Quadrant II – Transcript and Related Materials

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Notes

Sibling species: Sibling species are defined as sympatric populations that are morphologically similar but are reproductively isolated. Sometimes two or more closely related species live in the same geographical area. Morphologically these species are more or less similar, but reproductively they are isolated; they can be identified by their breeding time, breeding habit and behaviour. Mayr (1942) has named these species as sibling species.

Sibling species occur in almost all animal groups but they are more common in insects.
Examples:

1. A well-studied example of sibling species is offered by genus Drosophila. ***D. pseudo-obscura*** and ***D. persimilis*** are so identical in their morphology that they are described as two races of the same species (race A and race B) by Lancefield in 1924. The salivary gland chromosomes of these two species are different, the gene arrangement in their chromosomes is different. Other minor differences occur in the sex comb, male genitalia and relative wing size. These two species coexist over a wide area without naturally occurring hybrids. Artificial crosses between the two produce F_1 Hybrids, of which only females are fertile and males are sterile. Lancefield found that the sterility is due to the difference is in the Y chromosome. Race A has J- shaped Y chromosome and Race B has V-shaped Y chromosome. With these observations, these races are now established as two distinct species and are described as sibling species. In addition to morphological and chromosomal differences, these two species exhibit differences in ecological, physiological and sexual behavior.

2. A number of species of genus Anopheles were found to represent sibling species. ***Anopheles maculipennis, A. atroparvus***, ***A. labranchiae***, ***A. sacharovi*** *and* ***A. subalpinus*** are all found to be morphologically similar, but they are reproductively isolated and they cannot produce viable hybrids.

Significance of sibling species:

Three-fold importance in Biology.

1. These provide an opportunity to test the validity of the biological species concept with regards to morphological species concept.
2. They are of great practical importance in applied biology, medical entomology, and in agricultural pest control.
3. They help in understanding the process of speciation. First the population of a species becomes isolated due to the intervention of geographic isolation. Then each geographically isolated population accumulates changes in its gene pool due to the effects of mutation and recombination. As a result of genetic drifts and natural selection, these differences accumulate in due course of time and each population becomes so much diverged genetically that it becomes reproductively isolated from others. This results in the formation of a new species.

But the morphological similarities between sibling species are on account of 'developmental homeostasis' and not due to genetic similarity.

Subspecies

A polytypic species consists of subdivisions which have been variously described by different authors. The oldest concept recognised only one subdivision of the species differentiated as subspecies, subspecies are subdivided into clines and clines into demes.

LINNAEUS recognised varieties within a species. In the beginning this term was used to describe nongenetic variants of phenotype caused by climatic effects. It means that a variety is a group of plants changed by an accidental cause which may be climate, temperature, soil or wind etc.

Linnaeus' term of 'Variety' included two types of cases:

1)Individual variants within a polymorphic population representing ecological variants.

2)Distinguishable populations in a polytypic species or geographical races.

The three great taxonomists, Rothschild, Hartert and Jordan replaced the term variety by subspecies and restricted its use to the populations of a polytypic species.

As already stated before, the term subspecies when it came into general usage in taxonomy was a replacement of the term variety and represented a geographically and morphologically distinguishable population of a polytypic species. But it is seen that species is not a static unit but a dynamic structure ever changing due to the impact of various factors. Therefore, a species hardly comprises of uniform subtypes but comprises of infinite number of local populations (demes).

The modern definition of subspecies is different from that of Linnaean geographic variety and is summarised as

A subspecies is an aggregate of geographically isolated local populations (demes) of a species, which inhabit a geographic subdivision of the range of species and differ genetically as well

as morphologically from other populations of the species, but still interbreed or are capable of interbreeding and producing fertile hybrids.

In simple terms, these are geographically isolated populations of a species which are capable of interbreeding and producing fertile hybrid.

The subspecies is endowed with following characteristics.

1. A subspecies is a collective category or major subdivision of the species, composed of many local populations or demes.
2. Every subspecies has a normal name (trinomial nomenclature) having generic, specific and subspecific designation, for example, ***Panthera tigris tigris***.
3. A subspecies has diagnostic morphological features.
4. A subspecies inhabits a definite geographic subdivision of the range of distribution of the species.
5. The individuals of different subspecies of a species are not reproductively isolated that means they are interfertile and whenever they get an opportunity to interbreed, they produce sexually reproducing hybrids.

Examples of subspecies

1.The Australian golden whistler *(**Pachycephala** pectoralis) or* golden whistler has as many as 59 subspecies according to some authorities while others treat several of these as separate species (one of the highest number of subspecies in any bird)

2.Another example is deer mouse, ***Peromyscus maniculatus***, Largest of the species groups having 61 subspecies that range over a large geographic area and a variety of habitats in North America.

Differences between species and subspecies

1.Members of different species do not interbreed when they come in contact. Members of the different subspecies of the species, when they come in contact interbreed producing fertile hybrids i.e., they do not exhibit reproductive isolation.

2. Morphological differences between members of different species are usually greater than those found between members of different subspecies of a single species.

3.Species may occupy different territories (allopatric) or may occur in the same area (sympatric) or their areas of distribution may overlap. In all three cases, naturally occurring hybrids are not found.

Different subspecies occupy separate territories. Their territories usually do not overlap. In case their areas of distribution overlap, naturally occurring hybrids are frequently found.

How do subspecies arise from species?

A species population whether it has continuous or discontinuous distribution never forms one large one randomly mating population. However, how much uniform distribution it might have, each species is composed of a number of allopatric breeding populations, each separated to

some extent from others and pursuing its own independent evolutionary path. Moreover, organisms have a tendency to migrate and disperse so as to get a better opportunity of living. When descendants of a parental stock migrate out from a centre of dispersal and spread out in different areas, they become separate from each other both by distance and by other geographic or physical barriers. Although these populations in the beginning had very similar genetic constitution, but since they are living in different localities having different environment and are totally out of contact with each other, they gradually develop differences due to different selection pressures of the environment. As a result, they come to differ from the original parent stock and from other diverging groups.

Each group would then be ranked as a separate subspecies or a geographic race.

Evolutionary significance of subspecies in speciation.

The subspecies are regarded to represent a small step in the divergence of different species from a parental species. The different SUBSPECIES of a species gradually accumulate more and more structural and genic differences and a stage is ultimately reached when these become reproductively isolated. Such reproductively isolated group are then considered as a separate species. Therefore, A SUBSPECIES represents a step in the evolution of species.

A very good example of such speciation and subspeciation is illustrated in nature by Darwin's Finches of Galapagos islands. These birds have descended from the parental stock which migrated from the main island and occupied different islands. In several islands of the Galapagos Archipelago, these birds have gradually differentiated independently into 14 species which exhibit morphological differences as well as reproductive isolation. Some of these species are found to be differentiated into subspecies.