Sympatric Speciation

Source: IITB

Why in News?

A recent study from the **Indian Institute of Technology Bombay (IIT-B)** sheds light on the mechanisms of **sympatric speciation, challenging** the traditional view that new species can evolve only when populations are isolated by geographic barriers (a process called **allopatric speciation**).

What is Sympatric Speciation?

- **Definition:** Speciation occurs when a group within a species separates from other members of its species and develops its unique characteristics.
    - **Sympatric speciation occurs** when new species evolve from a single ancestral species **while inhabiting the same geographic region.**
- **Allopatric Speciation:** Traditionally, speciation was thought to occur mainly through allopatric speciation, it **occurs when a species separates into two isolated groups due to a geographical barrier,** leading to different development based on their unique habitat or genetic characteristics.
    - **Example:** When the **Grand Canyon formed in Arizona,** it separated a population of **squirrels and other small mammals**, leading to allopatric speciation.
        - As a result, **two separate squirrel species now inhabit** the north and south rims of the canyon.
        - In contrast, birds and other species were able to cross the canyon barrier and continue to **interbreed without being divided into separate populations.**

Other Types of Speciation

- **Peripatric Speciation:** It occurs when **small groups break off from a larger group to form a new species,** due to physical barriers preventing interbreeding.
    - The main **difference from allopatric speciation** is that in peripatric speciation, **one group is much smaller than the other.** Unique traits of the smaller group become more common in future generations**, distinguishing it from the others.**
- **Parapatric Speciation:** It occurs when a species is spread out **over a large geographic area, and individuals only mate with those in their region.**
    - Different habitats influence the development of different species in parapatric speciation. This can happen **when part of an environment is polluted,** leading to the **formation of unique species that are suited to survive** in different environments.

What are the Key Highlights of the Study?

- The study focused on three key factors like **disruptive selection** (where extreme traits are favoured), **sexual selection** (mate choice based on specific traits), and **genetic architecture** (how genes influence traits). Researchers simulated a bird population to understand these

processes.

- **Disruptive Selection:** Individuals with **extreme traits have higher fitness** than those with intermediate traits due to non-uniform resource distribution in the environment.
    - **Example**: Birds with small beaks were better suited for food resources like nuts, while those with longer beaks were more efficient at utilising flower nectar as food.
    - Researchers found the disruptive selection, favouring extreme traits based on environmental resource variations, can create a **"divide" within a population without geographic isolation.**
- **Sexual Selection:** Contrary to traditional belief, the study reveals that **sexual selection favouring resource-relevant traits** (e.g., beak size) drives sympatric speciation, not **arbitrary traits like feather colour.**
    - Arbitrary trait-based sexual selection does not lead to speciation. The study also notes potential lower offspring fitness due to sexual selection.
- **Genetic Architecture:** The study found that genetic architecture plays a key role in sympatric speciation likelihood. **Even with weak disruptive selection,** if genetic architecture permits trait changes (e.g., beak size), **new species can emerge.**

//