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# Introduction to Environmental Genomics for (Eco)Toxicology

Queen's University Biological Station, June 2018

Course website:

**http://colauttilab.github.io/SETAC.html**

# BUT first, more libraries…

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See list on course website:

**http://colauttilab.github.io/SETAC.html**

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# Rapid Evolution
# in novel environments

# Research Background

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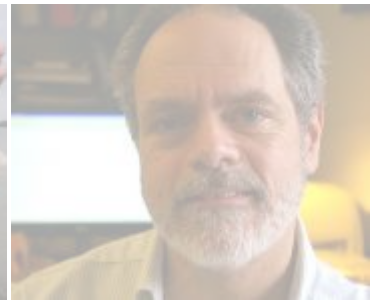
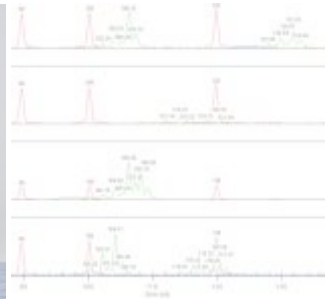
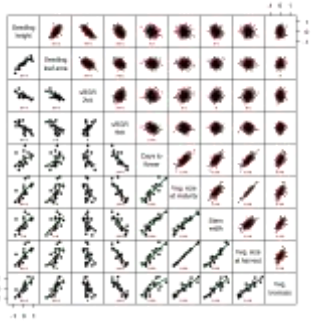
## University of Windsor & GLIER – Bsc (Hs), MSc





Hugh MacIsaac Dan Heath

## University Toronto – PhD



Spencer Barrett

# Research Background

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## Duke University – Postdoc

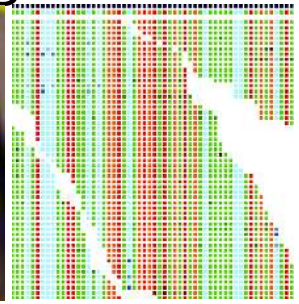
Tom Mitchell-Olds

Jill Anderson

## University of British Columbia – Postdoc

Loren Rieseberg

## University of Tuebingen – Postdoc



Oliver Bossdorf

# Ecology & Evolution in the Anthropocene

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Environment --> Natural Selection --> Genome Evolution

Photos by Ed Burtynsky

# Grand, unplanned experiments in ecology/evolution

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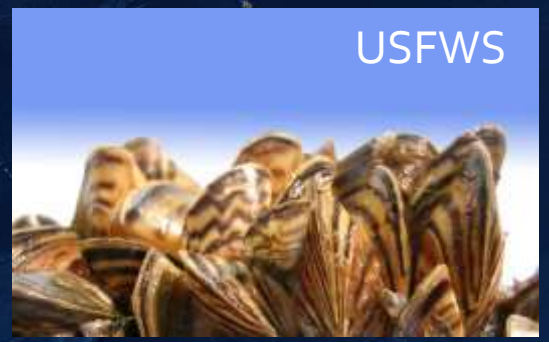
Photos by Ed Burtynsky




