

Modes of Speciation & Adaptive Radiation

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Prepared By Dr. Sujoy Midya
Assistant Professor
Department of Zoology

Modes of Speciation:

The modes of speciation that have been hypothesized can be classified by several criteria including the geographic origin of the barriers to gene exchange, the genetic bases of the barriers, and the causes of the evolution of barriers. Speciation may occur in three kinds of geographic settings that blend one into another.

1. Allopatric speciation :

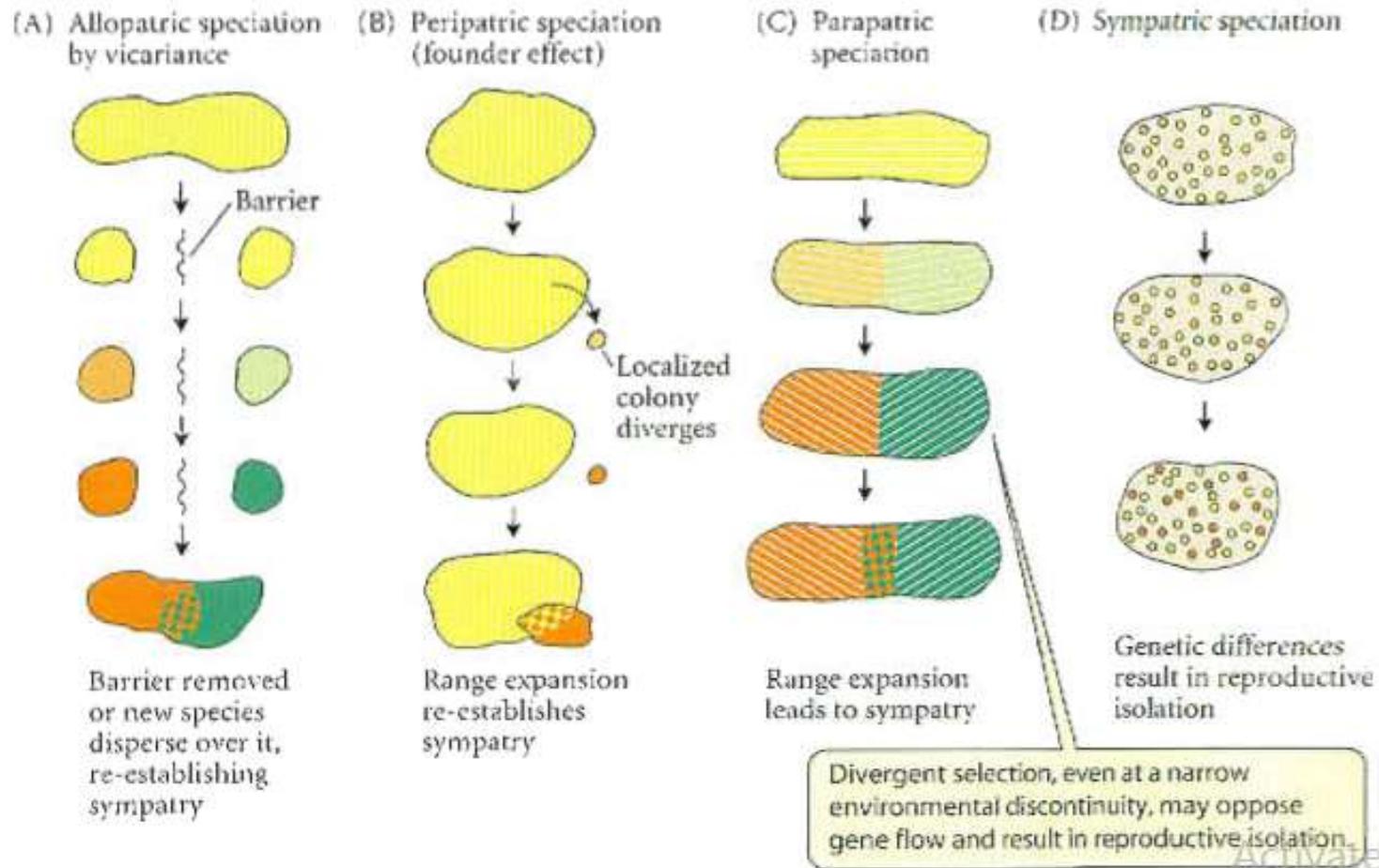
Allopatric speciation is the evolution of reproductive barriers in populations that are prevented by a geographic barrier from exchanging genes at more than a negligible rate.

2. Peripatric speciation: Peripatric speciation (divergence of a small population from a widely distributed ancestral form).

3. Parapatric speciation

In parapatric speciation, neighboring populations, between which there is modest gene flow, diverge and become reproductively isolated.

4. Sympatric speciation : Sympatric speciation is the evolution of reproductive barriers within a single, initially randomly mating population.



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Diagrams of successive stages in each of four models of speciation differing in geographic setting. (A) Allopatric speciation by vicariance (divergence of two large populations). (B) The peripatric, or founder effect, model of allopatric speciation. (C) Parapatric speciation. (D) Sympatric speciation.

Allopatric speciation:

Allopatric speciation is the evolution of genetic reproductive barrier between populations that are geographically separated by a physical barrier such as topography, water (or land), or unfavorable habitat. The physical barrier reduces gene flow sufficiently for genetic differences between the populations to evolve that prevent gene exchange if the populations should later come into contact. Allopatry is defined by a severe reduction of movement of individuals or their gametes, not by geographic distance. Thus, in species that disperse little or are faithful to a particular habitat, populations may be "microgeographically" isolated.

All evolutionary biologists agree that allopatric speciation occurs, and many hold that it is the prevalent mode of speciation, at least in animals (Mayr,2004).

Peripatric speciation

Peripatric speciation, or founder effect speciation, is a hypothetical form of allopatric speciation in which genetic drift in a small peripheral population initiates rapid evolution, and reproductive isolation is a by-product. The likelihood of this form of speciation differs greatly depending on the mathematical model used. Although the geographic pattern of speciation predicted by this hypothesis may be common, there is little evidence for the process of drift-induced speciation.

Sympatric speciation

Sympatric speciation, the origin of reproductive isolation within an initially randomly mating population, may occur due to disruptive selection. However, the sympatric evolution of sexual isolation is unlikely, due to recombination among loci affecting mating and those affecting the disruptively selected character. Sympatric speciation may occur, however, if recombination does not oppose selection. For example, if disruptive selection favors preference for different habitats and if mating occurs within those habitats, prezygotic isolation may result. How often this occurs is debated.

Adaptive Radiation:

Evolutionary radiation is divergent evolution of numerous related lineages within a relatively short time. In most cases, the lineages are modified for different ways of life, and the evolutionary radiation may be called an adaptive radiation (Schluter 2000). The characteristics of the members of an evolutionary radiation usually do not show a directional trend in anyone direction. Evolutionary radiation, rather than sustained, directional evolutionary trends, is probably the most common pattern of long-term evolution.

Several adaptive radiations have been extensively studied and are cited in many evolutionary contexts. The most famous example is the adaptive radiation of Darwin's finches in the Galapagos archipelago. These finches, which are all descended from a single ancestor that colonized the archipelago from South America, differ in the morphology of the bill, which provides adaptation to different diets. Different species of *Geospiza* feed on seeds that vary in size and hardness. Other genera include *Camarhynchus*, which excavates insects from wood, *Certhidea*, which feeds on nectar and insects, and *Cactospiza*, in which one species has the unique habit of the using cactus spines as tools to extricate insects from crevices.

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