* Concept of Species

Dr . G. B. CHAND

Associate Professor

Aquatic toxicology Laboratory

Department of Zoology

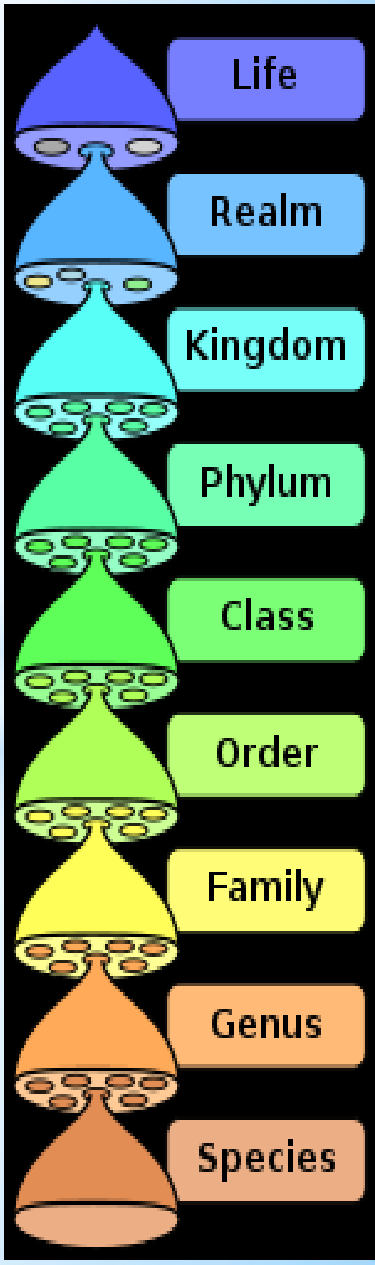
Patna University, Patna

Email : gbchand@rediffmail.com

INTRODUCTION

What is a species ?

- According to **Cuvier (1829)-"**The species is the assemblage descended from one another or from common parents and of those, who resemble each other".
- **Thompson** defined **species** as "The group of individuals distinguished by an inducible set of constant properties and connected by descent and genetic relationship".
- According to **Dobszhansky (1937a)"**there is a single systematic category, which in contrast to others , withstood all the changes in the nomenclature with an amazing tenacity and that is the category of Species".
- According to **Huxley (1942)** the species can be regarded as "a geographical definable group, whose numbers actually interbreed or are potentially capable of interbreeding in nature, which normally in nature does not inter breed freely or with full fertility with related groups and is distinguished from them by constant morphological differences".
- Species is the most specific major taxonomic rank; species are sometimes divided into subspecies, but not all species have multiple forms that are different enough to be called subspecies.
- There are an estimated 8.7 million different species of organisms on Earth, but the vast majority have yet to be discovered and categorized.
- While each genus name is unique, the same species names can be used for different organisms. For example, *Ursus americanus* is the American black bear, while *Bufo americanus* is the American toad.
- The species name is always italicized, but never capitalized. It is the only taxonomic rank that is not capitalized.
- In scientific articles where the species name is used many times, it is abbreviated after the first full use by using just the first letter of the genus name along with the full species name. Homo sapiens is abbreviated to H. sapiens.



SPECIES CONCEPTS

- The objective of a scientifically sound concept of the species category is to facilitate the assembling of *phena* in to meaningful *taxa* on the species level.
- Taxonomic literature reports innumerable number of species concept. Mayr (1953) reviewed all these concepts of species and grouped them under three broad headlines:

    1. Typological species concept or essential species concept
    2. Nominalistic species concept
    3. Biological species concept

- However, two more species concepts have been elucidated as-

    4. Evolutionary or Phylogenetic species concept and
    5. Recognition species concept

SPECIES CONCEPTS

1. TYPOLOGICAL SPECIES CONCEPT :

- According to this concept, the observed diversity of the universe reflects the existence of a limited number of underlying "universal" or types.(eidos of Plato). Individuals do not stand in any special relation to each other, being merely expression of the same type. If two individuals or group of individuals appears sufficiently different , they are different species.
- Variation is considered a trivial or irrelevant phenomenon. It is the result of imperfect manifestation of the same type.
- This concept going back to the philosophy of Plato and Aristotle, was the species concept of Linnaeus and his followers(Cain,1958). This school of philosophy is now usually refereed to as essentialism, following Karl Popper.
- This species concept is also called as **Essentialist species concept**. According to it, the species can be recognized by their essential natures or essential characters and these are expressed in their morphology or species in a group of organism, whose physical characteristics, colour, size, habitat etc. segregate them from all other organism. Hence it is also called as **Morphological species concept**.

