

Drowsy Drosophila
What is evolution?



“Nothing in biology makes sense except in the light of evolution” – T. Dobzhansky

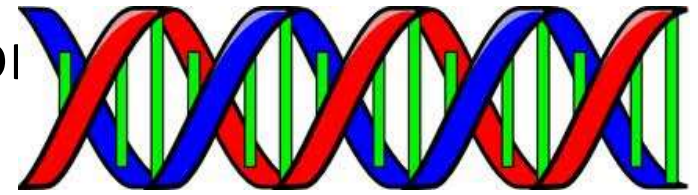
-----What is evolution?



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Evolution is a change in gene (allele) frequencies through time.

Genotype = Internally coded (on the DNA molecule), inheritable information
Based on the nucleotide sequence of a gene.



Phenotype = Physical manifestation of an organism.
e.g., height, hair color, high cholesterol

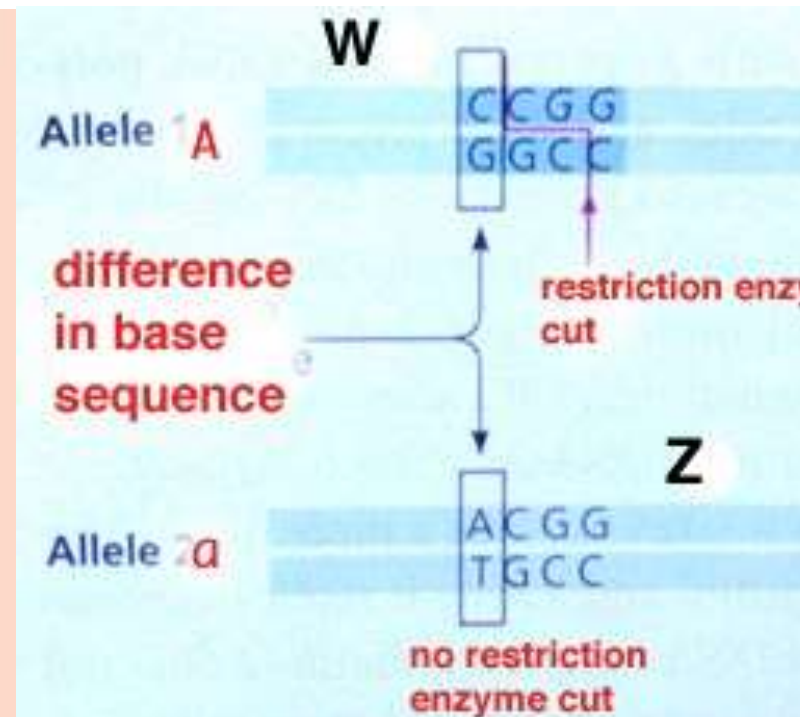
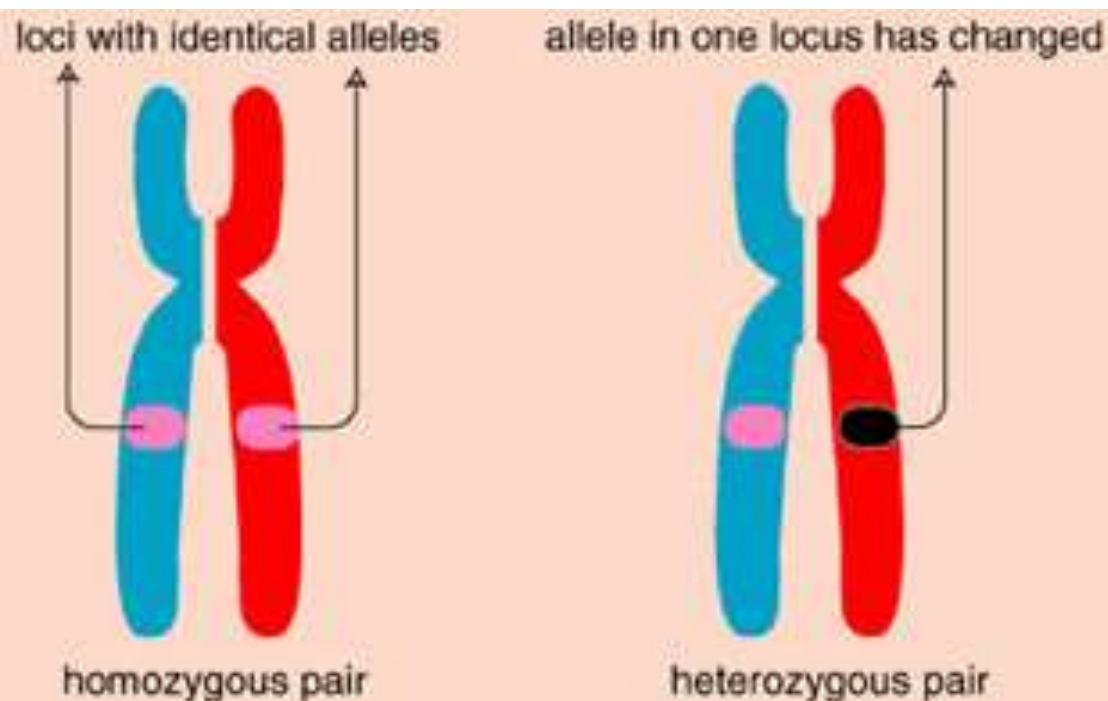


