

UNIT I: BASICS OF ANIMAL CLASSIFICATION

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Definition of Classification:

A classification is generally regarded as the primary product of systematic effort, although two students hardly agree as to their concepts of classification. It is a difficult affair to compare characters or to get agreement for ranking taxa.

However, it is a known fact that organism in nature seems to fall into groups or classes such as birds, butterflies, trees, grasses etc. The numbers of each group have at least one key attribute or a number of attributes in common. Thus, the definition of classification is the grouping of objects into classes (or sets) owing to their shared possession of attributes.

According to Mayr and Ashlock (1991) a biological classification is the ordered grouping of organisms according to their similarities and consistent with their inferred descent.

Thus, it is evident that for grouping two independent sets of criteria are responsible — similarity and sameness in causation (lines of descent) Basing on this, organisms can be assembled into taxa.

However, these two sets of criteria are frequently in conflict and their application is controversial. Classification is not static but changes continually in the light of new information and ideas and the addition of new species.

Components of Classification:

1. All entities appearing in a biological classification are generally called taxa (singular: taxon), which is distinct from the taxonomic categories (such as species, genus, family etc.) to which we refer the individual taxa in accordance to the rank (ordinal level) we recognise for them.
2. Classification is a hierarchical arrangement of organism within classes.
3. Two organisms are placed in the same class because they share one or more attributes (the defining properties of that class).
4. Hierarchy thus is a systematic framework for zoological classification with a sequence of classes (or sets) at different levels in which each class except the lowest includes one or more subordinate classes.

Rules of Classification:

Some general rules of classification are:

1. Organisms that are to be classified are assembled into classes depending upon similarity of attributes.

2. Individuals included in a class has members who share the greatest number of attributes.

3. Separate classes are established for organisms that are too different to be clubbed into the previously established classes.

4. Classes, depending on their degree of differences, are expressed by arranging them in a hierarchy of nested sets. In this hierarchy each categorical level expresses a certain level of distinctness.

Identification of Classification:

Many classifications attempt to be both identification schemes as well as classifications. This creates conflicts. The procedure of identification is based on deductive reasoning. One starts out with a given set of taxa (classes) and attempts to fit the investigated specimen into one of them. If one succeeds, then one has identified it. Identification deals with individuals.

On the other hand, the procedure of classification is inductive. Unlike identification, classification deals with and evaluates a multitude of characters, ideally all of them. Classification deals with populations and aggregates of populations. A classification is a filing system. It is the key to the entire literature on that taxon.

Much of the development of taxonomy in the last 200 years has been towards clearer and clearer separation of these two (classification and identification) entirely

different operations. He who tries to include classification and identification in a single operation is bound to become confused and thwarted in both endeavors. Prior to Linnaeus, virtually all so-called classificatory schemes were actually identification schemes and so also was the artificial downward classification of Linnaeus.

Downward and Upward Classification:

Downward classification:

During the period of Cesalpino (1519- 1603) and Carolus Linnaeus (1707-1778), the classification of plants flourished. Their method of classification was downward, based mainly on logical divisions. It consisted in dividing a larger group of dichotomy into two subordinate groups.

For example, animals with or without blood, animals with blood, then hairy or not hairy, and so on. This principle dominated taxonomy up to the end of the eighteenth century.

Linnaeus, the father of taxonomy, followed the principles of downward classification by logical division, as he was an essentialist (species reflect the existence of fixed, unchanged types). However, he was a methodological innovator because of his authority. Linnaeus was able to impose his methods, some of which (those on insects) are still largely acceptable.

Drawback:

1. Downward classification was actually a method of identification and not of classification, since the arrangement it produced depended entirely on the sequence in which the differentiating characters were used. It was blatantly artificial.
2. This method was incapable of producing order in a large fauna.

Upward classification:

By the middle of the eighteenth century an entirely new method of classification – called upward classification gradually surfaced. This method consists of assembling species by inspection into groups of similar or related species and forming a hierarchy of higher taxa by again grouping similar taxa of the next lower rank.

