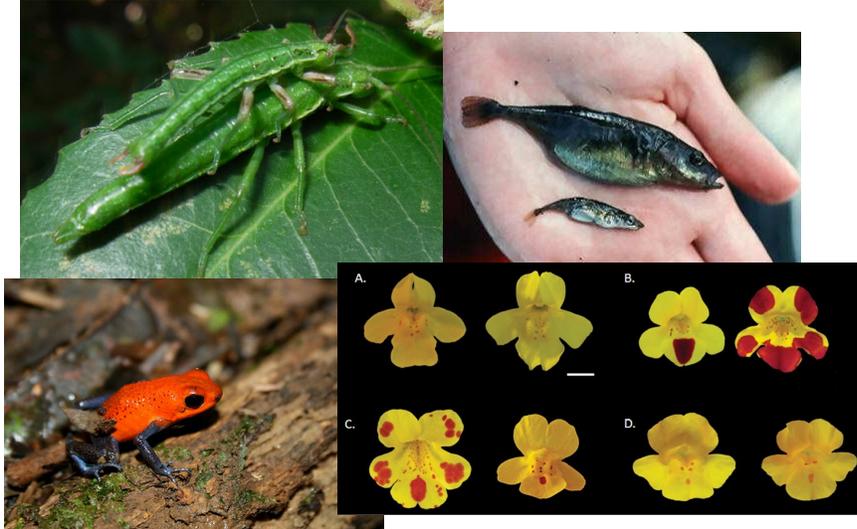


Ecological Speciation



mechanisms of speciation

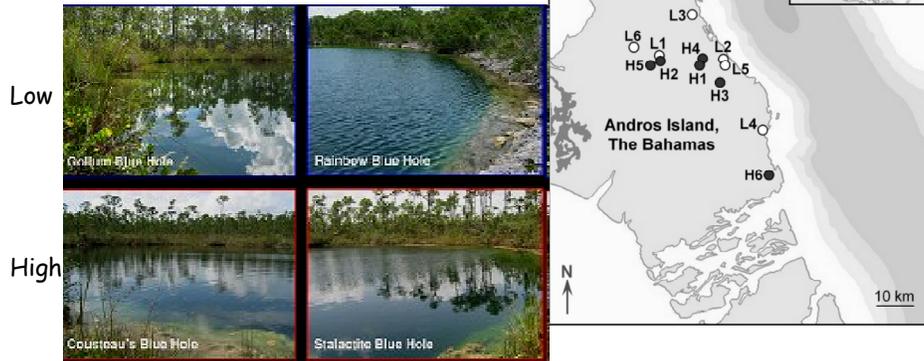
geographic isolation (allopatric speciation)
 vicariance
 founder event

ecological speciation

selection models

disruptive selection favors extreme phenotypes
 assortative mating by ecological "type"

