RE Peter Biology Conference Abstracts Booklet

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Table of Contents

Oral Presentations

14 Using genomics to uncover the role of phenolics in pine defences against mountain pine beetle and their fungal associates

Colleen Fortier, Janice Cooke

15 The first oviraptorosaur (Dinosauria: Theropoda) bonebed: insights into social behaviour in a maniraptoran theropod

Gregory Funston

16 Defining Roles for SVP-like Genes in the Activity-Dormancy Transition of White Spruce Terminal Buds

Gregoris, A.S., Hall, J.C., El Kayal, W., Cooke, J.E.K.

17 Choosing Between Sex and Food: Resources and Reproductive Success in Red Squirrels

Jessica A. Haines, David W. Coltman, Jamieson C. Gorrell, Murray M. Humphries, Andrew G. McAdam, Stan Boutin

18 Elucidating the role of MEMI: a novel regulator of C. elegans meiosis-to-mitosis transition

Jens Herzog, Maryam Ataeian, Tegha Dunghu, Ellen Sykes, Ashkan Nozohour, Kelly Adames, Caitlin Slomp, Martin Srayko

19 Journey to the Center of the Cell: HCV core protein enters the host nucleus

Collin Horn, Aviad Levin, Karyn Berry-Wynne, Lorne Tyrrell

20 Zebrafish Unc119b is required for cilia-dependent processes

Francesca Jean, Dave Pilgrim

21 The effects of CRISPR knockouts of chaperone network candidates hsf1 and Ier5l on maintenance of sarcomere structure in zebrafish

Kelsey Johnson

22 When your dinner bites back: resistance of alsike clover to red clover casebearer moth

Amanda Jorgensen, Maya Evenden, Jennifer Otani, Lyn Baldwin

23 Spicule and tissue formation in growing regions of a glass sponge

Amanda S. Kahn

24 Production of a plant hormone in Emiliania huxleyi: a role for intraspecies signalling?

Leen Labeeuw

25 Forbidden fruit: Human settlement and abundant fruit create an ecological trap for an apex omnivore

Clayton T. Lamb, Garth Mowat, Bruce N. McLellan, Scott E. Nielsen, Stan Boutin

26 Effects of pH on Salt Tolerance in White Spruce and Trembling Aspen

Nathan Lauer

27 The distribution and function of glass sponge (Porifera, Hexactinellida) reefs in Hecate Strait, British Columbia

Lauren Law

28 Using lake islands as natural models to measure the utilization of habitat fragments by butterflies

Zachary G. MacDonald, John H. Acorn, Scott E. Nielsen

29 Dynamic role of plant of chitinases in pine tree defence against mountain pine beetle attack

Elizabeth Mahon

30 Riding the current to a free lunch: Glass sponge adaptation to a food poor environment

Evgeni Matveev

31 The Effect of Different Patch Configurations of Disturbance for the Recolonization of Mesofauna

Matthew Meehan, Zoë Lindo

32 Heart patterning, looping, and function require UNC45b to fold an unknown cardiac transcription factor.

Dana Miller, Kendal Prill, Dave Pilgrim

33 An Ornithurine Bird from the Late Cretaceous of Alberta, Canada

Sydney Mohr, Phil Currie

34 Growth comparisons between migratory and resident northern form Dolly Varden

C. Morrison, K. Howland, C. Gallagher, K. Tierney

35 Changes in Shisa2 expression in the zebrafish heart and pectoral fin

Gavin Neil

36 Exploring the Effects of Targeted Cone Ablation on the Integrity of Neighbouring Photoreceptor Subtypes in Zebrafish

Nicole C. L. Noel, Gordon F. Hagerman, A. Phil Oel, Michèle G. DuVal, W. Ted Allison

37 Subfertility improves with age in male mice with Cecr2 mutations

Kacie A. Norton, Chelsey B. Weatherill, Kenji Rowel Q. Lim, Vivian V. Nguyen, Ross C. Humphreys, Heather E. McDermid

38 Goldfish (carassius auratus) immune responses to intravenously injected polymer-coated TiO2 nanoparticles

Van Ortega, David Boyle, James Stafford, Greg Goss

39 Many ways to make a hermaphrodite: comparative genetics in Caenorhabditis sex determination

Katharine Pelletier, Keith Reidy, Dave Pilgrim

40 A comparison of diluted bitumen (dilbit) and conventional crude oil toxicity to developing zebrafish

D. Philibert, C. Philibert, C. Lewis, K. Tierney

41 The road less travelled: characterizing elk behavioural responses to roads

Christina M. Prokopenko, Mark S. Boyce, Tal Avgar

42 Butterfly Responses to Fragmentation Associated with In Situ Oil Sands Developments in Northern Alberta Boreal Forests

Riva, F., Acorn, J.H., Nielsen, S.E.

43 Taz dependent regulation of Notch and Wnt signaling is required for hindbrain ventricle development

Lyndsay G. Selland, Andrew J. Waskiewicz

44 Myomesin is a maintenance protein for the sarcomere during muscle development in Zebrafish

Megan Stannard, Kendal Prill, Dave Pilgrim

45 Active mite choice drives aggregation of parasites among fruit fly hosts

Emily Stolz

46 A phylogenetic reassessment of Mosasaurus systematics

Hallie Street

47 Armoured herrings: evolutionary patterns of the scute armour development in clupeomorph fishes (Teleostei: Clupeomorpha)

Oksana Vernygora

48 Estimating Density of Sitatunga in Uganda

Camille Warbington, Mark S. Boyce

49 Post-prandial physiological changes of the Pacific hagfish (Eptatretus stoutii)

Alyssa Weinrauch, Alexander Clifford, Greg Goss

50 bmp3 is a novel regulator of neural crest cells in the vertebrate eye

Sonya Widen, Prajakta Desai, Ordan Lehmann, Andrew Waskiewicz

51 Songbird response to vegetation recovery on reclaimed well sites in the boreal forest of Alberta

Scott Wilson, Erin Bayne

52 MOLECULAR AND CELLULAR MECHANISMS BY WHICH BEHAVIOURAL FEVER INCREASES TELEOST IMMUNE EFFICIENCY

Michael Wong, Jeffrey Havixbeck, Aja Rieger, Keith Tierney, Daniel Barreda

53 Elucidating mechanisms affecting abundance and prevalence of acanthocephalans in freshwater amphipods

Zhuoyan Song, Victoria Giacobbo, Qi Liu, Heather Proctor

Poster Presentations

54 A 10,000-year record of atmospheric mercury deposition in northern Yukon, Canada

Sasiri Bandara, Duane G. Froese, Colin Cooke, Vincent St. Louis

55 Linking aquatic and terrestrial ecosystems: effects of introduced fish on alpine birds and their aquatic-derived prey

Allison Banting

56 Does ambient temperature influence polar bear terrestrial movement in western Hudson Bay?

Alexandra Beatty, Nick Pilfold, Ron Togunov, Evan Richardson, Nick Lunn, Vicki Sahanatien, Erin Bain, Andrew Derocher

57 Hen Houses and Predator Removal: Tools for Management of Upland Duck Nesting Success in the Alberta Parklands?

Emily Blythe

58 Organic Carbon Dynamics in Permafrost Thaw in the Western Canadian Arctic

Cara Bulger

59 Characterization of the sodium-phosphate transporter, NaPi-II, in the Pacific hagfish (Eptatretus stoutii)

Dylan Cole

60 Ecological Relevance of Ucrit: The Link Between Sustained Swimming Performance and Prey Capture Behaviour in Juvenile Rainbow Trout (Onchorhynchus mykiss)

Kyle Dehaan

61 Toxicological impacts of hydraulic fracturing fluid spills to two model aquatic species

Perrine Delompré, Tamzin Blewett, Henry He and Greg Goss.

62 A skeletochronological assessment of age structure in a boreal population of wood frogs (Lithobates sylvaticus)

Caitlyn Donadt

63 Impact of Aspen and Willow homogenate on the detection of PrPC in a western blot

Janay Fox

64 Brain malformations in mice with Cecr2 mutations

Dora Gyenes, Kacie Norton, Heather McDermid

65 Cavitation fatigue and drought-induced xylem pit membrane damage in aspen and balsam poplar

Rachel Hillabrand

66 The Effect of Syncytiotrophoblast Extracellular Vesicles on the Production of Reactive Oxidative Species and Toll-Like Receptor Nine Expression

Jamie Hudson, Anita Quon, Floortje Spaans, Sandra Davidge

67 Effects of OSPW exposure on the feeding efficiency of zebrafish larvae

Daniel Hwang, Danielle Philibert, Clara Philibert, Keith Tierney

68 Resilience of soil bacteria to long-term nitrogen and sulfur depositions in the boreal forest of northern Alberta

Stephanie Ibsen, Bin Ma, Scott X Chang

69 Population-level and temporal trends in polar bear (Ursus maritimus) foraging ecology in Western Hudson Bay

Amy Johnson

70 Effects of forest fire severity and configuration on boreal songbirds in naturally regenerating forests

Michelle Knaggs, Erin Bayne, Scott Nielsen

71 Use of automatic acoustic recognition for Common Nighthawk habitat modelling

Elly Knight

72 The role of sonic hedgehog and BMP in the formation and closure of a novel superior ocular fissure

Sophie Koch, Jennifer Hocking, Jakub Famulski, Sonya Widen, Kevin Yoon, Tara Stach, Omri Weiss, Adi Inbal, Ordan Lehmann, Andrew Waskiewicz.

73 Zebrafish targeted mutagenesis to unveil normal physiological functions of, and interactions between, Prion Protein (PrP) and Amyloid Precursor Protein (APP): Relevance to Alzheimer's disease

Patricia L.A. Leighton, Natasha Lifeso, Richard Kanyo, Niall Pollock, W. Ted Allison

74 A novel Cecr2 isoform is predicted to partially rescue subfertility in mutant male mice

Kenji Rowel Q. Lim, Kacie A. Norton, Heather E. McDermid

75 Living in sympatry: Habitat selection by grizzly and black bears in a multi-use landscape

Anne E. Loosen, Andrea T. Morehouse, Greg C. Hale, Mark S. Boyce

76 Transcriptional responses of two fish species following crude oil exposure

Danielle Lyons, Danielle Philibert, Keith Tierney

77 Ungulate predation risk through carnivore diet analysis in the Rocky Mountains of Alberta

Kara MacAulay

78 Retinoic Acid promotes development of the vestibular system in the vertebrate inner ear

Kacey J. Mackowetzky, Andrew J. Waskiewicz

79 The Genetic Foundations of the Sponge Osculum

Jasmine L. Mah, Sally P. Leys

80 Regulation of the Bmi1 and Ret proto-oncogenes by the DLX2 transcription factor in the developing gastro-intestinal tract

H. McColl, M. Novel, M. Fonseca, J. Zagozewski, D. Eisenstat

81 Yukon Ice Patches: Role of Ice-entombed Bryophytes in Alpine Environments

Brittney Miller

82 Interaction and Localization of Sequence Variants in Dnmbp, a putative neural tube defect susceptibility factor

Mckenzie Mitchell, Parmveer Singh, Renee Y. M. Leduc, Deidre R. Krupp, Natalie Mola, Erica E. Davis, Nicholas Katsanis, Simon G. Gregory, Allison E. Ashley-Koch, Heather E. McDermid

83 Immune Consequences of Genetic Instability in Colorectal Cancer

Courtney Mowat, Sharmin Sumi, Alison McNamara, Kristi Baker

84 Oil exposure effects on swimming performance, metabolic rate, and gene expression in adult male zebrafish (Danio rerio)

Zachary Mueller

85 Relating genotype and phenotype: Assaying the strength of feminizing alleles in C. briggsae mutants.

Muhammad Muneer, Katharine Pelletier, Keith Reidy, Dave Pilgrim

86 Alleles of White-Tailed Deer PRNP Influence Chronic Wasting Disease in Elk Transgenic Mice

Jeffrey P. Narayan, Camilo Duque Velasquez, Chiye Kim, Hristina Gapeshina, Judd Aiken, Debbie McKenzie

87 Acetylcholinesterase chemical inhibitor effects on in vitro prion replication

Anthony Ness, Jacques Van der Merwe, Judd Aiken, Debbie McKenzie

88 A comparison of dispersant application and weathering on crude oil toxicity sheepshead minnow embryos

Anthony Nguyen, Danielle Philibert, Keith Tierney

89 The role of ancestral nrl in rod development– mechanism for the evolution of mammalian rod-dominated retinas

Phil Oel, Keon Collett, W. Ted Allison

90 The role of grem2b in zebrafish ocular development

Sparsh Patel, Sonya Widen, Jennifer Weekes, Andrew Waskiewicz

91 Microbial Activity Shifts in Athabasca Oil Sands Region Reclamation Soils: Establishing a Community Level Physiological Profile Using MicrorespTM

Patrick Neuberger

92 Density-dependent Winter Habitat Selection by Elk in the Ya Ha Tinda

Jed Pettit, Evelyn Merrill, Joshua Killeen, Holger Bohm, Jodi Berg, Scott Eggeman, Mark Hebblewhite

93 Temporal changes within cladoceran communities subjected to a low calcium environment: A comparison of the sediment record and direct limnological monitoring

Laura E. Redmond, Adam Jeziorski, Andrew M. Paterson, James A. Rusak, John P. Smol

94 Interaction amongst thyroid hormone receptor-beta, gdf6a, and tbx2b in determining cone photoreceptor fate.

Ramona Rosca

95 Responses of barred owls, boreal owls and great horned owls to chronic and intermittent industrial noise sources

Julia Shonfield, Erin Bayne

96 The evolutionary significance of morphological similarities between tadpoles and lampreys

Christine Simard

97 Assessing the effect of sequence variants in DNMBP, a putative neural tube defect susceptibility gene

Parmveer Singh, Renee Y. M. Leduc, Deidre R. Krupp, Natalie Mola, Erica E. Davis, Nicholas Katsanis, Simon G. Gregory, Allison E. Ashley-Koch, Heather E. McDermid.

98 Colocalization and physical interaction of murine CECR2 chromatin remodelling complex members

Alaina N. Terpstra, Farshad H. Niri, Kenji Rowel Q. Lim, Heather E. McDermid

99 The influence of brood size and prey abundance on magnitude of nesting behaviours by adult male and female Ferruginous Hawk (Buteo regalis)?

Simon Tkaczyk

100 The use of spring arrival date and song rate to inform habitat quality for the Olive-sided flycatcher (Contopus cooperi)

Emily Upham-Mills

101 Age dependent fertility defects in Cecr2 mutant mice

Chelsey B. Weatherill, Kacie A. Norton, Ross C. Humphreys, Heather E. McDermid

102 The varix: Repeated evolution of a shell sculpture innovation

Nicole B. Webster, Geerat J Vermeij, A Richard Palmer

103 Vibrio cidicii: A Newly Isolated Potential Pathogenic Species of Vibrio

Yue Xu

104 Standardizing audio recording and human observer detection distance for integrated analysis of point count data

Daniel Yip

105 Elucidating the role of eye dorsoventral axis patterning genes in the formation of a superior coloboma and a novel optic fissure

Kevin Yoon, Jennifer C. Hocking, Jakub Famulski, Sonya Widen, Sophie Koch, Ordan Lehmann, Andrew J. Waskiewicz

106 Biomonitoring And Assessment Of Hydrogen Fluoride From Fertilizer Production On Perennial Rye Grass

Yihan Zhao

Abstracts

Oral Presentations

1 The impact of retention harvesting on bee and hoverfly assemblages in the boreal forest of Alberta

Jared Amos, John Spence, David Langor

Declining populations of bees have received considerable attention recently. However, little work has been done on the impact of logging on bees in the boreal forest where native bees and hoverflies are both important pollinators of understory plants. To determine what effect variable retention harvesting has on their assemblages, I sampled bees and hoverflies at the Ecosystem Management Emulating Natural Disturbance (EMEND) project in 2013, 15 years post-harvest. Using net capture and pan traps, I sampled pollinators in clearcut, 20% retention, 50% retention, and control stands in deciduous dominant and coniferous dominant forest. Nearby forest and agricultural roadsides were also sampled. Treatment and forest cover type both have a significant effect on the abundance of bees caught by net and pan trap with a significant interaction between the two. No post-hoc tests were significant. Neither factor has a significant effect on the abundance of hoverflies. In coniferous dominant stands, there is a non-significant trend of decreasing abundance as harvesting retention increases for both groups. An RDA ordination revealed that agricultural roadsides have a different composition of bees from all other treatments. Observed differences in abundance are due to differences in flower assemblages and canopy and shrub cover between treatments.

2 Locomotor Biomechanics of the Red Panda (Ailurus fulgens): Semiarboreality and the Adaptive Significance of the Fine-Branch Niche

Karl Berendt

Primate quadrupedal locomotion is fundamentally different from that of other mammals, being characterised by diagonal rather than lateral sequence gaits, and lower, rather than higher, vertical substrate reaction forces on their forelimbs relative to their hindlimbs. It is currently thought that these features represent basal adaptations for movement on thin, flexible branches, and previous studies have shown that select few arboreal primates that share the primate niche exhibit remarkable convergence on these traits. However, little data exists on so-called “semiarboreal” mammals, which use trees in a fundamentally different way from specialised “fine branch” arboreal forms. To that end, we examined the gait mechanics of the red panda (Ailurus fulgens), a carnivoran species inhabiting a “semiarboreal” niche. Data on the footfall sequence and peak vertical substrate reaction forces were obtained for two adult red pandas walking quadrupedally on a wooden runway. For all steps, red pandas consistently used lateral sequence walking gaits, and experienced peak vertical substrate reaction forces on forelimbs that were significantly greater than those on the hindlimbs. These classic terrestrial dynamics reveal that primate-like locomotion is not necessary for arboreal life, and outlines the dichotomy in adaptive pressures between “fine branch” and generalised arboreal niches.

