intracellular signalling utilized by sGnRH and cGnRH-II in stimulating GTH-II release (funded by NSERC).

REGULATION OF OVARIAN PROSTAGLANDIN SYNTHESIS IN THE ZEBRAFISH: ACTIONS OF GONADOTROPIN, 17ALPHA, 20BETA-DIHYDROXY-4-PREGNEN-3-ONE AND INSULIN-LIKE GROWTH FACTOR-1 [59]BH

RÉGULATION DE LA SYNTHÈSE DE PROSTAGLANDINE OVARIENNE CHEZ LE POISSON ZÈBRE: ACTIONS DE LA GONADOTROPINE, 17-ALPHA, 20-BÊTA-DIHYDROXY-4-PREGNE-3-ONE ET FACTEUR DE CROISSANCE-1 ANALOGUE À L'INSULINE (IGF-1)

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University of Guelph

Oocyte maturation and ovulation are sequential events leading to the release of an oocyte that is ready to be fertilized. Oocyte maturation in the zebrafish (*Danio rerio*) is mediated by the maturation inducing steroid 17 α , 20 β -dihydroxy-4-pregnen-3-one (17,20 β -P) and the insulin-like growth factor (IGF) system. Ovulation is mediated by prostaglandins, which are synthesized by the enzymes phospholipase A2 (cPLA2) and cyclooxygenase 2 (COX-2). Using *in vitro* methods, this study aimed to determine if 17,20 β -P and IGF-1 also play a role in ovulation by mediating prostaglandin production in full grown zebrafish ovarian follicles. Addition of 17,20 β -P caused an increase in cPLA2 (cpla2) gene expression, whereas IGF-1 increased both cPLA2 and COX-2 (ptgs2) gene expression. Both 17,20 β -P and IGF-1 induced PGF2 α production. Furthermore, the effects of IGF-1 on gene expression and prostaglandin production were enhanced when combined with the gonadotropin analog human chorionic gonadotropin (hCG). These results suggest that the regulation of ovulation through the arachidonic acid pathway involves the coordinated actions of multiple hormones.

THE IMPACT ON THE STRESS RESPONSE OF EXPOSING EMBRYONIC AND ADULT ZEBRAFISH (DANIO RERIO) TO THE BETA-BLOCKER PROPRANOLOL [77]

L'IMPACT DE L'EXPOSITION AU BÊTA-BLOQUEUR PROPRANOLOL SUR LA RÉPONSE AU STRESS CHEZ DES POISSONS ZÈBRES EMBRYONNAIRES ET ADULTES

Kimberly Mitchell and TW Moon

University of Ottawa

Human pharmaceuticals and personal care products (PPCPs) are now considered to be emerging contaminants due to their increased usage, pseudopersistence and bioactivity. In this study the beta-blocker propranolol (PROP) is used as an example of such PPCPs. The concentration of PROP in wastewater and surface waters is reported at 1.9 $\mu\text{g l}^{-1}$ and 0.59 $\mu\text{g l}^{-1}$, respectively. This study tests the hypothesis that PROP exposure during development will alter gene expression of beta-ARs in zebrafish and as a result this drug will act as an endocrine disrupting chemical to modify the ability of zebrafish to respond appropriately to a standardized stress. Various components of the stress response in zebrafish will be examined after exposure to PROP. Cortisol and mRNA levels of stress-related proteins as well as energy fuels including carbohydrates and lipids will be assessed in control and exposed zebrafish. This work is supported by a grant from NSERC.

DIFFERENTIAL EXPRESSION OF NESFATIN-1 IN SPRAGUE-DAWLEY RAT TISSUES DURING DEVELOPMENT [51]

EXPRESSION TISSULAIRE DIFFÉRENTIELLE DE NESFATINE-1 AU COURS DU DÉVELOPPEMENT CHEZ LE RAT SPRAGUE DAWLEY

Haneesha Mohan and S Unniappan

York University

Nesfatin-1 is a novel metabolic peptide encoded in the precursor protein, nucleobindin-2 (NUCB2). We, for the first time, studied NUCB2 during the development of Sprague Dawley rats. Nesfatin-1 immunoreactivity was abundant in islet beta cells of adults, but at embryonic day 21 and postnatal days 1 and 6, only a small number of islet cells were nesfatin-1 immunopositive. Nesfatin-1 immunoreactivity was found in the stomach from postnatal day 13 to 27, but was relatively less in embryonic day 21 to postnatal day 6. We found colocalization of nesfatin-1 with prohormone convertases 1 and 2 in the pancreatic islets of adult rats, but not in the embryonic or post-natal islets. Plasma nesfatin-1 levels increased with age, reaching adult levels at postnatal day 27. Collectively, NUCB2 mRNA expression and serum nesfatin-1 levels gradually increased during development. These results suggest that nesfatin-1 has age- and tissue-specific roles in the developmental physiology of rats.

PERFORMANCE TRADE-OFFS AND ENERGY UTILIZATION IN NEURAL CIRCUITS FOLLOWING METABOLIC STRESS [41]

COMPROMIS DE PERFORMANCE ET UTILISATION DE L'ÉNERGIE DANS LES CIRCUITS NEURAUX SUITE À UN STRESS MÉTABOLIQUE

Tomas GA Money, EJ Pollock, K Inozemtsev and RM Robertson

Queen's University

Nervous systems are energetically expensive to maintain. Action potentials in particular require a significant investment to maintain ion homeostasis. It would be adaptive to reduce energy utilization when under metabolic stress. We have tested the hypothesis that severe metabolic stress alters the properties of neural circuits in ways that reduce the energetic demand. The locust, *Locusta migratoria*, was used to study recovery of neural activity following an anoxic coma. Neural function was monitored using the visual looming detector circuit, namely the descending contralateral movement detector (DCMD). We show that the observed anoxic effects on measures of metabolic rate, flight steering behaviour, and AP properties were modifiable through modulation of the AMPK metabolic pathway. We suggest this is evidence of a coordinated cellular mechanism to reduce neural energetic demand following a severe metabolic stress.

THE METABOLIC COST OF ELECTRIC SIGNALLING IN A WEAKLY ELECTRIC FISH [100]
COÛTS MÉTABOLIQUES DU SIGNALISATION ÉLECTRIQUE CHEZ LES POISSONS FAIBLEMENT ÉLECTRIQUES

Mayron Moorhead, KM Gilmour, SF Perry and JE Lewis
University of Ottawa

Wave-type weakly electric fish emit a highly regular electric discharge using a specialized electric organ. This electric organ discharge (EOD) forms the basis for an electric sense used for navigation, prey detection and communication. The metabolic cost of the EOD is not fully understood, but recent research suggests that it constitutes a significant portion of the fish's energy budget. In the current study, manipulation of metabolic rate via exposure to hypoxia did not significantly alter EOD frequency. Changes in metabolic rate through swimming resulted in EOD frequency increase. To manipulate EOD frequency directly in individual fish, the jamming avoidance response (JAR) and long term frequency elevation (LTFE) were used. EOD frequency elevation and jamming stimulation resulted in an increased MO_2 possibly associated with increases in sensory processing. Taken together, these data indicate that electric signaling in wave-type weakly electric fish is not a major contributor to whole-animal energetic cost. (Funded by NSERC)

DO PARASITES MIX? WATER MITE AND GREGARINE COINFECTION IN LESTID DAMSELFLIES [12]B

LES PARASITES SE MÉLANGENT-ILS? COINFECTION D'HYDRACHNES ET DE GRÉGARIENS CHEZ LES DEMOISELLES LESTIDES

André W Morrill, MR Forbes and JJ Mlynarke
Carleton University

Host populations are commonly infected by multiple parasites. It is important to determine whether studies which limit observations to a single subset or species within that population should control for covariation between inspected and unobserved patterns of infection. In this study, prevalence and intensity of ectoparasitic water mites and endoparasitic gregarines of lestad damselfly species, *Lestes disjunctus* and *L. forcipatus*, were analyzed for covariance. Calculated expected frequencies of coinfection based on individual prevalences did not differ significantly from observed frequencies. Simulation models demonstrated that the typically L-shaped distributions of sample mite and gregarine intensities plotted together is the expected outcome based on the aggregated distributions of parasite populations among hosts. Little to no natural variation in parasitism of either the mites or gregarines is explained by the presence or intensity of an infection by the other, providing further evidence in defence of the damselfly-water mite study system for parasitological research.

