Science Atlantic Aquaculture & Fisheries and Biology Conference 2016

Saint Mary's University
Halifax, Nova Scotia

March 11, 2016 − March 13, 2016
CONFERENCE SCHEDULE

Friday March 11

5-8 pm  Registration
        Welcome and put up posters
        Loyola Conference Hall L290

6:30-7:30  Supper Loyola Conference Hall L290
        Members of the Biology and Aquaculture & Fisheries Committee go to Secunda
        Marine Boardroom (4th floor Sobey Building)

7:30-8:00  Aquaculture & Fisheries and Biology Joint Meeting Secunda Marine Boardroom

8:00-9:30  Biology meeting Secunda Marine Boardroom
        A/F meeting Sobey 159

Saturday March 12

8:00 – 8:30 am Registration and last poster setup Loyola Conference Hall L290

8:30 – 8:45  Welcome Address Scotiabank Theater, Sobey Building

8:45-9:45  Keynote Speaker
        Dr. Marva Sweeney-Nixon
        Biology Department
        University of Prince Edward Island
        Title: Blueberries – from field to functional food.
        Scotiabank Theater, Sobey Building

9:45-10:15  Health Break and Poster Viewing Loyola Conference Hall L290

10:15-noon  Presentations (A/F Sobey 255 and Biology Scotiabank Theater, Sobey Building)
            (Presenter practice room is Sobey 260)

12:00-1:00  Lunch and Poster Viewing Loyola Conference Hall L290

1:00-2:00  Poster Viewing Loyola Conference Hall L290
        Also -
        A/F Keynote speaker
        Dr. Peter Tyedmers
        Department of Resource and Environmental Studies
        Dalhousie University
        Title: Seafood's future: The importance of fisheries and aquaculture in achieving
        global food sustainability and security.
        Scotiabank Theater, Sobey Building
2:00–3:30  Presentations (A/F Sobey 255 and Biology Scotiabank Theater, Sobey Building)
3:30–3:45  Health Break Loyola Conference Hall L290
3:45–5:00  Presentations (A/F Sobey 255 and Biology Scotiabank Theater, Sobey Building)
6:30  Banquet Ice Breaker Loyola Conference Hall L290
7 – 9 pm  Banquet Loyola Conference Hall L290

**Sunday March 13**  (REMEMBER - time goes ahead one hour Sat night)

9:00–10:15am  Presentations (A/F Sobey 255 and Biology Scotiabank Theater, Sobey Building)
10:15–10:45  Health Break and Poster Viewing Loyola Conference Hall L290
10:45–12:30  Presentations (A/F Sobey 255 and Biology Scotiabank Theater, Sobey Building)
12:30–2:00pm  Lunch and Awards Ceremony Loyola Conference Hall L290
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<tr>
<th>Sess.</th>
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<tbody>
<tr>
<td>1*</td>
<td>Sat. 10:30- 10:45</td>
<td>Brisseau</td>
<td>Clarissa</td>
<td>Dalhousie</td>
<td>Multilocus sequence typing analysis of <em>Streptococcus pneumoniae</em> isolates that are non-typable by Quellung serotyping</td>
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<td>1</td>
<td>10:45-11:00</td>
<td>Castle</td>
<td>Beth</td>
<td>Dalhousie</td>
<td>The role of Rho-associated coiled-coil kinase and mammalian diaphanous protein in Kaposin B-mediated processing body dynamics</td>
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<td>1</td>
<td>11:00-11:15</td>
<td>Bennett</td>
<td>Caitlin</td>
<td>Cape Breton</td>
<td>Mapping voltage-gated sodium channels &amp; sodium-potassium pumps along the electric organ of <em>Brachyhypopomus gauderio</em></td>
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<td>1</td>
<td>11:15-11:30</td>
<td>Doyle</td>
<td>Hillary</td>
<td>Memorial</td>
<td>Molecular characterization of the Aleutian disease virus in the urban striped skunk (<em>Mephitis mephitis</em>) population of British Columbia</td>
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<td>1</td>
<td>11:30-11:45</td>
<td>Cochkanoff</td>
<td>Nicholas</td>
<td>Mount Allison</td>
<td>Effect of intra-hypothalamic administration of endocannabinoids and nitric oxide on food intake in young rats</td>
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<tr>
<td>1</td>
<td>11:45-12:00</td>
<td>Brooks</td>
<td>Cody</td>
<td>University of New Brunswick</td>
<td>Do population genetic analyses of red algae support the kelp conveyor hypothesis?</td>
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<tr>
<td>2</td>
<td>2:00-2:15</td>
<td>Corkum</td>
<td>Emily</td>
<td>Dalhousie</td>
<td>Floral sex allocation in three species of <em>Lobelia</em></td>
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<tr>
<td>2</td>
<td>2:15-2:30</td>
<td>Krishnakumar</td>
<td>Shanthanu</td>
<td>Dalhousie</td>
<td>Burndown glufosinate ammonium and foramsulfuron combinations for suppression of fescues (<em>Festuca</em> spp.) in wild blueberry (<em>Vaccinium angustifolium</em> Ait.) fields</td>
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<tr>
<td>2</td>
<td>2:30-2:45</td>
<td>MacDonald</td>
<td>Nicolle</td>
<td>Memorial</td>
<td>A molecular systematic study of the Palm Tribe Euterpeae</td>
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<tr>
<td>2</td>
<td>2:45-3:00</td>
<td>Poirier</td>
<td>Jennifer</td>
<td>St. Francis Xavier</td>
<td>The Eastern Mountain Avens: A survival story</td>
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<tr>
<td>2</td>
<td>3:00-3:15</td>
<td>Norton</td>
<td>Christian</td>
<td>University of Prince Edward Island</td>
<td>Comparative, developmental morphometric analysis of <em>H. rosa-sinensis</em> cultivars</td>
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<tr>
<td>2</td>
<td>3:15-3:30</td>
<td>Revell</td>
<td>LeAnne</td>
<td>University of Prince Edward Island</td>
<td>Enhancing blueberry's health benefits with probiotics</td>
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ORAL PRESENTATIONS SCHEDULE - BIOLOGY

<table>
<thead>
<tr>
<th>Session</th>
<th>Time</th>
<th>Name</th>
<th>Institution</th>
<th>Title of Presentation</th>
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<tbody>
<tr>
<td>3</td>
<td>3:45-</td>
<td>Brown</td>
<td>Acadia</td>
<td>Fall migration decisions of Northern Saw-whet Owls at an ecological barrier</td>
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<td>4:00</td>
<td>Taylor</td>
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<tr>
<td>3</td>
<td>4:00-</td>
<td>Bond</td>
<td>Dalhousie</td>
<td>Pre-nesting behaviour of western Atlantic leatherback sea turtles, <em>Dermochelys coriacea</em></td>
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<td></td>
<td>4:15</td>
<td>Emily</td>
<td></td>
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<tr>
<td>3</td>
<td>4:15-</td>
<td>Walthers</td>
<td>Saint Mary's</td>
<td>City noise as a potential stressor on an urban bird: an analysis of heterophil/lymphocyte ratios in European Starling nestlings</td>
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<td>4:30</td>
<td>Alyssa</td>
<td></td>
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<tr>
<td>3</td>
<td>4:30-</td>
<td>Hambrook</td>
<td>University of New Brunswick</td>
<td>Insights into the establishment and regional expansion of an exotic swim bladder nematode of American eels</td>
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<td>4:45</td>
<td>Jacob</td>
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<tr>
<td>4*</td>
<td>Sun.</td>
<td>Landry</td>
<td>Acadia</td>
<td>Marine fungal biodiversity of Kingsport, Nova Scotia seawater</td>
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<td></td>
<td>9:00-</td>
<td>Brandon</td>
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<td>9:15</td>
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<tr>
<td>4</td>
<td>9:15-</td>
<td>MacDonald</td>
<td>Cape Breton</td>
<td>Early barley (<em>Hordeum vulgare</em> L.) performance following application of a novel fish hydrolysate</td>
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<td></td>
<td>9:30</td>
<td>Cassie</td>
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<tr>
<td>4</td>
<td>9:30-</td>
<td>Steell</td>
<td>Mount Allison</td>
<td>Reproductive ecology of <em>Ascophyllum nodosum</em> in differing salinity</td>
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<td>9:45</td>
<td>S. Clay</td>
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<td>4</td>
<td>9:45-</td>
<td>Griffin</td>
<td>Mount Saint Vincent</td>
<td>Tannic acid tolerance in dark septate endophytic fungi</td>
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<td></td>
<td>10:00</td>
<td>Amanda</td>
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<td>5</td>
<td>10:45-</td>
<td>Robinson</td>
<td>Saint Mary's</td>
<td>Mercury concentrations in wetland invertebrates exposed to historic tailing material at Montague Gold Mines, Dartmouth, Nova Scotia</td>
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<td></td>
<td>11:00</td>
<td>Julianne</td>
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<tr>
<td>5</td>
<td>11:00-</td>
<td>Feehan</td>
<td>St. Francis Xavier</td>
<td>Inhibition of <em>Campylobacter</em> spp. attachment and growth by <em>Lactobacillus plantarum</em> C9</td>
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<td></td>
<td>11:15</td>
<td>David</td>
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*Sessions 1, 2 and 3 are on Saturday, Sessions 4 and 5 are on Sunday*

NOTES FOR PRESENTERS

Each session will have a moderator.

It is your responsibility to make sure you contact the moderator for your session on FRIDAY so that your presentation can be loaded onto the computer in the appropriate session room.

Each talk will be 12 minutes MAX with 3 minutes for questions. The moderators will strictly enforce this time limit.
ORAL PRESENTATIONS SCHEDULE - BIOLOGY

Moderators: Biology oral presentations

Session 1  Celina Campbell and Alyssa Walthers
Session 2  Yeonsu Koh and Amanda Brown
Session 3  Hannah Corney and Alysha Dupuis
Session 4  Elizabeth Lewis and Ashley Fletcher
Session 5  Kudzaishre Gondora and Julie Anne Dayrit

There is a practice room (Sobey 260) set aside so you can check your presentation.
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<tbody>
<tr>
<td>1</td>
<td>Sat 10:15-10:30</td>
<td>Marks</td>
<td>Andree-Anne</td>
<td>University of New Brunswick, Fredericton</td>
<td>Assessment of <em>Pseudoloma neurophilia</em> autofluorescence in Zebrafish (<em>Danio rerio</em>)</td>
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<tr>
<td>1</td>
<td>10:30-10:45</td>
<td>Hirtle</td>
<td>Sarah</td>
<td>University of New Brunswick, Fredericton</td>
<td>Zebrafish as a model organism for parasitic infections of translational significance to aquaculture</td>
</tr>
<tr>
<td>1</td>
<td>10:45-11:00</td>
<td>Frenette</td>
<td>Aaron</td>
<td>University of New Brunswick, Fredericton</td>
<td>Integrative approach for specific identification and reliable quantification of a fish microsporidian impacting aquaculture</td>
</tr>
<tr>
<td>1</td>
<td>11:00-11:15</td>
<td>Carey</td>
<td>Heather</td>
<td>Dalhousie, Faculty of Agriculture</td>
<td>Parasite prevalence and intensity in green crabs (<em>Carcinus maenas</em>) and lobsters (<em>Homarus americanus</em>) harvested from the Northumberland Strait</td>
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<tr>
<td>1</td>
<td>11:15-11:30</td>
<td>Deonarine</td>
<td>Danielle</td>
<td>University of New Brunswick, Fredericton</td>
<td>Recovery of neural function in American lobsters (<em>Homarus americanus</em>) following sub-lethal exposures to Salmosan (azamethiphos)</td>
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<tr>
<td>1</td>
<td>11:30-11:45</td>
<td>Castillejos</td>
<td>Andrea</td>
<td>University of New Brunswick, Saint John</td>
<td>Metal concentrations and stable isotope ratios in juvenile American lobsters exposed to aquaculture sites</td>
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<tr>
<td>1</td>
<td>11:45-12:00</td>
<td>Murphy</td>
<td>Kieran</td>
<td>St. Francis Xavier</td>
<td>Nonlinear mixed-effects modelling of <em>Ciona intestinalis</em> population growth, dependent upon abiotic conditions</td>
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<td>Time</td>
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<td>2:00-2:15</td>
<td>Annis Alanah</td>
<td>University of New Brunswick, Fredericton</td>
<td>A developmental metric of early Atlantic salmon (Salmo salar) ontogeny based on external morphology</td>
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<tr>
<td>2:15-2:30</td>
<td>Gillard Lindsey</td>
<td>Dalhousie, Faculty of Agriculture</td>
<td>Dietary butyric acid as a live feed supplement in larval striped bass and sea bream aquaculture.</td>
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<tr>
<td>2:30-2:45</td>
<td>Normand Louis-Philippe</td>
<td>Dalhousie</td>
<td>Effects of a Spirulina based diet on the growth performance of Arctic Char, (Salvelinus alpinus), and Striped bass (Morone saxatilis)</td>
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<tr>
<td>2:45-3:00</td>
<td>Moores Angela</td>
<td>Dalhousie</td>
<td>Evaluating the functional trophic level of the global aquaculture sector</td>
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<tr>
<td>3:00-3:15</td>
<td>Robertson Matthew</td>
<td>Dalhousie</td>
<td>Determining abalone body weight using structured light scanning of shell morphology as well as regular photography</td>
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<tr>
<td>3:15-3:30</td>
<td>Sharp Iain</td>
<td>Dalhousie</td>
<td>The quantification of color in pearls</td>
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<tr>
<td>3:45-4:00</td>
<td>Breau Hayden</td>
<td>Dalhousie, Faculty of Agriculture</td>
<td>Effect of over-ripening on survival of diploid and triploid eggs from Atlantic salmon (Salmo salar) and Arctic charr (Salvelinus alpinus)</td>
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<tr>
<td>4:00-4:15</td>
<td>Latimer Krista</td>
<td>University of New Brunswick, Fredericton</td>
<td>Effect of temperature on the aerobic scope of triploid brook charr (Salvelinus fontinalis)</td>
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<tr>
<td>4:15-4:30</td>
<td>Wei Minmin</td>
<td>Dalhousie, Faculty of Agriculture</td>
<td>Over-winter 24h light start and end date affects the maturity rate of Arctic charr</td>
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<tr>
<td>4:30-4:45</td>
<td>MacLean Hilary</td>
<td>University of New Brunswick, Fredericton</td>
<td>Hormonal sex reversal in zebrafish (Danio rerio)</td>
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<tr>
<td>4:45-5:00</td>
<td>Hasson Alyson</td>
<td>University of New Brunswick, Fredericton</td>
<td>Effects of citalopram hydrobromide on embryonic development and physiology of zebrafish (Danio rerio)</td>
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</table>
4  Sun 9:00-9:15  Zielonko Katya Dalhousie  Life history variation within and among four species of freshwater fishes in Ontario

4  9:15-9:30  Small Christopher University of New Brunswick, Fredericton  Testing the waters: harnessing adaptive developmental plasticity to improve hypoxia tolerance

4  9:30-9:45  Prystay Tanya Dalhousie  Fisheries stress and temperature influences the cardiac performance and recovery of migrating Sockeye salmon (*Oncorhynchus nerka*)

4  9:45-10:00  Sherker Zachary St. Francis Xavier  Reducing sea turtle interactions off the coast of Atlantic Canada: methods to increase fishing selectivity

4  10:00-10:15  Westell Annabel Dalhousie  Incorporating threats with elasmobranch population distribution patterns to delineate priority protection areas for reef shark and ray conservation in Thailand

5  10:45-11:00  Hurtubise Jessica Dalhousie  Distribution of satellite tagged immature female blue shark, *Prionace glauca*, in the Northwest Atlantic ocean and its link to selected environmental parameters

5  11:00-11:15  Quinn Danielle Memorial  Characterization of school and site fidelity patterns of striped bass (*Morone saxatilis*), little skate (*Raja erinacea*), and winter skate (*Raja ocellata*) in a spatially confined basin

5  11:15-11:30  Findlay Kamryn Dalhousie, Faculty of Agriculture  Distribution of Atlantic tomcod under-yearlings in the Shubenacadie River estuary

5  11:30-11:45  Bo Tammy (Sha) University of New Brunswick, Saint John  Identification of American lobster (*Homarus americanus*) stocks based on analyses of historical and recent changes in fisheries landings

5  11:45-12:00  Simmons Olivia Memorial  Progression of an alien invasion: the European green crab, *Carcinus maenas* (Linnaeus, 1758), in Bonne Bay, Newfoundland
Mapping voltage-gated sodium channels & sodium-potassium pumps along the electric organ of *Brachyhypopomus gauderio*

Caitlin Bennett and Vielka Salazar, Cape Breton University

Weakly electric fish produce electric organ discharges (EODs) from electric organs (EOs) that create a dynamic electric field used for electrocommunication and electrolocation. These EODs are essential for their survival. The electric signal of the gymnotiform species *Brachyhypopomus gauderio* has emerged as a champion model system to understand the relationship between membrane transport heterogeneity and signal plasticity because they produce sexually dimorphic EODs that change from day to night and in different social situations, under hormonal control. This allows for investigation of physiological substrates within the EO modulate a measurable output, the EOD. When recorded remotely (approximately 10 cm from the fish) B. gauderio produce a biphasic EOD. Local recordings (measured within millimeters) however, have revealed that the biphasic signal is a composite of slightly different waveforms produced by different parts of the EO along the rostrocaudal axis. While the electrocytes, the electrogenic cells that comprise the EO, display morphological differences along the rostrocaudal axis, these differences are not sufficient to explain all signal heterogeneity. My project applies an immunohistochemistry protocol to label two major membrane proteins in electrocytes, voltage-gated sodium channels and sodium-potassium ATPases. As predicted, my analyses of the expression pattern for these two membrane proteins have revealed unequal distribution of both proteins across the membranes of individual electrocytes along the rostrocaudal axis that match signal heterogeneity. By mapping the distribution of these proteins along the rostrocaudal axis of male and female B. gauderio, we can better understand their role in signal heterogeneity and cell-cell communication.