3 A Reappraisal of the Arboreal Theory for Primate Evolution from an Ecological Perspective

Karl Berendt

In the early Eocene, the first primates diverged from their semiarboreal mammalian ancestors, and radiated into the so-called "fine-branch niche" of the rainforest canopy. Eventually, primates were able to fully restrict themselves to the treetops, not returning to the ground until the Miocene radiation of the apes. In the words of the late Dr. Farish Jenkins, "the adaptive innovation of ancestral primates was therefore not the invasion of the arboreal habitat, but their successful restriction to it." The majority of research has focussed on morphological traits that could have enabled this innovation, which has led some to postulate a coevolutionary relationship between primates and angiosperms. Indeed, global data from an initial study we conducted indicates that there is a strong, significant, positive correlation between primate and angiosperm diversity by genus during the Cenozoic (Pearson's Correlation, $r = 0.80$, $p << 0.01$). However, such a relationship has never been examined from an ecological standpoint. The present study analyses recurring associations between primate and angiosperm species or morphotypes, and whether these relationships extend into the past, in a further effort to shed light on the impeti for the primate radiation that led to the evolution of our own species.

4 The Effect of Density on Movement Rate and Implications for Wildlife Monitoring

Kate Broadley

Scientists and managers need to be able to monitor changes in unmarked populations accurately, and motion-based cameras are an increasingly popular tool for monitoring changes in populations. Cameras produce a series of detections over time, and many camera studies use changes in detection rate to estimate relative abundance. However, camera detections are affected by both density and movement rates of individuals. If movement rates are density dependent and subject to variation within and between populations, then estimates of density from camera data are potentially confounded. My objective is to determine the magnitude of changes in movement rates across densities and what effect this may have on estimates of relative abundance for unmarked individuals. I performed a meta-analysis of studies that reported densities and movement rates for mammal species. I have also analyzed telemetry data for white-tailed deer (Odocoileus virginianus), moose (Alces alces), and grey wolf (Canis lupus) to determine relationships between movement parameters within populations. I found that increases in population density were associated with significant decreases in movement rate and home range size. I also found significant heterogeneity in effect size amongst studies. I make recommendations on the use of camera data for monitoring unmarked populations.

5 A new taxon of aquatic pythonomorph from the Turonian of Croatia: discovery, decay and description.

Michelle Campbell, Drazen Japundzic, Katarina Krizmanic, Michael Caldwell

In the summer of 2008, a new marine squamate was discovered on the island of Dugi Otok, Croatia (Turonian; U. Cretaceous). The articulated specimen was nearly complete from the anterior of the pelvis to the anterior cervical vertebrae. Unfortunately, after two years of weathering on sea cliffs, it now consists of worn impressions and few remaining bones. Fortunately, the right forelimb was protected under a layer of rock and is preserved in exquisite detail in medial view. The individual, which would have been roughly a metre in length, has a distinctively long, cylindrical body with 8-10 cervical vertebrae and at least 23 dorsal vertebrae with posteriorly curved ribs. This is consistent with other long-bodied pythonomorphs, and the length of the neck (> 7 cervical vertebrae) implies that this animal can be assigned to the family Dolichosauridae. Assessment of the forelimb suggests that a new taxon is represented, showing unique features of the paddle-like forelimb; and in particular, the manus. The articulated hand shows a broad, flattened first metacarpal similar to that found in the Mosasaurinae. This fossil expands the range and speciocity of Turonian pythonomorphs, and also represents the importance of updated legislation that allows quick recovery of exposed fossils.

6 When does one species become two? Phylogenomic and population genomic evidence for distinct lineages of the butterfly species Speyeria cybele

Erin Campbell, Emily Dong, Felix Sperling

Traditionally, species delimitation has relied on observable traits such as morphology, ecology, and behaviour. This becomes complicated in biological systems where species exhibit high degrees of phenotypic variability. The butterfly genus Speyeria (Nymphalidae: Argynnini) is one such example. High rates of intraspecific morphological variation complicate the designation of species in this genus using traditional approaches; yet, little is known about the genetic basis for this variation, or whether morphological and genetic differences correlate to one another. Using traditional Sanger sequencing as well as de novo single nucleotide polymorphism (SNP) discovery, we explore genomic species boundaries in the butterfly Speyeria cybele across western North America. Preliminary results indicate support for distinct lineages within S. cybele, and the implications of these findings are explored.

7 Molecular characterization of slow myosin-deficient striated muscle in the jam mutant strain of zebrafish

Tonia Cappellano

The structure and functions of striated muscle are well understood, yet gaps exist in our understanding of the molecular processes regarding the generation and maintenance of the three dimensional structure of the vertebrate sarcomere. One approach to finding factors required for muscle patterning is to identify and characterize mutants where muscle function or patterning is compromised. Our study concerns the jam zebrafish mutant strain: a slow muscle mutant with a late-onset phenotype, where the gene responsible is not known. We hypothesize that the cognate gene for the mutation lies in the Hedgehog signaling pathway; a pathway critical in the differentiation between slow and fast muscle fibers and swim bladder development. Expression analysis using qPCR and in situ hybridization shows the up-regulation of transcription factors in this pathway in the mutants. Our study also explores the role of muscle pioneer cells and associated transcription factor engrailed2a. These factors are well established in the developmental process; however, they have yet to be validated with respect to muscle maintenance. The identification of a novel factor involved in muscle maintenance would strengthen our understanding of muscle maintenance and would advance therapies that target human muscular dystrophies, especially those in which muscle maintenance is affected.

8 Understanding the molecular assembly of muscle using the zebrafish mutant herzschlag

Casey Carlisle, Kendall Prill, Dave Pilgrim

The process by which muscle proteins interact and assemble to form the highly organized sarcomere is poorly understood. Using the zebrafish titin mutant herzschlag, we show via immunofluorescence that the sarcomere is disorganized, beginning at 22hpf. We hypothesize that this disorganization of actin and myosin is due to the truncated titin protein in herzschlag, which results in myosin damage. We believe that titin acts as a sarcomere brace, preventing extreme contraction and limiting overextension upon relaxation. In support of this hypothesis, paralyzing herzschlag to stop contractions limits the damage to the sarcomere. Further examination of the sarcomere via qPCR and in situ hybridization revealed novel information about the role of the myosin chaperones hsp90a1, smyd1b, and unc45b during sarcomere assembly. We propose that these chaperones are only involved in initially folding and inserting myosin into the sarcomere, and do not respond to the subsequent misfolded myosin that results from contraction induced damage. Instead, we suggest this myosin is removed from the sarcomere and subsequently targeted for degradation via proteolysis. This will be tested by examining expression of E3 ligases.

9 Oxygen uptake in Pacific hagfish (Eptatreteus stoutii) occurs primarily via the gills, refuting a major respiratory role for the skin.

Alexander M. Clifford, Alex M. Zimmer, Chris M. Wood, Greg G. Goss

Having diverged ~500 million years ago, hagfishes are the most ancient extant craniates and have become a model for understanding the origins of vertebrate physiology. Previous reports have highlighted the skin of hagfish as an important site for ammonia excretion and the dominant site for oxygen uptake. However, there is contentions debate as to whether cutaneous oxygen uptake is the dominant route of uptake; all evidence supporting this hypothesis has been derived using indirect measurements. Using specialized chambers, which separate anterior and posterior flux constituents, direct measurements of oxygen consumption and ammonia excretion were quantified into cutaneous and branchial exchanges in Pacific hagfish (Eptatretus stoutii) at rest and following exhaustive exercise. Hagfish primarily relied on the gills for both oxygen uptake (81.0%) and ammonia excretion (70.7%). Following exercise, both oxygen uptake and ammonia excretion increased, but only across the gill; cutaneous exchange was unchanged. When branchial oxygen availability was reduced by exposure to anteriorly-localized hypoxia (~4.6 kPa O2), hagfish did not utilize cutaneous mechanisms to supplement whole-animal metabolic requirements. These results refute a significant role for cutaneous O2 acquisition in the hagfish.

10 Breeding parasites: heritability of parasitic behavior in a facultatively parasitic mite

Emily Durkin

Parasitism is currently recognized as the most common way for organisms to obtain nutrients and the transition from free-living to parasitic life likely outnumbers any other major evolutionary shift in life history strategy. Although the evolution of parasitism from a free-living existence is quite prevalent in nature, our understanding of how and why it occurs is limited. My research investigates the evolutionary shift from a free-living to a parasitic life strategy and the possible evolutionary trade-offs associated with this shift. I began my research by artificially selecting for parasitic and free-living behaviours expressed in a facultatively parasitic mite: Macrocheles muscaedomesticae. After 15 generations of selection, I have seen divergence in the prevalence of parasitic behavior (host attachment). Currently, to investigate costs associated with parasitic behavior, I am measuring the persistence of parasitism after relaxed selection as well as the fecundity and survival of mites from both selection lines. My research will contribute to the limited knowledge on why and how populations become parasitic and how genetic variation for this trait, including facultative parasitism, is maintained in a natural population.

11 gdf6a and thyroid hormone receptor β interact in zebrafish cone photoreceptor differentiation

Michele DuVal

The cone photoreceptor neurons of the retina mediate colour perception, provide high visual acuity, and are essential for daytime vision. In retinal degenerative disease, cone death severely compromises functional vision; however stem cell therapy offers much hope to restore vision. The known gene regulatory network of cone subtype development is scant, so our group aims to enhance the success of stem cell therapy by studying zebrafish, a powerful cone vision model with impressive neuroregenerative capacities.

We are dissecting genetic pathways shared by three identified regulators of cone photoreceptor differentiation: thrβ, gdf6a, and tbx2b. Using our transgenic model of conditional disruption of thrβ activity, crossed to mutants of gdf6a and tbx2b, we examined the interactions among these genes on determination of three cone subtypes. Preliminary findings indicate a synergistic effect between gdf6a mutation and thrβ disruption, causing a paucity of blue-sensitive cones. This novel interaction suggests a shared pathway between gdf6a and thrβ in blue cone fate specification.

We are describing the gene pathways of cone photoreceptor development, which will be critical to optimize stem cell therapy for efficacious restoration of vision.

12 INTERACTION OF AVIAN INFLUENZA NON-STRUCTURAL PROTEIN 1 (NS1) WITH HUMAN AND DUCK TRIPARTITE MOTIF-CONTAINING PROTEIN 25 (TRIM25).

Danyel Evseev

The ability of influenza viruses to block innate immune response during the early stages of infection is crucial to its success in a host. The influenza non-structural protein 1 (NS1) is the main viral antagonist to innate immunity within host cells. In humans NS1 blocks the RIG-I signaling pathway for viral detection, by interacting with an essential co-activator – tripartite motif-containing protein 25 (TRIM25). I am investigating whether NS1 interacts with duck TRIM25, because ducks are the reservoir hosts of influenza and mount robust and effective innate immune responses to highly-pathogenic flu strains that kill chickens and humans. I compare the ability of several different NS1 proteins to interact with human and duck TRIM25 proteins (which are quite divergent), to determine which structural features of NS1 are critical for these interactions, and to correlate TRIM25-binding with infection outcomes. I show that different NS1 proteins interact with human and duck TRIM25, despite similar subcellular distribution patterns. I also show that NS1 proteins from a fatal human influenza isolate, and a closely-related avian isolate have different binding affinities for human TRIM25. Work is ongoing to determine critical NS1 amino acid residues by mutagenesis, and to perform in vitro infections with recombinant viruses. Knowing the sequence features of NS1 that contribute to human virulence is important for global surveillance and disease control. Comparing this to the function of NS1 in ducks will expand our understanding of the changes that occur when influenza jumps the species barrier.

13 Is Hydraulic Fracturing Flowback and Produced Water Toxic? Sub-lethal Toxicity Characterization of Hydraulic Fracturing Flowback and Produced Water in Rainbow Trout (Oncorhynchus mykiss).

Erik Folkerts, Yuhe Hu, Greg Goss

The emergence of hydraulic fracturing to extract natural gas reserves in western Canada has made it necessary to query the potential toxic and ecological effects this relatively new practice has on the environment.
This study is part of an overall investigation looking to elucidate the chemical and toxicological profile of hydraulic fracturing flowback and produced water (HF-FPW). In particular, part of my research is to determine HF-FPW exposure biomarkers and endpoints in the fresh water vertebrate rainbow trout (Oncorhynchus mykiss - RT). By performing various sub-lethal assays in multiple tissues exposed to different fractions of HF-FPW, we determined that specific transcriptional and sub-lethal effects, which cannot be attributed to hyperosmotic stress, are seen in fish upon HF-FPW exposure. Specifically, we show that phase I and II xenobiotic metabolism and oxidative stress responses are significantly upregulated in RT gill and liver tissue.
This is one of the first experiments to look at HF-FPW toxicity on key indicator species. Future sub-lethal, acute and chronic exposure assays will allow us to determine what exact toxicological effects HF-FPW has on freshwater fish species, and help guide the process of making robust and effective clean-up efforts for industry when spills and leaks occur.

14 Using genomics to uncover the role of phenolics in pine defences against mountain pine beetle and their fungal associates

Colleen Fortier, Janice Cooke

The current mountain pine beetle outbreak has devastated British Columbia's pine lumber industry, reaching epidemic levels of attack in its historic host, lodgepole pine. Mountain pine beetle has undergone host range expansion into jack pine, a keystone species of Canada's boreal forest. The goal of my project is to characterize chemical defenses invoked by lodgepole and jack pine in response to mountain pine beetle and its pathogenic fungal partners, and determine how stressful environmental conditions such as drought may alter these defenses. I hypothesize that differences in phenolic defenses between lodgepole and jack pine may affect host susceptibility to mountain pine beetle and associated fungi, and that host susceptibility is affected by drought. I have mined genomic datasets to identify genes encoding enzymes of the phenolic biosynthesis pathway, and constructed expression profiles for these genes in response to both drought and inoculation with Grosmannia clavigera, a fungal associate of mountain pine beetle. Expression profiles for several of these genes vary between lodgepole and jack pine; these expression profiles are also strongly influenced by drought. These genes are good candidates for exploring whether phenolic defenses contribute to differences in tree host susceptibility to beetle attack, and if drought compromises host susceptibility.

15 The first oviraptorosaur (Dinosauria: Theropoda) bonebed: insights into social behaviour in a maniraptoran theropod

Gregory Funston

A monodominant bonebed of Avimimus from the Nemegt Formation of Mongolia is the first oviraptorosaur bonebed described and the only recorded maniraptoran bonebed from the Late Cretaceous. Cranial elements recovered from the bonebed provide insights on the anatomy of the facial region, which was formerly unknown in Avimimus. Both adult and subadult material was recovered from the bonebed, but no small juvenile material is present. Combined with the taphonomic evidence, this suggests that Avimimus engaged in social behaviour in which adults and subadults grouped to the exclusion of smaller individuals. The association of Avimimus specimens in the bonebed may be interpreted as the first evidence of birdlike flocking behaviour in a maniraptoran. Gregarious behaviour in ornithomimids and oviraptorosaurs may be an adaptation for predator avoidance to compensate for ontogenetic constraints on locomotion.

16 Defining Roles for SVP-like Genes in the Activity-Dormancy Transition of White Spruce Terminal Buds

Gregoris, A.S., Hall, J.C., El Kayal, W., Cooke, J.E.K.

Perennial plants survive winter by developing buds to protect shoot apical meristems, terminating meristematic cell proliferation to enter the dormant state, and resuming cell divisions the following spring. A group of MADS-box transcription factors known as SHORT VEGETATIVE PHASE (SVP) genes play well-characterized roles in floral bud formation in angiosperms annuals, and have been implicated in regulating bud formation and dormancy acquisition in angiosperm perennials. Our goal is to determine the role of SVP-like genes in bud formation and dormancy acquisition in the conifer white spruce.
Phylogenetic reconstruction shows that white spruce SVP-like (PgSVP-like) genes are closely related to angiosperm SVP genes. PgSVP-like genes displayed distinct expression patterns during bud development, consistent with diverse roles in bud formation and/or dormancy acquisition. In situ hybridizations for two PgSVP-like genes showed that they are expressed in most tissues within the bud. Some PgSVP-like genes restored a wildtype flowering phenotype in Arabidopsis svp mutants, suggesting conservation of functional features. We are preparing to use yeast one-hybrid to identify transcription factors interacting with PgSVP-like promoters, to decipher the molecular pathway regulating conifer bud development. We hope to uncover that there are shared elements in the signal transduction networks regulating vegetative and reproductive bud formation.

17 Choosing Between Sex and Food: Resources and Reproductive Success in Red Squirrels

Jessica A. Haines, David W. Coltman, Jamieson C. Gorrell, Murray M. Humphries, Andrew G. McAdam, Stan Boutin

It is intuitive to expect that animals with access to more resources will invest in reproductive effort, and therefore that food availability is linked with reproductive success. However, animals face many trade-offs, such as intraspecific competition, which may constrain their reproductive investment regardless of food resources. I will explore the relationships between food availability, reproductive effort, and reproductive success in male red squirrels. Red squirrels cache spruce cones in a central hoard, allowing us to assess individual-level resources. Male red squirrels access females during the breeding season by traveling over large areas, and we can estimate reproductive effort by measuring this behaviour. Thus, I will first investigate whether males with large caches also have higher reproductive effort and, consequently, higher reproductive success. However, caching in a central hoard could create a trade-off between resource defense and reproductive effort, as they cannot defend their midden when they leave to access females. Thus, males with large hoards may face a trade-off: they could invest in high reproductive effort but face higher intrusion rates and a loss of cached resources. Thus, I will also examine whether males who have higher reproductive effort and higher cached cones also have higher rates of intraspecific intruders.

