**Week 2 – Local Adaptation (Conceptual)**

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| **17 Groups** | **136+ individuals** |

**Summary:** Groups discussed conceptual issues surrounding local adaptation based on papers by Kawecki and Ebert 2004 (*Ecology Letters*) and Blanquart et al. 2013 (*Ecology Letters*).

**Primary Discussion Themes:**

* Local adaptation is a property of a metapopulation. Patterns of local adaptation may be inferred when common garden or reciprocal transplant experiments reveal gene by environment (GxE) interactions in components of fitness across multiple demes after controlling for alternative sources of apparent differentiation such as phenotypic plasticity, genetic drift, dispersal, maternal effects, etc.
* Local adaptation can be both a pattern and a process.
  + Pattern does not always inform of process, and vice versa. However, to improve ability to predict, we must understand how processes lead to adaptive patterns
  + For example, post-settlement establishment can produce patterns that appear divergent (but may not be) or could be a process through which local adaptation occurs (purifying selection).
* Therefore, studies on local adaptation is complex and should be conducted carefully:

**In particular, studies on local adaptation should be careful to:**

* Understand that definition of local adaptation (e.g. Home vs. Away, Local vs. Foreign, Sympatric vs. Allopatric) affects study design and inference. Use study motivation or question to inform choice.
  + Does species X show local adaptation? Sympatric vs. Allopatric
  + Is population X locally adapted to environment Y? Home vs. Away (appropriate for conservation)
  + Will population X perform well in environment Y? Local vs. Foreign (Where should MPE be?)
  + Tradeoffs associated with decisions, so exercise caution. For example, Home vs. Away can confound habitat quality with local adaptation.
  + If using sympatric vs. allopatric design, invest in wider population sampling with fewer individuals over wider individual sampling across fewer populations
* Choose and define demes/populations carefully
  + The term “local” is subject to different interpretations. Be specific in definitions
  + Dispersal, fecundity, and gene flow within and across demes has large impact on adaptive dynamics
* Correlate findings to fitness, vital rates, or population growth metrics
  + Local adaptation should be reflected in genetic signatures among populations, but to be considered adaptive, genetic change must be correlated with improved fitness.
  + Fitness can be difficult to measure directly but is important to confirm LA because other sources can cause differentiation but differences less likely to be adaptive.
  + Be cautious in correlating traits to fitness. Bigger is often better in ectotherms, but not always.
* Weigh benefits and costs of common garden vs. reciprocal transplant experimental designs
  + Reciprocal transplant:
    - Most closely mimics natural environmental conditions
    - Can be logistically or experimentally infeasible
    - Consider ramifications of introducing foreign individuals to different demes
  + Common garden designs:
    - Allows for more experimental control and manipulation, often more feasible
    - Not as representative of natural environments (may miss key trait or biotic interactions)
    - If unsure of selective driver, common garden may neglect important drivers
* Understand influence of alternative drivers of differentiation
  + Strong drift can lead to genetic differentiation but is not correlated with increase in fitness
  + High gene flow can reduce appearance of local adaptation
  + If possible, test across generations to control for maternal effects
  + Effect of environment on phenotype should be tested as phenotypic plasticity can generate phenotypes that appear different across populations are genetically unchanged
* Provide detailed justification and explanation of choices in papers
  + Synthesis efforts such as reviews or meta-analyses require detailed methods to handle heterogeneity among studies.