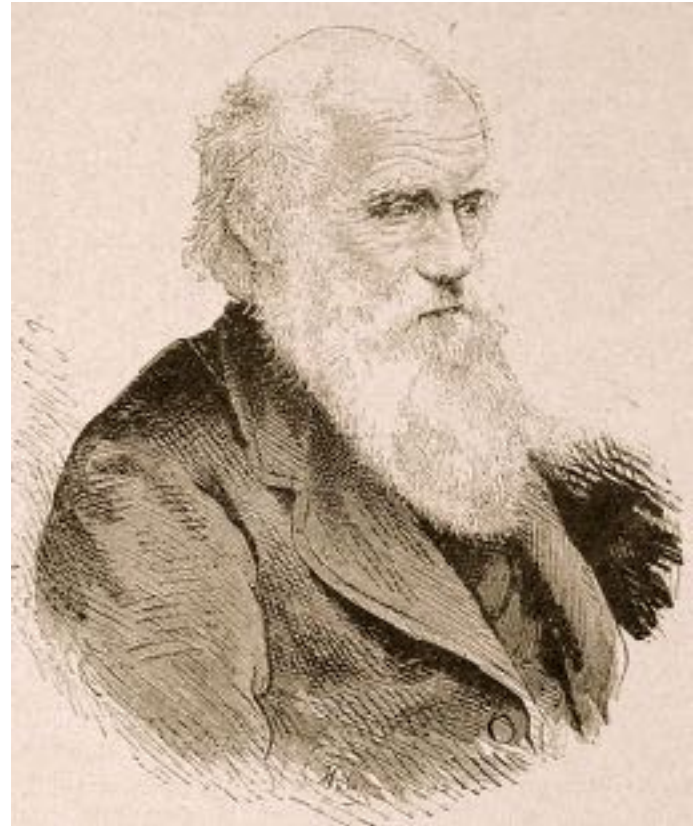
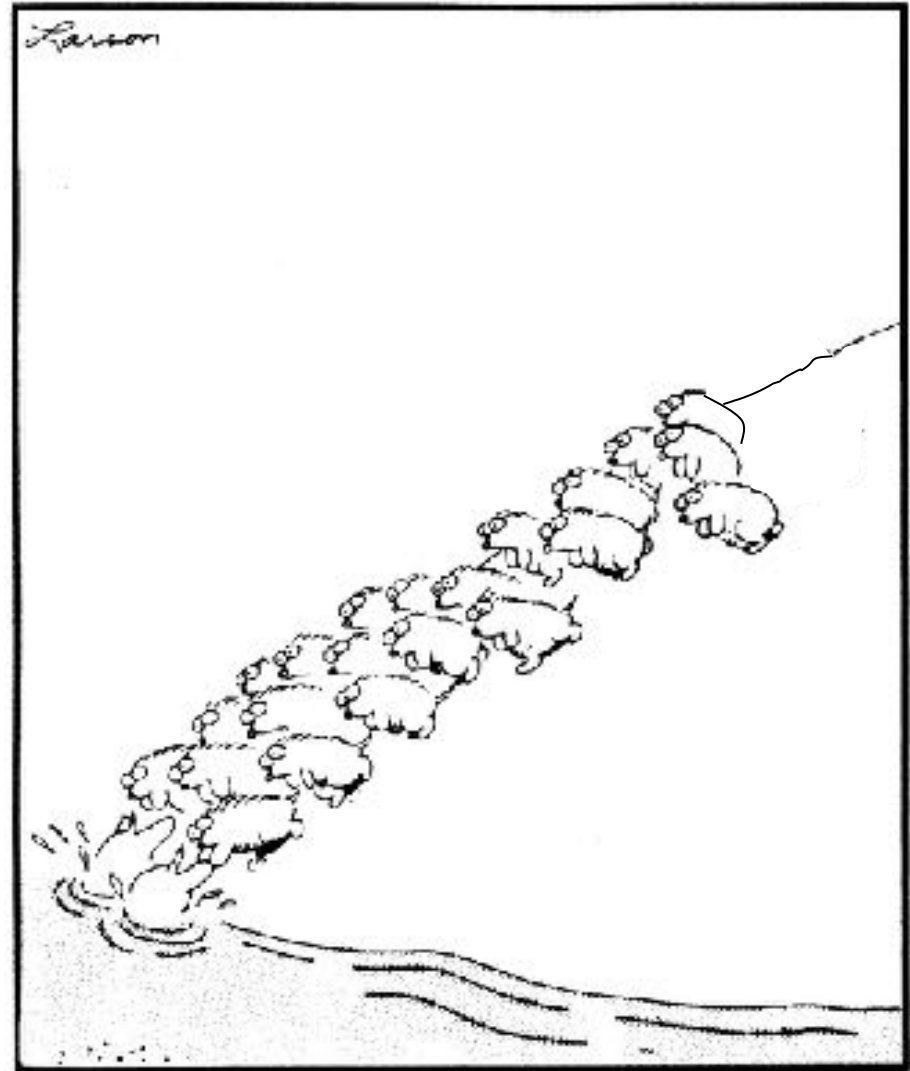


