



BIOL645

2015 BIODIVERSITY SCIENCE INTENSIVE SCHOOL

Gault Nature Reserve
Mont St-Hilaire, Quebec



CENTRE DE LA SCIENCE DE LA BIODIVERSITÉ DU QUÉBEC
QUEBEC CENTRE FOR BIODIVERSITY SCIENCE



McGill

UQÀM

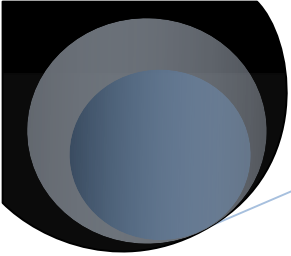


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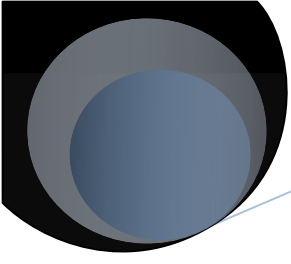
2015 Biodiversity Science Intensive School

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COURSE OVERVIEW

A WORD FROM THE COORDINATORS

Welcome to the 2015 QCBS Biodiversity Science Intensive School.

The mission of the QCBS is

- i) to foster and promote a world-class research and training program in biodiversity science,
- ii) to facilitate scientific exchange and learning between QCBS researchers and stakeholders in government and the public and private sectors of society, and
- iii) Contribute to the public's understanding of the causes and consequences of biodiversity change.

Now in its 5th year, the Biodiversity Science course is composed of a series of modules relating to the three axes of the QCBS:

- **Axis 1: Discovery of biodiversity:**

To describe the genomic, phenotypic, and functional diversity of poorly described components of Québec's biodiversity, and to link phylogenetic and phylogeographic information to functional species traits.

- **Axis 2: Changes in biodiversity and ecosystem services:**

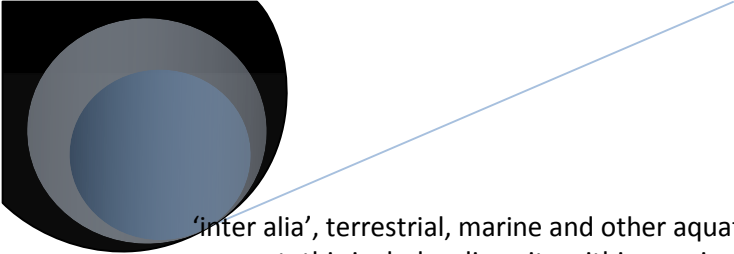
To develop General Biodiversity Functioning Models (GBFMs) that establish the link between the drivers of biodiversity change and the consequences of that change for ecosystem functioning and services.

- **Axis 3: Management and adaptation to biodiversity changes:**

To identify tools to adaptively manage biodiversity and ecosystem services in human-dominated landscapes; to reveal socioeconomic drivers of biodiversity loss; to evaluate market and non-market values of biodiversity and associated ecosystem services; to better understand the role of local communities in biodiversity decision making and management; to generate scientifically sound, socially relevant and politically feasible strategies for biodiversity management and governance

Each module is taught by an expert in the field, and combines a mix of set lectures, practicals, and project work. This year the program will be held at the Gault Nature Reserve of McGill University, a private reserve which protects 1000 hectares of natural primeval forests of the St. Lawrence Valley. Situated at Mont-Saint-Hilaire approximately 40 km from Montreal, this panoramic natural landscape is ideal for discovering nature, teaching and academic research.

The term biodiversity was formally defined at the 1992 United Nations Conference on Environment and Development in Rio de Janeiro as "the variability among living organisms from all sources, including,



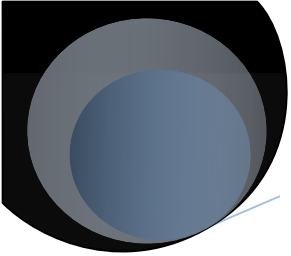
‘inter alia’, terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems”. Biodiversity provides us with multiple services, yet we still do not even have accurate estimates of how many different species share the planet with us. Today the terrestrial environment is now dominated by people – approximately 1/3 of land area has been transformed for human use and 1/4 of global productivity diverted to human consumption. It is estimated that current extinction rates are over an order of magnitude greater than background rates and are projected to increase further over the next several decades. We are only just starting to get to grips with how this impending extinction crisis might impact human welfare and the state of the Earth. The Biodiversity Science program aims to foster the emergence of an integrated science of biodiversity within Québec.

We have invited some of the top biodiversity scientists in Québec and elsewhere to contribute to the teaching and discussion. They will cover a wide range of topics, but of course the field of biodiversity science stretches beyond that which can be covered within a two-week course. At the end of the course, you will have become familiar with the different aspects of biodiversity science. You will have applied the concepts of biodiversity science to various examples and integrated them in your project work. You will have made links between the different research axes of the QCBS. Importantly, you will also have built a network of students working in biodiversity science. We hope you will enjoy the course and that you will gain much from it.

Special thanks to Roa Cho, Helen Elina and Philippe Auzel from the QCBS, without whom this course would not have been possible.

We look forward to meeting you.

Jonathan Davies & Pedro Peres-Neto
Course coordinators



COURSE OVERVIEW

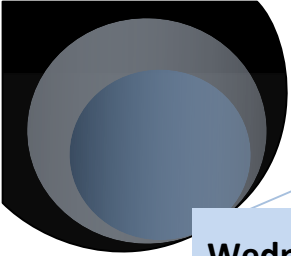
GENERAL SCHEDULE

Monday, October 26th

9:00-10:30	Travel to Mont St-Hilaire - Bus pick-up at McGill (Biology Department)
10:30-11:00	Coffee break
11:00-12:30	Welcome (Jonathan Davies & Pedro Peres-Neto)
12:30-14:00	Lunch
14:00-15:30	Key Note (Dr. Graham Bell)
15:30-16:00	Coffee break
16:00-17:00	Patterns of plant biodiversity change over time and what they mean for arguments we make concerning biodiversity conservation (Mark Vellend)
18:00-19:00	Supper

Tuesday, October 27th

8:00-9:00	Breakfast
9:00-10:30	What is this? (Jade Savage)
10:30-11:00	Coffee break
11:00-12:30	What is this? (Jade Savage)
12:30-14:00	Lunch
14:00-15:30	What is this? (Jade Savage)
15:30-16:00	Coffee break
16:00-17:00	What is this? (Jade Savage)
18:00-19:00	Supper
19:00-20:00	Pedro Peres-Neto guest lecture



Wednesday, October 28th

8:00-9:00	Breakfast
9:00-10:30	Katja Neves
10:30-11:00	Coffee break
11:00-12:30	Katja Neves
12:30-14:00	Lunch
14:00-15:30	Managing Forest Ecosystems in a changing environment: the need of a paradigm shift Part I (Christian Messier)
15:30-16:00	Coffee break
16:00-17:00	Managing Forest Ecosystems in a changing environment: the need of a paradigm shift Part II (Christian Messier)
18:00-19:00	Supper
19:00-20:00	Local biodiversity monitoring in Canada's North (Murray Humphries)

Thursday, October 29th

8:00-9:00	Breakfast
9:00-10:30	Introduction to R for Ecologists (Steve Kembel)
10:30-11:00	Coffee break
11:00-12:30	Introduction to R for Ecologists (Steve Kembel)
12:30-14:00	Lunch
14:00-15:30	Introduction to R for Ecologists (Steve Kembel)
15:30-16:00	Coffee break
16:00-17:00	Introduction to R for Ecologists (Steve Kembel/Jonathan Davies)
18:00-19:00	Supper



Friday, October 30th

8:00-9:00	Breakfast
9:00-10:30	Phylogenetic Comparative Methods (Jonathan Davies)
10:30-11:00	Coffee break
11:00-12:30	Phylogenetic Comparative Methods (Jonathan Davies)
12:30-14:00	Lunch
14:00-15:30	Linking trait evolution with ecological structure (Will Pearse)
15:30-16:00	Coffee break
16:00-17:00	Linking trait evolution with ecological structure (Will Pearse)
18:00-19:00	Supper
19:00-20:00	Monteregian Flora (Martin Lechowicz)

