Biology 1B—Evolution Lecture 1 (February 24, 2010), Introduction to Evolution

Why do we care about evolution?

1. Evolution helps us understand ourselves
    - By studying evolution, we better know our own place on a planet with 1.8 million identified species, and perhaps 10 million total species. We know that all species have evolved, and that we are not the pinnacle.
    - The context of evolution helps us know how to behave to members of our own species and to members of other species.
    - Evolution helps us understand the purpose and reasons for our physiology and anatomy.
    - Studying evolution has helped us in the field of human health because it has equipped us to fight many diseases. This is known as evolutionary medicine, a topic that will be discussed more later in the course.
      An example of evolutionary medicine is antibiotic resistance to penicillin. The drug was mass produced around 1943, and by 1947 the bacteria it was created to kill had begun to develop a resistance. The same is true of rapid evolution of the resistance of HIV to the 3TC drug today.
2. Evolution is a major part of the planet's food supply
    - The Green Revolution has led to a widespread application of monoculture crops, now including genetically modified organisms. Due to their genetic similarity, pests (weeds, insects, and pathogens) could take out entire crops.
    - Evolution comes into play as pests develop resistance to the insecticides and herbicides used to combat them.
3. Humans must acknowledge our own role in evolution
    - Humans have shaped the planet, and might be considered the greatest evolutionary force:

Invasive Species	Habitat Fragmentation	Climate Change
↓	↓	↓
Rapid Hybridization	Reduced Gene Flow	Many populations move, adapt, or go extinct

Development of the Theory of Evolution

Before Darwin, there was Aristotle and Linnaeus

- Aristotle had the idea of fixed species that were part of a great chain of being, or *scala naturae*
- This meant that all species sat somewhere along a hierarchy from slime molds to humans (at the pinnacle)
- Linnaeus developed the binomial system used today to classify organisms, though he did not work on evolution. See an example of his system of hierarchy below:

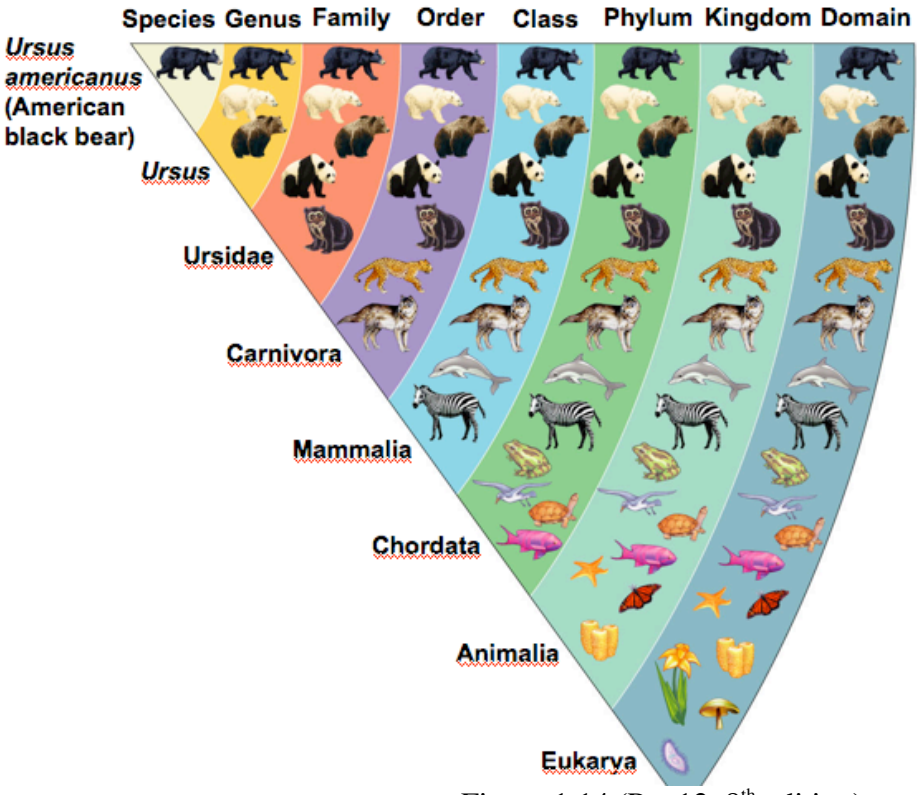


Figure 1.14 (Pg. 12, 8th edition)