Ethology, Evolution and natural selection



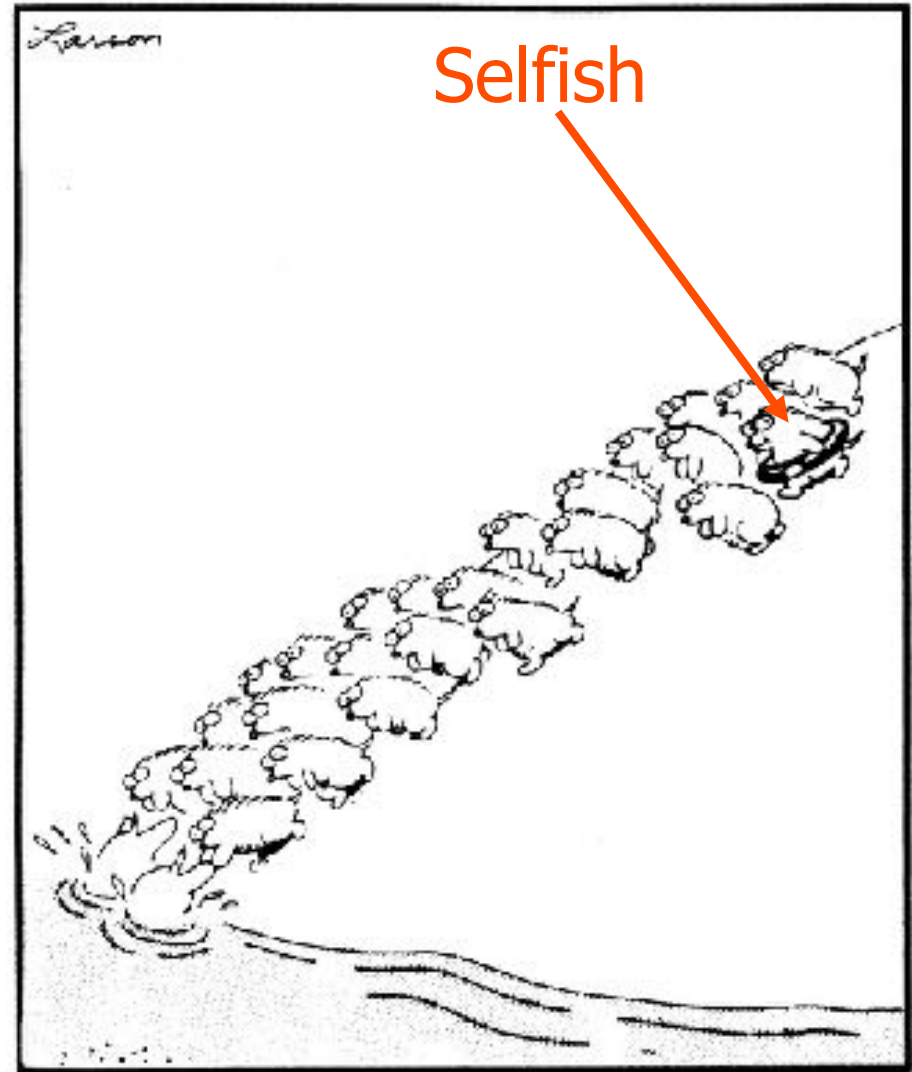
Clear thinking about natural selection

What is wrong with the lemming suicide myth?



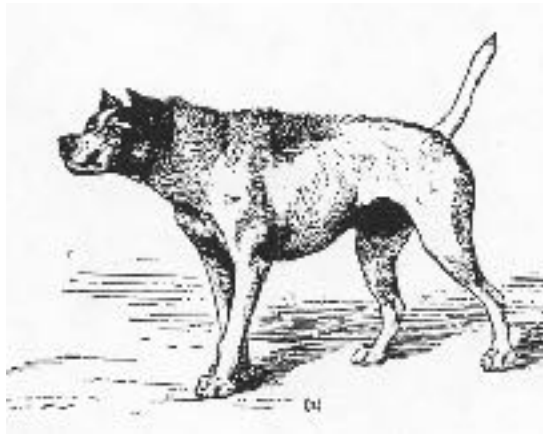
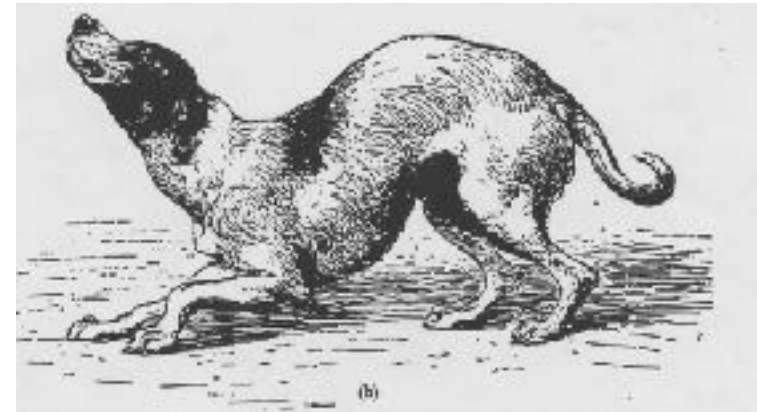
Clear thinking about natural selection

- Behavior does not evolve or occur “for the good of the species” or “group”
- Genes promoting **selfless behavior** would be eliminated by natural selection



Original term for study of Animal Behavior: Ethology

- *Ethos* = habit
- What is animal behavior?
 - Responses (or lack thereof) in response to changes in an animal's environment



Historical perspectives

- The study of animal behavior emerged as far back as recorded history!!! (cave paintings)
- Aristotle (384-322 B.C.)
 - First written records of mutualism, tool use, and brood parasitism
- Major advances
 - 1. Evolutionary context (Darwin)
 - 2. Mechanism of change (Mendel)
 - 3. Detailed description of complexities of behavior (Von Frisch, Lorenz, Tinbergen)
 - 4. Thinking about selection at the level of the gene (George Williams and Richard Dawkins)



Historical perspectives

- The study of animal behavior emerged as far back as recorded history!!! (cave paintings)
- Aristotle (384-322 B.C.)
 - First written records of mutualism, tool use, and brood parasitism
- Major advances
 - 1. Evolutionary context (Darwin)
 - 2. Mechanism of change (Mendel)
 - 3. Detailed description of complexities of behavior (Von Frisch, Lorenz, Tinbergen)
 - 4. Thinking about selection at the level of the gene (George Williams and Richard Dawkins)



Historical perspectives

- The study of animal behavior emerged as far back as recorded history!!! (cave paintings)
- Aristotle (384-322 B.C.)