18 Elucidating the role of MEMI: a novel regulator of C. elegans meiosis-to-mitosis transition

Jens Herzog, Maryam Ataeian, Tegha Dunghu, Ellen Sykes, Ashkan Nozohour, Kelly Adames, Caitlin Slomp, Martin Srayko

Successful oocyte meiosis is critical for sexual reproduction. In many species, fertilization occurs before the oocyte finishes its meiotic divisions and is required for the completion of meiosis. In the nematode Caenorhabditis elegans, fertilization occurs during meiosis I (MI), which is initiated when the oocyte is activated by a diffusible signal from the sperm. Then, sperm entry is necessary for the completion of MI and progression into meiosis II (MII); unfertilized oocytes initiate MI, but abort the program and skip MII. The memi-1, 2, 3 genes encode oocyte-specific proteins in C. elegans and are good candidates to “sense” sperm entry and initiate MII. In memi-1/2/3(RNAi) embryos, fertilized oocytes abort MI and skip MII. The MEMI protein levels decrease abruptly after MI, suggesting that they are important for the MI-to-MII transition. The gain-of-function mutation, memi-1(sb41), causes MEMI-1 protein to persist abnormally into mitosis. memi-1(sb41) embryos do not exit MII properly, as MEMI-1 is not removed resulting in embryonic death. A genetic screen for suppressors of memi-1(sb41) embryonic lethality identified 17 mutations within 5 different genes. These mutations will be identified by genetic mapping and whole genome sequencing. These genes will likely encode important new components of the MEMI pathway.

19 Journey to the Center of the Cell: HCV core protein enters the host nucleus

Collin Horn, Aviad Levin, Karyn Berry-Wynne, Lorne Tyrrell

Of the 150 million chronic cases of HCV approximately 350 000 people die annually. The HCV life cycle is thought to be entirely in the cytoplasm; however, new studies suggest that some of the HCV proteins interact the host nucleus. Work by Cerutti et. al. shows that HCV core protein translocates to the nucleus early in infection. However, this work depended on manipulating host nuclear export systems; we cannot exclude the possibility that this modification is the cause for the nuclear localization of core. In our studies, we synchronized the HCV infection in cell culture using a temperature shift and fixed cells during the first 14 hours post temperature shift. HCV core was not in the nucleus at 4 hours or 12 hours, but was present at 8 hours. Reverse transcriptase qPCR and IF microscopy showed that the viral RNA uncoated before entry. Our work has identified a new step of the HCV life cycle, extending understanding of HCV replication and pathology. Microarray analysis of transcription early in infection was performed, and opens new avenues of research on various aspects of the HCV lifecycle. These studies may lead to new viral or host targets that will assist us in the control of HCV infection.

20 Zebrafish Unc119b is required for cilia-dependent processes

Francesca Jean, Dave Pilgrim

Cilia are microtubule-based structures that project from the cell body. Until recently, they were thought to be vestigial structures despite nearly every cell in the vertebrate body possessing a cilium. However, it has been shown that several pleiotropic diseases are caused by defective cilia; these diseases are now collectively referred to as ciliopathies. Given that cilia have many essential functions at both cellular and developmental levels, identifying and classifying novel ciliary proteins has become a major field of research. The goal of my project is to use zebrafish to study the roles of a novel ciliary candidate called Unc119b.
I have knocked down the function of Unc119b and noticed developmental phenotypes associated with ciliary defects, including truncated primary cilia in the retina (photoreceptors) and defective motile cilia in the Kupffer's vesicle (responsible for establishing the left-right axis). Interestingly, I have also observed defects in the lens of the eye where a role for cilia has not yet been defined. To further explore this, I have been characterizing the role of cilia within the lens. This work will ultimately establish Unc119b as a ciliary protein and it will explore a novel role for cilia in the lens.

21 The effects of CRISPR knockouts of chaperone network candidates hsf1 and Ier5l on maintenance of sarcomere structure in zebrafish

Kelsey Johnson

Formation and maintenance of the sarcomere - the fundamental contractile unit in muscle - is a process that depends on the precise interactions of many proteins. Investigation into the roles of chaperones in this process indicates that their role is not limited to the folding and integration of sarcomere components, but that there is a dynamic interplay between chaperones and structural proteins that is critical and responsive. Members of the chaperone network and how they respond to damaged or improperly folded proteins remains unknown. We hypothesize that these transcription factors are vital to the sarcomere maintenance and that a knockout will cause a loss of the chaperone response to damage, which can be measured using myomesin, an indicator of sarcomere integrity. We will use CRISPR technology to knock out essential domains of chaperone network candidates hsf1, Ier5l (transcription factors) in order to analyze the function of these factors during sarcomere formation and maintenance.

22 When your dinner bites back: resistance of alsike clover to red clover casebearer moth

Amanda Jorgensen, Maya Evenden, Jennifer Otani, Lyn Baldwin

The red clover casebearer moth (RCCB) is an invasive red clover seed pest introduced to Canada in the 1960's. RCCB larvae feed within florets, ovules and developing seed from June to late August then overwinter in crop debris. RCCB can cause seed yield losses of ≥99% in second-year seed stands of red clover. Both larvae and adults have been reported in alsike clover fields but little damage is seen on these plants, and female moths display lower fecundity on alsike clover. Presented are results from a preliminary study in 2014 that founded the questions for the M.Sc. project proposed. This research investigates the apparent resistance of alsike clover to RCCB. Preliminary work tested field abundance (338 larvae collected from red clover, 0 from alsike) and larval development differences (mean weight gain red ± SEM = 0.00438 ±0.000721 g, n=19, mean weight gain alsike ± SEM =0.00274± 0.0001788 g, n=109], t = -2.9093, p= 0.01407). Future work will investigate mechanisms through adult female preferences for oviposition and volatiles, following development to adult emergence, and examining nutritional and morphological differences.

23 Spicule and tissue formation in growing regions of a glass sponge

Amanda S. Kahn

Glass sponges form dense reefs along the continental shelf of western Canada. The reefs serve important ecosystem functions by providing habitat for other species and filter feeding, through which they sequester carbon into their tissue as biomass. Growth by reef sponges is important to both of these ecosystem functions, yet how glass sponges build new reef (spicule skeletons) and biomass (tissue) is not understood. Glass sponge tissue is syncytial; most tissue is multinucleate but some regions are uninucleate and function largely as cells. The skeleton is made of silica, which is fused secondarily into a rigid scaffold. I studied spicule and tissue formation in growing regions of Aphrocallistes vastus. Skeletal and tissue growth occurred only at the uppermost extensions of the sponge where the spicules had not yet fused into a rigid scaffolding. Small spicules (microscleres) in all regions labelled with the ratiometric dye PDMPO, but fused spicules and larger megascleres labelled at the growing edge. In the same region, the most obvious new tissue formed first as clusters of cell-like bodies, choanoblasts. These later formed enucleate collar bodies and expanded to a full-size feeding chamber, making structures for feeding while using fewer rounds of costly mitosis than cellular sponges.

24 Production of a plant hormone in Emiliania huxleyi: a role for intraspecies signalling?

Leen Labeeuw

The plant hormone, indole-3-acetic acid (IAA), is an important small molecule in terrestrial systems which influences development through a variety of cellular mechanisms, such as altering cell orientation, organ development, fertility, and cell elongation. However, it remains contentious whether photosynthetic and marine algae can produce it. Homologs of genes involved in several tryptophan-dependent IAA biosynthesis pathways were identified in Emiliania huxleyi, a globally abundant marine unicellular haptophyte. This suggests that this haptophyte can synthesize IAA using various precursors derived from tryptophan. Addition of the IAA precursor, L-tryptophan, to E. huxleyi stimulated IAA production, as detected by using Salkowski's reagent and GC×GC-TOFMS. However, there were strain variations, as IAA was produced in the C cell type (coccolith-bearing), but not in the N cell type (bald). Exogenous IAA added at various concentrations to these two cell types led to differing physiological responses, with the N cell type showing increased sensitivity, including an increased variation in cell size and membrane permeability, and a corresponding increase in the photosynthetic potential quantum yield of Photosystem II (PSII). The C cell type did not show these effects. This suggests that IAA plays a novel role in the signalling between different E. huxleyi cell types.

25 Forbidden fruit: Human settlement and abundant fruit create an ecological trap for an apex omnivore

Clayton T. Lamb, Garth Mowat, Bruce N. McLellan, Scott E. Nielsen, Stan Boutin

Habitat choice is an evolutionary product of animals experiencing increased fitness when preferentially occupying high-quality habitat. However, when presented with novel conditions, an animals' assessment of habitat quality may be poorly matched to its' fitness resulting in an ecological trap. Here we use demographic and movement data for grizzly (brown) bears in an area with rich food resources and concentrated, human-settlement to test for an ecological trap. Our results demonstrate that a valley high in berry resources and human density was more attractive than surrounding areas and that bears occupying this region faced 17% lower apparent survival. Despite lower fitness, we detected a net flow of bears into the trap contributing to a study-wide population decline. These results demonstrate the presence and pervasiveness of an ecological trap for an apex omnivore that lacks the evolutionary cues to assess tradeoffs between food resources and human-caused mortality resulting in maladaptive habitat selection.

26 Effects of pH on Salt Tolerance in White Spruce and Trembling Aspen

Nathan Lauer

Revegetation of land disturbed by oil sands surface mining in northeastern Alberta can be hindered by elevated soil pH and salt levels found at reclamation sites. In this study, the tolerance of white spruce (Picea glauca) and trembling aspen (Populus tremuloides) to elevated pH and salinity was investigated. Seedlings were exposed to three pH levels (5, 7, and 9) with three separate NaCl concentrations (0, 30, and 60 mM NaCl) for a total of 9 treatments. For white spruce, elevated pH caused decreases in leaf phosphorus, calcium, and iron. Elevated NaCl induced decreases in leaf iron, potassium, total chlorophyll content, net photosynthesis, and net transpiration. However, elevated pH and NaCl did not induce mortality or changes in biomass. For trembling aspen, elevated pH and NaCl induced mortality as well as decreases in leaf nitrogen, phosphorus, calcium, iron, total chlorophyll content, net photosynthesis, net transpiration, and total biomass. Interestingly, aspen exhibited a great ability to exclude sodium ions from entering the leaves by storing the ions within the root tissue. Ultimately, this information could be used for reclamation efforts of lands disturbed by oil sands surface mining in northeastern Alberta, especially lands affected by elevated pH and salt levels.

27 The distribution and function of glass sponge (Porifera, Hexactinellida) reefs in Hecate Strait, British Columbia

Lauren Law

The world's largest glass sponge reefs are found in Hecate Strait, British Columbia. Sponge reefs are important habitat-forming structures that support deep-sea biodiversity. Trawl damage is well documented on the reefs and future oil/gas explorations threaten their future viability. With recent interests in establishing the reefs as marine protected areas (MPA), measures of sponge cover and composition are needed for developing MPA management strategies. The distribution and extent of the reefs is largely unknown. Although the reefs have been mapped using multibeam sonar, this technique does not distinguish between live, dead, and buried sponge nor between the primary reef-building species – Aphrocallistus vastus, Heterochone calyx, and Farrea occa – which have different filtration capacities. Using a remotely operated vehicle, imagery from fine-scale photographic surveys was used to generate high-resolution maps of live sponge cover. Preliminary results show the reef extent to be smaller than implied from multi-beam mapping. The maps also illustrate patterns of association between fish and invertebrate species and glass sponges. Whereas some animals are closely associated with the reefs others appear to be independent of reef structure. This study is the first to provide a biological baseline for the glass sponges in the Hecate Strait.

28 Using lake islands as natural models to measure the utilization of habitat fragments by butterflies

Zachary G. MacDonald, John H. Acorn, Scott E. Nielsen

Two opposing hypotheses have been proposed to explain patterns of species diversity within fragmented landscapes. Drawing parallels to island biogeography, the island effect hypothesis suggests that the size and isolation of remaining habitat patches structure diversity. Contrastingly, the habitat amount hypothesis assumes that habitat patch edges do not delimit populations or communities, and predicts that aggregate habitat patch area alone structures diversity. In the current study, we measure butterfly diversity of lake islands to test these two hypotheses. This design allows for the non-arbitrary delineation of patch edges—something found to be problematic in past studies—and the assumption of homogeneity within the uninhabitable matrix (open water) surrounding patches. Thirty islands occurring on Lake of the Woods, Ontario were selected to represent a 'special patch set' sampling design, where island size is reduced in half but total area is maintained across habitat patch sets by doubling the number of islands per size reduction, effectively decoupling fragmentation from area. No severe differences in butterfly species richness were observed between sets of smaller and larger islands summing to equivalent areas. Analyses of species-area relationships also suggest that fragmentation does not depress species richness. Both analysis methods give support to the habitat-amount hypothesis.

29 Dynamic role of plant of chitinases in pine tree defence against mountain pine beetle attack

Elizabeth Mahon

To date, the mountain pine beetle (MPB) outbreak is estimated to have affected 19 million ha. of Canadian forests, resulting in wide spread tree mortality and devastating ecological consequences [1]. Grosmania clavigera, a highly pathogenic associate of MPB, plays a critical role in eventual tree mortality, by growing into a tree host's water conducting tissue and disrupting water transport [2]. Early induction of tree host defenses, such as the expression of chitinase enzymes is critical in successful defense against fungal invaders [3]. Through a broad scale microarray analysis we examined the transcriptomic response of pine seedlings inoculated with G. clavigera, and identified differences in the timing and magnitude of key defensive response regulators between co-evolved and naïve pine seedling hosts. Quantitative reverse transcription PCR analysis of key defensive chitinase enzymes reveal a diversified response from various members of the chitinase gene family, suggesting that, in pine hosts, these enzymes are responding dynamically to attack by MPB and fungal associate G. clavigera.

30 Riding the current to a free lunch: Glass sponge adaptation to a food poor environment

Evgeni Matveev

In low food environments, such as the deep ocean, it is (especially) important that the benefit of food quality and quantity is maximized, while the cost of obtaining food is minimized. Glass sponges live on the deep ocean seafloor, but being sessile filter feeders they have little say in food choice, and must resort to decreasing the cost of obtaining food. It has previously been suggested that sponges use the surrounding ambient flow to decrease the cost of pumping water through their filtration system; however it is difficult to assess the energetic benefits of passive flow without examining the metabolic expenditure of the sponge. Using a remotely operated submersible off the coast of British Columbia, we measured flow and oxygen from the glass sponge Farrea occa using custom-made instruments. We analyzed the relationship of ambient flow, excurrent flow (out of the sponge), and the oxygen used by the sponge. Our study shows that sponges use up to 40% less oxygen under high ambient flow, suggesting they use the surrounding flow to lower their cost of pumping. The thin, upright glass sponge morphology may therefore be adapted to take advantage of the ambient flow, ensuring survival in a food poor environment.

31 The Effect of Different Patch Configurations of Disturbance for the Recolonization of Mesofauna

Matthew Meehan, Zoë Lindo

Decreasing global biodiversity through disturbance has prompted the devising of solutions to counteract this loss. One solution has emerged from the forestry industry with the use of silviculture treatments that vary in harvesting (disturbance) size to allow for greater recolonization of species. This experiment looked at similar themes, by determining how different patch configurations of disturbance affect the recolonization of invertebrates within a moss-microarthropod system which consisted of three equal area disturbance treatments of: single large patch, two medium patches and three small patches with an undisturbed control. I hypothesized that the three-patch treatment will allow for greater colonization of invertebrates due to a decrease in intensity of disturbance and predict that several small-disturbed patches would lead to greater species richness, abundance and diversity of invertebrates after recolonization, and lead a community most similar to the undisturbed control. Consistent with this, species abundance of the three-patch system was greater than other disturbance designs and was not statistically different than the control. Community analysis also revealed that the control and three-patch treatment were the most similar in community composition. Overall, this supports the hypotheses that having several smaller patches of disturbance will allow for a greater recolonization of invertebrates.

32 Heart patterning, looping, and function require UNC45b to fold an unknown cardiac transcription factor.

Dana Miller, Kendal Prill, Dave Pilgrim

The sarcomere – basic contractile unit of muscle tissue – is a highly organized structure that relies on several assembly and maintenance proteins for its formation and integrity. Mutations in these proteins lead to various cardiomyopathies. Included in these proteins is Unc45b, a myosin chaperone. In zebrafish, unc45b mutants have distinct defects in their cardiac and skeletal muscle. UNC45b is required for the formation of the thick filaments within the skeletal sarcomeres; however, the phenotype of the heart does not match that of a myosin defect alone. We have previously found that unc45b hearts do not loop, never beat, and show a loss of chamber identity. Interestingly, in mice, UNC45b has been shown to be responsible for folding GATA4, one of the key transcription factors in the heart morphogenesis pathway. We hypothesize that Unc45b is folding a cardiac transcription factor in addition to myosin in zebrafish. We have examined the expression profile of various cardiac transcription factors in the unc45b mutants, and have chosen candidates based on these profiles for a yeast-two-hybrid analysis. This will test for direct interactions between Unc45b and various cardiac transcription factors. Furthermore, we hypothesize Unc45b is required for incorporation of cardiomyocytes in the developing myocardium. We are testing these hypotheses using qPCR, in situ hybridizations, and antibody staining.

33 An Ornithurine Bird from the Late Cretaceous of Alberta, Canada

Sydney Mohr, Phil Currie

Bird material in the Late Cretaceous of Alberta is rare and fragmentary, and consists mainly of isolated teeth and postcranial elements, therefore allowing for few definitive identifications to the genus or species level. In spite of the nature of this fossil avian assemblage, the majority of specimens have been assigned to Ornithurae, making it the most abundant and diverse group in the Late Cretaceous of the province, if not all of North America. One genus in particular, Cimolopteryx, is represented elsewhere mainly by coracoids, although its presence in Alberta is uncertain. A new coracoid fragment from the upper Campanian Dinosaur Park Formation (77–75.5 Ma), Dinosaur Provincial Park, resembles morphologically members of the putative family Cimolopterygidae, including Cimolopteryx, as well as a few unassigned North American ornithurines. It represents one the oldest and largest of the comparable specimens. Earlier inconclusive systematic analyses including these ornithurines recovered a single polytomy, requiring the addition of new material to potentially resolve relationships. The poor representation of birds in the fossil record necessitates detailed examination of this new coracoid in order to better understand Late Cretaceous avian diversity in Alberta, as well as its relationships to other birds in North America as a whole.

