

## EVOLUTION, LECTURE 6: SPECIATION (501–504, 525–531)

Before we discuss that “mystery of mysteries” (speciation), we need to establish our species concepts. Numerous such concepts are available in the published literature, but we will focus on three of them: the **morphological species concept** (MSC), the **biological species concept** (BSC), and the **phylogenetic species concept** (PSC).

The MSC distinguishes among species based on appearance (morphology, anatomy). This is a widely used approach that is grounded in common sense. If two things look very much alike, they are the same species, if they appear different, then they are assigned to different species.

The application of genetic analysis to the study of organismal relationships has confirmed most hypotheses of organismal relationships based on morphology alone, albeit with many notable, and sometimes spectacular, exceptions. The MSC continues to serve scientists well, particularly paleontologists who often have only the gross form of organisms available for study.

**Phenotypic plasticity**, and **polymorphism** in general, have complicated the application of the MSC. In general, the MSC works best when used by a skilled and experienced investigator.

**Ernst Mayr** introduced the biological species concept in the 1950s, and he grounded the new concept in the tenets of population genetics and the Evolutionary Synthesis. According to the BSC, a species is a population (or a group of populations) whose members have the potential to interbreed in nature and produce viable, fertile offspring. The emphasis of the BSC is on reproductive isolation and the barriers to gene flow.

Please see your book (Figure 24.4) for a summary of the **prezygotic** and **postzygotic** mechanisms that maintain the distinctiveness of species.

The *Ensatina* **ring species** complex presents an interesting challenge to a strict application of the BSC.

A central question that exercised Darwin during his long voyage was the question of how new species are formed. We can define **speciation** as a lineage-splitting event that produces two or more separate species.

The distribution of species on islands was of particular interest to Darwin, and the study of islands remains an important part of evolutionary biology. The speciation of an original colonist, or group of colonists, in an island environment, is a type of **allopatric speciation**.

**Vicariance**, or the splitting of a population by a geographic barrier, is another process that can lead to speciation. Note that organismal natural history (such as relative **vagility**) can influence the relative effectiveness of a geographic barrier to the prevention of gene flow (contrast squirrels and dragonflies, for example).

**Parapatric speciation**, a type of allopatric speciation, is related to the formation of peripheral isolates at the margin of an original population's range. Why would we expect small peripheral isolates (with low numbers of individuals) to be good candidates for speciation? **Incipient species** are those populations that are in the process of forming good species.

How do **refugia hypotheses** (related to glaciation, or fire) relate to the distribution of organisms in the world today (for example in the forests of South America)? And what is the connection to speciation?

**Sympatric speciation** refers to species formation in populations that occupy the same geographic area. As in allopatric speciation, the establishment of a barrier to gene flow is critical to the process.

We discussed the potential roles of **disruptive selection**, **female mate choice** (in cichlids), **microhabitat specificity** (in *Rhagoletis* flies), and **polyploidy** (in a large number of plant species) as mechanisms of sympatric speciation. Please be careful to distinguish **autopolyploidy** from **allopolyploidy**.

We finished by discussing **adaptive radiation**—defined as evolution of a group of diversely adapted species upon introduction to a new environment—and I mentioned three examples from the Hawaiian archipelago (the silversword alliance, *Drosophila* fruit flies, and the Hawaiian honeycreepers), as well as the classic case of Darwin's finches.