

## COMMENTS ON THE TERM OF BIOLOGICAL SPECIES

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**Abstract.** In scientific biological community there is a number of widespread misconceptions concerning the term species. The species as a taxonomic category, defined by a concept, denotes the rank of a species taxon in the Linnaean hierarchy. The modern evolutionary synthesis theory appeared to unify ideas on species from different biological specialities: genetics, cytology, systematics, botany, morphology, ecology and palaeontology. This neo-Darwinian synthesis reconciled Mendelian genetics with the gradual evolution by means of natural selection and explained changes in local populations as broad scale changes or macroevolution. Biological species reproduce isolatedly from each other, which protects the integrity of their genotypes. Taking into consideration only the morphological difference is not an appropriate to define species. Unequal rates of evolution of different characters and lack of information on the mating potential of isolated populations are the major difficulties in the demarcation of species as taxa.

**Keywords:** biological species, evolution, philosophy of biology, concepts.

**Rezumat. Comentarii asupra termenului de specie biologică.** În comunitatea științifică biologică există unele concepții greșite asupra termenului de specie. Categoria taxonomică la nivel de specie este definită printr-un concept, care indică nivelul taxonului specie în ierarhia Linéană. Modernă teorie sintetică evoluționistă a apărut pentru unificarea ideilor asupra speciei, în diferite specialități biologice: genetică, citologie, sistematică, botanică, morfologie, ecologie și paleontologie. Această sinteză neodarwinistă împacă genetica mendeliană cu evoluția gradualistă, prin intermediul selecției naturale și explică schimbările din populațiile locale ca modificări la o scară largă sau macroevoluție. Speciile biologice sunt izolate reproductiv între ele și această izolare le conferă protecția integrității genotipurilor lor. Definirea speciei nu mai este adecvată, dacă se bazează numai pe baza diferențelor morfologice. Ritmurile diferite ale evoluției diferitelor caractere și lipsa informațiilor asupra posibilelor încrucișări între indivizi ai populațiilor izolate sunt marile dificultăți în separarea speciilor ca taxoni.

**Cuvinte cheie:** specia biologică, evoluție, filosofie, concepții.

### INTRODUCTION

The term of species is perceived, influences and determines the specialists' entire reporting manner to the biological science and its current theories. A serious research in the natural history cannot exist without the specific identification of the studied creatures (RACOVITĂ, 1926). MAYR (1957) and GRANT (1994) mentioned that a study of the history of the species problem helps dispel some of the misconceptions.

The species is the principal unit of evolution and it is impossible to write about or to refer to evolution as well as about almost any aspect of the philosophy of biology, without having a sound understanding of the meaning of biological species. This article is: a concise overview of the philosophically important aspects of the problem of the "species".

### DISCUSSIONS

Writing the first edition of *Systema Naturae*, LINNÉ (1735) introduced the binominal nomenclature for the scientific names of the species. But maybe Buffon - the father of natural history, first used the term of species, attributed to only plants and animals, and not to the inorganic Kingdom.

Some recent authors have dealt with the concept of species as if it were merely an arbitrary, man-made concept. The term "species" refers to a concrete phenomenon of nature and this fact severely constrains the number and kinds of possible definitions. After MAYR (1992), the word "species" is, like the words "planet" or "moon" - a technical term for a concrete phenomenon. The meaning of the term "species" must be based on careful study of the phenomenon of nature to which this term is applied. The conclusion that there are concrete describable objects in nature which deserve to be called "species" is not unanimously accepted.

The evolutionists are always asking **why**, because they know that every being in the nature is the product of evolution and must have had some selective significance in order to have evolved. What selection forces in nature favour the origin and maintenance of species? The answer to this question becomes evident when one makes a certain thought experiment.

MAYR (1949) wrote: "It is quite possible to think of a world in which species do not exist but are replaced by a single reproductive community of individuals, each one different from every other one, and each one capable of reproducing with those other individuals that are most similar to it. Each individual would then be the centre of a concentric series of circles of genetically more and more unlike individuals. What would be the consequence of the continuous uninterrupted gene flow through such a large system? In each generation certain individuals would have a selective advantage because they have a gene complex that is specially adapted to a particular ecological situation. However, most of these favourable combinations would be broken up by pairing with individuals with a gene complex adapted to a slightly different environment. In such a system there is no defense against the destruction of superior gene combinations except the abandonment of sexual reproduction. It is obvious that any system that prevents such unrestricted outcrossing is superior".