Criticism:

- Even though the morphological evidence is still used for inferences on the delimitations of biological species, a morphological species concept is no longer accepted by the modern biologists. Two basic reasons for its universal rejection is that:

  1. Individuals are frequently found in nature, that are clearly conspecific with other individuals in spite of striking differences in structure owing to sexual dimorphism, age differences, polymorphism and other forms of individual variation. Although often described originally as a different species, they are deprived of their species status, regardless of the degree of morphological differences, as soon as they are found to be members of same breeding population. Different *phena* that belong to a single population can not be considered different species.

  2. Sibling species differ hardly at all morphologically, yet are good biological species. Degree of difference is not the specific criterion in the ranking of taxa as species.

SPECIES CONCEPTS

2. NOMINALISTIC SPECIES CONCEPT :

- Nominalistic species concept was put forwarded by Occam and his follower, who believed that only individuals exist, while species are man's own creation.

- The nominalistic species concept was very popular in France in 18th century and has adherents to the present day.

- According to the concept, species have no actual existence in nature. They are mental concepts and nothing more and these have been invented in order that we may refer to great numbers of individuals collectively (Bessey,1908).

- **Criticism:**

- No biologist can agree with the idea that the species are man made, when it is now established fact that they are the products of evolution.

- The basic drawback with the nominalists was their misinterpretation of the casual relation between similarity and relationship. Members of a species taxon are similar to each other because they are similar, as they are claimed by these workers. The situation is the same as that of identical twins, where two brothers are identical twins not because they are extraordinary similar, but because both are derived from a single zygote.

- Thus any one who understands evolution, out rightly reject this concept.

SPECIES CONCEPTS

3. BIOLOGICAL SPECIES CONCEPT :

- It was realized in the late 18th century that neither of the medieval species concept was applicable to the biological species, so an entirely new species concept emerged around 1750.

- The biological species concept was enunciated by Mayr (1940). According to this concept " Species are groups of inter breeding natural populations that are reproductively isolated from the other such groups".

- The species has three separate functions:

  1. It forms a reproductive community i.e. the individuals of an animal species recognise each other as potential mates and seek each other for the purpose of reproduction. The species specific genetic programme of every individuals ensures intraspecific reproduction; this is not absolute that some times different species can interbreed (the horse and the donkey produces mule when interbreed).
  2. It is an ecological unit regardless of the individuals composing it, interacts as unit with the other species with which, it shares the environment.
  3. It is also a genetic unit consisting of a large intercommunicating gene pool for a short period of time.

- These three properties raise the species above the typological interpretation of a class of object (Mayr,1963)

BIOLOGICAL SPECIES CONCEPTS: CONTD..

Merits of Biological Species Concept:

- The development of the biological concepts of species is one of the earliest manifestation of the emancipation of the biology from an inappropriate philosophy based on the phenomenon of inanimate nature. The species concept is called biological not because it deals with the biological taxa, but because the definition is biological. It utilises criteria that are meaningless as far as the inanimate world is concerned.

- A species is a protected gene pool. It is a Mendelian population which has its own devices (called isolating mechanism), which protects it against harmful gene flow from other gene pool. Genes of the same gene pool forms harmonious combinations, because they have become co-adapted by natural selection.. Mixing of the genes of the two different species leads to a high frequency disharmonious gene combinations; mechanism that prevents this are therefore favoured by selection. This makes clear that the word species in the biology is a relational term.: A is a species in relation to B and C because it is reproductively isolated from them. It has its primary significance to sympatric and synchronic populations, and these are precisely the situations, where the application of the concept faces the fewest difficulties. The more distant two populations are in space and time, the more difficult it becomes to taste their species status in relation to each other, but the more irrelevant biologically this also becomes.

- The biological species concept also solves the paradox caused by the conflict between the fixity of the species of the naturalist and fluidity of the species of the evolutionists. It was this conflict, which made Linnaeus deny evolution and Darwin the reality of species (Mayr, 1957b).

- Taxa of the species category can be delimited against each other by operationally defined criteria. It is only taxonomic category for which the boundaries between the taxa at that level are defined objectively.

BIOLOGICAL SPECIES CONCEPTS: CONTD..

Difficulties in the applications of Biological Species Concept:

- **T**he fact that difficulties sometimes, arise when the biological species concept is applied to natural taxa, does not mean that the concept as such is invalid.
- The three most serious difficulties in the application of the biological species concept are:

1. Insufficient information:

- Individual variations in all of its forms often raises doubt as to whether a certain morpho-type is a separate species or only a phenon within a variable population.
- Sexual dimorphism, age differences, polymorphism and other such kinds of variation can be unmasked as individual variation through a study of life histories and through population analysis. The neonatologists, who normally works with preserved material are confronted by the same problem as the palaeontologist who likewise must assign phena to species.