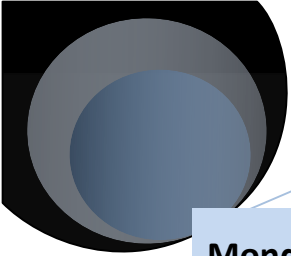
Saturday, October 31st

7:15-8:45	Bus to Montreal
9:00-16:30	QCBS-CBD-Future Earth joint workshop
17:30-19:00	Bus to Gault
19:00-20:00	Supper

Sunday, November 1st

DAY OFF

8:00-9:00	Breakfast
12:30-14:00	Lunch
18:00-19:00	Supper

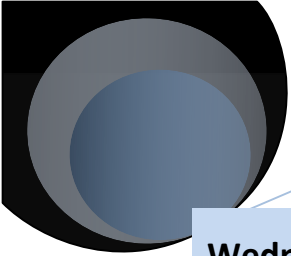


Monday, November 2nd

8:00-9:00	Breakfast
9:00-10:30	Beta diversity and ordination of community data; spatial eigenfunction analysis (Pierre Legendre)
10:30-11:00	Coffee break
11:00-12:30	Beta diversity and ordination of community data; spatial eigenfunction analysis (Pierre Legendre)
12:30-14:00	Lunch
14:00-15:30	Beta diversity and ordination of community data; spatial eigenfunction analysis (Pierre Legendre)
15:30-16:00	Coffee break
16:00-17:00	Beta diversity and ordination of community data; spatial eigenfunction analysis (Pierre Legendre)
18:00-19:00	Supper
19:00-20:00	A comprehensive view on the determinants of ant community structure: from individual behavior to the evolutionary history of lineages (JP Lessard)

Tuesday, November 3rd

8:00-9:00	Breakfast
9:00-10:30	Modelling single-species distributions (Pedro Peres-Neto)
10:30-11:00	Coffee break
11:00-12:30	Modelling single-species distributions (Pedro Peres-Neto)
12:30-14:00	Lunch
14:00-15:30	Modelling single-species distributions (Pedro Peres-Neto)
15:30-16:00	Coffee break
16:00-17:00	Endangered species legislation and the conservation of biodiversity (Marco Festa-Bianchet)
18:00-19:00	Supper
19:00-20:00	Forecasting the impacts of climate change with non-stationary niche models of regional population density (Jason Samson)

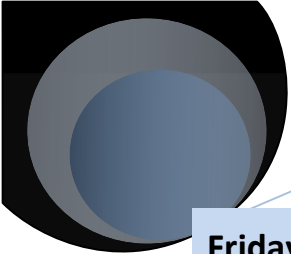


Wednesday, November 4th

8:00-9:00	Breakfast
9:00-10:30	Biodiversity, Ecosystems function and Services (Andrew Gonzalez)
10:30-11:00	Coffee break
11:00-12:30	Biodiversity, Ecosystems function and Services (Andrew Gonzalez)
12:30-14:00	Lunch
14:00-15:30	Projects
15:30-16:00	Coffee break
16:00-17:00	Projects
18:00-19:00	Supper
19:00-20:00	Projects

Thursday, November 5th

8:00-9:00	Breakfast
9:00-10:30	Projects
10:30-11:00	Coffee break
11:00-12:30	Projects
12:30-14:00	Lunch
14:00-15:30	Presentations
15:30-16:00	Coffee break
16:00-17:00	Presentations
18:00-19:00	Supper
19:00-20:00	Party – self-organized



Friday, November 6th

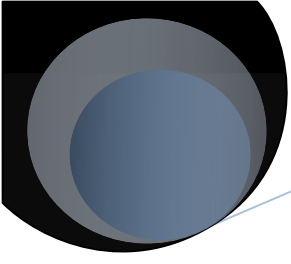
8:00-9:00 **Breakfast**

9:00-10:30 **Pack up**

10:30-11:00 **Coffee break**

11:00-12:30 **Wrap-up**

12:30-14:00 **Bus to McGill**



COURSE OVERVIEW

DETAILED PLAN (PER DAY)

Monday October 26th

Welcome to the Gault Nature Reserve

Graham Bell
Guest Lecture

Mark Vellend
Patterns of plant biodiversity change over time and what they mean for arguments we make concerning biodiversity conservation

Lecture outline: I will present the current state of knowledge concerning how terrestrial plant species diversity has changed during recent decades and centuries – the period of time during which human impacts on the earth have been especially profound. We will discuss results at the global and regional scales (other people’s work) and at the local scale (work from my lab group), specifically with respect to how they relate to the argument that biodiversity conservation can be justified by experiments demonstrating that biodiversity loss compromises ecosystem function. In short, while major land-use transitions (e.g., converting forest to agriculture) tends to cause local declines in plant diversity, otherwise there is no general tendency for plant biodiversity to decline at the local scale. This clearly contradicts an assumption underpinning the argument that biodiversity-ecosystem function experiments provide a justification for biodiversity conservation in general.

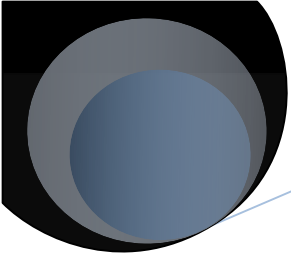
From this point of departure, we will discuss some much broader issues:

- The degree to which ecologists’ value systems and beliefs may (or may not) colour their interpretation of scientific results, thereby determining what science ends up reported in (or excluded from) the field’s top journals (and therefore the public eye).
- Whether this might be putting our scientific credibility is at risk.
- Which arguments in favour of nature conservation are actually supported by science and which are not.

Tuesday, October 27th

Jade Savage
What is this?

The contribution of Dr. Savage will revolve around the definition and identification of operational taxonomic units using Diptera (true flies) as a model. The morning session will consist of a lecture addressing topics such as taxonomic resolution, taxon limits, sampling designs and techniques, specimen identification as well as a discussion of the relevance (or obsolescence) of classic taxonomic nomenclature today. The afternoon session will consist of a series of applied identification exercises supplementing the material covered in the lecture using specimens and DNA sequences of root-maggot flies, an important but hard to identify group of agricultural pests in Canada.



Pedro Peres-Neto

Guest lecture

Reading:

Peres-Neto P (2015) Will technology trample peer review in ecology? Ongoing issues and potential solutions. *Oikos* 000: 001-007.

NB: Please read prior to lecture.

Wednesday, October 28th

Katja Neves

TBA

Christian Messier

Managing Forest Ecosystems in a changing environment: the need of a paradigm shift

Lecture outline: The world surrounding us is evolving rapidly. This is also true for forest managers facing unprecedented social, economic, climatic and environmental changes. Worldwide, there is increased concern about the disappearance of old-growth and primary forests, the role of managed forests in the maintenance of biodiversity, carbon budgets, and the provision of many other ecosystem services. At the same time, we are gaining a better understanding of the multitude of environmental services that natural and managed forests provide. Forest managers are struggling with these developments and with the rapidity of changes in expectation and global paradigm shifts in how forests are viewed. In this talk, I will review the 300-year-old principles at the base of modern forestry, discuss the role of plantations and managed natural forests in achieving sustainability, present a large scale experiment in central Quebec where TRIAD is being implemented and suggest that the new paradigm in forest management be based on the principles of Complex Adaptative System.

Murray Humphries

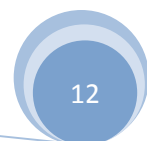
Local biodiversity monitoring in Canada's North

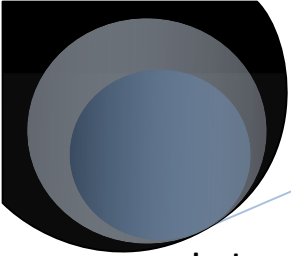
Lecture outline: Biodiversity in the northern circumpolar region is interesting, unique and, in many ways, difficult to study. While many focus on the logistical, financial and climatic challenges associated with working in remote, high latitude landscapes, we will focus primarily on the community challenges and opportunities involved in northern biodiversity research. Who lives in the North, what is the value of biodiversity and biodiversity research to northern people, and how do you conduct effective and ethical biodiversity research within their homeland.

