Bio1B Evolution 5

Last lecture:

- Predicting genotype freq's: Hardy (Castle) Weinberg Equilibrium
  - Application: Predicting heterozygote frequencies for recessive traits

Evolutionary processes

- Sampling effects => "genetic drift"
  - Relevance in evolution - loss of variation, bottlenecks

Today

Evolutionary processes

- Mutation as the ultimate source of variation; effects on fitness
- Migration (as gene flow)
- Selection
  - Fitness
  - Forms of selection
  - Heterozygote advantage - eg. sickle cell anaemia
  - Directional selection - eg. coat color in mice; genome signatures, experimental evidence

Mutations - forms

Changes in:

Coding sequence

Gene regulation

Gene copy number

Chromosome number & structure

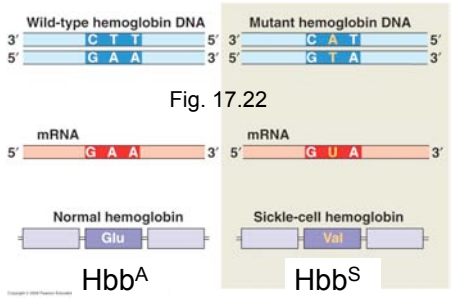


Fig 18.8

Exons -> mRNA -> aa

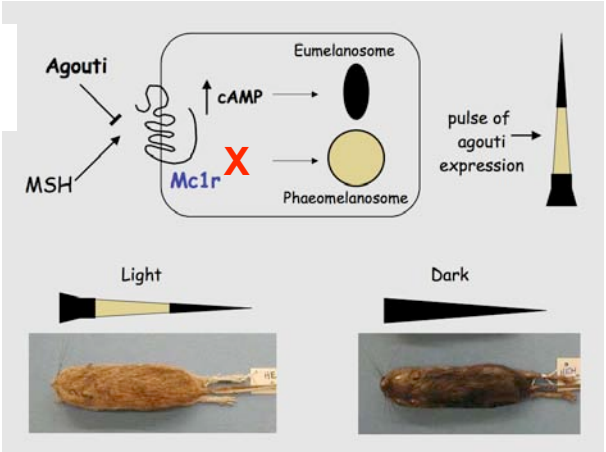
Some key genes in melanin production pathway

Agouti melanistic mutations:

Recessive [regulatory & coding]

Mc1r Melanistic mutations

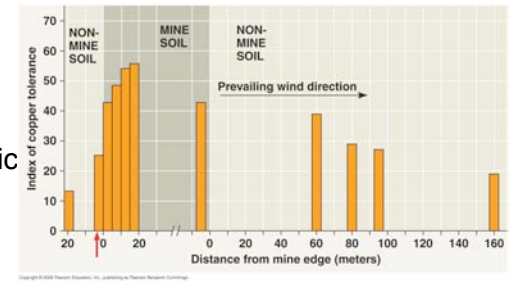
Dominant [structural]



So what? … Mc1r & melanoma!

Migration (as gene flow)

- Gene flow = movement of genes among populations
- Arises from net movement birth -> reproduction or gamete dispersal -> zygotes
- Spreads new mutations; maintains variation
- Opposes effects of genetic drift or local selection
- Spread of genes from GMO crops is a concern