ALLOMETRIC SCALING OF MUSCLE METABOLIC ENZYMES IN MAMMALS [101]
ÉCHELONNAGE ALLOMÉTRIQUE DES ENZYMES MÉTABOLIQUES MUSCULAIRES CHEZ LES MAMMIFÈRES

CD Moyes, CE Genge and KM Kocha
Queen's University

Are the transcriptional mechanisms that control mitochondrial content in an individual - PGC1alpha (PGC1a) and NRF1- also responsible for interspecies differences? We explored the origins of allometric scaling of cytochrome

oxidase (COX) activities in muscles from 12 rodents differing 1000-fold in mass. Muscle COX scaling patterns ranged from isometric (soleus) to allometric (tibialis anterior). In tibialis anterior, there was no significant scaling relationship in mRNA g^{-1} for COX4-1, PGC1a or NRF1 yet COX4-1 mRNA g^{-1} predicted COX activity, PGC1a and NRF1 mRNA correlated with each other, and both predicted COX4-1 mRNA and COX activity. Multivariate analysis explained 90% of COX variation between species, about equally partitioned between mass effects and mass-independent effects on PGC1 mRNA. PGC1 proximal promoters (50 mammals) showed no mass-linked differences in regulatory elements or reporter gene activities. Collectively, transcriptional regulation via PGC1a does not account for scaling patterns, though it does explain most of the mass-independent differences between species. Funded by NSERC Canada.

FORELIMB MORPHOLOGY OF A FOSSIL STEM PINNIPED, *PUIJILA DARWINI*, FROM THE CANADIAN HIGH ARCTIC [3]

*MORPHOLOGIE DES PATTES ANTÉRIEURES D'UN PINNIPÈDE FOSSILE (*PUIJILA DARWINI*) DE L'EXTRÊME ARTIQUE CANADIEN*

Joanna M Northover¹, NR Rychynski^{2*}, C Schröder-Adams¹

¹Carleton University; ²Canadian Museum of Nature

Puijila darwini, a fossil carnivore discovered on Devon Island, Nunavut, has been identified as a stem pinniped (seals, sea lions and walrus) and to be related to the Oligocene taxon *Potamotherium vallentoni*. Its lack of flippers, retention of terrestrial limb proportions, and a long tail differentiate *Puijila* from extant pinnipeds. A comparative description of the forelimb of *Puijila* has identified some possibly phylogenetically informative characters and its many swimming specializations. The forelimb skeleton of *Puijila* appears to be adapted to provide powerful forward and recovery strokes during swimming. The morphology of the proximal forelimb elements suggests the limb was used differently than those of modern otters, perhaps for quadrupedal paddling. As *Puijila* is a morphological intermediate between modern pinnipeds and their terrestrial ancestors further understanding its swimming behaviour could provide insight into the group's early land-to-sea evolution.

LINKING CHRONIC EFFECTS OF WATERBORNE CADMIUM ON *LYMNAEA STAGNALIS* AND *HYALELLA AZTECA* [79]

*EFFETS CHRONIQUES DU CADMIUM DANS L'EAU SUR *LYMNAEA STAGNALIS* ET *HYALELLA AZTECA**

Nish M Pais and J McGeer

Wilfrid Laurier University

The tissue residue approach (TRA) conventionally links the toxic effects of a contaminant to its bioaccumulation within a species. However, for metals the TRA approach generally does not work due to essentiality, natural background and detoxification. This study develops an alternative TRA by linking Cd bioaccumulation in *Lymnaea stagnalis* with impacts to *Hyalella azteca*. Chronic (28 d) exposures in moderately hard or soft water (80 or 20 mg l^{-1} CaCO_3) with survival, bioaccumulation and growth (weight and shell length for *Lymnaea* and dry weight for *Hyalella*) as endpoints. Exposure concentrations ranged from 0.4 to 6.4 $\mu\text{g l}^{-1}$ Cd. In soft water, *Hyalella* were very sensitive to the effects of Cd, while *Lymnaea* were not impacted but bioaccumulated in a reliable dose dependent manner. A tissue burden of 49 $\mu\text{g g}^{-1}$ Cd in *Lymnaea* was associated with an LC_{50} in *Hyalella*. Supported by the NSERC Strategic Program and Rio Tinto Alcan.

DIFFERENTIAL INVOLVEMENT OF PHOSPHOINOSITIDE 3-KINASE IN ENDOGENOUS GONADOTROPIN-RELEASING HORMONE SIGNALLING IN GOLDFISH PITUITARY GONADOTROPHS AND SOMATOTROPHS [57]H

PARTICIPATION DIFFÉRENTIELLE DE LA PHOSPHOINOSITIDE 3-KINASE DANS LA SIGNALISATION ENDOGÈNE DE LA GONADOLIBÉRINE DANS LES CELLULES GONADOTROPHES ET SOMATOTROPHES PITUITAIRES DU POISSON ROUGE

Joshua G Pemberton, JL Stafford, Y Yu and JP Chang

University of Alberta

In goldfish, *Carassius auratus*, two endogenous gonadotropin-releasing hormones (sGnRH and cGnRH-II) control

maturational gonadotropin (LH) and growth hormone (GH) secretion via Ca^{2+} -dependent signalling pathways. We investigated whether phosphoinositide 3-kinase (PI3K) mediates GnRH-stimulated LH and GH release and associated intracellular Ca^{2+} increases ($[\text{Ca}^{2+}]_i$) in identified goldfish pituitary somatotropes and gonadotropes. Both GnRHs increased phosphorylation of immunoreactive PI3K p85 α , the regulatory subunit for PI3K, in excised pituitary fragments. Two selective PI3K inhibitors attenuated GnRH-elicited LH and GH release and selectively reduced $[\text{Ca}^{2+}]_i$ responses to GnRH (sGnRH on LH cells; cGnRH-II on LH and GH cells), but had no effect on ionomycin-evoked LH and GH secretion. These results indicate that PI3K is involved upstream of $[\text{Ca}^{2+}]_i$ increases in mediating LH and GH responses in a cell- and GnRH isoform-specific manner. (Supported by NSERC)

A-SALTED STURGEON: ACUTE EFFECTS OF SALTWATER EXPOSURE IN JUVENILE SHORT-NOSE STURGEON [87]BH

UN ESTURGEON SALÉ : EFFETS AIGUS DE L'EXPOSITION À L'EAU SALÉE CHEZ DES ESTURGEONS À MUSEAU COURT JUVÉNILES

Faith Penny and JD Kieffer

University of New Brunswick Saint John

This study focused on the acute physiological responses to saltwater exposure in juvenile shortnose sturgeon. Adult shortnose sturgeon routinely enter saltwater to forage, yet little is known about how (or if) juveniles cope with the associated osmoregulatory pressures. In three laboratory experiments, juvenile shortnose sturgeon were exposed to either full or half-strength seawater for up to 24 hours. First, oxygen consumption rates were used to estimate metabolic costs. Second, blood samples were analyzed for the stress hormone cortisol, as well as various measures of osmoregulatory status, oxygen carrying capacity and energy use. Finally, critical swimming speed tests will be used to determine whether salinity affects performance ability. These experiments integrate haematological (cortisol and other blood parameters) metabolic (oxygen consumption) and performance (critical swimming) responses to a range of salinities that could be encountered in nature.

EFFECTS OF SILVER NANOPARTICLES ON EXPRESSION OF OXIDATIVE STRESS AND REPRODUCTION-RELATED GENES IN GOLDFISH HEPATOCYTES [80]B

EFFETS DES NANOPARTICULES D'ARGENT SUR L'EXPRESSION DE GÈNES LIÉS AU STRESS OXYDATIF ET À LA REPRODUCTION DANS DES HÉPATOCYTES DE POISSON ROUGE

David Poisson Paré, R Hafizi, TW Moon and VL Trudeau

University of Ottawa

Increasing studies of silver nanoparticles (nano-Ag) report DNA damage, inflammation, and cellular necrosis in different tissues and organisms following exposure, however, few focus on changes in gene expression. Consequently, the objective of this study is to examine the changes in transcription of oxidative stress-related genes caused by nano-Ag in goldfish primary hepatocyte cultures in order to measure its potential hepatotoxic properties. In addition, since fish hepatocytes are also involved in synthesizing vitellogenin, an estrogen-regulated protein, it is appropriate to investigate the effect of nano-Ag on the estrogen signalling pathway as measured by vitellogenin and estrogen-receptor transcription. Using real-time PCR, results to date show little or no effects of nano-Ag on the estrogen pathway in goldfish hepatocytes. However, changes in the expression of certain oxidative stress markers (e.g. catalase and glutathione reductase) were observed. The preliminary data illustrate the need for further studies - namely microarray - for identifying mechanisms of nano-Ag toxicity.

SEX HORMONE-BINDING GLOBULIN AS A PORTAL FOR SELECTIVE ENVIRONMENTAL CONTAMINANT UPTAKE [81]

LA GLOBULINE DE LIAISON D'HORMONES SEXUELLES COMME PORTE D'ENTRÉE POUR DES CONTAMINANTS ENVIRONNEMENTAUX SÉLECTIFS

Jason T Popesku and GL Hammond

University of British Columbia

Non-steroidal anti-inflammatory drugs (NSAIDs) have been found to bioaccumulate in the gill and bile of fish. Our laboratory has previously shown in zebrafish that sex hormone-binding globulin (SHBG) protein is found in

the bile duct as well as in the gill, where it acts as a portal for chemical uptake from the environment. With these observations, we hypothesized that NSAIDs, although designed not to bind to human SHBG, are capable of binding to fish SHBG. Radioligand binding assay of fathead minnow, coho salmon, European seabass, and human serum were assessed for their ability to bind ibuprofen or naproxen competitively against endogenous radiolabelled steroid. The results indicate that fathead minnow SHBG and coho salmon SHBG- α bind both NSAIDs in the micromolar range, but SHBGs for seabass, coho (beta isoform), or human do not bind. These results provide a mechanism for the differential sensitivity of fish to environmental contaminants. Supported by NSERC-Discovery.

