Announcements

- Exam 1
  - Key posted
  - At least 1 week for grading
- Seminars:
  - Fri, 6 Oct, UI, 277 Life Sciences
    - Dr. Paul Turner, "Sex, conflict, and dominance in RNA virus evolution"
  - Mon, 9 Oct, 201 Abelson
    - Dr. Sean Rice, "Developing an exact, and universal, evolutionary theory"

Lab next week

Discussion, Discussion Reading Reports

1. Download paper of choice from website
2. Read paper
3. Write a Discussion Reading Report
   - Instructions in lab manual, website
   - Example on website

Linkage Disequilibrium

- When $D \neq 0$, selection on one locus causes evolutionary change at another
- Disequilibrium broken down by recombination (unless maintained by selection, etc.)

The evolution of sex and recombination

- Selection creates linkage disequilibrium: "coadapted gene complexes"

Asexual reproduction maintains these gene combinations (should be advantageous)

Asexual reproduction also avoids the two-fold cost of sex (males)

Sexual reproduction (Recombination: meiosis, crossing over, random mating) breaks down LD

Sexual reproduction and recombination is common, Purely asexual species are rare
What if selection changes?

- Changing environments

Gen 1: hot, dry
Gen 5: hot, wet
Gen 10: cold, dry

Parasites impose changing environments

- Red Queen Hypothesis
  - Parasite-host coevolution favors sexual reproduction

Multiple loci: quantitative genetics

- Continuous variation, polygenic control, small effect of each Mendelian locus
- Models of natural selection: phenotypic selection, evolutionary response

3 Modes of Phenotypic Selection

- Directional selection
- Stabilizing selection
- Disruptive selection

Measuring Directional Selection

Selection differential

\[ S = X_a - X_b \]

A measure of the strength of phenotypic selection

Evolutionary response?
Phenotypic variation heritable?

Genotype \( V_G \) → Phenotype

Environment \( V_E \) → Phenotypic variation \( V_P \)

Phenotypic Variation

Heritability = \( \frac{V_G}{V_P} \)

“Broad sense heritability”

Measures proportion of \( V_P \) due to \( V_G \)

Environment \( V_E \) → Phenotypic variation \( V_P \)

Evolutionary response?

Selection differential

\[ S = X_a - X_b \]

Response to selection

\[ R = X' - X_b \]

Realized heritability:

\[ h^2 = \frac{R}{S} \]

Song sparrow beak size

Genotype or environment?

Mating system

Heritability = slope = 0.98

Foster Chicks!

Genotype, not common environment

Directional Selection Example

\[ S = 10.06 - 9.47 = 0.59 \]

\[ R = h^2S = 0.6(0.59) = 0.35 \]

Mean in next gen = 9.47 + 0.35 = 9.82
• Evolution at two loci
  - LD: selection at one locus affects others
  - Sexual recombination favored when environments change

• Quantitative genetics
  - Evolutionary models: phenotypic selection, evolutionary response
  - Evolutionary response predictable from \( h^2 \) and \( S \)