2. Uniparental reproduction:

- In many organism system of reproduction are found that are not based on the principle of an obligatory recombination of genetic material between the individuals prior to the formation of new individuals.. Self fertilization, parthenogenesis, pseudogamy and vegetative reproduction (budding and fusion) are some of these forms of uniparental reproduction.
- A population as defined in evolutionary biology, is an interbreeding group. By definition, therefore an asexual biological population is a contradiction, even though the word population has other usage in which a combination with asexual is not contradictory. So the biological species concept based on the presence or absence of interbreeding between the population is therefore, inappropriate for uniparentally reproducing organism.

BIOLOGICAL SPECIES CONCEPTS: CONTD..

Difficulties in the applications of Biological Species Concept (Continued):

3. Evolutionary intermediacy :

- The species as manifested by a reproductive gap between populations , exist in full classical distinctness only in a local fauna. As soon as the dimension of space (latitude and longitude) and time are added, the stage is set for insipient speciation. Population will be found under these circumstances which are in the process of becoming separate species and have acquired some but yet not all of the attributes of distinct species. The various difficulties for the taxonomist, which may result from evolutionary intermediacy may be summarized as (Mayr,1957a,):

  1. **Acquisition of reproductive isolation without equivalent morphological changes-**

  Reproductively isolated species without morphological differences are called as sibling species. Such sibling and cryptic species pose a great problem to taxonomists as they are feebly or not at all morphologically distinct.

  2. Acquisition of strong morphological differences without reproductive isolation:

  A number of genera of animals and plants are known in which, morphologically very different population interbreed at random where ever they come in contact. The typological solution of calling every morphologically distinct population a species is clearly inappropriate in such situation. Conversely, there are genera in which, the isolating mechanism in any two species may break down occasionally. To consider such species conspecific would be going to the opposite extreme. No generalized solution is possible where morphological divergence and acquisition of reproductive isolation do not coincide. It can be well exemplified in case of West Indian snail genus *Cerion*.

BIOLOGICAL SPECIES CONCEPTS: CONTD..

Difficulties in the applications of Biological Species Concept (Continued):

3. The occasional breakdown of isolating mechanism:

- Reproductive isolation may break down occasionally even between good species. Most frequently this will lead to the generation of occasional hybrids that are either stele or lower viability and this will not cause any taxonomic difficulties. More rarely, there is a complete breakdown of isolation resulting in the production of extensive hybrid swarms and more or less complete introgression (Mayr,1963).
- The biological species concept fails to give satisfactory answer when applied to hybrid complex. Lotsy (1925) called it as "syngameon". In a syngameon, the original biological species may either persist as discrete entity or comes to occupy definitely sub-ordinate position to the total complex, when it is found in varying degree of dissolution. We can recognise several types of natural population that owe their origin to the hybridization.

A. Sympatric hybridization:

- In all instances in which the two parental species maintain their genetic integrity over amore or less wide area in which they occur together, it is advisable to upload their species status, even though in a portion of their ranges there is a breakdown of the isolation. The example of two Mexican towhees (*Pipilo erythrophthalamus* and *P. ocai*) is an excellent illustration of this situation (Sibley,1954).
- No taxonomic recognition is given to hybrid population that result from the such a local breakdown of the reproductive isolation. The only possible exception in such a complete breakdown of the isolation that the two parental species fuse into a single new species.

BIOLOGICAL SPECIES CONCEPTS: CONTD..

Difficulties in the applications of Biological Species Concept (Continued):

B. Amphiploidy:

- Hybridism in plant may lead to the instantaneous production of an allopolyploid, an individual that combines the chromosomes sets of two parental species. Such hybrids may give rise by uniparental reproduction to a new population, that is reproductively isolated from both parents and behaves like a new species. If it is able to reproduce and by occupying a new ecological niche, is able to compete with each other species (including the parents).
- It is doubtful that such speciation by amphiploidy has ever been incontrovertibly established in sexually reproducing animals. Polyploidy among parthenogenetically reproducing insects , annelids and turbullerians is not in frequent, but it is not certain that any of these parthenogenetic lines owes its origin to hybridization.

4. Semi species:

1. Geographical isolates occasionally have an intermediate status in between sub species and species. On the basis of some criteria they would be considered as species; on the basis of others, they would not. It is usually more convenient for the taxonomists to attach such doubtful populations to the species with which they are most nearly allied. Circular overlaps and other boarder line cases are other instances of evolutionary intermediacy, that will have to be decided from case to case on the basis of convenience and degree of evolutionary intermediacy. Sibkley(1954) considered semi-species as discernible on the basis of partial reproductive isolation externally contrasting with free gene exchange internally.