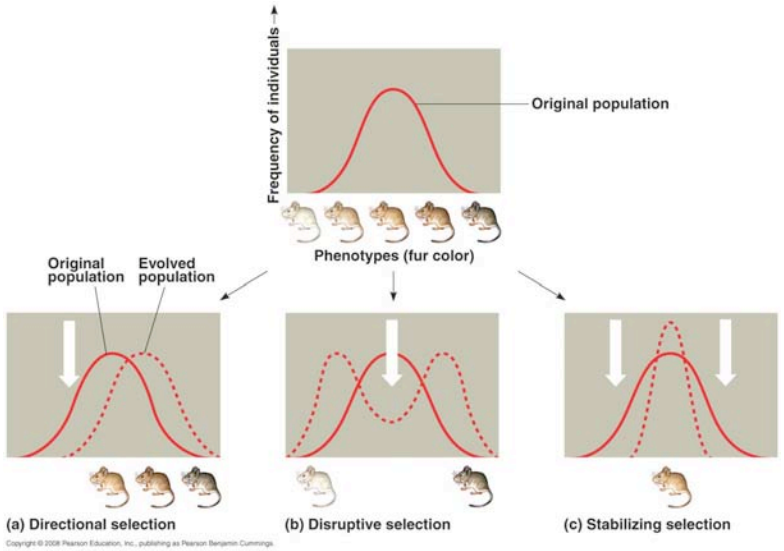


Genetic **fitness**

- Selection acts through the phenotype
- Fitness = Survival and reproduction relative to other phenotypes or genotypes in the population
- Relative fitness can be environment dependent

Sorry Arnie….

Forms of selection (Fig. 23.13)



Example of Heterozygote advantage sickle-cell anaemia

Relative fitnesses:

Without malaria:

$Hbb^{AA} > Hbb^{AS} > Hbb^{SS}$

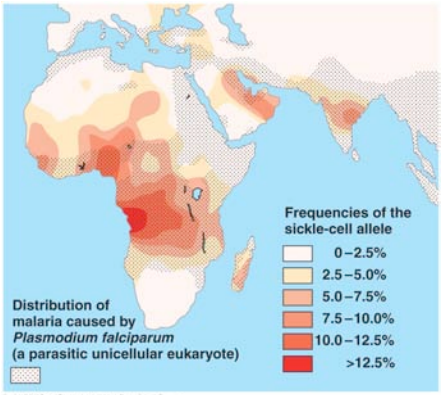
⟶ anaemia

With malaria:

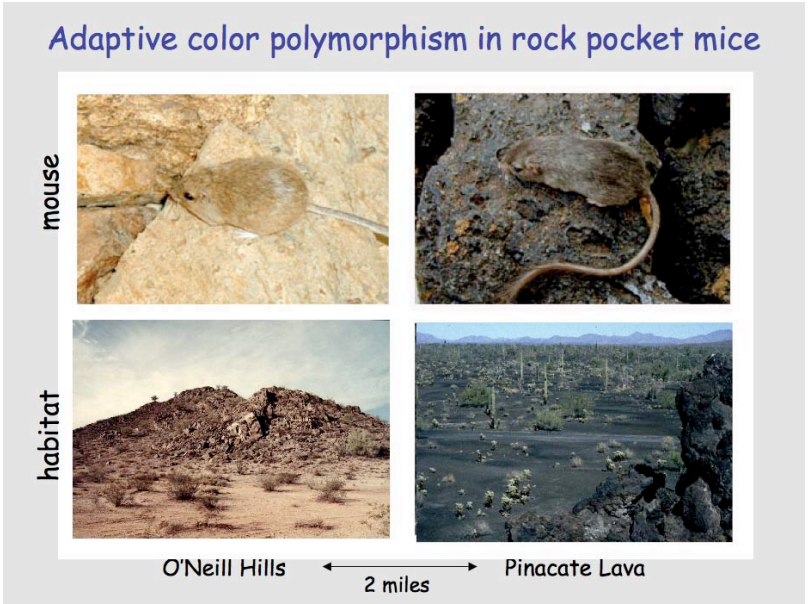
$Hbb^{AS} > Hbb^{AA} > Hbb^{SS}$

↑

More resistant to malaria

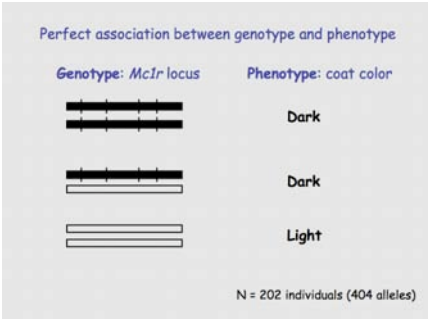


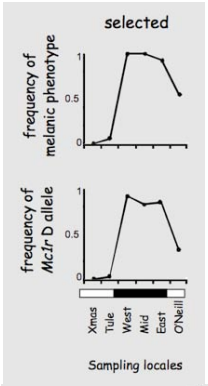
Note - fitness of Hbb^{AS} depends on environment (+ malaria)