Phenotype = genotype X environment



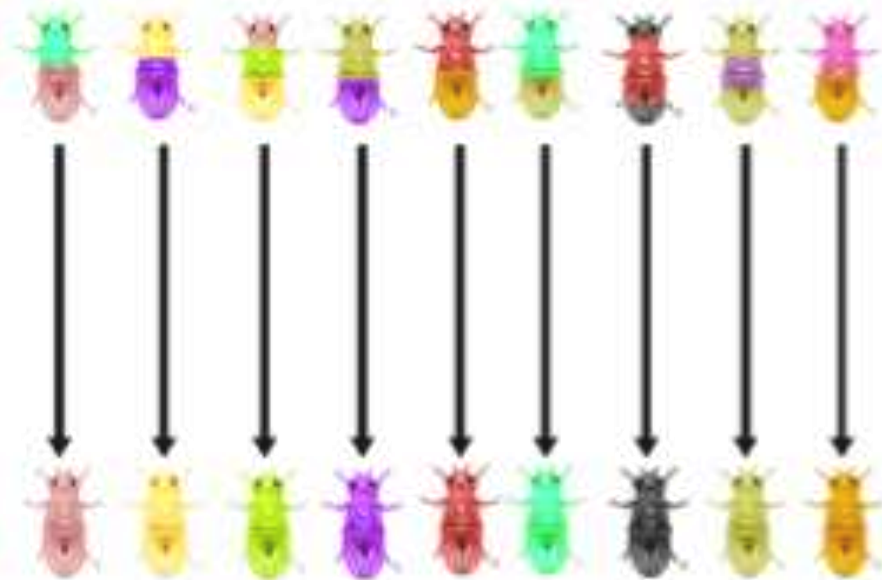
Loci and Alleles

- The physical location of a stretch of DNA on a chromosome that contains a gene is called a **locus** (plural loci).
- Different forms of a gene at a locus are called **alleles**.



Why so many differences?

- How could 1 species of fruit fly, from NC, have so many differences?
- What could be causing these changes?



Mutation

- Change in a gene that gives rise to a new allele.
- For example the appearance of an A instead of a C nucleotide in a gene during gamete production.



- Mutation can be passed from parent to offspring, and mutation may have an effect on phenotype.