Characters were weighed, not by prior principles, but by a posterior determination of a covariance of characters. This work was made easier by the work of Buffon, who for the first time stressed upon using the sterility barrier as the species criterion. It prepared the way for the biological species concept.

Four developments characterised this period:

1. Specialisation became more pronounced.
2. Classification became more hierarchical.
3. Philosophical guidelines were totally rejected.

4. The search for a natural system was intensified.

Kinds of Classification:

Macro-taxonomy did not show much development until the 1950s and 1960s. The three schools of macro-taxonomy disagree to the method of classification which often lead to heated controversies which are still not resolved.

The nature of their disagreement can be best understood when presented as a disagreement about how classification can reflect both similarity and lines of descent. The criteria of these two indications of relationship are often in conflict and to resolve it, four procedures have been proposed. A. Preference is given to one of the two sets of criteria, hoping that it would automatically satisfy the other set.

Based on this, classification may be:

(a) Phenetics:

It gives weightage to similarity.

(b) Cladistics:

It gives preference to the lines of descent.

B. The two sets of criteria are given equal weightage but sequentially.

Based on this, classification may be:

(a) Evolutionary taxonomy:

Here taxa is provisionally delimited by similarity and subsequently tested by monophyly.

(b) Cladistic:

Cladistic approach where cladogram is constructed, with taxa delimited by cutting branches of approximately equal length. The above three schools of macro-taxonomy has its own advantages and disadvantages. Thus, the controversy regarding their relative merits has not ended.

Functions of a Classification:

Classification has utmost value today and it serves multiple purposes; both practical and theoretical.

Its functions may be summarised as:

(a) Communication System:

The first purpose of classification is to provide a simple practical means by which students of any group may know what they are talking about. Classification helps to keep track of the diversity and numbers of more than one million of animal species and provision for the discovery of new ones.

(b) Index to Stored Information:

Classification is an index to facilitate access to individual items. Although classification stores only a small part of information, still it is the key to the storage system of biological science. This storage system consists of

museum collections and the vast scientific literature published in the form of books and journals.

The quality of a classification is judged by its ability to facilitate the storing information in a homogeneous division and also help in rapid discovery and retrieval of this information.

(c) Heuristic Properties:

Biological classification leads to the discovery of new knowledge. It always is the result of observation of attributes and it results in new knowledge of the variation and distribution of these attributes. Thus, classification permits one to make predictions concerning the attributes of other members of the taxon (and also those still undiscovered) and previously unused characters.

For example, one identifies a parrot on the basis of just a few diagnostic characters. But knowing that it is a parrot, one can make probabilistic statements about its skeleton, internal organs, physiology, reproduction and behaviour without examining it.

A classification helps to extrapolate from known to previously unstudied characters. A sound system will permit all sorts of inference from the genetically well-known types to the much needed information about the distribution of a new enzyme, hormone or metabolic pathway.

Systematists, thus, can fill many gaps in our knowledge that specialists in the experimental branches of biology cannot. Therefore, the goodness of a classification is documented by the degree to which such predictions are validated. As taxa vary from one another, such predictions are not universal.

(d) Generalisation:

Depending on the goodness of classifications it may permit the making of generalisation. Thus, it is the objective of classification to construct groups that are homogeneous in the sense that they consist of descendants of the nearest common ancestor.

(e) Explanatory Powers:

When one concludes that cows and monkeys, together with some other families, constitute a natural mammalian order, he has implicitly advanced the theory that they have all descended from a common ancestor. Such theory, thus, explains the shared attributes of members of a taxon as well as the gaps that separate different taxa.

One thing has to be made clear at this point, that it is not true that classification gives phylogeny, but rather that an analysis of characters permits deductions on phylogeny that are used in the construction of a classification.

Hierarchical Classification:

In nature, organic diversity does not consist of one evenly-spaced array of equally different species. Rather, depending on their relatedness, species are arranged in groups.

This necessitated:

(i) Arranging them into categories and taxa of different grades.

(ii) Then arranging these categories and taxa in an ascending order so that a higher category includes one or more lower categories and higher taxa include one or more lower taxa.