*Dreissena polymorpha*

gbif.org

# Invasion Genetics

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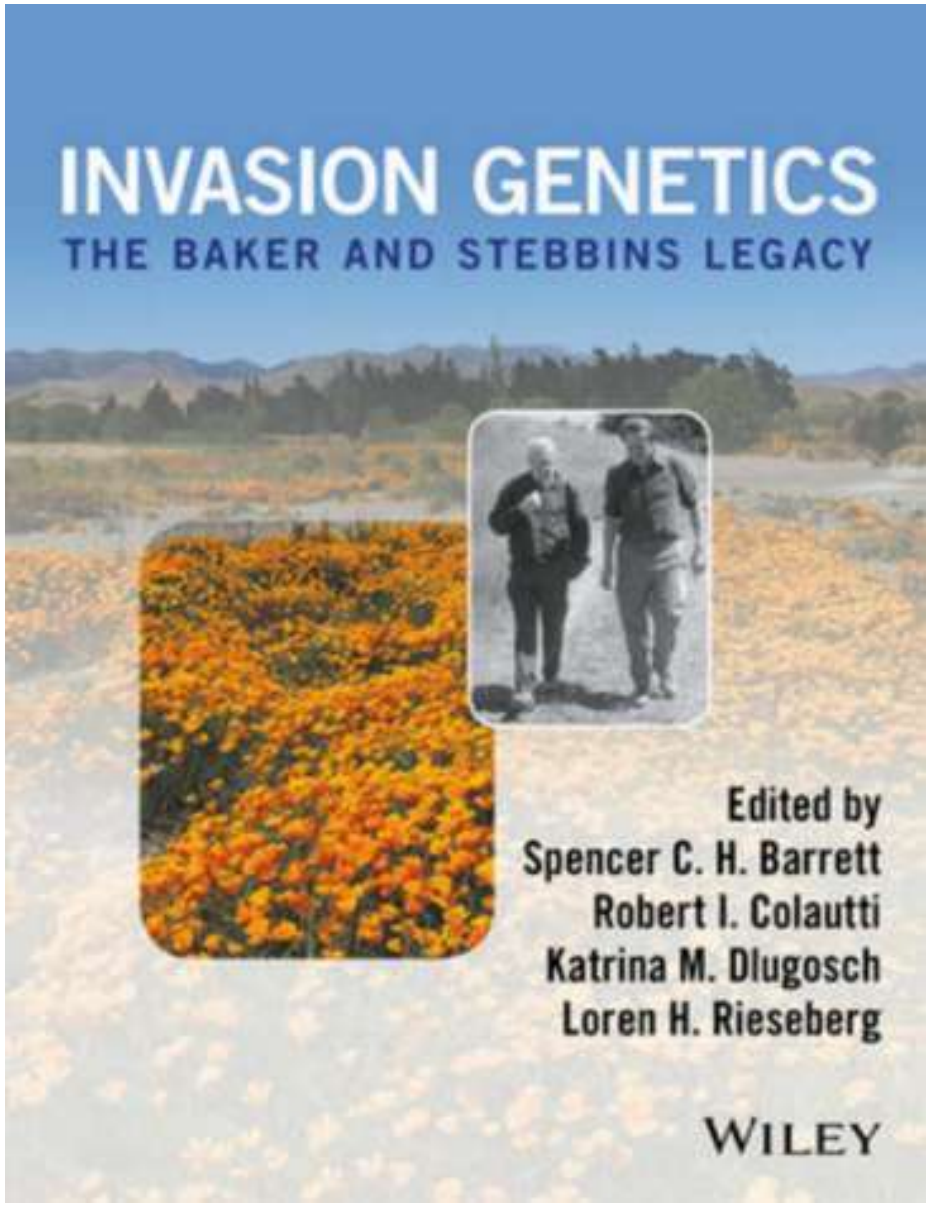


"Invasion genetics of the spiny waterflea"
– Colautti et al. 2005

"Invasion genetics is a relatively new discipline that investigates patterns of genetic variation in populations of invasive species and their ecological and evolutionary consequences."
– SCH Barrett 2016

# Ecological and environmental genomics

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"**Invasion genetics** is a relatively new discipline that investigates patterns of genetic variation in populations of invasive species and their ecological and evolutionary consequences."
– SCH Barrett 2016

**Ecological & environmental genomics** investigate patterns of genome-wide variation in natural populations or species communities, to address ecological and environmental questions.