Pre-nesting behaviour of Western Atlantic leatherback sea turtles, *Dermochelys coriacea*

Emily Bond and Michael James, Dalhousie University

Satellite telemetry can provide rare insight into the life histories of highly migratory marine species. In the Northwest Atlantic, the leatherback sea turtle, *Dermochelys coriacea*, has a broad geographic range extending from nesting beaches at low latitudes to foraging grounds off the coast of Eastern Canada. Leatherbacks are capital breeders that fast during the nesting season and exhibit relatively low levels of multiple paternity within clutches. Though various hypotheses regarding the timing and location of leatherback mating activity have been proposed, these are largely not supported by empirical data. In this study, six mature female leatherbacks were equipped with satellite-linked transmitters off Nova Scotia prior to their southern migration. Tracked turtles completed their southward migration before nesting in Colombia (n=2), Trinidad (n=2), Guyana (n=1) and French Guiana (n=1). Using kernel density estimates, residency areas were inferred from 50% volume contours over a standardized time interval of 120 days prior to first nesting. All individuals first exhibited offshore residency within a relatively small range of latitude before transiting to their respective nesting beaches. Analysis of the movements of mature male leatherbacks (n=11) revealed similar offshore seasonal residency patterns. While previous telemetry work indicates that some males reside adjacent nesting beaches for a portion of the nesting season to seek mates, analysis of offshore residency at low latitudes during the period of follicular development before first nesting highlights additional important mating areas for this population.
**Multilocus sequence typing analysis of Streptococcus pneumoniae isolates that are non-typable by Quellung serotyping**

Clarissa Brisseau, Ross Davidson, Jason LeBlanc, Dalhousie University

**Background:** *Streptococcus pneumoniae* is a significant human pathogen that has 98 known serotypes. Only some serotypes are vaccine-preventable, therefore monitoring serotype distribution is important. For serotyping, the Quellung reaction is well recognized as the reference method, and uses capsule-specific antibodies to assign a serotype. Over the years, polymerase chain reaction (PCR)-based serotype deduction has gained much interest by targeting differences in the capsule biosynthesis genes but is limited to the detection of 70 serotypes and lack of discrimination between serotypes. In addition, using either Quellung or PCR-based serotyping, some *S. pneumoniae* remain non-typeable. Multilocus sequence typing (MLST), which relies on comparing the genetic sequences of seven housekeeping genes, has been extensively used in molecular surveillance to define genetic lineages of *S. pneumoniae*, and can be associated to serotypes in international databases. **Objectives:** This study aimed to evaluate whether MLST or PCR could deduce serotypes of *S. pneumoniae* that were previous characterized as non-typeable by Quelling. **Methods:** DNA extracted from *S. pneumoniae* strains were analyzed using PCR-based serotyping and MLST. Four reference strains (serotypes 7F, 7A, 22F, and 22A) and three non-typeable strains were evaluated. **Results:** While the proof-of-principle was demonstrated using the references strains, to date, a serotype has not been deduced for the 3 non-typeable using PCR. MLST on the other hand has revealed one non-typeable *S. pneumoniae* to be serotype 7C. **Conclusions:** While MLST has some merit in the repertoire of genetic techniques for *S. pneumoniae* surveillance of vaccine-preventable serotype, further validation is required.

**Do population genetic analyses of red algae support the kelp conveyor hypothesis?**

Cody Brooks and Gary Saunders, University of New Brunswick, Fredericton

At the species level ~10% of the Haida Gwaii seaweed flora has a disjunct distribution – these species being found also in California but not southern British Columbia. The kelp conveyor hypothesis posits that this biogeographical pattern is explained by turf forming seaweed hitchhiking along with giant kelps dislodged by winter storms in California and rafted north on the Davidson Current. If this hypothesis has merit, then this pattern should be visible at the population level in species with a continuous distribution along the entire Northeast Pacific coast. The purpose of this study was to complete population genetic analyses on three red algal species that are widely distributed along this coastline. Species were selected to target the mid and lower to sub tidal zones because the kelp conveyor hypothesis should impact these habitats to different degrees. We generated data for the mitochondrial cytochrome oxidase I gene and the nuclear internal transcribed spacer of the ribosomal cistron. These data were analysed with Migrate-n to model and rank the kelp conveyor hypothesis relative to other possible migration patterns for our three species. The results of our analyses will be discussed, which will provide the first test of the kelp conveyor hypothesis at the population level and an indication of the importance of this mode of long-distance dispersal in structuring benthic communities in the Northeast Pacific.
Fall migration decisions of Northern Saw-whet Owls at an ecological barrier

Taylor Brown, Phil Taylor, Dave Shutler, Acadia University and Shawn Craik, Universite Sainte-Anne

Migration is a perilous undertaking for any organism, and is often only undertaken within a restricted range of intrinsic and extrinsic motivating factors. The added risk of crossing an ecological barrier such as a large body of water means that migratory decisions based on these factors are much more crucial for survival than they would be otherwise. Aside from limited data garnered from banding-recapture studies, little was previously known about migratory habits of northern saw-whet owls (*Aegolius acadicus*), especially with respect to how they navigated large expanses of water such as the Gulf of Maine. Between 12 October 2015 and 10 November 2015, 26 saw-whet owls were captured at two NS sites using mist nets, banded, and fitted with VHF radio-transmitters. Using data downloaded from receiver towers along the coastlines of Canada’s Maritime Provinces and the northeastern United States, we tracked individual saw-whet owls as some reverse migrated, some remained on winter territories, and some forward migrated directly over the Gulf of Maine. The latter results provide insights into a previously unknown feat of migration by a small (80-100g) nocturnal raptor.

The role of Rho-associated coiled-coil kinase and mammalian diaphanous protein in Kaposin B-mediated processing body dynamics

Beth Castle, Carolyn-Ann Robinson and Jennifer Corcoran, Dalhousie University

Human Herpesvirus 8 or Kaposi’s sarcoma herpesvirus (KSHV) is the etiologic cause of Kaposi’s sarcoma, a common cancer in immunosuppressed individuals. When the virus latently infects a cell, it expresses Kaposin B (KapB), a viral protein that causes changes in the cell cytoskeleton and secretory profile. These changes can promote tumour formation and cancer progression. Specifically, KapB promotes stress fibre formation and dispersal of processing bodies (PBs). PBs are ribonucleoprotein granules responsible for the translational suppression and degradation of certain messenger RNA (mRNA), including mRNA with AU-rich elements that often encode cytokines and angiogenic factors. Upon PB dispersal, more of these cytokines and angiogenic factors are produced, promoting a cancerous phenotype. KapB mediates these changes by binding to MK2 and activating the non-canonical MK2-hsp27-p115RhoGEF-RhoA axis. The signaling following RhoA is unclear. Rho-associated kinase (ROCK) and the mammalian diaphanous proteins (mDia) are both RhoA-effectors that mediate changes in the actin cytoskeleton. Using shRNAs and chemical inhibitors to eliminate expression of the ROCK and mDia isoforms, the role of these proteins in the dispersal of PBs can be examined with immunofluorescence. Knockdown of mDia1, ROCK1 and ROCK2 with isoform-specific shRNAs and non-isoform specific chemical inhibition of ROCK resulted in an increase in number and size of PBs in KapB-expressing cells suggesting a role for mDia1, ROCK1 and ROCK2 in PB dispersal. Data for the knockdown of mDia2 and mDia3 are still being collected. The research on these pathways will improve the understanding of the mechanisms through which KSHV causes cancer.
Effect of intra-hypothalamic administration of endocannabinoids and nitric oxide on food intake in young rats

Nicholas Cochkanoff, Mount Allison University

In Canada, over half of all adults and one quarter of teenagers are overweight or obese. Obesity is largely due to an imbalance in food intake and energy expenditure, and is linked to a variety of pathophysiological conditions, such as heart disease, type II diabetes, and various cancers. Several brain regions have been implicated in appetite regulation, but no region is as fundamentally linked to satiety as the dorsomedial nucleus of the hypothalamus. Recent evidence suggests that the activity of satiety neurons in the dorsomedial nucleus of the hypothalamus is controlled by two chemical signals, endogenous cannabinoids and nitric oxide. Although endogenous cannabinoids and nitric oxide have been shown to alter food intake in rats, the exact mechanisms underlying this appetite regulation remain unknown. We hypothesize that endogenous cannabinoids and nitric oxide modulate food intake through direct actions on satiety neurons in the dorsomedial nucleus of the hypothalamus. To test this hypothesis, we administered endogenous cannabinoids and nitric oxide directly into the dorsomedial nucleus of the hypothalamus through bilateral cannulas surgically implanted in young, male, Sprague-Dawley rats. Following this intra-hypothalamic administration, food intake was measured and brains were removed for subsequent analysis of neuronal activity. This research will advance our understanding of the mechanisms by which endogenous cannabinoids and nitric oxide modulate appetite and may lead to therapeutic interventions to combat the obesity epidemic.

Floral sex allocation in three species of Lobelia

Emily Corkum, Dalhousie University

Sex allocation theory predicts that hermaphrodite organisms will display an optimal pattern of investment in each sex function in order for each individual to maximize its reproductive success. Plants of the genus Lobelia (Campanulaceae) provide an ideal system in which to study floral sex allocation as their flowers are protandrous (sequentially male and then female) with no overlap. Because flowers open acropetally reproductive opportunity for a given sex changes with flowering position within an inflorescence. Under negative frequency-dependent selection, early (basal) flowers are expected to have higher relative female allocation, while late (apical) flowers are expected to have higher male allocation. This effect is expected to be strongest in highly outcrossing species, and weak or nonexistent in self-fertilizing species. Three related Lobelia species with different mating systems were used to test this theory: L. cardinalis, (primarily outcrossing), L. inflata, (completely self-fertilizing), and L. dortmanna, whose mating system falls somewhere in between. In order to quantify absolute and relative sex allocation, all pollen grains (male allocation) and ovules (female allocation) were collected from 60 flowers of each species. Pollen grains and ovules were counted using image analysis of photos taken through a stereomicroscope. In agreement with sex allocation theory, self-fertilizing L. inflata showed no relationship between position along the flowering stem and relative femaleness, while the more outcrossing L. dortmanna showed a negative relationship. No relationship was found in highly outcrossing L. cardinalis; potential explanations for this result are discussed.
Molecular characterization of the Aleutian disease virus in the urban striped skunk (Mephitis mephitis) population of British Columbia

Hillary Doyle, Marta Canuti, Anne Britton and Andrew Lang Memorial, University of Newfoundland

Aleutian mink disease virus (AMDV) is a parvovirus that infects farmed and wild mink, causing severe disease. AMDV can also infect other small mammals, representing a threat to wild populations, and the virus appears to move back-and-forth between farmed and wild animals. Skunks and raccoons might be reservoirs for this virus because AMDV is highly prevalent in these animals and infections appear mainly asymptomatic. The focus of this study was to determine the genetic make-up of AMDV in the urban striped skunk (Mephitis mephitis) population of British Columbia to compare these viruses with AMDV from other species. Thirty-two partial sequences of the gene encoding the non-structural protein were obtained from skunks originating the Vancouver area and molecularly analyzed. Phylogenetic analysis showed the presence of two viral lineages, one containing 17 viruses (within-lineage identity of 98.8%) and the other containing 15 viruses (within-lineage identity 97.7%). The between lineage identity was 93.2%. All obtained sequences clustered separately from other known AMDV strains and this novel skunk clade was < 85% identical on the amino acid level to reference species, indicating that these viruses possibly represent a novel parvovirus species. No clear geographical distribution of strains was observed. Future work will focus on obtaining the complete genome sequences of these viruses, to confirm whether they represent a separate species, and on obtaining viral sequences from other animals (mink and raccoon) from British Columbia to look for similar strains and thereby evaluate the potential role of skunks as a natural reservoir of AMDV.

Inhibition of Campylobacter spp. attachment and growth by Lactobacillus plantarum C9

David Feehan, St. Francis Xavier University

Probiotics are bacteria that confer a health benefit to their host following consumption. One benefit of probiotics can be the prevention of pathogen colonization in the respiratory, urogenital and gastrointestinal tracts through inhibition of pathogen growth and attachment to epithelial cells. This study will investigate the effect that a potential probiotic bacterium, Lactobacillus plantarum C9, has on the growth and attachment of human gut pathogens Campylobacter fetus and Campylobacter jejuni. Supernatant of L. plantarum C9, isolated from knoydart cheese, has previously demonstrated inhibition of Campylobacter spp. growth. To determine if L. plantarum inhibited Campylobacter spp. growth when cultured together, a co-culture was conducted over 24 hours and viable plate counts were used to enumerate the bacteria present in the culture. C. fetus and C. jejuni growth was inhibited over 24 hours when co-cultured with L. plantarum. An adhesion assay was conducted using Caco-2 and INT 407 cells to model L. plantarum attachment to intestinal epithelial cells. Viable plate and microscope counts were used to enumerate the attached L. plantarum. L. plantarum demonstrated attachment to both Caco-2 and INT 407 cells. To investigate Campylobacter spp. attachment to intestinal epithelial cells while in the presence of L. plantarum, a co-infection assay on Caco-2 and INT 407 cells was conducted and attached bacteria were enumerated using viable plate and microscope counts. L. plantarum demonstrated inhibition of Campylobacter spp. attachment to INT 407 cells. In summary, L. plantarum exhibited some probiotic characteristics, but further work must be done to investigate its full probiotic potential.
Tannic acid tolerance in dark septate endophytic fungi

Amanda Griffin and Gavin Kernaghan, Mount Saint Vincent University

Tannins are polyphenolic plant defense compounds. They are common in the bark and roots of woody plants, as well as in wine, tea, and chocolate and they give temperate lakes and streams their characteristic brownish yellow colour. Tannins inhibit microbial growth by forming complexes with proteins, amino acids, and some metals. Fungal endophytes are ubiquitous within plant tissues and must regularly come into contact with tannins, especially in roots where tannin concentrations are high. Our objective was to determine if root endophytes are relatively tannin tolerant compared to other groups of fungi. We measured the tolerance of a number of fungi from different ecological groups to tannic acid. We also compared the ability of these fungi to produce enzymes to digest pectin, a common cell wall component, in the presence of tannin. We found that one particular group of root endophytes, the “dark septate endophytes”, including species of *Phialocephala*, were significantly more tolerant to tannic acid than fungi from other groups. Tannin had little impact on the pectinolytic ability of the dark septate endophytes, but was inhibitory in all of the other fungi we tested. We also used a series of enzymatic assays to determine the mechanism by which dark septate endophytes are able to survive in the presence of tannins. There appears to be a correlation between the tannin tolerance of dark septate endophytes and their ability to produce polyphenol oxidases.

Insights into the establishment and regional expansion of an exotic swim bladder nematode of American eels

Jacob Hambrook, Katie Baba, Aaron Frenette, Devin Ward, Mick Burt and Michael Duffy, University of New Brunswick, Fredericton

*Anguillicola crassus* is a parasitic nematode that infects eels and causes swim bladder pathology. The parasite was first documented in the Japanese eel *Anguilla japonica* in East Asia. It was introduced to American eels (*Anguilla rostrata*) and was first identified in South Carolina in 1995. The first recorded instance of the exotic parasite in Canadian waters was in Nova Scotia in 2007. We monitored invasion and establishment of this parasite in New-Brunswick. We observed rapid establishment of *A. crassus* infection in two New-Brunswick river systems draining into the Bay of Fundy. A significant increase in parasite prevalence was observed from 2013 to 2015. We report for the first time, the establishment and proliferation of the parasite in a Prince Edward Island river (2014-2015). *Anguillicola crassus* was absent from New-Brunswick rivers draining into the Northumberland Strait in 2013-2014, but was identified in three of four rivers sampled in 2015. Parasite morphometrics and PCR amplification of the large ribosomal DNA subunit were performed to confirm species identity across the expanded host range. Parasite establishment in American eel populations and invasion of Atlantic Canadian river systems is rapidly ongoing and parasite transmission dynamics must still be elucidated. Our molecular tools for parasite identification are amenable to antemortem detection of infection towards elucidation of transmission dynamics. Given that the American eel is currently classified as threatened (COSEWIC), population level impacts are best studied without the need to kill the host.
**Burndown glufosinate ammonium and foramsulfuron combinations for suppression of fescues (Festuca spp.) in wild blueberry (Vaccinium angustifolium Ait.) fields**

Shanthanu Krishnakumar, Dalhousie University, Faculty of Agriculture

In view of the variable results obtained from foramsulfuron (Option™), field and greenhouse studies were conducted in 2015 to evaluate the effect of glufosinate ammonium (Ignite™) applications on suppression of fescues with foramsulfuron (Option™) in wild blueberry. A 4 X 2 factorial experiment of glufosinate ammonium application rate (0, 405, 750, and 1005 g a.i. ha\(^{-1}\)) and foramsulfuron application at 35 g a.i. ha\(^{-1}\) (yes or no) was arranged in a completely randomized design in the greenhouse and a randomized complete block design in the field. The higher rates of glufosinate ammonium followed by foramsulfuron reduced fescue leaf number and biomass in the greenhouse experiment. Glufosinate ammonium application at 750 and 1005 g a.i. ha\(^{-1}\) followed by foramsulfuron reduced fescue biomass by 73 and 93%, respectively, compared to foramsulfuron applied alone. In the field study, fescue tuft inflorescence height and seed production was reduced by foramsulfuron alone, but there was a trend towards lower seed production and tuft height when fescues were treated with higher rates of glufosinate ammonium followed by foramsulfuron. Though the results were variable in the field, they suggest that glufosinate ammonium increased the efficacy of foramsulfuron in controlling fescues. Future research should investigate the effects of different glufosinate ammonium application timings to determine the optimum combination of these products under field conditions.