Thursday, October 29th

Steve Kembel

Introduction to R for Ecologists





Lecture outline: An introduction to the use of the R statistical computing environment for analysis of biodiversity data. This workshop will provide a brief introduction to R, an overview of resources for ecological and evolutionary analysis in R, and give participants hands-on experience generating phylogenetic hypotheses for ecological communities and using R to analyze the evolution of species traits and the taxonomic, functional, and phylogenetic diversity of ecological communities.

Friday, October 30th

Jonathan Davies

Phylogenetic Comparative Methods

Lecture outline: Why are some species at greater risk of extinction than others? Identifying the underlying causes of high extinction risk is an important step in understanding the processes contributing to current species declines, and predicting the probable future declines in the face of escalating human pressure on natural habitats. In general, the distribution of extinction risk among species is phylogenetically non-random, with some taxonomic groups more likely to contain threatened species than others. This implies that biological differences among taxa are at least partly responsible for the differences in extinction risk. In this module, I will discuss the distribution of extinction risks in plants and animals, and demonstrate how phylogenetic comparative methods, which account for the evolutionary non-independence of species, can help identify the key predictors of extinction using IUCN RedList data. As a group, we will then discuss whether it is possible to generalize across taxa, and the difficulties in projecting current trends into the future. Finally, we will review how predictive modeling of extinction risk can inform conservation management.

Readings:

Cardillo M, Mace G, Gittleman JL, Purvis A (2006) Latent extinction risk and the future battlegrounds of mammal conservation. *Proc Natl Acad Sci USA* 103:4157–4161.

Mace GM, Gittleman JL, Purvis A (2003) Preserving the tree of life. *Science* 300: 1707–1709.

Purvis A, Gittleman JL, Cowlshaw G, Mace GM (2000) Predicting extinction risk in declining species. *Proc R Soc B* 267: 1947–1952.

Will Pearse

Linking trait evolution with ecological structure

Lecture outline:

- Reproducible data management
- Modelling the evolution of one trait
- Modelling two (or more) traits evolving with each other
- Mapping trait evolution onto ecological patterns (fingerprint regression)
- Modelling ecological structure using phylogeny, traits, and environment (Phylogenetic Generalised Linear Mixed Models)



Readings:

Cavender-Bares J, Keen A, and Miles B. (2006) Phylogenetic structure of Floridian plant communities depends on taxonomic and spatial scale. *Ecology*. 87: S109 – S122.

Clavel, J., Escarguel, G., Merceron, G. (2015), mvMORPH: an R package for fitting multivariate evolutionary models to morphometric data. *Methods in Ecology and Evolution*. doi: 10.1111/2041-210X.12420

Ives AR, Helmus MR (2011) Generalized linear mixed models for phylogenetic analyses of community structure. *Ecological Monographs*. 81: 511 – 525.

Pearse W.D., Purvis A., Cavender-Bares J. & Helmus M.R. (2014) Metrics and Models of Community Phylogenetics. In: *Modern Phylogenetic Comparative Methods and Their Application in Evolutionary Biology*. Springer Berlin Heidelberg, pp. 451-464.

Pennell MW, and Harmon LJ (2013) An integrative view of phylogenetic comparative methods: connections to population genetics, community ecology, and paleobiology. *Ann. N.Y. Acad. Sci.* 1289: 90 – 105.

NB: No need to do readings before the lecture!

Martin Lechowicz
Monteregian Flora

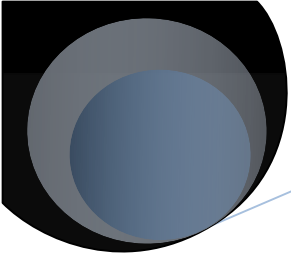
Lecture outline: The course coordinators kindly invited me to give an after-dinner presentation midway through the course entitled “Monteregian Flora”, a topic that I have interpreted broadly. To complement the opportunity you have to walk the trails in the reserve, I’ll first present a brief summary of the local flora and its postglacial development. I’ll then turn to one element of the flora - the genus *Carex* in the Cyperaceae. The ecology and evolution of the 62 species of *Carex* in the reserve serve as a model study system for many of the themes that organize the course as a whole.

Saturday, October 31st

QCBS-CBD-Future Earth joint workshop

Monday, November 2nd

Pierre Legendre



Beta diversity and ordination of community data; spatial eigenfunction analysis

Lecture outline: The first part of the course will describe ordination and canonical ordination methods to study (site I species) community composition data, and show that these methods produce an analysis (or partitioning) of the variation of the community composition data. The second part of the course will describe newly developed methods to study beta diversity.

Jean-Philippe Lessard

A comprehensive view on the determinants of ant community structure: from individual behavior to the evolutionary history of lineages

Don't be fooled by the small size of ants. One might think these conspicuous insects that live in your backyard and steal food from your kitchen are unimportant or boring. With this talk, I aim to show you that, in fact, ants are extremely cool. Ants consist of about half of the animal biomass in tropical forest ecosystems. They also play a wide variety of ecosystems functions and are true soil engineers. My passion for ants has fueled my interest in a scientific career. They have taught me that, to understand how biodiversity arises and is maintained through time, one needs to look into events that are happening now in front of us (behavior and ecology) and events that have occurred a long time ago (history and evolution).

Tuesday, November 3rd

Pedro Peres-Neto

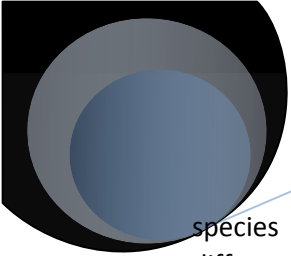
Modelling single-species distributions

Lecture outline: This workshop will provide an overview of the different classes of frameworks available today for modelling species distributions. We will cover the basic aspects of species modelling from data collection to model fit to model validation. Given the plethora of modelling techniques available to ecologists, we will concentrate on the important aspects that are common to all of them such as goodness-of-fit measures and model comparison, types of cross validation, parameter estimation versus statistical testing and the issues that spatial autocorrelation may have on modelling procedures. We will use the R statistical computing environment to implement some of the concepts and procedures discussed in the workshop.

Marco Festa-Bianchet

Endangered species legislation and the conservation of biodiversity

Lecture outline: Several laws, treaties and regulations seek to protect endangered species. In Canada, most provinces, territories and the federal government have some sort of endangered species legislation, and international treaties such as CITES target individual species. We will first examine the role of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) within the Federal Species at Risk Act (SARA). We will then consider some of the successes and shortcomings of SARA and examine a particularly controversial COSEWIC assessment, that of polar bear. We will briefly examine the Québec law on endangered species. Finally, we will discuss some of the more problematic aspects of endangered-



species conservation: Why protect species when it is habitats that need protection? What are the differences between the legal and biological definitions of species? What are the legal consequences of taxonomic problems? Should politicians or biologists decide what species are legally protected?

Readings:

Green, D.M. 2005. Designatable units for status assessment of endangered species. *Conservation Biology*, 19: 1813-1820.

Hutchings, J.A., and Festa-Bianchet, M. 2009. Scientific advice on species at risk: a comparative analysis of status assessments of polar bear, *Ursus maritimus*. *Environmental Reviews*, 17: 4551.

McDevitt-Irwin, J.M., Drake Fuller, S., Grant, C., and Baum, J.K. 2015. Missing the safety net: evidence for inconsistent and insufficient management of at-risk marine fishes in Canada. *Canadian Journal of Fisheries and Aquatic Sciences*, 72: in press

Jason Samson

Forecasting the impacts of climate change with non-stationary niche models of regional population density

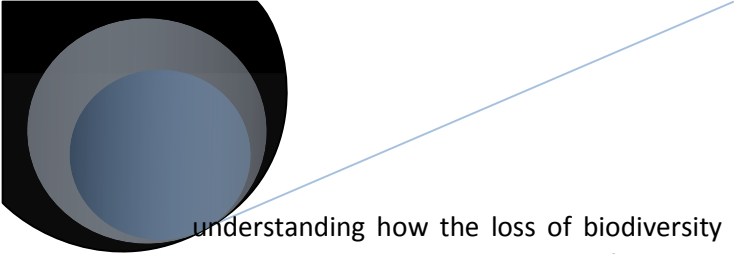
Environmental niche models (ENM) are generally used to predict species distribution in a changing world (e.g. climate and land use). However, little attention has been given to regional density within the distribution despite the ecological importance of density at the regional level. Species with broad distribution are better suited for ENM but the relative importance of each niche dimension may not be uniform across space. Non-stationary ENM allows spatial flexibility in the importance of predictors and these spatial patterns can be evaluated with existing knowledge of the species' ecological requirements. Jason Samson will discuss the opportunities and challenges of such modeling exercise and push the envelope by looking at human regional density across the globe. A discussion about collaborative work with governmental scientists will take place at the end of the presentation.

