

evolution

a journey into where we're from
and where we're going

Evolutionary Forces

What changes populations?



Forces of evolutionary change

■ Natural selection

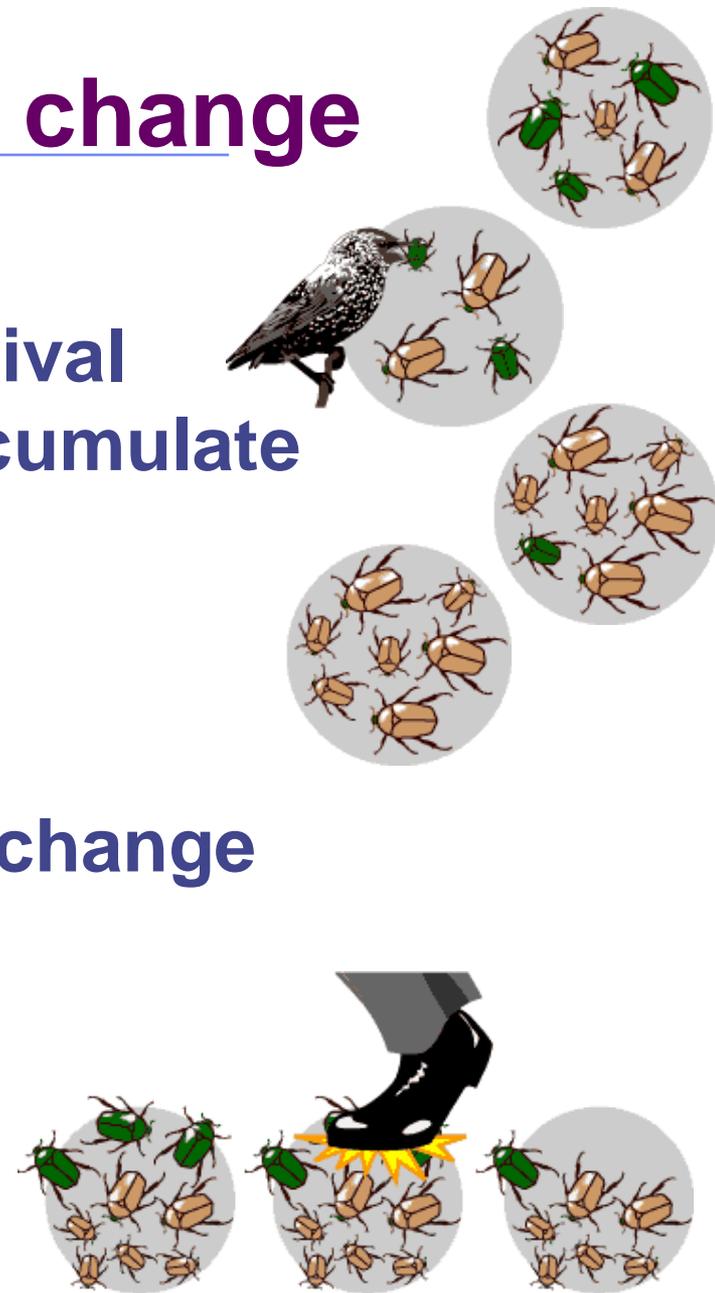
- ◆ traits that improve survival or reproduction will accumulate in the population

