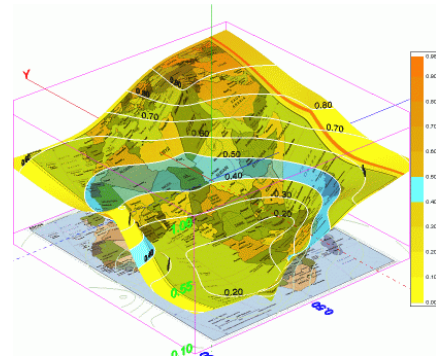


Quantitative Genetics

1

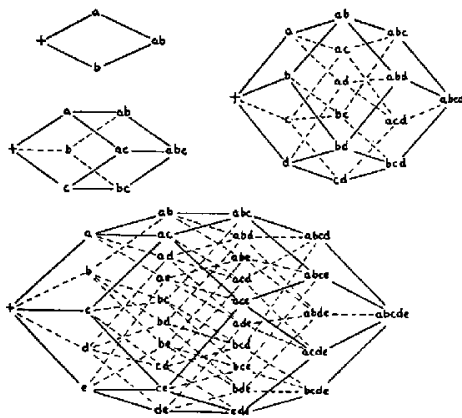
Fitness surfaces & Adaptive landscapes



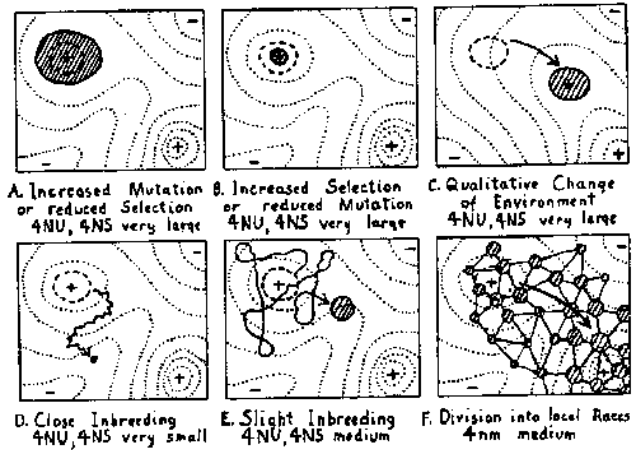
Plot mean pop. fitness as a function of gene freq. or mean phenotype

4

Visualizing interactions at multiple loci

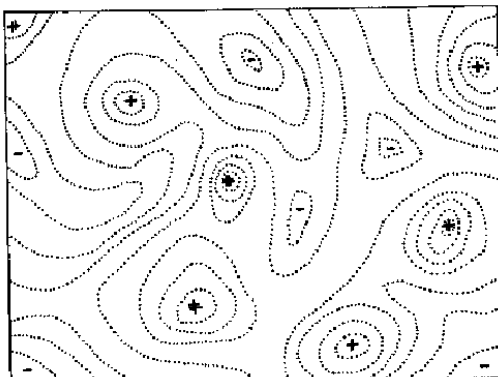


2



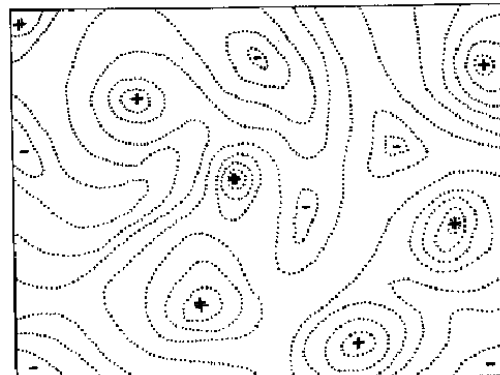
5

Soln 1: Fitness surface or Adaptive landscape



3

'The Shifting Balance' - Sewall Wright, 1932



- 3 phases
- 1: Drift
 - 2: Selection
 - 3: Migration

Peak shifts most likely in metapopulations of small, isolated demes

6

Adaptation according to....