**Marine fungal biodiversity of Kingsport, Nova Scotia seawater**

Brandon R. Landry and Allison K. Walker, Acadia University

Marine fungi are an integral part of ocean ecosystems, serving primarily as saprobes and parasites. Due to their powerful degradative enzymes, some marine fungi also show promise for hydrocarbon degradation. Despite their importance, these organisms remain relatively understudied. The objectives of this project were to assess the biodiversity of marine fungi in seawater collected from Kingsport, NS and to test the ability of selected species to grow on crude oil as sole carbon source. Three plating methods were used to isolate marine fungi: vacuum filtration of seawater, direct plating of seawater and direct plating of marine sediment. DNA was extracted from 29 samples and analyzed via PCR and Sanger DNA sequencing. Taxonomic information was obtained for each sample using GenBank’s Basic Local Alignment Search Tool. Results indicated that the 29 samples included 7 Zygomycetes, 7 Ascomycetes, 4 Basidiomycetes, and 1 Oomycete (non-fungal protist). Twelve samples were selected to test their hydrocarbon-degrading potential using Bunker C oil as a sole carbon source. Six species demonstrated the ability to proliferate on the oil: *Dipodascus geotrichum*, *Guehomyces pullulans*, *Mucor flavus*, *M. heterogamus*, *M. hiemalis* and *M. strictus*. Although preliminary, our results indicate a broad diversity (4 phyla) of culturable marine fungi in Kingsport, NS seawater as revealed through DNA barcoding, including several species that are potentially new to science. Furthermore, the ability of certain marine fungi to grow on Bunker C oil suggests these species possess powerful degradative enzymes which could be further explored for bioremediation or other industrial purposes.
A molecular systematic study of the Palm Tribe Euterpeae

Nicolle MacDonald and Julissa Roncal, Memorial University

With around 2,600 species, the palm family Arecaceae is one of the world’s largest plant families. The palm tribe Euterpeae is located in the Neotropical region of Central and South America including the Caribbean. Euterpeae are of economic importance as it contains palms that are harvested for palm hearts, acai berries, and oil. The most detailed phylogeny of this tribe is currently incomplete and uses morphological characters, which often do not provide a useful phylogenetic signal in palms. In this study, a molecular phylogenetic analysis was conducted for Euterpeae using a low-copy nuclear gene, which I sequenced for 24 of the 32 Euterpeae species, and concatenated it with two chloroplast sequences available from Genbank. Phylogenies were reconstructed using the nuclear gene alone and the concatenated nuclear and chloroplast sequences using maximum parsimony, maximum likelihood, and Bayesian inference methods. Both data sets yielded the same intergeneric relationships with relatively high support, showing that Euterpeae is monophyletic with Prestoea sister to Neonicholsonia, Euterpe sister to the Neonicholsonia and Prestoea clade, Oenocarpus sister to the previous clade, and Hyospathe sister to the rest of Euterpeae. This molecular phylogeny rejected the hypothesis that Oenocarpus’ hippuriform inflorescence was derived from Euterpe as Euterpe was found to be a more recent and derived taxa. To achieve a complete species level phylogeny, future studies should include the remaining species of the tribe and sequence more genes, particularly those of the chloroplast as these helped to resolve the position of Neonicholsonia within the tribe.

Early barley (Hordeum vulgare L.) performance following application of a novel fish hydrolysate

Cassie MacDonald, Cape Breton University

Rapid global population growth increases the demand for agricultural food crops while climate change increases the vulnerability of food crops even in the northern hemisphere. Growing demands for food and climate change amplify the critical role of water in food production. Water is the most crucial natural resource input in world food production. From a purely physiological perspective, water use by plants is known to be a function of plant nutrition. The purpose of this project was to test the growth and drought response in seedlings of barley (Hordeum vulgare L.) following the amendment of an organic hydrolysate from fermented fish and mineral fertilizer. Examination of seedling morphology, biomass allocation, chlorophyll, plant sugars, and soil leachate will give insight as to how the hydrolysate affects barley seedlings and their capacity to cope with drought compared to mineral fertilizer. If successful, the organic fish-based amendment may be used to improve the crop production in drought-prone areas and help to increase food security for millions of people worldwide.
**Comparative, developmental morphometric analysis of *H. rosa-sinensis* cultivars**

Christian Howard Norton, University of Prince Edward Island

*Hibiscus rosa-sinensis* is a eudicotyledonous plant belonging to the Malvaceae family. *H. rosa-sinensis* exists in two distinct floral morphologies: single (wild-type) and double (mutant). The distinct floral morphologies provide a novel context to explore the ABC Model of Floral Development. The ABC model describes how organ identity genes work together to control floral organ development. The objective of this research was to morphometrically compare single and double floral development in the context of the ABC model. This study mathematically quantified morphological differences between single and double floral organ development using morphometric techniques. The double anther primordia exhibited a wider range of morphologies than the single anther primordia. Unlike the doubles, the singles displayed discrete developmental stages and earlier anther development. The doubles completed anther development later in floral development than the singles. With respect to the ABC model, results suggest that genes controlling anther and petal development are the genes affected by mutations in the double flowers. This work indicates that these double flowers have a delayed, less-regulated expression of floral identity genes than the single variety.

**The Eastern Mountain Avens: A survival story**

Jennifer Katlyn Poirier, St. Francis Xavier University

The Eastern Mountain Avens (*Geum peckii*) is a globally imperiled flowering plant which is only found in two locations in the world. In Canada, the largest population of Avens is found within Big Meadow Bog on Brier Island, Nova Scotia. The Big Meadow Avens population has been in decline since the 1950s when three drainage ditches were dug to create agriculturally-friendly land. The ditches continue to drain Big Meadow today, reducing viable Avens habitat through shrub encroachment, competition, and gull destruction. In order to investigate the relationship between the depth of water table and the overall health of the Avens, 36 plants were removed from Big Meadow and transplanted to 8 locations across Brier Island with different water table levels. Transplant sites were revisited monthly throughout the summer of 2015 in order to quantify health measurements such as leaf number and discoloration, percentage of dead leaves, frequency of red petioles, and number of flowers. Fluorometric measurements were used to compare health of the Avens between treatments and to in situ plants. Initial results indicate that transplantation had little to no effect on the test plants, regardless of relocation to areas with or without natural Avens. The results also show a higher frequency of red petioles in areas with water tables near surface level, which may be an indication of stress. The measurements will continue throughout the Big Meadow restoration project, which is scheduled to break ground this spring.
Enhancing blueberry's health benefits with probiotics

LeAnne Revell, University of Prince Edward Island

Cardiovascular disease is the second leading cause of death in Canada. Ischemic heart disease and stroke, both hypertension related diseases, account for 74% of cardiovascular disease deaths. Oxidative stress, damage to cellular molecules and blood vessels, is a marker of hypertension. Previous studies in our lab demonstrated that a blueberry-enriched diet significantly reduced oxidative stress and hypertension in spontaneously hypertensive and stroke prone rats. Probiotics are known to break antioxidant polyphenols into smaller metabolites, increasing bioavailability. This study investigates whether adding probiotics to a blueberry-enriched diet will further enhance the antioxidant effects of blueberries. Thirty-two spontaneously hypertensive male rats were divided into four diet groups (n=8): control group, 3% freeze-dried blueberry-enriched diet, 1% probiotic-enriched diet and a combination diet of 3% freeze-dried blueberry and 1% probiotic, and fed accordingly for eight weeks. Oxidative stress was analyzed by determining hepatic and renal catalase activity, superoxide dismutase activity, and glutathione concentration across diet groups. There was little significant change in activity and concentration of hepatic enzymes, and renal catalase activity remained unchanged. However, adding probiotics to a blueberry-enriched diet enhanced superoxide dismutase activity by 17.0% and 35.6% greater than the blueberry and probiotic stand-alone diets, respectively (p=0.03). The combined diet also increased glutathione concentrations 18.6% and 46.6% from blueberry and probiotic stand-alone diets, respectively (p=0.03). These results suggest that adding probiotics to a blueberry-enriched diet further enhances the ability of superoxide dismutase to eliminate dangerous superoxide species and reduce oxidative stress to a greater degree than a blueberry-enriched diet alone.

Mercury concentrations in wetland invertebrates exposed to historic tailing material at Montague Gold Mines, Dartmouth, Nova Scotia

Julianne Robinson, Saint Mary's University

Mercury (Hg) is an element that occurs naturally in the environment and has the potential to be released via natural processes as well as various anthropogenic activities. One of the most toxic species of mercury is methylmercury, a highly bioavailable form of mercury that can easily bioaccumulate in aquatic organisms. Aquatic organisms, such as invertebrates, can be good bioindicators of contaminants and analyzing their tissues can help to reveal a lot of information about the types of contaminants present in the surrounding area. One anthropogenic activity that will be considered in this report is the effects of historic mercury-containing tailing material and its potential bioavailability on aquatic invertebrates in a small wetland located in the historic Montague Gold Mining District in Dartmouth, Nova Scotia. In order to determine whether the tailing material from historical mining practices were above Canadian soil quality guidelines and whether it was bioavailable in aquatic invertebrates, sediment samples and invertebrates were collected from 4 15 x 15 meter quadrants of a wetland connected to a slow moving river running through Montague Gold Mining District. Two non-contaminated reference sites were chosen and invertebrates were also collected from these regions. All invertebrate and sediment samples were first frozen to preserve chemical composition, dried at 50°C for 48 hours, ground separately into a fine powder and then analyzed for total mercury content using the Milestone Direct Mercury Analyzer. Sediment samples from quadrants 1-4 contained approximately 100 mg/kg of total Hg, 320 mg/kg of total Hg, 20 mg/kg of total Hg and 220 mg/kg of total Hg, respectively. These values are far above Canadian soil quality guidelines and indicate heavy mercury contamination of
the sediment. Total Hg values for invertebrates collected from the wetlands far exceeded the total Hg in invertebrates collected from the reference sites with some invertebrate species being approximately 6 times higher in total Hg at the wetlands compared to the reference sites. Total Hg for invertebrates at the wetlands was also considerably higher than published data of similar studies done in Nova Scotia analyzing invertebrates for total mercury content. The results suggest the mercury contained in the wetland is bioavailable in aquatic invertebrates, which can lead to the potential of biomagnification to different trophic levels. In addition, these invertebrates have the potential to act as important vectors for contamination from aquatic ecosystems to terrestrial ones.

**Reproductive ecology of *Ascophyllum nodosum* in differing salinity**

Clay Steell, Mount Allison University

*Ascophyllum nodosum* is a species of brown seaweed that dominates rocky intertidal coasts in the Bay of Fundy and much of the North Atlantic. They are known to grow abundantly in estuaries, or brackish bodies of water where a river flows into the ocean, but have received relatively little research attention in these habitats. Estuaries are low-saline environments, and low salinity is a physiological stressor to *A. nodosum*, which grows optimally in higher-saline marine conditions. This study investigated the reproductive ecology of *A. nodosum* in two estuaries and in a nearby marine site in the Passamaquoddy Bay, New Brunswick. *A. nodosum* reproduction varied with salinity, however this effect varied among study sites. Estuarine populations of the seaweed had higher levels of reproductive tissue than marine populations, and may therefore be important to the species’ local population ecology. This is the first study to examine *A. nodosum* reproduction in light of salinity, and has implications to the species’ conservation and management.

**City noise as a potential stressor on an urban bird: an analysis of heterophil/lymphocyte ratios in European Starling nestlings**

Alyssa Walthers, Saint Mary's University

Anthropogenic disturbances are known to induce stress in a variety of urban species. This study aims to determine if one particular disturbance, ambient urban noise, influences the stress levels of nesting European Starlings (*Sturnus vulgaris*). Nest boxes were randomly assigned to either an experimental (increased urban noise level) or a control treatment (normal ambient noise). Heterophil/lymphocyte (H/L) ratios were determine and used to estimate stress levels of nestlings at 11 and 15 days of age (day 0 is hatch day). Higher H/L ratios are associated with increased stress levels. I predicted that nestlings in the experimental treatment would have higher H/L ratios than those in the control group. I also predicted that habituation to the noise would occur; nestlings would have lower H/L ratios on day 15 than on day 11. No significant difference in H/L ratios was detected between the two treatments at day 11. However, at day 15, control nestlings had significantly higher H/L ratios than did experimental nestlings. Experimental nestlings tended to have a lower H/L ratio at day 15 than at day 11, but no such pattern was detected in control nestlings. These findings suggest that, contrary to my prediction, constant loud noise may not be as important to inducing stress in urban-thriving European starling nestlings as was previously thought. A future avenue of research would be to examine how the unpredictability of noise affects H/L ratios in this species.
**POSTER ABSTRACTS - BIOLOGY**

**Notes:**

All posters will be shown in Loyola Conference Hall.

Poster setup is from 5-8pm on Friday with all posters to be in place before 8:30am on Saturday. Poster presenters must hang their poster on the display board by the number corresponding to their abstract below (materials for hanging the poster will be provided).

Poster sessions are scheduled on Saturday from 9:45-10:15 and noon-2:00 pm and on Sunday from 10:15-10:45 and 11:35 - noon. Presenters are expected to be at their poster station for these times.

1. **Foliar endophyte diversity of the Eastern Mountain Avens, *Geum peckii*, from degraded and pristine habitats in Digby County, Nova Scotia**

Sarah Adams, Diane LaRue, Robin Browne, Brent M. Robicheau, and Allison K. Walker Acadia University

The Eastern Mountain Avens, *Geum peckii* (Rosaceae), is a globally rare and endangered plant found only in coastal bogs in Digby County, Nova Scotia and alpine sites in New Hampshire. The Nova Scotian population is in decline due in part to habitat degradation. The role of endophytic fungi is being investigated for application in the recovery of this species. Fungal endophytes colonize living plant tissue without showing any symptoms of disease, and can be beneficial to plant growth and development. Leaves were collected from wild *G. peckii* plants located along a habitat disturbance gradient in Digby County, NS. In the laboratory, leaf samples were surface-sterilized and plated onto two types of nutrient agar. Endophytes were grown from the leaf samples at room temperature, isolated, and cryopreserved. Species-level identifications were made by DNA barcoding. DNA was extracted from each isolate, and the fungal barcoding gene region (ITS rDNA) was amplified, sequenced and compared with the reference NCBI GenBank database to identify species. Preliminary results indicate differences in diversity of foliar fungal communities along the habitat disturbance gradient sampled, with a predominance of the fungal family Gnomoniaceae (Sordariomycetes, Ascomycota). Recovering sites showed lower endophytic diversity (9 to 17 species) than the pristine habitat (28 species). Several of the fungal species isolated may represent novel species and will be characterized further. Individual roles of endophytic species within the plant are being evaluated for potential applications for propagation and restoration purposes to aid in the recovery of this red-listed plant species in Nova Scotia.

2. **Identification of *Rickettsia* species in Nova Scotia and New Brunswick ticks**

Alyssa Catherine BeLong, Mount Allison University

*Rickettsia* spp. bacteria, also known as spotted fever group bacteria, are obligately intracellular bacteria that can cause potentially lethal illnesses in humans and other mammals. Due to the intracellular replication of this group, Rickettsiae are typically transmitted between vertebrates via arthropod vectors such as ticks. The best known illness of this type, Rocky Mountain spotted fever (RMSF), is the most lethal tick borne illness in North America and is caused by one species member of this group, *Rickettsia rickettsii*. In this study, the risk of spotted fever rickettsiosis in the Maritimes was assessed by examining the prevalence of different rickettsial species in Nova Scotia and New Brunswick ticks. This was done by PCR amplification and sequencing of the rickettsial gltA, 17kDa, 16S, OmpA and OmpB genes under supervision of Dr. Vett Lloyd. The rickettsial genus gltA gene was amplified in 50% (5/10), 60% (6/10)
and 100% (10/10) of Dermacentor, *Ixodes cookei* and *Ixodes scapularis* ticks, respectively. An additional 83 Dermacentor ticks were tested for *R. rickettsii*. Sequence analysis revealed a variety of Rickettsia species were present in all three tick species. Though sequence confirmation of the rickettsial species is ongoing, candidates include *R. monacensis*, *R. tamurae*, and *R. peacockii*. These species are generally considered non- or only moderately pathogenic. Nevertheless, the prevalence of various rickettsial species observed in ticks from Nova Scotia and New Brunswick validates the importance of surveillance of tick populations.

3. Testing the effects of sediment acidification and predator cues on the burrowing behaviour of juvenile *Mya arenaria*

Melanie Bishop, University of New Brunswick Saint John

The increasing concentration of atmospheric carbon dioxide (CO₂) from human activities has led to greater absorption of CO₂ into ocean surface waters, altering seawater chemistry and lowering pH. This so-called Ocean acidification can also lower sediment pH and can result in physiological and behavioural impacts on marine organisms. This study aimed to investigate the impacts of sediment acidification (addition of CO₂) and green crab (*Carcinus maenius*) predator cues on the burrowing behaviour of juvenile (≤ 5 mm) soft-shell clams, *Mya arenaria*. Additionally, this study aimed to assess whether changes to GABAₐ (gamma-aminobutyric acid) neurotransmitter functioning could be a possible mechanism driving clam burrowing responses to more acidic sediment conditions. In the first experiment, clams were exposed simultaneously to conditions that varied in terms of acidity and predator cues. In a second experiment, clams were treated with an antagonist of the GABAₐ neurotransmitter receptor (gabazine) to investigate whether burrowing responses to acidic sediment conditions would change when clams were treated with gabazine. In the first experiment, there was no significant interaction between sediment acidity and presence of predator cues, although acidic sediments significantly reduced the proportion of clams burrowing. In the second experiment, there was a significant interaction between the effects of gabazine and sediment acidification. When treated with gabazine, clam burrowing in acidified sediment was restored to proportions similar to those observed in non-acidified sediment, suggesting that elevated CO₂ concentrations can interfere with GABAₐ neurotransmitter receptor functioning in soft-shell clams (likely in their pedal ganglia), resulting in atypical behaviour.