34 Growth comparisons between migratory and resident northern form Dolly Varden

C. Morrison, K. Howland, C. Gallagher, K. Tierney

Northern Dolly Varden char (Salvelinus malma malma) are listed as special concern by COSEWIC due to their limited distribution, population declines, and concerns over their ability to tolerate climate change. Research focus to date has been on the anadromous (migratory) life history form; information on resident (non-migratory) Dolly Varden and their overall role in populations is unknown, despite the fact that anadromous and resident Dolly Varden are genetically the same within rivers. Therefore, this research aims to compare resident and anadromous life histories and identify factors that contribute to the selection of different life history strategies, specifically looking at early growth rates and associated traits. Research will involve comparison of biological data collected in conjunction with ongoing stock assessment studies. Otoliths (ear-bones) will be analyzed to determine fish age and growth rates. Traits such as juvenile growth will be compared between resident and anadromous Dolly Varden within and among rivers to determine how growth influences life history selection. Preliminary results presented will include comparison of size-at-age of from two river systems and four cohorts. The results of this study will aid in management efforts for Dolly Varden and enhance the overall understanding of life history strategies within this species.

35 Changes in Shisa2 expression in the zebrafish heart and pectoral fin

Gavin Neil

The inherited disorder Duchenne Muscular Dystrophy is characterized by progressive muscle wasting. Though the primary symptoms usually manifest themselves after several years, the muscles themselves are affected at birth. Many physiological changes accompany DMD, including various changes in gene expression. These changes may cause problems for researchers studying involved molecular pathways, as the effects of particular mutations may become confounded by the effects of other affected genes. The question therefor becomes; how much, if at all, is the observed phenotype caused by changes in the expression of related genes.
This study aimed to characterized the role of Shisa2, a gene responsible for promoting the development of the head, in Zebrafish. Shisa2 functions by inhibiting the maturation of Wnt and Fgf receptors, thereby potentially implicating it in the regulation of muscle development. It was hypothesized that Shisa2 expression should be downregulated in a dystrophy model Zebrafish, in order to reduce inhibition of myogenic factors. However, we demonstrated that Shisa2 expression was not greatly changed in the first 48 hours post fertilization in a dystrophy mutant. In fact, expression appears to increase in both the heart, and the pectoral fins.

36 Exploring the Effects of Targeted Cone Ablation on the Integrity of Neighbouring Photoreceptor Subtypes in Zebrafish

Nicole C. L. Noel, Gordon F. Hagerman, A. Phil Oel, Michèle G. DuVal, W. Ted Allison

Zebrafish have the capacity to regenerate tissues and possess the robust ability to replace lost photoreceptors after destruction. The ablation of photoreceptors can be accomplished in numerous ways - however, most methods result in generalized destruction. Our lab has engineered zebrafish lines to allow the ablation of specific photoreceptor subtypes (blue or UV cones) via treatment with an otherwise inert pro-drug, metronidazole (MTZ). The effect that ablating one photoreceptor subtype has on neighbouring photoreceptors has been investigated using these transgenic fish lines. Blue or UV cones were ablated at 7 days post fertilization (dpf) and the characteristics of surrounding photoreceptors analyzed. We investigated whether neighbouring, non-target cells underwent additional apoptosis via a cell death assay, and also assessed whether the abundance of remaining photoreceptor types was skewed after treatment. No detectable toxic or deleterious effect was noted in either cone ablation line. This indicates that our model of targeted ablation is specific and cell autonomous, meaning that these zebrafish cone ablation lines can be used to explore changes in retinal physiology, cone connectivity, and regenerative responses after only one cone subtype is lost.

37 Subfertility improves with age in male mice with Cecr2 mutations

Kacie A. Norton, Chelsey B. Weatherill, Kenji Rowel Q. Lim, Vivian V. Nguyen, Ross C. Humphreys, Heather E. McDermid

Mammalian reproduction is dependent on a myriad of genes, all of which must be carefully regulated spatially and temporally to ensure successful fertilization and embryonic development. Part of this process depends on chromatin remodellers, which are able to affect nuclear processes such as gene transcription, DNA replication, recombination or repair through modulation of chromatin structure. Mutations in chromatin remodelling gene Cecr2 result in subfertility. Interestingly, mutant males are most subfertile immediately after sexual maturity (42-60 days) and within 2 months litter sizes improve from 11.7% to 58.3% the size of litters from normal males. Histological analysis has revealed severe defects in the seminiferous tubules of young adults, including tubules that have very few cell layers and are not completing spermatogenesis. These defects become less common and less severe with age. Using immunofluorescence to visualize zygotes 5 hours post mating, I have shown that the fertilization frequency of mutant males follows the same pattern, indicating that subfertility is due to fewer oocytes being fertilized. Intriguingly, this rescue of phenotype with age may be due to increasing levels of Cecr2 transcript within the mutant testis. Transcription of Cecr2 in the testis appears to occur from both canonical exon 1 and a novel upstream exon, and the novel isoform may increase in prevalence in mutants as they age. Investigating the regulation of Cecr2 and the cause of subfertility in Cecr2 mutant males will advance our understanding of the various roles that chromatin remodeling plays during spermatogenesis and fertilization.

38 Goldfish (carassius auratus) immune responses to intravenously injected polymer-coated TiO2 nanoparticles

Van Ortega, David Boyle, James Stafford, Greg Goss

Evidence of nanoparticle (NP) effects on immune cell function has been demonstrated using in vitro models in previous studies that report both the over-activation of pro-inflammatory responses, and suppression of others. Our group has also demonstrated modified immune effects for both cell lines and isolated primary goldfish neutrophils when exposed in vitro to polymer-coated metal-oxide NPs. However, the translation of these effects to in vivo models has not yet been explored. Despite a lack of information of in vivo immune effects, it has been shown that when NPs enter circulation in fish, the vast majority is deposited into kidney tissues, which in fish are the major hematopoietic organ and where many innate immune cells reside. Thus, there is an increased opportunity for neutrophils and macrophages in the kidneys to interact and be affected by tissue-accumulated NPs. In this study we have isolated kidney neutrophils and macrophages at 0, 1, 7 and 14 days from mature goldfish (Carassius auratus) injected on day 0 with either polymer-coated TiO2 (1 μg/g) or to Cortland's saline (control). At each time point, kidney, spleen, blood, kidney neutrophils and macrophages were extracted for measurement of tissue metal distribution, expression of various immune and apoptotic-related genes and neutrophil degranulation and respiratory burst. Peripheral blood and tissue prints were also collected for analysis of white blood cell proportions. Preliminary results show increased neutrophil degranulation and respiratory burst relative to control. Gene expression, tissue metal distribution and blood proportional results will be presented.

39 Many ways to make a hermaphrodite: comparative genetics in Caenorhabditis sex determination

Katharine Pelletier, Keith Reidy, Dave Pilgrim

The evolution of novel traits relies on heritable changes in gene content or gene expression, but the processes by which these occur is not always clear. Sex determination is a particularly interesting trait with which to model these processes because its regulation seems to be subject to rapid evolution. Androdioecy, or a species ability to make an ovotestis in an otherwise female animal, has independently evolved three times in the Caenorhabditis nematode clade from a dioecious ancestor. The sex determination regulatory network has been well described in the androdicious species C. elegans and we are using similar genetic and molecular tools to understand regulation of sex in androdicious species, C. briggsae and C. tropicalis. Through comparative genetics, we have identified novel regulatory loci in C. briggsae sex determination. I will present our current understanding of the C. briggsae sex determination pathway and how this can be used to better understand the evolution of genetic regulatory networks.

40 A comparison of diluted bitumen (dilbit) and conventional crude oil toxicity to developing zebrafish

D. Philibert, C. Philibert, C. Lewis, K. Tierney

To facilitate pipeline transport of bitumen, it is diluted with natural gas condensate, and the resulting mixture, ‘dilbit’, differs greatly in chemical composition to conventional crude oil. Despite the risk of accidental dilbit release, the effects of dilbit on aquatic animals are largely unknown. In this study, we compared the toxicity of water accommodated fractions (WAFs) of dilbit and two conventional crude oils, medium sour composite and mixed sweet blend, to developing zebrafish. To characterize the toxicity of the WAFs, we assessed differences insurvival, morphometrics, shelter-seeking behavior and behavioral phenotypes in early life stages of zebrafish embryos. Regardless of WAF type, benzene, toluene, ethylbenzene, and xylene (BTEX) content was a more accurate predictor of lethality and pericardial edema than polycyclic aromatic hydrocarbon (PAH) content. Shelter-seeking behavior was decreased by dilbit and conventional crude WAF exposures, and continuous swimming behaviour was affected by all tested WAF exposures. Our results suggest that the toxicity of dilbit to a model fish is less than or similar to that of conventional crudes.

41 The road less travelled: characterizing elk behavioural responses to roads

Christina M. Prokopenko, Mark S. Boyce, Tal Avgar

The perception of and response to human disturbance is thought to be equivalent in impact to predation risk. Overall, we might expect a negative response towards roads to manifest itself as direct avoidance of roads, and indirectly through increased selection for cover and increased speeds in the vicinity of roads. Disentangling the effect of roads on selection and movement necessitates a comprehensive approach. We investigated fine-scale habitat selection and movement of elk, with a focus on the response to roads using integrative Step Selection Analysis applied to GPS relocation data obtained from 150 elk collected from 2007 to 2013 during the winter season. After accounting for core movement and selection processes, we found that elk avoided roads and this response was sensitive to time of day. Avoidance was greatest during active foraging times (twilight), and lowest during times of low traffic (night). Further, elk sought cover when in proximity to roads. Finally, elk moved greater distances when they were closer to roads, indicating a possible flight response to human disturbance. Findings from this research can inform management decisions pertaining to elk winter range habitats, which will help to maintain a viable elk population on Alberta's rapidly changing landscapes.

42 Butterfly Responses to Fragmentation Associated with In Situ Oil Sands Developments in Northern Alberta Boreal Forests

Riva, F., Acorn, J.H., Nielsen, S.E.

Alberta's oil sands represent the 3rd largest oil deposit, underlying 142,200 km2 of boreal forests. In situ oil sands require seismic assessments that use cleared linear corridors ('seismic lines') to map the bitumen layer. These disturbances are known to affect plants, birds and mammals. Less is known about how this fragmentation affects other groups. To mitigate these effects, seismic line width has been reduced from 8-10 m to 3-5 m. A network of lines is typical, with densities often reaching 10 km/km2.

We used butterflies (Lepidoptera: Papilionoidea and Hesperioidea) as indicators to investigate how different disturbance footprints from in situ oil sands affect the boreal forest ecosystem. Twenty-five Pollard transects were stratified to control (forests with no recent disturbance), road, well pad, conventional and low-impact seismic line treatments.

We identified 1744 specimens belonging to 45 species. Species abundance and richness was higher in roads, well pads and conventional seismic lines compared to control treatments, with no significant difference between controls and low impact seismic lines. Results suggest that forest disturbances associated with in situ oil sands can result in increase to butterfly diversity, although responses of individual species may vary among treatments with turnover between native to non-native species.

43 Taz dependent regulation of Notch and Wnt signaling is required for hindbrain ventricle development

Lyndsay G. Selland, Andrew J. Waskiewicz

Specialized boundaries form between the rhombomeres in the hindbrain and provide signaling cues to the surrounding tissues. We are investigating the role of rhombomere boundaries in regulating formation of the hindbrain ventricle, a structure that forms a specialized neural circulatory system. Aberrant ventricle development correlates with neural tube defects, hydrocephalus and neurodevelopmental disorders. To identify novel signaling pathways that regulate hindbrain ventricle formation, we screened for components with the correct spatio-temporal expression. In zebrafish, the transcriptional co-activator, taz is expressed specifically in the hindbrain roofplate. Using Talen mutagenesis, we demonstrated that taz-/- mutants display ventricle midline separation defects. This phenotype is apparent by 20 hpf indicating defects in initial brain shaping and inflation. We hypothesized that a loss of signaling cues from rhombomere boundaries may be responsible for the defects in ventricle development. Notch and Wnt signaling pathways are selectively activated at rhombomere boundaries. Taz-/- mutants fail to express the Notch glycosyltransferase rfng and wnt1 ligand at rhombomere boundaries. Our data support a model in which Hippo signaling functions via Notch and Wnt signaling pathways to regulate hindbrain ventricle formation.

44 Myomesin is a maintenance protein for the sarcomere during muscle development in Zebrafish

Megan Stannard, Kendal Prill, Dave Pilgrim

The sarcomere - the basic unit of striated muscle - is highly structured, with many protein elements required for its formation and maintenance. The processes by which the many components of the sarcomere are assembled during early muscle development are of great interest, for knowledge of the sarcomere and its composition may be used to determine causes and possible treatments of various myopathies. Myomesin is a sarcomere protein known to be present in all types of vertebrate striated muscle. Myomesin has frequently been used as a marker for the M-line of the sarcomere, and its function has been hypothesized but not definitively proven. By determining that myomesin is present later in zebrafish development, we can theorize that myomesin has a role in sarcomere maintenance, rather than sarcomere formation. The zebrafish model system is advantageous for muscle development research because of the availability of techniques and they can survive for a period of time with a fatal myopathy. We have begun to determine the role of myomesin by establishing the time points which myomesin is present during early zebrafish muscle development when compared to other sarcomere proteins.

45 Active mite choice drives aggregation of parasites among fruit fly hosts

Emily Stolz

Host populations tend to display parasite distributions where most individuals have few or no parasites, while a few individuals are infected with high numbers of parasites (i.e., aggregated distribution). This study examines the role of host preference by an ectoparasitic mite, Macrocheles subbadius that parasitizes a fruit fly host, Drosophila nigrospiracula. The aim of this study was to test whether mites can generate aggregation within the host population by preferentially attaching to hosts that are already infected. We also predict that this preference will be density dependent, in that as mite load increases, the frequency of attachment to infected hosts will also increase. We performed choice-tests whereby mites were simultaneously exposed to an infected and an uninfected fly of the same sex and size and allowed to attach to either hosts. The number of mites on the infected host was manipulated, ranging from 1-3 mites per fly. Our results indicate a preference towards attachment to a previously infected host, particularly when the choice was between an uninfected fly and a fly already infected with 3 mites. This study provides experimental evidence that ectoparasitic mites can generate aggregation within the host population by attaching to hosts that are already infected.

46 A phylogenetic reassessment of Mosasaurus systematics

Hallie Street

To date, no phylogenetic analysis of the extinct marine squamate lineage known as mosasaurs has included more than three species of the type genus Mosasaurus. Since the genus was first erected in 1822, nearly 50 species have been referred to the taxon, though most of these have since been found to be invalid. This is the first study to consider the worldwide diversity of Mosasaurus including taxa from New Zealand and Japan in addition to those from North America and Europe. A morphological comparison that served as the foundation of this analysis began by considering 13 taxa of Mosasaurus to be potentially valid. From that comparison, two species were determined to share more affinities with a different lineage of mosasaurs, and three species were recognized as junior synonyms of the type species M. hoffmannii. The preliminary analysis returned a well supported Mosasaurini clade composed of Mosasaurus, Moanasaurus, and other closely-related taxa but found little resolution within this clade. Combining the data from the taxa considered to be synonymous by the morphological comparison improved the resolution within Mosasaurini. Mosasaurus is now more precisely defined and less speciose, but the global diversity of Mosasaurini is revealed to be greater than previously understood.

47 Armoured herrings: evolutionary patterns of the scute armour development in clupeomorph fishes (Teleostei: Clupeomorpha)

Oksana Vernygora

In clupeomorphs (herrings and allies), scutes are modified scales that are present along the ventral and/or dorsal margins of the body. Among the extant members of the order Clupeiformes, scute armour is limited to the abdominal series, and predorsal scutes are only present in few species of the genera Nematalosa, Hyperlophus, Ethmidium, Gosiutichthys, and Clupanodon; however, predorsal scutes are very common and well-developed in most fossil clupeomorphs (order Ellimmichthyiformes). These bony structures can have a very complex form with surface sculpturing as well as marginal spines and projections. The loss of dorsal scutes has long been considered a derived characteristic of the extant clupeiforms; however, recent discoveries of the Early Cretaceous ellimmichthyiforms that lack dorsal series of scutes suggest a different evolutionary pattern. Revised phylogeny of the Clupeomorpha helps trace evolutionary history of the scute armour development within the group and discuss possible reasons of its loss and reduction in the extant clupeiforms.

48 Estimating Density of Sitatunga in Uganda

Camille Warbington, Mark S. Boyce

A well-regulated hunt can provide crucial conservation funds, especially in areas seldom visited by tourists. However, sustainable harvest management requires knowledge about populations and habitats. Sitatunga is a unique, spiral-horned, semi-aquatic African antelope that provides economic incentive for conservation of wetlands, yet we know little about this spiral-horned species. In 2015, we began a research project to estimate the density of sitatunga in central Uganda using mark-resight population estimation and spatially-explicit capture-recapture models. Although data analysis is ongoing, we calculated a coarse density estimate for sitatunga in the study area of 6.8 per square kilometer (95% confidence interval: 2.7 – 17.1). Future steps in this research include GPS telemetry to estimate home range size, habitat use, and activity patterns; mapping the extent of habitat in the study area and across Uganda; and DNA analysis to characterize the genetic diversity of the population, and estimate immigration and genetic mixing among populations. This research will improve harvest management on a local scale, specifically in Uganda, and provide a framework for sitatunga management throughout its range in sub-Saharan Africa. Enhanced harvest management for sitatunga can contribute to sustainable economies in rural Africa and motivate landowners to conserve wetlands.