- adaptive change

■ Genetic drift

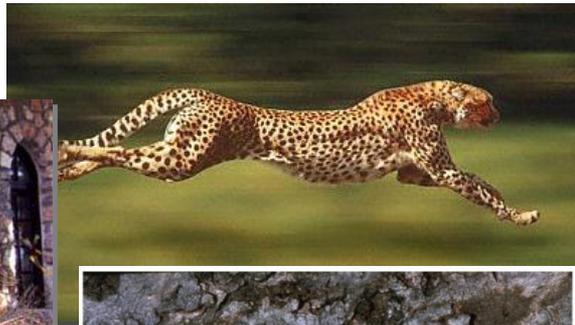
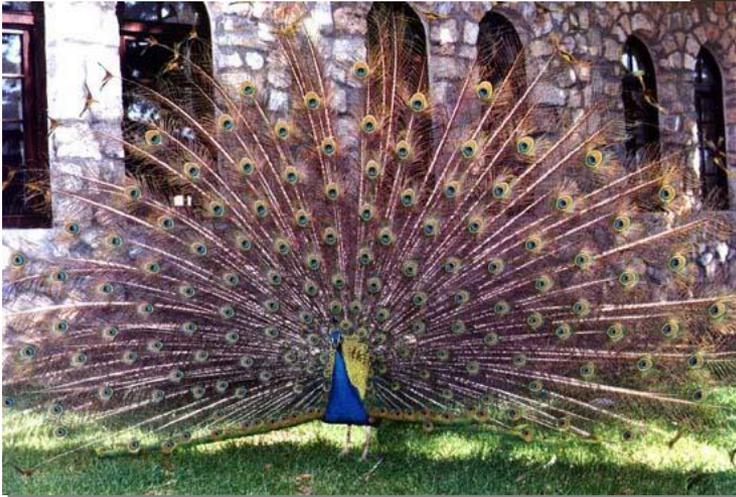
- ◆ frequency of traits can change in a population due to chance events

- random change



Natural Selection

- Selection acts on any trait that affects survival or reproduction
 - ◆ predation selection
 - ◆ physiological selection
 - ◆ sexual selection

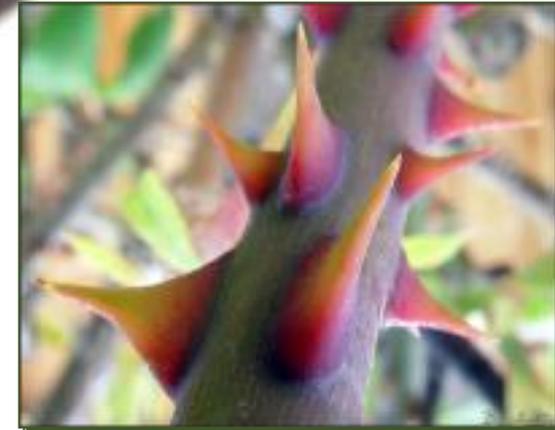




■ Predation selection

◆ act on both predator & prey

- behaviors
- camouflage & mimicry
- speed
- defenses (physical & chemical)



Physiological Selection

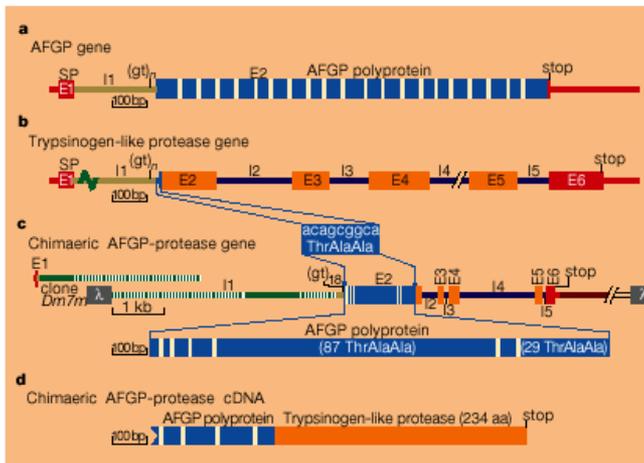
- Acting on body functions
 - disease resistance
 - physiology efficiency (using oxygen, food, water)
 - biochemical versatility
 - protection from injury

Evolution of an antifreeze glycoprotein

A blood protein that keeps Antarctic fish from freezing arose from a digestive enzyme.

The ice-binding antifreeze glycoprotein (AFGP) that circulates in the blood of Antarctic notothenioid fishes enables them to avoid freezing in their perpetually icy environment'. This crucial survival protein probably arose from a functionally unrelated pancreatic trypsinogen-like protease². We have now discovered an important intermediate in this evolutionary process — transcriptionally active chimaeric genes that encode both an AFGP polyprotein and the protease, confirming the protease origin of AFGP and indicating how it was created.