First written records of mutualism



Alleles will spread in a proportion to how well they help build bodies that are unusually good at reproducing

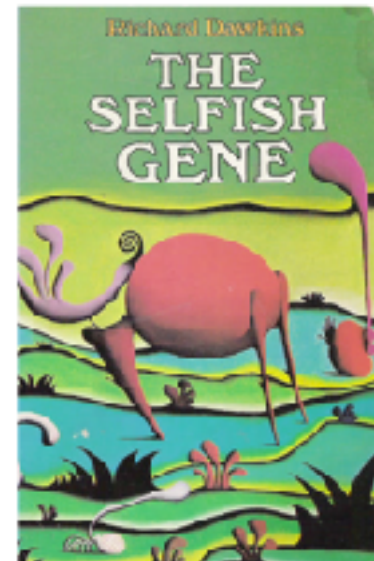
(Frisch, Lorenz, Tinbergen)

- 4. Thinking about selection at the level of the gene (George Williams and Richard Dawkins)

Levels of selection: vehicles and replicators

Replicator: any entity of which accurate copies are made (i.e., genes)

Vehicle: something that is built by replicators to help them survive and reproduce; the survival machinery of genes





On a stream in the Adirondacks there is a beaver, and he builds a dam with a lodge. The lodge provides a safe refuge from predators. This beaver has a big lodge, so will have more offspring than is average for his population.

Is there more than one vehicle in this scenario? Explain.

Historical perspectives

- The study of animal behavior emerged as far back as recorded history!!! (cave paintings)
- Aristotle (384-322 B.C.)
 - First written records of mutualism, tool use, and brood parasitism
- Major advances
 - 1. Evolutionary context (Darwin)
 - 2. Mechanism of change (Mendel)
 - 3. Detailed description of complexities of behavior (Von Frisch, Lorenz, Tinbergen)
 - 4. Thinking about selection at the level of the gene (George Williams and Richard Dawkins)



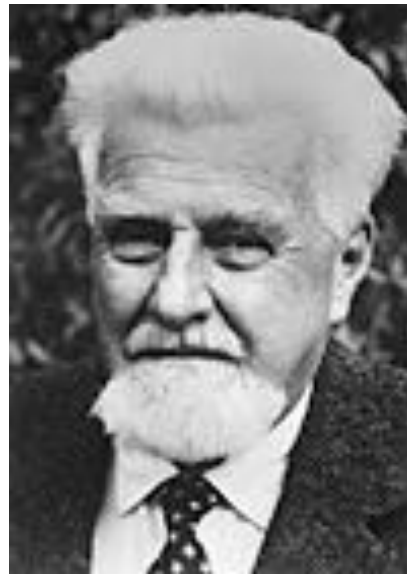
Founding fathers of ethology

- Pioneering work starting in 1930's
- All were recognized with Nobel Prize in 1973



Karl von Frisch

Germany



Konrad Lorenz

Austria



Nikolaas Tinbergen

Netherlands

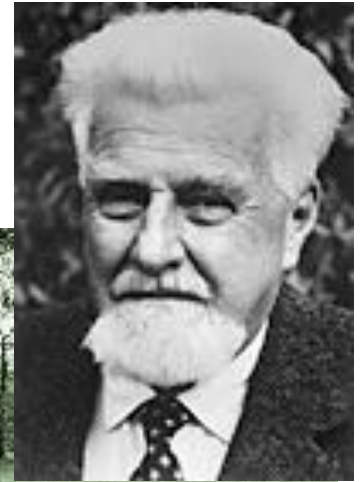
Founding fathers of ethology

- Von Frisch
 - Focus on honeybees:
 - social organization, communication, etc.



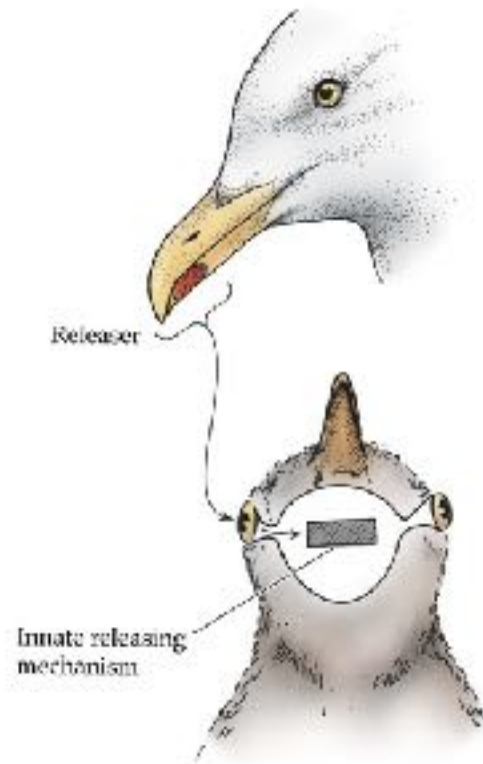
Founding fathers of ethology

- Lorenz
 - Pioneered studies of genetically programmed behavior (instinct)
 - Concept of imprinting and a “critical period”



Founding fathers of ethology

- Tinbergen
 - Levels of analysis (Tinbergen's 4 questions)
 - Fixed Action Patterns (FAPs)



AMNH/USNM/DPUS/ES/EP/PA/14 © 2002 Science Associates, Inc.