SPECIES CONCEPTS

4. EVOLUTIONARY(PHYLOGENETIC) SPECIES CONCEPT :

- Species are evolving system and the vertical delimitation of species in the time dimension should in theory be impossible. Unbroken sequences of fossil population are, however, extremely rare. Where they exist, the named morpho-species are usually so similar that they are better not recognized at all or, at most, ranked as subspecies.
- In most fossil sequences there are convenient breaks between horizons to permit a non arbitrary delimitations of species.. Since much speciation occurs in peripheral isolates, the discovery of strata with intermediate populations is highly improbable and will occur only rarely. Range fluctuation contributes towards the appearance of breaks even in cases of speciation, owing to uncomplicated phyletic evolution in a single vertical column. An evolutionary species may be absent from a given locality for a shorter or longer periods, and when it reoccurs, it may have changed sufficiently to be classified as a different species.
- Simpson defines an evolutionary species as a "lineage (an ancestral-descendent sequence of populations) evolving separately from others and with its own unitary evolutionary roles and tendencies." The evolutionary species concept of Grant is based on this fact and it is applicable to not only apomictic populations but also fossil lineages.
- Willey(1978) reconsidered the evolutionary concept and concluded that the "species is a single lineage of ancestral descendent population of organism, which maintains its own evolutionary tendencies and historical fate."
- Willis(1981), on the contrary believes that each species is an internally similar part of a phylogenetic tree. A species may be branched or not; it originated and perhaps ended at some intermediate plane or cross section across a branch in the case of allopatric speciation or at a plane across the base of the branch in the case of sympatric speciation.
- The evolutionary species concept, recognised for uniparental organism, is also not very promising. It does not possibly give positive clue to the rest of either inter-fertility of conspecific populations or inter-sterility of hetero-specific individuals. Moreover, our knowledge of the number of uniparental organism is is too incomplete to permit an estimation of the proportion of the evolutionary species that are not also biological species. There may be even, some biological species whose evolutionary roles appears identical to the observer, but the number of such close sibling species is impossible to estimate and by their very nature, such cases would be extremely difficult to detect.

SPECIES CONCEPTS

5. RECOGNITION SPECIES CONCEPT :

- This concept has been put forwarded by Patterson(1985) and Lambert *et al*.(1987) as a replacement to biological species concept. They have been advocated their superiority over the latter.

- According to this concept a species is " that most inclusive population of individual biparental organisms, which share a common fertilization system". The fertilization system includes all aspects of an organism's biology that "contribute to the ultimate function of bringing about fertilization while organisms occupies its normal habitat." The organism recognise each other as mates or passive.

- This concept does not includes all barriers to gene flow that act after fertilisation, including zygotic or hybrid in viability and hybrid sterility.

- The concept was strongly criticised by Butlin (1987) and Coyne *et al*.(1988), who were in the opinion that this concept of species strongly violates the idea of Dobzhansky and Mayr.

* VARIOUS KINDS OF SPECIES

Kinds of species:

Polytypic species:

- It is now well accepted fact that some species are widely distributed and form many local population. If these populations are sufficiently distinct from each other, they are called sub species. Species which contain two or more sub species are called polytypic species and those, which are not divided into sub species are monotypic species.
- Beckner (1959) firstly enunciated the concept of the polytypic species. Sneath (1962), the proponent of numerical taxonomy, used polythetic and monothetic terms in place of polytypic and monotypic respectively.

Significance of Polytypic species:

- The greatest benefit derived from the recognition of polytypic species is that in well known groups of animals, such as birds, mammals, butterflies or snails, it has lead to a considerable simplification of the classification. This recognition of classification is virtually completed in birds. It is in full swing for mammals and some group of insects and land molluscs, but has hardly begun in other groups of animals. The 19000 monotypic species in birds listed in 1910 have been reduced to about 8600 species. A similar kind of simplifications have been reported for several vertebrates and invertebrates groups. Of much greater significance is the restoration to the species category of a definite biological meaning and homogeneity.
- The task of assembling local population in to polytypic species or more broadly, of sorting large number of nominal species and varieties in to the polytypic species reveals many taxonomically and biologically situations (Mayr,1963).
- The consistent application of the polytypic species concept to all groups of animals is one of the major task of taxonomy. Certain local species, that had been described from various parts of the world can be combined into species groups (allopatric species), because they were obviously more closer to one another than to any other species and live in mutually exclusive geographical areas. When gaps between the ranges of allopatric species are explored, these allopatric species are included in a single polytypic species.