AFGP binds to and arrests the growth of ice crystals that enter the fish, thereby preventing the fish from freezing. There are at least eight forms of the protein of different sizes (AFGP 1–8), all composed of repeats of a simple glycotripeptide monomer (Thr-Ala/Pro-Ala-) with a disaccharide attached to each threonine



HOT STUFF!
Some fish had the variation of producing anti-freeze protein

5.5 mya
The Antarctic Ocean freezes over



Physiological selection

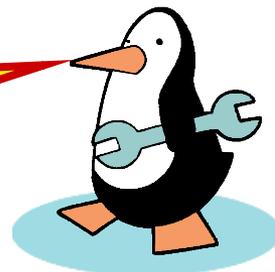
Dogs pee on trees...Why don't trees pee on dogs?



plant nutrient

animal waste

One critter's trash
is another critter's treasure!



Sexual Selection

- Acting on reproductive success
 - ◆ attractiveness to potential mate
 - ◆ fertility of gametes
 - ◆ successful rearing of offspring



Survival doesn't matter
if you don't reproduce!

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

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Sexual selection



It's FEMALE CHOICE, baby!



The lion's mane...



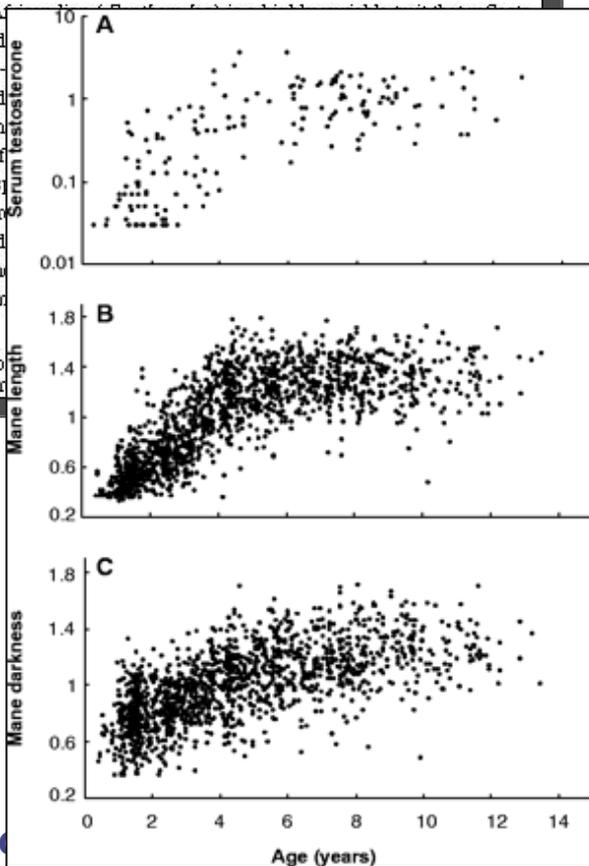
Science magazine HELP SUBSCRIPTIONS FEEDBACK
SEARCH BROWSE

Sexual Selection, Temperature, and the Lion's Mane

Peyton M. West* and Craig Packer

The mane of the African male lion is a long, shaggy growth of hair that varies in length and color. Mane darkness indicates male condition and choice and male-male competition only appears to influence reproductive life-span. Surface temperature of the year. Males with shorter manes in hot years suggests that the mane is a temperature-dependent trait.

Department of Ecology
1987 Upper Bufor



- Females are attracted to males with larger, dark manes
- Correlation with higher testosterone levels
 - ◆ better nutrition & health
 - ◆ more muscle & aggression
 - ◆ better sperm count / fertility
 - ◆ longer life
- But imposes a cost to male
 - ◆ **HOT!** Is it worth it??

Sexy = fitness markers



Sexual selection

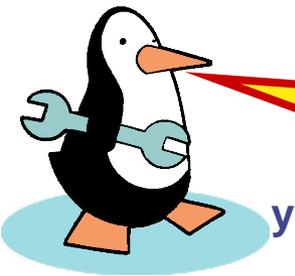
- Acts in all sexually reproducing species
 - ◆ the traits that get you mates
 - sexual dimorphism
 - ◆ influences both morphology & behavior
 - ◆ can act in opposition to natural selection



Jacanas



Is there a testable hypothesis in there?