Ronald Fisher
- advantageous mutations



Sewall Wright
- genetic drift, ns, gene flow, interdemic selection

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QTL analysis identifies multiple behavioral dimensions in ethological tests of anxiety in laboratory mice

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FEATURE ARTICLE

Genetic Polymorphisms and Personality in Healthy Adults: A systematic review and meta-analysis

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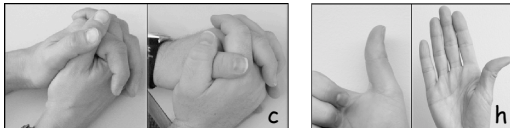
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Soln 2:

Quantitative Traits

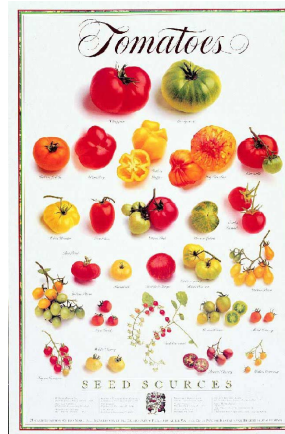


Mendelian trait examples



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Quantitative Genetics includes tools for measuring:

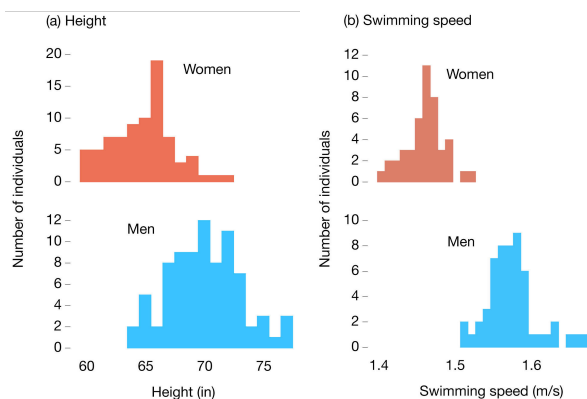


- heritable variation
- differences in survival/reproductive success
- predicting response to selection

11

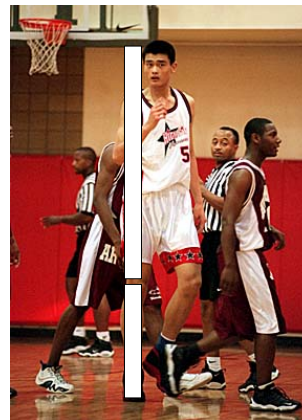
Soln 2:

Quantitative Traits



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What is heritability?



Not 'nature vs nurture'!

12

$$P = G + E$$

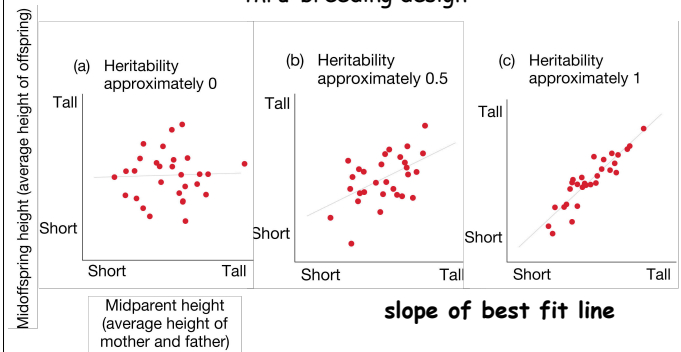
Assumptions

- large # of loci
- phenotypic diff result from G & E
- Mendelian theory valid
- many genotypes > same phenotype

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1. Measuring heritable variation in practice...

components estimated statistically thru' breeding design



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Components of variation

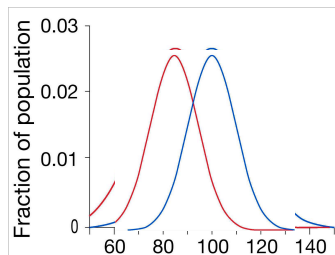
$$V_P = V_G + V_E + V_{GE}$$

V_P = total phenotypic variance

V_G = genetic variation

V_E = environmental variation

V_{GE} = genotype-environment interaction



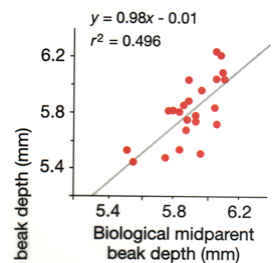
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Estimating heritability from parents & offspring...