49 Post-prandial physiological changes of the Pacific hagfish (Eptatretus stoutii)

Alyssa Weinrauch, Alexander Clifford, Greg Goss

Hagfish are an excellent model for comparative vertebrate physiology owing to their basal position in vertebrate phylogeny. Occupying a unique feeding niche, the hagfish devour both live and dead prey ranging from polychaetes to cetaceans. Recently it was discovered that multiple epithelia are utilized in nutrient acquisition, however the physiological changes at the whole-animal level have never been described. Thus, we measured physiological parameters commonly altered with feeding in fed and fasted hagfish. We hypothesized that following feeding, like in other fishes, the hagfish would demonstrate specific dynamic action (increased metabolic oxygen consumption following feeding) and elevated nitrogenous waste excretion. We also investigated whether the alkaline tide phenomenon (elevated pH levels in the bloodstream to counteract acidic digestion) occurs in the hagfish. We found evidence of specific dynamic action as metabolic oxygen consumption more than doubled from 0.81 µmol g-1 h-1 to 1.91 µmol g-1 h-1 and ammonia excretion rates increased nearly 15-fold from 19.4 µmol g-1 h-1 to 277.8 µmol g-1 h-1. Furthermore, excretion of base equivalents significantly increased ~11-fold, 8 hours following feeding, while the blood acid/base parameters remained tightly regulated and relatively constant.

50 bmp3 is a novel regulator of neural crest cells in the vertebrate eye

Sonya Widen, Prajakta Desai, Ordan Lehmann, Andrew Waskiewicz

Proper development of the vertebrate embryo requires fusion of epithelial cell sheets, resulting in closure of the developing neural tube, palate and retina. Within the eye, failure of optic fissure closure results in ocular coloboma, a leading cause of pediatric blindness. Previous work from our laboratory has defined a key role for Bone Morphogenetic Protein (BMP) signaling in regulating optic fissure closure. Dorsally expressed ocular BMPs are required for proper eye development. Outside of the retina, a population of neural crest cells known as periocular mesenchyme (POM) migrates to the fissure sites and is required for optic fissure closure, although the mechanism is currently unknown. We identify a novel regulator of ocular fissure closure: bmp3. Loss of zebrafish bmp3 results in fissure closure defects. Surprisingly, bmp3 is expressed not in the eye, but in a population immediately adjacent to it, across which POM cells migrate. We hypothesize that bmp3 regulates POM migration to target tissues, as loss of bmp3 results in mislocalization of POM to the pharyngeal arches. Current studies focus on identifying zebrafish carrying induced bmp3 mutations to define molecular mechanisms underlying POM function in the optic fissure.

51 Songbird response to vegetation recovery on reclaimed well sites in the boreal forest of Alberta

Scott Wilson, Erin Bayne

Industry is required to reclaim oil and gas well sites in Alberta with the intention of recovery to an equivalent ecological function as prior to disturbance. Limited information exists on how bird communities change with vegetation recovery on reclaimed well sites. This study will use biacoustic methods to determine how bird communities are influenced by well site reclamation efforts.

Autonomous recording units (ARUs) were used to determine bird community composition on and surrounding reclaimed well sites (n=43) near Lac la Biche, AB in 2015. Grids of GPS time synced ARUs were deployed at a subset of sites (n=9) in order to use the method of acoustic localization to determine singing locations of individual birds.

Variation in bird community composition based on vegetation characteristics was assessed using Canonical Correspondence Analysis. Relative abundance of individual species was determined using single season N-mixture models. Preliminary acoustic localization data found that alder flycatcher (Empidonax alnorum) and clay-coloured sparrow (Spizella pallida) sang from regenerated well sites.

The potential to use bioacoustic methods to collect spatial data on birds will be evaluated. These results will provide insight into the strategies that have been effective in promoting bird use of reclaimed well sites.

52 MOLECULAR AND CELLULAR MECHANISMS BY WHICH BEHAVIOURAL FEVER INCREASES TELEOST IMMUNE EFFICIENCY

Michael Wong, Jeffrey Havixbeck, Aja Rieger, Keith Tierney, Daniel Barreda

Behavioural fever has previously been implicated in increased responsiveness to pathogen challenges and clearance, though mechanisms by which immunity might be modulated to achieve these effects remain largely unclear. To study the impact of behavioural fever on teleost innate immunity, a goldfish (Carassius auratus) self-resolving peritonitis model was used in conjunction with a specially designed aquatic temperature preference apparatus. Quantitative behavioural analysis identified a distinct period of high temperature preference accompanied by signs of lethargy in challenged, but not control fish. The strict regulation of this behaviour was accompanied by an early increase in pro-inflammatory cytokines IL-1β, TNF-α and CXCL-8 expression at the inflammatory site coupled to distal modulation of cytokine gene expression in the brain of challenged fish. Changes to cytokine profiles were further associated with increased recruitment of circulating leukocytes into the inflammatory site. Notably, we also observed distinct changes in the kinetics and levels of ROS and NOS production among infiltrating leukocytes. Our new data provides a mechanistic basis for the increased pathogen clearance previously associated with ectothermic behavioural fever.

53 Elucidating mechanisms affecting abundance and prevalence of acanthocephalans in freshwater amphipods

Zhuoyan Song, Victoria Giacobbo, Qi Liu, Heather Proctor

What factors determine parasite abundance and prevalence is a central question for modern ecologists and parasitologists. For freshwater ecosystems, parasite abundance and prevalence can be influenced by colonization time for both host and parasite, or be controlled by waterbody size, eutrophication, and bottom-up effects from hosts. In Edmonton, Alberta, Canada, thorny-headed worms (Acanthocephala) are common parasites, many of which (e.g. Polymorphus and Corynosoma spp.) have amphipods such as Gammarus lacustris Sars (Gammaridae) as intermediate hosts for their larval stage and are transmitted to the guts of their final hosts (mostly waterfowl) via predation. Amphipods are important prey for many species of waterfowl in western Canada. In my talk, I will present some preliminary results of my 2015 summer investigations of waterfowl, G. lacustris, and Acanthocephala in 36 Edmonton's wetlands to look into how waterbody size and age, waterfowl usage, eutrophication and G. lacustris density influence Acanthocephala abundance and prevalence.

Poster Presentations

54 A 10,000-year record of atmospheric mercury deposition in northern Yukon, Canada

Sasiri Bandara, Duane G. Froese, Colin Cooke, Vincent St. Louis

Lake sediments, peatlands, tree rings, and ice cores are often used to estimate the influence of recent human activities such as coal burning and climate change on the biogeochemical cycling of Hg. Over thousands of years, sub-arctic and arctic yedoma and peat permafrost sequestered atmospherically deposited Hg prior to human impacts. However, with continued climate warming, it is hypothesized that these northern cryosols will shift from stable carbon/Hg sinks to carbon/Hg sources through permafrost degradation. Accelerated loss of Hg from yedoma silts and peat bogs to adjacent aquatic environments may pose a threat to both wildlife and humans. Here, we reconstruct natural fluxes of atmospheric Hg deposition during the Holocene (last 10,000 years) through the drilling, recovery, and analysis of permafrost from peatlands along the Dempster Highway and the Old Crow and Bluefish basins in northern Yukon, Canada. Based on our analyses, we quantify the natural variability in atmospherically deposited Hg fluxes in light of millennial-scale climate as derived by pore-ice stable isotope ($\delta^{18}O$ and δD) trends over the last 10,000 years, from which we will be able to compare current rates of deposition due to human activities and quantify potential fluxes of Hg to downstream freshwater systems.

55 Linking aquatic and terrestrial ecosystems: effects of introduced fish on alpine birds and their aquatic-derived prey

Allison Banting

Aquatic organisms with complex life histories spend their early life under water before emerging as adults, a process that links aquatic and terrestrial systems. The introduction of non-native fish into freshwater systems can directly and indirectly influence the trophic structure in each system and is particularly magnified at high elevations. Fish predation by non-native fish can reduce aquatic insect abundance (top-down) and lead to fewer emergent adults for terrestrial consumers, such as songbirds (bottom-up). The magnitude and timing of aquatic insect emergence affects both the survivorship and foraging behavior in birds. Songbirds that are experiencing population declines in North America and forage and nest at high elevation environments may be especially vulnerable to a reduction in prey availability. This study will assess the direct role of introduced non-native fish in altering the aquatic insect community, and evaluate whether relative bird abundance is related to a reduction in prey availability. From data collected in 2015 and 2016, I will compare littoral invertebrate abundance and relative songbird abundance at forty fishless (n=13) and fish bearing (native (n=13); non-native (n=14)) alpine and sub-alpine lakes in Banff National Park, Alberta. Preliminary results from pilot data showed a significant separation ($P < 0.001$) between fish-bearing and fishless lakes using non-metric multidimensional scaling (NMDS) and PERMANOVA analyses. Understanding the effects of historic stocking practices on the ecological integrity of mountain lake ecosystems can provide recommendations for restoration projects in Banff National Park.

56 Does ambient temperature influence polar bear terrestrial movement in western Hudson Bay?

Alexandra Beatty, Nick Pilfold, Ron Togunov, Evan Richardson, Nick Lunn, Vicki Sahanatien, Erin Bain, Andrew Derocher

The western Hudson Bay polar bear (Ursus maritimus) population spends the ice-free summer months conserving energy on land. Temperature variations impact polar bear behavior and movements. Understanding how polar bear behavior is influenced by temperature is paramount for their preservation. However, the influence of external factors, such as temperature, wind and precipitation on polar bear movement has not been researched. This study will determine how air temperature, wind and precipitation influences terrestrial movement rates. Previous research of cold-adapted species like polar bears suggests individual movement could decrease in response to hyperthermia, or warming. Additional studies established that warmer temperatures might cause a decrease in movement as a method of energy conservation. This research will examine the influence of ambient temperature on polar bear terrestrial movement rates. Climate change will continue to increase the amount of time polar bears spend on land. Knowing how temperature influences their terrestrial behavior will contribute to polar bear conservation.

57 Hen Houses and Predator Removal: Tools for Management of Upland Duck Nesting Success in the Alberta Parklands?

Emily Blythe

Within the Prairie Pothole Region (PPR), Alberta parkland habitats have been identified as crucial breeding areas for migratory waterfowl. Duck nesting success has decreased across the PPR over the last several decades, often below the 15-20% threshold necessary to maintain populations. The decline is largely attributed to increased predation resulting from habitat alteration, specifically loss of native prairie. In both the 2016 and 2017 nesting seasons, each of 200 hen houses installed in the Buffalo Lake region will be visited a minimum of 3 times, and active nests will be regularly monitored for incubation stage and nest fate. Use and success rates of hen houses will be calculated. From March-July of each study year, professional trappers will target corvids and mammalian predators including coyotes, skunks, foxes, and raccoons on select upland plots. Nest searching will be done on all trapped and control plots at least 3 times per season using the chain-drag method, and active nests regularly monitored. An estimate of nesting success will be determined for both regions, and used to evaluate the efficacy of each management tool. Habitat associations with successful versus depredated nests might help to identify those habitats where nest predators would be of least consequence.

58 Organic Carbon Dynamics in Permafrost Thaw in the Western Canadian Arctic

Cara Bulger

Anthropogenic climate change has affected the Canadian Arctic cryosphere, accelerating the development of retrogressive thaw slumps (RTS) across the Western Canadian landscape. Much of this landscape is susceptible to thermokarst features, as it is underlain by ice-rich permafrost. The Peel Plateau is the area of focus for this research as high amounts of RTS activity has been recorded and the soil profile is rich in inorganic materials. The nature of the thawing substrate in Peel Plateau RTS is predicted to alter the carbon dynamics in ways that contrast with thermokarst features in organic-rich soils common in other Arctic regions. Retrogressive thaw slumps result from the thawing of ice-rich permafrost and develop due to ablation of ground ice exposed in the slump headwall. These disturbances can persist for several decades and individual disturbances can impact several hectares of terrain. RTS provide pathways for dissolved organic carbon previously inaccessible while stored in permafrost, to become available for either processing within soils, or loss through downslope transport, creating a relatively novel input source for the global carbon budget. As a result of the increase in abundance and magnitude of permafrost disturbances they are now recognized as an important biophysical variable influencing greenhouse gas exchange in the North.

59 Characterization of the sodium-phosphate transporter, NaPi-II, in the Pacific hagfish (Eptatretus stoutii)

Dylan Cole

Inorganic phosphate (Pi) is an essential nutrient for organisms and is often in limiting supply. It was recently demonstrated that the Pacific hagfish, Eptatretus stoutii, has the unique ability to obtain Pi from the environment through its gills and skin, in contrast to vertebrates which rely on intestinal Pi uptake. This study aims to characterize the sodium-phosphate transporter, NaPi-II, found in the gills of the hagfish using Xenopus leavis oocytes. Thus far, the hagfish NaPi-II gene has been cloned into the pXT7 vector using restriction enzymes. Plasmid DNA has been extracted, linearized, and transcribed in vitro. The next step in this study is to inject synthesized RNA into mature oocytes to produce functional proteins. The oocytes will then placed in media containing the radioisotope 32P, which will be used to quantify uptake rates by the transporter. A variety of experimental conditions will tested and uptakes rates measured. A surface biotinylation experiment will be used to confirm transporter expression on the surface of the oocyte. Lastly, two-electrode voltage clamp will determine the ratio of Na+ to HPO4-2 transport. This research will aid in understanding the transporter responsible for the unique method of Pi acquisition seen in hagfish.

60 Ecological Relevance of Ucrit: The Link Between Sustained Swimming Performance and Prey Capture Behaviour in Juvenile Rainbow Trout (Onchorhynchus mykiss)

Kyle Dehaan

Swimming performance in fish is a key aspect of their fitness and relates to activities such as predator avoidance, prey-capture, migration, spawning, maintaining position in currents, and establishment of dominance hierarchies. There are three classifications of swimming in fish: sustained swimming, prolonged swimming, burst swimming. Ucrit is used as a measure of maximum sustained swimming prior to fatigue in fish, and has allowed researchers to compare the swimming speeds of different species. While this has been useful for comparisons, the link between Ucrit and ecologically relevant behaviours has not been well documented. In my research I intend to use carbamazepine (CBZ) to test if a decrease in Ucrit is associated with the prey capture ability of juvenile rainbow trout (Onchorhynchus mykiss). From our pilot experiments, it appears that there is a link between CBZ and Ucrit and so will be an appropriate way to test whether prey capture ability is linked to Ucrit.

61 Toxicological impacts of hydraulic fracturing fluid spills to two model aquatic species

Perrine Delompré, Tamzin Blewett, Henry He and Greg Goss.

Hydraulic fracturing (HF) is a process allowing access to gas or oil, trapped in deep sedimentary deposits. To fracture the rocks, a high-pressure liquid is injected into wells. Then, the Flowback and Produced Water (FPW), a highly saline solution containing metals and organic constituents, is pumped to the surface. Between 2005 -2013 there were >2500 documented flowback spills in Alberta. The goal of this research is to understand the mechanistic toxicological effects of FPW on two important species. The 48h-LC50 (Lethal concentration where 50% of the population is deceased) of Daphnia magna and 96h-LC50 for Rainbow Trout (RT) were measured. In RT, liver tissues were analyzed for CYP enzyme activity (EROD) and qPCR to observe biomarkers of estrogenic distress. The LC50 for Daphnia, occurred at 1% of the FPW compared to 6% for RT. Analysis of EROD displayed 7.5-fold induction compared to control liver tissue. Liver qPCR displayed mRNA induction of vitellogenin and CYP enzymes compared to control group. This study is the first to show the toxicological effects of FPW in two key species and help us to understand the relative impacts of fluid spills, and ultimately use this information to design post-spill environmental effects monitoring and risk assessment.

62 A skeletochronological assessment of age structure in a boreal population of wood frogs (Lithobates sylvaticus)

Caitlyn Donadt

Amphibians are an integral part of biodiversity in forest ecosystems. Their use of both aquatic and terrestrial habitats, and their sensitivity to environmental change, makes them an excellent indicator of ecosystem health. Ascertaining basic demographic information of a population is important for assessing population dynamics under potential stressors such as anthropogenic land-use change. I am currently examining the age structure of a population of wood frogs (Lithobates sylvaticus) in the boreal mixedwood forest of northwestern Alberta using skeletochronology. Skeletochronology is a technique used to determine the age of an individual by counting annual growth rings known as Lines of Arrested Growth (LAGs) in a section of bone. Although many studies have reported using this technique in a variety of amphibian species, our results show that reading LAGs alone may be unreliable for age determination. Thus far, we have found evidence of natural bone degeneration in many sections, making conclusive estimation of age challenging. To address this, we are currently developing methods to compensate for potential LAG loss. These results will be important for consideration of future studies of age and growth of amphibian populations.

63 Impact of Aspen and Willow homogenate on the detection of PrPC in a western blot

Janay Fox

Chronic wasting disease is known to be efficiently horizontally transmitted through the spread of infectious PrPCWD in the environment. However, there is still no information on how to detect these infectious agents in the environment. There are various studies that verify that environments can be contaminated by excretions from infected animals and that this contamination can result in the spread of the disease but no studies delve into the detection of PrPCWD. The detectable limit of PrPCWD in brain homogenate diluted with water was compared to the detectable limit of PrPCWD in brain homogenate diluted with aspen and willow homogenate in a western blot. The presence of aspen and willow homogenate was found to have no impact on the limit of detection of PrPCWD in a western blot.