Coevolution

- Two or more species reciprocally affect each other's evolution
 - predator-prey
 - disease & host
 - competitive species
 - mutualism



pollinators & flowers



Effects of Selection

- Changes in the average trait of a population

**DIRECTIONAL
SELECTION**

**STABILIZING
SELECTION**

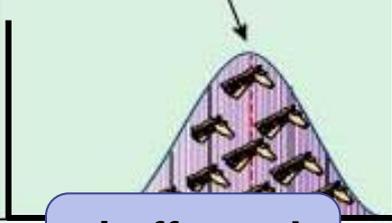
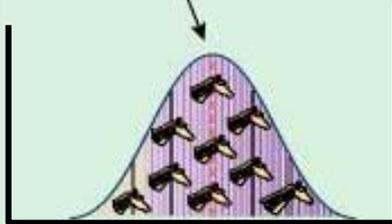
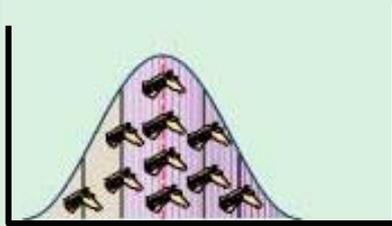
**DISRUPTIVE
SELECTION**

BEFORE
SELECTION

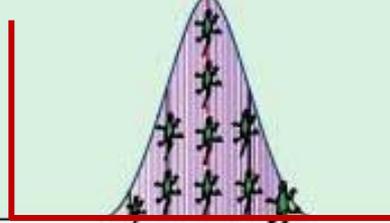
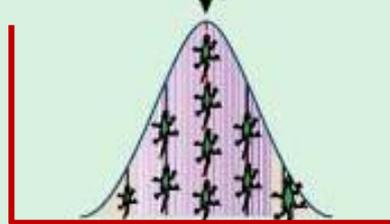
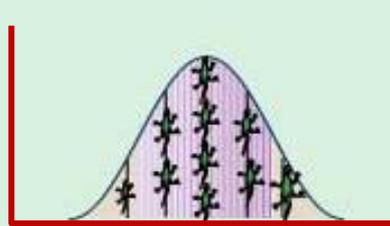
time

percent of population

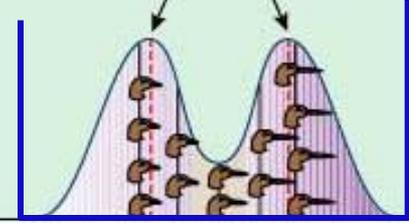
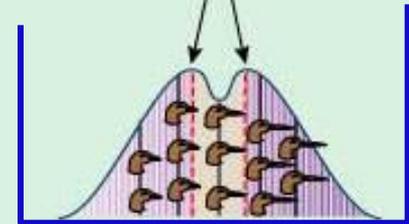
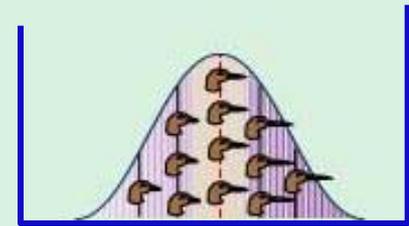
AFTER
SELECTION



giraffe neck
horse size



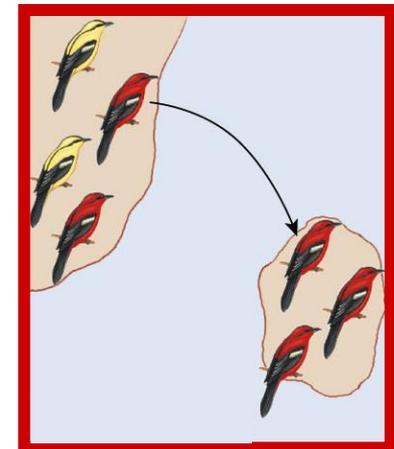
human birth weight



rock pocket mice

Genetic Drift

- **Chance events changing frequency of traits in a population**
 - ◆ **not** adaptation to environmental conditions
 - **not** selection
 - ◆ **founder effect**
 - small group splinters off & starts a new colony
 - ◆ **bottleneck**
 - some factor (disaster) reduces population to small number & then population recovers & expands again but from a limited gene pool



