E-Content entitled Speciation

Speciation is the process of formation of new species from existing populations. In the course of evolution, speciation involves the splitting of a single evolutionary lineage into two or more genetically independent lineages.

Allopatric Speciation

As a general rule, species is composed of a number of interbreeding population physically separated from one another to some extent and tend to pursue independent evolutionary path. When a true species is formed and the individuals are increased in number, then they tend to expand their range of distribution. During their expansions, they face different environment and as no two environments however close they may be are likely to be identical biologically and physically they are to adapt with this environment.

As environment is different, each population is exposed to differential selection pressure. So, different environments act as barrier to the population distributions. Two things may happen to the population. When they encounter such barrier, either they may extinct locally or may adapt to the environment by random gene mutations and genetic drifts on which selection pressure acts. This established genetic differences between the populations which previously had similar genetic makeup. These differences gradually accumulate and cause more and more genetic divergence in the population. This divergence will lead to the establishment of cline, geographical races and finally the distinct sub species. The members of any of these categories if allowed to interbreed, they will produce fertile hybrids. This means that complete reproductive isolation has yet to be established in these cases and though they may prefer to mate with the members of their own group. Addition of more mutant genes to the gene pool if gets selective advantages, then the gene pool will vary so much that interbreeding is not possible and it will establish reproductive isolation. Once reproductive isolation is established, the sub species is known as allopatric species.

Mayr(1942) defines allopatric speciation as "in sexually reproducing animals a new species develops when a population that is geographically isolated from the other populations of its parental species , acquires during this period of isolation, characters that promote or guarantee reproductive isolation after the external barriers break down."

Examples:

1) Fresh water animals show the greatest regional diversities in mountainous

regions where there are many river systems.

2) Darwin's finches in Galapagos Islands.

Sympatric speciation

The method of origin of reproductive isolating mechanisms within the dispersal area of the offsprings of a single deme without geographical isolation is called sympatric speciation.

Sympatric speciation is based on two postulates-

(i) the establishment of new population of a species in different ecological niches within the normal cruising range of the individuals of the parental populations and

(ii) the reproductive isolation of the founders of new populations from individual of the parental population. Gene flow between the daughter and parental population is inhibited by extrinsic factors and not by intrinsic factors.

The method of natural selection for phenotypic extremes in a population until a discontinuity is achieved is called disruptive selection (Mather, 1955) or diversifying selection (Dobzhansky, 1967).

But Mayr(1970) said that a selection pressure that would permit the survival of only two opposite extremes is unlikely under the variable conditions of natural environment, so how diversifying selection can lead to sympatric speciation. Mayr(1970,1975) expressed his doubt about sympatric species. He categorically said that allopatric speciation is the only important mean for gradual multiplication of species because sympatric speciation is not supported by strong evidences.

Examples: Different species of *Drosophila* have developed from *Drosophila virlis* which is regarded as ancestral type and has 6 pairs of chromosomes. From this ancestral stock *D. melanogaster*(4p), *D. pseudoobscura*(5p), *D. persimilis*(5p), *D.willistoni*(3p) have developed by chromosomal rearrangements and translocation.

Parapatric Speciation

Parapatric speciation is the development of reproductive isolation among the members of a continuous population in the absence of a geographical barrier.

Unusually a species boundary forms where there is an important environmental discontinuity as among populations of plants growing at the boundaries of different soil types. Soil discontinuities occur naturally, but unusually striking ones are created by mining activities that leave tailing with very high concentration of heavy metals that are detrimental to plant growth. The soils developing on the tailing at the Goginian lead mines near Aberystwyth, Wales, are highly contaminated with lead but they suddenly give way to normal rich pastureland. The pasture grass *Agrostis tenuis* is common to al sites but there is a sharp gradient in lead tolerance among plants in less than 20 meters. Plants on the mine tailings grow well under lead concentrations that are lethal to plants just a few meters away. Reproductive isolation exists between plants on contaminated soil and plants on normal soil because they flower at different times.

Parapatric speciation has occurred in landsnails of the genus *Partula* on the islands of Moorea, near Tahti, in the society of Islands. Eleven species of *Partula* have been described from Moorea, even though the islands is only 15 km wide at its widest. The species fall into two groups. The members of a species group may behave as distinct

species at one locality but hybridized freely at another place within 200 meters of it. Species boundaries occur where there is no obvious geographical feature likely to impose barriers to the movement of individuals.

This type of speciation has also been studied by White (1868, 1978). He observed that in sedentary wingless grasshoppers, populations within the broad range of the species differ in chromosomal configuration. White proposed that a chromosomal aberration- a partial isolating mechanism arose within a population and expanded its range, forming an even expanding narrow hybrid zone.

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