4. Landscape Genetics Of Lake Chub (*Couesius plumbeus*) In A Branching River Drainage In Northern Labrador

Hilary Brewis, Dalhousie University

Knowledge of population genetic structure in spatially complex river systems is necessary for future attempts of conservation of freshwater fish species in Canada’s vulnerable northern watersheds. I examined patterns of contemporary and historical connectivity to determine the population structure of Lake Chub (*Couesius plumbeus*) for seven lakes in the Kogaluk River system in northern Labrador. Fin clip samples of Lake Chub (N=726) collected from the drainage were examined for polymorphism at 19 microsatellite loci. Relatively high levels of population structure were observed, along with low contemporary migration rates between lakes, thus indicating populations to be relatively isolated. Factors responsible for this observed structure were then explored. No pattern of isolation-by-distance was observed despite migration being physically possible, suggesting a lack of migration-drift
equilibrium. Estimates of effective population sizes were positively correlated with lake area, suggesting that drift plays an important role in contemporary meta-population structure. Preliminary results show that the Lake Chub recently colonized the Kogaluk River system from the west, after the retreat of the Laurentide Ice Sheet from the area approximately 8 000 years ago. The order of the subsequent lake colonization likely influences the contemporary observed effective sizes and population structure.

5. **Inferring population structure of the mite *Spinturnix americanus* between two host species, *M. lucifugus* and *M. septentrionalis*, via cytochrome b sequencing**

Amanda Dawn Brown, Saint Mary's University

In studies of European bat wing mites, it has been found that life history of the bat host effects mite population structure and genetic differentiation at mitochondrial and nuclear sites. To test if this pattern could be seen in the Atlantic Canadian wing mite species Spinturnix americanus, the cytochrome b sequence of the mitochondrial genome was amplified. Samples used were collected from female hosts in the Hayes Cave roosting site in South Maitland Nova Scotia from August-September 2006 from two different hosts: Myotis lucifugus and Myotis septentrionalis. It was predicted that mites collected from *M. lucifugus* hosts would present with weaker population structure due to larger roosts, more roost groups mixing, farther travel between hibernacula and roosts, and generalist tendencies which would act to increase horizontal transmission resulting in increased inter and intra-colony breeding. The implication of such research suggests with a reduced influence of genetic drift and more gene flow there would be more evolutionary potential for *S. americanus* to adapt locally to its major host, helping understand the evolutionary trajectory of the parasite species, and its effect on host health, survival, and evolution as well. Such research could ultimately also contribute to novel genetic species ID for *Spinturnix americanus*.

6. **The effects of increased ambient urban noise levels on the vocal development of European Starling nestlings**

Celina Campbell, Saint Mary’s University

Within urban areas, anthropogenic noise has had documented detrimental effects on animal health and communication. Decreased fitness along with impaired nestling-parent communication have been detected in a few urban avian species. The focus of this study was to examine the effects of artificially increased ambient urban noise on nestling begging calls in European starlings (*Sturnus vulgaris*). It is hypothesized the nestlings will increase the sound frequencies of their calls to overcome higher noise levels. Vocalizations were recorded within 8 nests for each of two groups: a) the experimental group, subjected to artificially increased noise for 7 hours a day from days 5 to 15 (day 0 is hatch day), and b) the control group. Recordings were made on day 14 in the control (over one hour) and in experimental nests (over half an hour with extra noise being played, and half an hour with no extra noise). Twenty minutes of continuous calls were selected for each group. Five values were obtained for each nest: the 5%, 25%, 50%, 75%, and 95% sound frequencies (kHz). From these, a calculated weighted mean was derived. Nestlings in the experimental nests called at significantly higher frequencies when extra noise was being played than in the control nests. Nestlings appear to be unmasking their begging calls from the lower frequency of the extra ambient noise playback.
7. Investigation of growth rates in thyasirid bivalves

Natasha Collins, Memorial University

Some marine bivalves form symbioses with chemoautotrophic, sulphur-oxidizing bacteria, and supplement their particulate feeding diet with symbiont-derived nutrients. The broadly distributed family Thyasiridae contains both symbiotic and asymbiotic species, and the former often reach larger sizes than the latter, presumably due to the extra nutrients obtained from their symbionts. In Bonne Bay, Newfoundland, multiple thyasirid species coexist: symbiotic *Thyasira cf. gouldi*, closely related but genetically distinct asymbiotic *T. cf. gouldi*, and another asymbiotic species, *Parathyasira* sp. Symbiotic *T. cf. gouldi* can reach larger sizes than asymbiotic *T. cf. gouldi*, and *Parathyasira* may be even larger. Here, I use different methods to test whether larger thyasirids have a greater growth rate than smaller thyasirids, or whether they are older. I hypothesize that symbiotic *T. cf. gouldi* have the most efficient nutrient assimilation capacity and therefore the highest growth rate, followed by *Parathyasira* sp. (which may live longer) and asymbiotic *T. cf. gouldi*. Measurements of shell growth bands, carbon and oxygen stable isotope analysis of shell carbonates, elemental analysis on cross-sections of shells, and growth measurements after marking shells with a fluorescent dye all indicate that *Parathyasira* sp. has the fastest growth rate of the three groups of bivalves. Stable isotope analysis shows that asymbiotic and symbiotic *T. cf. gouldi* have similar growth rates, while growth bands and elemental analysis suggest that symbiotic individuals grow slightly faster than asymbiotic ones. *Parathyasira* appears to have very efficient particulate feeding, and symbiont presence may only provide a small growth enhancement to Bonne Bay thyasirids.

8. Expression of a Type III secretion system in a plant growth-promoting bacterium

Jamie William Cook and Cheryl Patten, University of New Brunswick, Fredericton

Many pathogenic bacteria of plants and animals secrete proteins into host cells using a type III secretion system (T3SS). Secreted effector proteins suppress host defenses and promote infection. The genome sequence of the plant growth-promoting rhizobacterium *Pseudomonas syringae* GR12-2 revealed genes predicted to encode a T3SS, however, little is known about the function of these in plant-beneficial bacteria. Bioinformatic analysis showed that the GR12-2 T3SS locus is similar to one (Hrp/Hrp3) of the two T3SS loci in the closely-related plant pathogen *P. syringae* 1448A. Although the GR12-2 locus does not include a homologue of HrpK, the translocon that forms a pore in the host membrane and is required for effector secretion, a gene encoding a protein with high identity (85%) to the 1448A HrpK is present elsewhere in the GR12-2 genome. To determine if the T3SS is functional in *P. syringae* GR12-2, real-time reverse transcriptase PCR was used to measure the expression of the predicted hrpK and two genes of the secretion apparatus. In media containing sugars that are present in the rhizosphere, hrpK and hrcV were expressed, while hrcN was expressed to a lesser extent. These results are a first step toward understanding the role of the T3SS in beneficial plant-bacterial interactions. Determination of the conditions under which the T3SS is expressed in vitro will facilitate identification of effector proteins secreted into the culture medium by the wild type but not mutant strains.
9. The morphological variation in fish in Nova Scotia streams
Emily Cowie St. Francis Xavier University

This project discusses the natural morphological variability of three species of game fish in Nova Scotia rivers. During the past five summers, data has been collected on fish populations in eight different rivers in Antigonish county. Four control sites and four treatment sites were studied and data was collected regarding length, weight, age and population structure of brook trout, brown trout and Atlantic salmon, along with habitat assessments. I will discuss the analysis being done to study how the fish differ from each other as well as compared to other variables. This is done to create a baseline to compare to for further research. This project is part of an ongoing, long-term study exploring the effects of river restoration on fish populations and health.

10. Sedimentation negatively affects reef-associated fish diversity in the Wakatobi Marine Park, Indonesia
Rebecca Croke, University of Prince Edward Island

Throughout their evolutionary history, coral reefs have been subject to a wide variety of natural disturbances, collectively referred to as the natural disturbance regime of coral reefs. One such disturbance is sedimentation, which has been shown to have wide-ranging negative effects on coral reef health. Sedimentation in the Coral Triangle and other areas has been increased by human activity. The effects of sedimentation have been expected to negatively affect reef-associated fish, in terms of abundance, biodiversity and biomass. Three survey sites at the Operation Wallacea field site at the Wakatobi Marine Park were investigated – B3, PK and S1. B3 and PK are sites representative of healthy reefs. S1 is located near a local fishing village and is subject to high levels of sedimentation. Through an assessment of settled sediment levels, turbidity levels and HAS scores (Habitat Assessment Survey), coral reef health was assessed. Analysis of fish biodiversity and abundance was conducted along a 50m UVC (Underwater Visual Census) survey. Fish biomass was visually estimated using a fish length model. Sedimentation at S1 was significantly higher than at PK and B3. Fish biodiversity and abundance was significantly lower at S1 than at B3 and PK. Coral reef organisms are especially susceptible to the effects of climate change and anthropogenic influence. Understanding the relationship between sedimentation, reef health and their effects on fish communities is essential to preparing management strategies as the effects of climate change become more pronounced.

11. An evaluation of muskrat middens as a tool for monitoring freshwater mussel populations
Lauren M G Douglas, Cape Breton University

The objective of my study was to examine the value of muskrat middens as tools for monitoring freshwater mussel populations. Potentially muskrat middens represent a cost and time effective way of monitoring this endangered freshwater taxa. We collected mussel shells from six muskrat middens on two lakes within Cape Breton, Nova Scotia. Living populations adjacent to middens were also sampled using quadrats and scuba. A total of 5,636 shells were collected. The length of all shells collected were measured, identified to species, and in the case of sexual dimorphic species, identified to sex. We found that the species Elliptio complanata was over represented in middens by 28% and Lampsilis cariosa was under represented by 25%. This could be explained by the fact that E. complanata is more visible and easily extracted from the sediments than L. cariosa. There was also a male bias for L. cariosa found in
midden sites, with a 2:1 male to female ratio in midden sites compared to a 1:1 ratio in living populations. This is not easily explained by differences in visibility and accessibility. We found no significant difference.

12. Is what we see, what we hear? Temporal variation in right whale (Eubalaena glacialis) population indices and vocalizations measured concurrently in Roseway Basin

Delphine Durette-Morin and Kimberley Davies, Dalhousie University

North Atlantic right whales (Eubalaena glacialis) are one of the most endangered species of baleen whales in the world, therefore effective monitoring is critical to their conservation and protection. This species has been monitored for many years using both visual and acoustic methods, each of which provides different information about the population. In recent years, visual surveys have revealed unusual changes in the abundance and demographic distributions of this population in certain habitats. Acoustically detected vocalisations are known to vary with population indices, but have mainly been used to establish species presence or absence. The objective of my thesis is to compare and contrast the information obtained from the two monitoring methods over multiple years in Roseway Basin, a well-studied critical habitat of right whales. I hypothesize that changes in the type and rate of vocalisations detected will vary positively with visual observations. Population and abundance indices were developed from sightings-per-unit-effort and photo-identification data recorded during spatial sightings surveys in the basin spanning August through September for the years 2004, 2005, 2013, and 2014. A subset of the acoustic data collected concurrently was manually examined for 3 types of right whale calls with documented demographic associations. The call detections were categorised by uncertainty levels based on the context of the calls and were used to quantify the variation in rates of detections. Preliminary results show that sightings of the whales varied inter- and intra-annually, and that the sex ratios changed from high numbers of males (~6-10) relative to females in 2004 to more equal ratios (~2-3) in 2013 and 2014. Comparison between the visual and acoustic data remains to be completed. Visual results and preliminary analysis of the acoustic data will be discussed.

13. Anti-inflammatory mechanism of relaxin-2 and 3 neuroprotection on oxygen and glucose deprived brain tissue

Luke Edgar and Dr. Brian Wilson, Acadia University

Stroke is the third leading cause of death in Canada. At least two relaxin peptides are now known to confer protection to heart, kidney, liver, pancreas, and brain tissues during ischemia through anti-inflammatory, vasodilatory, angiogenic, and anti-fibrotic actions. This makes relaxin a promising candidate as a stroke therapeutic. This study shows that relaxins reduce cell death in cultured brain slices exposed to oxygen and glucose-deprived conditions which mimic conditions in brain tissue under ischemic stress. Evidence also suggests that anti-inflammatory effects of relaxins in the brain might be conferred by a reduction of pro-inflammatory cytokines. Neonatal rat brains were sectioned, plated, and cultured for two weeks. Subsequently, slices were treated with one of three media conditions: a normoxic glucose control, an oxygen and glucose-deprived control, or oxygen glucose deprivation with one of three relaxin treatments (100 pM): human relaxin-2, human relaxin-3, or relaxin-3/insulin-5 (a relaxin-3 receptor agonist). After treatment for 1 hour, slices were placed back into culture for 1 or 6 hours. Subsequently, slices were stained with propidium iodide to highlight dead cells or flash frozen and stored at -80° C. Protein was isolated from the latter group and assayed for interleukin-1 beta and
tumour necrosis factor alpha. Although relaxin did not significantly reduce cytokine levels, relaxin-3 and relaxin-3/insulin-5 appear to reduce levels of both interleukin-1 beta and tumour necrosis factor alpha, suggesting that relaxin peptides are protective in brain tissue by suppressing inflammation.

14. Horizontal transmission of the microsporidia, *Nosema adaliae*, from the *Adalia bipunctata* to the *Chrysoperla carnea*

Ashley Fletcher, Saint Mary's University

The green lacewing, *Chrysoperla carnea* Stephens, and the two-spotted lady beetle, *Adalia bipunctata* L., are two natural enemies commonly used in biological control in North America. They are used in greenhouses and agriculture through augmentative release, and are mass-produced in commercial insectaries in Europe. Both have been found to host different species of microsporidia; however *Nosema adaliae* has been successfully identified and maintained within *A. bipunctata*, having a chronic effect on its host. Due to coexistence of the two insects, horizontal transmission of *N. adaliae* from *A. bipunctata* to *C. carnea* will provide knowledge of host specificity of the pathogen and lacewing susceptibility. The objective of this study is to determine if *N. adaliae* is successfully transmitted through oral consumption, if dose affects transmission, and if the pathogen has effects on *C. carnea* larval development. Three treatments of varying doses of infected and non-infected *A. bipunctata* eggs were fed to *C. carnea* larvae, and development was observed over 30 days. Experimental trials were conducted under controlled environmental conditions. Sample smears were prepared upon death or after the 30 days, and all test larvae were examined for microsporidian spores. The microsporidium was transmitted to two lacewing larvae, both had died early in development suggesting acute effects of the pathogen. Low transmission suggests pathogen resistance and poor susceptibility of *C. carnea* to *N. adaliae*.

15. Will *Cyanea capillata* (Linnaeus 1758) achieve global ocean domination?

Tess Forbes, Memorial University of Newfoundland

*Cyanea capillata* is an important planktonic predator in the northern waters of the Atlantic, Pacific and Arctic Oceans. It has been recently hypothesized that jellyfish will take over the oceans as a result of over-fishing, ocean warming, acidification and pollution. Biology of *C. capillata* was studied in Bonne Bay, western Newfoundland to investigate this possibility. *C. Capillata* was found to feed mainly on small zooplankton including amphipods, copepods and smaller medusae including *Aurelia aurita*. No major consumption of larval fish was observed. No clear relationship between medusa size or maturity and feeding rates could be established. The only predation on *C. capillata* to be observed was that by cunners, *Tautogolabrus adspersus*. Cunners show no interest in juvenile *C. capillata*, which presumably have little energetic food value. Once *C. capillata* has reached sexual maturity, however, they become an intense target of the cunners. Predation efficiency was almost 100% as medusae approach the shore in late summer. These observations in Bonne Bay provides evidence that there is no danger of *C. capillata* taking over local seas in the foreseeable future.
16. Feasibility assessment of antioxidant peptides as a dietary supplement in a zebrafish model

Corey Hanson, Cape Breton University

This study will focus on the effects of antioxidant peptides (AOPs), extracted from Black Soldier Fly (*Hermatia illucens*) larvae (BSFL), on zebrafish (*Danio rerio*) when administered orally utilizing food as a vehicle. Antioxidant peptides are naturally and artificially produced oligopeptides that function to inhibit reactive oxygen species (ROS) activity and prevent oxidative damage. Antioxidants, such as Vitamin C, also exhibit efficiency in inhibiting ROS activity and oxidative damage when consumed in the diet. The objective of this study was to evaluate the feasibility of orally administered antioxidant peptides to reduce the oxidative damage experienced by zebrafish when exposed short-term to an oxidative stresser, ferric nitritriacetate (FeNTA). Newly hatched zebrafish embryos were exposed to varying levels of antioxidant peptide hydrolysate to determine toxic antioxidant peptide concentrations, as well as any concentrations that negatively impact early life-stage development of zebrafish larvae. Upon determining non-toxic levels, newly hatched zebrafish embryos were exposed to varying levels of waterborne antioxidant peptides and FeNTA, and adult zebrafish were orally administered antioxidant peptides and exposed to FeNTA. Mortalities were recorded daily; hematocrit levels and lipid peroxidative damage (2-thiobarbituric acid reactive substances assays) were measured to determine the ability of the antioxidant peptides to reduce the oxidative damage as a result of FeNTA exposure.