Wednesday, November 4th

Andrew Gonzalez

Biodiversity, Ecosystems function and Services

Lecture outline: Soon after the 1992 Earth Summit in Rio de Janeiro, interest in understanding how biodiversity loss might affect the dynamics and functioning of ecosystems and the supply of goods and services, grew dramatically. Major international research initiatives formed; hundreds of experiments were performed in ecosystems all over the globe; new ecological theories were developed and tested against experimental results. The past 20 years has thus seen remarkable progress made towards



understanding how the loss of biodiversity affects the functioning of ecosystems and in turn affects society. I will give an overview of two decades of research that has examined how biodiversity loss influences ecosystem functions, and the impacts that this has on the goods and services ecosystems provide. I will begin with a brief historical introduction. I will then summarize the major results from research that has provided increasingly rigorous answers to the question of how and why the Earth's biological diversity influences the functioning of ecosystems. After this, I will consider the closely related issue of how biodiversity provides specific ecosystem services of value to humanity. I will close by considering how the next generation of biodiversity science can reduce our uncertainties and better serve policy and management initiatives.

Readings:

Cardinale *et al.* 2012. Biodiversity loss and its impact on humanity. *Nature* 486: 59-67 (doi: 10.1038).

Hooper *et al.* 2012. A global synthesis reveals biodiversity loss as a major driver of ecosystem change. *Nature* 000: 1-5 (doi: 10.1038).

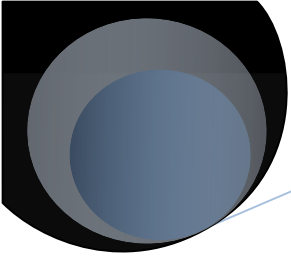


COURSE OVERVIEW

WORKLOAD INFORMATION

Course evaluation

- Class participation (25%)
- Problem questions set by Prof Pierre Legendre, to be completed after the end of the course (10%)
- Oral presentation(s), set by Profs Kembel/Davies/Pearse (15%)
- Final project, subject to be developed during the course (50%)
 - Project presentation (10%)
 - Write-up of project (30%)



PRESENTATION OF PARTICIPANTS

THE INSTITUTIONS

The Institutions

McGill University

The 5th edition of QCBS Biodiversity Science Intensive School (2015) will be hosted by McGill University. The oldest university in Montreal, McGill was founded in 1821 from a generous bequest by James McGill, a prominent Scottish merchant. Since that time, McGill has grown from a small college to a bustling university with two campuses, 11 faculties, some 300 programs of study, and more than 35,000 students.

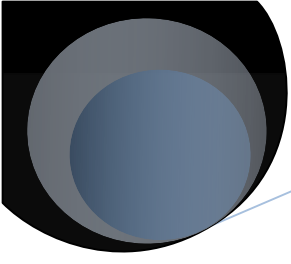
Gault Nature Reserve and Mont Saint-Hilaire Biosphere Reserve

The 2015 QCBS Biodiversity Science Intensive School will take place in the Gault Nature Reserve and Mont Saint-Hilaire Biosphere reserve. Gault Nature Reserve of McGill University is a private Reserve which protects 1000 hectares of natural primeval forests of the St. Lawrence Valley. Situated at Mont-Saint-Hilaire approximately 40 km from Montreal, this panoramic natural landscape is ideal for discovering nature, teaching and university research. The public sector with 25 km of trail network is open 365 days per year for visitors' enjoyment. Affiliated with the Faculty of Science of McGill University, the Gault team offers support to research and teaching of natural sciences while providing a wide range of services to the university community and the general public. In 1978, the mountain and its immediate surroundings were recognized as the first Biosphere Reserve in Canada under the UNESCO Man and the Biosphere Program.

Quebec Centre for Biodiversity Science (QCBS)

The Quebec Centre for Biodiversity Science (QCBS) was launched in February 2010. This FRQNT-funded institution brings together some of the province's best scientific minds to work on the problem of biodiversity loss. The objective of the QCBS is to foster the emergence of an integrated science of biodiversity within Québec. There is growing recognition that the diversity of life on Earth, including the variety of genes, species and ecosystems, is an irreplaceable natural heritage crucial to human well-being and sustainable development. The QCBS will seek to uncover the basic scientific principles required for the discovery, study, and sustainable use of Québec's biodiversity.

The QCBS comprises more than 120 researchers and 8 academic partner institutions—



McGill University, Concordia University, Université de Montréal, Université du Québec à Montréal, Bishop's University, Université du Québec à Rimouski, Université de Sherbrooke, Université de Laval—2 additional universities – Université du Québec à Chicoutimi, Université du Québec en Outaouais – and 2 public institutions the Montreal Botanical Gardens and Agriculture and Agri-food Canada. It is hosted by McGill University, under the leadership of director Andrew Gonzalez. The province of Québec is home to an exceptional concentration of internationally recognized biodiversity scientists. The QCBS seeks to integrate biodiversity science by facilitating collaboration among these researchers, providing training opportunities for students, and helping to answer key questions that will contribute to more sustainable management of the province's biodiversity. The objective of the QCBS is to foster the emergence of an integrated science of biodiversity within Québec. In line with Québec's strategic plan for research and innovation in environmental science, the QCBS seeks to uncover the basic scientific principles required for the discovery, study, and sustainable use of Québec's biodiversity. Web site: <http://www.qcbs.ca>

The Montréal Biodiversity Centre

The Montréal Biodiversity Center is a centre of excellence in conservation and digitization of biological collections and in biodiversity research and training.

The Montreal Biodiversity Centre is an initiative of Professor Anne Bruneau, who is scientific director, and other researchers from the plant biology research institute of Université de Montréal (Institut de recherche en biologie végétale, or IRBV).

The new building of the Biodiversity Centre follows the LEED green building standards and is located at heart of the Montréal Botanical Garden. The building will house the principal collections of plants, insects and fungi currently held in Montreal. The Centre's cutting edge laboratories will gather about fifty researchers and students dedicated to the discovery and preservation of the natural heritage of Quebec, Canada and the world. Finally, the Centre will also encourage the general public to learn more about biodiversity and biological collections by offering free displays and activities in its exhibition hall.

The Biodiversity Centre will be a world-class centre of excellence in biodiversity research and preservation. It represents a major source of knowledge and expertise in the three main areas identified by the government of Quebec in its sustainable development strategy, which are to expand knowledge, promote responsible action and facilitate participation.

Its mission:

- ✓ allow long-term conservation and digitisation of the main plant, insect and fungi collections currently in Montreal;
- ✓ develop innovative research programs and training of young experts in disciplines relevant for the inventory of biodiversity;
- ✓ coordinate the networking of – and international access to – the databases of major biological collections of Canadensys; and
- ✓ increase public awareness of the importance of inventorying and preserving biodiversity.

web site: http://www.biodiversite.umontreal.ca/index_en.htm



The United Nations Convention on Biological Diversity

The United Nations Convention on Biological Diversity (CBD) was adopted in 1992 during the United Nations Conference on Environment and Development, also known as the Earth Summit. From the Earth Summit, five international agreements followed: Rio Declaration on Environment and Development, Agenda 21, Forest Principles, the Framework Convention on Climate Change and the Convention on Biological Diversity. The Earth Summit and the agreements which resulted from it were a major turning point marking a departure from the strict conservation approach that had characterized international agreements until then and, together with the 1987 Brundtland Report, an embrace of the concept of sustainable development. Canada was one of the first countries to ratify; the only major country yet to ratify is the United States.