In other words, species in nature are ranked, according to their comprehensiveness, in a hierarchy of nested categories — the so-called Linnaean Hierarchy.

Linnaean Hierarchy:

Hierarchy (used in many classifications other than that of organisms) was developed mainly in the seventeenth and eighteenth centuries and reached nearly definitive form (for zoologists) in the tenth edition (1758) of *Systema Naturae* of Linnaeus. Linnaeus recognised within the animal kingdom only five categories — class, order, genus, species and varieties.

As the number of known animals grew, making finer divisions necessary, two additional categories were soon added — family (between genus and order) and phylum

(between class and kingdom). The varieties used by Linnaeus was subsequently either discarded or replaced by the subspecies.

The above-discussed categories form the basic taxonomic hierarchy of animals. Thus any given species belong to these seven obligatory categories

Kingdom
Phylum
Class
Order
Family
Genus
Species

The sequence from top to bottom and the customary indentation indicate decreasing scope or inclusiveness of the various levels.

However, as the number of known species increased, and with it our knowledge of the degree of relationship of these species, the need arose for a more precise indication of the taxonomic position of a given species. This was achieved by splitting the original seven basic categories and inserting additional ones.

These additional categories are formed by adding prefixes, designate as super above various of the basic levels and as sub- and infra-, successively below them. Thus, there are superclass, subclass, infra- class, superorder etc. Numerous proposals to add to the seven

basic levels have also been made, but these are not standardised and are not in general use.

However, the most frequently used additional new category name are cohort, between order and class in case of vertebrate classification, and tribe, between genus and family used in entomology. Some authors use terms for additional subdivisions, such as *cladus*, *legio* and *sectio*. Some cladists have proposed numerous additional categories for the fine dichotomous branching of cladograms.

However, there are as many as 33 categories presently in use in the hierarchic classification, of which 18 (asterisk-marked) are generally widely followed: They are as follows in the next page. For the names of the sub-tribes, tribes, subfamilies, families and super-families, the standardised endings in zoology are indicated in the parentheses. The same categories are also accepted in botany, but the standardised endings are generally different.

Use of the seven basic Linnaean levels is required by convention, that is, no animal is considered to be satisfactorily classified unless it has been placed implicitly or explicitly in some definite group at each of the seven levels. Use of any of the other levels is optional, depending on the taste of each individual classifier and the requirements he finds in the particular group of organisms in question.

There is, however, one restriction on freedom of action in this respect—if a subsidiary level is used within any group it should, as far as possible, be used for all the organisms in that group. For example, if a subfamily is used within a family, then the whole family should be divided into subfamilies and all genera should be placed in one subfamily or another.

However, the fact that subfamilies are used in one family of an order does not require that they also be used in other families of the same order.

Kingdom*
 Subkingdom
 Infrakingdom
 Superphylum
 Phylum*
 Subphylum*
 Infraphylum
 Superclass*
 Class*
 Subclass*
 Infraclass
 Supercohort
 Cohort*
 Subcohort
 Infracohort
 Superorder*
 Order*
 Suborder*
 Infraorder
 Superfamily* (-oidea)
 Family* (-idae)
 Subfamily* (-inae)
 Infracolony
 Supertribe
 Tribe* (-ini)
 Subtribe (-ina)
 Infracolony
 Supergen
 Genus*
 Subgenus*
 Superspecies
 Species*
 Subspecies*

The Linnaean hierarchy with its arbitrary ranking has often been attacked as an unscientific system of classification. Alternate methods — such as numerical schemes have been proposed. These schemes — have not found favour among taxonomists, primarily for two reasons:

(i) The assigning of definite numerical values to taxa demands a far greater knowledge of the taxa than can be inferred from the available evidences.

(ii) Assignment of such values would freeze the system into a finality which would preclude any further improvement.

It is the very subjectivity of the Linnaean hierarchy which gives it the flexibility required by the incompleteness of our knowledge of relationships. It permits the proposal of alternate models of relationship and gives different authors an opportunity to test which particular balance between lumping and splitting, permits the presentation of a maximum amount of information. Therefore, like any other scientific theory, Linnaean hierarchy will remain provisional forever.