**TPSS/PEPS 615: Quantitative Genetics and Genomics**

**Course Information:**

Seminar/Lecture Time: M/W 3:00-4:30

Lecture Location: Gilmore 301

Course Credits: 3

**Instructor:**

Dr. Michael Kantar

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**Course Objectives:** This course will explore the genomic underpinnings of organismal evolution and quantitative genetics. We will explore current and classical literature to survey a range of topics that include multiple dimensions that will include an overview and lab-based course exploring theory and methods to understand genome evolution and adaptation; focus will be on a range of organisms with a specific emphasis will be placed on current methods in genomic analysis.

**Learning objectives:**

* Learn how genomes evolve across the different domains of life and in different ecological contexts.
* Understand how genome evolution promotes and constrains speciation and adaptation.
* Survey current research approaches in evolutionary and quantitative genomics.
* Practice presenting scientific literature and concepts to an audience.
* Engage in critical discussion of research.
* Become familiar with the tools associated with genomic analysis

**Learning Resources:**

Required Reading:

**Genomic Origins** (All life)

Lynch et al., 2003. The origins of genomic complexity. Science. 302:1401.

**New Genes** (Humans)

Ruiz-Orera et al., 2015. Origins of *De Novo* genes in human and chimpanzee. PloS Genetics. 11: e1005721.

**Gene Deletion** (All Life)

Kuo & Ochaman 2009 Deletional bias across the three domains of life. Genome Biology and Evolution. 1:145

**Mutations** (Bacteria)

Barrick et al., 2009. Genome evolution and adaptation in a long-term experiment with E. coli. Nature. 461:1243.

**Genome Duplication** (Plants)

Vallejo-Marin et al., 2013. Speciation by genome duplication: repeated origins and genomic composition of the recently formed allopolyploid species *Mimulus peregrinus*. Evolution. 69:1487.

**Genome Rearrangements** (Insects)

Lohse. et al., Genome-wide tests for introgression between cactophilic *Drosophila* implicate a role of inversions during speciation. Evolution. 69:1178-1190

**Population Genomics and Adaptation** (Polar Bears)

Liu et al,. 2014. Population genomics reveal recent speciation and rapid evolutionary adaptation in polar bears. Cell. 157:785.

**Adaptive Radiations** (FISH)

Jones et al,. 2012. The genomic basis of adaptive evolution in threespine sticklebacks. Nature. 484:55.

**Natural Selection** (Insects)

Soria-Carrasco et al., 2014. Stick insect genomes reveal natural selection’s role in parallel speciation. Science. 344:738.

**Hybridization** (Humans & Neanderthals)

Vernot & Akey. 2014. Resurrecting surviving neandertal lineages from monder human genomes. Science. 343:1017.

Sankararaman et al., 2014. The genomic landscape of Neanderthal ancestry in present-day humans. Nature. 507:354.

**Interacting Genomes & Symbioses** (Coral & Bacteria)

Baumgarten et al., The genome of Aiptasia a sea anemone model for coral symbiosis. PNAS. 112:11893.

Lin et al., The *Symbiodinium kawagutti* genome illuminates dinoflagellate gene expression and coral symbiosis. Science. 350:691.

**Epigenetics** (Insects)

Lyko et al,. The honey bee epigenome: differential methylation of brain dna in queens and workers. PloS Biology. 8:e1000506.

Flores et al., 2012. Genome-wide association between DNA methylation and alternative splicing in an invertebrate. BMC Genomics. 13:480.

Supplemental:

*Lynch. 2010. The origins of genome architecture. Sinauer Associates (Book)*

*TFC, Falconer and DS Mackay. 1996. Introduction to quantitative genetics. 4th Longman Essex, UK. (Book)*

**Evaluation of Student Performance:**

Grade distribution:

|  |  |
| --- | --- |
| **Activity** | **% of grade** |
| Homework | 30 |
| Lab Exercises | 30 |
| Paper Presentation(s) | 20 |
| Discussion | 20 |
| ***Total :*** | ***100*** |

***Homework assignments:*** Students are expected to read the assigned papers for the week. Each student will submit a *1 paragraph summary of the important points* from the reading and *3 questions/concerns about the reading*. Questions should be focused on aspects of the biological system, authors’ rationale, and/or authors’ conclusions.

***Lab exercisers*:** Lab exercises will consist of analyzing datasets that are similar to those discussed during lecture, students will be introduced to different software, they will be expected to create visualizations and turn in code associated with exercises.

***Student Presentations***: ***Student Presentations***: Students will prepare two 20-30 min presentations on the assigned paper and facilitate a discussion with the class. Presentation format should include (1) *Introduction* to the system, any relevant information, and background; (2) *Questions* that motivate the research; (3) *Methods & Results* used to address research questions (explanation of approaches); and, (5) *Discussion* of how approach and results answer research questions.

**Academic Integrity:** You will be responsible for upholding high standards of academic honesty. Cheating and plagiarism will result in failure of assignments or exams, and may result in disciplinary action. Please review UH Manoa’s policies on academic integrity at http://www.catalog.hawaii.edu/about-uh/campus-policies1.htm