# Evolution of phenology in response to climate

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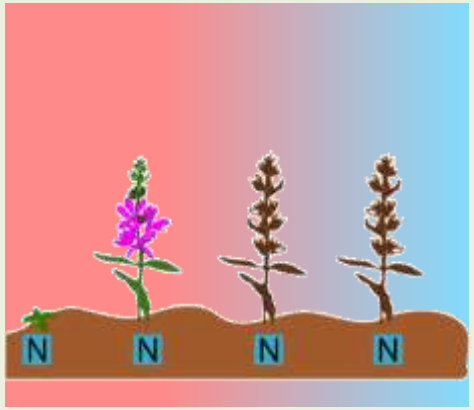
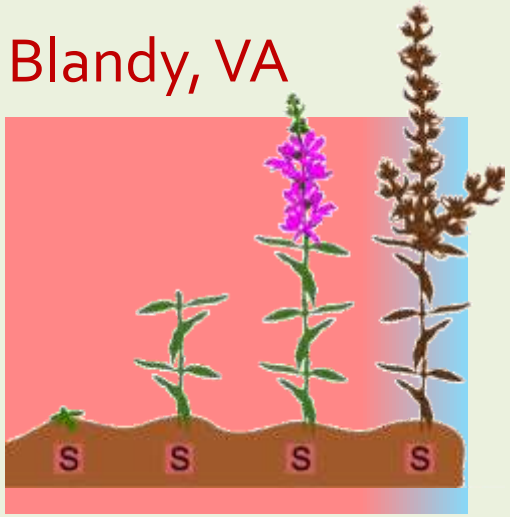
Timmins, ON




Time

Blandy, VA




Time

# Rapid evolution of herbivore resistance?

Muzz Abdur-Razak

Sierra Klueppel

Eugene Sit

# *Alliaria petiolata* ecology: plant-microbe interactions

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# Population genomics of garlic mustard (Alliaria petiolata)

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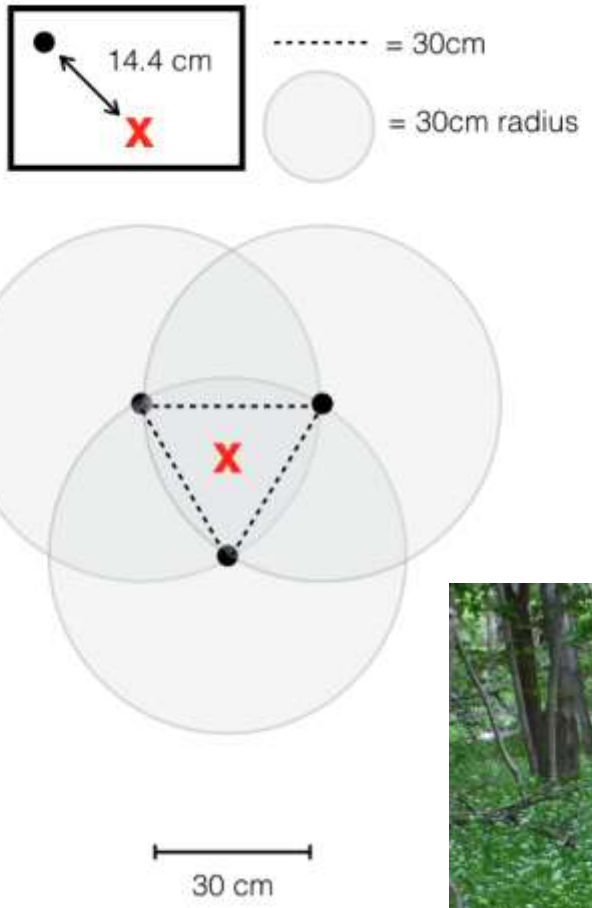

