

Anthro 101:
Human Biological Evolution

Lecture 6: Macroevolution & Speciation

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Reminders

- Exam next class
- Taxonomy Project Wednesday
 - homework on the website

Species are easy to recognize but hard to define

Biological species concept

- Fertile interbreeding (gene flow)
(gets stopped by) Reproductive isolation

Ecological species concept

- Exploit a single ecological niche
- Natural selection keeps same

The Birds of Northern Melanesia SPECIATION, ECOLOGY, AND BIOGEOGRAPHY



Ernst Mayr ~ Jared Diamond

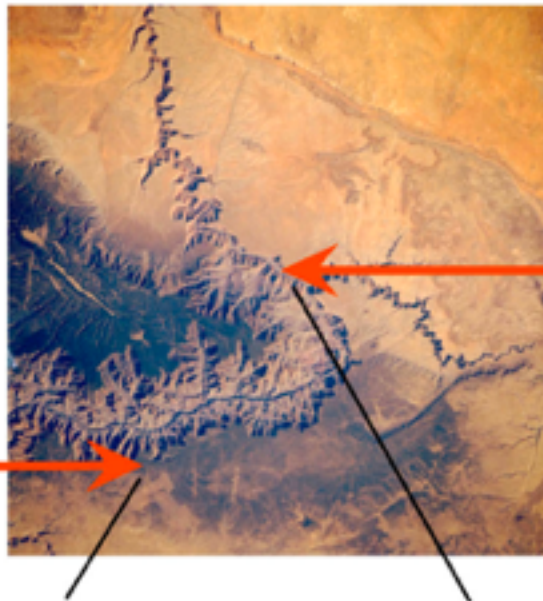
Biological Species Concept: Reproductive isolation prevents gene flow

- Isolated populations can't exchange genes
 - Geographical barriers (pre-mating)

Kaibab Squirrel



Grand Canyon



Abert's Squirrel



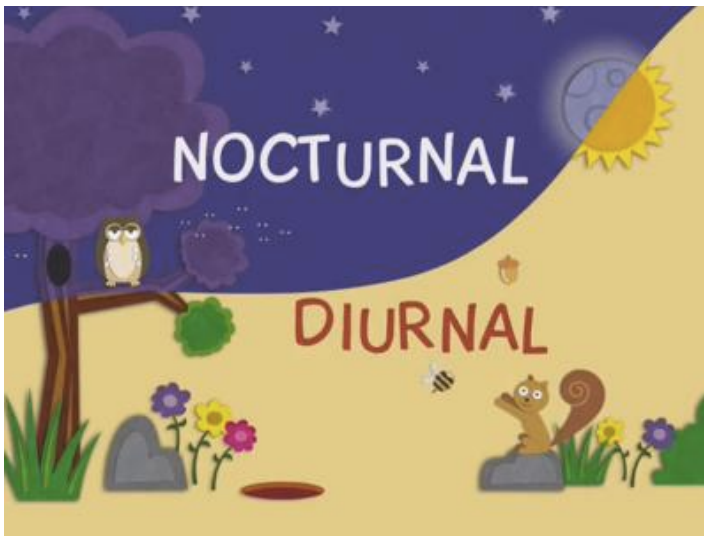
Kaibab Plateau North Rim of Grand Canyon

South Rim of Grand Canyon

Biological Species Concept:

Reproductive isolation prevents gene flow

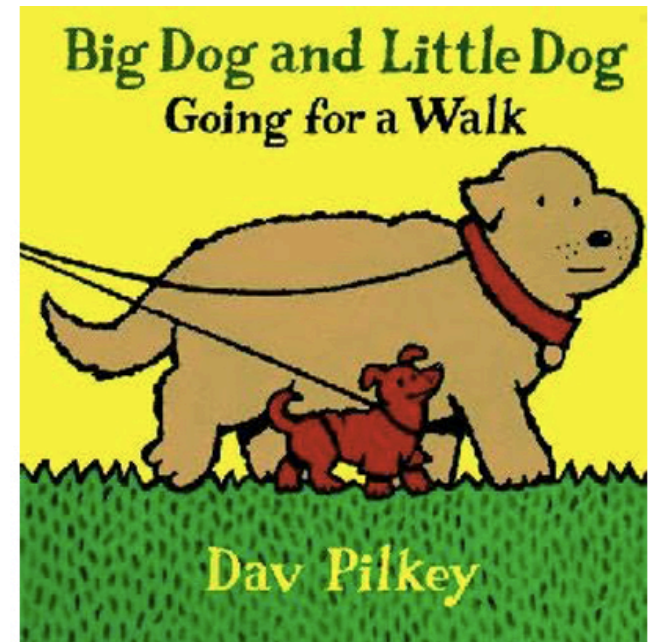
2. Behavioral differences (pre-mating)
 - Temporal isolation
 - Behavioral isolation



Biological Species Concept:

Reproductive isolation prevents gene flow

- Mechanical incompatibility (pre-mating)



Biological Species Concept:

Reproductive isolation prevents gene flow

Reduced Fertility of accidental matings... (post-mating)

- Sperm-egg incompatibility
- Zygote failure
- Embryonic failure
- Offspring death
- Offspring sterility



Zedonkey – sterile hybrid

Biological Species Concept

Problems:

- Gene flow can occur between “good” species
- Medium finches mate with large ground finches 10% of time
- Why aren't they one species?