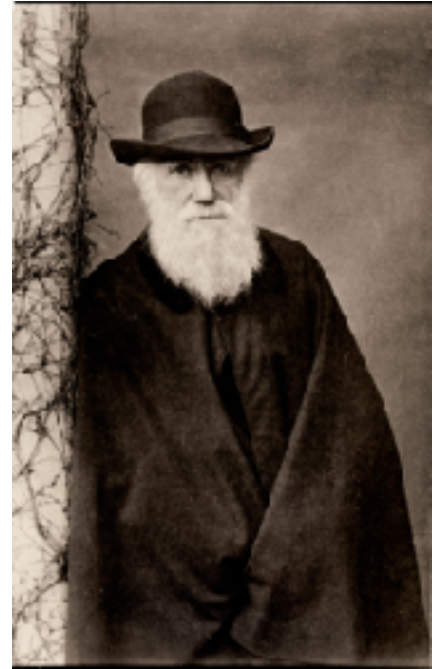
Historical perspectives

- The study of animal behavior emerged as far back as recorded history!!! (cave paintings)
- Aristotle (384-322 B.C.)
 - First written records of mutualism, tool use, and brood parasitism
- Major advances
 - 1. Evolutionary context (Darwin)
 - 2. Mechanism of change (Mendel)
 - 3. Detailed description of complexities of behavior (Von Frisch, Lorenz, Tinbergen)
 - 4. Thinking about selection at the level of the gene (George Williams and Richard Dawkins)



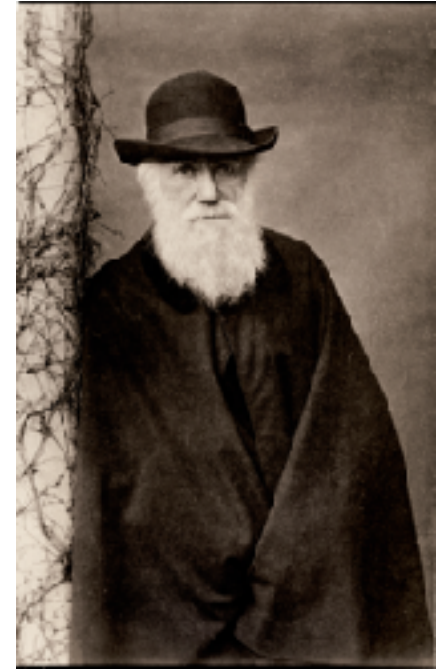
Charles Darwin

- Changed the way people looked at life, especially the diverse forms of behavior



Charles Darwin

- Changed the way people looked at life, especially the diverse forms of behavior



Alfred Russel Wallace

On the tendency of species to form varieties (1858)

- Joint publication with Darwin *on the perpetuation of varieties and species by natural means of selection*