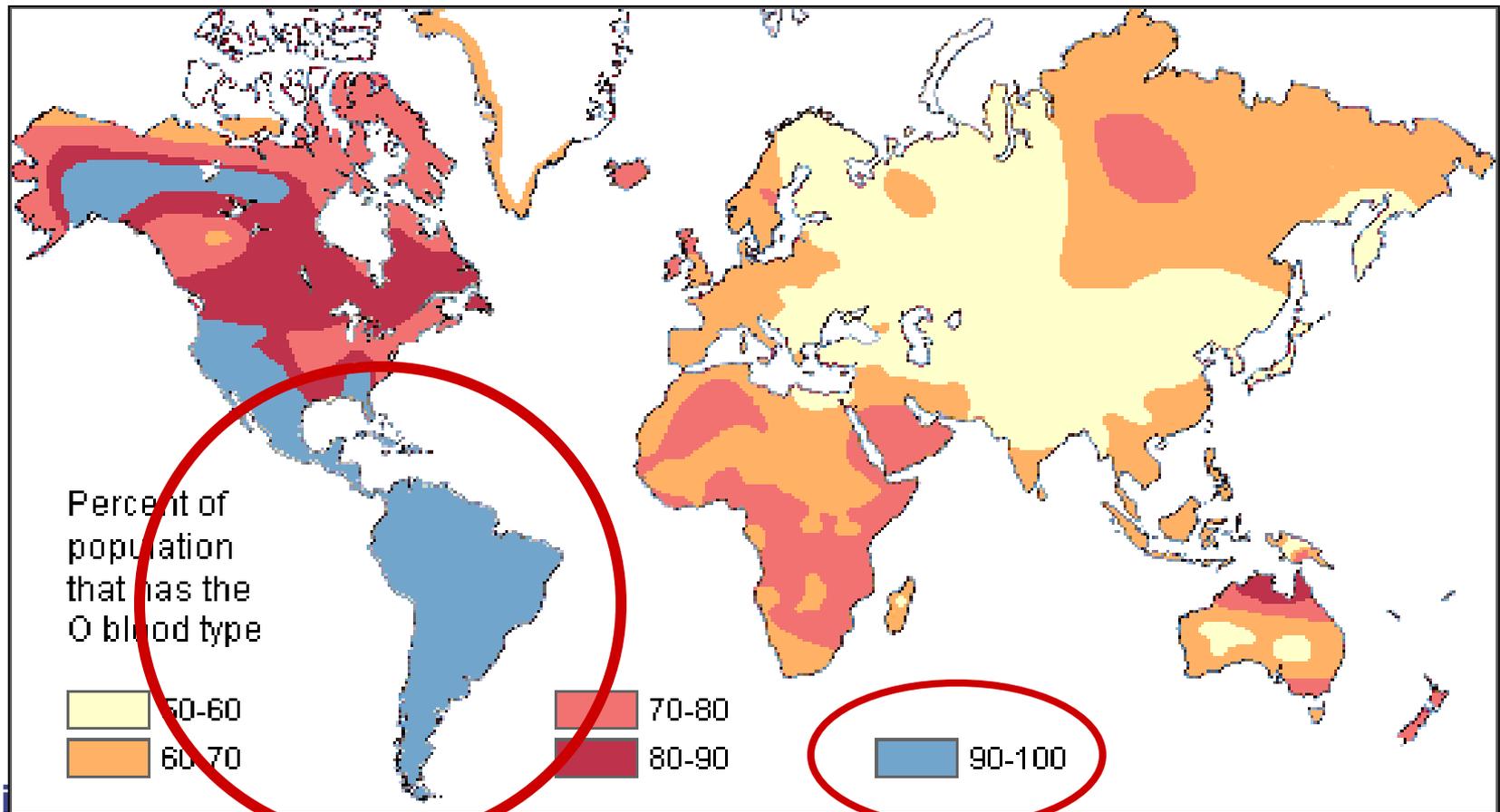
Founder effect

- When a new population is started by only a small group of individuals
 - ◆ just by chance some rare alleles may be at high frequency; others may be missing
 - ◆ skew the gene pool of new population
 - human populations that started from small group of colonists
 - **example:**
colonization of New World