17. In Vitro validation of FAM156 as a potential mediator of paclitaxel resistance in breast cancer

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Despite advances in treatment, breast cancer remains one of the leading cause of cancer-related mortality affecting Canadian women. Paclitaxel is a principle chemotherapeutic used to breast cancer, however some patients demonstrate no response to paclitaxel treatment. The goal of our project is to develop a genetic profile to predict a patient’s response to paclitaxel prior to drug administration by identifying genes that mediate resistance to paclitaxel. FAM156 gene was identified in a previously performed RNAi *in vivo* screen. An *in vitro* assessment was performed to validate their proposed role. Individual knockdown of FAM156 was generated by performing a lenti-viral shRNA knockdown in a MDA-MB-231 triple negative breast cancer cell line. A cell proliferation assay using trypan blue dye exclusion was used to determine the growth rate of the knockdown when treated with 2.5nM paclitaxel. An apoptosis assay was performed using flow cytometry and annexin V 647 and 7AAD to determine level of apoptosis when treated with paclitaxel. A cell viability assay was performed to generate a dose response curve to determine the IC50 of the knockdown when treated with paclitaxel. Interestingly, FAM156 knockdown had a significant decrease in the level of live cells and IC50 when treated with paclitaxel. FAM156 knockdown also showed a significant increase in apoptosis compared to the control. FAM156 was identified as a novel paclitaxel resistance gene in breast cancer. To further investigate its role, an *in vivo* assessment needs to be performed to determine if the gene knockdown actually translates to more treatment sensitive tumors.
18. **Effects of water stress on growth, ethylene evolution and methane emission in sunflower**

Anna Jessop, Mount Saint Vincent University

Ethylene evolution has been shown as a common stress response in plants. Also, there is evidence that methane is emitted by plants in response to stress factors. We studied the effects of drought and flood stresses on plant growth and development and the evolution of ethylene and methane. Sunflower plants were grown from seeds in a controlled-environment growth chamber (22/18°C, 16 h light/8 h dark; photosynthetic photon flux density of 300 µmol m-2 s-1). One-week-old seedlings were exposed to two drought (mild and severe) and two flooding (mild and severe) conditions. In each of these conditions, control plants (under no stress) were also included. After three weeks, a number of plant morphological and physiological parameters were measured. Methane and ethylene were measured using a gas chromatography-flame ionization detector system. Preliminary results showed that plants under severe drought had decreased growth than plants under normal conditions, and plants under severe flood had an accelerated growth compared to the unstressed plants. Results also showed that plants under severe flood had more chlorophyll a than plants under severe drought; however, chlorophyll b remained relatively the same. Carotenoids were highest for plants grown under severe stress of flood and drought. Methane evolution was 25% greater in plants under severe drought than in plants under severe flooding, and it was 7.8% higher than in plants grown under normal condition. Ethylene evolution was highest under both severe drought and flooding conditions. Finally, the results showed a strong relationship among watering regime, plant growth and methane emission.

19. **Influence of avian biovectors on mercury speciation in a wetland**

Jocelyn Kickbush, Jennie Rand, John Murimboh, Mark Mallory and Nelson O'Driscoll, Acadia University

Mercury is a persistent and bioaccumulative chemical that is present in many remote environments due to its ability to be transported long distances in the atmosphere, and to be deposited far from the original source. Wetland ecosystems are important “hot spots” for mercury in eastern Canada, providing anoxic environmental conditions that promote the bacterial methylation of mercury. Methyl mercury is the most biologically available form of mercury and the form which biomagnifies in food webs. Seabird guano is a well-documented biovector for metals – including mercury – and nutrients, which may indirectly affect metal speciation. The site for this study, Big Meadow Bog (Brier Island, Nova Scotia, Canada) has a history of ditching in the 1950s, which changed hydrology significantly, resulting in colonization by 3000 pairs of herring gulls (*Larus argentatus*) in the 1980s. To quantify changes in mercury mobilization and speciation in response to this biovector, groundwater samples were collected from this site as well as a reference bog with similar geological and hydrological characteristics. The filtered samples were analyzed for total mercury, methyl mercury, and water chemistry (pH, conductivity, anions, cations, and dissolved organic and inorganic carbon). Preliminary results show significantly higher nutrients (nitrate, phosphate, and sulfate), total mercury, and methyl mercury concentration when compared to the reference bog that is minimally impacted by avian biovectors. This elevated availability of methyl mercury could potentially pose a threat to the local ecosystem and wildlife population due to methyl mercury’s toxicity to living organisms.
20. Oligosaccharide as the effective component of seaweed extract on plant growth promotion

Yoonsu Koh, Saint Mary's University

*Ascophyllum nodosum* extract (ANE) is a processed brown seaweed extract that is sprayed on crops. The effects of ANE include amplified plant growth, improved abiotic and biotic stress tolerance, enhanced fruit quality, and productivity. ANE contains partially hydrolized carbohydrates, proteins, hormones, and minerals of the brown seaweed and its endophytic fungus, *Mycosphaerella ascophylli*. Although exogenous proteins, hormones, and minerals can promote plant growth and immune system, the extremely low concentration (e.g. 3mL/L) and quantity of ANE may not cause the beneficial effects observed. Carbohydrates are the major component of brown seaweed’s dry matter. During the ANE production, insoluble carbohydrates are broken down into water-soluble oligosaccharides. Studies have shown that some oligosaccharides (oligoalginate and oligochitins) can increase plant growth and immune responses. Thus, we hypothesize that one or more of these oligosaccharide components (oligoalginate, oligochitin) in ANE are responsible for inducing the improved plant growth and enhanced resistance to abiotic and biotic stresses. Soybean and duckweed will be used to test the hypothesis. We predict that ANE and oligosaccharide mixture (oligochitins 10ppm + oligoalginate 10ppm) treated plants will have higher concentration of chlorophyll, phenolic, protein, and increased enzyme activity and growth rate under salt stress.

21. A comparison of the effects Of common stream restoration techniques on the freshwater habitat quality of Brook Trout (*Salvelinus fontinalis*) across Nova Scotia

Molly LeBlanc, Dalhousie University

Nova Scotia stream restoration modifies the properties of a watercourse in an attempt to reverse or reduce damage and improve stream environments to sustain wildlife, particularly valued fish species. At considerable expense groups across Nova Scotia restore an estimated 200,000 m² of freshwater aquatic habitat yearly, primarily using two techniques: digger logs and deflectors. However, the effectiveness of these projects, many of which are carried out by volunteers, has not been systematically examined for the Province. My project conducted a meta-analysis that compared Fish Habitat Assessments (FHA) before and after stream restoration work (installation of digger logs and/or deflectors). Data were obtained from my own work, and from projects undertaken throughout the Province by local groups. These projects were mainly focused on improving habitat for brook trout (*Salvelinus fontinalis*), the number one preferred sportfish species in the province. Data were derived using a standardized method of FHA created for use in Nova Scotia by Adopt-a-Stream and Clean Foundation personnel. These assessments record factors important to brook trout habitat quality including average pool area (m²), average pool depth (m), substrate size in potential spawning habitat, dissolved oxygen levels (mg/L), and in-stream cover for both adult and juvenile fish (%). My hypothesis is that the installation of digger log and deflector structures leads to a significant improvement in each of these parameters (e.g. larger and deeper pooling areas, larger substrate size in spawning habitat, increased dissolved oxygen levels and more in-stream cover) resulting in higher quality Brook Trout habitat across the province.
22. Cooperative nest defense in the European Starling (Sturnus vulgaris) when met with the threat of a predator

Elizabeth Anne Lewis, Saint Mary's University

One direct benefit of mating outside the pair bond for female passerine birds is to enlist the aid of neighbouring males in communal activities such as nest defense. Literature states that female passers are more heavily invested in offspring than males. Males would cooperate for the public good as they may have sired offspring in neighbouring nests (cooperative neighbourhood hypothesis). European starlings (Sturnus vulgaris) have unique reproductive strategies with not only males producing genetic offspring outside the pair bond in other nests (extra-pair paternity), but females as well (quasi-parasitism, intraspecific brood parasitism). Therefore, I predicted that both males and females would respond to a predation threat in neighbouring nests. European starlings were exposed to a taxidermy mount of a red squirrel (Tamiasciurus hudsonicus) (experimental treatment) as well as to a similarly sized/shaped rock (control) on the 11-13th day of the nestling period (day 0 is hatch day). An aggregate score of defensive responses was calculated. Significantly more birds (other than parents) responded to the experimental than control treatment, demonstrating that the taxidermy mount was effective, and that communal defense occurs in this species. Of the parents, females responded more often to the experimental mount than males, supporting that females are more heavily invested in the offspring. Both male and female European starlings participated in mobbing at neighbouring nests during the experimental treatment, supporting one of the main predictions of the cooperative neighbourhood hypothesis. Therefore, paternity and maternity uncertainty in neighbouring nests appear to increase communal nest defense in this species.

23. Combined effects of carbon dioxide, temperature and water stress on growth and chemical constituents of flax (Linum usitatissimum L.) seedlings

Jamie MacDonald, Mount Saint Vincent University

Elevated atmospheric CO2 concentrations increase air temperatures and alter water availability. Elevated CO2 increases plant growth rate. Higher temperature can increase photosynthesis rates and modify plant growth patterns. Drought, on the other hand, decreases vegetative growth by damaging plant tissues. Flax (Linum usitatissimum L.) is an essential crop of western Canada, and because of climate change, its yield reductions would be economically destructive. Due to the strength and durability of its fibres, flax is an asset to textile industry and has numerous human health benefits. Flax is a source of omega-3 and omega-6 fatty acids, essential amino acids, and fibre. We investigated the interactive effects of elevated CO2, increased temperature, and water stress on the growth and chemical constituents of flax seedlings. Plants were grown under two temperature regimes (22/18°C and 28/24°C, 16 h day/8 h night), two CO2 concentrations (400 and 700 μmol mol-1), and two watering regimes (well watered and water stressed). Twelve ten-day-old seedlings were randomly assigned to one of eight experimental conditions where they were grown for 21 days. Upon harvest, a number of morphological and physiological parameters, including stem height, leaf number, leaf moisture, total biomass, photosynthesis, water potential, and nitrogen balance index, were measured. Preliminary results showed that higher temperatures decrease total mass but increase chlorophyll a; elevated CO2 increases stem height, leaf number, and root mass but decreases leaf water potential; and water stress decreases stem height. This study can be used to develop adaptive measures for this economic crop.
24. Molecular characterization of melanocortin and androgen receptors in the electric organ of the gymnotiform fish *Brachyhypopomus gauderio*

Holly MacKinnon and Dr. Vielka Salazar, Cape Breton University

The nocturnal gymnotiform fish *Brachyhypopomus gauderio* emits electric signals for electrolocation and electrocommunication. These electric signals result from the summation of the action potentials emitted by electrically excitable cells found within the fish’s electric organ (EO). *B. gauderio* dynamically regulates the action potentials in their EO resulting in changes in their electric signals in response to social and environmental challenges. Previous work suggests that melanocortins and androgens are the two main players orchestrating electric signal plasticity in *B. gauderio*. For my study, I used molecular techniques to characterize the melanocortin and androgen receptors present in the EO of *B. gauderio*. I also determined the phylogenetic relationship of these genes to those characterized in other teleost fish. To date, I have successfully isolated the partial sequence for *B. gauderio*’s melanocortin-5 receptor (MC5R). In addition, phylogenetic analysis indicates that *B. gauderio*’s MC5R sequence has the highest similarity to the zebrafish’s MC5aR isoform. Preliminary findings suggest that an androgen receptor (AR) and the melanocortin-4 receptor (MC4R) are also present within the EO of *B. gauderio*. The results of my study will be instrumental for the development of in situ probes to visualize these receptors and help us to better understand the mechanisms for regulating the activity of excitable membranes.

25. Annual cycle in body mass and organ size in long-tailed ducks (*Clangula hyemalis*)

Savannah Mahoney, Acadia University

Organ use varies throughout the annual cycle of a various organisms. Tradeoffs between functional importance and cost of organ maintenance therefore change at different time periods. Many migratory birds have cycles of atrophy and hypertrophy in different organs to accommodate these tradeoffs, thereby adjusting nutrient allocation to tissues to match their energetic needs. These cycles have not been studied yet in Long-tailed Ducks (*Clangula hyemalis*). This study focuses on the adjustments in organ size and body mass during three distinct time periods in the lifecycle of Long-tailed Ducks. We collected over 150 Long-tailed Ducks at several Canadian field locations over a period of three years, and dissected the carcasses, recording body mass and the size of the heart, gizzard, and liver. Preliminary results indicate that the mass increases throughout the year, heart gradually increases, and the liver and gizzard atrophy during breeding. Patterns were similar for females and males. Further evaluation of these patterns is underway, including controlling for metrics of body size.

26. Biodiversity trends in urban storm water ponds

Holly McCulloch, Acadia University

City environments are eliminating habitat for many species thereby reducing biodiversity. This study examined storm water pond facilities (SWF) as potential wildlife habitat in urban areas, using Odonata (dragonflies and damselflies) as indicator species. 37 SWF and 5 natural (NAT) ponds were studied in Canada’s National Capital Region. Odonata were sampled on two occasions reflecting their temporal variation. Odonates were sampled in one or more circuits around each pond for a total effort of one hour during peak flight conditions. Vegetation was also sampled on two occasions, matched closely in timing to odonate sampling, using the interrupted belt transect method. Sampled quadrats were selected based on preliminarily observed maximum diversity. Preliminary results show greater
vegetation species richness at SWF than at NAT ponds. There was no significant correlation between Odonata and vegetation species richness among sites. Vegetation complexity at each pond will be examined as it relates to odonate composition. Odonata richness decreased in subsequent circuits at both SWF and NAT ponds. The age of the SWF will be compared to vegetation complexity and odonate richness. The results suggest SWF are potentially good sites for management or enhancement to better support the presence of wildlife, helping to replace disappearing urban wetland habitat, while still performing their primary task of maintaining storm water runoff.

27. Evaluating the application of charged and uncharged biochar, in combination with arbuscular mycorrhizae inoculation, to the growth of *Glyceria striata* in a greenhouse setting

Sadie Moland and Allison Walker, Acadia University

Biochar is gaining attention worldwide for its potential use as an organic soil amendment that could increase agricultural yields and improve soil fertility. Additionally, biochar provides an effective method of carbon sequestration that is of interest given the current state of global CO2 emissions. This research studies biochar in the context of restoration projects with regards to its potential use in increasing the survival rate of the wetland grass *Glyceria striata* grown in greenhouses for future re-introduction into restored sites. We tested 3 different application rates of biochar (10%, 50%, 75% by volume) and compared these application rates for charged (pre-treated with fertilizer) and uncharged biochar, as well as biochar with and without arbuscular mycorrhizal inoculation. The aboveground biomass, belowground biomass, and the shoot height of 166 G. striata plants were recorded after 92 days of growth. Results suggest that the 50% application rate of biochar is favourable for promoting *G. striata* growth. DNA analysis also indicates that *G. striata* does support arbuscular mycorrhizal fungi which, to our knowledge, the first recorded evidence of this particular symbiosis. In the future, this project could be expanded to include field trials in restoration sites using material grown in soil amended with biochar.

28. Defining community structure of Neotropical bats using stable isotope analysis to determine dietary niche breadth

Phillip Oelbaum, Dalhousie University

Stable isotope analysis (SIA) has become an increasingly popular method in community ecology studies of trophic structure especially for cryptic species whose diets are not well known or readily observable. By analyzing the ratio of $^{13}$C/$^{12}$C and $^{15}$N/$^{14}$N isotopes, denoted by $\delta^{13}$C and $\delta^{15}$N respectively, niche dimensions (breadth, overlap, etc.) of sympatric species can be quantified to characterize community structure. $\delta^{13}$C is useful for determining a species’ diet while $\delta^{15}$N permits inference on the relative trophic position of a species in a community. In May 2014 hair samples were collected from 24 bat species in Lamanai and Ka’kabish, Orange Walk County, Belize. A prediction of community structure was created from data in literature; most dietary information came from previous stomach content or fecal analysis studies. Using the data obtained through SIA and statistical programs SIAR and SIBER, this study presents a model of the community structure of this Neotropical bat fauna.
29. **Cytoprotective action of soluble heme oxygenase-1-cell penetrating peptide (sHO-1-CPP) observed in in vitro ischemia-reperfusion injury (IRI) models**

Ananda Baskaran Venkatachalam¹, **Ayush Ray**¹*, Jessica MacLean¹, Qianni Hu¹, Ian Patrick Joseph Alwayn¹, ², ¹ Atlantic Centre for Transplantation Research, Dalhousie University, Halifax, Nova Scotia, Canada. ² QEI Health Sciences Centre, Halifax, Nova Scotia, Canada.

Livers are susceptible to ischemia-reperfusion injury (IRI) seen during transplants and ischemic hepatitis. Hemeoxygenase-1 (HO-1) is a stress-inducible endogenous protein that provides protection against IRI. Our laboratory has conjugated the soluble HO-1 (shO-1) to a cell penetrating peptide, allowing shO-1 penetration even in non-metabolically active cells, to produce a novel soluble hemeoxygenase-1-cell penetrating peptide (shO-1-CPP). The aim of the study was to discover in vitro cytoprotective effects of shO-1-CPP on liver cells during IRI. We chose two rat liver cell lines: a high growth-rate hepatoma cell line (McA-RH7777) for an initial investigation of cytoprotection and an epithelial cell line (Clone 9) as liver epithelial cells are responsible for a majority of IRI-related damage associated molecular patterns (DAMPs). In vitro IRI model was achieved by placing the cells in a hypoxic chamber for 8 hours of ischemia, followed by re-oxygenation in a normally oxygenated incubator for 2 hours of reperfusion. Cell apoptosis/necrosis flow cytometry analysis following the 10-hour IRI determined shO-1-CPP treated cells (McA-RH7777 and Clone 9) showed higher cell viability in comparison to controls: cells not treated with protein and cells treated with just shO-1.