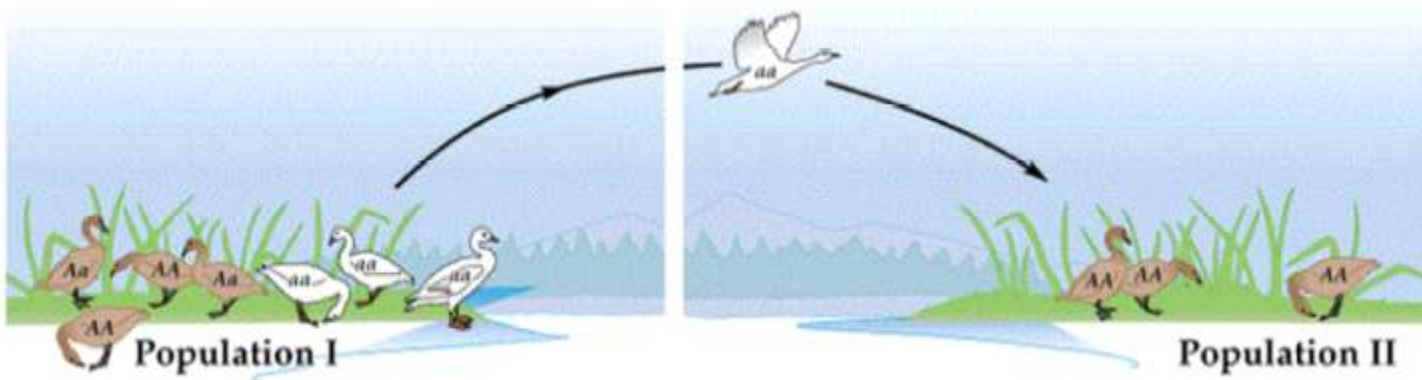
Mutation

- Important because generates **genetic variation** which is key to evolution.
- Do not usually radically alter traits or generate new traits, mostly small changes.
- Most mutations have a slightly deleterious effect, but a very few confer an advantage.



Migration

- Individuals entering or leaving a population take their alleles with them!



a allele for white color moves from Pop I to Pop II in snow geese

- Can be a source of new alleles
- Can change the frequency of preexisting alleles.



Evolution



- Evolution is a change in population-level gene (allele) frequency through time.
- How do we know whether allele frequencies are changing through time?



Evolution



- Evolution is a change in population-level gene (allele) frequency through time.
- How do we know whether allele frequencies are changing through time?
- Know allele frequencies in one generation, make predictions about the next generation if no change is occurring.
 - This can also work with frequencies of genetically determined trait.

Natural Selection

- Three conditions necessary for natural selection.
 1. Within population variation
 2. Variation leads to differential reproduction
 3. Variation is genetically inherited

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Evolution by Natural Selection for Climatic Adaptation



(a) *Otocyon megalotis*



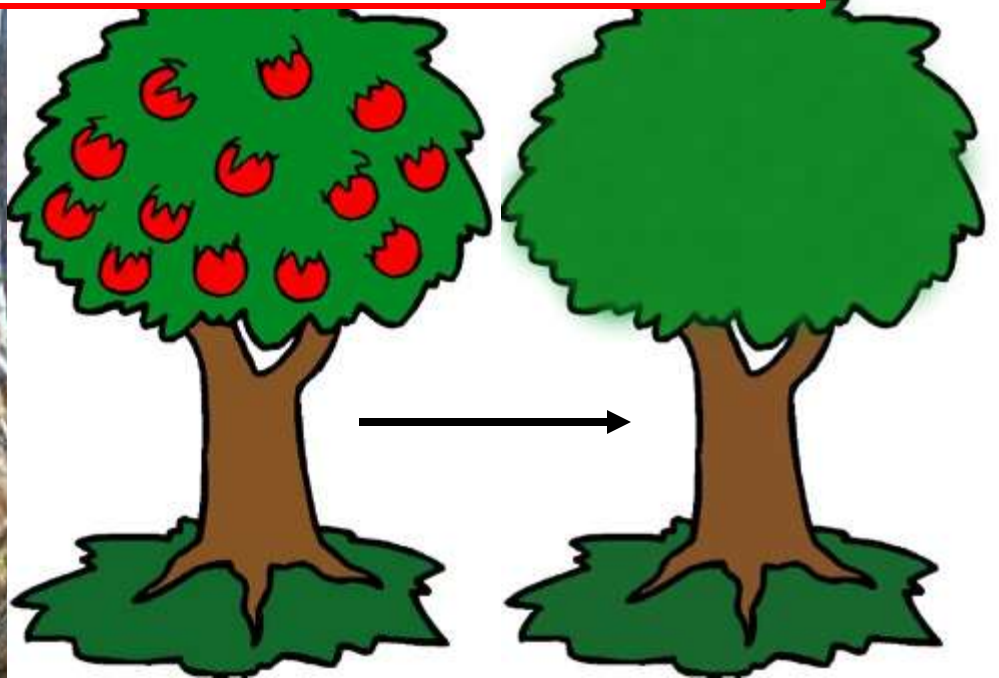
(b) *Alopex lagopus*



41.16 Adaptations to Hot and Cold Climates (a) The bat-eared fox lives on the dry plains of central and southern Africa. Its large ears serve as heat exchangers, passing heat from the fox's blood to the surrounding air. (b) The thick fur of the arctic fox provides insulation in the frigid winter. Its ears and extremities are relatively smaller than those of the desert fox.