The segregation of the total genetic variability of nature into discrete packages, so called species, which are separated from each other by reproductive barriers, prevents the production of too great a number of disharmonious incompatible gene combinations. This is the basic biological meaning of species. MAYR (1969) considered that there are discontinuities between sympatric species and genotypes are extremely complex epigenetic systems. Hybrids between species, particularly in animals, are almost always of inferior viability and more extreme hybrids are usually even sterile.

DOBZHANSKY (1935) noticed that among the attributes members of a species share, the only ones that are of crucial significance for the species definition are those which serve the biological purpose of the species - the protection of a harmonious gene pool or *isolating mechanisms*. It is immaterial whether or not the term isolating mechanism was well chosen, nor is it important whether one places the stress on the prevention of interbreeding with non-conspecific individuals or the facilitation ("recognition") of breeding with conspecific individuals. The concept which we just are developing is articulated in the so-called biological species definition given by MAYR (1942): "Species are groups of interbreeding natural populations that are reproductively isolated from other such groups".

The isolating mechanism by which reproductive isolation is effected is represented by the properties of individuals. Geographic isolation therefore does not qualify as an isolating mechanism. The populations of one species are "reproductively isolated" from the populations of all other species. Typologically conceived, this would mean that no individual of species *A* would ever hybridize with any individual of species *B*.

But botanists pointed out that this did not correctly describe many situations in nature. They discovered cases of occasional (sometimes even rather frequent) hybridization between seemingly "good" sympatric species.

ANDERSON (1949) estimated that this was the normal situation with closely related sympatric species and that through such "introgressive hybridization", either species would be enriched by genes from other species. Other authors minimized the frequency of such hybridization and considered parallel variation in sympatric species as the residues of ancestral polymorphisms. Recent molecular analysis has, however, confirmed the frequency of clandestine introgression. However, if the two species continue their essential integrity, they will be treated as species, in spite of the slight inefficiency of their isolating mechanisms.

It is known that a leakage of genes occurs among many good "reproductively isolated" species. Thus, according to MAYR (1970), the isolating mechanisms prevent the interbreeding or fusion of populations. Thus, isolating mechanisms do not always prevent the occasional interbreeding of non-conspecific individuals, but they nevertheless prevent the complete fusion of such species populations.

MAYR (1988) demonstrated that behavioural isolating mechanisms can be acquired through a change of the function of factors favouring sexual selection. The contingent nature of the acquisition of isolating mechanisms is documented by their great diversity, resulting the genetic uniqueness of every individual of a sexually reproducing population.

Members of any species have in common many species-specific properties. This includes, in particular, the isolating mechanisms but also many adaptations as are niche utilization and certain contingent. If one knew the genetic basis of all the species specific characters, one might be able to give a genetic characterization of a species taxon.

The biological species concept is based on the recognition of properties of populations. It depends on the fact of non-interbreeding with other populations. For this reason the concept is not applicable to organisms which do not form sexual populations.

Therefore, the supporters of the biological species concept agree that this concept does not apply to asexual or to uniparental organisms. Their genotype does not require any protection because it is not threatened by destruction through outcrossing.

KITCHER (1989) observed difficulties for nonbiologists to understand differences between biological populations and from classes of inanimate objects.

Only a small fraction of any biological population reproduces, because not every individual in a population survives up to the reproductive age and reproduces successfully. This is true on the average for only two of the total number of offspring of a prenatal pair in a sexually reproducing species. In most marine organisms, with their high number of larvae, successful survival and reproduction is to a large extent a matter of chance, but most of the zygotes have, at the moment of their formation, an equal probability of success.

The term "species" is applied to species taxa and to the concept of this category or of species. As a result, their so-called species definition is nothing but a recipe for the demarcation of species taxa. This is, for instance, true for most of the recent so-called phylogenetic species definitions.

The word taxon refers to a concrete zoological or botanical object consisting of a classifiable population or group of populations of organisms.

The species category indicates the rank in the Linnaean hierarchy. This category is the class that contains all taxa of species rank. It articulates the concept of the biological species and is defined by the species definition. The principal use of the species definition is to facilitate a decision on the ranking of species level populations or an isolated population.

As long as the inventory taking of kinds of organisms was the primary concern of the students of species, the typological species concept was a reasonably satisfactory concept. But when species were studied more carefully, all sorts of properties were discovered that did not fit with a species concept that was strictly based on morphology. This

was particularly true for behavioural and ecological properties. Most damaging was the discovery of the unreliability of the morphological characters for the recognition of biological species.