30. **Expression of transcriptional signature genes of innate immunity in zebrafish**

Emily Rogers, Acadia University

Zebrafish xenotransplantation has emerged as an alternate method in screening pharmaceuticals, particularly in the area of cancer research. While transplantation of human tissues or cancers into zebrafish is very promising, there is much to be learned about the zebrafish genome before results from such experiments can be conclusive. This work focuses on studying the genes involved in innate immunity in zebrafish. Total mRNA was isolated from various zebrafish tissues (i.e., liver, kidney, eggs and sperm) then reverse transcribed. cDNA was then screened using gene specific primers and PCRs to determine which transcriptional signature genes of innate immunity were being expressed in each tissue type. Genes of interest were Eomes1, id2, tbx21 and zbtb16a. The above experiments included designing novel primer pairs for the amplification of tbx21 and zbtb16a. Agarose gel electrophoresis results indicated the presence of mRNA transcripts of Eomes1 and tbx21 in kidney, egg and sperm tissues (i.e., not in liver); presence of id2 transcripts in all tissues; and strong presence of zbtb16a transcripts in egg and sperm, while only minimally detected transcripts in liver and kidney samples. Expression of each gene in the respective tissue types may be indicative of the involvement of that organ in innate immunity. For example, PLZF gene, a human homologue of zbtb16a, is a transcriptional signature of natural killer T (NKT) cells in humans. Our detection of the presence of zbtb16a in zebrafish may therefore be indicative of the presence of NKT cells in this species.
31. Analysing Nova Scotia lichens for mercury content

Cardy H. Saunders, Acadia University

Many lichens (a symbiosis of green algae or cyanobacteria and fungi), being epiphytic upon plant substrates, are known to be excellent air pollution indicators. A variety of lichen species are known to sequester airborne chemicals, including heavy metals such as mercury and are thus ideal biological indicators of such pollutant levels in the natural environment. Currently the spatial patterns of mercury associated with the lichens of Nova Scotia is largely unknown. This study will quantify spatial relationships in mercury adsorbed to lichens across Nova Scotia. Lichens in the genera *Usnea* and *Hypogynnia* were collected from sites across the province, including from long-term lichen monitoring plots. Samples were dried at air temperature, cryogrinded and analysed for total mercury by thermal degradation, gold amalgamation- atomic absorbance using a Nippon Mercury Analysis System (MA-2000). Geographic Information Systems will be used to produce mercury concentration gradient contour maps for the province in order to identify areas of high mercury contamination. Additionally, lichens of Nova Scotia are poorly represented in GenBank, and DNA barcoding of select specimens will be conducted, and the findings made available to the scientific community.

32. Specific Spherical Nucleic Acids for targeting cancerous cells

Sessyly Hope Scheller, Cape Breton University

Spherical Nucleic Acids (SNAs) consisting of densely packed and highly oriented oligonucleotides with an inorganic gold nanoparticle core exhibit exciting chemical and physical properties; revolutionizing the field of biomedicine. To be applicable for use in medical diagnostics and cancer therapy, it is essential that SNAs are assembled in a way ensuring high hybridization capacity to their complementary sequences. The traditional salt-aging method is effective, but is quite tedious and requires 1-3 days to complete. Alternatively, the faster low-pH assisted procedure is efficient, but presents concerns related to nonspecific DNA adsorption to the gold core. To address these issues, we compared two novel treatments to specifically assemble thiolated DNA on to the gold nanoparticle core under low pH conditions. The first method involves utilizing non-thiolated DNA to first stabilize the nanoparticle, followed by the addition of thiolated DNA to then replace the previously bound ligands. The second one-step method involves the addition of both non-thiolated DNA and thiolated DNA at the same time. Results show that it becomes increasingly more difficult to bind thiolated DNA to the gold core when there is already previously bound non-thiolated DNA on its surface. Furthermore, the one-step method displayed a higher loading capacity of thiolated DNA to the gold core surface compared to the two-step method. Outcomes of this project are directly relevant to cancer treatment due to the non-toxicity, high specificity, and high loading capacity of these SNAs, making them applicable for use in a variety of areas including drug delivery and diagnostics.
33. Phenotypic plasticity and thermal tolerance: A case study in the mangrove Rivulus Kryptolebias marmoratus
Laura Steeves, Mount Allison University

Phenotypic plasticity describes the extent to which an individual can reversibly cope with changes in its environment. We were interested in the behavioural and physiological mechanisms aquatic animals use to deal with high temperatures, and if these responses are plastic or genetically hardwired. Changes in phenotype are often obscured by genetic variation. To circumvent this problem, and to focus on environmental influences of thermal tolerance we used a unique model fish, Kryptolebias marmoratus. The mangrove rivulus is the only known self-fertilizing hermaphroditic vertebrate, producing genetically identical clones. Using this fish we hypothesized that thermal tolerance and the cellular response to thermal stress are phenotypically plastic traits. To test this, we compared acute thermal tolerance, and heat shock protein expression in fish with distinct genetics, thermal acclimation, and social environments. We predicted that thermal responses would be different between 1) fish held at two different acclimations (25°C and a 25-30°C diel cycle) and 2) in isolated fish versus paired fish. We predicted that there would be no differences between genetically distinct fish held in identical conditions. Our results indicate that different thermal acclimations and different social settings do impact the thermal tolerance but genetics, with the two lines we tested, do not. Initial results suggest that thermal tolerance is phenotypically plastic in this species. In light of warming ocean temperatures, it is critical to understand thermal limits and potential flexibility in how aquatic animals respond to high temperature. This project has particular relevance for the changes in survival and distribution of tropical marine ectotherms.

34. Ion transport regulation in cold acclimated killifish
Janet Tait and William Marshall, St. Francis Xavier University

The northern killifish (Fundulus heteroclitus) is a eurythermal and euryhaline teleost fish found in estuaries along the Atlantic coast of North America. To survive the range of temperature and salinity they encounter in their estuarine habitats, they are impressive ion transport regulators. Ion transport in the killifish is under apparently redundant control. It operates by a hormone-receptor mediated adrenergic pathway and a stretch-sensitive osmotic pathway. We hypothesized that when these fish are exposed to the cold, the complex receptor mediated adrenergic pathway would become less responsive, whereas the osmotic pathway would retain its responsiveness. We tested the responsiveness of these two pathways by placing opercular epithelia (OE) of both warm (20°C) and cold (5°C) acclimated fish in an Ussing chamber and measuring changes in short circuit current (ISC, a measure of Cl- secretion rate) across the OE in response to transport inhibitors (clonidine, an α2-adrenergic agonist, and hypotonic Cortland’s saline) and stimulators (isoproterenol, a β-adrenergic agonist, and hypertonic Cortland’s saline). We found that the total change in ISC was significantly lower for cold acclimated fish in all treatments except hypertonicity. Osmotic decrease was a fully effective inhibitor of Isc in the cold, but clonidine inhibition was blunted in the cold. Clonidine also had a significantly higher effective dose at 50% (ED50) in cold acclimated fish compared to warm acclimated fish (P 2-adrenergic pathway is less responsive at low temperatures, while the parallel osmotic pathway becomes critical to survival of killifish in the cold.
35. **Influence of acclimation temperature on the survival and physiology of shortnose sturgeon** (*Acipenser brevirostrum*) **exposed to seawater**

Samantha Taylor, Adam Downie and James Kieffer, University of New Brunswick, Saint John

Previous observations from our lab show that there is low survivability of juvenile shortnose sturgeon exposed to full strength seawater (30-32‰) at warmer water temperatures (18-20°C), indicating a potential interaction between the two variables. The effect of this interaction is important to understand, as shortnose sturgeon can be exposed to a variety of temperature and salinity conditions. The combined effects of exposure to different temperatures and salinities have not been previously studied in shortnose sturgeon. The effects of the exposure are difficult to predict, notably because salinity and temperature have conflicting impacts on metabolism. This study investigated the effects of acclimation temperature (5°C, 10°C, 15°C and 20°C) on the 24 hr survival and physiology of shortnose sturgeon exposed to freshwater or full strength seawater. Blood samples were taken and analyzed for various physiological measures, including plasma ions (sodium, chloride and potassium) and energy metabolites (glucose, protein). Fish survival rates and % body mass loss was also assessed over the 24hr exposure period. Fish mortality (~27%) occurred only at 20°C. Percent (%) body mass losses were larger in sturgeon exposed to full strength seawater and the largest losses (~25%) occurred at 15 and 20°C. Ion levels were higher in fish exposed to full strength seawater, but there was no effect of temperature on the levels. These findings, coupled with some previous results from our lab, suggest that juvenile shortnose sturgeon are more tolerant to salinity challenges than previously thought.

36. **Post-hurricane succession of trees and ground flora in Point Pleasant Park, Halifax, Canada**

Mariya Turchin, Dalhousie University

Point Pleasant Park is an urban park located on the southern tip of the Halifax Peninsula. On September 29 2003, Nova Scotia was hit by Hurricane Juan, a Category 2 storm that destroyed 85% of trees in the park. The goal of this study was to evaluate succession in the park by examining the abundance, composition, diversity, richness and evenness of ground flora and tree species at 3 year intervals after the hurricane. Four, 20 x 20 m sites within the park were chosen to represent the most affected areas. In each site, quadrats were used to assess the percent cover of the ground flora species and all trees ≥2.5cm in diameter at breast height were measured and identified. Preliminary results found a significant difference in the ground flora composition between years and sites as well as a significant interaction between year and site. Grasses, fungi, *Gaultheris procumbens*, *Rubus* spp., *Cornus canadensis*, *Maianthemum canadense*, and *Viburnum nudum* were found to contribute to more than 10% of the differences. Overall, the average percent cover of these seven ground flora species decreased since 2009, with each individual flora species following a different trajectory. The differences in response are likely due to each species’ niche requirements as well as the changes in the physical environment and biological interactions after the hurricane and as succession proceeds. Once completed, this study will contribute to our understanding of secondary succession in the Acadian forest, forests with similar flora composition, isolated forest communities and urban parks.
37. Investigating the potential role of long non-coding RNA in breast cancer

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Breast cancer remains one of the top causes of cancer-related deaths among women today. Our recent data suggests that the retinoic acid (RA) pathway plays an important role in determining breast cancer progression. The RA signaling pathway modulates a number of cellular processes via gene expression regulation of up to thousands of genes, but the mechanisms surrounding this regulation are not completely understood. Recently, our microarray gene expression analyses of RA-treated MDA-MB-468 breast cancer cells revealed that many RA-induced genes are long non-coding RNAs (lncRNAs). Examination of one lncRNA, LNC284, revealed significant upregulation in MDA-MB-468 cells following RA treatment, by real-time quantitative PCR (RT-qPCR). In addition, expression of LNC284 was also increased in MCF7 and T47D breast cancer cell lines following RA treatment. In order to study the functional role of LNC284, knockdown of LNC284 expression was performed using LNA GapmeRs, which are short antisense oligonucleotides that silence expression of nuclear and cytoplasmic RNAs. Preliminary findings indicate successful knockdown of LNC284 using LNA GapmeRs. Together, these results aim to show that RA-induced lncRNAs, such as LNC284, may have a global role in RA-regulated gene expression. The role of lncRNAs, such as LNC284, in RA-regulated gene expression will be elucidated through functional studies made possible by successful knockdown with LNA GapmeRs.

38. Using laser photogrammetry to measure long-finned pilot whales (Globicephala melas) in the field

Joanna Wong, Dalhousie University

Measuring animals is useful for differentiating sex, age, subspecies and geographic forms. By attaching two parallel lasers to a camera, called laser photogrammetry, a scale is projected onto photographed whales. Dorsal base lengths (DBL) of pilot whales were measured to test the accuracy of laser photogrammetry, and to determine whether DBLs were related to the sex and leading role of individuals. Using photographs, 194 individuals were measured and individually-identified based on natural markings, with 33 of these photographed on multiple encounters. Individuals were compared to a catalogue of previously-sexed whales from which DNA had been extracted from skin biopsies, resulting in sex-identification of 8 individuals. Photographs were taken as perpendicular to whales as possible, and lasers were frequently aligned to minimize error. To determine whether lasers had remained parallel during encounters, I photographed a fixed scale before and after each encounter, and used these photographs to calculate the difference in distance estimated with the lasers during the encounter. Results indicated that 58% of pairs of photographs of the DBL of the same individual were less than 5 cm different from one another, where more accurate measures were produced when whales were in closer proximity. This confirms changes in laser alignment appear to have important effects on measurement accuracy, and future mounts should focus on preventing laser movement. Male DBL’s did not appear to be consistently larger than those of females, suggesting DBL may not be a reliable determinant of sex. Leaders were also not necessarily bigger than other individuals in the same cluster. Despite these limitations, laser photogrammetry’s ease of use still makes it a valuable tool in collecting accurate body measurements, especially when coupled with photo-identification.
39. DNA barcoding of the E.C. Smith herbarium’s boland fungal collection using the nuclear ribosomal internal transcribed spacer (ITS) region

Alex Young, Acadia University

Our DNA-based fungal identifications are only as good as our reference databases. Unfortunately, fungi remain greatly underrepresented in GenBank in terms of reliable DNA barcode sequences. Many fungal specimens exist in herbaria around the world and contain an untapped wealth of taxonomic and ecological fungal biodiversity information; however DNA can be difficult to obtain from legacy specimens. The E.C. Smith Herbarium at Acadia University houses a fungal collection which has never been sequenced, including the Boland collection. This collection represents a fungal biodiversity survey conducted by Gregory Boland in 1975 in the saltmarshes of the Minas Basin, Nova Scotia. I developed of a DNA extraction protocol that provides a base on which Acadia’s entire fungal collection (~20 000 specimens) can be sequenced. Expanding the number of ITS barcode sequences present in GenBank using identified vouchered specimens will allow anyone to more easily identify fungi by culturing or environmental screening. Increased capacity for species identification of fungi will support bioprospecting of previously unknown and undescribed fungal biodiversity, some of which may produce secondary metabolites which could revolutionize medical and commercial industries. Additionally, improving our phylogenetic knowledge of the Boland collection will provide a more accurate representation of the fungal diversity in the Minas Basin in 1975. This information will complement future biodiversity studies in the Bay of Fundy region and allow us to investigate changes over time in these enigmatic, ecologically relevant saprotrophic communities.
A developmental metric of early Atlantic salmon (Salmo salar) ontogeny based on external morphology

Alanah Annis, J.M. Lavery, R.A. Cunjack, University of New Brunswick, Fredericton and Jennifer Nafziger, University of Alberta

Precise state assignment of early Atlantic salmon (Salmo salar) ontogeny is important for researchers. A consistent baseline is required for comparing embryonic developmental progress accurately, to assess the impacts of environmental factors. Additionally, state assignment is important for hatchery procedures as protocols are performed at specific times, dependent on developmental context. Previous developmental schemes for Atlantic salmon have primarily focused on internal morphologies and required the use of advanced laboratory techniques, making developmental assessment time-consuming and impractical. The metric presented here is based on external morphological features, and allows for quick developmental state assignment with minimal laboratory equipment required. Field and hatchery-reared embryos from two Atlantic salmon populations in New Brunswick, Canada were studied. Distinguishable features of embryos and alevins were noted through observation under a dissecting microscope and compared to Battle’s (1944) and Gorodilov’s (1996) developmental frameworks for initial state assignment. Additional features were noted and, after refinement of feature development, the metric was established. The metric is comprised of three stages; green embryos, eyed embryos and alevins. Stages are categorized by eye visibility through the chorion, and embryo emergence from the chorion. Stages are classified into sub-stages, characterized by one defining feature (i.e. somite pair generation in somitogenesis). Sub-stages are further categorized into states, where specific morphological features differ. This metric is time efficient, requires minimal equipment and is suitable for field and hatchery-reared specimens.

Identification of American lobster (Homarus americanus) stocks based on analyses of historical and recent changes in fisheries landings

Tammy (Sha) Bo, Rémy Rochette and Brady K. Quinn, University of New Brunswick, Saint John

Fisheries stocks, as defined by management, are based more upon distribution and types of fishing activities than species biology and thus can miss important aspects of population structure and dynamics. Mismatches between biological processes and management regulations could cause the overexploitation and the depletion of fished stocks. American lobster (Homarus americanus) is a valuable commercial fishery resource in Atlantic Canada, which there is much incentive to conserve. Possible biological lobster stocks have been identified in previous studies using several different methods, including genetics, larval drift modeling, tracking, etc. Lobster landings are a good indicator of lobster abundance, so analyses of how landings change over time, and similarity or difference of these changes among areas, can be used to estimate stock boundaries. In this study, 63 years of landings data from 77 statistical districts across the Canadian Maritimes will be used to test how well these data support stock structures proposed by published studies, as well as current fisheries management zones. A new model of stock structure will also be developed based on these updated landings data, which should allow for better estimates than were possible in previous studies with more limited datasets. This study will then compare landings before (1947–1980) and after (1981–2009) recent changes to lobster landings to determine whether lobster stock structure has changed over recent years. Results will provide important information to the lobster fishery, as identification of stocks on which to base assessment and management is an essential tool for a sustainable fishery.
Effect of over-ripening on survival of diploid and triploid eggs from Atlantic salmon (*Salmo salar*) and Arctic charr (*Salvelinus alpinus*)

Hayden Breau, Dalhousie University, Faculty of Agriculture

Interest in sterile triploid salmon is reviving due to increasing evidence of genetic introgression among fragile wild salmon stocks due to interbreeding with escaped farmed salmon. Arctic charr triploids are desirable for land-based culture because diploids exhibit a high incidence of maturation prior to reaching market size. Egg survival following the pressure shock triploid treatment is dependent on over-ripening. To assess this relationship, eggs were stripped from each of four Atlantic salmon and four Arctic charr from 3 to 21 days post-ovulation and fertilized with milt from four males. Each batch of eggs was sub-divided and subject to the same handling except half were pressure shocked to induce triploidy, then incubated at 7°C. Survival at the eyed stage among pressure shocked and diploid salmon eggs fertilized three days post ovulation (dpo) was similar 81 vs. 73%, but decreased with over-ripening, particularly among eggs that were pressure shocked. Survival of salmon eggs fertilized 17 dpo was 0% among pressure treated eggs compared to 31% among diploid controls. Arctic charr eggs were even more sensitive to the pressure shock procedure, their survival to the eyed stage when fertilized at 2 dpo was 53%, and at 12 dpo was 3.4%. Survival of pressure shocked eggs, by comparison, was 7% when fertilized at 2 dpo and 3% at 12 dpo.