Ecological speciation of mosquitofish (*Gambusia*) in Bahamian blue holes



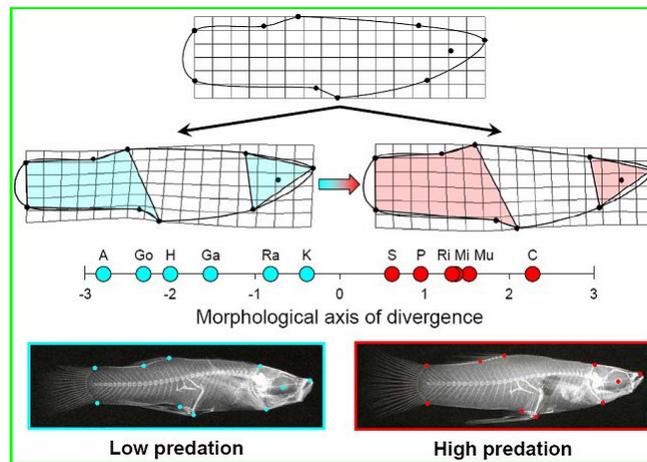
Langerhans et al 2007

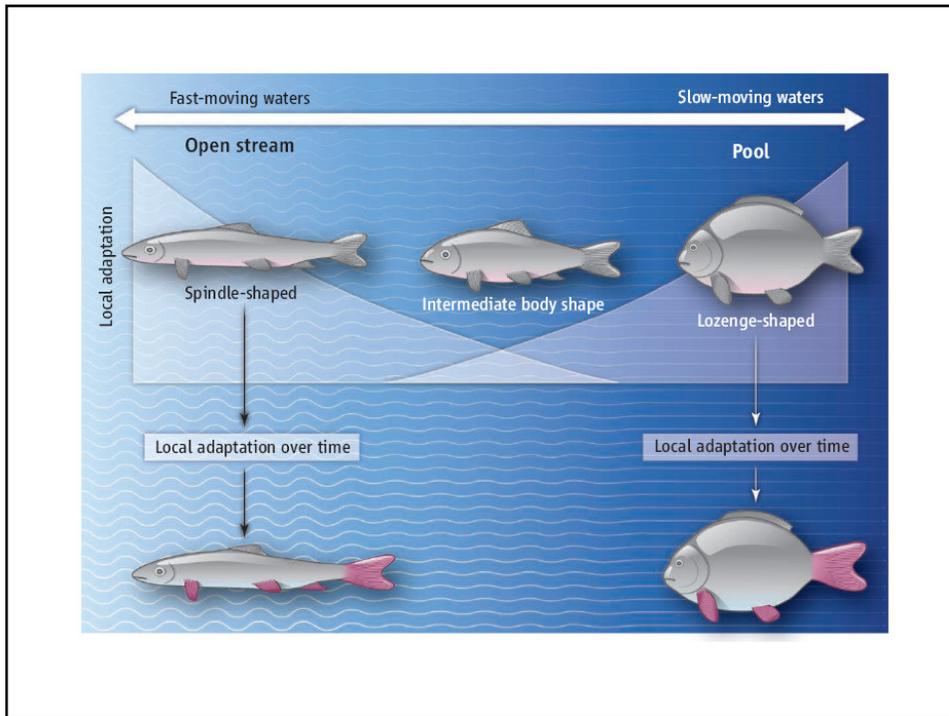
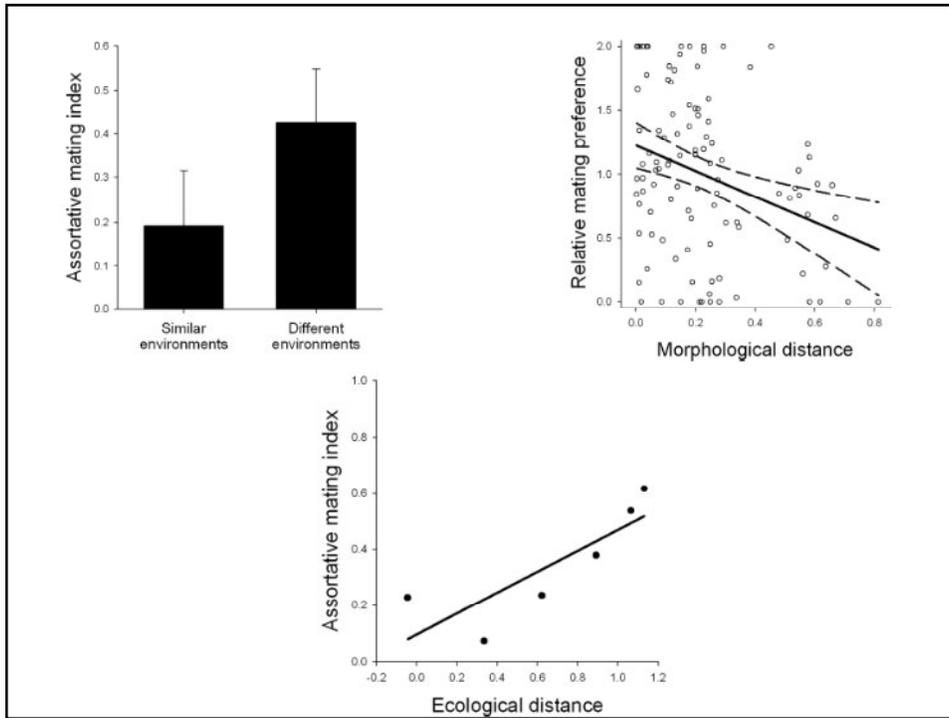
two types of swimming: sprints and endurance