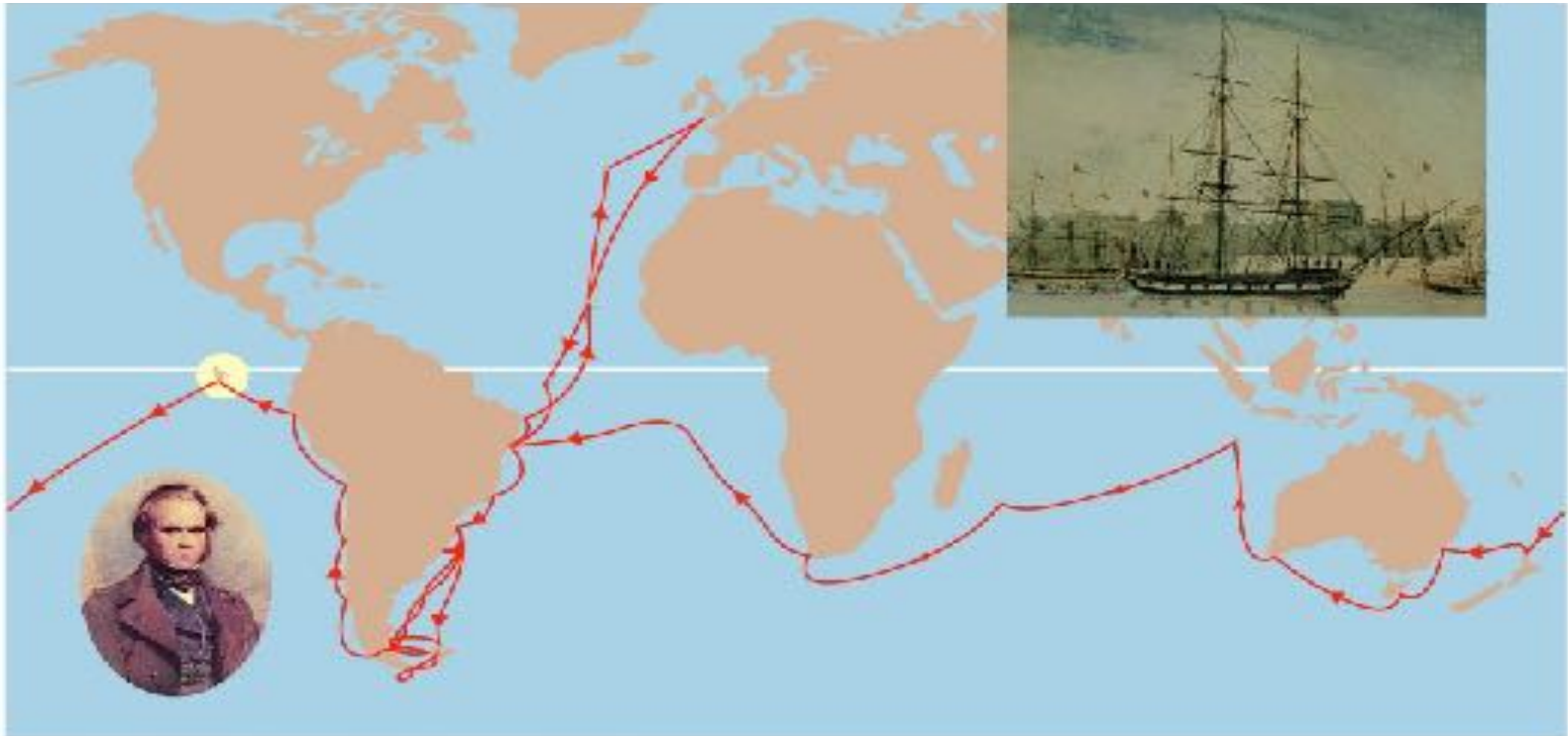


Darwin and his voyage

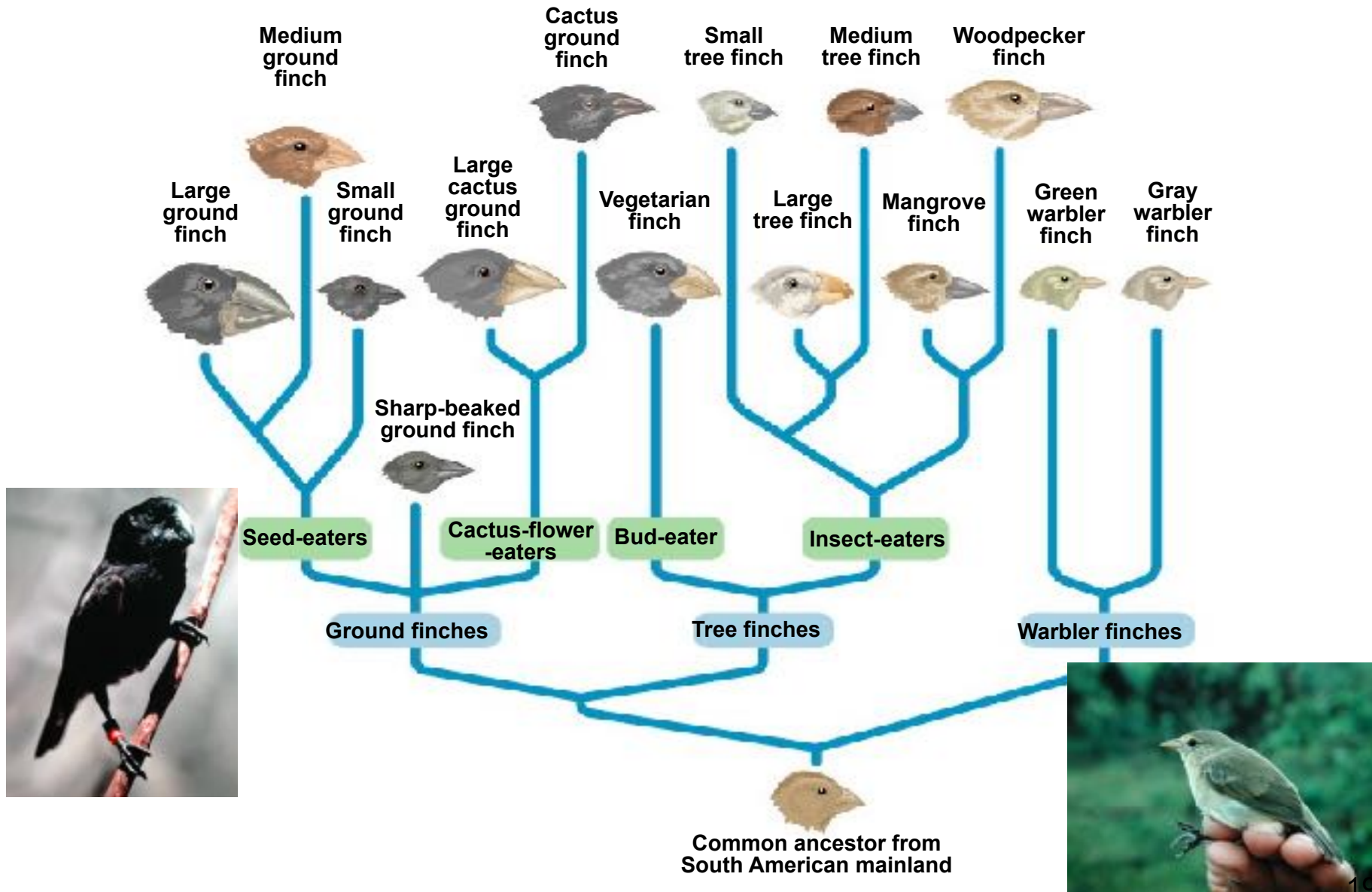
1831-1836 on *HMS Beagle*

spent 5 years away: three years and three months on land; 18 months at sea

- Collected thousands of specimens
- Galápagos Islands = important stop

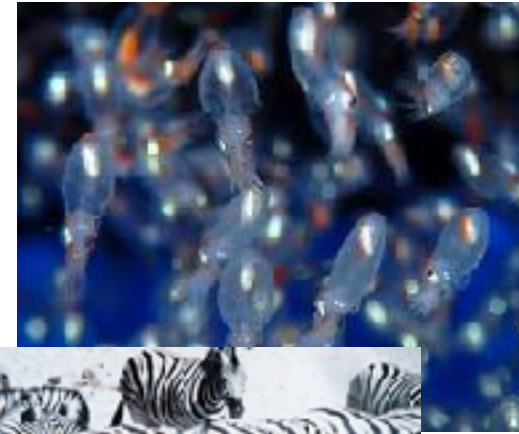


Darwin's observations: Finches



The logical structure of Darwin's reasoning

- Living organisms could increase their numbers geometrically -- but they don't.
- Variation exists among individuals in every species.
- Many such variations can be transmitted from parent to offspring.
- Variations that result in greater survival and reproduction will increase in frequency as time passes.



What is evolution and natural selection?

- Evolution = allele frequency change
- Natural selection = differential reproduction (measured as fitness)
 - *Natural selection is the only evolutionary force leading to adaptation*



What Darwinism does involve

- Natural selection is inexorable and unavoidable.
- Lifetimes can be viewed as sequences of cost/benefit 'decisions' about how to maximize survival and reproduction.

