Anthro 101: Human Biological Evolution

Lecture 4: Evolution by Natural Selection

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Darwin and the history of evolutionary thinking

• Historical Context

• Darwin’s theory of evolution
• Darwin’s postulates in nature
• The finer points of natural selection
• Common myths about natural selection
(a) Lamarck's view
Original, short-necked ancestor
- Keeps stretching neck to reach leaves higher up on tree
- And continues stretching until neck becomes progressively longer
- Long-necked descendant after many generations

(b) The Darwin-Wallace view
Original group exhibiting variation in neck length
- Natural selection favors longer necks
- The favored characteristic is passed on to next generation in greater proportion than the shorter neck
- After many, many generations, group is still variable, but showing a general increase in neck length
Evolution changes the characteristics of a population, NOT an individual.
The Vocabulary of Evolution

• **Evolution**: Change over time

• **Natural Selection**: Process by which species evolve

• **Reproductive Success**: The number of offspring an individual produces and rears to reproductive age

• **Fitness**: A measure of *relative* reproductive success

• **Adaptation**: An anatomical, physiological, or behavioral trait which improves an organism’s fitness *in a given environment*

• **Selective Pressures**: Forces in the environment that influence reproductive success in individuals
Birds of the Galapagos show us how natural selection works.
Postulate 1: Environment constrains population growth

- Severe drought occurred 1976-78
- Drought affected seed availability and quality
- Many birds died of starvation
Postulate 2: Individuals vary in ability to survive and reproduce

- Beak size varies
- Small beaked birds have trouble with large seeds
- During drought, larger beaked birds were at advantage
Postulate 3: Variation is transmitted from parents to offspring

- Beak size is inherited
Characteristics of population changed over time

- Large beaked adults survived better
- Large beaked birds had large beaked offspring
- Mean beak size increased in population
But, natural selection can: produce change (Directional Selection) or maintain status quo (Stabilizing Selection)

- Small beaked birds can’t find enough food
- Large beaked birds have higher juvenile mortality
- Selection favors intermediate beak size
- At equilibrium, selection will maintain stasis (no change)
Darwins Finches

- http://www.youtube.com/watch?v=l25MBq8T77w
Ok, you guys break it down

• How is Darwin’s Theory of Evolution different than Lamark's?
• Can evolution effect individuals?
• What are Darwin’s 3 Postulates?
Adaptations evolve in many small steps each favored by natural selection

- The key to natural selection is variation + selective retention
- Small changes occur
- Selection retains beneficial changes
- Complexity emerges
- Each step must be favored by natural selection
Evolution can produce rapid change

- Examples in nature
  - Radiation of Darwin’s finches (≈ 500,000 yrs)
  - Radiation of African cichlids (≈ 12,000 yrs)
Evolution doesn’t mean change towards greater complexity, progress, or improvement.
Loss and Imperfection

- Natural Selection can remove complexity
  - Cave fish lose eyesight
  - Penguins have small wings

- Imperfect features
  - Human fondness for sugar, fat, salt
  - Peacock’s tail
  - Human appendix
MYTH: ‘Survival of the fittest’ justifies everyone for themselves

- Survival of the fittest is NOT natural selection
- Fittest does NOT always mean most aggressive, strongest, most selfish

- Don’t use the NATURALIST FALLACY
  - “because its natural its the right way to behave, or its moral or good”

- Natural selection describes what happens in the world, NOT how we should chose to live our lives
MYTH: Evolution cannot be disproved

What would disprove evolution?

• Major jumps or different ordering in the fossil record
• Novel combinations that counter the predicted trajectory of evolutionary history
• Animals & plants that don’t change
• Young earth = not enough time for all that we see to have evolved
• Variety in the building blocks used by life and perfect forms
Key points

• Without variation, there can be no evolution
• Characteristics acquired during life are not heritable
• Whether a trait is favorable or not is determined by the environment
• Natural selection acts on individuals
  • Even at a cost to the population or species
  • No “good of the species”
• Populations evolve
• Small steps add up to more complex traits
Let's check out a real example

• [http://www.youtube.com/watch?v=wrTXvrKBlbc](http://www.youtube.com/watch?v=wrTXvrKBlbc)
Homework

• Video and Questions on WEBSITE!!!

• Watch video at home again and answer questions on the website.

• Due Monday