METABOLIC RATE SUPPRESSION AND HYPOXIA TOLERANCE IN ZEBRAFISH [102]

SUPPRESSION DU TAUX MÉTABOLIQUE ET TOLÉRANCE À L'HYPOXIE CHEZ LE POISSON ZÈBRE

Matthew D Regan, JM Gosline and JG Richards

University of British Columbia

Problems in energy supply and demand arise from exposure to hypoxia. There are three main ways an organism can maintain energy balance under these conditions: 1, extract what environmental oxygen is available; 2, activate oxygen-independent mechanisms of energy production; 3, decrease the rate of cellular energy consumption (metabolic rate suppression). There is a strong correlation between hypoxia tolerance and variation in the first two of these traits, suggesting adaptation; however, owing to a paucity of studies on only a few species, one cannot comment on hypometabolism as an adaptation to hypoxia survival. The present study aims to address this by gauging the hypoxia-induced metabolic responses of closely related species of zebrafish. Furthermore, it employs the seldom-used method of calorimetry, which, unlike respirometry, allows for the direct quantification of total metabolic rate through the cumulative measurement of both aerobic and anaerobic processes.

THE EFFECT OF ENVIRONMENTAL TEMPERATURE ON METABOLIC RATE AND THERMO-REGULATION IN THE BUMBLEBEE BOMBUS IMPATIENS [103]BH

EFFETS DE LA TEMPÉRATURE ENVIRONNEMENTALE SUR LE TAUX MÉTABOLIQUE ET LA THERMORÉGULATION CHEZ LE BOURDON BOMBUS IMPATIENS

Bénédicte A Rivière and C-A Darveau

Université d'Ottawa

How organisms cope with temperature fluctuations has been and remains a central effort in animal physiology. Metabolic latitudinal compensation has been observed in many groups of aquatic ectotherm poikilotherms; organisms living in colder climates (e.g. higher latitudes) show a higher metabolic rate when measured at similar temperature, to compensate for the effects of cold temperature. Less is known for terrestrial species, which have to cope with more frequent and faster thermal changes than aquatic species. We performed a temperature acclimation experiment, in order to assess if metabolic thermal compensation is exhibited in the bumblebee *Bombus impatiens*. Unexpectedly, no metabolic compensation (flight metabolic rate and resting metabolic rate) has been observed. In fact, thermographic measurements of the nests showed that bumblebees seem to cope with cold temperatures by adjusting the whole hive behaviour. Similarly, a field data collection showed no differences in flight metabolic rate of bumblebee populations from different latitudes.

EFFECT OF METABOLIC RATE ON EE2 UPTAKE IN FUNDULUS HETEROCLITUS [82]B

L'EFFET DU RYTHME MÉTABOLIQUE SUR L'APPORT DE EE2 CHEZ FUNDULUS HETEROCLITUS

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¹McMaster University; ²Wilfrid Laurier University

The aim of this study was to determine whether metabolic rate influences 17 α -ethynylestradiol (EE2) uptake in *Fundulus heteroclitus*, potentially via a similar mechanism as oxygen uptake. EE2 – the major component of birth control – cannot be fully broken down by sewage treatment, resulting in varying background water levels. Male *F. heteroclitus* were exposed to 100 ng l⁻¹ radio-labeled [³H]EE2 for 2 hours while swimming at 0, 15, and 40 cm s⁻¹, and oxygen consumption (MO₂) and EE2 accumulation were measured. A positive correlation between MO₂ and EE2 accumulation was seen (R²=0.974), and more EE2 was taken up during the 40 cm s⁻¹ swim than the lower

swim speeds, meaning that oxygen uptake is indeed a predictor of EE2 uptake in *F. heteroclitus*. EE2 tended to accumulate in the liver (where toxicants are metabolized), the gall bladder (where metabolized toxins enter bile), and the gut (where bile is dumped) (NSERC Strategic Grant, D. MacLachy, P.I.).

PARASITISM, MERCURY CONTAMINATION AND STABLE ISOTOPES IN CORMORANTS [13]

PARASITISME, CONTAMINATION AU MERCURE ET ISOTOPES STABLES CHEZ LES CORMORANS

Stacey A Robinson¹, MR Forbes¹ and CE Hebert²

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Contaminants and parasitism have been positively related in free-ranging birds. One proposed explanation is that contaminants reduce host immunity resulting in a greater susceptibility to parasitism. However, alternative explanations should be addressed to further inform and test hypotheses about relationships between contaminants and parasitism. We investigated whether total mercury and *Contracaecum* spp. were related in double-crested cormorants *Phalacrocorax auritus* and whether there was support for contaminants and infective stages of parasites being co-ingested. Males had 1.5 times more total mercury in breast muscle than did females and > 2 times more *Contracaecum* spp. (nematodes). Different males were responsible for the two sex biases hence separate explanations for each pattern were required. Males tended to forage in more pelagic areas, as determined by stable carbon isotope signatures. Sex biases in parasitism but not mercury concentration could be explained by sex differences in use of foraging habitats in two lake ecosystems.

HYPOTHERMIA PROTECTS THE NERVOUS SYSTEM FROM REPETITIVE SPREADING DEPRESSION IN DROSOPHILA [42]BH

L'HYPOTHERMIE PROTÈGE LE SYSTÈME NERVEUX CONTRE LA PROPAGATION RÉCURRENTÉ DE LA DÉPRESSION CHEZ LA DROSOPHILE

EC Rodriguez and RM Robertson

Queen's University

Oxygen deprivation in nervous tissue induces spreading depression (SD) manifest as a slowly propagated wave of depolarization with electrical silence and an increase in extracellular potassium concentration ($[K^+]_o$). We examined the effect of temperature on the deleterious consequences of repetitive SD by measuring the loss of ion homeostasis in the brains of male and female *Drosophila melanogaster* during repeated bouts of anoxia induced by nitrogen gas (2.5 mins on, 4 mins off for 1.4 hours). Temperature was maintained at 16°C, 23°C or 30°C using a Peltier plate while $[K^+]_o$ was measured in the brain using K^+ -sensitive microelectrodes. Repetitive anoxia resulted in a loss of the ability to maintain baseline $[K^+]_o$ at ~10 mM. Hyperthermia (30°C) exacerbated this whereas hypothermia (16°C) stabilized baseline $[K^+]_o$ for the duration of the experiment. We suggest this system is a useful model for examining deleterious consequences of peri-infarct depolarizations associated with stroke.

CORRELATION BETWEEN MEMBRANE COMPOSITION, BODY SIZE AND THERMOREGULATORY CAPACITY: THE CASE OF TROPICAL AND NORTH-AMERICAN BEES [104]B

CORRÉLATION ENTRE LA COMPOSITION MEMBRANAIRE, LA TAILLE CORPORELLE ET LA CAPACITÉ THERMORÉGULATOIRE : LE CAS DES ABEILLES TROPICALES ET NORD-AMÉRICAINES

Enrique Rodriguez, J-M Weber and C-A Darveau

University of Ottawa

The basis for the variation of metabolic rate among animals is subject of debate, recent studies pointing to the lipid composition of cellular membranes as a key component. As such, it was shown that vertebrates with higher mass-specific metabolic rates have membranes containing more polyunsaturated fatty acids (PUFA). However, whether this relationship among vertebrates of drastically different sizes stands for invertebrates remains unknown. We have tested this membrane 'pacemaker' theory by quantifying flight muscle membrane lipid composition of 26 species of Panamanian orchid bees with a 20-fold variation in size and found that the same relationship applies to these invertebrates. Moreover, due to their ability to operate at very different temperatures and the relative plasticity of membranes, we are currently testing the link between thermoregulatory capacities and membrane lipid composition in North American bees.