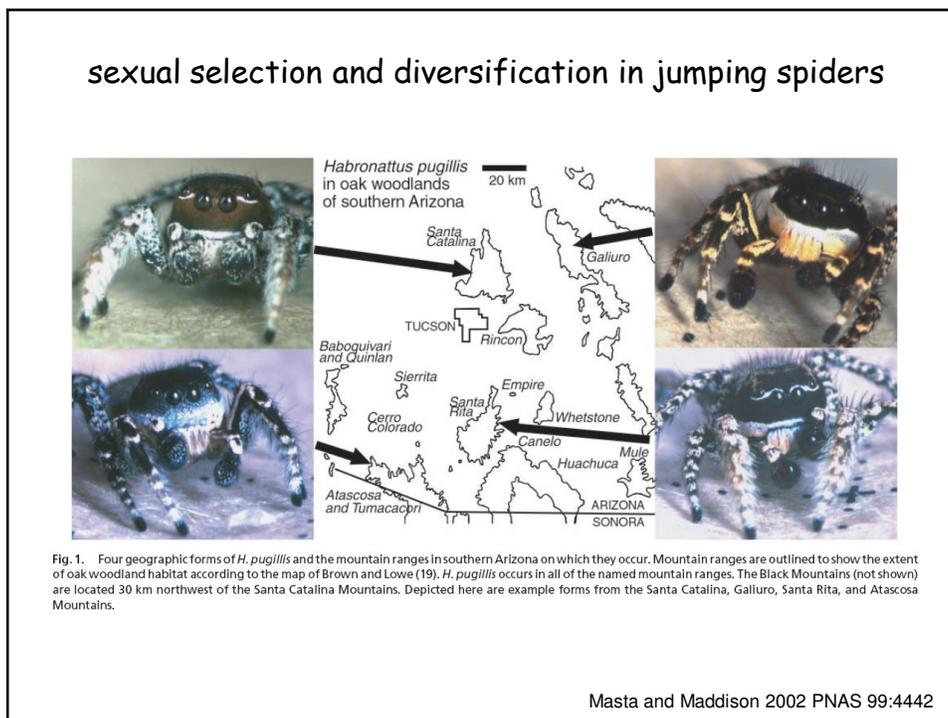
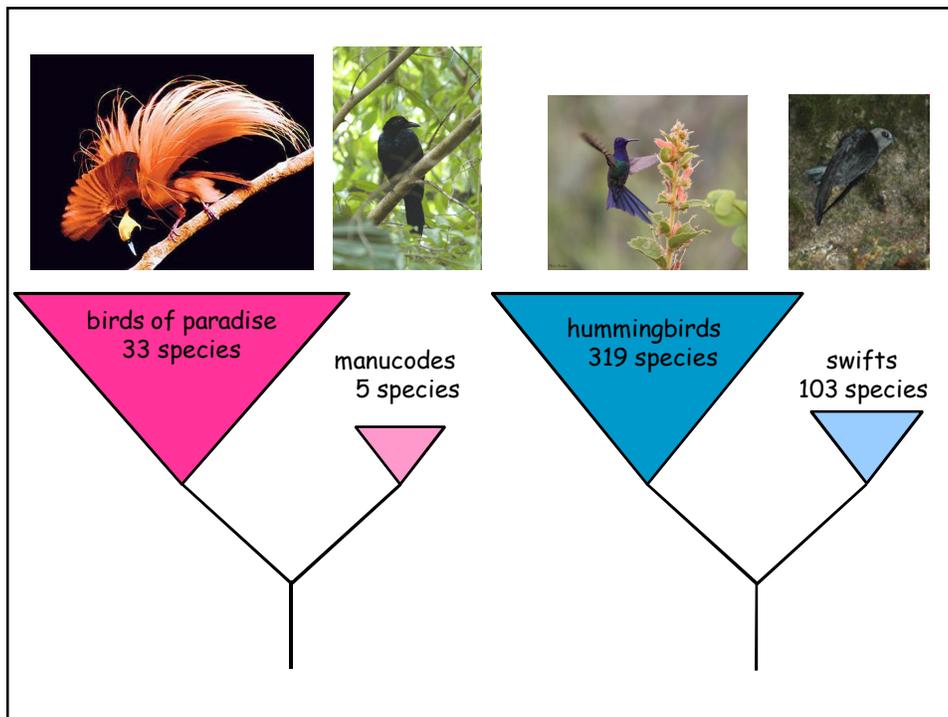
biomechanical trade-off in morphology:

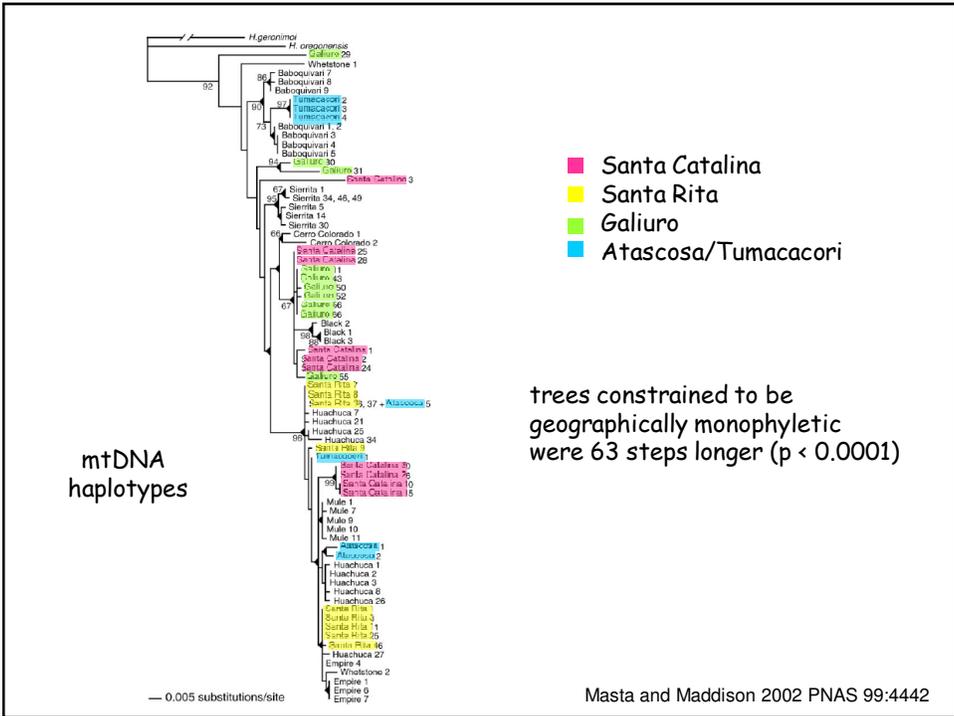
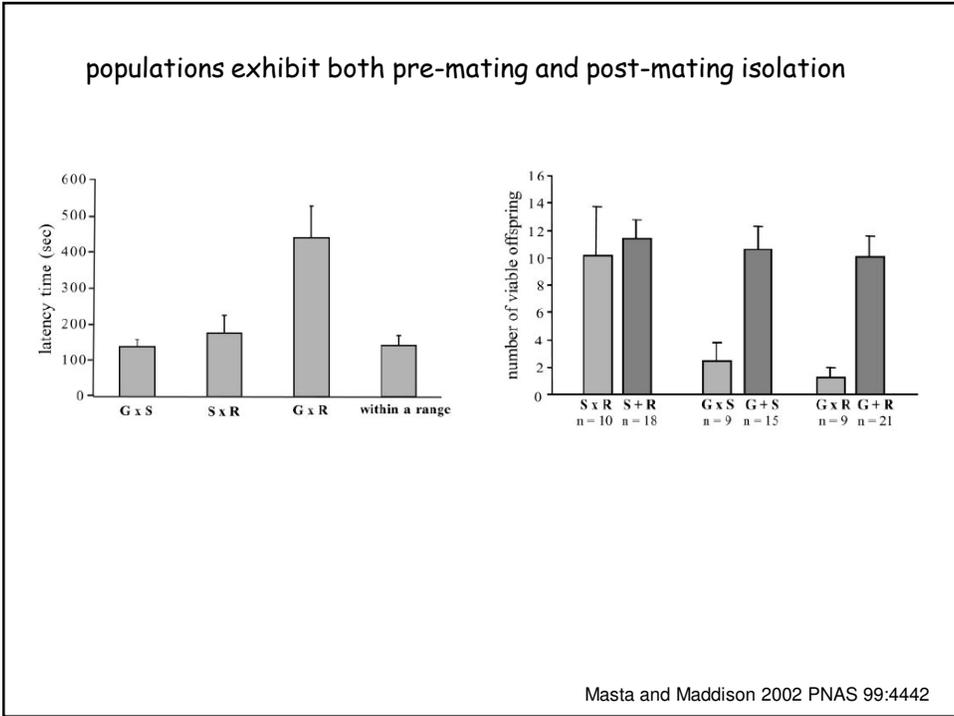
sprints: deep caudal peduncle, shallow anterior body/head