Climate is important, drives adaptation.

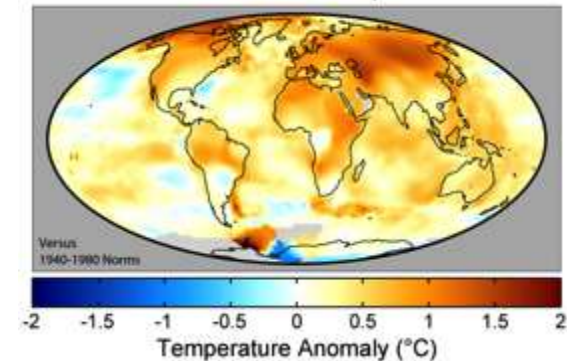


Thermotolerance & Global Change

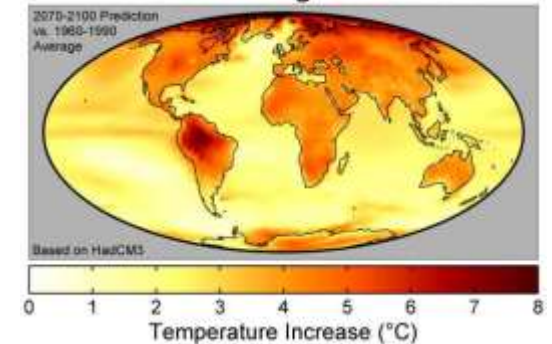
- 1) Range shifts
- 2) Shifts in hibernation/dormancy/migration
- 3) Greater Stress resistance

Genetic architecture of thermal resistance unknown – Evolution?

1995-2004 Mean Temperatures



Global Warming Predictions



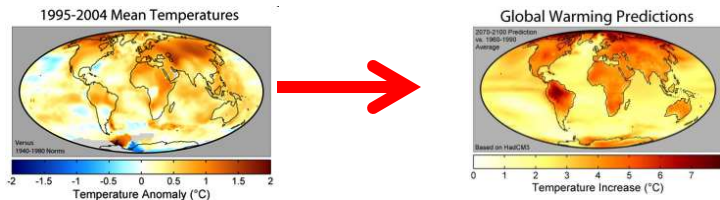
Will populations adapt to climate change by natural selection?

- Conditions necessary for natural selection.