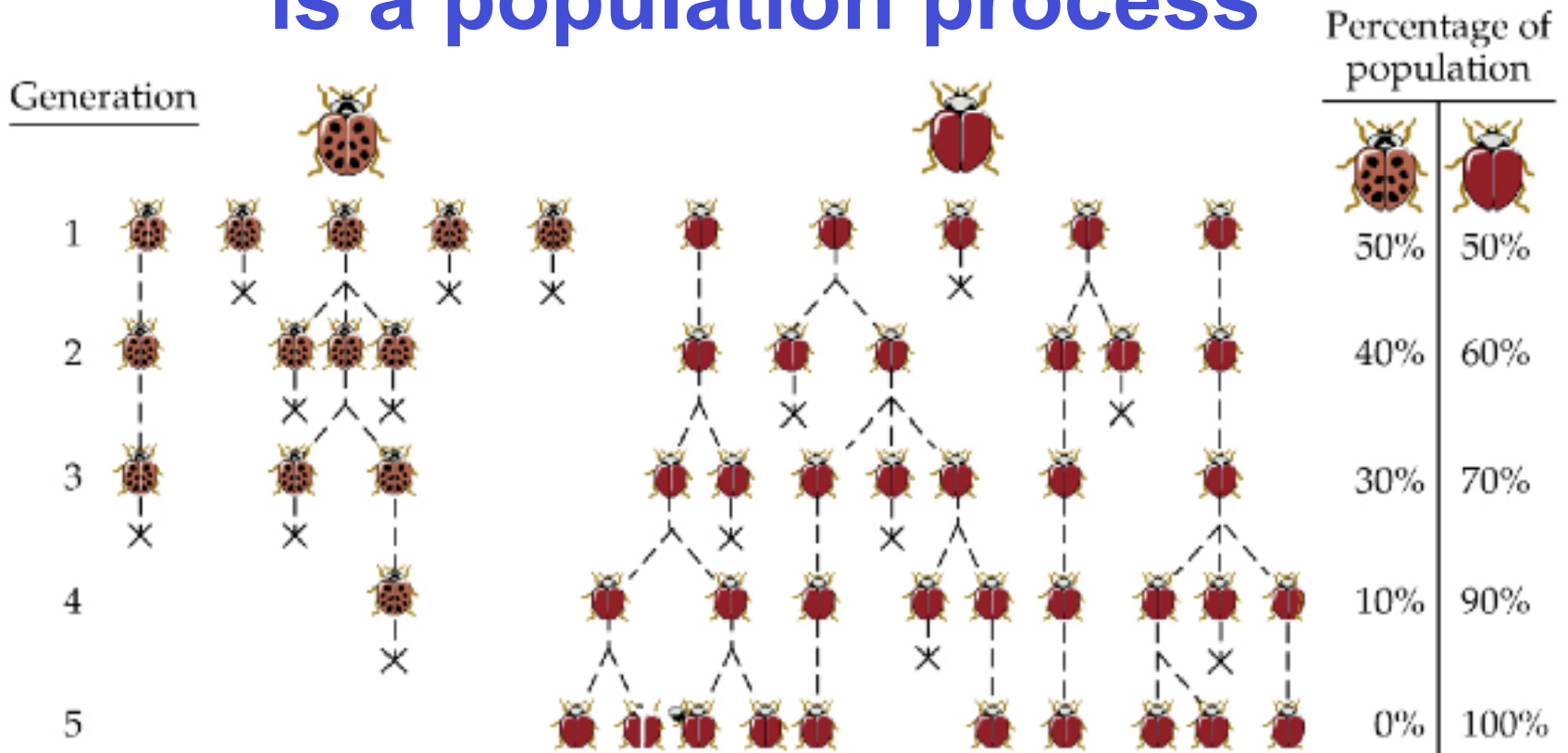


What Darwinism does NOT involve

- Survival of the "fittest"
Survival is of no significance by itself: differential reproduction is the key
- Perfection is a myth.
The vole lineage has evolved to monogamy and then away from it depending on environmentally influenced selection pressures



Evolution is a population process



© 2001 Sinauer Associates, Inc

'Better' trait predominates over time because individuals bearing it have greater success in each generation

Vigilance in geese



**Predator eats:
50% of non-vigilant
25% of vigilant**



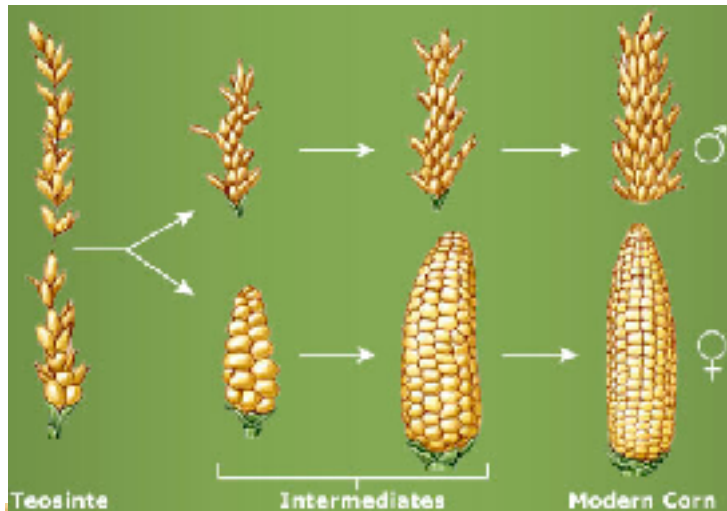
**Predator eats:
75% of non-vigilant
20% of vigilant**