endurance: relatively shallow caudal peduncle, deep anterior body/head









Outline

Species concepts

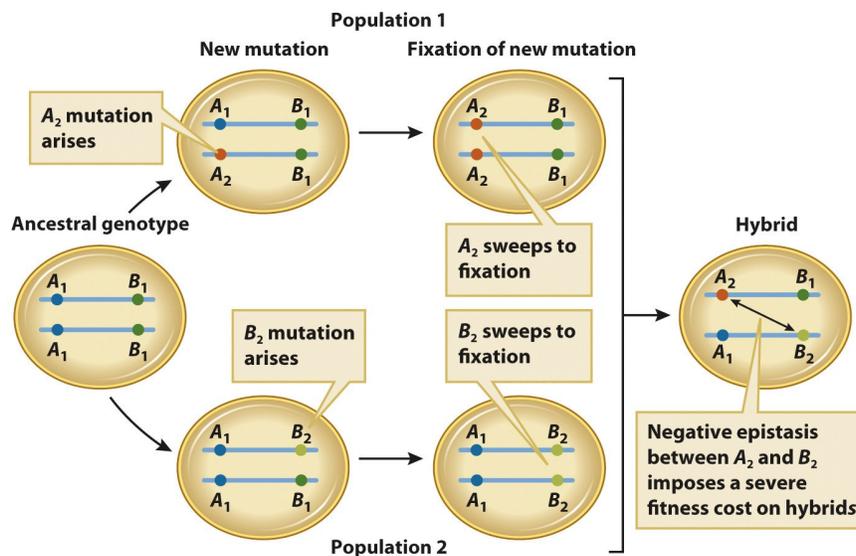
Mechanisms of speciation

- geographic isolation
- natural or sexual selection

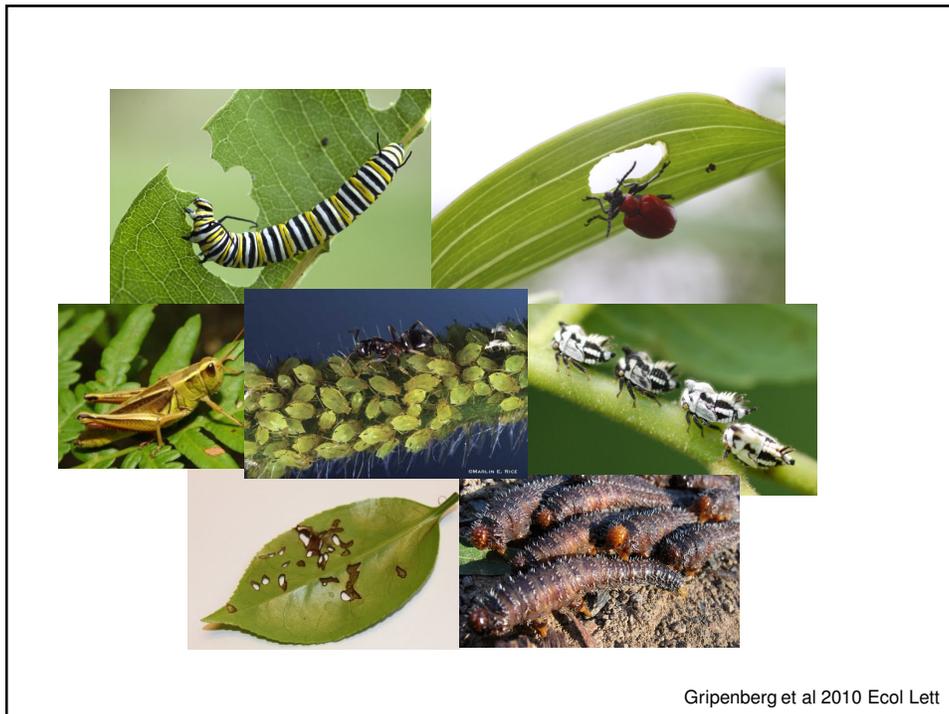
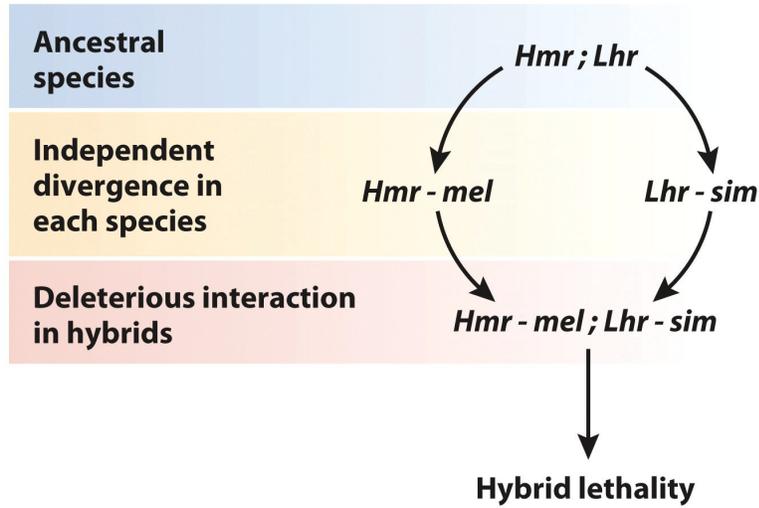
Genetics of speciation