ANTIAPOPTOTIC SIGNALING AS A CYTOPROTECTION MECHANISM DURING MAMMALIAN HIBERNATION [65]

LA SIGNALISATION ANTI-APOPTOTIQUE COMME MÉCANISME DE CYTOPROTECTION LORS DE L'HIBERNATION DES MAMMIFÈRES

Andrew Rouble, ST Tessier and KB Storey
Carleton University

Apoptosis (programmed cell death) is an essential natural biological process. A synergy between proapoptotic and antiapoptotic proteins, interacting at several signalling crossroads determines a cell's commitment to mitochondria-activated apoptosis. We proposed that changes in expression of antiapoptotic proteins may aid cytoprotection during hibernation of thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*) to cope with events including low body temperatures, changes in metabolic requirements, ischemia-reperfusion, muscle disuse, etc. Immunoblotting was used to analyze expression of proteins associated with apoptosis in three tissues. In brown adipose Bcl-2, cIAP and xIAP decreased significantly during torpor (compared with euthermia) whereas p-Bcl-2 (Thr 56), p-Bcl-2 (Ser 70), Bcl-XL, Bcl-3, Mcl-1, and BI-1 were unaltered. In skeletal muscle only xIAP levels were altered during hibernation. In heart, most proteins increased significantly, except for Bcl-XL (significant decrease) and xIAP/BI-1 (unchanged). The data show that antiapoptotic pathways have organ-specific responses in hibernators with a prominent potential role in heart.

INFLUENCE OF DIFFERENTIAL DIETS ON THE GROWTH OF JUVENILE LEOPARD GECKOS (EUBLEPHARIS MACULARIUS) [7]

L'INFLUENCE DE DIÈTES DIFFÉRENTIELLES SUR LA CROISSANCE DE GECKOS LÉOPARDS JUVÉNILES (EUBLEPHARIS MACULARIUS)

Anthony P Russell and SE Hynes
University of Calgary

Caudal autotomy, or voluntary tail loss, is widespread among lizards and is assumed to function in predator escape. Various impacts and costs are associated with tail loss and subsequent regeneration; however, the consequences for juveniles are not well understood. Caudal autotomy and regeneration are likely to occur relatively early in life, before sexual maturity is attained; therefore, energy may be diverted from general body growth into tail regeneration. Constraining caloric intake during growth and regeneration may impact the rate of, and investment in, caudal regeneration following tail removal. However, as no data are available on the amount of food required to promote 'normal' growth (increase in length and mass) in captivity, it is not possible to extrapolate how much to reduce caloric intake before impacting growth rates. In order to determine how a restricted diet affects 'normal' growth, experiments were conducted to determine 1) the caloric intake that represents satiation (an ad libitum diet) for young leopard geckos, and 2) the levels of dietary restriction that impact growth - thus demonstrating an energetic challenge to the individual. Understanding these factors allows us to segregate the effects of caloric intake restriction from those relating to the energetic demands of caudal autotomy.

SEASONAL CHANGES IN THE OSMOREGULATORY CAPACITY OF PINK SALMON (ONCORHYNCHUS GORBUSCHA) FOR FRESHWATER ACCLIMATION [89]

CHANGEMENTS SAISONNIERS DANS LA CAPACITÉ OSMORÉGULATOIRE DU SAUMON ROSE (ONCORHYNCHUS GORBUSCHA) POUR L'ACCLIMATATION À L'EAU DOUCE

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The osmoregulatory preparations associated with salmon ocean entry are well studied, but those associated with the freshwater return to spawn are not. This study examined the capacity of seawater acclimated pink salmon (*Oncorhynchus gorbuscha*) to acclimate back to freshwater at four different periods during the summer/fall. One transfer time coincided with the freshwater re-entry of naturally migrating pink salmon from the same population. Freshwater transfers were also performed approximately one and two months prior to, and one month following, their natural migration. During each transfer, pink salmon were moved to freshwater (or seawater control) tanks and individuals were sacrificed after 1, 2, 4, 7 and 14 days. Osmoregulatory status was assessed by determining muscle water content and plasma sodium/chloride. The expression and activity of gill H⁺-ATPase and several isoforms of

Na⁺K⁺-ATPase were also monitored and are discussed in relation to freshwater acclimation.

DOES GENE FLOW IMPEDE ADAPTATION? AN ARTIFICIAL SELECTION DROSOPHILA MODEL
[20]

EST-CE QUE LE FLUX GÉNÉTIQUE ENTRAVE L'ADAPTATION? UN MODÈLE DE SÉLECTION ARTIFICIELLE CHEZ LA DROSOPHILE

Justin P Saindon and BJ Sinclair

University of Western Ontario

Gene flow can limit a species' range from expanding along an environmental gradient by swamping adaptation to stressors at and beyond the current range-edge boundary; however, the threshold above which gene flow inhibits local adaptation in these range peripheral populations remains unknown. I am testing the hypothesis that gene flow modulates the rate of adaptation using laboratory populations of *Drosophila melanogaster* under strong selection for desiccation resistance. I am quantifying the development of desiccation resistance (survival analyses and measurements of bulk water content) in selected populations subject to a gradient of migration from unselected populations. Preliminary results from populations at the extremes of the migration gradient suggest that low levels of gene flow permit local adaptation, whereas high levels of gene flow hinder local adaptation. Yielding an empirical threshold of gene flow that permits local adaptation will likely have substantial ecological implications for the management of pest and vulnerable species.

VARIATION IN THERMAL TOLERANCE AND HYPOXIA TOLERANCE AMONG FAMILIES OF ATLANTIC SALMON [92]

VARIATION DE TOLÉRANCE THERMIQUE ET HYPOXIQUE PARMI DES FAMILLES DE SAUMON DE L'ATLANTIQUE

Patricia M Schulte, RS Dhillon and K Anttila

University of British Columbia

Although theory suggests that temperature and hypoxia tolerance may be functionally linked in fish, most of the empirical evidence supporting this claim is indirect, or comes from comparative studies between species or populations. Here, we examine the potential for correlation between these two traits in 41 families of Atlantic salmon that are part of a long term breeding program for aquaculture. There was substantial variation in both maximum tolerated temperature (assessed as CT_{max}) and hypoxia tolerance (assessed as time to loss of equilibrium at ~10% air saturation) both within and between families of salmon. At the family level, we found that hypoxia tolerance and thermal tolerance were positively correlated; families with high thermal tolerance also had greater tolerance of hypoxia. We are currently examining the biochemical and genetic basis of these traits.

DOMINANCE HIERARCHIES AND pH TOLERANCE OF FOUR STRAINS OF DIPLOID AND TRIPLOID RAINBOW TROUT (ONCORHYNCHUS MYKISS) [119]

HIÉRARCHIES DE DOMINANCE ET TOLÉRANCE AU pH DE QUATRE SOUCHES DE TRUITES ARC-EN-CIEL (ONCORHYNCHUS MYKISS) DIPLOÏDES ET TRIPLOÏDES

Mark A Scott, WA Thompson and JG Richards

University of British Columbia

The goal of this project is to determine why 3n rainbow trout exhibit higher mortalities in the wild when compared with their 2n counterparts. We are currently investigating whether dominance hierarchies form between 2n and 3n varieties of wild and domesticated rainbow trout and whether exposure to an environmental perturbation exacerbates the prevalence of subordination in triploids. Preliminary data suggests that diploids are dominant more often than triploids, but at this point it is not clear if acute exposure to hypoxia or other environmental disturbances affect this relationship. Also, we are measuring pH tolerance by assessing both acute and chronic exposure to current and predicted British Columbia lake alkalinities in 2n and 3n trout. Preliminary data suggests there is a difference in alkalinity tolerance between strains, but not ploidies.

INSIGHTS INTO THE MECHANISM OF REGULATION OF T-TYPE CALCIUM CHANNELS USING THE INVERTEBRATE GENE LCAV3, FROM THE POND SNAIL, LYMNAEA STAGNALIS [37]BH

APERÇUS DES MÉCANISMES DE RÉGULATION DES CANAUX CALCIQUES DE TYPE T AVEC L'UTILISATION DU GÈNE D'INVERTÉBRÉ LCAV3, CHEZ L'ESCARGOT D'EAU DOUCE, LYMNAEA STAGNALIS

Adriano Senatore and JD Spafford

University of Waterloo

T-type voltage-gated calcium channels play key roles in excitable cells. Of significant interest is how T-types are modulated, and how channel surface expression and degradation are regulated. Our work characterizing an invertebrate T-type channel (*Lymnaea stagnalis* Cav3: LCav3) has revealed that some regulatory mechanisms are evolutionarily conserved with vertebrates. We have identified alternative splicing events within the intracellular linker regions of LCav3 that are conserved with vertebrate channels. A large optional exon in the I-II linkers of LCav3 and vertebrate Cav3.1 has negligible effects on steady-state voltage properties and kinetics, but significant effects on channel surface expression. In contrast, a small and highly developmentally regulated optional exon in the III-IV linkers of LCav3, Cav3.1, and Cav3.2 causes strong changes in steady-state properties and kinetics. The invertebrate Cav3 channel is as a new tool to probe the regulation and modulation of T-type calcium channels, whose usefulness is further augmented by the simplicity and tractability of the *Lymnaea* nervous system.

