Lecture Notes 1/25/02: Natural Selection

Outline

- What is natural selection?
  - Darwin’s observations
  - Necessary Conditions/ logic
- How does it work?
  - Galapagos finches (evolution in action)
  - HIV application

Variability

- Finches on different Galapagos islands came from common ancestor
- Adaptation – “fit” between beaks and food

Inheritance

- Darwin thought a lot about his family

An influence – Thomas Malthus

- (1798): An Essay on the Principle of Population
  - populations grow faster than food supply
  - population growth checked by famine, disease and war

Another influence – Charles Lyell

- Scottish lawyer/ geologist
- Principles of Geology (1830-1833)
  - earth was old
  - Earth changed slowly
  - No direction to earth history

Differential Reproductive Success

- Fact #1 – Overproduction of offspring/ struggle for existence
- Fact #2 – Individual variation
- Conclusion – unequal reproductive success
  - “Survival of the fittest”

Darwin’s Finches- An Example

Galapagos Islands; 14 species; Similar appearance; variation in size and beak measures

- Variability in beak depth (1976)
- Beak depth is heritable
  - offspring resemble parents
- Competition –
– seeds limited during winter
– as seed ↓, so did # finches

• Non-random success
  – Birds w/bigger beaks survived & reproduced

• Evolution –
  – Population had bigger beaks on average
  – Avg. body size ↑

HIV/AIDS – Another example

• 40 million people infected (HIV) worldwide
• >23 million in Africa!
• ~ 3 million in Americas
• China- 67% ↑ in 1 year!

Key point: HIV uses host cell’s own machinery to copy itself
HIV is RNA virus – first makes DNA, then its DNA gets into host cell
  HIV causes AIDS because it destroys cells of immune system

Why so hard to treat?

AZT inhibits HIV replication – prevents virus from making DNA
BUT, Virus Mutates quickly – AZT target changed! (Variation)

Lessons about HIV from evolutionary biology:
• HIV continually evolves resistance
• Resistant strains likely to increase
• Use drug cocktails
  – Some suggest no drugs for awhile – “wild type” increases again
• Simple vaccine unlikely
• Best defense: decrease transmission

Natural Selection: Key points

• Requires:
  1. Variation
  2. Heritability
  3. Differential reproductive success
• Acts on individuals, but shapes populations
• Neither progressive or forward-looking
• Adaptations usually benefit individuals, not groups, populations or species