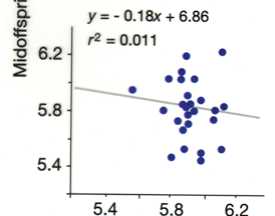
Song Sparrows

Beak depth
heritability = 0.98

Biological parents



Foster parents



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$$P = G + E$$

$$P = A + D + E + I$$

$$V_P = V_A + V_D + V_E + V_I \quad (\text{for populations})$$

Heritabilities.....

$$H_b^2 = V_G / V_P \quad (\text{Broad sense})$$

$$h^2 = V_A / V_P \quad (\text{Narrow sense})$$

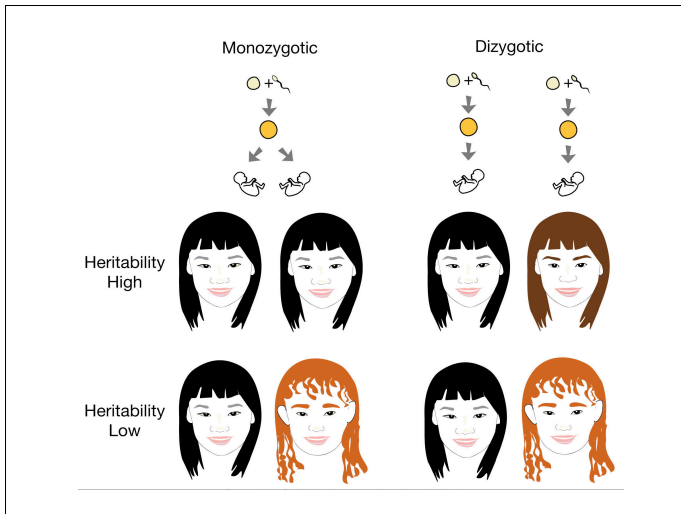
how a trait will respond to selection

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Estimating heritability from Twin studies...

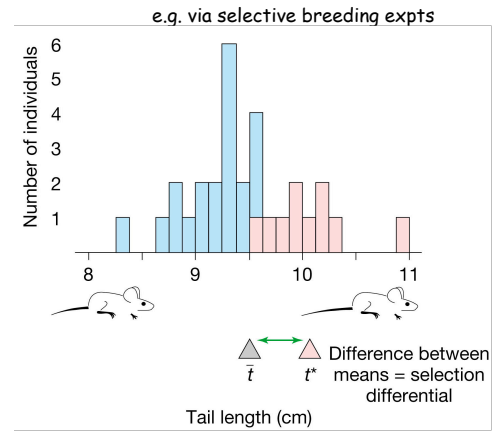


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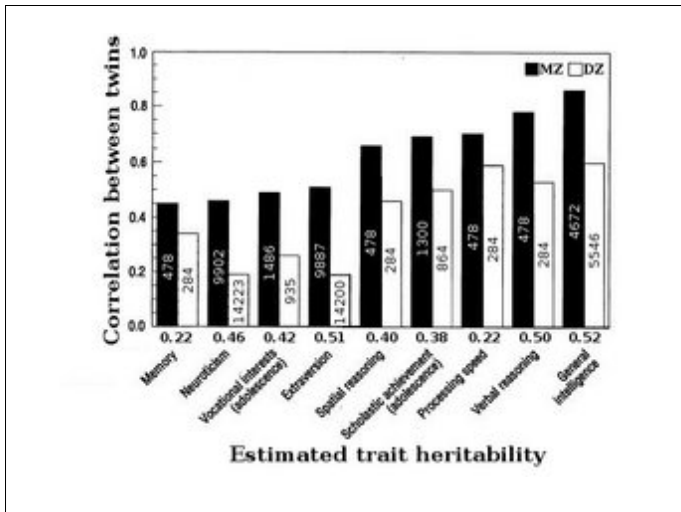


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2. Measuring differences in survival & rep success...