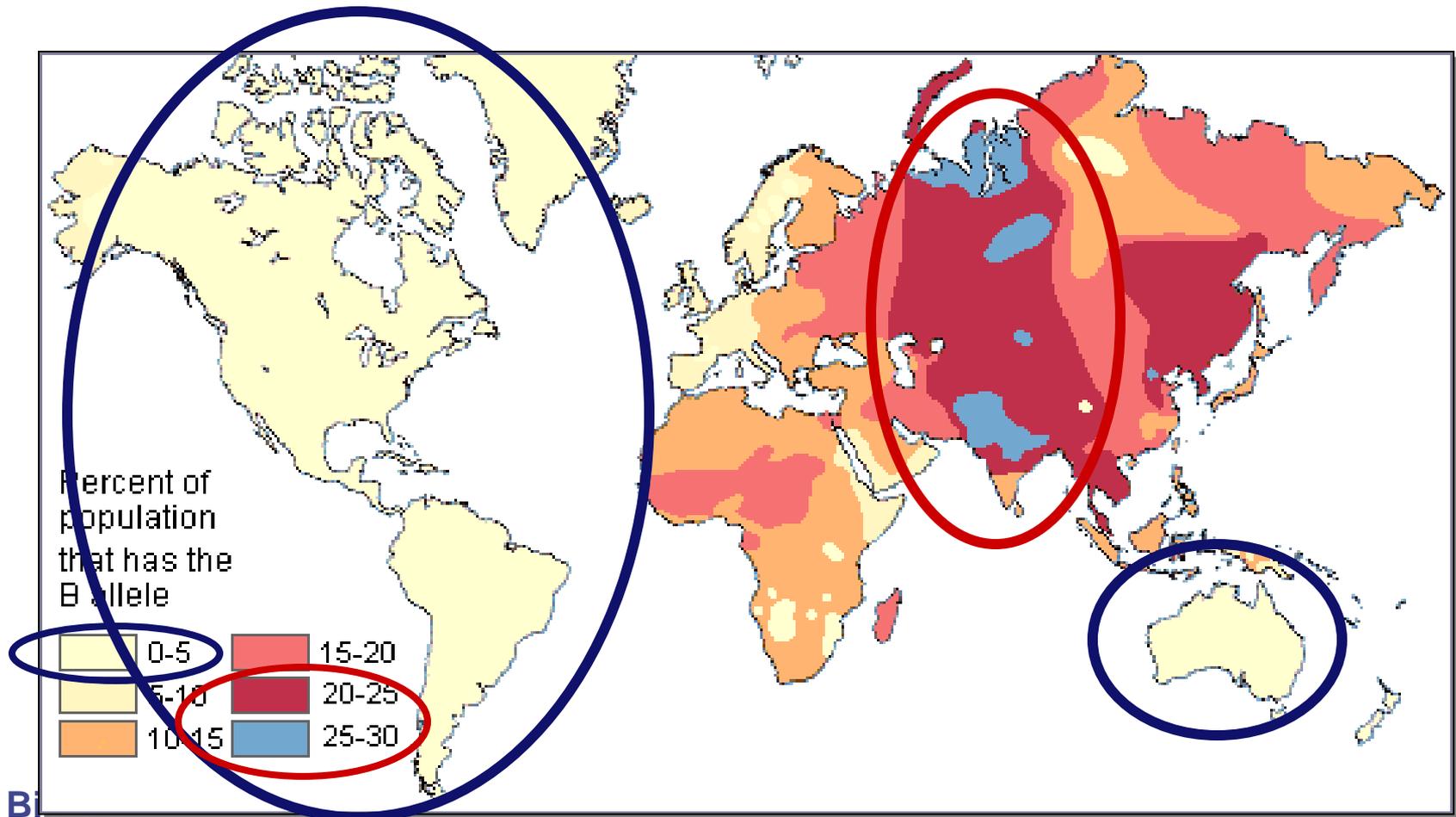
Distribution of blood types

- Distribution of the **O type** blood allele in native populations of the world reflects original settlement