Large ground finch



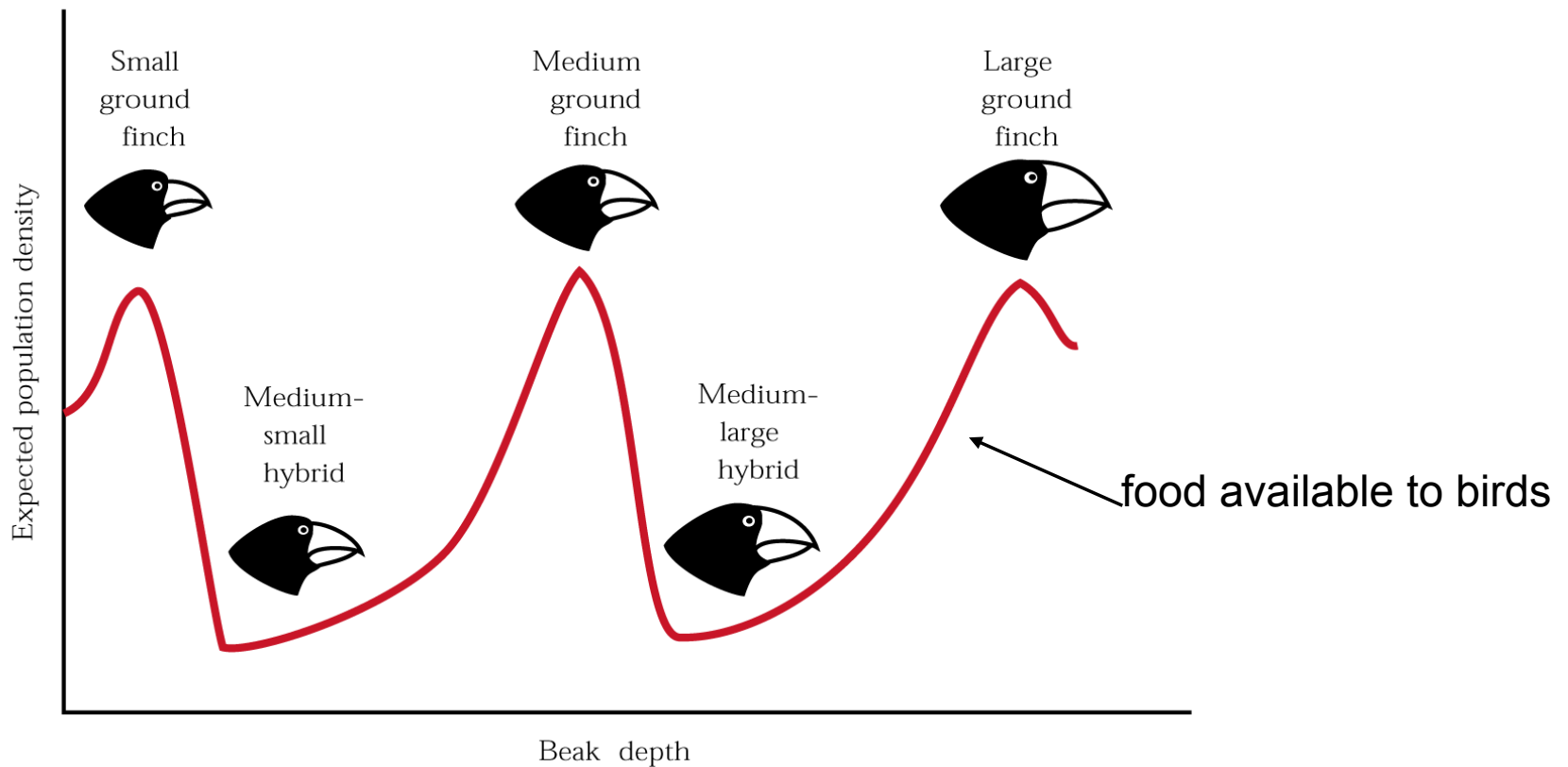
Medium ground finch

biological species concept

- <http://www.youtube.com/watch?v=PKb8Yi5xzhE>

Ecological species concept is based on selection

- Selection favors certain phenotypes in a particular niche
- Hybrids do poorly (post-mating reproductive isolating mechanism!)



Ecological species concept is based on selection

- Selection maintains differences between species even if gene flow occurs
 - ♦ Darwin's finches
- Selection maintains similarity between species even if no gene flow occurs
 - ♦ Checkerspot butterfly



Checkerspot butterfly

How does a new species form?

- **Speciation** - process by which a new species evolves from an earlier species = **macroevolution**
- **Adaptive Radiation**
 - ♦ Competition pushes some individuals to exploit new habitats
 - ♦ Diversify and separate from original species
- **Adaptive potential (species & traits)**
 - ♦ Generalized
 - ♦ Specialized