* VARIOUS KINDS OF SPECIES

Kinds of species:

Polytypic species:

Short comings:

- The concept of polytypic species gave rise to the concept of “Population taxonomy”. But it is not easy to apply because still there is no fool proof method of recognising sub species. The taxonomists encounter two basic difficulties in applying polytypic species concept:

  1. polytypic species are composed of allopatric or allochronic populations that differ from each other. However, all populations of sexually reproducing animals differ slightly from each other and certain standard must be met before sub species can be recognised.

  2. Occasionally closely related species with similar ecological requirement replace each other geographically and yet are full species not a sub species.

- The polytypic species is, in a sense, the lowest of the higher categories. Being multidimensional, it lacks the simplicity and the objectivity of the non-dimensional species.
- Nomenclature problem is associated with the polytypic species concept.

VARIOUS KINDS OF INFRASPECIFIC CATEGORIES: SUB SPECIES

INFRASPECIFIC CATEGORIES:

SUB SPECIES:

- It is a basic and universal fact that all species vary and it has been known since long that certain species split in to sub species and races. Linnaeus and Fabricius called it as 'Varieties'. Kant (1775) was the first to differentiate species, sub species and variety.
- The term sub species was coined by H. Schlegel (1844) into zoological nomenclature giving rise to trinomial nomenclature, later approved by International congress of Zoology for its inclusion in International Rules of Zoological Nomenclature.
- Presently sub species is the lowest taxonomically nameable category and it may be defined as-"***A sub species is an aggregate of phenotypically similar populations of a species, inhabiting a geographic sub division of the range of a species, and differing taxonomically from other populations of the species."***
- In other words "sub species are geographical races within the same species which, are sufficiently different in some regard for them to be classified in this manner".
- According to Grant (1960): " Sub species are group of interbreeding population with strong morphological differences , combined with geographic, ecological, edaphic or physiological distinctions, which give rise to such groups a species like distinctiveness."
- The sub species are neither incipient species nor models for the origin of species, but more or less diversified blind alleys within the species.
- The true sub species exist in nature. So it is a partial sub category of the species and is a biological unit existing as an objective reality independent of man's contemplation, which forms the basis for the concept of sub species.

VARIOUS KINDS OF INFRASPECIFIC CATEGORIES: SUB SPECIES

INFRASPECIFIC CATEGORIES:

Types of Sub species :

- Edwards (1955) on the basis of morphological, geographical and ecological characteristics categorised sub species in the following:

1. Geographical sub species :

- These are synchronic infra specific populations which are isolated amacro-geographically during their mating times, but whose respective members would cross breed freely and normally, if the populations are sympatric under natural condition.

2. Temporal sub species:

- In Palaeontology slightly different populations separated in time are increasingly often assigned to the sub species. These are sympatric infra-specific populations or which are temporally isolated during mating season, but whose members would cross breed freely and normally, if the populations were to become synchronic under natural condition. Geographical and temporal sub species are closely allied terms and they must be applied as separate terminology in every cautious manner.

3. Seasonal sub species:

- If two distinct sympatric population or aggregates of populations within a given species are composed of individuals, which mature at different respective times during the same calendar year (e.g.one in spring and the other in the fall),with no period of time during which reproductive forms of both demes coexist, then interbreeding can occur between the members of the respective populations. Such a group of population, is referred as seasonal sub species.

* VARIOUS KINDS OF INFRASPECIFIC CATEGORIES: SUB SPECIES

INFRASPECIFIC CATEGORIES:

4. Annual sub species:

- If the members of one distinctive population or aggregates of population within a given species, mature only during different year from those of another populations of the same species, then the respective population might be termed as annual sub species, if temporal isolation between their reproductive forms is complete.

5. Geological sub species:

- Populations which function during different geological times respectively, have absolutely no chances of becoming synchronic. Hence the test of how freely and normally their members could interbreed, is purely conjectural.

6. Ecological sub species

- Distinctive, different macro geographically sympatric, infra-specific populations or aggregates of populations, which are isolated micro-geographically, but whose members would cross breed rather freely and normally if the populations were to become micro-geographically sympatric under natural conditions. These occur in different niches, biotopes, which cannot be indicated successfully on ordinary read-maps, but require the use of topographic maps and usually of special faunistic maps to indicate the exact micro-geographic habit of the ecological sub species.