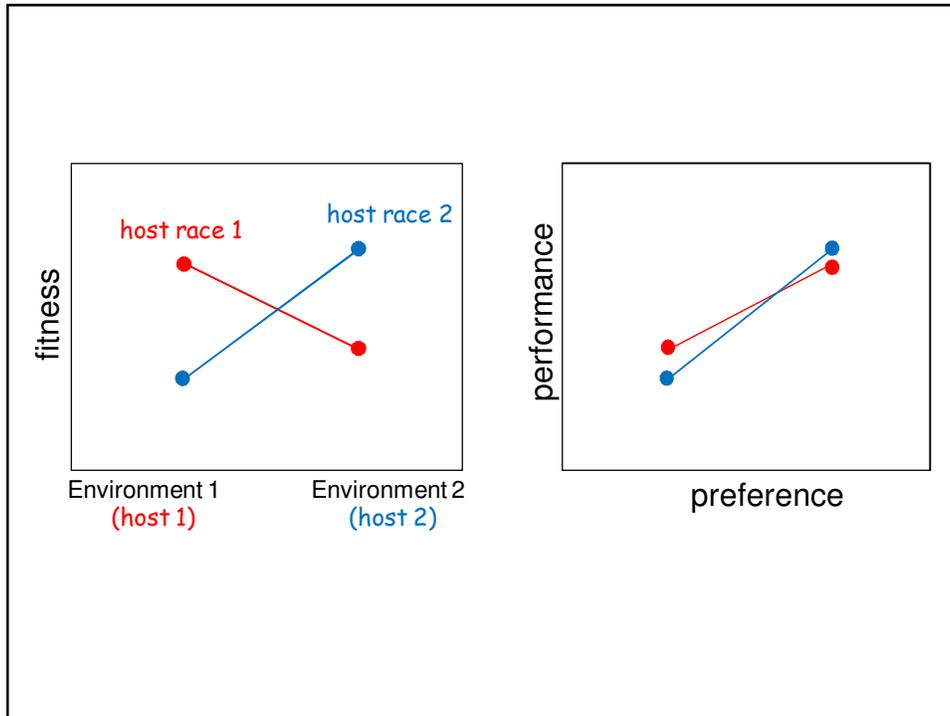
Haldane's rule

speciation via Dobzhansky-Muller incompatibility



Dobzhansky-Muller incompatibility has occurred between *Drosophila melanogaster* and *D. simulans*