For those countries that have ratified it, the CBD is a legally-binding agreement through which Parties have committed themselves to achieving the CBD's three objectives:

- ✓ Conservation of biodiversity
- ✓ Sustainable use of the components of biodiversity

The fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding.

While not a specific objective, the notion of sustainable development runs throughout the CBD. Sustainable use itself is defined in Article 2 of the CBD as “the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.”

The institutional structures set up through CBD are used to translate its general commitments into guidelines to assist Parties with implementation. The following are some of the main mechanisms through which the Convention achieves its goals:

Conference of the Parties (COP), Ad-Hoc Working Groups, Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), CBD Secretariat, Clearing House Mechanism, Financial Mechanism

One of those mechanisms, the **CBD Secretariat** is a neutral organization, based in Montreal and staffed by international civil servants. It services the meetings of the COP and other subsidiary bodies of the

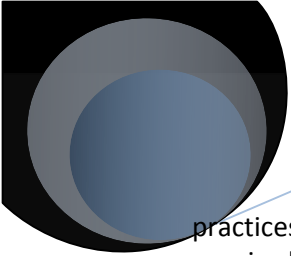
Convention. The CDB also houses all National Biodiversity Strategies and Action Plans (NBSAPs) and National Reports as submitted by Parties, which are made available on its website.

Web page: <https://www.cbd.int/> and: <https://www.cbd.int/convention/about.shtml>

Purdon, M. (2010). The United Nations Convention on Biological Diversity: Background Document. Ottawa: Canadian Environmental Network. Online at: http://www.cen-rce.org/IYB2010/pdf/RCEN_CBD_backgrounder_2010.pdf

The Centre for Forest Research (CFR)

The Centre for Forest Research (CFR, CEF in French) is a university-based research centre unique to Quebec that draws together scientific expertise in forestry from across the province. This new centre extends the mandate of its predecessors (CRBF and GREFi), favouring an overall vision that links understanding of the function roles of organisms and dynamic processes in forest ecosystems with the design of innovative alternatives related to forest management(planning strategies and silvicultural



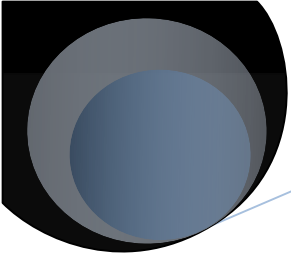
practices). The strength of CFR lies in its ability to integrate appropriate scientific knowledge that is required to conceive new strategies and practices which will allow shifting current management approaches to ecosystem-based management of provincial forest lands, a key recommendation of the recent Coulombe Commission Report, Commission d'étude sur la gestion de la forêt publique québécoise (Rapport Coulombe, December 2004). The Centre is currently under the codirection of Professors Louis Bernier and Pierre Drapeau.

Université du Québec à Montréal

The Université du Québec à Montréal (UQAM) is a comprehensive public university based in Montreal, Quebec, Canada. It is a French language university and is the largest constituent element of the Université du Québec (UQ), a public university system.

UQAM was founded on April 9, 1969 by the government of Quebec, through the merger of the École des Beaux-Arts de Montréal, a fine arts school; the Collège Sainte-Marie, a classical college; and a number of smaller schools. Although part of the UQ network, UQAM possesses a relative independence which allows it to print its own diplomas and choose its rector.

In 2013, UQAM had a student population of 43,140 in six faculties (Arts, Education, Communication, Political Science and Law, Science and Social science) and one school (Management). It offers Bachelors, Masters, and Doctoral degrees. It is one of Montreal's two French-language universities, along with the Université de Montréal, and only 1% of its student population is Anglophone.



PRESENTATION OF PARTICIPANTS

COURSE COORDINATORS

The Organizers

Jonathan Davies – Assistant Professor, McGill University

Department of Biology



Development and application of phylogenetic methods in ecology and conservation biology. Phylogenetics offers a powerful means to explore evolutionary mechanisms shaping ecological patterns and the distribution of species richness. A better understanding of the processes shaping biodiversity patterns will be critical if we wish to reduce current rates of biodiversity loss.

Web page: <http://biology.mcgill.ca/faculty/davies/>

Email: j.davies@mcgill.ca

Pedro Peres-Neto – Associate Professor, Université du Québec à Montréal

Département des Sciences Biologiques



analyzed jointly.

My research interests lie at the interface of community and quantitative ecology, incorporating principles from a diverse suite of areas including spatial ecology, multivariate statistics, modelling, ecomorphology and evolution. Examining the roles of multiple ecological factors in driving species distributions and community structure relies heavily on quantitative methods to detect statistical patterns in data. I develop and assess the performance of quantitative frameworks where different sources of information based on observational and experimental approaches can be embedded and

Web page: www.communityecology.uqam.ca

Email: peres-neto.pedro@uqam.ca

PRESENTATION OF PARTICIPANTS

COURSE INSTRUCTORS

The Instructors

Graham Bell – Research Director, James McGill Professor

Chair, Department of Biology



- ✓ Adaptive radiation
- ✓ Sex & sexual selection
- ✓ Adaptation to elevated CO₂
- ✓ Antibiotic resistance
- ✓ Yeast population structure
- ✓ Plant species diversity
- ✓ Neutral theory of biodiversity
- ✓ Food webs

Web page: <http://biology.mcgill.ca/faculty/bell/>

Email: graham.bell@mcgill.ca

Marco Festa-Bianchet – Professor, Université de Sherbrooke

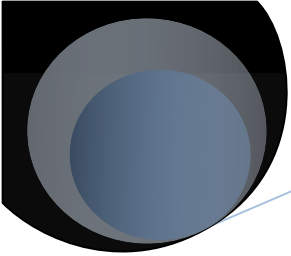
Département de Biologie



Marco Festa-Bianchet is Professor of Ecology at the Université de Sherbrooke in Québec. His research on the evolutionary ecology and conservation of large mammals seeks to understand how individual differences affect population dynamics and the evolution of reproductive strategies in both sexes. Marco has worked with bighorn sheep, mountain goats, chamois, ibex, fallow deer, caribou and kangaroos. Much of his research involves long-term monitoring of marked individuals. He is a past Chair of COSEWIC.

Web page: <http://pages.usherbrooke.ca/mfesta/marco.htm>

Email: M.Festa@USherbrooke.ca



Murray Humphries – Associate Professor, McGill University

Department of Natural Resource Sciences



In general, our research explores how environment, physiology and behaviour influence the abundance, distribution, and coexistence of mammal populations. Our research is conducted both in the lab and in the field, often in collaboration with northern communities or one of our many partners.

One of our research focuses is on energetics (the process by which animals acquire and assimilate energy from the environment, and allocate assimilated energy between maintenance, growth, and reproduction). We firmly believe that understanding the ecological implications of energetics ultimately requires field studies that integrate measures of energy intake and expenditure, under conditions of known resource availability, and in situations where behaviour, survival and reproductive success can be documented. Another of our research focuses is on understanding, predicting and monitoring environmental change impacts on northern wildlife and traditional food security in Canada.

Web page: <http://murray-humphries.lab.mcgill.ca/>

Email: murray.humphries@mcgill.ca

Andrew Gonzalez – Professor, McGill University

Department of Biology



Our research is broadly focused on the causes and consequences of biodiversity loss. As a corollary we hope to gain a better understanding of what it will take to slow extinction and mitigate its effects. We use experiments (field and lab), theory, and databases to tackle the following research projects:

1. Extinction in Fragmented Landscapes
2. The Functional Importance of Dispersal
3. Source-Sink Dynamics in Changing Environments
4. The Structure and Function of Metacommunities
5. Ecosystem Impacts of Climate Change
6. Anthropogenic Impacts on Adaptive Radiation
7. Economic Inequality and Biodiversity Loss

Web page: <http://biology.mcgill.ca/faculty/gonzalez/>

Email: andrew.gonzalez@mcgill.ca



Steve Kembel – Assistant Professor, Université du Québec à Montréal

Département des Sciences Biologiques



My research program focuses on 1) understanding the processes responsible for the assembly and evolution of plant and microbial communities, 2) the functional ecology of plant leaves and roots, and 3) the ecology of host-microbe associations. Current research in my lab includes the use of high-throughput environmental DNA sequencing to understand the biodiversity and assembly of microbial communities, and the evolutionary ecology of plant-microbes associations in forests.