Crash Course Speciation

- <https://www.youtube.com/watch?v=2oKIKmrbLoU>

Generalized vs. Specialized Traits

Hands vs. Feet



Generalized vs. Specialized Species: Norwegian Rat vs. Naked Mole Rat



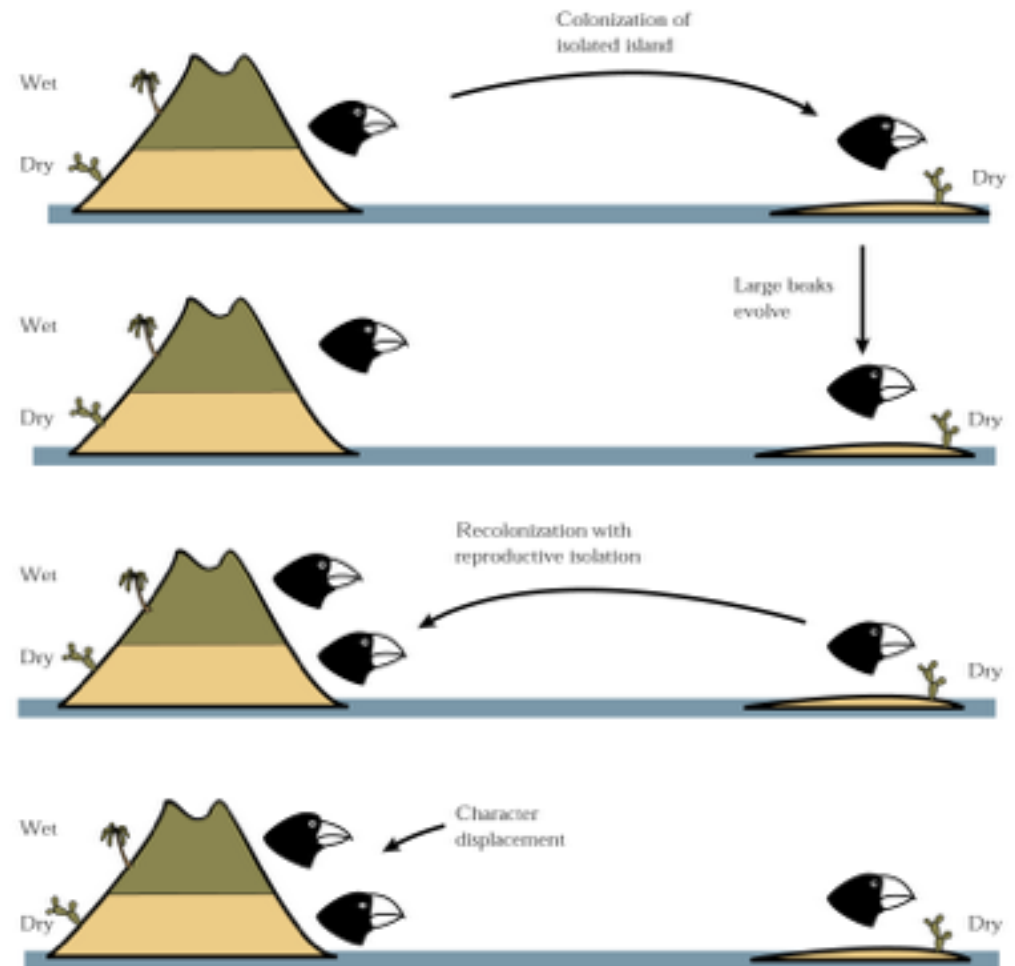
Two kinds of speciation

- Allopatric speciation
- Sympatric speciation