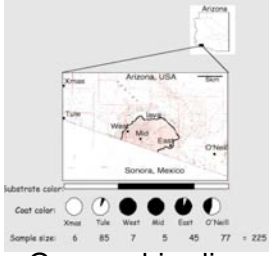


Association between melanic phenotype and Mc1r allele in rock pocket mice from Pinacates lava flow

Hopi Hoekstra in the field..







Geographic cline

Experimental evidence for rapid evolution due to selection

Eg. guppy color - field experiments; text pp460)

- Others - microbial evolution etc etc

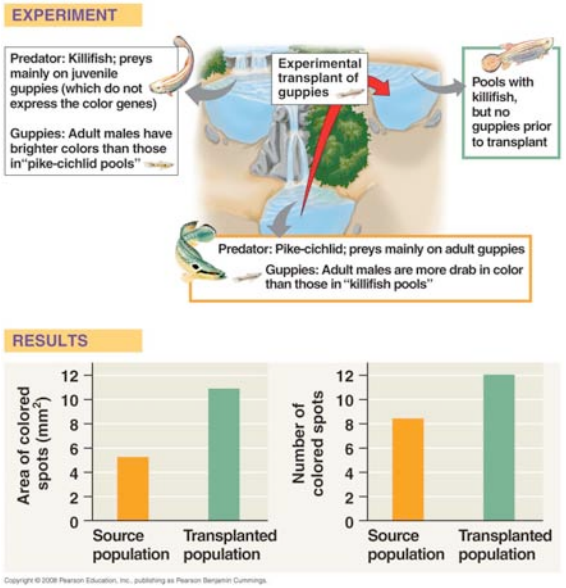


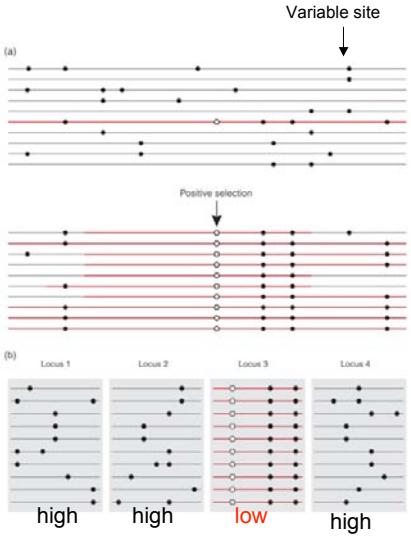
Fig. 22.13 10

Genomic signatures of recent selection

New mutation arises that increases fitness

Under directional selection increases to p = 1; drags linked sites with it

Results in a region of low variation relative to others

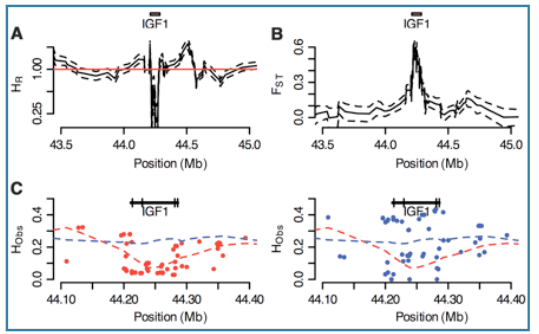


Storz 2005

Genomic signatures of selection; localized reductions in diversity

A Single *IGF1* Allele Is a Major Determinant of Small Size in Dogs

What's with my crazy dog?



Sutter et al. 2007 Science 316:112