Biol 405/505

Principles of Organic Evolution

Instructor: Dr. Mark Dybdahl
Outline

• What is organic evolution?
  - Descent with modification
  - Natural selection
• Darwin’s insight
• Evolution of the theory of evolution
• What evolution explains?
• Course logistics & info
What is Organic Evolution?
What is Organic Evolution?

Change over time

1928

today
What is Organic Evolution?

Change in the form, physiology, life-history, or behavior of organisms between generations.
What is Organic Evolution?

Populations evolve, individuals do not.
What is Organic Evolution?

Current species are evolved from pre-existing, ancestral species.
Darwin's Insight

Charles Darwin
1809-1882

H.M.S. Beagle
(1831-1836)

Origin of Species, 1859
Darwin’s Theory of Evolution

1. Species evolve over time: “descent with modification”

2. Adaptations arise by natural selection

Charles Darwin
The Insight

Alfred Russell Wallace
1823–1913

• Similar ideas
• Less evidence
Descent with Modification

Organic Evolution -->
  tree-like branching
  • splitting, extinction
  of lineages

1. Species are
   Ancestral & Derived
2. Common ancestors

Phylogeny
Descent with Modification

Variation, divergence from common ancestor

“Germanic” from German type

“Romance” from Latin

Good day (English)
Guten tag (German)
Goedendag (Dutch)
Buongiorno (Italian)
Bonjour (French)
Bom día (Portuguese)
Buenos dias (Spanish)
Natural selection

variability

heritability

competition

Fitness differences

Freq. of long necks increases
Before Darwin

Two views:
1. Species were immutable, fixed
2. Species changed but there was no mechanism
2. Species change

- Aristotle’s “Great Chain of Being”
- Evolutionary “ladder”
- Progressive
- Mechanism = Supernatural force
2. Species change

Jean-Baptiste Lamarck

Mechanism of species Change:
Inheritance of acquired characters

1744-1829
After Darwin: 'Evolution' of the theory of evolution

1. Species evolution:
   - Quickly accepted

2. Natural selection:
   - Controversial until 1920s
   - No mechanism of inheritance
“Evolution of a theory”
Natural selection?

Problem: No mechanism of inheritance

- Darwin accepted Lamarckian heredity
- A. Weissman 1880’s: acquired characters are not inherited!
After Darwin

- 1900–1920 Mendelian genetics rediscovered
- 1940’s Modern Synthesis

Evolution: Changes in gene frequencies of populations over time

Fig 3.3a
“Evolution is just a theory”

**Oxford English Dictionary**: 2. “a hypothesis that has been confirmed or established by observation or experiment, and is propounded or accepted as accounting for the known facts.”
What does evolution explain?

Why study Evolution?

1. The processes that create biodiversity
   - Macroevolution
   - Lineage branching
   - Extinction
• Microevolution and speciation
• Darwin’s finches, Galapagos: divergence

Adaptive radiation of 14 species of Darwin's finches. Figure from Grant, 1986.
What does evolution explain?

2. The shape of life: mechanisms of adaptations

Darwin (1859)

'how the innumerable species inhabiting this world have been modified, so as to acquire that perfection of structure and coadaptation that most justly excites our admiration.'
What does evolution explain?

3. The history of life
   • Ancestor of whales?
   • Ancestor of modern humans?

Fig. 14.4
What does evolution explain?

4. Evolution and society: The management of...

- infectious disease
- crop pests
- endangered species
- fisheries
- etc...
What does evolution explain?

“Nothing in biology makes sense except in the light of evolution”

T. Dobzhansky, 1900-1975
There are two main features of Darwin’s theory: Organisms evolve, and natural selection leads to Adaptation.

Natural selection was controversial, and Darwin Agreed with Lamarckian inheritance.

The rediscovery of Mendel’s laws of inheritance And its incorporation into Darwin’s theory lead to The Modern Synthesis.

The theory of evolution underwent important changes Until it was universally accepted, and continues to Change today.