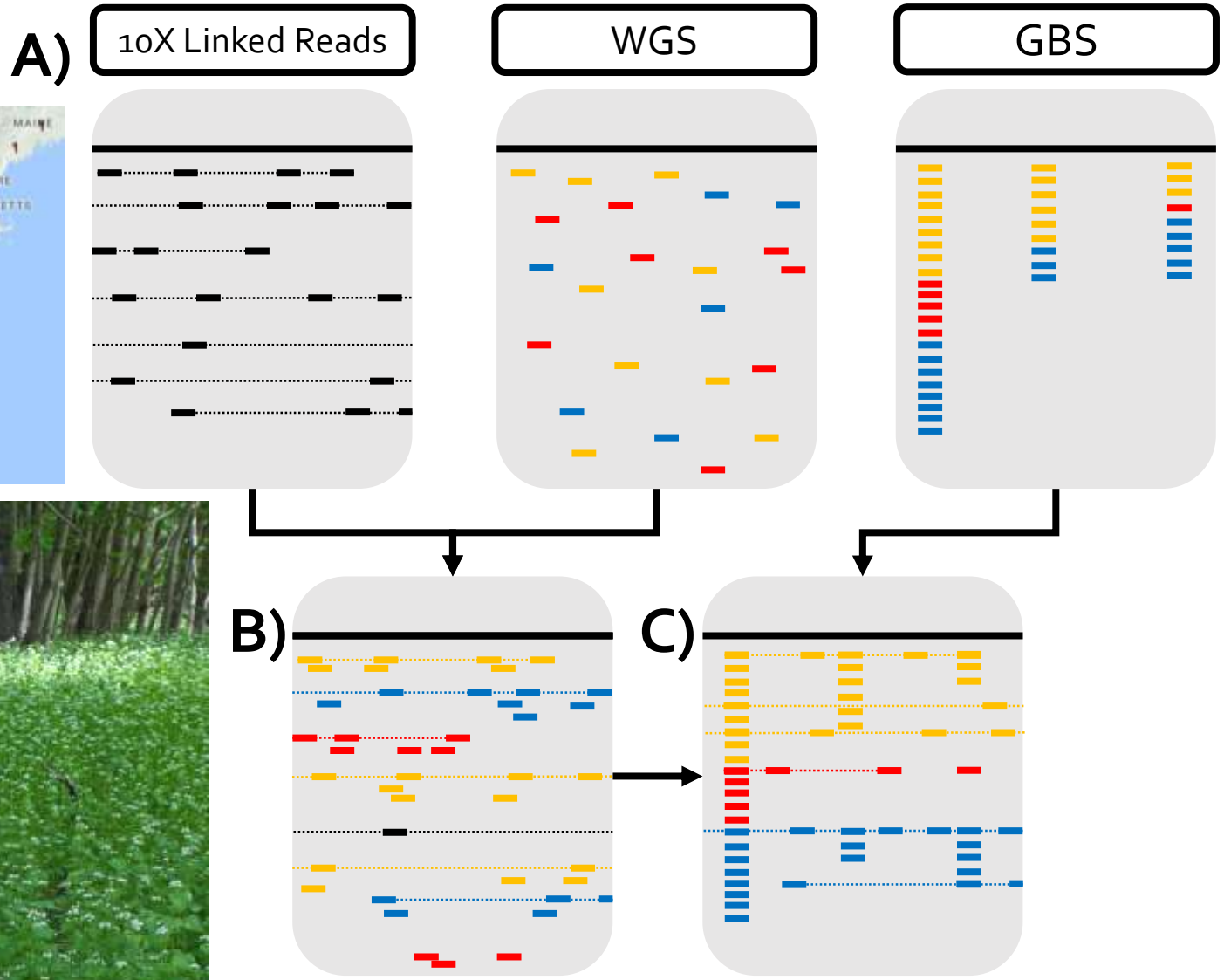

# *Alliaria petiolata* ecology: plant-microbe interactions

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