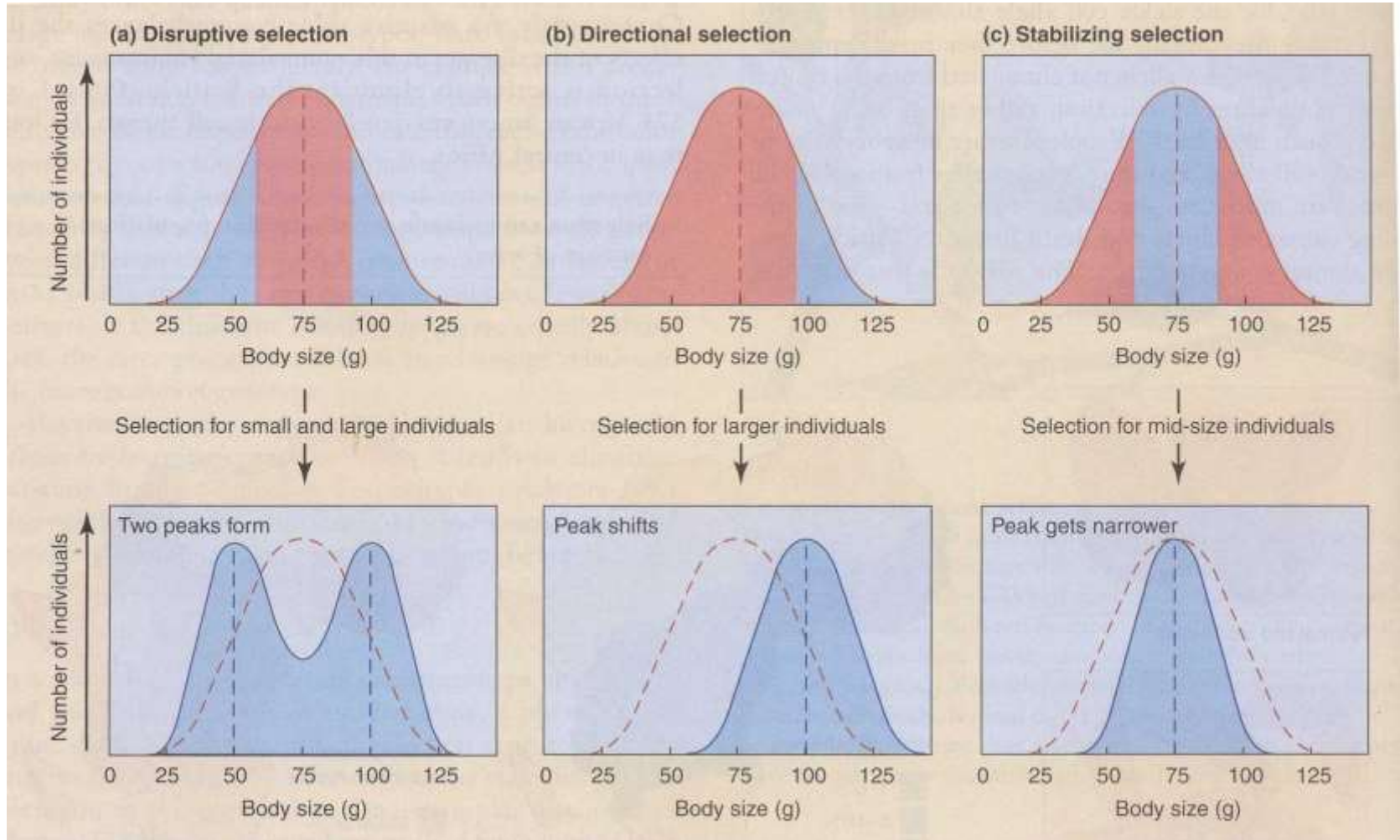
1. Within population phenotypic variation

