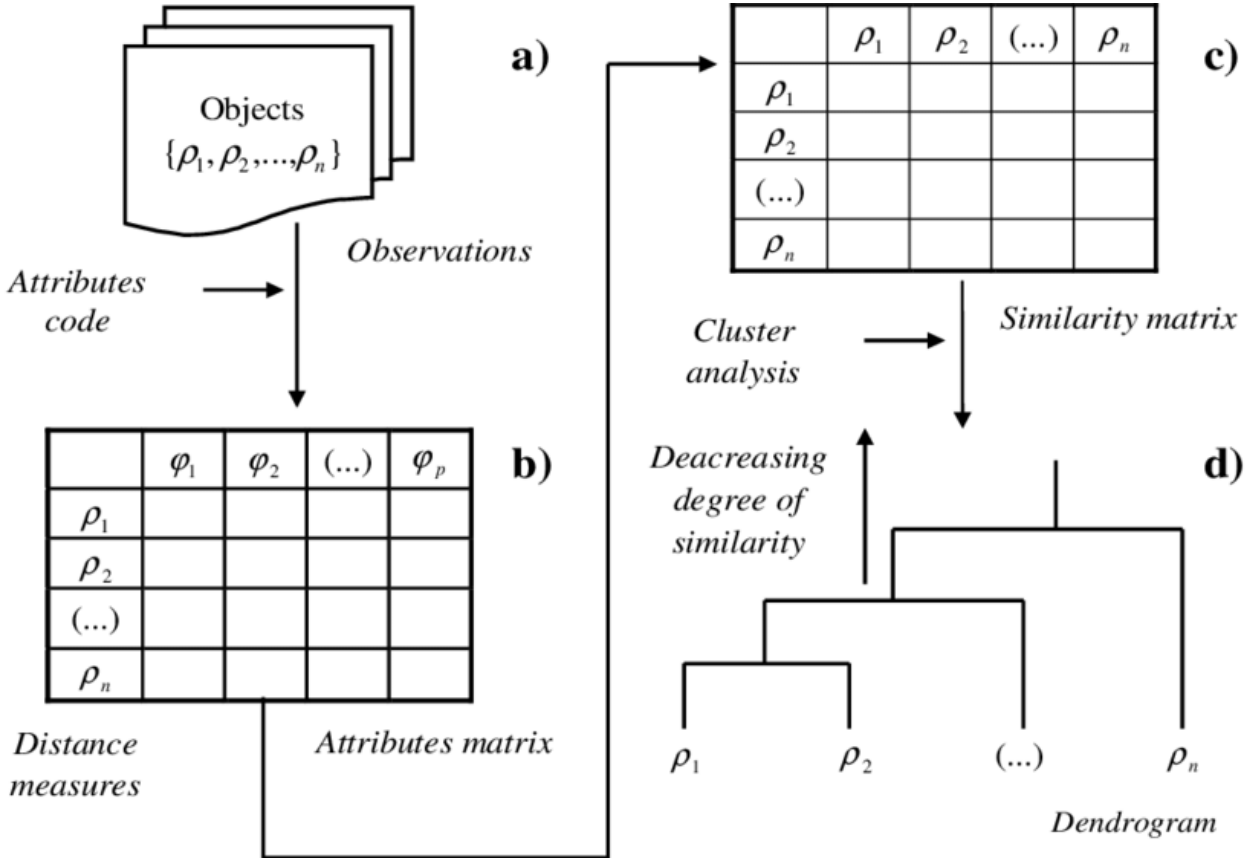
Methodologies in Systematics

Numerical Taxonomy



Dr. Rupesh B. Yadav

Asst. Prof.