QUANTIFYING INDIVIDUAL VARIATION IN AGGRESSION IN APTERONOTUS LEPTORHYNCHUS: A BEHAVIOURAL SYNDROME APPROACH [15]

QUANTIFIER LA VARIATION INDIVIDUELLE DE L'AGRESSION CHEZ APTERONOTUS LEPTORHYNCHUS: UNE APPROCHE BASÉE SUR LE SYNDRÔME COMPORTEMENTAL

Isabelle Shank, G Hupé and JE Lewis

University of Ottawa

Apteronotus leptorhynchus, a weakly electric fish species, produce a quasi-sinusoidal electric signal that sets up an electric field surrounding their bodies. Electroreceptors distributed on the skin can detect distortions in the field, permitting complex behaviours such as communication, electrolocation and navigation. Transient increases in frequency of the electric signal called chirps are believed to act as aggressive communication signals as their incidence generally increases with the presence of a conspecific or a synthetic playback signal. However, pronounced inter-individual variation in chirp and aggressive responses to playback intruders has been found. A behavioural syndrome approach was taken to quantify individual variation in aggressive behaviour in order to shed light on the relationship between aggression and chirping behaviours. Preliminary data suggest the presence of an aggression-behavioural syndrome in *A. leptorhynchus*. However, future work is needed in order to confirm the nature of the syndrome as well as its plasticity.

IS GHRELIN INVOLVED IN THE REGULATION OF GONADAL FUNCTIONS IN FISH? [52]BH

LA GHRÉLINE EST-ELLE IMPLIQUÉE DANS LA RÉGULATION DES FONCTIONS GONADIQUES CHEZ LES POISSONS?

Erin Shepperd and S Unniappan

York University

Ghrelin is a novel orexigenic peptide proposed to be linking the hypothalamo-pituitary-gonadal (HPG) axis, thus integrating energy balance and reproduction in fish. Our objective was to characterize the reproductive functions, especially the direct gonadal effects of ghrelin in fish. We found ghrelin receptor expression in the ovaries and testes of goldfish and zebrafish. Ghrelin receptor mRNA expression in the ovary and testes was relatively lower during the sexually mature stages of goldfish. Further, incubation with native ghrelin at 10ng ml⁻¹, 50ng ml⁻¹ and 100ng ml⁻¹ concentrations significantly inhibited zebrafish oocyte maturation. Ghrelin also inhibited maturation inducing hormone triggered oocyte development. Overall, our results suggest that the endogenous ghrelin system in the gonads changes during reproductive stages in goldfish. Ghrelin also has an inhibitory role on zebrafish oocyte maturation *in vitro*. Collectively, our results for the first time indicate a direct role for ghrelin in the gonadal biology of fish.

ROLE OF TEMPERATURE ON THE TRANSMISSION AND IMPACT OF A PARASITE TO ITS HOST

[14]B

LE RÔLE DE LA TEMPÉRATURE SUR LA TRANSMISSION ET L'IMPACT D'UN PARASITE SUR SON HÔTE

Kum C Shim and M Forbes

Carleton University

We were interested on the effects an increase in temperature might have on the transmission of a parasite to its second intermediate host. We conducted laboratory experiments to see these effects using the digenean *Ganaecotyla adunca* and its second intermediate host, the amphipod *Corophium volutator*. We measured, under different temperatures, the output of *G. adunca* cercariae from its snail host, the survivorship and swimming activity of the cercariae, the infectivity (penetration success) of the parasite to the amphipod host, and the survivorship of infected hosts. The parasite output was significantly higher at 22°C than at 17°C and 12°C; however, the cercariae survived significantly shorter periods of time and were swimming less at 22°C. The infectivity was not different between 22°C and 17°C, while the survivorship of infected hosts was only significantly shorter to their (non-infected) controls at 12°C and not different on the higher temperature (17°C and 22°C) treatments.

EXPRESSION OF CYTOCHROME P450 AROMATASE IN THE CATFISH, RHAMDIA QUELEN [54]

EXPRESSION DU CYTOCHROME P450 AROMATASE CHEZ LE POISSON CHAT, RHAMDIA QUELEN

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University of Ottawa

Jundia (*Rhamdia quelen*) is a neotropical catfish that shows a high potential for aquaculture in Southern Brazil, due to high growth rate, carcass yield, and reproductive potential. Molecular genetics of jundia requires more attention as it may support animal breeding programs, genetic conservation and understanding of phylogeny. Aromatase plays a central role in the regulation of vertebrate sexual development but has not been characterized in this species. The aim is to characterize and study both brain (AroB) and gonad aromatase (AroA) gene expression. A homology cloning strategy was used to obtain a partial sequence (1047 bp) of AroB. At the nucleotide level it is 88% identical to *Ictalurus punctatus*. The predicted amino acid sequence is between 80 to 91% similar to other teleosts. Ongoing work targets cloning of AroA, and analysis of gene expression in the brain and gonads of both sexes in normal animals and those exposed to xenobiotics.

DIETARY MACRONUTRIENTS REGULATE TISSUE-SPECIFIC MRNA EXPRESSION AND CIRCULATING LEVELS OF NUCLEOBINDIN-2/NESFATIN-1 IN RATS [53]

LES MACRONUTRIMENTS ALIMENTAIRES RÉGULENT L'EXPRESSION DE L'ARNM SPÉCIFIQUE AUX TISSUS ET LES NIVEAUX DE NUCLÉOBINDINE-2/NESFATINE-1 DANS LA CIRCULATION CHEZ LES RATS

Lynda JM Simpson, R Ceddia and S Unniappan

York University

Nesfatin-1 is a novel eighty-two amino acid hormone encoded in a precursor peptide, nucleobindin-2 (NUCB2). Nesfatin-1 has been found to decrease feeding and body weight when administered centrally and peripherally. In this study, we identified the role of various macronutrients in regulating NUCB2 mRNA expression and serum nesfatin-1 levels. Preliminary results indicate that chronic (7 weeks) feeding of a diet high in fat or carbohydrates significantly lowers the circulating levels of nesfatin-1 by ~35% and 50% respectively, while acute oral gavage of macronutrients appears to have an opposite (stimulatory) effect on circulating nesfatin-1 levels. Acute administration of a high fat diet resulted in decreased liver NUCB2 mRNA expression, while a high carbohydrate diet decreased NUCB2 mRNA expression in the stomach. The identification of macronutrient specific NUCB2 expression and nesfatin-1 release provide us useful information required to modulate the release of this anorexigenic peptide with anti-obesity properties for potential therapeutic purposes.

THE SIGNIFICANCE OF DEPRESSION OF PLASMA [NON-ESTERIFIED FATTY ACIDS] FOR SUSTAINED CARDIAC FUNCTION DURING HYPOXIA EXPOSURE IN TILAPIA [93]H

L'IMPORTANCE DE LA DÉPRESSION PLASMATIQUE (ACIDES GRAS NON-ESTERIFIÉS) POUR LA FONCTION CARDIAQUE SOUTENUE PENDANT L'EXPOSITION À L'HYPOXIE CHEZ LE TILAPIA

Ben Speers-Roesch, SL Lague, AP Farrell and JG Richards
University of British Columbia

Non-esterified fatty acids (NEFA) are a major lipid fraction in fish blood essential for fatty acid oxidation. Plasma [NEFA] decreases during hypoxia exposure in some fishes. We have shown that the greatest reduction occurs in the hypoxia-tolerant tilapia (*Oreochromis hybrid*), where levels plummet by 80% during hypoxia exposure. We hypothesize that this reduction obviates hypoxic cardiac lipotoxicity and associated cardiac dysfunction. We are measuring normoxic and hypoxic function of the tilapia *in situ* perfused heart and comparing the effects of high and low [palmitate], mimicking *in vivo* plasma [NEFA] during normoxia and hypoxia, respectively. We predict that hypoxic function including maximum power output, which we have shown is impressively similar to normoxic function in the absence of palmitate, will be compromised by high but not low [palmitate]. Future experiments will address how manipulation of plasma [NEFA] affects *in vivo* cardiovascular function and hypoxic MO₂ depression.

BLOCKADE OF GAP JUNCTIONS INDUCES REPETITIVE SPREADING DEPRESSION-LIKE EVENTS IN THE LOCUST CNS [44]BH

LE BLOCAGE DES JONCTIONS GAP INDUIT LA PROPAGATION RÉCURRENTE D'ÉVÉNEMENTS DE TYPE DÉPRESSIF CHEZ LE LOCUSTE CNS

Kristin E Spong¹, CI Rodgers-Garlick² and RM Robertson¹

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In the locust (*Locusta migratoria*) stress-induced arrest of ventilation is correlated with an abrupt increase in extracellular potassium concentration ([K⁺]_o) surrounding the ventilatory central pattern generator. This stress response observed in locust neural tissue shares many characteristics of cortical spreading depression (CSD) in mammals. We believe that SD-like events in the locust are triggered by a positive feedback cycle initiated when processes of [K⁺]_o accumulation overwhelm the ability to clear [K⁺]_o. Using K⁺-sensitive microelectrodes, we measured [K⁺]_o in the ventilatory neuropile while simultaneously recording the ventilatory rhythm. We found that blockade of gap junctions with either carbenoxolone or 18beta-glycyrrhetic acid reliably induced repetitive [K⁺]_o events. We propose that glial mechanisms of K⁺ clearance are hindered during gap junction blockade allowing for processes of [K⁺]_o accumulation to predominate and ultimately leading to a SD-like event.