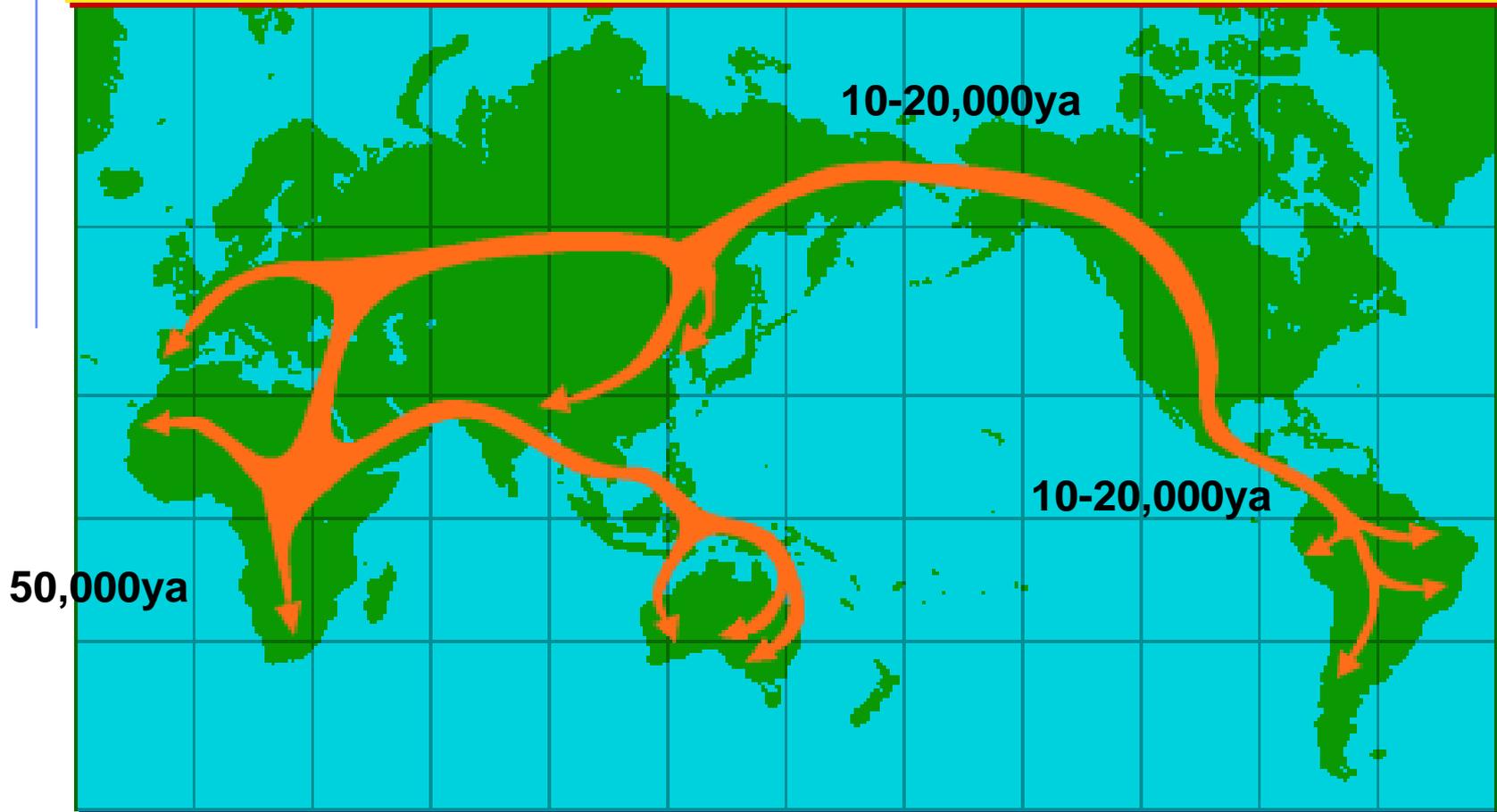
Distribution of blood types

- Distribution of the **B type** blood allele in native populations of the world reflects original migration



