



University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

Ecological Genomics

3 credits

MEES 663

Fall 2020

Course Objectives / Overview

New technologies in genomics, especially next-generation sequencing, have revolutionized the fields of ecology, evolutionary biology, and biological oceanography. With greater detail and higher throughput we can now study adaptive responses of marine organisms to their environment, use phylogenetic and metagenomic approaches to study the evolution and biogeochemical relevance of microbes, and monitor and track species for conservation.

This course will cover the major research topics in ecological genomics, including the basic bioinformatics tools of the field (e.g. assembly, alignment of sequence reads, sequence clustering), microbial community metagenomics and metabarcoding, and genome scan approaches in animal populations. The course will comprise lectures, student-led discussions of primary literature exemplifying applications of genomics to contemporary environmental problems, and hands-on assignments manipulating and analyzing real genomic data sets with the latest bioinformatic tools in the UNIX/Linux and R environments.

Expected Learning Outcomes

- Current next-generation sequencing methods and genomic tools and their applications to question in ecology
- Selected concepts in population genetics and microbial ecology/evolution amenable to next-gen data
- Basic bioinformatic manipulation of next-generation sequencing data in UNIX
- Advanced scientific paper analysis and presentation skills

Course Assessment / Grading

Course grades will be based on the discussions (25%), final presentation and paper (40%), homework assignments (25%), and general participation (10%).

INSTRUCTOR DETAILS:

Clara Fuchsman

cfuchsman@umces.edu

410-221-8382

Louis Plough

lplough@umces.edu

410-221-8474

CLASS MEETING DETAILS:

Dates: MW

Times: 3:00-4:20 pm

Originating Site: HPL

IVN bridge number: (*****)

Phone call in number: (***)

Room phone number: (*****)

COURSE TYPE:

Check all that apply

Foundation

Professional Development

Issue Study Group

Seminar

Elective

Prerequisites

N/A

Teaching Assistant

N/A

Tentative Weekly Course Schedule

| Date | Instructor | Section | Topic | Homework Due |
|--------------------|-------------|---|---|---------------------------|
| Week 1 M | Louis/Clara | Introduction/Bioinformatic resources | Introduction to Ecological Genomics /Joint intro | |
| Week 1 W | Louis | | Next-generation sequencing - technologies and data | |
| Week 2 M | | | LABOR DAY! | |
| Week 2 W | Louis | | Intro to Linux/Unix | |
| Week 3 M | Louis | | Linux 2 (awk,sed,other functions) | |
| Week 3 W | Clara | | Python. | |
| Week 4 M | Louis | Ecological (population) genomics of plants and animals | Working with NGS data in populations - Assembly, alignment, and variant calling | Linux basics |
| Week 4 W | Louis | | Population genetics - Theory and concepts | |
| Week 5 M | Louis | | Population genetics II - markers and diversity | Project ideas due |
| Week 5 W | Louis | | Landscape/seascape genomics | |
| Week 6 M | Louis | | Local adaptation - genome scans and isolation by environment | |
| Week 6 W | Louis | | Gene expression and gene network analysis | |
| Week 7 M | Louis | | Experimental functional genomics (Crispr) and GWAS | Pop gen |
| Week 7 W | Clara | Community analysis - microbial and macrobial | 16S rDNA | |
| Week 8 M | Clara | | 16S rDNA-- network analysis | |
| Week 8 W | Louis | | eDNA I - Methods and targets | |
| Week 9 M | Louis | | eDNA II - community analysis (metabarcoding) | |
| Week 9 W | Clara | | Phylogenetic Trees-- evolution and application | Community analysis |
| Week 10 M | Clara | | Phylogenetic Trees-- placement of reads/amplicons on trees | |
| Week 10 W | Clara | | Horizontal gene transfer | |
| Week 11 M | Clara | | Metagenomics and microbes | |
| Week 11 W | Clara | | Metagenomics II-- binning genomes | |
| Week 12 M | Clara | | Microbial transcriptomics | Metagenomics |
| Week 12 W | Clara | | Proteomics | |
| Week 13 M | | Final projects/presentations | THANKSGIVING! (Work on Project) | |
| Week 14 M | | | Work on Project | |
| Week 14 W | | | Work on Project | |
| Week 15 M | | | Work on Project | |
| Week 15 W (Dec. 2) | | | Student presentations | Final presentation |
| Week 16 | | | Work on paper | Final paper due |

Required textbooks, reading and/or software or computer needs

Readings will be provided to students (some text references, mostly scientific papers). Access to a Linux server or cluster will be provided.

Course Communication

Moodle, phone, or email. Meetings by appointment.

Resources

[Course website: www.moodle.com/xxxxx]

Campus Policies

The University of Maryland Center for Environmental Science has drafted and approved of various academic and research-related policies by which all students and faculty must abide.

Please visit <http://www.umces.edu/consolidated-usm-and-umces-policies-and-procedures> for a full list of campus-wide academic policies.