Parasite prevalence and intensity in green crabs (*Carcinus maenas*) and lobsters (*Homarus americanus*) harvested from the Northumberland Strait

Heather Carey, Sarah Stewart-Clark and Fraser Clark, Dalhousie University, Faculty of Agriculture

Green crab (*Carcinus maenas*) were first observed in Atlantic Canada in the early 1950’s, and are known to carry a number of parasites and pathogens. One of these parasites, known as *Profilicollis botulus*, is of growing concern, as in 2002 the Department of Oceans and Fisheries began issuing permits, which allowed fishermen to legally catch green crab and use them as an alternative bait for fishing lobster (*Homarus americanus*). However, new research now indicates that the *Profilicollis botulus* parasite can be transferred after consumption. 558 lobster collected from various locations along the Northumberland Strait (smallest n=10, largest n=100), have undergone routine necropsy to inspect the intestine for parasitic infection to determine the prevalence and intensity of *Profilicollis botulus*, and to determine if there is any correlation between susceptibility to infection and sex of the lobster. It is unlikely that many parasites will be found in lobster from the Northumberland Strait, as the permits to use green crab have not yet been issued there. Using Quantitative Parasitology statistical software the percentage prevalence and mean intensity were determined, and using the Chi square, Fisher’s exact, Unconditional exact, and Mood’s median tests the statistically significant values were determined. As hypothesized, few parasites were found in lobster harvested from the Northumberland Strait, and there was no significant correlation between sex and susceptibility to infection.
Metal concentrations and stable isotope ratios in juvenile American lobsters exposed to aquaculture sites

Andrea Castillejos Sepulveda, Karen Kidd and Rémy Rochette, University of New Brunswick, Saint John

Salmon aquaculture is an important source of income for communities surrounding the Bay of Fundy but concerns have been raised over the possible effects that effluents from aquaculture cages might have on American lobsters, which support the most important traditional fishery in the region. These possible effects include the accumulation of metals, such as copper and zinc, which in very high concentrations may cause negative effects in lobsters. Previous studies in the Bay of Fundy found elevated concentrations of copper and zinc in lobster tissue that were traced back to aquaculture feed pellets. Feed pellets also act as extraneous sources of carbon and nitrogen to the local ecosystem. Analysis of stable isotope ratios may show if lobsters close to cages consume salmon feed, either directly or indirectly. In this study stable carbon and nitrogen isotope ratios and the concentrations of copper and zinc in the tissue of juvenile lobsters were compared between lobsters collected near four aquaculture sites and lobsters from four reference sites, with one set of paired control sites and a secondary control site. Preliminary results show similar average values of δC13 in exposed sites (-15.44‰ ±0.32) and unexposed sites (-15.43‰ ± 0.30). Values of δN15 were also similar between exposed sites (9.82‰±0.89) and unexposed sites (9.91‰ ±1.39). The isotopic data suggest that salmon feed may not significantly affect tissue composition of lobsters. Data for metal analyses are forthcoming. Results will aid in identifying the extent to which juvenile lobsters are exposed to aquaculture effluents.

Recovery of neural function in American lobsters (*Homarus americanus*) following sub-lethal exposures to Salmosan (azamethiphos)

Danielle Deonarine and Tillmann Benfey, University of New Brunswick, Fredericton

Atlantic Canada is a key exporter of seafood products, including wild-harvested Atlantic lobsters (*Homarus americanus*) and farmed Atlantic salmon (*Salmo salar*). The sea louse (*Lepeophtheirus salmonis*) is a parasite that can infect and cause diseases in salmon, resulting in a loss for farmers. Salmosan® (azamethiphos) is an organophosphate that is applied as a treatment to control sea lice outbreaks, but it can cause mortality in non-target species such as lobsters. This study aims to determine the threshold of Salmosan® at which neural function of lobsters is affected and how long it takes for that function to recover. Lobsters will be exposed to a range of Salmosan® concentrations and exposure durations, from lethal to no observable effect, and their behaviour observed. Subsequent lethal sampling will be used to collect muscle and neural tissue to determine acetylcholinesterase activity. This study will clarify the physiological and behavioural effects of a sub-lethal exposure to Salmosan® in lobsters, and thereby allow veterinarians and salmon farmers to schedule cage treatments with minimal impact on non-target species.
Distribution of Atlantic tomcod under-yearlings in the Shubenacadie River estuary

Kamryn Findlay, Dalhousie University, Faculty of Agriculture

*Microgadus tomcod* are widely distributed in Atlantic Canada and are a useful indicator of the health of estuarine ecosystems, but information on the inner Bay of Fundy population is sparse. Tomcod are included in a long-term monitoring of the Shubenacadie River estuary to identify potential impacts of the 'Alton Gas Project', a water uptake and brine effluent facility, which is planned to start operating in 2016. Following spawning in mid-winter in freshwater, in spring 2015 under-yearlings were widely distributed in the upper estuary (rkm 25 to 40) over a broad range of salinities (0.1 to >20ppt) transported up and down the estuary by the strong tidal currents. Mean (SE) body length doubled between May and July 2015 from 23 (0.6) to 47 (1.5) mm. Stomach contents included striped bass (*Morone saxatilis*) eggs, mysids, copepods, daphnia, and amphipods. Tomcod were rare in May, but abundance peaked in June, reaching 17/m3 in 2015, then declined. Large inter-annual variation in abundance was evident, tomcod were absent in 2012 and 2013 but highly abundant in 2015 and 2009.

Integrative approach for specific identification and reliable quantification of a fish microsporidian impacting aquaculture

Aaron Frenette, Michael Burt and Michael Duffy, University of New Brunswick, Fredericton

Microsporidians are fungal parasites that infect a diversity of invertebrate and vertebrate hosts. Fish aquaculture endeavours support epizootics due to the high biotic potential achieved through asexual microsporidian reproduction and the ease of parasite transmission in settings with such high host density. A major obstacle limiting effectiveness of mitigation strategies against microsporidian parasites is the inability to quantify infections reliably. Rational strategies to mitigate infections rely on integrating traditional and molecular methods for parasite identification with knowledge regarding temporal and spatial features of host-parasite interactions. In this study we present an integrative approach using spore morphometrics and nucleotide sequence of the Internal Transcribed Spacer (ITS) of ribosomal DNA to identify *Loma morhua* infecting Atlantic cod. Related congeneric microsporidians were distinguished using a PCR assay that showed 100% sensitivity in confirming *L. morhua* infections. Our identification of 11 polymorphic ITS variants was compatible with the enhanced analytical sensitivity of parasite detection achieved using conserved primers that amplify known congeneric species. Spatial assessment of infections identified the spleen as most reliable organ for detecting parasites (96.6% prevalence). Accordingly, we focused on the spleen to developed qPCR methodologies effective in quantifying *L. morhua* infections. The utility of our qPCR assay was substantiated through the identification of differential infections between different cod family lines. This research is amenable to transfer of technology for integrative approaches that will be required for identification and mitigation of pathogens as aquaculture diversifies to include alternative finfish species.
Dietary butyric acid as a live feed supplement in larval striped bass and sea bream aquaculture

Lindsey Gillard, Sarah Stewart-Clark and James Duston, Dalhousie University, Faculty of Agriculture

Marine finfish aquaculture is challenged by larval cannibalism, high mortality, and low survival, leading to a devastating production bottleneck. Striped bass, (*Morone saxatilis*), has the potential to exploit a niche market in Canada, whereas sea bream (*Sparus aurata*) is fully established in the Mediterranean and European markets. Both perciformes suffer from these rearing issues that severely limit their potential. Larval striped bass and sea bream are fed nutrient-deficient artemia and rotifers until they can be weaned onto a pelleted diet. Butyric acid is a short chain fatty acid that has been linked to the gene expression of a transmembrane peptide transporter in the digestive tract of teleost fish, resulting in increased protein absorption. When 1.0% and 0.5% butyric acid is included in a pelleted diet of young striped bass (39 days post hatch) for 10 days, there is a significant increase in length (*p*=0.022) and weight (*p*=0.016) compared to the control. Further analyses will indicate that butyric acid can significantly affect digestive tract morphology and fatty acid profile. Weaning larvae onto an inert diet with greater nutritional gain sooner can lead to increased protein absorption at a stage when it is a limiting growth factor. Results suggest ontogenetic development is also a factor, as the same experiment conducted on younger sea bream did not yield significant differences. Whole transcriptome analysis will elucidate all physiological responses to butyric acid, providing a full understanding of butyrate as a dietary supplement and a direction for further studies on improving survival of marine finfish.

Effects of citalopram hydrobromide on embryonic development and physiology of zebrafish (*Danio rerio*)

Alyson Hasson and Bryan Crawford, University of New Brunswick, Fredericton

Citalopram hydrobromide is an aromatic heteropolycyclic compound belonging to the Phenylbutylamine family of compounds. It is used to treat anxiety, depression, obsessive-compulsive disorder and bulimia. The drug works by interacting with three cellular receptors, blocking the re-uptake of serotonin and promoting the response to treatment, but it also interacts with a multi-drug resistance protein, and may have other off-target effects. Due to the growing popularity of this drug, there has been an increase in output of the drug into waste treatment plants and ultimately into aquatic systems. Despite waste treatment processes, citalopram is an abundant contaminant in shallow-water sediments from lakes that are in close proximity of treatment facilities. Thus, the potential effects of this drug on vertebrate embryonic development have implications for both human and aquatic health. To evaluate the effects of citalopram on development, zebrafish embryos are being exposed to various concentrations of citalopram (up to 1 mM; in embryonic rearing medium) from tail-bud stage until 48 hours post fertilization. Controls are being treated with comparable amounts of lactose, the dominant carrier component of the pharmaceutical pills. In addition to assessing effects on morphology, effects on development of the circulatory system, neural crest and the innate immune system are being investigated using transgenic zebrafish, expressing green fluorescent proteins in the respective tissues. Finally, the effects on heart rate and response to mechanical stimuli will be characterized, to determine how exposure to this compound affects neural development and embryonic physiology.
ORAL PRESENTATION ABSTRACTS AQUACULTURE AND FISHERIES

Zebrafish as a model organism for parasitic infections of translational significance to aquaculture

Sarah Hirtle, Aaron Frenette, Christopher Small, Rachael Wyatt, Robyn O'Keefe, Bryan Crawford and Michael Duffy, University of New Brunswick, Fredericton

Aquaculture is a potential solution to the supply-and-demand problem posed by declining fish stocks (e.g. salmon, cod, eel). The high mortality rates inflicted by fish pathogens compromise the profitability of commercial aquaculture ventures. To combat pathogens, the basic processes by which they operate, especially their modes of infection and transmission must be known. Research colonies of zebrafish show a high prevalence of infection with microsporidian parasites, but little is known about the dynamics of their transmission. The zebrafish is widely used in basic and biomedical research. These parasitic infections represent a confounding variable in research because parasites are known to be master immune manipulators. In this study, we assess the feasibility for vertical transmission of the obligate intracellular microsporidian *Pseudoloma neurophilia*. This will be modeled through collection of spores from infected zebrafish and injection of these spores into zebrafish embryos. Parasite development and tissue tropisms will be evaluated by light and epifluorescent microscopy. This research will provide an opportunity for mass in vivo culture of *P. neurophilia* spores. Importantly, artificially inducing parasite infections in embryos may offer a new perspective and screening tools towards generating specific pathogen-free (SPF) zebrafish in addition to a source of parasites for empirical studies. Any developmental or immunological findings gained from zebrafish could also be translated to the study of parasitism in endangered/threatened wild fishes and fishes chosen to diversify finfish aquaculture.

Distribution of satellite tagged immature female blue shark, *Prionace glauca*, in the Northwest Atlantic ocean and its link to selected environmental parameters

Jessica Hurtubise and Fred Whoriskey, Dalhousie University

The pelagic blue shark (*Prionace glauca*) has a worldwide distribution. Blue sharks are frequently caught as bycatch in billfish fisheries, notably in Atlantic Canada, which poses a conservation threat. Acoustic telemetry research has shown juvenile females as annual summer residents of Nova Scotia waters with inter-year site fidelity, but reasons for their occupancy in this area remain unclear. Oceanographic parameters, such as depth of the water column and temperature potentially influence their habitat selection. Adult blue sharks in Nova Scotia are reported to prefer depths and mean temperatures of <50m and 15°C, respectively, but it is not known if juveniles show similar preferences to those of the adults. This research used satellite telemetry to address the following questions: do summer and winter habitats of juvenile female blue sharks differ?; are the temperature and depths occupied by these sharks similar to those used by adult sharks (<50m depth, mean 15°C)? Blue sharks were angled off the coast of Halifax, NS, and tagged with Wildlife Computers miniPAT satellite tags (n=5) during the summers of 2014 to 2015. Preliminary analyses show the juvenile females were located on the Scotian Shelf in summer/fall and offshore in the winter, as far south as the Bahamas. They occupied the top 50m of the continental shelf water column at a mean temperature of 13°C, similar to the adults. We hope the results of this research will determine important environmental variables that influence blue shark distribution off Nova Scotia, to reduce bycatch.
Effect of temperature on the aerobic scope of triploid brook charr (*Salvelinus fontinalis*)

Krista Latimer and Tillmann Benfey, University of New Brunswick, Fredericton

Triploid salmonids have become increasingly popular for use in aquaculture because of the efficiency of producing reproductively sterile populations. However, there have been observations of high mortality of triploids in persistently high temperatures. One proposed explanation for this is that triploids have decreased aerobic metabolic scope, which is the maximum metabolic rate minus the routine metabolic rate (i.e., the metabolic rate of routine daily activity). If this is correct, then they would have less energy available to maintain homeostasis. The objective of this research is therefore to determine the effect of temperature on aerobic metabolic scope in diploid and triploid brook charr (*Salvelinus fontinalis*) acclimated to 9, 11, 13 and 15°C. Routine metabolic rate will be measured by placing fish in a closed container and measuring their rate of $O_2$ consumption repeatedly throughout the day. Maximum metabolic rate will be measured as excess post-exercise oxygen consumption after exhaustive exercise. This research will illuminate the biological differences between diploids and triploids and therefore potential differences in their optimum rearing conditions.

Hormonal sex reversal in zebrafish (*Danio rerio*)

Hilary MacLean and Tillmann Benfey, University of New Brunswick, Fredericton

Zebrafish (*Danio rerio*) are widely used as a model vertebrate for research and teaching purposes. A common issue observed in captive zebrafish populations is female-biased sex ratios. In fish, it is well known that sex reversal can be induced by treatment with sex steroids during sexual differentiation in early development. For instance, the development of ovaries can be overridden by administration of androgens during this critical stage to produce males. In this study, 24-hour-old zebrafish (mpx:GFP casper strain) were dechorionated and exposed to 17α-methyldihydrotestotsterone for 16 days by daily immersion in a 50 ng/mL solution, followed by rearing using standard protocols, in order to examine the effect on sex ratio. The impact on gonadal differentiation will be examined by visual observation when the fish are approximately 3 months old, based on body colouration, abdomen size and presence of spawning tubercles. If sex ratios are observed to be skewed towards males, early androgen exposure could be developed as a protocol to maintain healthy breeding populations of zebrafish by producing more males in stock populations.
**Assessment of Pseudoloma neurophilia autofluorescence in Zebrafish (Danio rerio)**

Andree-Anne Marks, Aaron Frenette, Christopher Small, Robyn O'Keefe, Michael Duffy and Bryan Crawford, University of New Brunswick, Fredericton

*Pseudoloma neurophilia* is a microsporidian that infects zebrafish (*Danio rerio*) and is commonly found in the central nervous system (CNS). *Pseudoloma neurophilia* induces a subclinical infection that may cause behavioral, physiological or anatomical differences, such as emaciation, spinal curvature and decreased fecundity. 74% of zebrafish research facilities harbor fish with *P. neurophilia* infections. This parasite represents a confounding variable in biomedical research due to differential infections. Effective screening protocols for identifying *P. neurophilia* infections are currently lacking. Microsporidian infections often induce xenomas which are characterized as the hypertrophy of the host cells associated with parasite proliferation. Autofluorescent xenomas have been reported, thereby allowing for non-invasive detection of infection using in vivo microscopy. I examined whole zebrafish and zebrafish tissues for xenomas and associated autofluorescence. To date, autofluorescent signals have not been associated with xenomas containing microsporidian spores in the CNS. My preliminary data suggests that microsporidian spores observed in situ in zebrafish neural tissue do not exhibit autofluorescence that would facilitate reliable in vivo detection of infection. My future studies will expand to investigate autofluorescence associated with parasitic infections in other tissues that have previously been documented to harbor infection. Microsporidian infections will be identified specifically via sequencing of ribosomal DNA and comparison with GenBank data. Despite reports to the contrary, not all microsporidian infections in zebrafish can be reliably detected by autofluorescence.