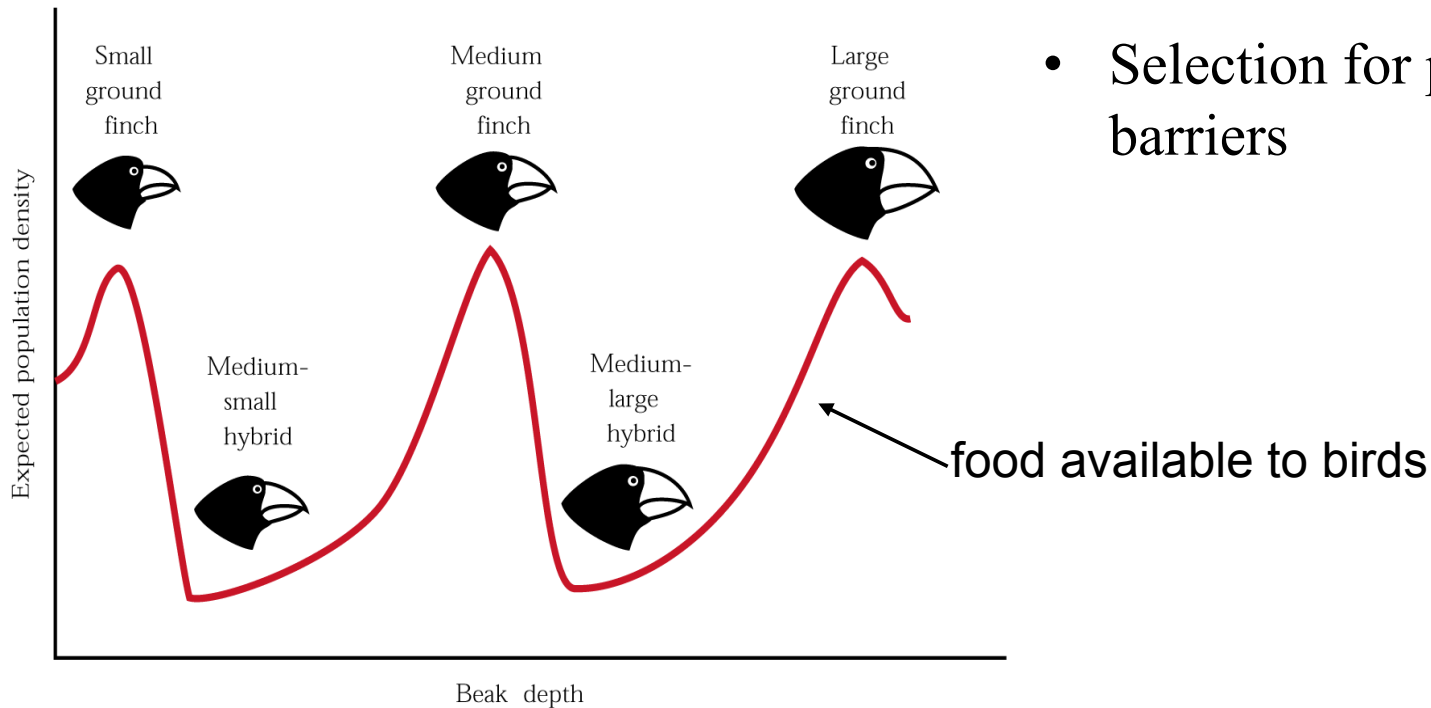
Allopatric Speciation

- **Closely linked to biological species concept**
- Gene flow interrupted
- Isolated population adapts
- If the two populations reunited
- **No longer able to interbreed**



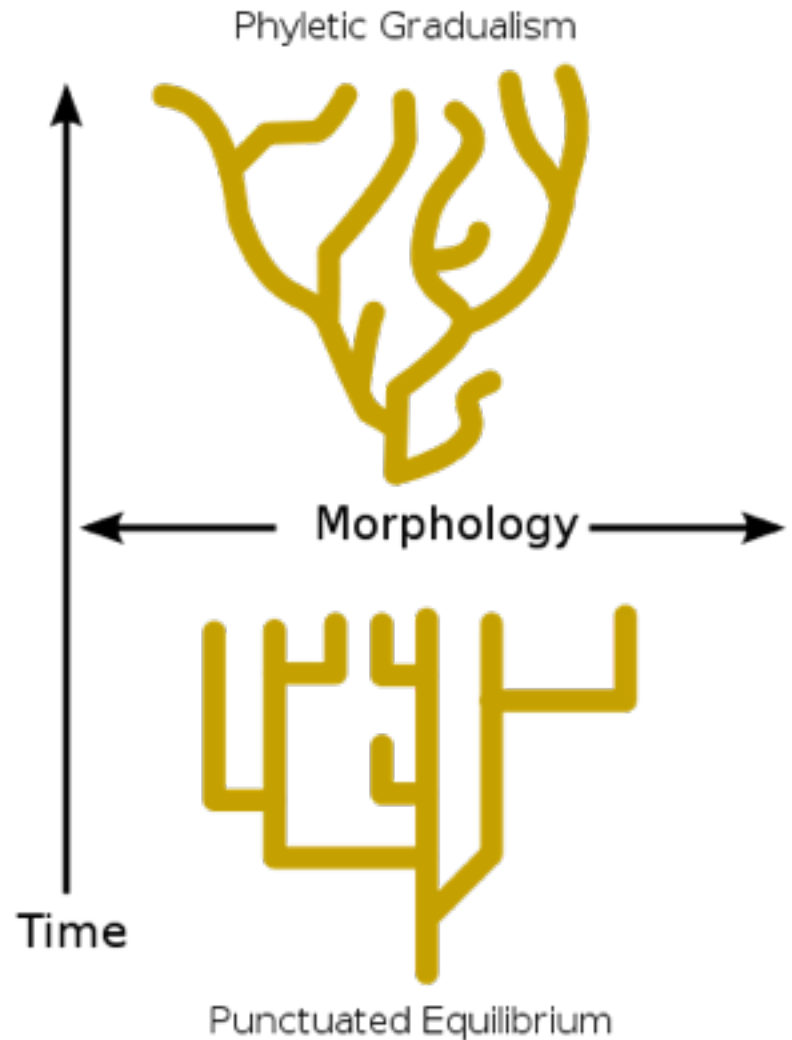
Sympatric species kept distinct via Reproductive Isolating Mechanisms