SIMPSON (1961) attempted to make evolution the basis of a species concept and mentioned: "An evolutionary species is a lineage (an ancestral-descendant sequence of populations) evolving separately from others and with its own unitary evolutionary role and tendencies". He replaced the clear-cut criterion (reproductive isolation) of the biological species concept with such undefined vague terms as "maintains its identity", "evolutionary tendencies" and "historical fate". This concept is applicable only to monotypic species. Every geographical isolate would, by implication, have to be treated as a different species. There are no empirical criteria by which either evolutionary tendency or historical fate can be observed in a given fossil sample. The definition does not help in the lower or upper demarcation of chronospecies, even though the main reason why the evolutionary species concept was apparently introduced, was in order to deal with the time dimension, which is not considered in the non-dimensional biological species concept. However, Simpson's definition is essentially an operational recipe for the demarcation of fossil species.

The so-called **phylogenetic species concept** is nothing more than the revival of a purely morphological species concept (WHEELER, 1996). The so-called **ecological species concept**, based on the niche occupation of a species, is for two reasons not workable: -in almost all more widespread species there are local populations which differ in their niche occupation; - an ecological species definition would require that these populations be called different species even though, on the basis of all other criteria, it is obvious that they are not.

After MEYER (1990), more fatal for the ecological species concept are the **trophic species** (e.g. the classical case of cichlids) which differentiate within a single set of offspring from the same parents. Finally, there are the numerous cases (but none exhaustively analyzed) where two sympatric species seem to occupy the same niche, in conflict with Gause's rule.

All this evidence shows not only how many difficulties an ecological species concept faces but also how unable it is to answer the Darwinian **why?** question for the existence of species.

It is said that a population is called a species when it has acquired isolating mechanisms, protecting its gene pool against its parental or a sister species. In other words, such a species is the product of the process of multiplication of species. The palaeontologist encounters also cases where a phyletic lineage changes over time to such a degree that sooner or later it is considered to be a different species. The occurrence of the origin of such phyletic species is usually ignored when non-palaeontologists speak of speciation.

Phyletic evolution does not produce an additional entity, it merely modifies an existing one. Nevertheless, the changes are sometimes sufficiently pronounced so that the palaeontologist gives a new species name to the modified phyletic lineage. Such a new species differ usually only in size and proportions, but not in the acquisition of any notable innovations. The phyletic speciation must be mentioned because it is what a palaeontologist usually seems to have in mind when he speaks of speciation. It is for such species that SIMPSON (1961) proposed the evolutionary species definition.

In his discussion of the origin of species, HENNIG (1966) only considers the case of a phyletic lineage splitting by dichopatric speciation into two daughter species. He considered both daughter species as new species.

Species taxa ordinarily have an extension in space (geography) and in time (history). They are composed of local or temporally circumscribed populations which differ slightly from each other. The conspecific such populations are combined into a *polytypic species*. The major species problem in species level taxonomy is to decide which local populations to combine into polytypic species. During the period when the typological species concept was dominant, almost any isolated population that differed by a morphological character was called a different species. Since the rise of the biological species concept, the question is always asked whether or not such a population would interbreed with other populations differing in space or time if they would meet in nature.

When two populations (in reproductive condition) meet at the same place at the same time, they either interbreed because they are conspecific or they do not do so because they are different reproductive communities (different species). In that case, their isolating mechanisms keep them apart. A geographically isolated population also has the isolating mechanisms of the species to which it belongs, but they are "invisible" since they do not need to be activated.

Normally, speciation is a gradual populational phenomenon. Saltational speciation as in the case of allopolyploidy, seems to be virtually absent in most groups of sexually reproducing organisms.

An important clarification of the status of species was achieved when it was realized by some taxonomists, that species taxa are not classes but particulars or "individuals" or biopopulations. Organisms that belong to sexually reproducing species have two sets of characteristics: - those that serve as isolating mechanisms and are jointly responsible for the fact that this population of individuals constitutes a biological species; - all other properties of the species.

Some evolutionary processes make the delimitation of species taxa from each other and the determination of their rank often is very difficult. The most important is so-called **mosaic evolution**. This means that certain characters may evolve much more readily than others. This results in a discord between the messages provided by various characters. The reproductive isolation and morphological difference often do not evolve in parallel with each other. This is why sibling species exist; they are reproductively isolated but morphologically indistinguishable. The basic problem is an insufficiency of needed information to take decision about the status of isolated populations and sometimes must be based on inference.

## CONCLUSIONS

- The definition of the biological species must be based on its biological significance, which is the maintenance of the integrity of well balanced, harmonious gene pools.
- The actual demarcation of species taxa uses morphological, geographical, ecological, behavioural, and molecular information to infer the rank of isolated populations.

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