OCTOPAMINE ATTENUATES HYPOXIA-INDUCED REDUCTION OF AXONAL CONDUCTION VELOCITY IN A VISUAL INTERNEURON [46]BH

L'OCTOPAMINE ATTÈNUE LA RÉDUCTION DE VITESSE DE CONDUCTION AXONALE INDUITE PAR L'HYPOXIE DANS UN INTERNEURONE VISUEL

Michael KJ Sproule, TGA Money and RM Robertson

Queen's University

In the migratory locust *L. migratoria* we investigated conduction delay and propagation fidelity of spike trains relayed from the brain via the descending contralateral movement detector (DCMD) to thoracic motor centers involved in escape jumps and evasive flight manoeuvres. We show that hypoxia had deleterious effects on the propagation of action potentials (APs) in the axon of the DCMD, with increases in conduction delay and a loss of transmission fidelity. Hypoxia-induced delays were largest in the mesothoracic ganglion where we observed an inverse correlation between conduction delay and fidelity of APs. Octopamine attenuated the deleterious effects of hypoxia within the ganglion, while exhibiting no effect in the connective. We suggest that octopamine may exert its effects through ion channel regulation at axonal branch points by reducing impedance mismatch or through the maintenance of potassium homeostasis.

BETA-PARVIN FACILITATES CONVERGENT EXTENSION IN XENOPUS EMBRYOS [8]

LA BÊTA-PARVINE FACILITE L'EXTENSION CONVERGENTE CHEZ DES EMBRYONS DE XENOPUS

Catherine Studholme and M Marsden

University of Waterloo

During *Xenopus* gastrulation cell rearrangements that drive axial extension require interactions between alpha5be-

tal integrin and fibronectin (FN). While the cell rearrangements are well characterized the molecules regulating integrin adhesion remain elusive. Here we characterize the adapter protein beta-parvin in *Xenopus*. In early *Xenopus* embryos beta-parvin mRNA is expressed maternally and following zygotic expression is enriched in tissues that undergo integrin-mediated cell movements. Over expression of constructs that delete either the N or C terminus calponin homology (CH) domain results in a decrease in FN matrix assembly and a failure in gastrulation. Expression of the N-terminus CH domain enables integrin-mediated adhesion and migration on FN. Significantly, the N-terminal domain can rescue activin induced animal cap extension in the absence of FN. Expression of the C-terminus CH domain has the reverse effect promoting cell-cell adhesion.

EXPRESSION PATTERNS OF THE NOVEL FREEZE RESPONSIVE GENES LI16, FR10 AND FR47 IN THE WOOD FROG, RANA SYLVATICA [67]

PATRONS D'EXPRESSION DES NOUVEAUX GÈNES DE RÉPONSE AU GEL LI16 ET FR47 CHEZ LA GRENOUILLE DES BOIS, RANA SYLVATICA

Katrina Sullivan and KB Storey
Carleton University

The wood frog's ability to endure freezing is well developed as an adaptation for winter survival. In order to survive the potential stresses placed on the tissues by freezing, *Rana sylvatica* has developed a variety of biochemical adaptation. Recently, it has been shown that these adaptations may include the expression of novel genes fr10, fr47 and li16. Initial analysis of mRNA expression levels of these genes in brain, heart, lung, liver, dorsal and ventral skin, muscle, kidney, testes, stomach, large intestine and small intestine tissue indicate that they may have cryoprotective actions in the wood frog. It is hoped that full characterization of these genes and their proteins will reveal their specific function and their role in freeze tolerance. Furthermore, this information may prove to be important in the future as a tool to improve tissue survival for the purpose of hypothermic or cryopreservation of tissues and organs for transplant.

ADAPTATIONS OF CARDIAC MUSCLE FUNCTION DURING MAMMALIAN HIBERNATION [66]BH *LES ADAPTATIONS DES FONCTIONS DU MUSCLE CARDIAQUE LORS DE L'HIBERNATION DES MAMMIFÈRES*

Shannon Tessier, B Luu and KB Storey
Carleton University

Entry into torpor during hibernation has major consequences for mammalian heart. Heart must continue to beat at cold body temperatures and although heart rate is much slower, contractile force must increase to deal with higher viscosity blood. Muscle remodelling is needed. We examined responses of the GATA-4 and Nkx2-5 transcription factors that are essential regulators of cardiac hypertrophic growth in thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*) over a time course of torpor-arousal. Immunoblot analysis showed that both GATA-4 and phosphorylated-GATA-4(S262) increased significantly during entrance into torpor and GATA-4 also showed enhanced binding to DNA. However, Nkx2-5 did not change. Two downstream targets of GATA-4, Troponin C and Troponin I, also showed increased protein levels during entrance into torpor. The data indicate that GATA-4 regulates expression of downstream genes that are important to heart function during transition periods. However, unlike other situations, GATA-4 and Nkx2-5 do not cooperate during torpor.

MODEL OF SEGMENT FORMATION AND RAY BRANCHING IN ZEBRAFISH CAUDAL FINS [9] *MODÈLES DE FORMATION DE SEGMENTS ET DE RAMIFICATIONS DES RAYONS DANS LES NAGEOIRES CAUDALES DE POISSON ZÈBRE*

Valerie Tweedle, V Lefebvre, M-A Akimenko and A-G Rolland-Lagan
University of Ottawa

The caudal fin rays of zebrafish are a convenient model system to study bone patterning and regeneration. To complement recent progress in our understanding of fin development at the molecular level, we developed 1) a quantitative methodology to statistically quantify fin ray patterns, and 2) a computer simulation model of fin ray patterning. We modelled growth, bone segment formation and bony ray bifurcation patterns in whole caudal fins under differ-

ent hypothetical patterning mechanisms. Model results could then be compared to quantitative experimental data in order to select likely mechanisms underlying segment formation and branching. Preliminary results of model/data comparisons suggest that ray bifurcation and segment formation both depend on the accumulation of a patterning substance to a threshold triggering bifurcation or joint formation, respectively. In future work, we will integrate the current whole fin model with morphogen-based cellular models, providing a multi-level modeling framework to elucidate bone development and regeneration.

IS NESFATIN-1 A NOVEL HYPOPHYSIOTROPIC HORMONE IN GOLDFISH? [56]BH

LA NESFATINE-1 EST-ELLE UNE NOUVELLE HORMONE HYPOPHYSIOTROPE CHEZ LE POISSON ROUGE?

Vijay Vetri Thiruppugazh¹, RG Gonzalez¹, C Grey², Y Yu², J Pemberton², J Chang² and S Unniappan¹

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Nesfatin-1 is a recently reported anorexigenic peptide in goldfish. In this study, we provide novel data indicating the presence and regulatory effects of nesfatin-1 on the hypothalamo-pituitary-gonadal axis of goldfish. Nesfatin-1 mRNA expression was up-regulated in the forebrain of goldfish, while it was down-regulated in the gonads during non-reproductive months. Nesfatin-1-like immunoreactive cells are present in the pituitary, suggesting a hypophysiotropic role for nesfatin-1. In support of this, a single intraperitoneal injection of synthetic goldfish nesfatin-1 (50 ng g⁻¹ body weight) resulted in an acute decrease in the expression of GH-II, LH and FSH mRNAs in the pituitary. Furthermore, nesfatin-1 administration resulted in a significant reduction in serum LH and GH levels. Together, our current results indicate that nesfatin-1 is a novel hypophysiotropic hormone in goldfish.

VARIATION IN CRICKET ACOUSTIC MATE ATTRACTION SIGNALING EXPLAINED BY BODY MORPHOLOGY AND METABOLIC DIFFERENCES [23]

LA VARIATION DES SIGNAUX ACOUSTIQUES D'ATTRACTION CHEZ LE CRIQUET PEUT ÊTRE EXPLIQUÉE PAR LA MORPHOLOGIE DU CORPS AINSI QUE DES DIFFÉRENCES MÉTABOLIQUES

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In crickets, some males signal extensively, spending over 50% of their adult lives attempting to attract a mate, while others signal rarely. Given signaling efforts are usually correlated with mating success, males should be selected to signal with high effort. Why then, do males exhibit such variability? To address the proximate causes underlying signaling effort variation, we quantified the morphological, physiological, and biochemical variation among male European house crickets and assessed whether they correlated with signaling effort variation. Variation in signaling efforts were driven by differences in body size and differences in the activity of the glycolytic enzyme pyruvate kinase. Surprisingly variation in signaling did not appear to be influenced by lipid metabolism. These findings suggest that the ability to locate and assimilate high quality diets during development and into adulthood may drive a substantial portion of the variation in signaling effort in this species.