Web page: <http://www.phylodiversity.net/skembel/>

Email: kembel.steven_w@uqam.ca

Pierre Legendre – Professor, Université de Montréal

Département des Sciences Biologiques



Pierre Legendre has been teaching biostatistics and numerical ecology at Université de Montréal for more than 30 years. He is the author of the highly cited manual “Numerical ecology” [11653 citations according to Google Scholar]; the third English edition of that manual appeared in June 2012. He is also the author of 290 refereed research papers and book chapters. His *h*-index on Web of Knowledge is 63 (25026 citations for his papers, not counting citations of his books). He is also a “Highly Cited Researcher 2015” in Environment/Ecology. Besides his regular teaching at Université de Montréal, he has given 65 short courses in 38 universities and scientific institutes around the world. He is also the author of Fortran programs and R packages widely used by community ecologists and phylogeneticists, and coauthor (with D. Borcard and F. Gillet) of the book “Numerical ecology with R” (2011).

Web page: <http://adn.biol.umontreal.ca/~numeralecology/>

Email: Pierre.Legendre@umontreal.ca



Martin Lechowicz – Professor, McGill University

Department of Biology



As a graduate student at the University of Wisconsin in the early 1970s Martin Lechowicz studied physiological plant ecology, arriving at McGill in 1976. His research centers at the interface between functional ecology and plant community ecology. He created the McGill University Phytotron, chaired the committee that created the McGill School of Environment, and was Director of the Gault Nature Reserve from 1995 to 2011. In recent years he has become more involved with conservation ecology, most notably the Connection Montérégie project (<http://www.monteregieconnection.com/>) and its sequel on conservation strategies at the western edge of greater Montreal under the PMAD legislation. He presently holds the *Liber Ero* Chair in Conservation Biology, but will retire in the coming year.

Web page: <http://biology.mcgill.ca/faculty/lechowicz/>

Email: martin.lechowicz@mcgill.ca

Jean-Philippe Lessard

Department of Biology



Our lab works toward elucidating the ecological and evolutionary drivers of biological diversity on planet Earth. We borrow concepts and tools from community ecology and biogeography to try and gain a better understanding of the mechanisms governing the emergence, distribution and maintenance of diversity. To accomplish this, we conduct observational and experimental field studies, and compile comprehensive databases on the distributions, ecological traits and evolutionary history of species.

Web page: <http://jeanphilippelessard.com/>

Email: jp.lessard@concordia.ca



Christian Messier – Professor, Université du Québec à Montréal

Département des Sciences Biologiques



Christian Messier is professor of Forest Ecology and scientific director at ISFORT at the University of Quebec (UQO and UQAM). He obtained his bachelor in forestry (1984) and M.Sc. (1986) in forest ecology from Laval University, Quebec City, Canada and his Ph.D. (1991) from the University of British Columbia, Vancouver, BC. After one year at the University of Helsinki, Helsinki, Finland as Post-doc, he started his professorship at UQAM in 1992. His research interests are wide, ranging from the basic understanding of tree growth and death to decision-making tools to better manage natural and urban forests. His research has brought him to study various biomes across the world. He has published more than 170 referee journal papers and recently co-edited a book for the general public on basic ecological concept that can be observed in the city titled “Nature all around us”. He is also co-author of a recent book titled « a critique of silviculture: managing for complexity » and a more recent one titled “Managing forests as complex adaptive systems”. He recently holds a new NSERC/Hydro-Quebec research Chair on the control of tree growth.

Web page: <http://www.bio.uqam.ca/personnel/christian-messier.html>

Email: messier.christian@uqam.ca

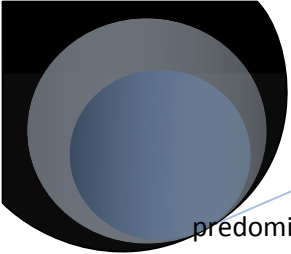
Katja Neves – Associate Professor, Concordia University

Department of Sociology and Anthropology



Initiated her career as invited assistant professor of Anthropology at the Institute of Anthropology, University of Heidelberg in Germany. Is currently associate professor of Sociology of the Environment and Social Sustainability at Concordia University, Montreal, Canada. Dr. Neves holds two research grants from the Social Sciences and Humanities Research Council (SSHRC), Canada, to investigate the contemporary reinvention of botanical gardens as agents of social and ecological biodiversity conservation. This research builds on Dr. Neves’ earlier scholarly output on neoliberal conservation and on socio-ecological sustainability, which has featured in top-rated journals. Her earlier research was financed by the *Fonds Québécois de Recherche Sur la Société et La Culture* (Quebec), and Concordia University

Dr. Neves’s current SSHRC projects have unveiled a major historical paradigmatic shift in the global governance, hegemonic understanding, and practice of biodiversity conservation. Whereas from the late 1980s onwards neoliberal biodiversity conservation tended to manage humans and non-humans as two dichotomous spheres in need of “reconciliation”, botanic gardens approach social and ecological sustainability as two inextricably connected dimensions of biodiversity conservation. Dr. Neves findings demonstrate that from this perspective, embracing social roles such as integration, food security, social justice and equity is as important as engaging with plant ecology and plant management. This contrasts with the “fortress conservation” approach of the hegemonic neoliberal conservation model that



predominated in Africa throughout the 1990s resulting in the eviction of local people from local ecosystems. Dr. Neves' findings also suggest that the aforementioned transformations reflect a much wider transformation in global and national socio-ecological governance. These challenge extant theorization.

Based on the findings of her current 2 SSHRC projects Dr. Neves has developed a new 5 year program of research whereby she will investigate and analyze the aforementioned new social dynamics of biodiversity conservation and governance. Dr. Neves is also collaborating with a network of scholars from international networks, Natural Science Museums and Zoos, working on parallel issues.

Web page: <http://explore.concordia.ca/katja-neves-graca>

Email: katja.neves@concordia.ca

Will Pearse – Postdoctoral Fellow, McGill University

Department of Biology



I received my PhD in 2012 from Imperial College London with Andy Purvis as my supervisor, and then did a post-doc with Jeannine Cavender-Bares at the University of Minnesota before my current position in Jonathan Davies' and Pedro Peres-Neto's labs. I use information on species' evolutionary history and functional traits to understand what structures ecological communities. Past ecological interactions affect the evolution of species, and I see no reason not to examine ecological and evolutionary interactions at the same time. I am broadly interested in ecology and evolutionary biology, and enjoy developing new methods that help answer an interesting question.

Web page: <http://willpearse.com/>

Email: will.pearse@gmail.com

Jason Samson

Department of Biology



Jason Samson is an ecologist working at the QCBS as a research professional in partnership with the Quebec government. He did his B.Sc. at Laval University in biology, M.Sc. in Zoology at Guelph University, Ph.D. at McGill University and a post-doc at UQAM. His main interests are the impacts of climate change on biodiversity and human societies. His current projects are:

- 1) Implementing a long-term biodiversity monitoring program in the province of Quebec,
- 2) Developing multi-species conservation strategies for Quebec endangered species,
- 3) Assessing the effectiveness of protected areas around the world in a changing climate, and
- 4) Collaborating with sociologists and geographers to improve the environmental justice framework to understand human vulnerabilities to climate change.

Email: samson.jason@gmail.com

Jade Savage – Associate Professor, Bishop’s University

Department of Biology



The research program of Jade Savage aims at documenting the systematics and biodiversity of muscoid Diptera (house flies and relatives) in different target habitats and develop various identification tools adapted for a broad range of questions and users. Current projects involve the development of a complete reference library of DNA barcode for Canadian Muscidae, classic morphological keys and near-infrared-based identification of agricultural pests such as root-maggot flies (*Delia*: Anthomyiidae), and short-term biodiversity changes in muscid species assemblages in northern Greenland.