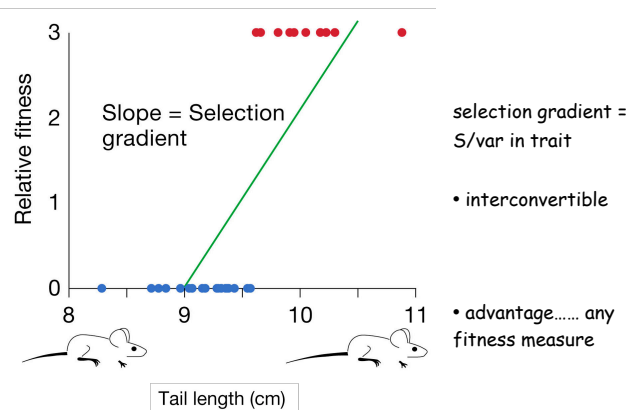


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• assign absolute fitness \gg relative fitness \gg selection gradient

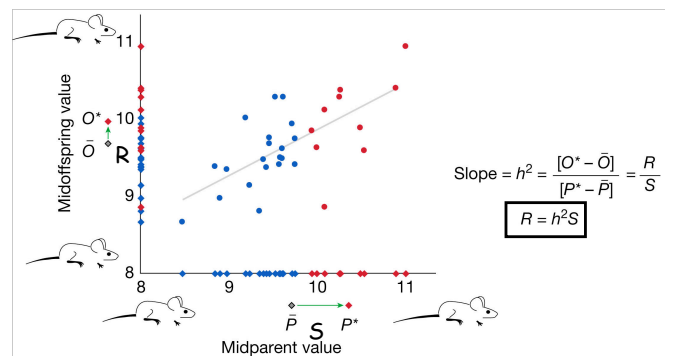


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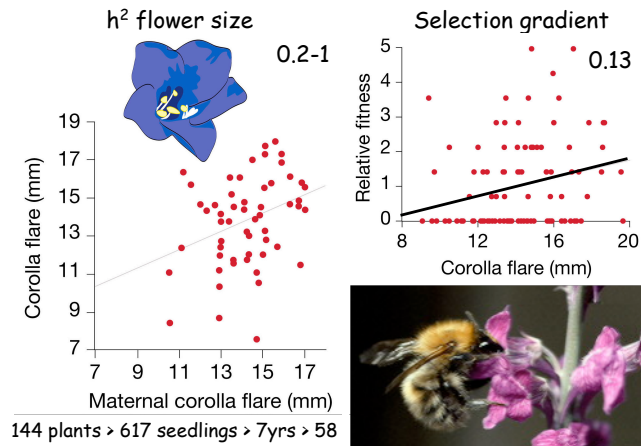
21

3. Predicting the response to selection...

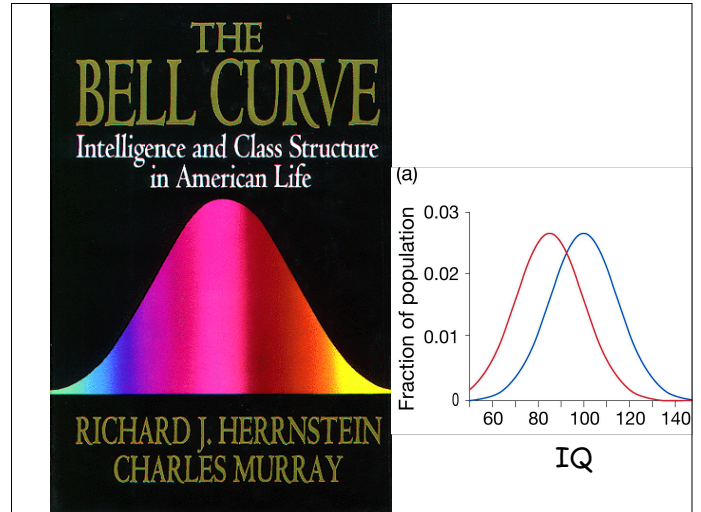


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e.g. Alpine skypilot pollinated by bumblebees (Galen 1996)