- Hybrids do poorly
- Selection for pre-mating barriers



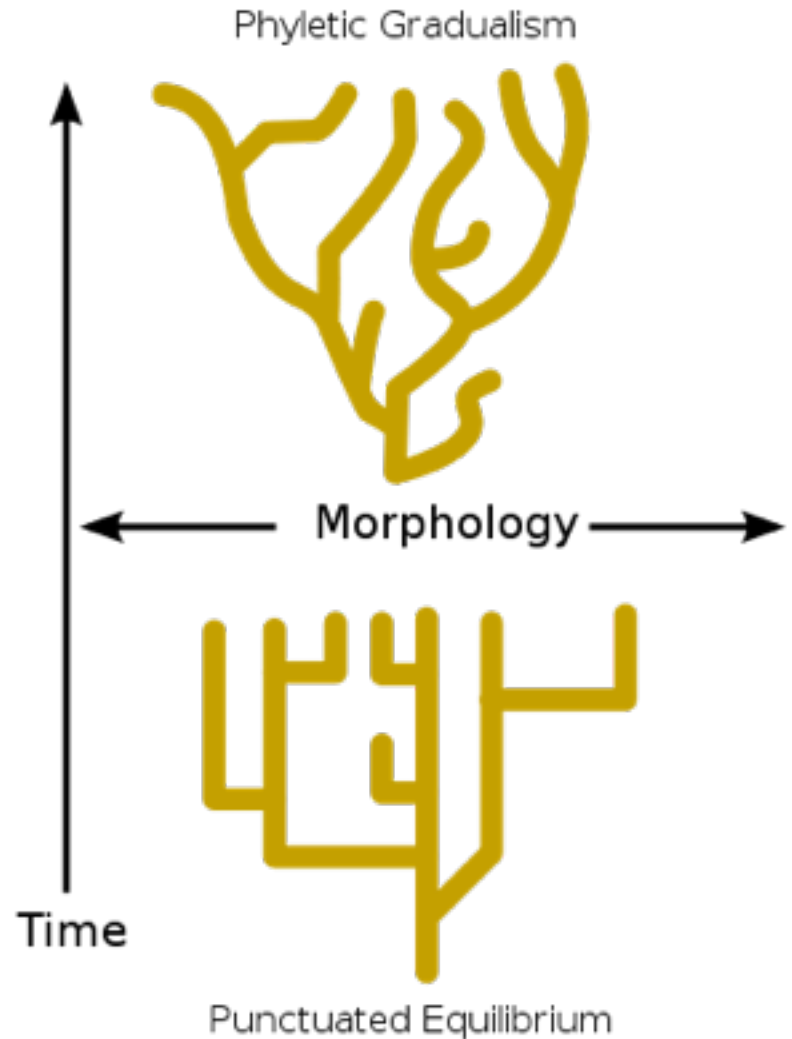
The tempo of evolutionary change

- **Gradualism** - Microevolution leads to the accumulation of small changes over time
 - ♦ Fossil record one long series of small changes from one generation to the next
 - ♦ Small differences eventually add up to a new species



The tempo of evolutionary change

- **Punctuated Equilibrium** - evolutionary change proceeds through long periods of stasis punctuated by rapid periods of change
- Transition to new species is rapid
- Evolution leads to new species (rather than gradual changes in same species)



questions

- What are the two species concepts
 - explain how they both work
 - give an example

Example text questions

1. Why is geographic isolation important for the process of speciation? What is this process called and briefly explain what would happen following geographic isolation. What might happen if the two populations moved back into the same area again?
2. What are the sources of variation and the forces that can alter variation in a population? Tell a story about the evolution of a new squirrel species using the vocabulary of variation, species, and speciation.

The Species Debate

- This video goes over why figuring out a species is not an easy gig.
- <http://naturedocumentaries.org/820/species/>