SCHOOLING IN ADULT ZEBRAFISH INCREASES MAXIMUM SUSTAINED SWIMMING SPEED [115]

LA FORMATION DES BANCS DE POISSONS CHEZ LES POISSONS ZÈBRES AUGMENTE LA VITESSE MAXIMALE DE NAGE PROLONGÉE

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Many species move in schools; however the energetic implications for fish that swim in schools remains unknown because energetic tests of fish are typically conducted on individuals. Here we examine the energetic benefits of fish schooling, as well as the potential mechanisms that underlie individual differences in schooling ability. The maximum sustained swimming ability of adult zebrafish (*Danio rerio*) was tested individually and in schools of 3, 5 and 10. Within schools, 'high performing' fish and were able to swim significantly faster than average fish. Additionally, the average swimming speed of large schools was greater than that of small schools or individuals. These findings suggest that testing swimming performance of individual fish might underestimate the actual swim-

ming ability of a fish in a natural setting. Currently we are conducting metabolic enzymatic assays and qPCR to address the causes of variation in performance.

MITOCHONDRIAL SUPEROXIDE PRODUCTION AND HYDROGEN PEROXIDE METABOLISM IN THE WARM RED AND AMBIENT WHITE MUSCLE OF PACIFIC BLUEFIN TUNA (THUNNUS ORIENTALIS) [106]

PRODUCTION DE SUPEROXYDE MITOCHONDRIAL ET MÉTABOLISME DU PEROXYDE D'HYDROGÈNE DANS LE MUSCLE ROUGE CHAUD ET LE MUSCLE BLANC AMBIANT DU THON ROUGE DE L'ATLANTIQUE (THUNNUS ORIENTALIS)

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While often speculated on, remarkably little is known about how temperature influences mitochondrial reactive oxygen species (ROS) metabolism. Superoxide is the primary ROS formed by mitochondria and is rapidly converted to hydrogen peroxide within the matrix. Matrix hydrogen peroxide is scavenged by endogenous antioxidant pathways (peroxidases). The regional endothermy of bluefin tuna allows for comparison of tissues at ambient temperatures and as much as 10°C higher than ambient. Mitochondria isolated from "cold" white and "warm" red muscle both display increasing superoxide production (measured as hydrogen peroxide efflux) with increasing assay temperature; however, red muscle mitochondria have higher maximal rates of ROS production. The peroxidase activity is similar in red and white muscle mitochondria but, unlike ROS production rates, this antioxidant response displays relatively low sensitivity to temperature. Combined, these data indicate that enhanced mitochondrial ROS production may be an unappreciated consequence of regional endothermy in tuna red muscle.

INNERVATION OF MITOCHONDRIA RICH CELLS IN THE GOLDFISH (CARASSIUS AURATUS) EXPERIENCING GILL REMODELLING [33]

INNERVATION DES CELLULES RICHES EN MITOCHONDRIES CHEZ LE POISSON ROUGE (CARASSIUS AURATUS) PENDANT LE REMODELAGE DES BRANCHIES

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Goldfish (*Carassius auratus*) develop an interlamellar cell mass (ILCM) at temperatures below 15°C. This leads to a redistribution of mitochondrion-rich cells (MRCs) which are involved in ion regulation in fish. This research focuses on the neural innervation of MRCs in goldfish at 7°C (ILCM present) and 25°C (ILCM absent). Based on previous studies on zebrafish we hypothesize that the majority of the MRCs are innervated under steady state conditions and that during hypoxia, when the ILCM retracts, the pre-existing MRCs remain innervated with a few new ones appearing. Using immunohistochemistry we show that at least 80% of MRCs in steady state 7°C goldfish are innervated and are mostly situated at the distal part of the lamella. Furthermore, using a time differential double labeling technique we demonstrate that after hypoxia induced shedding of the ILCM, both pre-existing and newly formed MRCs are innervated.

NESFATIN-1 CO-LOCALIZES APPETITE REGULATORY GASTROINTESTINAL HORMONES IN RATS [49]BH

LA NESFATINE-1 CO-LOCALISE DES HORMONES GASTRO-INTESTINALES IMPLIQUÉES DANS LA RÉGULATION DE L'APPÉTIT CHEZ LES RATS

Yona Vandersluis and S Unniappan

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Nesfatin-1, an anorexigen, decreases food intake and body weight gain after infusion in rats. It was hypothesized that nesfatin-1 affects other appetite-regulatory anorexigens cholecystokinin (CCK), glucagon like peptide-1 (GLP-1), peptide YY (PYY) and leptin, and orexigen ghrelin in its modulation of metabolism. We found that nesfatin-1 and CCK colocalize in glands and enteroendocrine cells of the duodenum, but that nesfatin-1 does not colocalize with GLP-1-immunoreactive enteroendocrine cells. Nesfatin-1 and PYY colocalized in duodenal enteroendocrine cells and large intestinal crypts and mucosa. Both leptin and ghrelin colocalized with nesfatin-1 in stomach mucosal

glands, though some populations of only nesfatin-1- or ghrelin-immunoreactive cells were evident. Sixteen hour nesfatin-1 infusion in rats decreased expression of nesfatin-1 (duodenum, distal large intestine, stomach, liver), GLP-1 (duodenum), PYY (large intestine), ghrelin, and leptin (stomach) mRNAs in postprandial conditions. CCK mRNA expression increased following nesfatin-1 infusion, which suggests that nesfatin-1 acts via CCK to inhibit feeding.

ESTABLISHMENT OF LONG-TERM HEMATOPOIETIC CULTURES FROM HEPATIC TISSUES OF JUVENILE WALLEYE, SANDER VITREUS [121]BH

ÉTABLISSEMENT DE CULTURES HÉMATOPOIÉTIQUES À LONG TERME À PARTIR DE TISSUS DE DORÉS JAUNES JUVÉNILES, SANDER VITREUS

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University of Waterloo

Long-term hematopoietic cell cultures have been developed from head kidney and spleen of a number of teleosts including salmonids, carps, goldfish, and channel catfish. However, no such culture systems have ever been described from perch-like species, and none from fish liver. Such cultures were sought from juvenile walleye in order to study the relationship between macrophages and pathogenic viruses. Three weeks after initiation of explant cultures, non-adherent progeny cells were produced on the surface of the stromal-like cells migrating out from the explants. Progeny cell production was best in cultures containing high serum concentrations and initiated from starved fish and continued after the explants had been transferred at least 4 times into new flasks. In the absence of stromal cells, two adherent cell populations became evident: large macrophage-like cells and multinucleated giant cells. Non-adherent progeny cells also persisted and possibly can be developed into a continuous macrophage cell line.

DOPAMINERGIC NEURON REGENERATION IN THE GOLDFISH BRAIN: A MODEL FOR PARKINSON'S DISEASE [28]BH

REGÉNÉRATION DES NEURONES DOPAMINERGIQUES DANS LE CERVEAU DES POISSONS ROUGES: UN MODÈLE POUR LA MALADIE DE PARKINSON'S

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Abnormalities in dopaminergic (DA) neurons can lead to Parkinson's disease. A parkinsonian syndrome can be induced by injecting the neurotoxin 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP). Goldfish (*Carassius auratus*) injected with MPTP (50µg g⁻¹ Bwt) had severe depletion of DA neurons in the telencephalon, optic tectum and cerebellum as determined using tyrosine hydroxylase (TH) immunohistochemistry. Other evidence indicates that these DA neurons regenerate, suggesting the existence of neuronal stem cells in the adult brain. Testing this hypothesis required the generation of an anti-goldfish nestin antibody in the rabbit. Western blotting experiments indicate that the predicted ~143 kDa nestin precursor protein is processed to smaller fragments of ~30, 37, and 70 kDa. Preliminary experiments indicate an unregulation of nestin coincident with DA-depletion. Characterization of MPTP toxicity using immunohistochemistry for TH and the neuronal stem cell marker nestin is ongoing.

THE EFFECT OF INTERMITTENT AEROBIC EXERCISE TRAINING ON HYPOXIA TOLERANCE IN CARRASSIUS AURATUS [94]

LES EFFETS DE L'ENTRAÎNEMENT EN EXERCICE AÉROBIQUE EN ALTERNANCE SUR LA TOLÉRANCE À L'HYPOXIE CHEZ CARRASSIUS AURATUS

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Goldfish were subjected to an exercise training regime (70% critical swimming speed, 10hr day⁻¹ for 9 days) to examine if exercise could expand the metabolic scope of the fish and how metabolic changes would influence its hypoxia tolerance. Aerobic exercise training decreased critical partial pressure (P_{crit}), reduced glycogen fuel stores in the white muscle and increased the rate of depletion of glycogen in the liver and white muscle under hypoxia.