Out of Africa

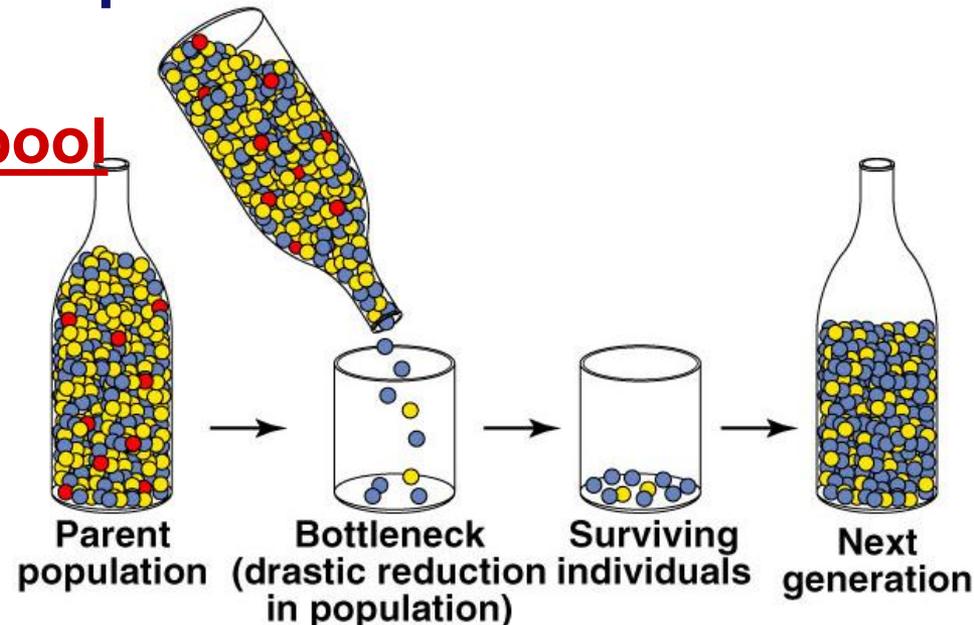
Likely migration paths of humans out of Africa



Many patterns of human traits reflect this migration

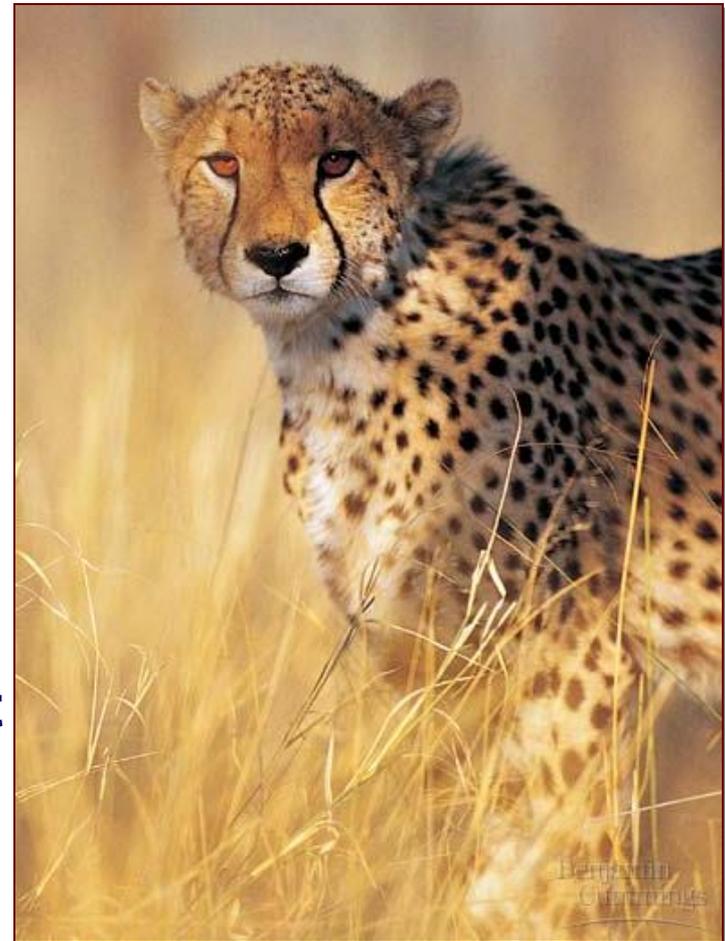
Bottleneck effect

- When large population is drastically reduced by a disaster
 - ◆ famine, natural disaster, loss of habitat...
 - ◆ loss of variation by chance event
 - alleles lost from gene pool
 - ◆ not due to fitness
 - narrows the gene pool



Cheetahs

- **All cheetahs share a small number of alleles**
 - ◆ less than 1% diversity
 - ◆ as if all cheetahs are identical twins
- **2 bottlenecks**
 - ◆ 10,000 years ago
 - Ice Age
 - ◆ last 100 years
 - poaching & loss of habitat



Any Questions??