2. Phenotypic variation leads to differential reproduction

3. Variation is genetically inherited

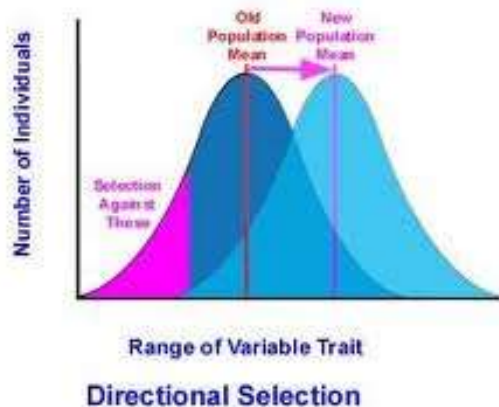


Types of Selection

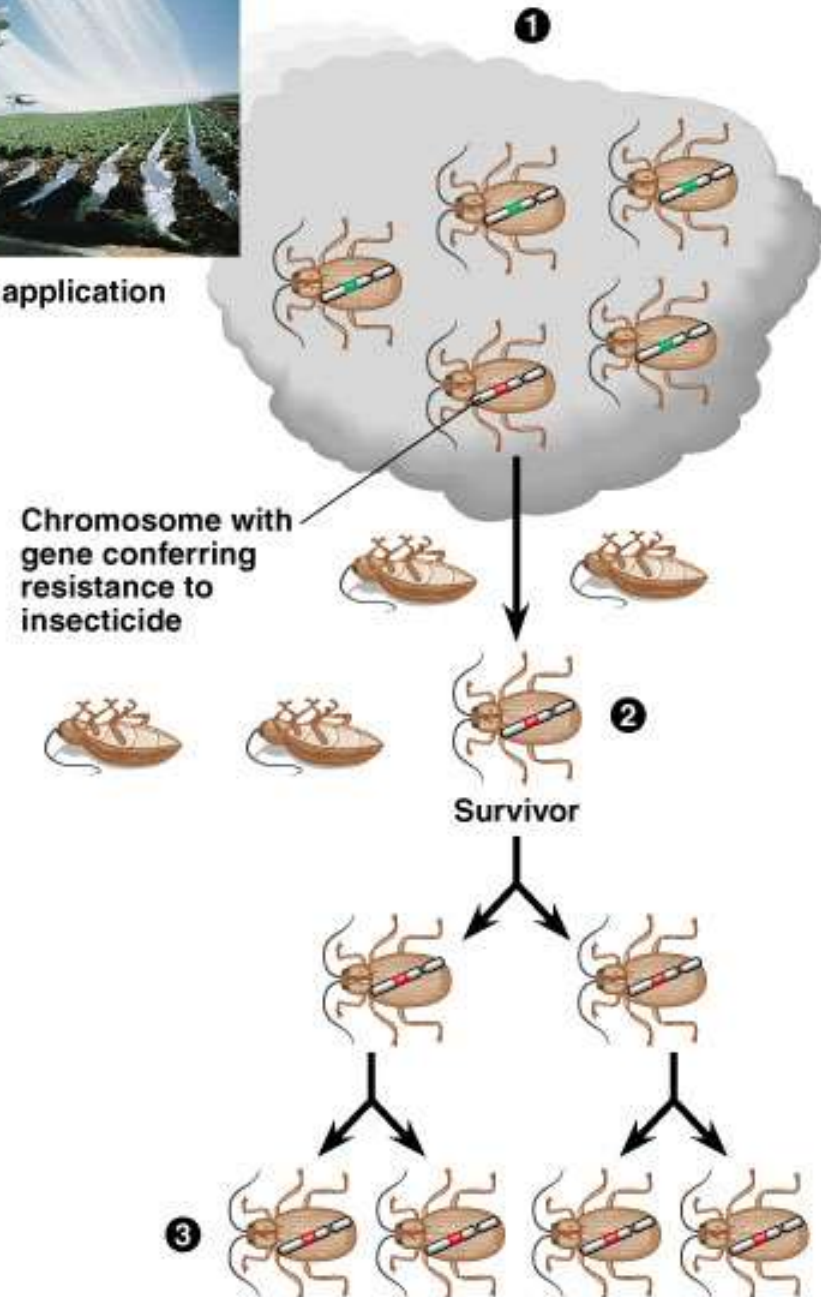


Directional Selection

- Resistance to pesticides can develop quickly in insect populations.
- Clear case of natural selection by man-made management.