7. Polytopic sub species:

- That, which is composed of widely separated; population or a geographically heterogeneous sub species. When sub species of a species differ in a single diagnostic character like colour, size or pattern, it may happen that several different and somewhat widely separated populations independently acquire an identical phenotype population. Although, such visually identical populations are different genetically, yet since the sub species is not an evolutionary concept, these are combined by taxonomists into a single sub specific taxon, called polytopic sub species (Mayr, 1969).

* VARIOUS KINDS OF INFRASPECIFIC CATEGORIES: SUB SPECIES

Difficulties in the application of sub species category:

- The term overlap is often misused in the concept of sub species. A subspecies consists of many local populations all of which, though very similar, are slightly different from each other genetically and phenotypically; a sub species is therefore a collective category.
- Every local population is slightly different from every other local population, and the presence of these differences can be established through sufficiently sensitive measurements and statistics. It would be absurd and lead to nomenclatural chaos, if each such population were given the formal trinomial name, that is customary for sub species. Therefore sub species are to be named only if, they differ taxonomically *i.e.* by sufficient diagnostic morphological characters.
- Even, when it is possible to assign population to sub species, an assignment on the basis of phenotype alone, is not necessarily possible for every individual, owing to an overlap of the range of variation of range of neighbouring populations.
- The breeding range of two species may overlap geographically, but not those of two sub species of the same species trinomial name.
- If two discrete breeding populations coexist at the same locality, they are full species. Where two sub species meet, intermediate or hybrid population may occur, which combine the characters of both sub species. It would be misleading in such a case, to say that the two sub species overlap in this area, since the species is represented in this are only by a single population, no matter how variable.
- Although recognition of the polytypic species requires the use of sub species category, with all the concomitant benefits, however various aspects of geographic variations cause difficulties. Indeed the sub species has been misused in many ways.

* VARIOUS KINDS OF INFRASPECIFIC CATEGORIES: SUB SPECIES

Difficulties in the application of sub species category (Contd..):

- Some authors applied the term to individual variants and sibling species., many authors named insignificant local populations as sub species, and finally some authors considered sub species, as a unit of evolution, rather than an arbitrary device to facilitate intraspecific classification.
- Wilson and Brown (1953) pointed four aspects of the sub species , which reduce its usefulness:

1. The tendency of different characters to show independent trends of geographic variation.

2. The independent re-occurrence of similar or phenotypically indistinguishable populations in geographically separated areas.

3. The occurrence of micro geographic races within formally recognized sub species.

4. The arbitrariness of the degree of distinction considered by different specialist as justifying sub specific separation of slightly differentiated local populations.

* OTHER INFRASPECIFIC CATEGORIES

OTHER INFRA- SPECIFIC GROUPS:

1. *DEME:*

- Morphologically homogenous group of organism, which are either from a single locality or from a single kind of habitat and is the starting point in all classification are considered as Deme. Mayr (1953, 1969) called it as *Phena* , while Simpson (1961) called it as *Deme*. Both these names are generally accepted. The term *Phenon* was used by Camp and Gilly (1943) to describe a particular kind of taxon of specific rank.
- The term *Deme* was proposed by Gilmore and Gregor (1939), as a neutral root. It includes a group of organism in the various special purposeful genealogical and genetical categories.
- It is a group of individual animals of one species or sub species so localized, that they are in easy and more or less frequent contact with each other, the uni-specific member of a single community in the most limited sense (Simpson,1961).
- *Deme* and *Phenon* have no nomenclatural status.

2. *VARIETY:*

- It was proposed by Linnaeus and was common use for many years. This has been the most controversial and abused term in zoological taxonomy. Under the typological principles , each species had a fixed pattern and anything, that did not fit under this pattern was named a *variety*.
- Earlier Darwin failed to recognise it, either as an individual variant, or a group of such variants or morphs conceptually associated by the variation alone and not forming a population, or a distinguishable populations within a species analogues to or perhaps identical with a species. But such distinctions occur in nature.
- Now this term has been abandoned from the zoological nomenclature and any such name used after 1960 is rejected outright.

* OTHER INFRASPECIFIC CATEGORIES

OTHER INFRA- SPECIFIC GROUPS:

3. *FORM OR MORPHOTYPE*:

- These terms have been applied to varieties in the second sense or to the aggregate of the populations rather than to all varying organism forming a population. Edwards (1955) defines *Morphs* as " Distinguishable , sympatric and synchronic interbreeding population of a single species".
- *Morphotype* has also not recognised as a nomenclatural category.