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Sel gradient = 0.13

$$0.13 = S \text{ differential} / V_t$$

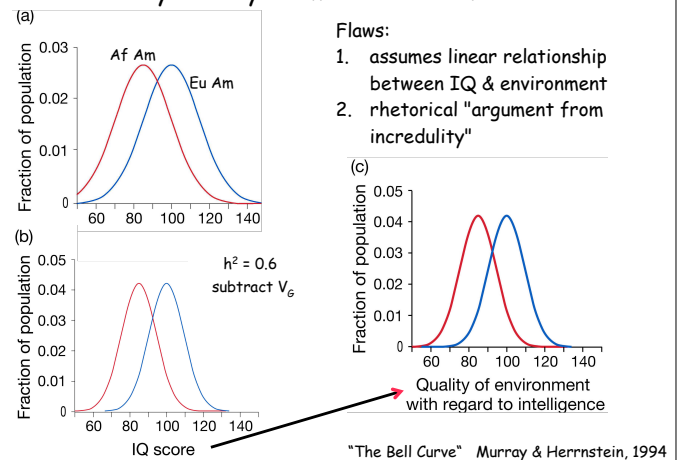
Variance in flower size 5.66

therefore $S = 0.74 \text{ mm}$

.... 'winners' were 5% larger than average

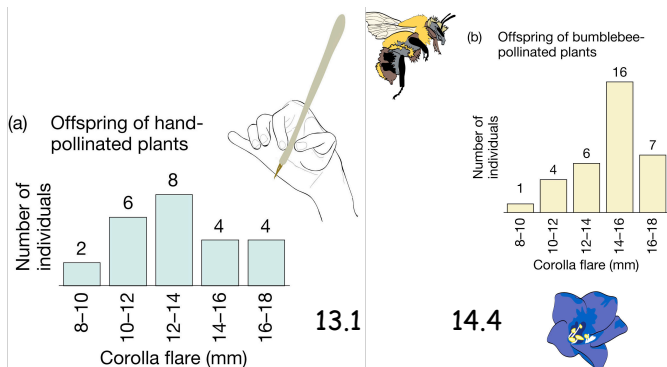
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Heritability is easy to misconstrue....