Natural selection gives rise to population-wide vigilance

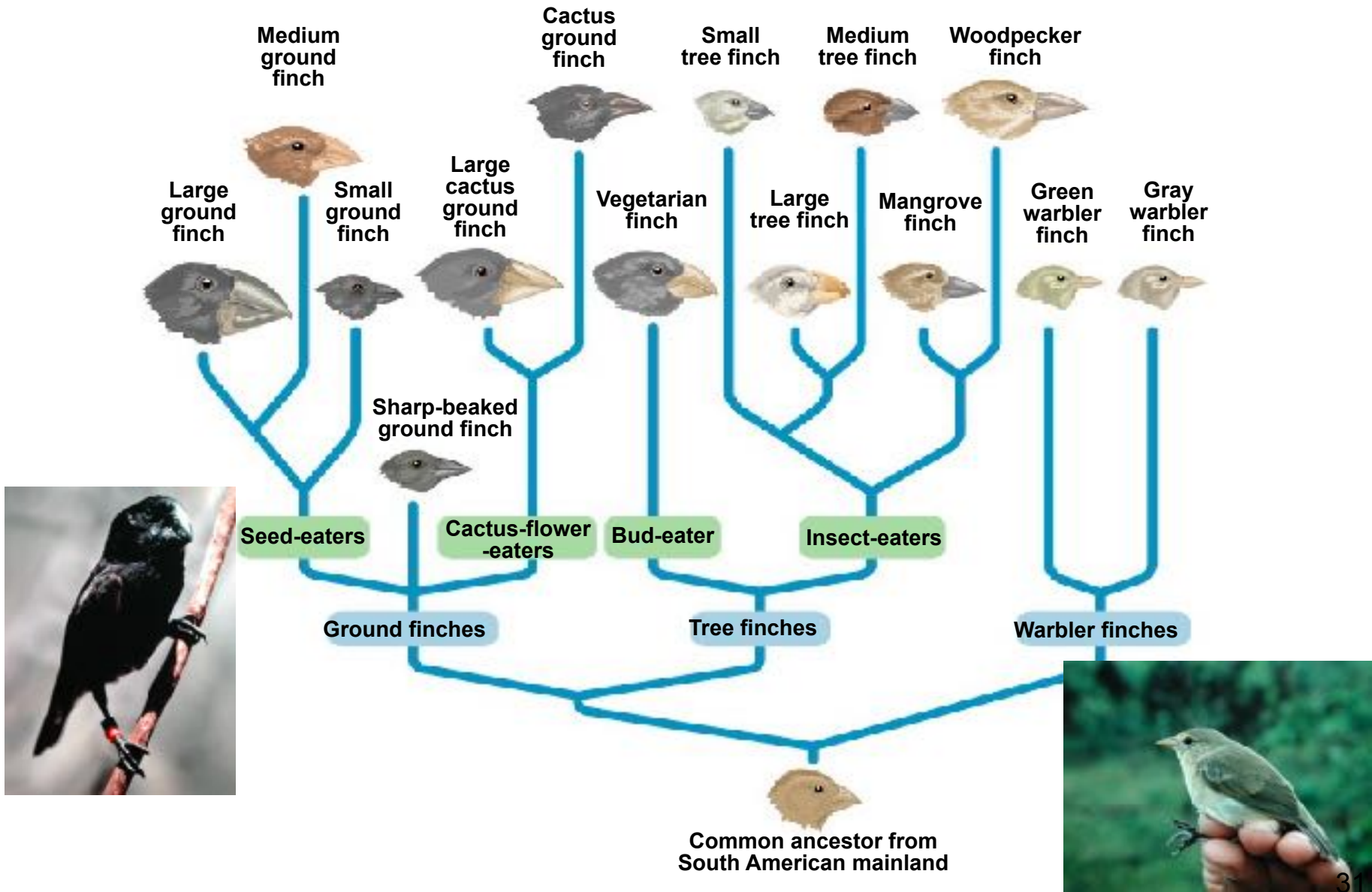


Evidence for natural selection: Artificial selection





http://en.wikipedia.org/wiki/List_of_dog_breeds



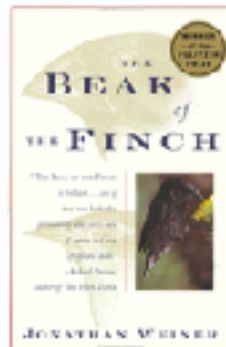
Measuring natural selection



Medium Ground Finch
Geospiza fortis

Recent research on Isla Daphne Major, Galápagos, by Peter & Rosemary Grant, and their team
—They measured natural selection in action

Great read:
Beak of the Finch, by
Jonathon
Weiner

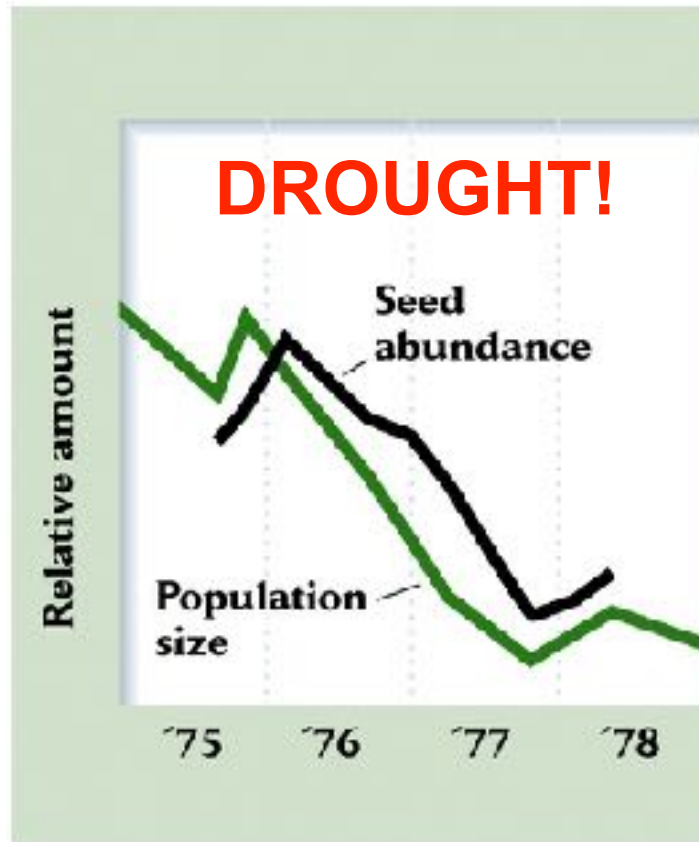


Field methods in a 'closed system'