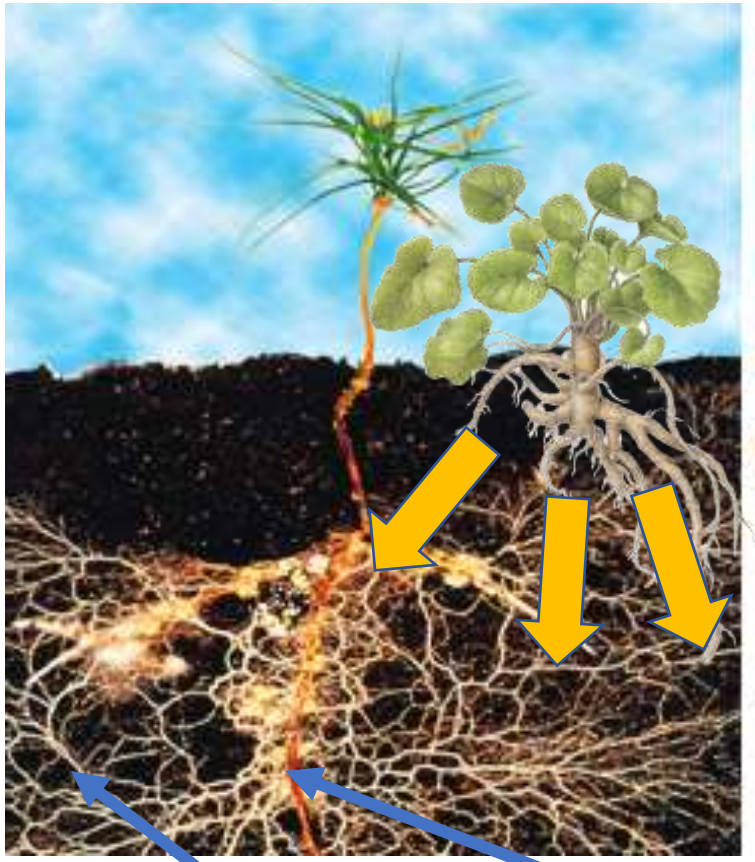
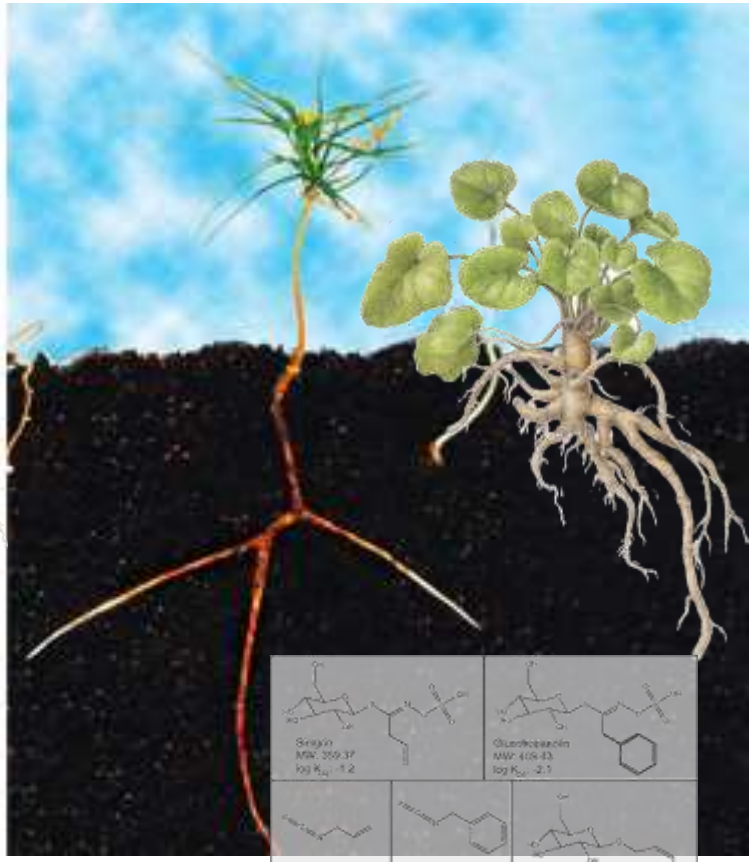
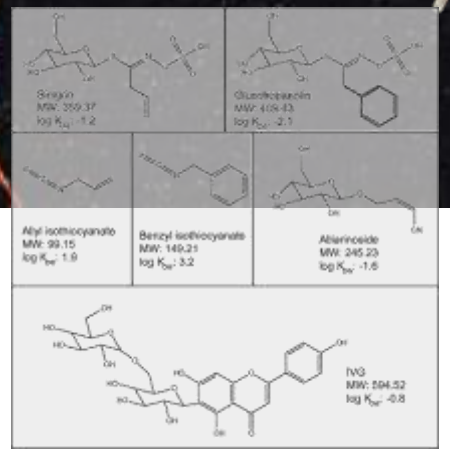