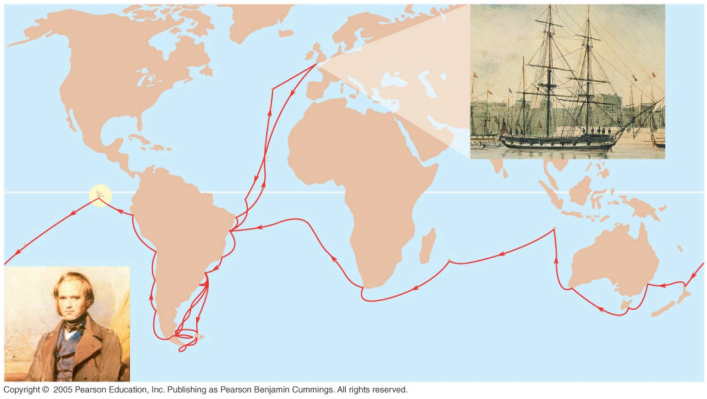
Darwin and Wallace's theory of evolution was based on two big ideas: descent with modification (which was not new to the world) and natural selection as the mechanism of evolution (this was their unique contribution).
They had many influences:

- The concept of species' ability to change (Buffon, Lamarck, and Erasmus Darwin)
- Biogeography, or the distribution of species across the globe (de Candolle, Humboldt, and Hooker)
- Taxonomic classification and hierarchy (Linnaeus)
- Population pressures and the idea that populations will run out of resources before they stop overproducing offspring (Malthus)
- Gradual geological change and uniformitarianism (Hutton and Lyell)
- Well-studies fossils and extinct species (Cuvier)
- Comparative anatomy and embryology (Huxley, Owen, and Saint-Hillaire)

Personal Influences on Darwin

Time on the *HMS Beagle*

- Darwin was hired as an educated companion and naturalist for the captain of this small ship, on the recommendation of his professors
- He spent 5 years on this ship and sailed a route that was literally around the world:



Formative experiences aboard the ship:

- His first look at tropical diversity was at a stop near Rio, Brazil, where the exuberance of biodiversity blew his mind!
- Darwin was in the Andes during a major earthquake that unearthed some fossils that he recognized as related to living species. The uplift also made him consider geologic change (Lyell's influence)
- Upon visiting islands, Darwin began to see how species changed from a common ancestor that colonized the island
  Island mockingbirds that resembled a mainland ancestor:

Darwin's Finches

- He studied 14 species, about half of the species present on the Galapagos Island
- Darwin thought that the finches were many species, such as grosbeaks and blackbirds, but upon returning to England, an ornithologist pointed out to him that they were all finches
- The finches are a good example of adaptive radiation

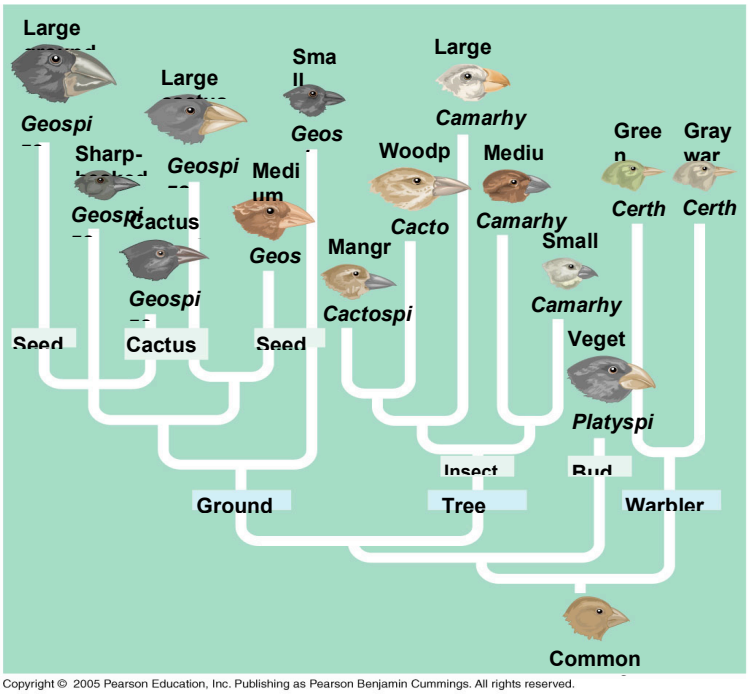


Figure 1-22: A finch classification tree (pg. 17, 8th edition)

Alfred Russel Wallace

- Unlike Darwin, Wallace came from humble backgrounds and started his work as a naturalist collecting specimens to sell to gentlemen collectors
- Went to the Amazon after Darwin had returned from his voyages on *The Beagle* and lost his entire collection due to a boat fire
- After returning to Britain, he traveled to the Indo-Malay archipelago for 8 years. While there, and shaking with Malaria, he remembered the works of Thomas Malthus (population studies) and wrote two papers that he sent back to England
- One paper outlined the Sarawak Law, or "Every species has come to existence coincident both in time and space with a pre-existing, closely related allied species"—Alfred Russel Wallace
- Wallace sent his paper on evolution by natural selection to Darwin, which immediately pushed him to publish a summary of his own work alongside Wallace's.