Insecticide application



Evolutionary Adaptation

Local Adaptation

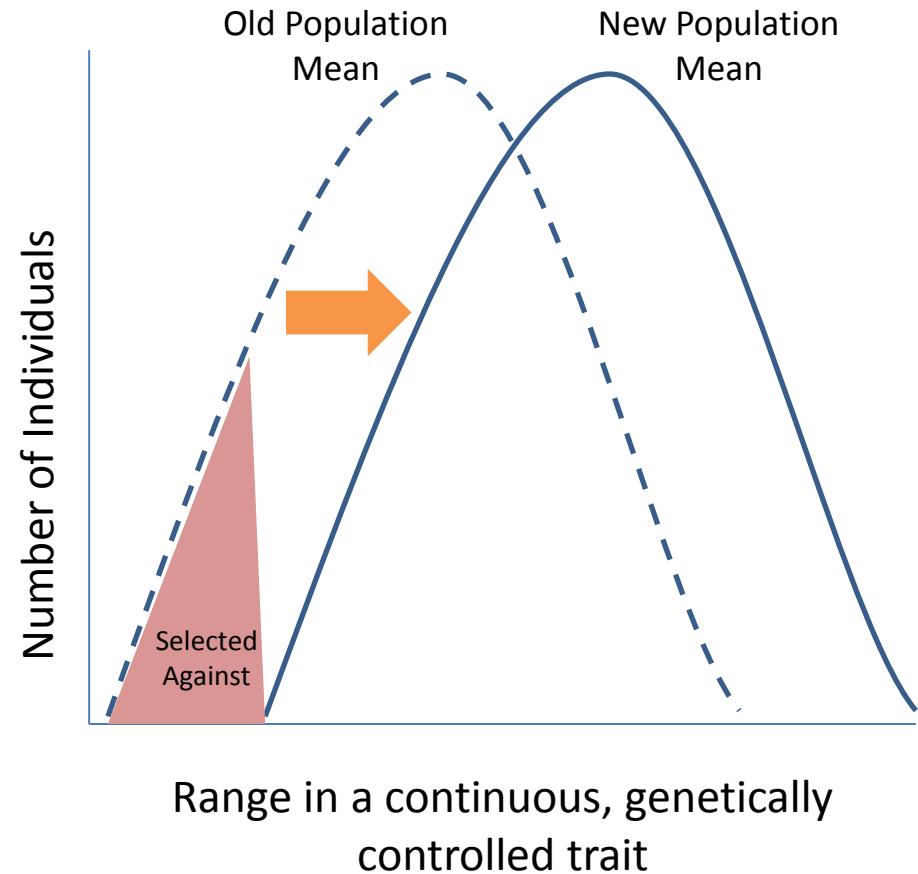
Bat-eared Fox



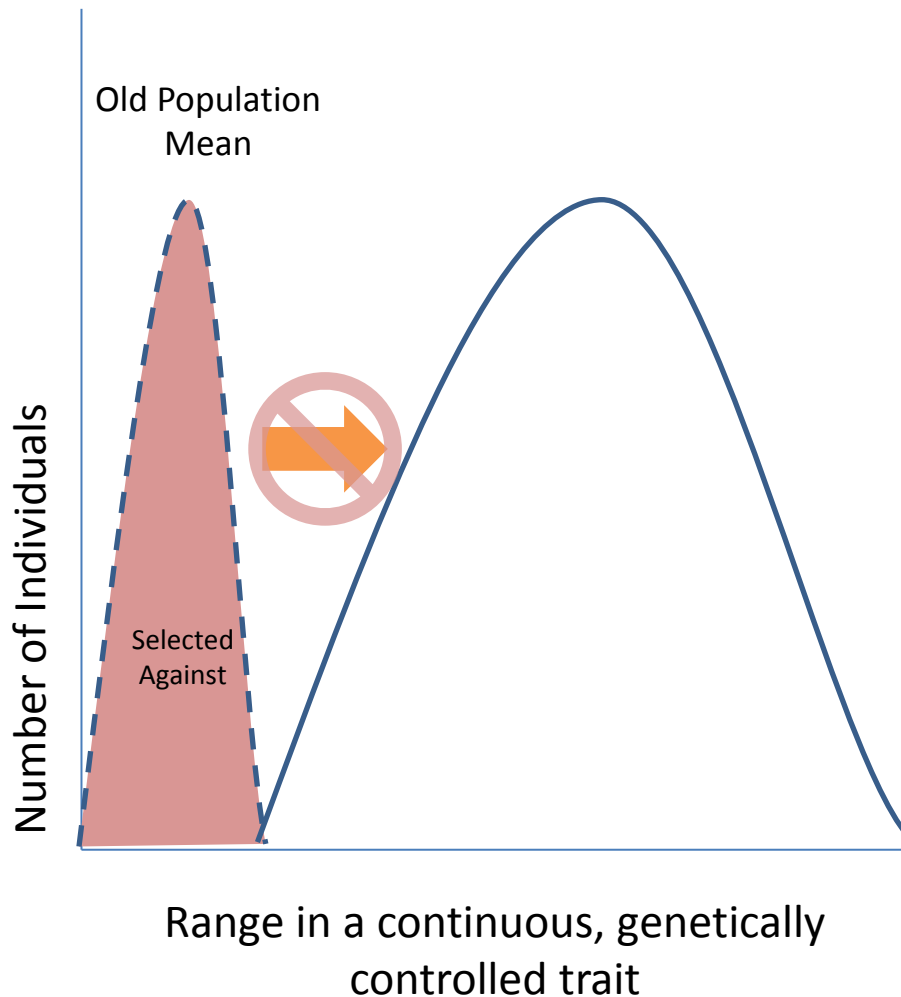
Arctic Fox



Directional selection typically drives local adaptation



Evolutionary Adaptation



Selection requires sufficient variation.