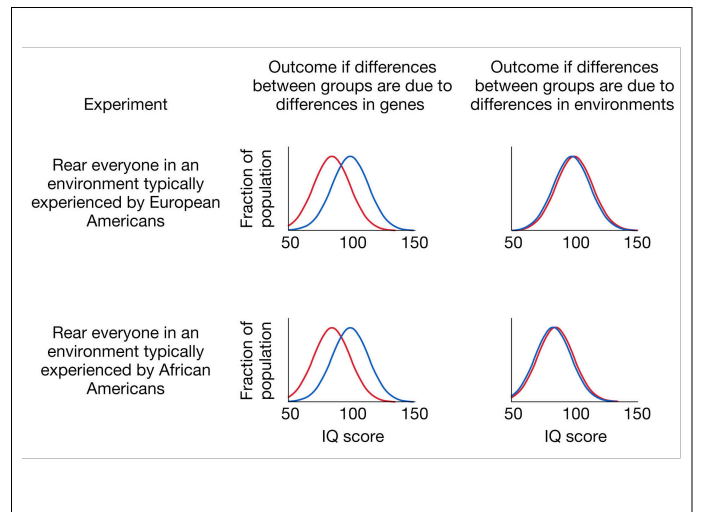


29

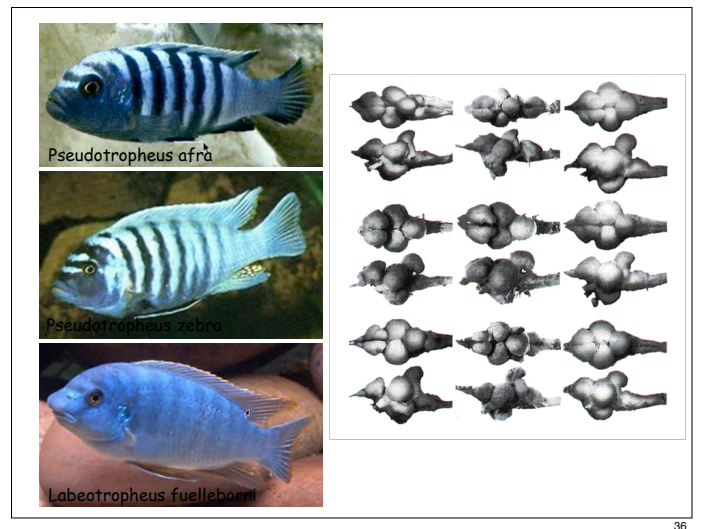
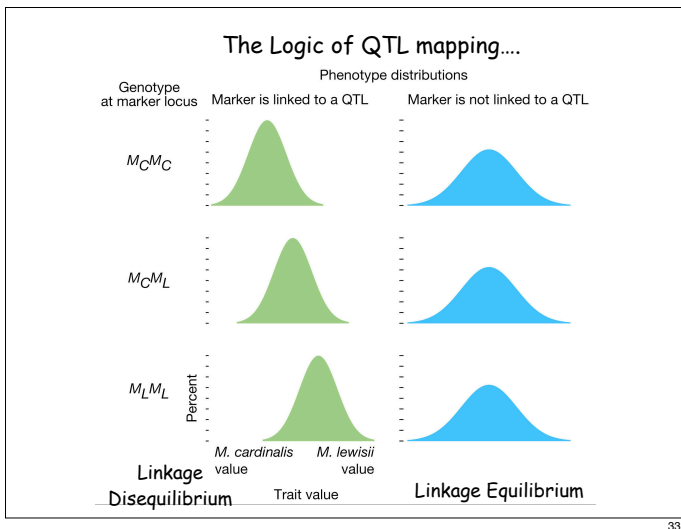
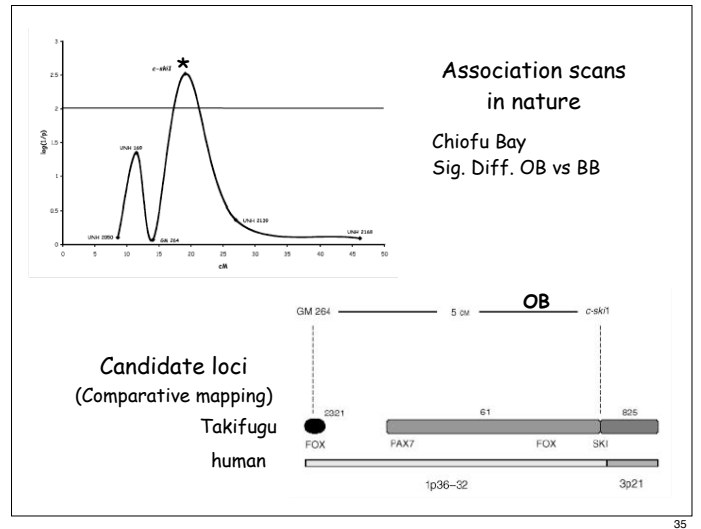
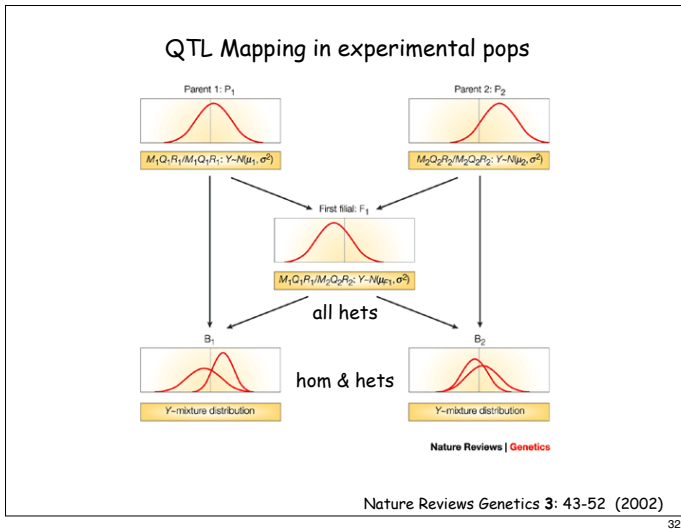
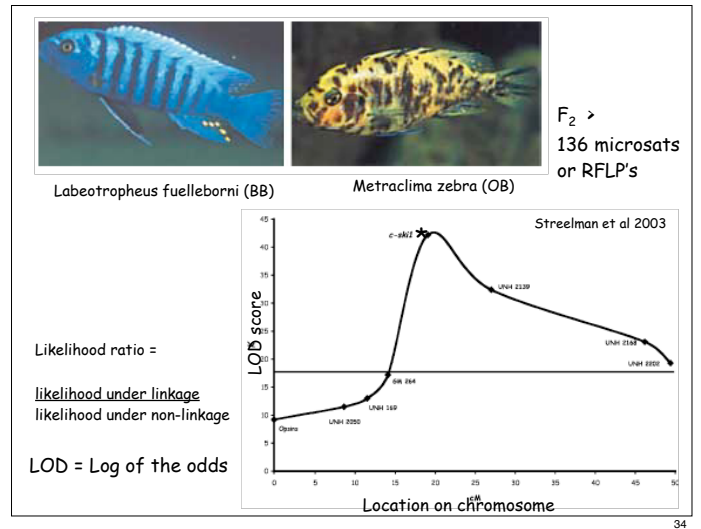
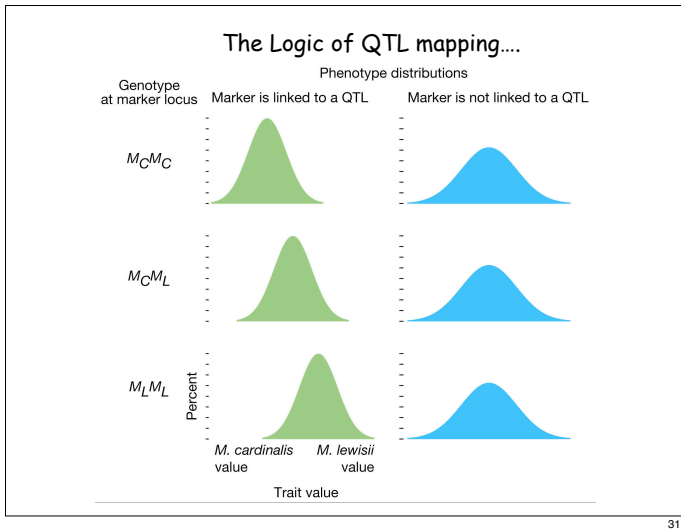
Control 1 = Control 2



