Numerical Taxonomy

Initially the plants were classified on the basis of their morphological characters and taxonomists classified plants in reliance of a particular character e.g. Monocotyledones (one cotyledon present) and Dicotyledon (two cotyledons present).The first time Michel Adanson (1763) pointed out that equal weightage should be given for all characters while classifying any plant species. He initiated this concept first time and these principles are called as 'Adansonian Principles'.

The Adansonian principles have received great support since 1960 and developed new methods in taxonomy included under a general term Numerical Taxonomy, which is also known as modern classification method. The mathematical or computerized method supports to analysis of various types of taxonomic data and its helps to find out the similarities or affinities between taxonomic units, and then arrangement of these units into taxa on the basis of their affinities.

According to the Heywood (1967) the Numerical Taxonomy may be defined as "The numerical evalution of the similarity between groups of organism and the ordering of these groups into higher ranking taxa on the basis of these similarities.Numerical Taxonomy is a developing branch of the taxonomy, which received importance with the development and advancement of the computer. This field of study is also known as mathematical taxonomy (Jardin & Sibson, 1971), Taxometrics (Mayer, 1966), Taximetrics (Rogers, 1963), Multivariant morphometrics (Blackith & Reyment, 1971) and Phenetics and Numerical Taxonomy (Sneath & Sokal, 1973).

Principles of Numerical Taxonomy

The philosophical methods of the modern Numerical Taxonomy are based on ideas that were first proposed by a French naturalist Michel Adanson (1763). Adanson rejected this idea to giving more importance for certain characters and believed that natural taxa are based on the concept of similarity which is measured by taking all the characters into consideration.The principles of modern Numerical Taxonomy were developed by Sneath & Sokal (1973), these are based on the modern interpretation of the Adansonian principles and as such are termed Neo-Adansonian principles. These Principles are as follow:

- The greater the content of information in the taxa of a classification and the more characters it is based upon, the better a given classification will be.
- Every character has equal weightage for creating of new taxa.
- Over all similarity between any two entities in a function of their individual similarities in each of the many characters in which they are being compared.
- Distinct taxa can be recognized because correlation of characters can be different in the group of organisms.
- Phylogenetic suggestion can be made from the taxonomic structure of a group and also from character correlation, this given certain hypothesis about evolutionary pathway and mechanisms.
- Taxonomy is viewed and practiced as an experimental science.

- Classification is based on phenetic similarity.
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There are two aspects of Numerical Taxonomy; the construction of taxonomic group and their discrimination.

Operational Taxonomic Units (OTUs)

Any individual, species, genus, family, order, or class are can be basic unit in Numerical Taxonomy and this known as Operational Taxonomic Units (OTUs). Generally when the OTU is supra individual (above the level of an individual), there should be adequate representation of various polymorphic form i.e. when genera are compared they should be represented by different species, when families are compared, they should be represented by different genera and so on. This is always remember that comparison of OTUs of equal rank is made in Numerical Taxonomy like species with species and genus with genus.

Taxonomic characters

A conventional definition of a taxonomic character is a "characteristic that distinguishes one taxon from another." Thus white flower may distinguish one species from another with red flowers. Hence, the white flower is one character and red flower is another character. A more practical definition given by numerical taxonomists like Micher and Sokal (1957), "as a feature,which varies from one organism to another," and by this second definition, flower color (not white or not red) is a character, and the white flower and red flower are its two characterstates.Some authors used the term attribute for characterstate but the two are not always synonymous. When select a character for numerical analysis it is important to selecting a character for numerical analysis as it is important to select a unit character. Unit character is defined by Sokal and Sneath (1963) as a taxonomic character of two or more states, which within the study at hand cannot be subdivided logically, except for subdivision brought about by changes in the method of coding. Like the trichome type may be glandular or eglandular. A glandular trichome may be sessile or stalked. An eglandular trichome may branch or unbranched. In such a case, a grandular trichome may be recognized as unit character. The first step in the handling of character is to make a list of unit characters. The list should include all such characters concerning which, information in available.All the characters should be weighed equally. Some authors advocate that some characters should subsequently be assigned more weightage than others, such consideration generally get nullified when a large number of characters are used. It is a general opinion that numerical studies should involve not less than 60 characters, but more than 80 are desirable. For practical consideration there may be some characters concerning which information is not available (like many plant not bear fruit) or the information is irrelevant (trichome type where as many plants are without trichome), or the characters which show a much greater variation within the some OTUs (flower colour in Lantana). Such characters are omitted from list. This constitutes residual weighing of characters.

Coding of Characters Many as characters are used for analysis of OTUs. So a huge amount is generated and this makes the use of computer essential. Before the data is fed into the computer,

it should be suitably coded. The characters most suitable for computer handling are two state characters (binary or presence/ absence), like habit is woody or herbaceous. However, all characters may not be two states. They may be qualitative multistate (flower white, red, blue) or Quantitative multistate character (leaves two, three, four or five at each node). Such multistate characters can be convered in to two states (flower white or coloured, leaves four or less than four). Some time the character may be splite (flowers white/not white, red/not red, leaves two/not two, three/not three and so on). The two state or binary characters are best coded as 0 and 1 for the two alternate states. The coded data may be entered in the form of a matrix with t number of rows (OTUs) and n numbers of columns (characters) with dimension of the matrix being t x n.Residual weighting involves excluding character from the list when enough information of OTUs is not available or is irrelevant. If these characters are used than NC code (Not Comparable) is entered in the matrix. For data handling by computers, the Numerical Taxonomy code (Not comparable) is entered in the matrix. Code is assigned a particular (not 0 or 1) numeric value. Such residual weighting should how ever be avoided but is appreciable for a particular character.

Applications of Numerical taxonomy

- Can be successfully used in the study of various angiospermic genera like Apocynum, Chenopodium, Crotalaria, Cucurbita, Oenothera, Salix, Zinnia, wheat cultivars, Maize cultivars, etc.
- With the help of numerical taxonomy similarities and differences in bacteria, other microorganisms can be studied.
- Phytochemical data from seed protein and mitochondrial DNA RFLP studies has been numerically analyzed to study the interspecific variations.