64 Brain malformations in mice with Cecr2 mutations

Dora Gyenes, Kacie Norton, Heather McDermid

CECR2 is a protein involved in neural tube closure. Mutations in the Cecr2 gene cause exencephaly in mice, equivalent to the fatal human neural tube defect anencephaly. CECR2 is part of a chromatin-remodeling complex, which organizes DNA to control gene expression. Our lab works with 2 Cecr2 mutations; a deletion (Cecr2Del) and a gene trap (Cecr2GT). A previous penetrance analysis found Cecr2Del/Del embryos have an exencephaly penetrance of 100%, but we had reason to believe this could have changed due to various genetic and environmental factors. Therefore, I performed a penetrance analysis to investigate if there were any Cecr2Del/Del embryos that did not show exencephaly, indicating the penetrance is lower than 100%. These non-penetrant Cecr2Del/Del mice could then be studied for their deficits after birth. Since it is not known if it is possible to study living Cecr2Del/Del mice, I concurrently studied compound heterozygote (Cecr2GT/Del) mice, which show a penetrance of ~75%. We know that Cecr2 is expressed throughout brain development in mice, so I hypothesized that there are differences in the brain structure of mutant mice compared to wild type that could manifest as functional deficits. I analyzed the brain of a Cecr2GT/Del mouse and a wild type mouse to observe structural differences. To date I have observed gross differences in the quality of white matter tracts, especially in the cerebellar region. This research provides new knowledge about genes and proteins involved in neural tube defects and their implications in non-penetrant human adult cases.

65 Cavitation fatigue and drought-induced xylem pit membrane damage in aspen and balsam poplar

Rachel Hillabrand

Tree-dieback in western Canada due to drought has been extensive in recent years. Predictions of a drier climate in the next decades have increased interest in the mechanisms of tree mortality following water stress. Cavitation fatigue is a phenomenon whereby trees previously subject to drought have an increased vulnerability to a loss of their hydraulic conductivity, possibly due to irreparable damage to the xylem pit membranes. Two species were included in the study, aspen (Populus tremuloides) and balsam poplar (Populus balsamifera), which are common in western Canada and known to experience cavitation fatigue. Experiments were conducted to test the hypothesis that trees which experience drought have more porous pit membranes. Pit membranes of control and drought-stressed trees were observed with scanning electron microscopy (SEM). Our findings are the first to document increases in pit membrane porosity due to drought, which we evaluated in two ways. We asked: (1) is the percentage of visibly porous membranes increased in trees exhibiting fatigue? And, (2) is the diameter of the largest pore in visibly porous membranes increased in trees exhibiting fatigue?

66 The Effect of Syncytiotrophoblast Extracellular Vesicles on the Production of Reactive Oxidative Species and Toll-Like Receptor Nine Expression

Jamie Hudson, Anita Quon, Floortje Spaans, Sandra Davidge

Preeclampsia is a pregnancy complication characterized by the development of hypertension and proteinuria in the second half of pregnancy. There is currently no definitive cause, however it is thought to result from malformed spiral arteries during placentation, leading to endothelial dysfunction and systemic inflammation. Syncytiotrophoblast extracellular vesicles (STBEVs) are produced when the syncytial placental surface is shed into the maternal circulation. We hypothesized that this causes vascular endothelial cell dysfunction via activation of the multi-ligand lectin-like oxidized low-density lipoprotein scavenger receptor (LOX-1), producing reactive oxidative species (ROS), which damage the mitochondria, inducing an increase in toll-like receptor 9 (TLR9) expression. To assess our hypothesis, human umbilical vein endothelial cells (HUVECs) were cultured with or without STBEVs in the presence or absence of a LOX-1 blocking antibody for 24hrs. The presence of ROS was determined by completing dihydroethidium (DHE) staining and TLR9 expression was determined by western blotting. Data collection is in progress; however we anticipate increased ROS production and TLR9 expression in response to exposure to STBEVs, which is reduced by LOX-1 receptor blocking. The increase of these factors may explain how STBEVs could contribute to systemic inflammation and vascular dysfunction in women with preeclampsia.

67 Effects of OSPW exposure on the feeding efficiency of zebrafish larvae

Daniel Hwang, Danielle Philibert, Clara Philibert, Keith Tierney

Oil sands mining requires water for bitumen extraction and the side product, oil sands process affected water (OSPW), is stored in tailings ponds. Large reservoirs OSPW are expected to be reclaimed by creating water bodies that mimic natural aquatic systems found in the region. Ozone treatment has been considered as a possible reclamation technology to reduce toxicity of OSPW. The impact of OSPW exposure on early developmental stages has been well studied, however, the sublethal impacts of ozonated and raw OSPW exposure in later stages of fish development have yet to be determined. In this study we compared the survival, heart rate and feeding efficiency of fish exposed to ozonated and raw OSPW to better understand the potential impact of OSPW on native fish populations.

68 Resilience of soil bacteria to long-term nitrogen and sulfur depositions in the boreal forest of northern Alberta

Stephanie Ibsen, Bin Ma, Scott X Chang

Intensified oil sands activities have resulted in elevated levels of nitrogen (N) and sulfur (S) inputs in the mixedwood boreal forest in the Athabasca oil sands region (AOSR). The deposition of N and S can have a variety of negative effects on the surrounding ecosystem and it is important to monitor possible changes. Because soil microbes, more specifically bacteria, are sensitive to changes, influence soil system processes, control deposition, and mediate soil C and N cycles, understanding how these increased depositions are affecting soil bacterial communities will help improve our ability to predict ecosystem responses. A simulated N and S deposition experiment was established in 2006 in the AOSR with the following treatments: control (CK), N addition (+N, 30 kg N ha-1 yr-1 as NH4NO3), S addition (+S, 30 kg S ha-1 yr-1 as Na2SO4), and NS additions (+NS, 30 kg N plus 30 kg S ha-1 yr-1). We used pyrosequencing based analyses of 16S rRNA genes in soil microbial communities to determine bacterial diversity and community composition and found no significant differences ($P > 0.1$). We can conclude that soil bacteria in the AOSR are more resilient to N and S depositions, than previously hypothesized.

69 Population-level and temporal trends in polar bear (Ursus maritimus) foraging ecology in Western Hudson Bay

Amy Johnson

Polar bears (Ursus maritimus) rely heavily on sea ice for hunting their main prey, ringed seals (Phoca hispida). However, sea ice is declining due to climate change which has negative effects on polar bear body condition, reproduction, survival, and abundance. Further sea ice declines are expected in the future which threatens the persistence of polar bears and indicates the importance of understanding the ecological consequences of environmental change.

This project's objectives are to: 1) Analyze dietary differences within the Western Hudson Bay population; and 2) Examine temporal trends in foraging ecology. Dietary differences within the population will be investigated by examining the relationship between individual characteristics (age, sex, reproductive status, condition) and diet (from Stable Isotope Analysis of guard hair) using Generalized Linear Models. Temporal trends will be analyzed by conducting ANOVAs on dietary composition from short-term (each season) and long-term (1990-2012) data. The relationship between diet and sea ice break up will also be examined.

This project will describe the trends in foraging ecology in relation to population dynamics as well as how polar bear ecology is responding to changing habitat conditions. This will be useful in monitoring the influence of climate change and in designing effective conservation strategies.

70 Effects of forest fire severity and configuration on boreal songbirds in naturally regenerating forests

Michelle Knaggs, Erin Bayne, Scott Nielsen

Fire is the most important natural disturbance in the boreal forest, and climate change models predict increased fire frequency and severity due to increases in atmospheric temperature and drought. Songbird population trends have been declining and it is important to understand the implications of increases in burned habitat on their breeding grounds. The objective of this project is to determine the effects that fire severity composition and configuration in the absence of salvage logging has on bird communities in the northern boreal forest. The study area encompases two large, recently burned forests in an accessible region where there is no forestry or salvage logging, creating the opportunity to study changes in bird communities in a naturally regenerating region of boreal forest. A sampling season was completed in 2015 and will be replicated in 2016. Auditory bird surveys are conducted using automated recording units (ARUs). ARUs record sounds in the field that are interpreted visually and aurally by trained individuals using computer software. Preliminary results will be discussed.

71 Use of automatic acoustic recognition for Common Nighthawk habitat modelling

Elly Knight

Habitat modelling is imperative for species at risk management and conservation; however, adequate inventory data is necessary to produce robust habitat models. Species with cryptic or nocturnal life histories, large geographic ranges, and remote habitats can be difficult to inventory using conventional methods. Common Nighthawks (Chordeiles minor), in particular, are highly understudied because their crepuscular habits preclude them from detection by standard monitoring programs. As a result, little is known about the habitat relationships of this federally Threatened species, particularly in the boreal forest, but initial Canada-wide models suggest high population densities in the boreal forest. Bioacoustic survey methods are ideal for inventorying Common Nighthawks because their simple, frequent vocalizations make them easy to detect with automatic recognition software, which is increasingly used to overcome the challenge of processing the large volumes of data produced through bioacoustic survey methods. I will present a habitat modelling case study from northeastern Alberta that uses automatically recognized data. Results presented will include an assessment of automatic recognition methods and recommendations for bioacoustic surveys for Common Nighthawks. Preliminary models presented will provide the first assessment of boreal habitat relationships for Common Nighthawks, including for anthropogenic land-use types.

72 The role of sonic hedgehog and BMP in the formation and closure of a novel superior ocular fissure

Sophie Koch, Jennifer Hocking, Jakub Famulski, Sonya Widen, Kevin Yoon, Tara Stach, Omri Weiss, Adi Inbal, Ordan Lehmann, Andrew Waskiewicz.

Ocular coloboma is a congenital disorder that arises due to failure of the ventral choroid fissure to close and results in pediatric blindness. We identified 7 patients in which coloboma exists not in the ventral aspect of the eye, but instead in the dorsal/superior side. Using zebrafish as a model, we identified a fissure in the dorsal aspect of the developing eye. In embryos lacking the bone morphogenetic protein (BMP) ligand, gdf6a, fissure closure is delayed resulting in superior coloboma. In gdf6a mutants the ventral patterning marker, vax2, is completely expanded and adults develop ocular defects. BMP signaling in the dorsal eye inhibits ventral sonic hedgehog (Shh) signaling. This, coupled with a patient mutation in VAX2, led us to investigate the role of ventral factors in superior fissure closure. Treatment with the Shh inhibitor cyclopamine causes early fissure closure in wildtype embryos and rescues the closure delay in gdf6a mutants. Additionally, embryos lacking gdf6a and Shh display altered superficial ocular vasculature, especially in the dorsal vessel that grows through the superior fissure. This demonstrates that ventral signaling plays a role in superior fissure morphogenesis and in vascular guidance regulated by opposing BMP and Shh signaling in the developing eye.

73 Zebrafish targeted mutagenesis to unveil normal physiological functions of, and interactions between, Prion Protein (PrP) and Amyloid Precursor Protein (APP): Relevance to Alzheimer's disease

Patricia L.A. Leighton, Natasha Lifeso, Richard Kanyo, Niall Pollock, W. Ted Allison

Introduction. We aim to uncover the elusive functions of prion protein (PrP) and amyloid precursor protein (APP) and to identify therapeutic targets for prion diseases and Alzheimer's disease. Zebrafish have two homologs of PRNP (prp1 and prp2) and APP (appa and appb) that have functional conservation with their mammalian counterparts. Our demonstration of a genetic interaction between prp1 and appa supports a role for PrP in Alzheimer's disease (Kaiser et al. 2012 PMID: 23236467).
Methods.
We targeted the zebrafish appa and prp1 genes using Tal Effector Nucleases (TALENs), and founded multiple fish lines with frameshift mutations. We visualized neuromasts in the posterior lateral line by staining endogenous alkaline phosphatase. We stained neuromast hair cells using FM 1-43 and detected β-catenin by immunohistochemistry.
Results and Discussion.
Maternal zygotic prp1-/- and appa-/- mutants survive to adulthood and have no overt phenotypes (similar to Prnp and APP knockout mice, respectively). Preliminary work suggests that appa and/or prp1 are involved in neuromast migration and neural cell adhesion. We will attempt to rescue phenotypes in the mutants using zebrafish and mammalian APP and PRNP mRNA. Our findings regarding the normal roles of PrP and APP will provide insights into prion diseases and Alzheimer's disease.

74 A novel Cecr2 isoform is predicted to partially rescue subfertility in mutant male mice

Kenji Rowel Q. Lim, Kacie A. Norton, Heather E. McDermid

Chromatin remodelers alter gene accessibility to regulatory factors, influencing both gene expression and structural integrity. Cecr2 codes for a protein member of a chromatin remodeling complex. Male Cecr2-mutant mice have subfertility, which surprisingly improves with age. Recent evidence suggests the existence of a novel Cecr2 splice isoform that may compensate for the loss of canonical CECR2 in mice. This study aims to determine if this mRNA isoform codes for a Cecr2 variant protein, and if its expression correlates with the partial subfertility rescue in Cecr2-mutant mice. In CECR2-detected Western blots of wild-type testes extracts, a "mystery" band (M-band) appears below the canonical CECR2 band and is the size of the predicted protein encoded by the isoform. I have shown that this band is absent in SNF2H-immunoprecipitated samples as expected, since the DDT domain required for SNF2H binding is predicted to be absent in the isoform protein. Further mass spectrometric analysis with Cecr2-mutant mice and a spermatogonial cell line should help confirm the M-band identity. In preparation for RNA expression analysis, I have optimized the specific amplification of the RNA isoform. Future quantitative real-time PCR analysis of the Cecr2 isoform in testes RNA extracts across different ages will help elucidate its possible role in subfertility partial rescue.

75 Living in sympatry: Habitat selection by grizzly and black bears in a multi-use landscape

Anne E. Loosen, Andrea T. Morehouse, Greg C. Hale, Mark S. Boyce

Southwestern Alberta is an important area for maintaining connectivity with wildlife populations in British Columbia and Montana; it is also a biologically diverse and multi-use landscape with agriculture as the primary industry. The area supports populations of both grizzly bears (Ursus arctos) and black bears (U. americanus), where population-level effects of competition may result in habitat partitioning. While both species use similar food resources, black bears typically have lower nutritional requirements and a higher tolerance for human-disturbed landscapes relative to grizzlies. In 2013 and 2014, we established 899 non-invasive genetic sampling stations to collect hair samples from grizzly and black bears. Rub objects were sampled every 3 weeks from May to November. We identified species, sex, and unique individuals using nuclear DNA extracted from hair follicles. In southwestern Alberta the resident grizzly bear population is growing 4.2% annually and expanding their range eastward, while anecdotally black bears appear also to be shifting their spatial patterns of habitat use. We hypothesize that relative to grizzly bears, black bears would be more likely to select habitats closer to roads, areas with higher road density, and closer to human settlements. While there are limitations in evaluating interspecific competition based on species' habitat selection patterns, the inherent variation across our study area will allow us to evaluate selection patterns based on proximity to human developments and habitat types. We will present preliminary data on the spatial distribution of grizzly and black bear detections in the summer and fall.

76 Transcriptional responses of two fish species following crude oil exposure

Danielle Lyons, Danielle Philibert, Keith Tierney

Studies have found that crude oil exposure is highly toxic to fish during early life stages. This exceptionally complex mixture has been shown to induce numerous abnormalities in developing fish, including cardiac and morphological deformities. Our study compares the molecular responses of two fish species after exposure to oil. Using both a saltwater (Cyprinodon variegatus) and a freshwater (Danio rerio) species, we are able to compare the effects of oil exposure in two different aquatic environments. This study evaluates the effects of three separate oil types; a source oil and two other oil types that vary in degree of weathering. We also assess the effects a commonly used chemical dispersant in combination with the three oil types. To interpret the relative toxicity of these exposures we measured changes in gene expression in fish embryos. Specifically, we have targeted genes involved in neurological and cardiac development as well as biotransformation. The results of this study will compare and contrast the consequences of oil spills in both freshwater and saltwater as well as demonstrate the implications of using a chemical dispersant in these environments.

77 Ungulate predation risk through carnivore diet analysis in the Rocky Mountains of Alberta

Kara MacAulay

MSc. Proposal: Ya Ha Tinda (YHT) is home to a partially migratory herd of elk that has been declining over the last several decades. Ungulates have been shown to alter their foraging, migratory and vigilance behaviours in response to the risk of predation. Previous studies have focused on single predator-prey relationships, but elk face the challenge of navigating a multi-predator community. I will be analyzing carnivore scats collected from YHT to determine proportion of elk, distinguishing between juveniles and adult. I will calculate relative abundance of carnivores through remote camera data, and develop a measure of predation risk as a function of landscape attributes, prey density and distribution of other carnivores. My study will take the next natural step in the ongoing research in YHT to link scat contents of multiple carnivores to predation risk for elk to assess the continued decline of the elk herds.

78 Retinoic Acid promotes development of the vestibular system in the vertebrate inner ear

Kacey J. Mackowetzky, Andrew J. Waskiewicz

The vestibular system is part of the inner ear and is responsible for balance and motion detection. Disorders of this system are caused by genetic and environmental factors, but developing therapeutics is hindered by an incomplete understanding of how the inner ear develops. Retinoic acid (RA), a derivative of vitamin A, induces the otic placode and vesicle formation during early ear development, although its role at later stages, such as the formation of the vestibular neurosensory patches and morphogenesis of the semicircular canals, has yet to be elucidated. During late ear development in zebrafish embryos, RA is synthesized by the aldehyde dehydrogenase aldh1a3, which is expressed in the presumptive cristae of the developing semicircular canals, as well as the endolymphatic duct and the anterior macula. Our goal is to ascertain changes in development of these vestibular structures following pharmacological inhibition of RA synthesis or treatment with RA agonists. Preliminary data suggests RA plays a role in otolithic crystal morphogenesis over the anterior macule and in regulating the formation of the central pillar of the inner ear, around which the semicircular canals will later form. We conclude that RA is necessary during both early and late development of the vertebrate ear.