With no change in routine metabolic rate entering P_{crit} , aerobic training may enhance the fish's ability to regulate basal metabolism at lower critical oxygen thresholds by enhancing oxygen acquisition; however, this may be detrimental to sustained hypoxia tolerance, as it depletes carbohydrate fuel for anaerobic metabolism. The aerobic exercise training regime may lead to an increased access to and subsequent depletion of anaerobic fuel stores across tissues that allow the fish to perform aerobic metabolism for a longer period under falling oxygen levels.

AUTONOMIC NEURONAL CONTROL OF Na^+ UPTAKE IN LARVAL ZEBRAFISH, DANIO RERIO [86]BH

CONTRÔLE NEURONAL AUTONOME DE L'APPORT DE Na^+ CHEZ LE POISSON ZÈBRE LARVAIRE, DANIO RERIO

Melissa Ward, Y Kumai and SF Perry
University of Ottawa

While a role for the autonomic nervous system (ANS) in regulating ion uptake in freshwater fish has been suggested, there is little known about the nature of this regulation. Because the ionocytes of zebrafish are innervated by 5 days post fertilization, there is a potential for neuronal regulation of ion uptake in developing larvae. In this study, the role of the ANS in regulating Na^+ uptake in larval zebrafish was investigated using pharmacological agents targeted to adrenergic receptors. Non-selective beta-receptor stimulation (100 μ M isoproterenol) significantly increased the rate of sodium uptake, an effect which was blocked by the non-selective beta-blocker, propranolol (100 μ M); propranolol treatment alone had no effect. Additionally, alpha-receptor stimulation (100 μ M phenylephrine) significantly decreased the rate of sodium uptake. These observations suggest opposing regulation on ion uptake by alpha- and beta-adrenergic receptors in zebrafish.

NEUROANATOMY OF THE HERMISSENDA CENTRAL NERVOUS SYSTEM: GABA, HISTAMINE, AND FMRFAMIDE IMMUNOREACTIVITY [35]BH

NEUROANATOMIE DU SYSTÈME NERVEUX CENTRAL D'HERMISSENDA: IMMUNORÉACTIVITÉ DE GABA, HISTAMINE ET FMRFAMIDE

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St. Francis Xavier University

The CNS and associated sensory organs of *Hermisenda crassicornis* have been extensively studied for their role in classical conditioning. In other opisthobranchs a variety of neurotransmitters are present in these systems, however there has been no broad survey of putative neurotransmitter content in *Hermisenda*. Accordingly, we used immunohistochemistry to map GABA, FMRF-amide, and histamine-containing cells in the CNS, eyes, and statocysts. Throughout the CNS, we found consistent patterns of histamine-immunoreactive and GABA-immunoreactive cells. Although lower quality anti-FMRF-amide labelling hindered observation, some FMRF-amide immunoreactive cells were also identified. Although conditioning studies support GABA-mediated visual-vestibular pathways, we found no evidence for GABA inside the photoreceptors and hair cells of the visual and vestibular systems. By contrast, FMRF-amide immunoreactivity was present in the visual system and both FMRF-amide and histamine immunoreactivity was present in the vestibular system. Further anatomical and biochemical studies are necessary to address this apparent contradiction with previous work.

GLUCOSE TRANSPORTER EXPRESSION IN THE ZEBRA FINCH AND HUMMINGBIRD [95]

L'EXPRESSION DES TRANSPORTEURS DE GLUCOSE CHEZ LE DIAMANT MANDARIN ET LE COLIBRI

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Hummingbirds and other small birds demonstrate remarkable abilities to rely on carbohydrate oxidation to fuel both resting metabolism and energetically expensive flight. Birds maintain much higher plasma sugar levels than comparably sized mammals and possess limited capacities for glycogen storage in flight muscle suggesting circulating sugars are a major fuel source for active flight muscle. However, little is known about capacities for sugar transport from circulation into tissues in birds other than domestic chickens. We examined patterns of protein and gene expression of several glucose transporters (GLUT) in zebra finch (*Taeniopigia guttata*) and ruby-throated

hummingbird (*Archilochus colubris*) flight and leg muscle, heart, liver and brain tissue. We compare GLUT expression patterns in zebra finches and hummingbirds to the limited existing avian dataset and in relation to diet type with the goal of understanding potential roles these transporters may play in supporting the use of extracellular fuels by exercising muscles.

RELAXIN FAMILY GENES IN TELEOST FISH [116]

LA FAMILLE DE GÈNES RELAXINE CHEZ LES POISSONS TÉLÉOSTÉENS

Brian C Wilson¹, SV Good-Avila² and S Yegorov²

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Relaxin genes in vertebrates evolved from 4 ancestral loci. Zebrafish possess 5 relaxins: telrln3a and 3b, telinsl3, and telinsl5a and 5b. While telrln3a, telinsl3 and telinsl5a are orthologous to mammalian rln3, insl3 and insl5 genes respectively, telrln3b and telinsl5b are paralogous to telrln3a and telinsl5a. Expression of relaxin genes was compared in zebrafish tissues using SYBR Green Real Time PCR (qPCR). cDNA in the qPCR reactions was reverse transcribed from total RNA extracted from brain, eye, gill, heart, gut and gonads of male and female zebrafish. Relative expression of each relaxin gene was normalized with B2m expression. qPCR results indicate that telinsl5b was barely detectable in any tissue, telrln3a was moderately expressed in the brain, but was also detected in gonads, telrln3b exhibited moderately low expression in the brain, and finally that telinsl3 exhibited the highest expression of all the relaxin genes, and was found predominantly in ovaries and testes.

PARTIAL CLONING OF CARDIAC PACEMAKER PROTEINS FROM THE MOST ANCESTRAL EXTANT CHORDATE, THE HAGFISH [31]BH

CLONAGE PARTIEL DES PROTÉINES CARDIAQUE "PACEMAKER" DE LA FORME LA PLUS ANCESTRALE DE CHORDÉ ENCORE EXISTANTE, LA MYXINE

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Intrinsic heart rate is set by the pacemaker current, a steady influx of Na⁺ and K⁺ ions through hyperpolarization-activated cyclic nucleotide-gated (HCN) protein channels that progressively depolarizes the cell membrane. In tetrapods and teleost fishes, the four subunits of the HCN channel are encoded by four genes (HCN1-4), which apparently arose from duplications of a single invertebrate HCN gene. To inform this ancestry, we partially cloned and sequenced HCN genes in the heart of the most ancestral known chordate, the hagfish. Five HCN genes were discovered. Phylogenetic analysis revealed that HCN2, 3 and 4 were represented in hagfish, with HCN3 likely the most ancestral. The further two genes appear to be products of hagfish-specific gene duplications, or gnathostome gene losses. The absence of HCN1, which is often associated with nervous tissue, may reflect the aneural nature of the hagfish heart. Supported by NSERC.

EXPLORING HAGFISH SLIME THREAD PRODUCTION: ANCIENT SOLUTIONS TO MODERN PROBLEMS [10]B

L'EXPLORATION DE LA PRODUCTION DE FILAMENTS DE MUCUS CHEZ LA MYXINE: D'ANCIENNES SOLUTIONS POUR DES PROBLÈMES MODERNES

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Hagfish arose more than 350 million years ago. Their success is related to their ability to produce copious quantities of defensive slime. Hagfish slime is comprised of: (1) ellipsoidal bundles of intermediate filament (IF) thread, and (2) disc-shaped mucin vesicles. My research is focused on examining how a 15 cm thread is assembled and packaged to fit within the gland thread cell (150 µm;GTC). We propose that microtubules (MT) are critical for thread development because: (1) they provide a scaffolding on which IF subunits align, (2) they facilitate coiling by increasing the flexural rigidity of the thread, and (3) their dissociation in mature GTCs dissipates unevenly stored strain energy generated during coiling. The goal of this study is to: (1) establish primary cell cultured GTCs, (2) histologically examine the temporal-spatial changes in IF-MT interactions that give rise to thread production,

and (3) to use *in vitro* techniques to probe the importance of MTs in thread development.

MOTION PARALLAX BEHAVIOUR IN WEAKLY ELECTRIC FISH [32]BH

COMPORTEMENT DE LA PARALLAXE DE MOUVEMENT CHEZ LES POISSONS FAIBLEMENT ÉLECTRIQUES

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Weakly electric fish perform active sensing through the use of a self-generated electric field to probe their environment, this is known as electrolocation. This study compares how two species of knifefish (*Apteronotus leptorhynchus* and *Eigenmannia virescens*) use electroreception to detect and react to moving objects. Experiments examined the ability of these fish to perceive motion parallax cues; or the movement of objects of differing distances across a receptive surface at varying velocities, when an animal is in motion. The hypothesis is that the fish will perceive rapidly moving objects as closer, and slowly moving objects as farther away. To test this we take advantage of a centering behaviour, or the tendency of these fish to hover between two rods. Lateral shifts from this center position provide a measure of how far away the fish perceive the object. Results propose that *E. virescens* make a lateral shifts according to motion parallax cues, whereas *A. leptorhynchus* do not, suggesting species differences.