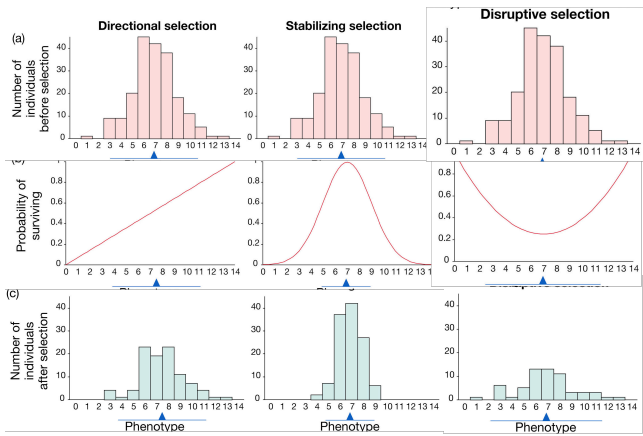
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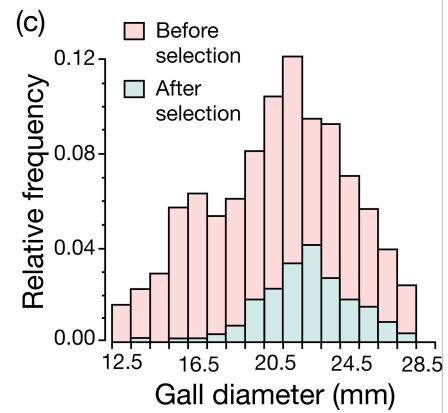
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Modes of selection & the maintenance of genetic variation