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**Evaluating the functional trophic level of the global aquaculture sector**

Angela Moores and Peter Tyedmers, Dalhousie University

Previous studies have characterized the average trophic level of aquatic animals in culture at national, regional or global scales. All of these prior analyses, however, have assumed that the trophic level of an animal in culture is identical to when feeding in the wild. While reasonable for filter feeding organisms, it may poorly represent the diets of farmed seafood that is fed. For these, an estimate of the animal’s functional trophic level is necessary. Building on previously unpublished work, this study attempts to piece together the functional trophic level of all animals in culture globally from 1970 to 2013. The model combines country- and species-specific production data as reported by the Food and Agriculture Organization of the United Nations, with published data on the fraction of a cultured specie’s growth that is feed-based, feed composition, and estimates of the trophic level of marine inputs to aquafeeds throughout the period of analysis. Results not only provide insight into which species in culture deviate most from their natural or wild trophic levels but also allow us to examine the relative dependencies and trajectories of aggregate dependence on terrestrial primary production via crop-based inputs and marine primary production based on fishery sourced inputs. Ultimately, our goal is to build a platform from which to examine the magnitude of resources that the aquaculture sector draws upon globally in comparison to other food production sectors, and its potential to sustainably expand and contribute to global food security.
Nonlinear mixed-effects modelling of *Ciona intestinalis* population growth, dependent upon abiotic conditions

Kieran Murphy, Cory D. Bishop and Russell C. Wyeth, St Francis Xavier University

*Ciona intestinalis* is a nuisance biofouling species due to its negative effects on the aquaculture industry, particularly mussel farming. I conducted a two-year observational study on the Atlantic coast of Nova Scotia to ascertain the relationship between abiotic conditions and the heterogeneous distribution and growth of *C. intestinalis* populations. Temperature, salinity, pH, and water flow were recorded with *in situ* data loggers at thirteen sites from May to October in 2014 and 2015, while *C. intestinalis* abundance was monitored on settlement plates. Nonlinear mixed-effects (NLME) modelling fit the most likely models to these data using a logistic growth function with parameter estimates determined by the abiotic variables. *C. intestinalis*’ response to the abiotic variables exhibited inter-annual and inter-site variation. The best model fit to the 2014 data contained salinity variables only, while the best model in 2015 contained temperature, salinity, pH, and water flow. Intra-annual model validation resulted in c. 90% model efficiency prediction. The inter-annual difference in *C. intestinalis* response meant that model predictions of alternate years were variable with reduced efficiency. The observed variability in this system has underlined the importance of continued long-term monitoring. All of the abiotic variables added valuable information to the models, possibly due to the lack of a dominant variable that would reduce the value of variables contributing less information. The use of random effects improved model fit compared to fixed effects alone, exhibiting that NLME modelling is an effective tool to explain the growth of *C. intestinalis* in stochastic abiotic environments.

Effects of a *Spirulina* based diet on the growth performance of Arctic Char, (*Salvelinus alpinus*), and Striped bass (*Morone saxatilis*)

Louis-Philippe Normand, James Eddington and Christophe Herbinger, Dalhousie University

Aquaculture is a fast growing industry, but is not without its controversies. Over the past few decades, the world’s small pelagic fish stocks have been heavily fished, for reduction to fish meal, a key ingredient in carnivorous fish feed. This study evaluates the use of *Spirulina platensis*, a photosynthetic micro algae, as a protein substitute for fish meal with regards to two species; Arctic char (*Salvelinus alpinus*), and Striped bass (*Morone Saxatillis*). All the fish were kept on the same recirculation system in the Dalhousie Aquatron for over 90 days of study, maintained at a salinity of 18 ppt, and water temperature of 13°C. Three balanced experimental diets were formulated at the Dalhousie agricultural campus. The control (diet#1) consisted of one without any spirulina, of which fish meal totals 40% of the feed ingredients, and is the main constituent. The second formulated feed (diet#2), contained 25% less fish meal, substituted by spirulina (75/25 mix). The third formulated feed (diet#3), had equal fish meal/spirulina ratio (50/50 mix). Every fish was individually identified with PIT tags and distributed randomly, at the beginning of the study. the growth rate of the fish was evaluated by comparing initial and final fish lengths, weights as well as individual length and weight increments, and differences in condition factor.
Fisheries stress and temperature influences the cardiac performance and recovery of migrating Sockeye salmon (*Oncorhynchus nerka*)

Tanya Prystay, Glen Crossin, Dalhousie University, Steven Cooke, Carleton University and Erika Eliason, University of British Columbia

Pacific salmon (*Oncorhynchus* spp.) are important to the economic, cultural and ecological fabric of Canada, yet populations are declining due to the combined pressure of fisheries harvest and climate change. To alleviate fisheries pressure, catch-and-release practices are being implemented among recreational and commercial sectors. However, despite the immediate benefits of catch-and-release, capture stress can result in post-release mortality minutes to days later. Past studies have used heart rate to quantify metabolic activity and physiological stress in salmon. The current study presents the heart rate data of 60 Fraser River sockeye salmon measured during catch-and-release simulations, conducted at three water temperatures (16°, 19°, 21°C). As cold-water adapted species, I hypothesized that sockeye salmon post-capture cardiac performance and recovery would be impeded at higher temperatures. Using experimental tanks and heart rate loggers, the fisheries simulation involved chasing individual, wild up-river migrating sockeye for three minutes, followed by a one minute air exposure and a 36 hour recovery period. Prior to the simulated capture, baseline heart rate increased with temperature. During the simulation, peak heart rate also increased with temperature. The resting scope for heart rate was higher in the 21°C treatment group compared to the 16°C group. Therefore, stress from fisheries capture increases with water temperature. Although temperature did not significantly affect the excess post-exercise heart beats and cardiac recovery time, the recovery profiles varied between treatments. This knowledge will be useful for salmon conservation management in rivers where temperatures now routinely approach the upper mortality threshold for sockeye salmon (~25°C).

Characterization of school and site fidelity patterns of striped bass (*Morone saxatilis*), little skate (*Raja erinacea*), and winter skate (*Raja ocellata*) in a spatially confined basin

Danielle Quinn, Memorial University, Trevor Avery, Acadia University and Julia Whidden, University of Miami

The overarching goal was to provide an overview of at-risk species in spatially confined areas, including the identification of potential approaches to analyze movement patterns, and school/site fidelity. The Inner Bay of Fundy is home to several at-risk fish species, including striped bass (*Morone saxatilis*; Endangered, COSEWIC 2012), little skate (*Raja erinacea*; Near Threatened, IUCN 2009), and winter skate (*Raja ocellata*; Endangered, COSEWIC 2005). Our fixed-site tagging program (2012 – 2015) saw uniquely numbered dart tags applied to over 1000 striped bass and over 2800 winter and little skate, with a 5 – 10 % recapture rate. The high frequency of recaptures and temporal span over which these recaptures have occurred have provided valuable data regarding movement patterns. A reoccurring phenomenon was the high frequency at which individuals tagged together were often caught together, up to three years later. A novel approach to quantifying school and site fidelity was used to describe these patterns. With more in-depth characterization of these patterns, including size-based metrics and simulations of capture probabilities, these observations may provide insight into schooling, movement, and migration behavior of these at-risk species in the confines of the Inner Bay of Fundy.
Determining abalone body weight using structured light scanning of shell morphology as well as regular photography

Matthew Robertson, Christophe Herbinger, Dalhousie University and Robert Day, University of Melbourne

A study was conducted on a hybrid farmed abalone, *Haliotis* sp. to identify an improved method of determining individual body mass without physical manipulation, therefore minimizing abalone stress and mortality. Individual abalones were photographed and the photographs were subsequently transformed into 3D images using the structured light software package. These images were used to analyse the morphometry of the shells of the abalone, which then allowed for the calculation of the volume of half of a spherical-ellipse as a proximate shell shape. Volume was determined to be very close to body mass for 100 abalone of five different size classes. However, the processing of structured light images was determined to be slow, and required a very specific hardware set-up. It seemed unrealistic to expect that such an approach would be routinely used in a real aquaculture application. A second project was conducted to determine if a reasonable approximation of body mass could be derived from simpler, typical 2D images. Using information from the 3D images, an equal proportion between all age classes was identified, in which shell height appeared to be predicted fairly well as ~20% of the sum of the length and width vectors. This allowed for approximate volume calculations to be done on 2D images using the software ImageJ. This method yielded slightly more variable individual results than what was seen with the structured light approach, but allowed for a much faster and simpler measurement of body mass, which potentially could have useful applications in aquaculture operations.

Reducing sea turtle interactions off the coast of Atlantic Canada: methods to increase fishing selectivity

Zachary Sherker, St Francis Xavier University

This project investigates the role of fisheries management in the conservation of loggerhead (*Caretta caretta*) and leatherback sea turtles (*Dermochelys coriacea*), both of which are currently listed as vulnerable by the IUCN (International Union for Conservation of Nature). These species migrate from nesting grounds in South America to feed on gelatinous zooplankton (jellyfish) in the North Atlantic off the coast of the United States and Canada. The seasonal foraging grounds of sea turtles heavily overlap with areas of high fishing effort for the longline tuna and swordfish fleet, a fishery that has significantly high rates of sea turtle incidents. The dynamic nature of sea turtle foraging patterns renders static spatio-temporal fishing area closures ineffective. Rather, turtle by-catch mitigation requires small-scale, event-triggered closures and decentralized management to reduce incidents while minimizing the negative socio-economic impact of area closures on fishermen. A number of methods that have increased fishing selectivity in other commercial fisheries include gear modifications, improved fleet communication, and voluntary closures. The implementation of these techniques in the Atlantic Canadian fleet moving forward is discussed herein.
The quantification of color in pearls

Iain Sharp and Christophe Herbinger, Dalhousie University

A genetic experiment was conducted on the black lip pearl oyster, *Pinctada margaritifera*, to determine the heritability of desirable traits for pearls. Pearl color was one of these desirable traits, and was the subject of this study. Using a visual classification system developed during the experiment, pearls were categorized as one of four main color groups (purple, peacock, grey, and green) and then further categorized into one of 15 sub-color groups. Photographs of the pearls which were used for color analysis were taken in ‘field’ conditions, and thus required some photo correction to standardize lighting conditions between photographs. Each individual pearl had its color profile extracted, quantified, and mapped in the 3D CIELAB color space system. CIELAB classifies an object’s color by where it maps in a 3D space, using three axes (L – white to black, a – red to green, b – yellow to blue) to define the color space. For each of the three color axes, there were significant differences between the four main color groups and among the 15 sub-color groups nested within the main groups (ANOVA, p<0.001). This indicates that the quantitative L a b signals seemed to recover adequately the qualitative color classification by eye. Knowing the pedigrees of the donor pearl oysters used to produce the pearls, the heritability of pearl color could be estimated with linear mixed modelling. Results from univariate heritability models suggested that color, as defined by the three L a b axes, has a fairly strong heritability.

Progression of an alien invasion: the European green crab, *Carcinus maenas* (Linnaeus, 1758), in Bonne Bay, Newfoundland

Olivia Simmons, Memorial University

The European green crab (*Carcinus maenas*) is an unpopular invasive species that has spread around world, including Atlantic Canada. Other populations were not discovered until they had become well established for an unknown number of years. My study examines green crab populations in Bonne Bay from the capture of the first individual in 2009 until the late fall of 2015. Results show the population increased significantly in numbers and distribution from 2009 to 2014. Populations observed in 2015 showed a major drop, especially in the smallest and largest size classes. It appears that few of the 2014 recruits survived the exceptionally harsh winter. The loss of large animals coincides with observations of predation by seabirds, crows, wolffish and Cancer crabs. Growth and breeding moults are most abundant in May and August. The usual trapping methods with baited Fukui traps may not be ideal. Manual shore sampling yields more small crabs and ovigerous crabs than trapping; therefore, the reproductive cycle of green crabs in non-native environments is likely not fully understood in studies that only use trapping to assess populations. Researchers have warned green crabs could be detrimental to populations of other decapods, including the commercially valuable lobster. If the population of green crabs continues to increase as it did from 2009-2014, lobster fishers in Bonne Bay would have need to be concerned. However, this study shows that climate and local predators can control the population, so the threat may not be as severe as has been predicted by other studies.
Testing the waters: harnessing adaptive developmental plasticity to improve hypoxia tolerance

Christopher Small, University of New Brunswick, Fredericton

Many organisms display a degree of adaptive developmental plasticity in which embryonic rearing conditions influence phenotype, thereby generating an organism better suited to its environment. For instance, exposing zebrafish (*Danio rerio*) embryos to short pulses of hypoxia 24 to 48 hours post-fertilization (hpf) increases larval hypoxia tolerance highlighting a critical window of plasticity during early development when physiological tolerances are being set, but the mechanisms underlying this plasticity are unknown. Hypoxia inducible factor 1 (Hif-1a) regulates hypoxic signalling and blocking this signalling pathway in zebrafish embryos causes 1) upregulation of hematopoietic genes, 2) more circulating red and white blood cells, and, intriguingly, 3) expanded populations of hematopoietic stem cells (HSCs). This apparent plasticity in the number of HSCs seems limited to early development as adults respond to hypoxia using strategies 1 and 2, but not 3. In order to develop a better understanding of the mechanisms underlying this plasticity, sibling embryos from transgenic zebrafish expressing HSC-specific green fluorescent protein were reared in hypoxia (5% DO) and normoxia (95% DO) for a range of durations between 24 and 48 hpf, and HSCs quantified using confocal microscopy. This experiment will test the idea that early exposure to hypoxia ‘primes’ the fish for a hypoxic environment, thereby leading to faster growth rates. Understanding these mechanisms for plasticity could lead to rearing strategies that produce fish optimally suited for aquaculture.

Over-winter 24h light start and end date affects the maturity rate of Arctic charr

Minmin Wei and James Duston, Dalhousie University, Faculty of Agriculture

A serious impediment to the commercialization of farming diploid Fraser River Arctic charr (*Salvelinus alpinus*) is the high incidence of sexual maturation before reaching market size. PIT-tagged yearlings were reared at 10°C and fed to satiation under eight photoperiod regimes (each 90 fish): 24h light (LL) started between August and December and ended between February and June including two controls (constant LL, natural day length LDN). Following the termination of LL, fish were reared under LDN until November (age 2 year-old), when the incidence of maturity was assessed. Starting LL between August and October, and ending LL between February and June were similarly effective (P>0.05), reducing the maturity rate to between 7 and 14% (females and males pooled), compared to 50% among LDN controls. However, delaying the start date of LL to December or maintaining LL to the next October resulted in unacceptable high maturation rates >30%.
Incorporating threats with elasmobranch population distribution patterns to delineate priority protection areas for reef shark and ray conservation in Thailand

Annabel Westell, Christine Ward-Paige and Heike Lotze, Dalhousie University

The waters around Thailand are characterized by extremely abundant and diverse aquatic life with high economic and ecological value. There is a long history of marine exploitation in this region and currently Thailand is a major exporter of fish and fishery products, including shark fins. Coastal elasmobranchs are targeted by small-scale fishers and are subject to high bycatch rates in the commercial trawl fishery. Previous studies have shown that sharks and rays in Thailand are in decline and at risk due to illegal, unreported, and unregulated fishing. Despite this, sharks and rays remain relatively abundant and diverse in Thai waters. However, the status of coastal elasmobranch populations is largely unknown, and shark fisheries are typically unmanaged. Here, using >13,000 unique records of coastal and reef-associated shark and ray observations (including zeros) made by divers and fishers in Thailand (submitted to eShark between 1989-2015; eOceans.org), the contemporary distribution of elasmobranchs is described, fishing effort and other natural and anthropogenic drivers are assessed, and vulnerability hotspots are identified. 112 sites in the Andaman Sea and 73 sites in the Gulf of Thailand were surveyed. 14 shark and six ray species were reported, including six listed as vulnerable by the IUCN Red List. Effectively managing fisheries and reducing bycatch is essential, but not trivial. The results of this study could be the first step in identifying hotspots of elasmobranch diversity and abundance, and prioritizing conservation areas to mitigate the impact of exploitation and prevent further loss of elasmobranch diversity.

Life history variation within and among four species of freshwater fishes in Ontario

Katya Zielonko and Jeffrey Hutchings, Dalhousie University

Life-history traits, such as age and size at maturity, reproductive effort, and lifespan can affect population productivity and viability. In addition to natural selection, organismal life history is affected by the environment. The present study focuses on life-history variation and its potential environmental determinants in four Ontario fish: walleye (Sander vitreus), lake whitefish (Coregonus clupeaformis), lake trout (Salvelinus namaychush), and smallmouth bass (Micropterus dolomieu). Data were obtained from the Broadscale Monitoring program (Ontario Ministry of Natural Resources and Forestry). First, I examined intra-specific variability in age and length at 50% maturity (A50 and L50, respectively, determined though binomial regressions) between sexes within and between lakes. I then explored whether variation in these life-history traits could be explained by among-lake differences in metrics of climate, total dissolved solids (TDS), and lake size. The results suggest that, on average, females mature at older ages and larger sizes than males within species. The results also suggest that A50 and L50 differ significantly among lakes within species. Metrics of water quality were linked with some of the variability in life history. These four fish species have expansive commercial and recreational fisheries within Ontario. The present study will provide key life-history information for each species that can be incorporated into management models for effective management and sustainable exploitation.
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