79 The Genetic Foundations of the Sponge Osculum

Jasmine L. Mah, Sally P. Leys

It is readily apparent that the excurrent vent of the sponge plays a central role in the biology of the filter feeder, but how does the sponge – a relatively 'simple' animal – organize cells and tissues to form such a specialized region? The osculum has organizer-like properties that define and maintain the body axis; the osculum has also been shown to be a sensory and coordinating hub triggering a sneeze-like behavior. Although components of the Wnt pathway are implicated in the osculum's development, and glutamate, GABA and nitric oxide play roles in the sneeze behaviour, there is nothing to say that these responses are the result of functional conservation of proteins and genes across Metazoa rather than a sponge-specific response using similar proteins/genes. Is this 'similar' behavior the result of convergence or homology of genes and proteins? Since the candidate gene approach is limited in breadth and narrowed by a bilaterian viewpoint, understanding these genes in the context of the organismal biology of basal animals is central to tracing their evolution. I will present the design of an RNA-seq experiment examining and comparing cohorts of genes upregulated in the osculum across all four sponge classes.

80 Regulation of the Bmi1 and Ret proto-oncogenes by the DLX2 transcription factor in the developing gastro-intestinal tract

H. McColl, M. Novel, M. Fonseca, J. Zagozewski, D. Eisenstat

Introduction: Colorectal cancer is responsible for the second most cancer related deaths. Mutations in oncogenes responsible for regulating cellular proliferation in the GI tract account for increased susceptibility to this cancer type. Within the intestinal crypts there is a stable, non-dividing stem cell group marked by the oncogene BMI1. The role of these cells is to maintain and support the epithelial cell lining of the intestine, which cannot replace itself mitotically. Unpublished work from the Eisenstat lab demonstrates co-expression of BMI1 and the homeobox transcription factor DLX2 in intestinal crypts. Additional unpublished data support a regulatory role of DLX2 over the Ret proto-oncogene. Ret is responsible for enteric nervous system development. Over-expression of Ret induces cancers associated with Multiple Endocrine Neoplasia, and loss-of-function leads to Hirschsprungs Disease, characterized by defects in intestinal innervation. We investigated the potential for a regulatory effect of DLX2 on both Bmi1 and Ret, with the hypotheses that DLX2 suppresses Bmi1 expression and promotes Ret expression and these interactions are due to direct binding of the targets promoters by DLX2 during intestinal and ENS development.
Methods: We investigated interactions between DLX2 and target promoters in vivo through Chromatin Immunoprecipitation (ChIP) using our high-affinity DLX2 antibody. Electrophoretic mobility shift assays (EMSAs) and with Site Directed Mutagenesis of DLX2 binding sites are used to determine the direct binding of the Bmi1 or Ret promoters by recombinant DLX2 in vitro. Reporter gene assays are being used to determine the effect that DLX2 has on Bmi1 Ret expression in vitro. Ongoing immunohistochemistry and qRTPCR assays using Dlx1/Dlx2 double knockout (DKO) mouse-derived tissues are used to determine the role of DLX2 in Ret and Bmi1 expression in vivo.
Results: DLX2 interacts with both Bmi1 and Ret promoter regions of interest in vivo. EMSA results demonstrate specific binding of DLX2 to the Bmi1 and Ret promoters in vitro.
Conclusion: ChIP results confirm DLX2 occupancy of the Bmi1 and Ret promoters while EMSAs demonstrate direct binding of DLX2 to the promoters in vitro. Future studies include in vivo gene expression assays comparing wild type expression in the Dlx1/Dlx2 double knockout mouse to the wild type will confirm the biological relevance of the in vitro results

81 Yukon Ice Patches: Role of Ice-entombed Bryophytes in Alpine Environments

Brittney Miller

Yukon alpine glacial ice patches are rapidly disappearing, exhuming 8000 year old plant populations that have been preserved in pristine condition. A major component of the ice patch flora are bryophytes, which are critical to alpine ecosystems. However, relative to diverse archeological work, they remained uninvestigated. Bryophytes have the incredible ability to generate a new organism from any viable cell (totipotency), allowing them to persist through extreme conditions. The regeneration of formerly ice-entombed vegetation would indicate that ice patches function as reservoirs of genetic diversity in alpine ecosystems. I initiated research at the Granger Ice Patch, SW of Whitehorse (YT) in August, 2015 and have compiled a rich data set on previously ice-entombed plant assemblages. Sampling within 40m of the ice margin has documented the extant diversity, and the plant succession with ice margin retreat. In vitro culturing of collected ancient plants has preliminarily shown a phenomenal regeneration ability. Next generation sequencing (restriction site associated DNA sequencing) will be conducted to determine the genetic variation between regenerated subfossil plants and modern populations (within the vicinity of Mount Granger) of the dominant taxa, Polytrichum hyperboreum. These preliminary results indicate that exhumed bryophytes contribute to establishment, revegetation, and maintenance of alpine ecosystems.

82 Interaction and Localization of Sequence Variants in Dnmbp, a putative neural tube defect susceptibility factor

Mckenzie Mitchell, Parmveer Singh, Renee Y. M. Leduc, Deidre R. Krupp, Natalie Mola, Erica E. Davis, Nicholas Katsanis, Simon G. Gregory, Allison E. Ashley-Koch, Heather E. McDermid

Cecr2 is one of many genes that causes neural tube defects (NTDs) in mice, however, expression of NTDs occur in a strain specific manner. A penetrance analysis revealed that mice homozygous for a mutation in Cecr2 develop the cranial NTD exencephaly 54% of the time in the BALB/c strain as opposed to 0% of the time in the FVB/N strain. The difference in penetrance suggests the presence of modifier genes, which are genes that effect the expression of other genes. A region on chromosome 19 was characterized as containing possible modifier genes. Amongst the multiple gene possibilities is DNMBP, which encodes a dynamin binding protein that plays a role in regulating cell junctions. A previous study found 8 sequence variants of DNMBP from a collection of 156 patients with cranial NTDs (mostly anencephaly) and one BALB/c mouse variant predicted to be damaging to the protein. Through co-immunoprecipitation, the protein-protein interactions of the variant DNMBP proteins are being investigated to determine if variants have reduced function. Additionally, the cellular localization of DNMBP variants are being observed through immunofluorescence for any localization abnormalities. Any changes illustrated by improper cellular localization or protein-protein interactions will suggest that DNMBP plays a role as a susceptibility gene in human NTDs.

83 Immune Consequences of Genetic Instability in Colorectal Cancer

Courtney Mowat, Sharmin Sumi, Alison McNamara, Kristi Baker

Colorectal Cancer (CRC) is claiming more lives due to the prevalence of unhealthy lifestyles causing changes in the bacterial community of the gut, as well as gut morphology. A complication of CRC is the tolerogenic mucosal immune system, which is required for the homeostasis of the bacterial microenvironment of the colon. This immune suppression hinders recognition of tumour specific antigens, allowing tumours to establish before the immune system can detect them. Approximately 80% of CRCs are chromosomally instable (CIN), which is associated with a poor immune response, making it the most deadly form of CRC. In comparison, microsatellite instable (MSI) CRC only constitutes 15% of all cases, but its high immune response results in a better prognosis. Using CRISPR technology, we have knocked out (KO) or knocked down (KD) genes specific to the mutation profiles of MSI and CIN CRCs. We hypothesize that mutations in the mismatch repair (MMR) pathway associated with MSI CRC cause aberrant proteins to buildup, enhancing the immune detection of cancer cells. The goal of our research is to determine if the loss of non-MMR DNA repair pathways alters bacterial recognition in a way that differentially impacts anti-tumour immune responses compared to MMR mutated cancers.

84 Oil exposure effects on swimming performance, metabolic rate, and gene expression in adult male zebrafish (Danio rerio)

Zachary Mueller

The testing of environmentally realistic mixtures of toxicants, as well as the use of physiologically relevant fitness endpoints, is a major push in ecotoxicology. The properties of oil in water is often much more than the sum of its parts and the use of standardized water and oil mixtures, such as water accommodation fraction's (WAFs), is essential. Although oil exposures on adult fishes has received attention, the toxicological implications of oil exposure on adult fish has struggled to link effects at different levels of biological organization. We endeavor to quantify how acute exposure of WAF affects organismal level parameters, such as in changes in gene expression. In this study we are attempting to find the possible effects of crude oil exposures on the fitness of a model organism, zebrafish (Danio rerio). We exposed adult male zebrafish for 96 h to 5, 25 and 50% WAF. We then measured swimming activity, metabolic rate (MO2), collected gill and liver tissue for qPCR analysis, and gave fish two swim performance tests (Ucrit and Uburst). Our preliminary data show a dose dependent decrease in both Ucrit and Uburst; as well as, a hormesis-like response for resting MO2.

85 Relating genotype and phenotype: Assaying the strength of feminizing alleles in C. briggsae mutants.

Muhammad Muneer, Katharine Pelletier, Keith Reidy, Dave Pilgrim

Hermaphroditism, the ability to transiently produce sperm in a female animal, has independently evolved three times in the Caenorhabditis clade of nematodes. Evolving this trait from a common gonochoric ancestor requires modifying a common genetic regulatory network, the sex determination pathway, so that feminizing genes are briefly down-regulated and masculinizing genes up-regulated in the female ovotestis, allowing sperm production. By understanding how regulation occurs in one hermaphrodite species, C. briggsae, and comparing this to the other, C. elegans, we will better understand how genetic regulatory pathways are modified to arise novel traits.

Ovotestis development is understood in C. elegans hermaphrodites and using similar genetic tools we investigate the development and regulation of sex in C. briggsae. Forward genetic screens for loci capable of rescuing a masculinized phenotype, identified over 70 feminizing alleles in C. briggsae. The causative mutation has been identified in a number of these alleles; however, the degree of feminization of the alleles is unclear. By assaying the number of sperm produced in the ovotestis, I will be able to determine the degree of feminization for each of these alleles and relate specific molecular lesions with strength of feminization. Understanding the relationship between the genotype and the phenotype of these will provide clues to how feminizing loci function in the C. briggsae sex determination pathway. Overall, this will help us better understand the structure and function of C. briggsae sex determination genes and how that differs from C. elegans.

86 Alleles of White-Tailed Deer PRNP Influence Chronic Wasting Disease in Elk Transgenic Mice

Jeffrey P. Narayan, Camilo Duque Velasquez, Chiye Kim, Hristina Gapeshina, Judd Aiken, Debbie McKenzie

Chronic wasting disease (CWD) is a fatal, infectious neurodegenerative disorder of cervids, caused by a misfolded conformer of cellular prion protein PrPc. The disease is characterized by accumulation of protease resistant material, spongiform degeneration and deposition of disease associated PrP in the brain. Amino acid variants of PrP influence both the host and infectious agent. This study aims to further characterize interspecies CWD transmission, and the role of prion protein polymorphisms.
Transgenic mice expressing prion protein from elk (Cervus elaphus) were inoculated with CWD isolates from elk, or white-tailed deer(WTD) (Odocoileus hemionus). All animals displayed clinical signs and characteristics of CWD infection, with differences being observed in those with PRNP allelic variants. Compared with elk CWD, incubation periods were extended with three of the four WTD CWD isolates. Lesion profiling and immunostaining showed elk isolate produced widespread spongiform degeneration and PrPd deposition, whereas deer isolates displayed regional vacuolation and PrPd deposition. The disease-specific abnormal prion protein from TgElk infected with WTD isolates showed variability in protease sensitivity, contrasting to elk, which appeared consistent. Our data show that CWD from deer with different PRNP genotypes display differential properties upon transmission into TgElk mice, suggesting these interspecies transmissions may result in novel CWD strains.

87 Acetylcholinesterase chemical inhibitor effects on in vitro prion replication

Anthony Ness, Jacques Van der Merwe, Judd Aiken, Debbie McKenzie

Prion and Alzheimer's diseases are fatal neurodegenerative amyloid diseases. Both diseases are hallmarked by neuronal loss associated with the formation of amyloid plaques in the central nervous system. Alzheimer's disease symptoms are managed by chemical inhibitors of acetylcholinesterase (AChE) including Tacrine and Donepezil. Prion diseases are characterized by amyloid plaques containing the host prion protein (PrP) that has been misfolded into a disease-associated isoform (PrPSc). We hypothesize that AChE may act as a co-factor enhances prion replication. Thus, exposure of AChE inhibitors to these prion-infected cells would be predicted to reduce the relative accumulation of PrPSc. Preliminary data shows that mouse C2C12 cells infected with the RML prion strain and exposed to AChE inhibitors, Tacrine or Donepezil, have a reduced accumulation of PrPSc compared to controls. This project will continue to explore of the role of AChE and its inhibitors on the accumulation of PrPSc in the C2C12 mouse muscle cell line and the L929 mouse fibroblast cell line. Complementary experiments in which AChE levels are increased will be performed by the over-expression of AChE in C2C12 myotubes. We hypothesize that AChE over-expressing cells will accumulate more PrPSc than controls.

88 A comparison of dispersant application and weathering on crude oil toxicity sheepshead minnow embryos

Anthony Nguyen, Danielle Philibert, Keith Tierney

Major catastrophes such as Exxon Valdez and Deepwater Horizon oil spills have spurred interest in the role dispersants and weathering on the toxicity of crude oil. Because of the complex nature of crude oils, the impacts of embryological exposure to crude oil can cause diverse spectrum of defects. Cardiac defects are the most well studied and can range from minor impairment of swim performance to severe cardiac edema and death. In this study we compared to toxicity of water accommodated fractions (WAFs) of a source oil and two weathered oils and chemically enhanced water accommodated fractions (CEWAFS) of a source oil and a weathered oil to better understand the role of weathering and dispersant application in crude oil toxicity. Using marine EPA tests species like the sheepshead minnow (Cyprinodon variegatus variegatus), will further our understanding of hydrocarbon toxicity and the impact that oil spills could have on marine fishes.

89 The role of ancestral nrl in rod development– mechanism for the evolution of mammalian rod-dominated retinas

Phil Oel, Keon Collett, W. Ted Allison

Rod and cone photoreceptors mediate vertebrate sight, with rods working in dim light, and cones enabling high-acuity vision in bright light. The ancestral vertebrate retina was likely cone-dominant, but nocturnal early mammals adopted a rod-dominant arrangement. We hypothesize that the pro-rod transcription factor nrl mediated this change; mammalian NRL is critical to rod development, and when ectopically expressed, converts cones to rods. We used zebrafish, a cone-dominant vertebrate, to explore the ancestral role of nrl, and to test the hypothesis that ectopic expression of nrl in cone photoreceptors facilitated the shift to rod-dominant retina in early mammals.

We constructed a transgene to drive ectopic expression of zebrafish nrl in a subset of cones, and depleted nrl during development using knockdown/knockout technologies (morpholino/CRISPR). By thus modulating nrl expression, we assessed its role in a cone-dominant vertebrate (zebrafish). As in mammals, nrl depletion reduced or abolished rod generation. Unlike in mammals, cones expressing ectopic zebrafish nrl did not fully convert to rods, but did express rod markers.

We are investigating the mechanism by which early mammalian retinas became rod-dominant, departing from the ancestral cone-dominant state. Our preliminary results suggest that ancestral NRL had the capacity to influence the development of cone photoreceptors.

90 The role of grem2b in zebrafish ocular development

Sparsh Patel, Sonya Widen, Jennifer Weekes, Andrew Waskiewicz

Vertebrate ocular patterning is essential to proper vision. Patterning is mediated by gradients of secreted factors along the dorso-ventral (DV) axis of the eye. Bone Morphogenetic Protein (BMP) signaling in the dorsal retina has well characterized roles in both specification and maintenance of dorsal retinal identity. However, ventral inhibitors of BMP signaling are poorly understood. Additionally, extraocular cells (periocular mesenchyme; POM) migrate to the eye and regulate patterning, but little is known about the mechanism of POM's role in DV axis patterning. We have identified a novel factor linking ventral BMP inhibition and POM: gremlin 2b (grem2b). Gremlin proteins are well-characterized extracellular inhibitors of BMP signaling. In situ hybridization in zebrafish shows that grem2b is expressed within POM that migrate to the ventral eye, immediately adjacent to cells in which exclusion of BMP signaling is essential for ocular patterning. We hypothesize that ventral POM cells secrete Grem2b, thereby inhibiting BMP signaling in the ventral retina. Morpholino inhibition of Grem2b causes the dorsal domain of BMP signaling to expand throughout the eye, consistent with a role for Grem2b as a ventral BMP inhibitor. Current experiments focus on generating grem2b mutant zebrafish to examine ocular phenotypes in a true grem2b null zebrafish.

91 Microbial Activity Shifts in Athabasca Oil Sands Region Reclamation Soils: Establishing a Community Level Physiological Profile Using MicrorespTM

Patrick Neuberger

Mine operators in the Athabasca oil sands region (AOSR) have a legal requirement to restore surface mined land to “equivalent capability”, but only 2km2 of mined land has been certified as restored while 750km2 has been disturbed. Using peat in reclamation plots, a soil which is characteristic of lowland forest, results in the overabundance of carbon in otherwise upland regions. Greenhouse soils, in situ plots, and indigenous boreal forest soils were sampled. Soil treatments used in our greenhouse trial included forest floor material (FFM), peat mineral mix (PMM), and dilutions of peat with increasing amounts of mineral subsoil. Each soil treatment consisted of replicates containing biochar and P. tremuloides. To investigate the functional community shifts following these soil treatments, we assessed the microbial activity response to carbon compound supplementation to establish a community level physiological profile (CLPP) using MicroResp microplate respiration systems. Shifts in microbial community function were found with differing supplements of peat, driven by glucose and carboxylic acids. We suggest that reclamation soils which most similarly resemble the community function of boreal forests soils, while showing success in P. tremuloides growth, are most fit for use in AOSR reclamation.

