**Week 3: Local Adaptation (Case Studies)**

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| **22 Groups** | **107+ participants** |

**Summary:** Groups discussed two case studies about local adaptation. The Kolaczkowski et al. 2011 (*Genetics*) paper focused on *Drosophila* (fly) adaptation to thermal clines using a genomic approach, while the Sanford and Worth 2010 (*Ecology*) paper focused on *Nucella* (snail) adaptation to prey availability using a reciprocal transplant approach.

**1. When does landscape genomic data present good evidence of local adaptation (without experiments)?**

* Genomic data can illuminate genetic differentiation among populations but cannot conclude local adaptation without data that links genetic divergence to improved fitness.
  + Divergent genotypes do not indicate different fitness and may not be the result of adaptive processes
  + Genetic drift, gene flow, and dispersal are non-adaptive processes that can cause genetic differentiation.
  + Genes may not scale to function. Complex traits, post-transcriptional or post-translational processing affect how genes affect function, so genetic sequencing alone may not indicate an allele’s effect on a trait or the trait’s effect on fitness.
  + Genomic markers of selection (e.g., selection scans) may strongly suggest local adaptation, but in the absence of phenotypic or fitness anchors, primary application is hypothesis generation.

**2. How do the different research approaches (experimental vs. genomic) give different insights?**

* Experimental approaches provide ecologically-relevant insights into trait and fitness changes along ecological gradient, while genomic approaches give mechanistic insights into adaptation.
  + Experimental is top-down way of hypothesis testing via manipulation, genomic is bottom up and allows for genetic signatures of adaptation to be identified without manipulation.
* Both approaches combined is powerful way to confirm local adaptation as phenotypic adaptations should have genetic basis, and genotypic differences should produce adaptive phenotypes.
  + Coupling two approaches is most informative in studies of local adaptation and allows for correlation of ecologically applicable traits and genotype to measures of fitness
* There are constraints associated with each approach
  + Experimental constraints include study feasibility (common-garden and reciprocal transplant studies can be logistically difficult), issues with long-lived, cryptic, or endangered species, obscure drivers of selection, and can be potentially confounded by maternal effects or phenotypic plasticity
  + Genomic constraints include lack of molecular resources, as high quality, annotated genomes are helpful but not available for many species.
  + Each requires different skillsets. Collaborations are possible, and individuals can also become proficient in both experimental/ecological and genomic/bioinformatic skills.

**3. How do the processes that drive local adaptation in the snail differ from the fly? How are they similar?**

* Snail adaptation was caused by biotic factor (prey recruitment) while fly adaptation was linked to abiotic factor (climate/temperature).
  + However, since prey availability is caused by abiotic processes (oceanographic/upwelling), the ultimate cause of adaptation is similar among the two studies.
* Snails and flies may have many biologically important differences such as habitat, dispersal, effective population size, and life history strategy that affect local adaptation.
* Several groups suggested that although the conclusions made by each study were cogent, they both presented unconvincing arguments for local adaptation.
  + Each study suggested that responses were linked to improvements in fitness, but fly study lacked phenotypic and fitness data, while the snail study lacked genetic support or solid fitness measures.