Web page:

Email: jsavage@ubishops.ca

Mark Vellend - Associate Professor, Université de Sherbrooke

Département de Biologie



Research in my lab focuses on the ecological and evolutionary responses of plant populations and

communities to environmental change. In one major line of research, we exploit historical records of many kinds – e.g., past vegetation surveys, paleoecological data, herbarium records – to quantify changes over time in ecological variables of interest, including the composition and diversity of communities as well as species’ phenology (e.g., flowering time). We also conduct in-depth observational and experimental studies of current constraints on plant species distributions and abundance, and how these may influence responses to climate warming. Most empirical work is focused on the forests of southern Québec, including Mont St-Hilaire and Mont Mégantic.

I frequently participate in collaborative and synthetic working groups on broad issues in ecology and evolution, and I recently completed a monograph entitled “The theory of ecological communities”, to be published by Princeton University Press in 2016.

Web page: <http://mvellend.recherche.usherbrooke.ca/>

Email: mark.vellend@usherbrooke.ca



PRESENTATION OF PARTICIPANTS

THE STUDENTS

Julie Arrowsmith

MSc year 2 with Prof. Jean-Philippe Lessard
Concordia University

Research axis: 1 (Discovering Quebec Biodiversity), 2 (Changes in biodiversity and ecosystem services)

My thesis focuses on the processes that influence aquatic communities in Quebec to better understand how species distributions are structured across a landscape. We are using dragonflies as model organisms to answer some general, long-standing questions about diversity patterns and our results may prove useful in advancing the discussion over the relative influence of deterministic and stochastic processes on community composition. In fact, my research encompasses all three of the research themes of the QCBS. Axis 1, Discovering Quebec Biodiversity, and Axis 2, Linking Biodiversity to Ecosystems, are included in my goal to learn more about odonate species in Quebec, their distributions across the landscape, and how they interact with their aquatic freshwater environments. I am interested specifically in how odonate diversity patterns are affected by climate and habitat and thus, the results of my research may be helpful in assessing how changes in climate, landscape structure, and connectivity may affect odonate populations. Since odonates are important as predators, prey, and interacting species, my results may also lead to the assessment of how other aspects of freshwater communities may be impacted. In this way, my research also involves Axis 3: Management and Adaptation to Biodiversity Change as the results could serve as the early stages to developing conservation and management plans.

Antoine Becker Scarpitta

PhD year 3 with Prof. Mark Vellend
Université Sherbrooke

Research axis: 1 (Discovery of biodiversity), 2 (Changes in biodiversity and ecosystem services)

My research interests are focused on forest plant communities. I am interested in assessing long-term taxonomic and structural changes in plant communities, as well as evaluating the causes of these changes. Especially my aim is to evaluate the effect of global changes during the last 50 years on composition, structure and ecology of forest plant communities in south Quebec.

I use both comparative and integrative approaches to two taxonomic taxa: bryophytes and vascular plants. In that way I include my main research project in the axe 2 of the CSBQ. But I also participate of the Axe 1, by the taxonomic inventories of bryophytes.



Pedro Henrique Pereira Braga

PhD year 2 with Prof. Pedro Peres-Neto and Prof. Steven Kembel

UQÀM

Research axis: 2 (Changes in biodiversity and ecosystem services), 3 (Management and adaptation to biodiversity changes)

I hold a Bachelor degree in Biological Sciences and a Master degree in Ecology and Evolution from the Universidade Federal de Goiás, in Brazil. I am currently pursuing the second year of PhD studies in Biology, at the Université du Québec à Montréal. I am being supervised by Pedro Peres-Neto and Steven Kembel. My main research interests are biodiversity synthesis, spatial macroecology, phylogenetic comparative methods, ecological modelling and conservation biology. I am particularly interested in understanding the association between patterns and processes involving the phylogenetic relationships among species, their ecological attributes and their geographical distributions. The overall objectives of my research is to integrate phylogenetic comparative methods, statistical knowledge and information about the biology and the distribution of bats (1) to test predictions associated to the phylogenetic niche conservatism hypothesis for the latitudinal diversity gradient of bats at a global scale, (2) to examine global dietary patterns of bats across their evolutionary history, geography and environmental characteristics, (3) to review and test for life-history, evolutionary and anthropogenic correlates of extinction risk in bats and apply conservation planning analyses to identify priority areas for conservation of bats in the long term, under different climate change scenarios and, (4) to explore methods to infer ecological niche parameters for species basing on their geographical occurrences and on the phylogenetic signal for their traits.

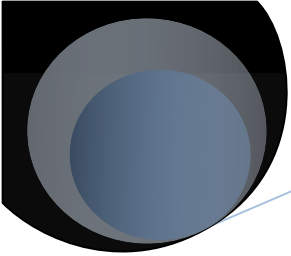
Erin Crockett

PhD year 1 with Prof. Elena Bennett

McGill University

Research axis: 2 (Changes in biodiversity and ecosystem services)

As a first year PhD student working with Dr. Elena Bennett at McGill, my research examines questions at the confluence of ecology and conservation science. I am intrigued by two main themes: In a dynamic world, what tools can we use to rapidly assess changes in biodiversity and ecological condition? Are there predictable relationships between biodiversity, ecosystem function, and ecosystem services across spatial scales? Although I enjoy working in the field, my current research primarily seeks to explore how 'big data' approaches may offer new insights for conservation. Through the Biol 645 course, I am keen learn more about how functional and phylogenetic diversity may modulate the provision of ecosystem services. I anticipate a trilling two weeks at Mont Saint-Hilaire and I look forward to getting to know all of you!



Amélie Gervais

PhD year 1 with Prof. Valérie Fournier and Prof. Marc Bélisle
Université Laval

Research axis: 1 (Discovering Quebec Biodiversity), 2 (Changes in biodiversity and ecosystem services)

I will work with bumblebee diversity found in Southern Quebec (Montérégie and Estrie). From a ten years data base (2006-2015), we want to understand how landscape, agriculture and climate changes affect community, colony and individual bumblebee development. First, we want to evaluate how bumblebee community varies throughout this ten years survey. After, by using commercial quads (4 bumblebee hives), we want to compare how each colony evolves in different agriculture levels and landscape diversity. Finally, we want to determine if bumblebee size changes through landscape and time.

Katherine Hébert

MSc year 1 with Prof. Jean-Philippe Lessard and Prof. Virginie Millien
Concordia University

Research axis: 1 (Discovery of biodiversity)

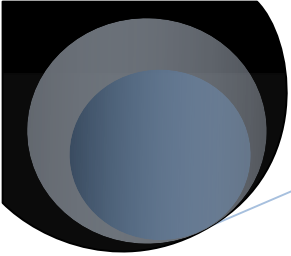
I started my Master of Science in Biology at Concordia University this fall. I'm being co-supervised by Jean-Philippe Lessard (Concordia University) and Virginie Millien (McGill University) as we work on a project related to QCBS' "Discover of biodiversity" research axis. I will be studying insular mammal communities on islands in Japan, the Sea of Cortés, Southeast Asia, and the Mediterranean to link functional species traits such as trophic level and body size to island characteristics such as isolation level and elevation range. My goal is to describe some of the processes shaping island mammal communities on islands, potentially providing insight into extinction risk for species with certain key functional traits.

Emma Hudgins

MSc year 1 with Prof. Brian Leung
McGill University

Research axis: 3 (Management and adaptation to biodiversity changes)

My research focuses on the use of statistical models and numerical simulation to forecast the spread of invasive species. I am creating predictive models that employ Bayesian and/or Maximum likelihood methods with the goal of developing informed management strategies to slow and prevent further spread of harmful invaders. These models will include the hidden process of the detection of invasive pest species in order to better fit pest spread data, as all spread data can only be collected once pests have been detected. This research focus aligns most closely with the third axis of biodiversity; management and adaptation to biodiversity changes. I am interested in taking this course to develop my knowledge of ecological research methods, and am most interested in the biological invasions and numerical ecology sections of the course, as these tie in very closely to my own research.



Elizabeth Lawrence

PhD year 1 with Prof. Dylan Fraser
Concordia University
Research axis: 1 (Discovery of biodiversity)

I am a first year biology PhD student, having just fast-tracked from the Master's program. My research falls under QCBS Axis 1, as I am assessing the population diversity of vertebrates in North America. I am first determining the extent of diversity, the locations of "hotspots", and comparing population diversity patterns to patterns of species diversity. I am also interested in exploring the driving forces for the observed population diversity patterns. Outside of my current research, I am also interested in fisheries science, marine ecology, and macro-ecological themes.