4. *CLINE:*

- This term was coined by J.S. Huxley (1939) for character gradient. It was defined as "a gradation in the measurable characters"
- It is also not a taxonomic category and a single population may be composed of as many different clines, as it has characters. A cline is formed by a series of contiguous populations in which, a given character changes gradually.
- At right angles to the cline, are the lines of equal expressions of the character (points of identical phenotypes); such a line is called *isophene* . For instance, if in the range of a species of butterfly, the percentage of white specimen varies from north to south, the corresponding *isophenes* may be indicated on a map.
- Clines may be of morphological, physiological, ecological and other characters and also the percentage frequencies of the polymorphic characters, and called as the geocline, ecocline and successional clines respectively.
- The geoclines are frequently used. However no clines have acquired the status of a taxonomic category. Indeed, when the geographic variation of a species is *Clinal*, it is equally inadvisable to recognise sub species, except possibly for the two opposite ends of the *Cline*, when they are very different or separated by a pronounced step.

* OTHER INFRASPECIFIC CATEGORIES

OTHER INFRA- SPECIFIC GROUPS:

5. ***RACE:***

- A *Race*, that is not formerly designated as a sub species is not recognized in the taxonomic hierarchy. However, the term sub species and geographical race are frequently used inter changeably by taxonomists in case of mammals, birds and insects. Other taxonomist as applied the term race to local population within sub species.
- The nature of ecological races among animals is still controversial (Mayr,1963). Since no two localities are exactly identical with respect to their environment, every subspecies is at least theoretically also an ecological race.
- More important from the taxonomic and the evolutionary point of view are host races among parasites and species specific plant feeders.
- If gene flow between populations on different hosts is drastically reduced, such host races are the equivalent of geographic races in free-living animals. He thought it a collective category of allopatric sub species or species.

6. FORMENKREIS* and *RASSENKREIS :

- kleinschmidt (1926) was the first to distinguish geoclines from the Linnaean morphological and monotypic species. He used the term (*form*-cycle or array of forms-*implicity* geographical) for the geographic series. He thought it a collective category of allopatric subspecies or species. In palaeontology, it is defined as ”A group of related species or variants”. No doctrine would support the concept that the *formenkrei*s is identical with the species of systematics. In contrast, species is the fundamental unit of the system, from which all research of infra-specific variation must begin.
- *Rassenkreis* applied by Rensch (1929) to polytypic species is not used now. Rensch later preferred *Artenkreis* for *Rassenkreis*.
- A *Rassenkreis* is a genetic species, with a series of intergrading, but local populations, occasionally so different that two terminal populations cannot interbreed directly, even through, still exchanging genes through intermediate populations.
- An *Artenkreis* is a genetical species, which does not break up into geographic races, thus nearly resembling the typological concept of species.

* OTHER INFRASPECIFIC CATEGORIES

OTHER INFRA- SPECIFIC GROUPS:

7. *SUPER SPECIES*:

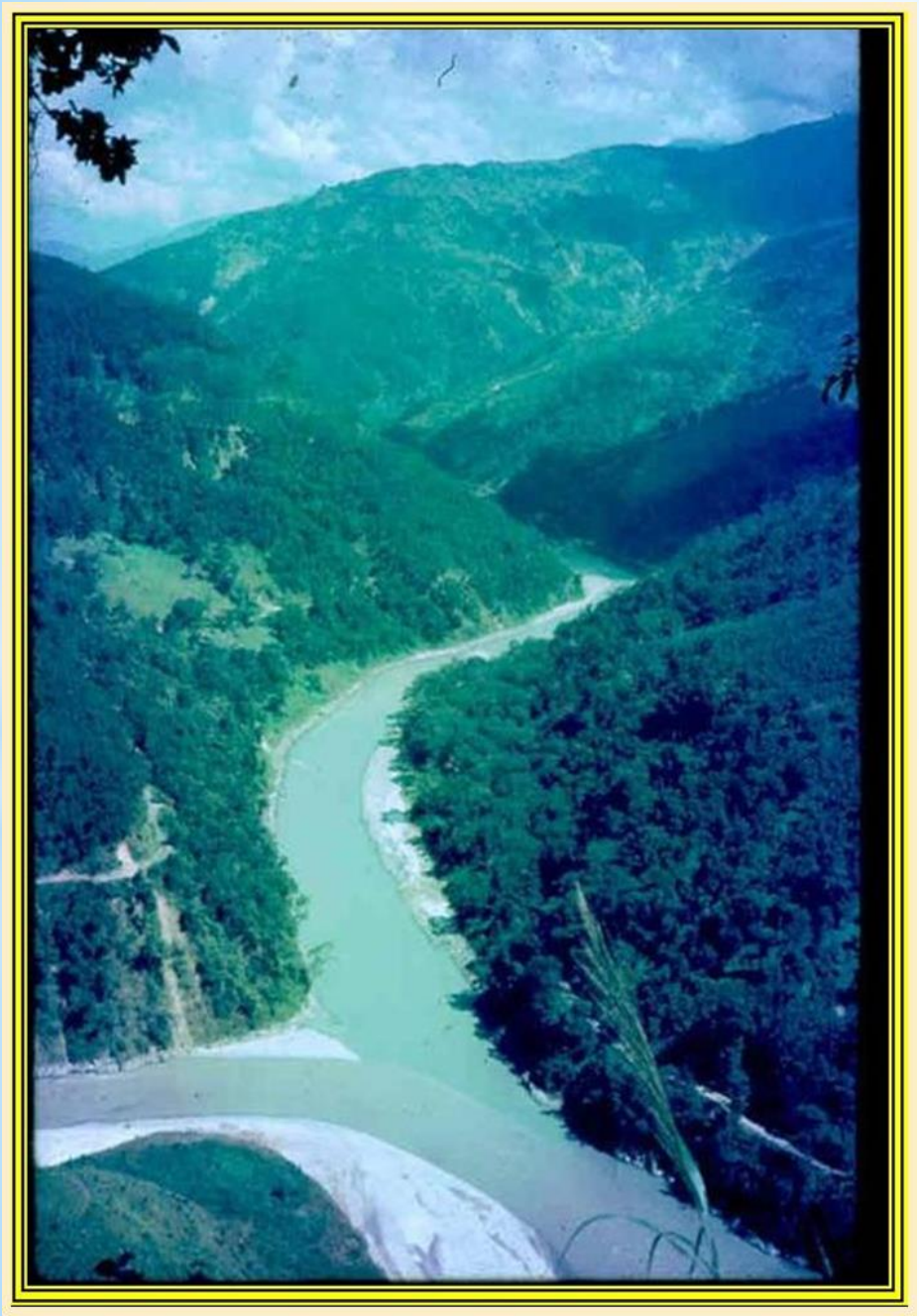
- Allopatric populations are often so distinct from each other, that there is little doubt about their having reached up to the species level. Rensch (1929) proposed for such group of allopatric species, the *Artenkreis*, since the literal translation, "*Circle of species*" was frequently misunderstood. So, Mayr (1931) introduced the term *Super species*, as a convenient International equivalent.
- A *Super species* is a monophyletic group of closely related and largely or entirely allopatric species (Simpson,1961).
- When the ranges of the component species are plotted on a map, the *Super species* usually present as the picture of a polytypic species.
- There are three kinds of evidences to indicate that the component species have attained reproductive isolation;

  1. Either these species, although completely isolated from each other, are morphologically as different as sympatric species in the respective genus, or
  2. They are in some areas in geographical contact (*parapatry*) without interbreeding or
  3. There is actually a slight distributional overlap.

- *Super species* are not given nomenclatural recognition, but are listed as such in monographs and catalogues by an appropriate use of headings or symbols.
- They are important chiefly in zoogeographical and speciation studies.
- The component species of a *Super species* were originally designated *Semi species*. However, according to Mayr (1963) the term *Semi species* includes not only members of *Super species*, but all borderline cases in speciation.

CONCLUSION

- Hence the species can be regarded as “a geographical definable group, whose numbers actually interbreed or are potentially capable of interbreeding in nature, which normally in nature does not inter breed freely or with full fertility with related groups and is distinguished from them by constant morphological differences(Huxley, 1942).
- According to Essentialist species concept or typological species concept- “the species can be recognized by their essential natures or essential characters and these are expressed in their morphology or species in a group of organism, whose physical characteristics, colour, size, habitat etc. segregate them from all other organism”. Hence it is also called as Morphological species concept.
- According to the nominalistic species concept, species have no actual existence in nature. They are mental concepts and nothing more and these have been invented in order that we may refer to great numbers of individuals collectively (Bessey,1908).
- According to Biological species concept “ Species are groups of inter breeding natural populations that are reproductively isolated from the other such groups”.(Mayr,1940).
- Simpson defines an evolutionary species as a “lineage (an ancestral-descendent sequence of populations) evolving separately from others and with its own unitary evolutionary roles and tendencies.” The evolutionary species concept of Grant is based on this fact and it is applicable to not only apomictic populations but also fossil lineages.
- According to Recognition species concept a species is “ that most inclusive population of individual biparental organisms, which share a common fertilization system”. The fertilization system includes all aspects of an organism’s biology that “contribute to the ultimate function of bringing about fertilization while organisms occupies its normal habitat.” The organism recognise each other as mates or passive.



THANK YOU