92 Density-dependent Winter Habitat Selection by Elk in the Ya Ha Tinda

Jed Pettit, Evelyn Merrill, Joshua Killeen, Holger Bohm, Jodi Berg, Scott Eggeman, Mark Hebblewhite

Density-dependent habitat selection is a process by which preferential use of certain habitats on the landscape varies as a function of population density. Most research in this field indicates that at higher densities, animals are forced to seek out less desirable habitats. For ungulates, these are areas of high predation, low forage abundance, or high anthropogenic activity. Using 82438 GPS fix locations from 89 individual elk over 13 winters (2002/03 – 2014/15), we investigate how elk habitat selection on the winter range at Ya Ha Tinda in the Canadian Rocky Mountains is changing in response to declining population density. We have defined winter as November 1 to April 1. We employ a resource selection approach in which we compare elk locations to random points generated within a polygon of the winter range. Habitat covariates include plant biomass, distance to forest edge, distance to road or ranch facilities, wolf and cougar predation risk, weather variables and elk density. Covariates are measured within a buffer with radius of median distance travelled by elk between 2-hour fixes (~175m). We test for changes in habitat selection by examining density x covariate interactions. Using these methods, we assess how population density affects elk winter habitat selection.

93 Temporal changes within cladoceran communities subjected to a low calcium environment: A comparison of the sediment record and direct limnological monitoring

Laura E. Redmond, Adam Jeziorski, Andrew M. Paterson, James A. Rusak, John P. Smol

Lakewater calcium (Ca) decline is an environmental stressor impacting softwater lakes across the Canadian Shield. Ca decline is, in part, a long-term consequence of acid deposition, and has impeded biological recovery in formerly acidified lakes. Reduced Ca availability may provide an advantage to taxa better adapted to low Ca. Crosson Lake in south-central Ontario (Canada) has experienced a striking Ca decline since the late 1970s, recently falling below 1.5 mg·L-1, a threshold value for some large Daphnia taxa. Paleolimnological analysis of the cladoceran assemblages revealed that changes associated with Ca decline began in the early 1970s. Specifically, increases in the relative abundances of the jelly-clad Holopedium glacialis, decreases of Ca-sensitive members of the D. longispina complex, and increases in the D. pulex complex occurred over time. Zooplankton net hauls (1981-2010) corroborate the paleolimnological analysis, revealing increases in the D. pulex complex were exclusively due to D. catawba (a taxon tolerant of low Ca). The Crosson Lake paleolimnological and direct monitoring data may describe ecological changes that are also occurring in many other softwater lakes across the Canadian Shield and elsewhere.

94 Interaction amongst thyroid hormone receptor-beta, gdf6a, and tbx2b in determining cone photoreceptor fate.

Ramona Rosca

Innovative impaired daytime vision treatments are an expanding research field. Stem-cell therapy has been proposed as a solution to blinding disorders; however more knowledge is required regarding cone photoreceptor differentiation. To characterize this process, zebrafish were utilized for their cone-rich retinas and regenerative photoreceptors. We examined the relationship amongst two genes and a nuclear receptor protein, all involved in cone subtype differentiation: gdf6a, tbx2b, and thyroid hormone receptor β (thrβ). Growth differentiation factor 6a (gdf6a) is a bone morphogenetic protein family ligand influencing blue cone abundance. T-box transcription factor tbx2b promotes ultraviolet (UV) cone differentiation instead of rod photoreceptor fate. thrβ is involved in the promotion of red cones. Endogenous thrβ activity was conditionally disrupted in gdf6as327/tbx2bfby zebrafish mutant larvae at 52-55 hpf using a hsp70 promoter-containing transgene encoding dominant-negative thrβ. Preliminary data indicate that gdf6a-/- larvae demonstrate low blue cone abundance, while tbx2b-/- exhibit a severe lots-of-rods phenotype: no UV cones and a significant increase of rods. Double homozygous mutants demonstrate less severe phenotypes in blue and UV cone abundance. This may imply tbx2b and gdf6a interact during cone differentiation. Understanding cone subtype development promises more effective stem-cell therapy, resulting in patients with an exceptionally improved quality of life.

95 Responses of barred owls, boreal owls and great horned owls to chronic and intermittent industrial noise sources

Julia Shonfield, Erin Bayne

Background noise in an environment can interfere with an animal's ability to detect important communication signals. Owls use vocal communication to attract mates and defend territories, and use acoustic cues to locate their prey. Industrial noise could reduce their ability to communicate with other owls, and negatively affect their hunting efficiency. To determine whether owls avoid forested areas surrounding industrial noise sources in northeastern Alberta, passive acoustic surveys were conducted in the spring using autonomous recording units deployed at sites in three different noise categories: chronic, intermittent and no noise. Detections of owls were extracted from the acoustic data and analyzed using occupancy models. Boreal owls and great horned owls were most commonly detected, followed by barred owls. All owl species were equally likely to occupy sites in any of the three categories. However, the pattern of spatial use by owls differed between sites, with seasonal use declining for all three species as noise levels increased. This study contributes to the expanding body of research on impacts of anthropogenic noise on animals. Understanding how animals such as owls respond to the presence of noise is necessary to predict the extent of habitat degradation due to noise.

96 The evolutionary significance of morphological similarities between tadpoles and lampreys

Christine Simard

In 1876, Thomas Huxley presented an illustrated diagram comparing the anatomy of two phylogenetically distant vertebrates: an adult lamprey and anuran larva (tadpole). Huxley's morphological comparison revealed striking similarities in the cranial structures of lampreys and tadpoles, which suggests convergent evolution between these lineages. This study focuses on creating a more detailed replication of Huxley's original study by using modern digital assembly of histological sections. The goal of this project is to create a three-dimensional model of lamprey anatomy that can be compared with existing models of tadpole anatomy. A juvenile lamprey specimen was sectioned, resulting in detailed images of abdominal, branchial, cranial and oral anatomy that are being studied as individual sections and will be used by the program Imaris to generate a three-dimensional digital model. As well, current literature was used to re-evaluate Huxley's original observations. In general, Huxley's comments on similarities in the arrangement of cranial cartilages are supported, but his suggested similarities in non-cartilaginous oral structures are not. Upon completion, this study will provide a detailed and interactive three-dimensional model of lamprey cranial anatomy, which will aid further morphological analysis to uncover the mechanisms by which these two distantly related species came to resemble one another.

97 Assessing the effect of sequence variants in DNMBP, a putative neural tube defect susceptibility gene

Parmveer Singh, Renee Y. M. Leduc, Deidre R. Krupp, Natalie Mola, Erica E. Davis, Nicholas Katsanis, Simon G. Gregory, Allison E. Ashley-Koch, Heather E. McDermid.

Neural tube defects (NTDs) are a group of common birth disorders affecting about 1 out of 1000 established pregnancies. Both genetic and environmental factors contribute to the formation of NTDs. Our research focuses on the Cecr2 gene, which encodes a protein involved in chromatin remodelling. Mutation to of Cecr2 leads to a lethal NTD (exencephaly) in mice in a strain dependent manner. This suggests the presence of modifier genes affecting the susceptibility. Previously, a modifier region was found on chromosome 19 through a whole genome linkage analysis. Further genetic analyses in mice and screening for variants in human NTD samples led to a list of candidate modifier genes, with the most likely modifier being Dnmbp. Dnmbp regulates actin cytoskeleton and vesicle movement, functions important for proper neural tube formation. I hypothesize that Dnmbp is a Cecr2 modifier gene that plays a role in human susceptibility to NTDs. Eight human sequence variants of Dnmbp found in fetuses with anencephaly and one mouse sequence variant from a susceptible strain are being tested for interaction, localization, and activation of protein partners. Irregularities of localization have been observed with one of the variants. By characterizing the function, localization, and interactions of Dnmbp variants, we will shed light on a possible NTD susceptibility gene. This study will also further elucidate the complexity of neural system development.

98 Colocalization and physical interaction of murine CECR2 chromatin remodelling complex members

Alaina N. Terpstra, Farshad H. Niri, Kenji Rowel Q. Lim, Heather E. McDermid

Early mammalian development cannot progress without targeted temporal and spatial expression of genes. Changing the accessibility of DNA to transcriptional machinery is one critical way gene expression is controlled. This process, known as chromatin remodelling, affects developmental processes and disruptions can result in severe dysfunctions. The CECR2 protein forms a chromatin remodelling complex affecting development. Mouse mutations of Cecr2 can lead to either the lethal neural tube defect exencephaly or a non-lethal subfertility phenotype. Cecr2 is particularly strongly expressed in embryonic stem (ES) cells and testicular germline stem cells (spermatogonia). CECR2 binds a protein required for proper neurulation, LUZP1, in ES cells but not in the testis. Although Luzp1 is expressed in the testes, I have preliminarily shown that CECR2 and LUZP1 do not co-localize, confirming their lack of interaction. I have also shown that they do co-localize in ES cells. I am further investigating the co-localization of CECR2 with a newly identified protein complex member, CCAR2, which has been pulled down with CECR2 in both ES cells and testes. CCAR2 is involved in cell cycle regulation, apoptosis, and has been shown to be involved in chromatin regulation. Confirming the varying CECR2 complex members is important as it suggests a tissue-specific role for CECR2 in transcriptional regulation. The identification of these interacting partners can guide us to the specific function and roles of CECR2, and suggest how its absence causes defects.

99 The influence of brood size and prey abundance on magnitude of nesting behaviours by adult male and female Ferruginous Hawk (Buteo regalis)?

Simon Tkaczyk

In raptors species such as the Ferruginous hawks, sophisticated cooperative parental behavior is especially predominant with both parents displaying asymmetric nestling care. However, the exact extent parental roles are shaped by biological factors is still poorly understood in a region where the natural resource and agricultural development is rapidly expanding. Our study examines how provision times between the sexes will change throughout the nesting season and will vary with the number of nestlings in the nest and the abundance of prey in the area. We examined 90 Ferruginous Hawk nests using digital video systems to recorded Ferruginous hawk prey deliveries to nests with a firm protocol on how to analyze the footage and in particular to identify the sex of the adult Ferruginous hawks once it was recorded. Our data showed that adjust their parental roles based on the biological factors of brood size and prey abundance to increase breeding success. Our study is among the first to observe the role these biological factors play in the breeding population of southern Alberta and Saskatchewan.

100 The use of spring arrival date and song rate to inform habitat quality for the Olive-sided flycatcher (Contopus cooperi)

Emily Upham-Mills

Boreal songbird populations in North America are declining. Population density is used to inform the best habitat to protect for bird conservation, but density may not truly indicate the best quality habitat. Spring arrival timing of birds can be used to infer habitat preference and quality; earlier arrivals have the first pick of habitats. Upon arrival to the breeding grounds, birds sing frequently to defend a breeding territory and attract a mate. After successful pairing, singing frequency decreases. The use of wildlife recorders to monitor spring arrival date and song rate across habitats could inform habitat quality by indicating habitat preference and reproductive success. I will test this by deploying recorders at hundreds of locations across a portion of the Olive-sided flycatcher's (Contopus cooperi) range to record simultaneously from pre-spring arrival to the end of the breeding season. Habitat quality will be measured at a subset of sites by collecting data on food abundance (aerial insect traps), predator abundance (audio recordings of squirrels and corvids), vegetation structure (remote sensing data) and reproductive success (nest searching and behavioural observations). Territory mapping will test the use of wildlife recorders to accurately estimate arrival date and song rate variation.

101 Age dependent fertility defects in Cecr2 mutant mice

Chelsey B. Weatherill, Kacie A. Norton, Ross C. Humphreys, Heather E. McDermid

Infertility is a major medical problem and the cause is often unknown. CECR2 is a chromatin remodelling protein and in mice, mutations in Cecr2 are known to result in subfertility. This study is focused on the fertility defects seen in the mutant male mice and at what point development becomes abnormal. Previous work has shown morphological defects such as thin seminiferous tubules, non-uniform tubules, abnormal cells types, and issues in developmental progression in the testes of Cecr2 mutant mice at 4 and 6 weeks old, but not in the fetal testes a day before birth. In this study, the morphological defect of thin tubules was identified in the testes of mutant mice at 3 weeks old, but 2 week old testes appear to be similar to wild-type, with no difference in the amount of pachytene spermatocytes present. Thus the fertility defect first becomes apparent between 2-3 weeks old, after which tubules become increasingly abnormal. This research will contribute to our current understanding of how CECR2 contributes to spermatogenesis and possibly help better characterize causes of fertility defects in humans.

102 The varix: Repeated evolution of a shell sculpture innovation

Nicole B. Webster, Geerat J Vermeij, A Richard Palmer

A recurrent theme in evolution is the repeated origin of similar traits and structures. The varix, a periodic axial thickening of snail shells, is such a structure. Like other forms of shell sculpture, these varices reinforce the shell, make it larger and sharper to deter or thwart predators. We conducted a large scale survey of fossil and recent gastropods to determine the timing and number of different origins of periodic varices. We discuss hypotheses on the predisposition, function, origin, and morphology of varices and how they represent an example of ‘phylogenetic clumping’. Some varixed clades diversified greatly, while others only have isolated varixed taxa, suggesting varices may represent a key innovation, but only in some cases. We found that periodic varices arose at least 37 separate times in snails, almost exclusively in more derived clades, and generally during or after the late Mesozoic. Furthermore, varices are found almost exclusively in marine tropical systems, where the strongest predation pressures are thought to exist. This coincides with the evolution of shell-crushing predators, suggesting that selection pressure from predation drove varix diversification/radiation.

103 Vibrio cidicii: A Newly Isolated Potential Pathogenic Species of Vibrio

Yue Xu

Molecular phylogeny of Vibrio isolates, collected by the Centers for Disease Control and Prevention from patient blood samples and stream water, formed a new clade, suggesting that they were part of an emerging species closely related to known pathogens. Genotypic and biochemical tests indicate some distinct characteristics of the isolates from their close relatives, V. navarrensis and V. vulnificus. All four isolates have the novel ability to utilize a specific carbon source, L-rhamnose, which is produced by some microalgae and terrestrial plants. Two of their major phenotypic characteristics raised our interest: when grown in a rich medium, they are able to live in a wide range of salinity from 0% (fresh water) up to more than 8% which is much higher than the salinity of seawater. Also, two of the isolates survive at 45°C. Comparing their whole-genome sequences to V. navarrensis, we found low DNA-DNA hybridization similarity and ANI value. Moreover, a phylogenetic tree based on 4 core genes (pyrH, recA, rpoA, and rpoB) in Vibiro. Sp., showed that the four isolates formed a monophyletic clade. Based on these findings, we concluded that the four newly collected isolates belong to a new Vibrio species, Vibrio cidicii sp. nov.

104 Standardizing audio recording and human observer detection distance for integrated analysis of point count data

Daniel Yip

Autonomous recording units (ARUs) are increasingly being used as an alternative or complimentary method of conducting point counts. ARUs give researchers the ability to conduct repeat visits in areas and time periods that are often under sampled due to logistical concerns (i.e. safety, access, remoteness, etc). However, whether count data is impacted by the use of ARUs is a topic that needs further study and integration of ARU and human point count data, especially for long term data sets, is problematic. Here, we investigate detection distances for a variety of species found in the boreal forest region of Alberta. We compared detection distance of four commonly used ARUs as well as human observers and developed corrections to standardize and integrate point count data from different sources.

105 Elucidating the role of eye dorsoventral axis patterning genes in the formation of a superior coloboma and a novel optic fissure

Kevin Yoon, Jennifer C. Hocking, Jakub Famulski, Sonya Widen, Sophie Koch, Ordan Lehmann, Andrew J. Waskiewicz

Congenital ocular coloboma is a genetic disorder that affects 10% of blind children worldwide. It is typically observed as a cleft formation in the inferior aspect of the iris due to the failure of the choroid fissure in the optic cup to close during eye development. Mechanisms surrounding normal development and closure of the choroid fissure have been well characterized, and putative genes have been identified. Recently, identification of individuals with colobomata in the superior aspect of their iris led to the discovery of a novel fissure, referred to as the superior fissure, that is transiently present on the dorsal aspect of the optic cup during early zebrafish eye development. Previous research in our lab has shown that disruption of dorsoventral axis patterning can affect proper superior fissure closure, and patient-derived exome sequencing data revealed a mutation in vax2, a key eye axis patterning marker. We are now using a CRISPR-Cas9-mediated knockout approach to study vax2 and the effects of its absence during eye development. In addition, the consequences of vax2 overexpression and the physiological consequences of the specific mutation found in the patient will be studied through injection of mRNA constructs.

106 Biomonitoring And Assessment Of Hydrogen Fluoride From Fertilizer Production On Perennial Rye Grass

Yihan Zhao

Airborne fluoride emission is an environmental concern resulting from fertilizer production and phosphogypsum storage. To monitor the concentration of hydrogen fluoride, Rye grass, Lolium perenne L., was used as a biomonitoring species, as it has been widely used in global studies. The study aims to improve the understanding of effects of hydrogen fluoride on surrounding plants and further develop a biomonitoring protocol for Alberta which can be used in various reclamation scenarios.In this study, Rye grass was exposed at 52 sites during four month long periods from June to early October 2015 and the biomass was used for fluoride analysis. Preliminary results show that highest fluoride concentrations appeared in the third period (mid-August to early September). Wind had significant impacts on the changing pollution pattern over periods of time. Obvious variability was found in fluoride geographical distribution. Fluoride concentrations in rye grass located on phosphogypsum stacks were highest; approximately 8, 50 and 80 times more than that in near (500 m), mid (1200 m) and far (2000 m) distances. Preliminary conclusions are that crop field, hay land and animals would need to be within 600 m of the phosphogypsum stacks to be at risk of fluoride pollution.