Alessandra Loria

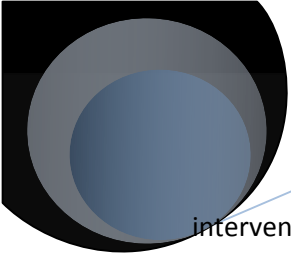
PhD year 4 with Prof. Andrew Gonzalez and Prof. Melania Cristescu
McGill University
Research axis: 2, theme 2.2 (adaptation in response to environmental changes)

The goal of my research project: "The interplay between environmental change and biodiversity" is to explore the ecological, evolutionary and genetic consequences of metal contamination on aquatic ecosystem species composition. I apply next generation sequencing on lake sediments (as natural archives of species assemblage information) to study the ecological and genetic consequences of long-term metal contamination in lakes situated in North America. In addition, using *Daphnia* (Cladocera) as model organism, I focus my attention on the supply of advantageous genetic variation and its interplay with copper pollution testing whether initial standing genetic diversity influence persistence and adaptation in natural populations.

Kim Marineau

Biologiste, MSc

Ms Marineau, a consultant in ecology and botany since 1999, has been a biologist since 1988 and has a Masters in Environmental Science (1992) from UQAM. For 25 years, she acquired experience in plant ecology, botany and environment while completing over 170 studies on ecosystems, flora and inventories in private and public territories around Quebec. She is also responsible for environmental impact studies, conservation and development projects integrated into ecological focused areas. Her expert advice is sought out in legal disputes on the protection of wetlands and natural ecosystems. She teaches at CUFÉ (2nd cycle) at the University of Sherbrooke, she lectures on subjects in biodiversity and trains her peers on wetlands. She has contributed to the creation of museum exhibition concepts, including the Biosphere and the Plaisance National Park. She also participated in studies on the impact of industrial projects (mining) and energies (wind and pipelines). Marineau founded the Biodiversité conseil inc. in 2013. She had been a member of several biodiversity consultation committees such as Table d'harmonisation du parc nationale du Mont-Saint-Bruno and Comité d'experts de la Fondation Hydro-Québec en Environnement. She has been mandated by the MDDELCC as inspector of the flora in connection with



interventions aiming to ensure the dispositions of the Act respecting threatened or vulnerable species is being respected. From 2010 to 2014 she was the administrator of l'Association des biologistes du Québec. She is also a founding member and the president of Écocorridors laurentiens.

Katie Millette

PhD year 2 with Prof. Andrew Gonzalez and Prof. Melania Cristescu
McGill University
Research Axis: 1 (Discovery of biodiversity)

I study the evolution of *Daphnia* in contaminated environments and aim to understand the role of the landscape, strength of selection, and gene flow on patterns of population genetic structure. I'm interested in molecular ecology and landscape genetics.

Elizabeth Nyboer

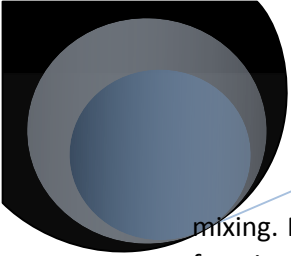
PhD year 3 with Prof. Lauren Chapman
McGill University
Research Axis: 1 (Discovery of biodiversity)

I am interested in taking this course to improve my understanding of techniques in biodiversity science, better situate my own work within the broader context of biodiversity research, and meet and collaborate with similarly focused students in Quebec. My research explores how heavily exploited tropical freshwater fishes respond to environmental stressors related to climate change, with an emphasis on African inland fisheries. Specifically, I investigate the ability of Nile perch to adapt physiologically to climate-induced environmental change by testing whether they can adjust their thermal tolerance limits when exposed to higher temperatures over different time scales. Determining the acclimation potential of exploited fish species is key to predicting how populations may respond to global warming, and can have implications for management practices in the fishery.

Anthony Sardain

MSc year 2 with Prof. Brian Leung
McGill University
Research axis: 2 (Changes in biodiversity and ecosystem services)

My research focuses on the spread of invasive marine species via the global shipping network and comprises two parts. For my first chapter, I am creating a 30-year forecast of the global shipping network using statistical and computational modelling. By making use of 30 years of historical data and published economic projection scenarios, I am simulating a number of key future drivers of change (eg. economic development in emerging markets, opening up of northern passages, expansion of the Panama Canal) and create a set of possible future networks. With these future networks, I aim to show the different outcomes of species exchange between different biotic zones, thus creating different scenarios for biodiversity



mixing. My forecast will also serve as a foundation for my second chapter, which is an examination of functional traits of successful invaders. Using historical data on successful invasions and invaders, I aim to use my shipping forecast to simulate the spread of marine invasive species, and see which traits confer greatest success under present and future shipping network scenarios. This would allow for targeting problem-species, both known and yet unknown. Both chapters are firmly grounded in the second research axis -- “changes in biodiversity” -- as they focus on identifying the link between shipping-mediated invasion, an important driver of biodiversity change, and potential consequences.

Shiva Nagaraju

PhD year 4 with Prof. Selvadurai Dayanandan
Concordia University
Research Axis: 1 (Discovery of biodiversity)

Current research: My doctoral thesis is focused on understanding the evolution of tree diversity in fresh water swamps in Western Ghats biodiversity hotspot in India. My thesis propose to use combined approaches of community phylogenetics, ecological niche modelling; coalescent simulations and DNA based molecular genetic data of tree species from fresh water swamps to evaluate several hypotheses related to evolution and diversification of swampy vegetation in lower altitude fresh water swampy habitats in Western Ghats. The proposed research links to the QCBS research structure axis 1 “discovering biodiversity” and the theme 1.2 “phylogenetics and phylogeography”.

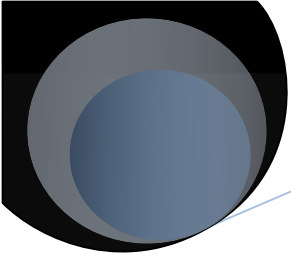
Research interests: I am always fascinated by Darwinian evolution and wondered about amazing diversity of life on earth. Since then I am interested in understanding evolution of tropical plant diversity using molecular and ecological tools. Mainly my research area includes

- Population genetics and Phylogeography
- Ecological niche modeling (ENMs)
- Conservation Biology
- Community ecology

Natalie Westwood

MSc year 2 with Prof. Alison Derry
UQÀM
Research Axis: 2 (Changes in biodiversity and ecosystem services)

The main focus of my project is examining how previous copper mining activity affects leaf litter decomposition in small streams in southern Québec. I am focusing on differences in macroinvertebrate and the microbial community between these mining sites and pristine, forested sites. To analyze the biodiversity in each site, I will be using DNA barcoding to identify the members of the fungi and bacteria community and microscopic identification for the macroinvertebrates and then estimate biodiversity using phylogenetic diversity. I believe that this course will broaden my understanding of biodiversity concepts and help me to better relate the findings of my own research to the large body of biodiversity knowledge.



Guang Zhang

MSc year 2 with Prof. Melania Cristescu

McGill University

Research Axis: 1 (Discovery of biodiversity)

My study is to use genetic tools to early detect aquatic invasive species and assess biodiversity in Canadian ports.

Metabarcoding (combination of DNA taxonomy and next-generation sequencing) can be used as a rapid method for monitoring biodiversity, but species level identification and quantification are limited by finding a suitable metabarcode. The mitochondrial cytochrome *c* subunit I (COI) gene has high interspecific genetic variation and comprehensive reference databases, but designing primers that successfully amplify diverse taxa remains a challenge. We address this issue by testing and developing a set of group-specific COI primer pairs that will be used to identify zooplankton species present in major Canadian ports. These primers will first be tested on mock zooplankton communities, examining correlation between species abundance and the number of sequence reads. This project contributes to global sampling networks that aim to generate catalogs of aquatic invertebrates, and the biodiversity estimates revealed by metabarcoding of natural port communities can enable broader research on food authenticity, trophic interactions, phylogeography, and human health.