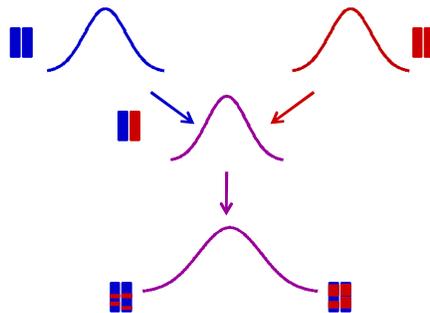


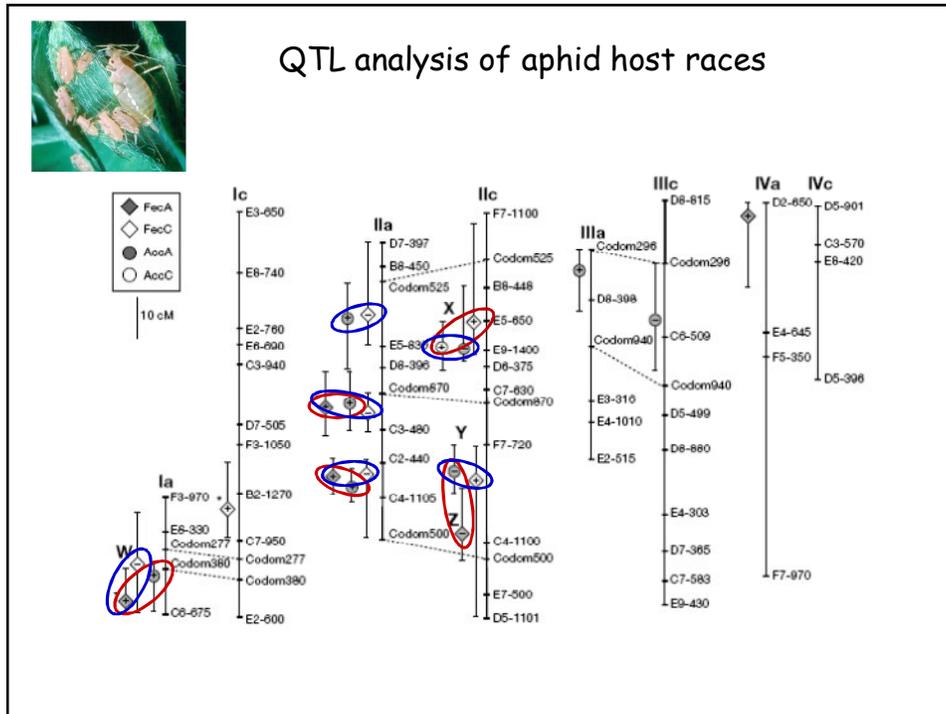
performance and habitat preference in pea aphids

two host races/incipient species -- alfalfa and clover
known trade-off between performance on clover and alfalfa

what is the genetic architecture of this trade-off?

are genes for performance independent of genes for
habitat choice/assortative mating?





Haldane's rule

if hybrid sterility or inviability is present in only one sex of F_1 offspring, it will be the heterogametic sex



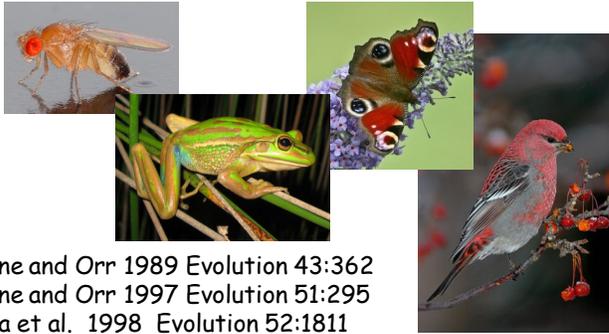
$A \sigma \times B \text{♀}$

$\sigma \sigma \quad \text{♀♀}$

$B \sigma \times A \text{♀}$

$\sigma \sigma \quad \text{♀♀}$

Haldane's Rule



<i>Drosophila</i>	Coyne and Orr 1989 Evolution 43:362 Coyne and Orr 1997 Evolution 51:295
frogs	Sasa et al. 1998 Evolution 52:1811
Lepidoptera	Presgraves 2002 Evolution 56:1168
birds	Price and Bouvier 2002 56:2083

hybrid sterility and inviability evolve gradually
positively correlated with the time since divergence

hybrid sterility evolves faster than inviability

gradual accumulation of deleterious epistatic interactions

causes of Haldane's rule

dominance theory

- genes causing hybrid problems are mostly X-linked recessives that interact epistatically with autosomal genes in the other genome
- XX individuals have a complete copy of each genome

faster male evolution

- male and female fertility typically involve different loci
- faster rate of divergence of genes involved in male than in female reproduction
- hybrid male sterility tend to arise before hybrid female sterility

faster X evolution

- most advantageous alleles in pure species are recessive
- "exposed" to selection in the heterogametic sex

Ecological speciation is a result of divergent natural selection.

Ecological speciation requires assortative mating to occur in parallel with ecological divergence.

Reproductive isolation is a consequence of deleterious epistatic interactions between alleles.

Genetic correlations for performance may facilitate the rate at which divergence occurs.

Haldane's rule is a general description of the early stages of speciation.