Beneficial fungus (Myccorhizae)

Root






Glucosinolates

# Metagenomics of ticks & their microbiomes

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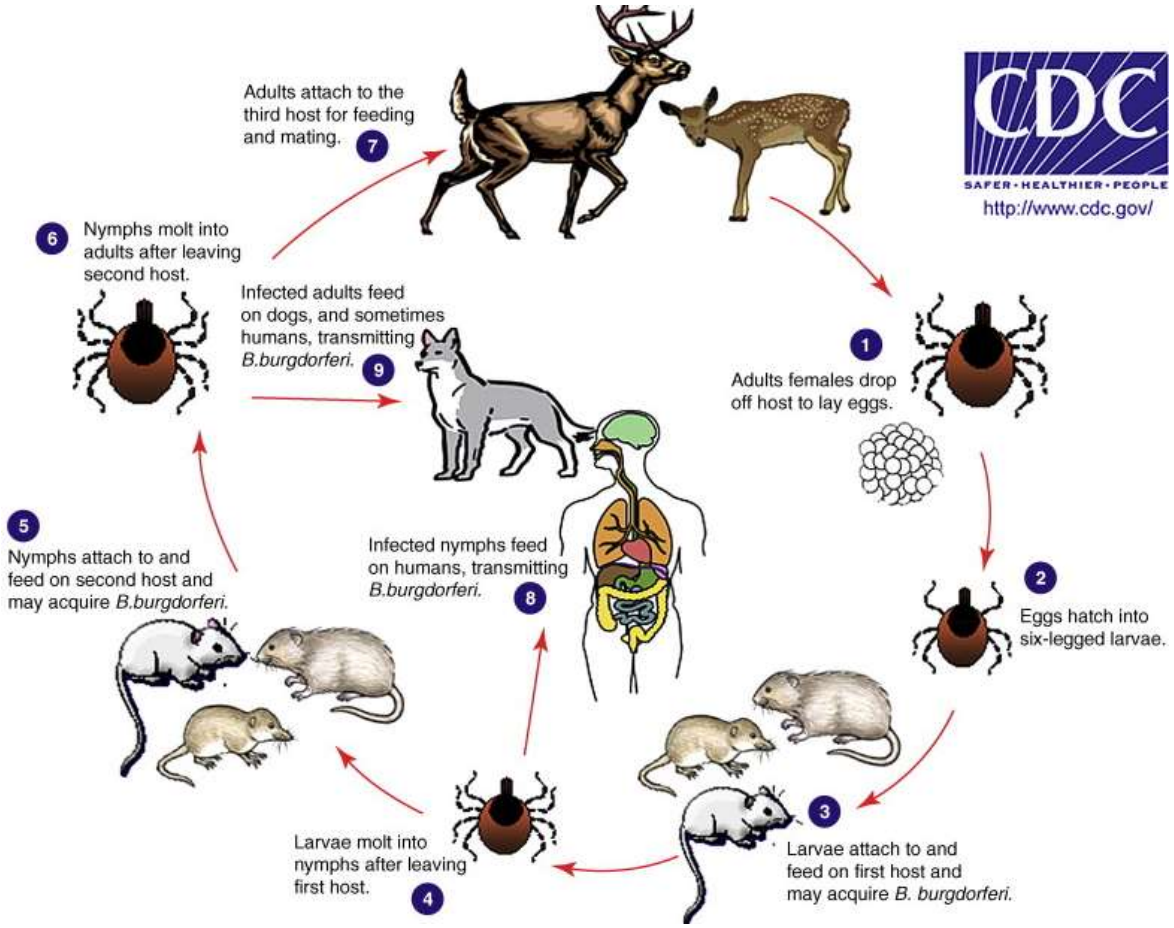
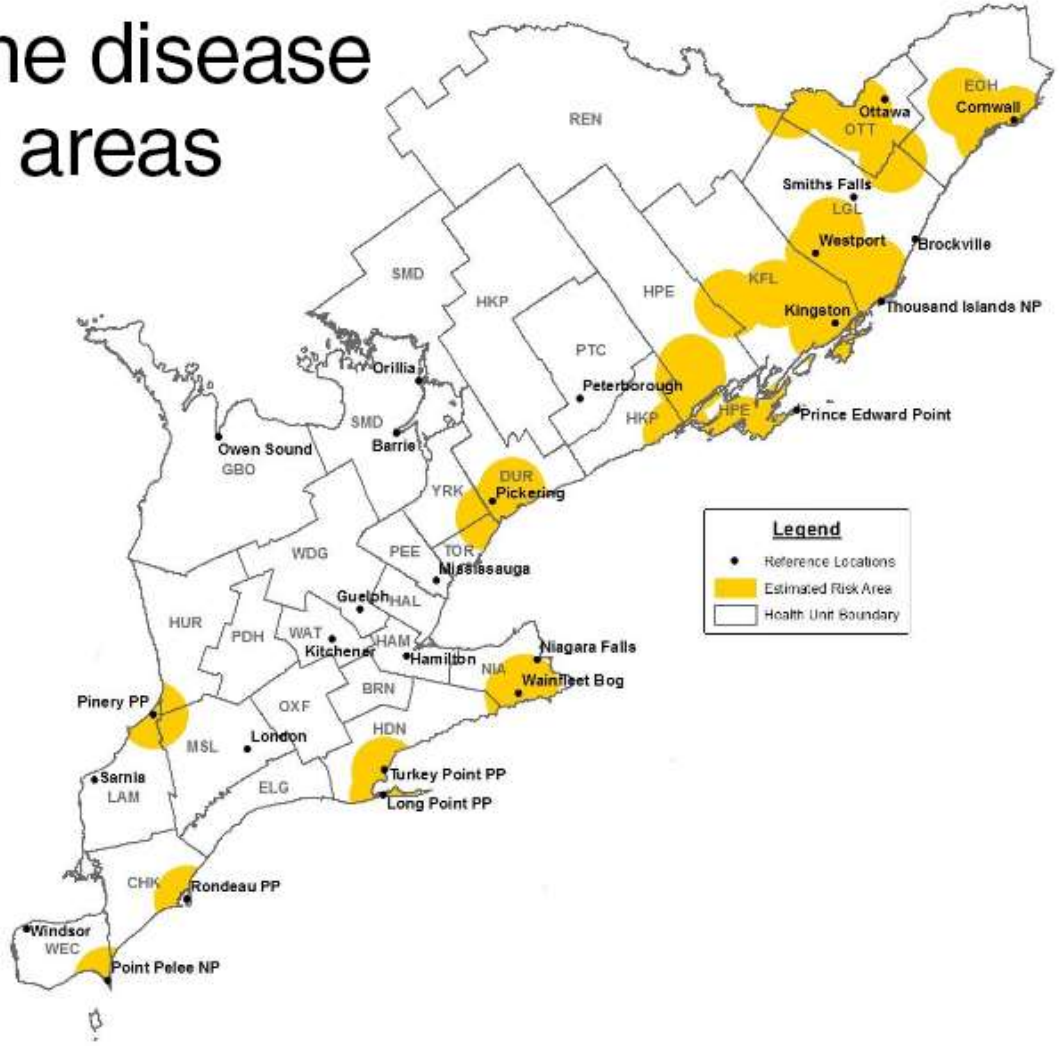
## Disease Ecology




