B. Sc. Part III Paper VII

05/02/24

Isolating mechanisms and their role in evolution

Mechanisms that prevent successful reproduction between members of two or more populations i.e. closely related species, that have descended from the same original population are called Isolating mechanisms. This is also an important pre-requisite of speciation. The role of Isolating mechanism in speciation was first of all recognised by the post-Darwinian evolutionist, Dobzhansky, in 1937.

Types of Isolation or Isolating mechanisms — Mayr (1970) and Stebbins (1971), have classified the reproductive Isolating mechanisms into two classes namely premating or prezygotic Isolating mechanisms and postmating or postzygotic isolating mechanisms.

I **Premating or prezygotic Isolating mechanisms** — It prevents wastage of gametes and so are highly susceptible to improvement by natural selection. It prevents interspecific crosses like fertilization and zygote formation. It is again of four types —

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1. Habitat Isolation : In such kind of Isolation, populations live in the same region, but occupy different habitats, so that potential mates do not meet.

2. Seasonal or Temporal Isolation - The populations exist in the same region, but are sexually mature at different times, so that, potential mates remain unable to mate.

3. Ethological Isolation - Three populations are isolated by different and incompatible behaviours before mating so that only potential mate occurs.

4. Mechanical Isolation - Cross fertilization or pollination is prevented or restricted by differences in structure of reproductive organs, so that, copulation is attempted but no transfer of sperms take place.

II Post-mating Isolating mechanisms - Fertilization takes place and hybrid zygote are formed, but these are inviable, or give rise to weak or sterile hybrids.

1. Gametic mortality - sperm transfer takes place but egg is not fertilized.

2. Zygotic mortality - Egg is fertilized but zygote dies.

3. Hybrid Inviability - Zygote produces an

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F_1 hybrid of reduced viability.

4. Developmental hybrid sterility — Hybrids are sterile because of abnormal segregation to the gametes of whole chromosomes or combination of genes.

5. Segregational hybrid sterility — Here also Hybrids are sterile as gonads develop abnormally or meiosis breaks down before it is completed.

6. F_2 breakdown — F_1 hybrids are normal, vigorous and fertile, but F_2 contains many weak or sterile individuals.

It is further recognized that for these reproductive Isolating mechanism to evolve, the separated populations of an original single group must be separated spatially or geographically or by time. Hence, three types of Isolation has been reported —

A. Isolation by time :— The palaeontological history of animals and plant suggest that the population at one time is always the descendant of the one living earlier. In Case of straight evolution or species simply get transformed gradually into a new species through accumulating genetic differences. If the

changes are great enough than a new species evolves. e.g. evolution of Horse. According to G.G. Simpson horse evolved some 16 million years ago in Eocene. It underwent successive changes produced by thousands of favourable mutations of every gene involved in the evolutionary trend of each characteristic.

2. Isolation by Distance - Sheer distance also acts as an isolating factor for a species which occupies a great range of area, which is unbroken by effective barriers. e.g. Wrens (birds) of South America. Wrens are found all over the continent but the wrens of one region differ from those of the other in colour changes, size, proportion and habits. Thus, only sheer distance can produce local races (subspecies).

3. Geographical Isolation - It is most common type of Isolation and occurs when an original population is divided into two or more groups by geographical barriers such as a river, desert, glacier, mountain or ocean, all of which prevent interbreeding between them, thus in the course of time, different mutations become incorporated in the gene

pools of the different groups. These differences are of such a great to nature that they don't interbreed, thus species have been formed by geographical Isolation. The e.g. Darwin's finches. Darwin found that there were 26 groups of finches among the Galapagos Islands. Only five of these groups are same as the finches found on the mainland. The other twenty-one were types peculiar to the groups of islands. Some of twenty one groups interbreed quite freely, while other didn't. Apparently, each of these groups became isolated by migration. Another example is provided by elephant seals. The Southern elephant seal, Mirounga leonina, occurs in the cool waters of the Southern hemisphere around Antarctica, coasts of South America, South Africa. A close ally, the northern elephant seal, Mirounga angustirostris, is found in cool waters along the coast of Western North America. However, the breeding populations of the two forms are separated by 3000 miles. Thus, these forms occupy discrete geographic or ecologic ranges separated by spatial barrier, are called Allopatric populations. And Such kind of Isolation is Allopatric Isolation and these species are called Allopatric Species.

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