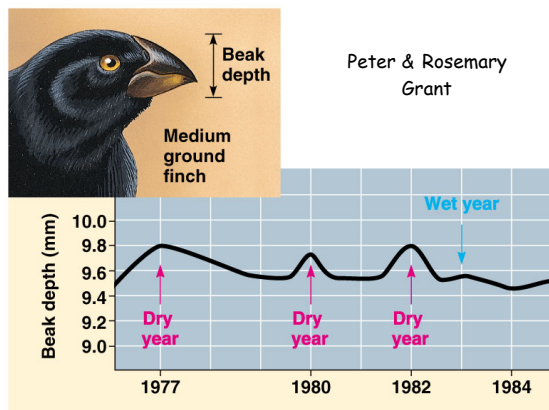


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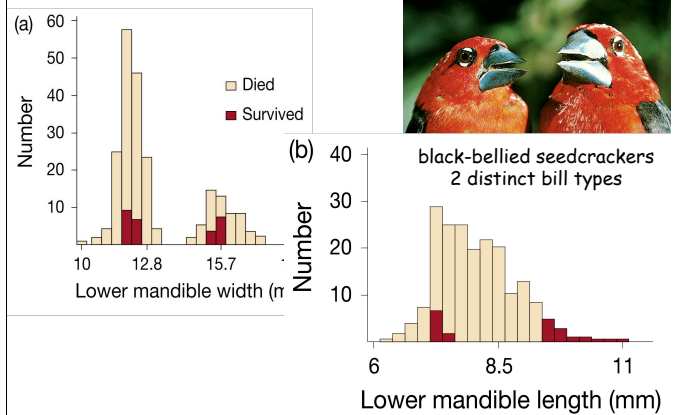
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Directional



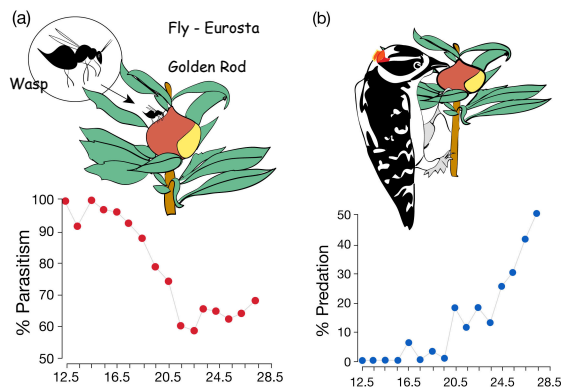
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Disruptive



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Stabilizing



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How is genetic variation for fitness maintained?

- Populations not in equilibrium with respect to directional or stabilizing selection (Fisher's Fundamental Theorem)
- Balance between deleterious mutations & selection
- Disruptive selection more common than recognized (e.g. freq dependent selection, fluctuating environment)

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