NUMERICAL TAXONOMY (TAXIMETRICS)

MBOTCC-6
Unit - III

M.Sc. Sem-II
(2018-20)

Introduction:

Numerical Taxonomy is a classification system in biological systematics which deals with the grouping of taxa by application of various mathematical procedures. It aims to create a systematics using numerical algorithms like cluster analysis rather than using subjective evaluation of their characters. It was Michael Adanson, a French botanist, who for the first time put forward a plan for assigning numerical values to the similarity between organisms and proposed that equal weightage should be given to all the characters while classifying plants. The concept was largely developed and popularised by Sokal and Sneath (1963). They divided the field into Phenetics in which classifications are based on the patterns of overall similarities and Cladistics in which classifications are based on the branching patterns of the estimated evolutionary history of taxa.

Although intended as an objective method, in practice the choice and implicit or explicit weighting of characters is influenced by available data and research interests. Creation of dendrograms and cladograms using numerical methods is the principal objective of taximetrics. The application of Adansonian principles and use of modern methods and computerized data processing techniques have helped in the evolution of several new classifications of plants.

Aspects of Numerical Taxonomy:

Numerical taxonomy involves two aspects: (a) Construction of taxonomic groups

(i) Individuals are selected and their characters are spotted out. There is no limitation

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to the number of characters.

(ii) Resemblances among individuals are then established on the basis of character analysis, often with computers. The best way to delimit taxa is to utilize maximum number of characters, with equal weightage given to all of them.

(b) Discrimination of the taxonomic groups:

When taxonomic groups show overlapping characters, discrimination should be used to select them. Discrimination analysis should be done by various techniques.

Thus, taximetrics is based on neo-Adansonian principles.

Principles of Numerical Taxonomy:

Sneath and Sokal have proposed the following seven principles of numerical taxonomy:

(i) Greater the content of information in the taxa, and more the characters taken into consideration, the better a given classification system will be.

(ii) Every character should be given equal weightage in creating new taxa.

(iii) Overall similarity between any two entities is a function of the individual similarities in each of the many characters, which are considered for comparison.

(iv) Correlation of characters differ in the group of organisms; thus distinct taxa can be recognized.

(v) Phylogentic conclusions can be drawn from the taxonomic structure of a group and from character correlations, assuming some evolutionary mechanisms and pathways.

(vi) Science of taxonomy is viewed and practiced as an empirical science.

(vii) Phenetic similarity is the basis of classifications.

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Merits of Numerical Taxonomy:

(a) It utilizes better and more number of described characters; thus the data of conventional taxonomy gets improved. Data are collected from a variety of sources, such as morphology, chemistry, physiology, etc.

(b) Numerical methods are more sensitive in delimiting taxa; hence the data obtained can be effectively used in the construction of better keys and classification systems, creation of maps, descriptions, catalogues, etc.

Numerical taxonomy has suggested several fundamental changes in conventional classification systems.

(c) A number of existing biological concepts have been reinterpreted.

(d) It allows more taxonomic work to be done by less highly skilled workers.

Demerits:

(a) Methods of numerical taxonomy are useful in phenetic classifications and not phylogenetic ones.

(b) Features of "biological" species concept may not accept the specific limits bound by these methods.

(c) Character selection is the greatest disadvantage in this approach. If characters chosen for comparison are inadequate, the statistical methods may give less satisfactory solution.

(d) Different taximetric procedures may yield different results. A major difficulty is to choose a procedure for the purpose and the number of characters needed in order to obtain satisfactory results by these mechanical aids.

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Applications of Numerical Taxonomy:

(i) Study of similarities and differences in bacteria, other microbes and several animal groups

(ii) Delimitation of several angiospermic genera like Oryza, Sarcostemma, Solarium, and other groups, including Farinosae of Engler and a few others

(iii) In the study of several other angiospermic genera like Apocynum, Cucurbita, Chenopodium, Crotalaria, Oenothera, Salix, Zinnia, wheat cultivars, maize cultivars, etc

(iii) Phytochemical data from seed protein and mitochondrial DNA RFLP studies have been numerically analyzed to study the interspecific variations among eight species of Cassia L. Based on the results of electrophoretic patterns, the degree of pairing affinity or similarity index has been calculated.

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