## Lyme disease risk areas



# Deer ticks (Ixodes scapularis)

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# Metagenomics of ticks & their microbiomes

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http://www.borg-cardona.com

# eDNA & DNA barcodes for environmental monitoring

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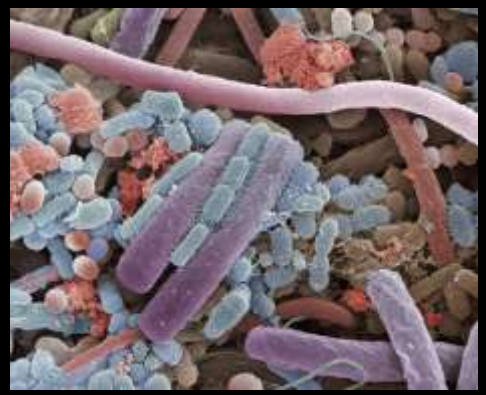
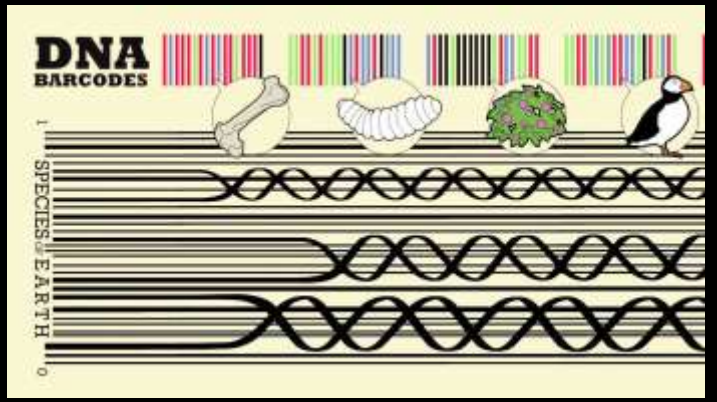


Barcode of Life Project
www.boldsystems.org




https://www.youtube.com/watch?v=ZImiXgU6bCk

# Environmental Genomics for (Eco)Toxicology

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Introduction to sequencing technology

Introduction to R for genomics, meta-genomics & transcriptomics

Working with high-throughput sequencing data: analyze & visualize

# Our approach – 3 pillars

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**1. Learn by doing**

- Hands-on tutorials
- (Short) field excursion

**2. Emphasis on transferrable skills**

- Coding
- Data Science! (collect → manage → visualize → analyze → report)
- Communication & Teamwork

**3. Cumulative learning** – each activity builds on previous one

# Our approach – 3 pillars

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1.

2.

3.

# Group introductions

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Name

University and education background

Current Research (or Research Interests)

Future Goals (short-term and long-term)

# Groups

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1. Team Assignments (1 vehicle per team?)
2. Make up a short, catchy name for your team
3. Which team member speaks the most languages?

Team 1 – Clare, Kate, Andrea, Richard, Jennifer

Team 2 – Travers, Heather, Christine, Katie, Ling

Team 3 – Tyler, Nathanael, Ève, Erin, Kurtis

Team 4 – Nicole, Tyler, Kathleen, Tariq, Ellyn

# About QUBS

Website: qubs.ca

Properties: qubs.ca/facilities/properties

Bathymetry: qubs.ca/resources/bathymetry

Soil and geography: qubs.ca/resources/soils-geology

***Maps: qubs.ca/resources/maps**

Species lists: qubs.ca/resources/species-lists

Fowler Herbarium: fowlerherbarium.ca