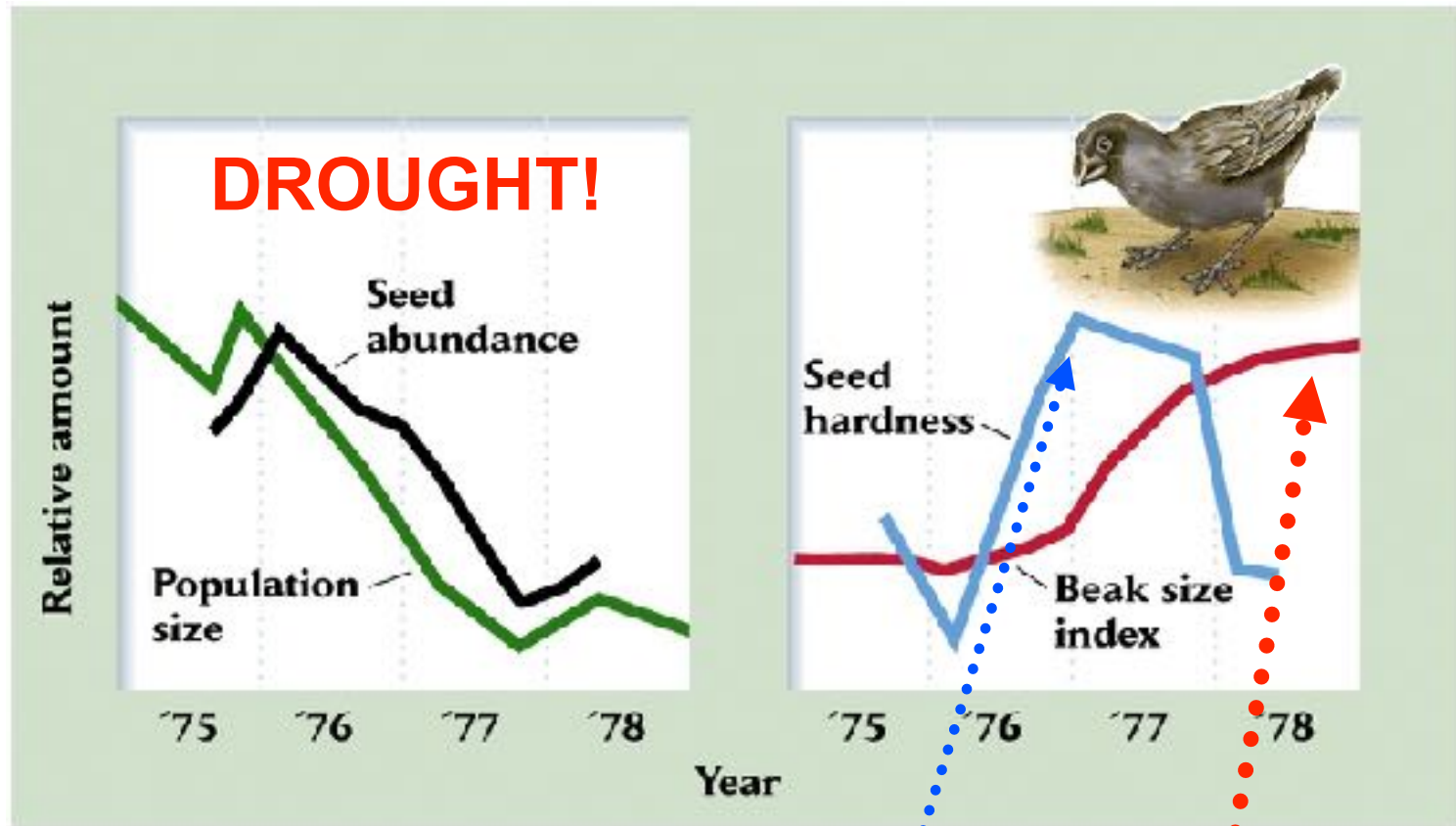
- Catch, measure, band all adults
- Find all nests
- Count eggs
- Measure & band nestlings
- Monitor nesting success
- Monitor adult & juvenile survival



Changes in beak size over time



Changes in beak size over time



Only seeds left were the largest ones

Only largest billed-birds able to survive

Was change due to phenotypic plasticity or evolutionary change?

Without genetic variation underlying the trait, genotypes in next generation would be just like those before selection 'event' (i.e., change could be due to phenotypic plasticity)

- Grants found: bill size & shape had positive heritability



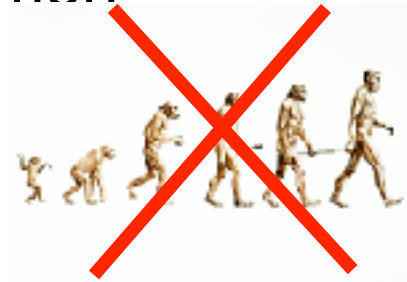
Clear thinking about natural selection

- Variation does not arise because organism needs to respond to a challenge in the environment
 - Variation either exists or it doesn't (requires mutations, immigration)
- If there is genetic and phenotypic variation, then there is potential for NS to lead to evolution



Clear thinking about natural selection

- Evolution proceeds as a tree, not a ladder
 - All extant species have been around the same amount of time since their most recent common ancestor
- Magnitude of evolutionary time is almost impossible for us to really comprehend
- NS works with what it has already available; evolution is not a steady march toward perfection (e.g., blind spot)
- NS is not a guide to social policy or morality (it may help us understand behavior, but not justify it)



Explain how evolution
can occur without
natural selection



Explain how natural selection can occur without evolution