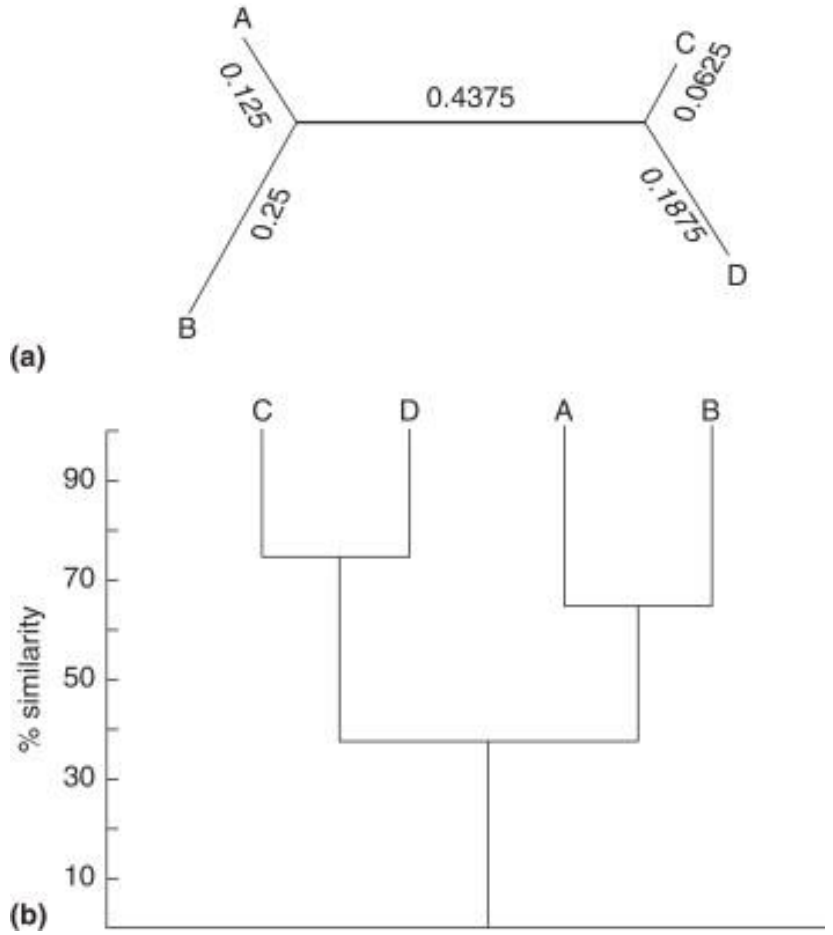
TC College, Baramati

What is Numerical taxonomy

- Numerical taxonomy is a classification system in biological systematics which deals with the grouping by numerical methods of Operational Taxonomic Units (OTUs) based on their character states

Numerical Taxonomy

- It aims to create a taxonomy using numeric algorithms like cluster analysis rather than using subjective evaluation of their properties.
- The concept was first developed by Robert and Peter in 1963 and later elaborated by the same authors.
- They divided the field into phenetics in which classifications are formed based on the patterns of overall similarities and cladistics in which classifications are based on the branching patterns of the estimated evolutionary history of the taxa.



Numerical Taxonomy

- Numerical taxonomy or taximetrics, nowadays frequently and perhaps more appropriately referred to as phenetics, refers to the application of various mathematical procedures to numerically encoded character state data for organisms understudy.
- Thus, it is the analysis of various types of taxonomic data by mathematical or computerized methods and numerical evaluation of the similarities or affinities between taxonomic units, which are then arranged into taxa on the basis of their affinities.
- According to Heywood the numerical taxonomy may be defined as the numerical evaluation of the similarity between groups of organisms and the ordering of these groups into higher ranking taxa on the basis of these similarities.

Principles of Numerical Taxonomy

Numerical taxonomy involves two aspects

1. Construction of Taxonomic Groups:

i. In numerical taxonomy, first, individuals are selected and their characters spotted out. There is no limitation to the number of characters to be considered. However, the larger the number of characters, better is the approach for generalization of the taxa.

ii. The resemblances among the individuals are then established on the basis of character analysis, which can often be worked out with the help of computers, the accuracy of which depends on the appropriateness in character. The best way to delimitate taxa is, to utilize maximum number of characters, with similar weightage given to all of them.

Principles of Numerical Taxonomy

Numerical taxonomy involves two aspects

2. Discrimination of the Taxonomic Groups:

When the taxonomic groups chosen for the study show overlapping of characters, discrimination should be used to select them. Discrimination analysis can be done by various techniques, specially devised for such purposes.

Following seven principles of numerical taxonomy have been enumerated by Sneath and Sokal

- **(i) The 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) The 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 groups of organisms under study. Thus distinct taxa can be recognized.**
- **(v) Phylogenetic conclusions can be drawn from the taxonomic structure of a group and from character correlations, assuming some evolutionary mechanisms and pathways.**

Following seven principles of numerical taxonomy have been enumerated by Sneath and Sokal

- **(vi) The science of taxonomy is viewed and practiced as an empirical science.**

- **(vii) Phenetic similarity is the base of classifications.**

	Characters									
Taxa	1	2	3	4	5	6	7	8	9	10
A	+	+	+	+	+	+	+	+	+	-
B	+	+	+	-	-	+	+	+	-	-
C	+	+	+	+	-	+	+	+	-	+
D	+	+	-	-	-	+	-	-	-	-
E	+	+	-	-	-	-	+	-	-	-

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- **(vi) The science of taxonomy is viewed and practiced as an empirical science.**

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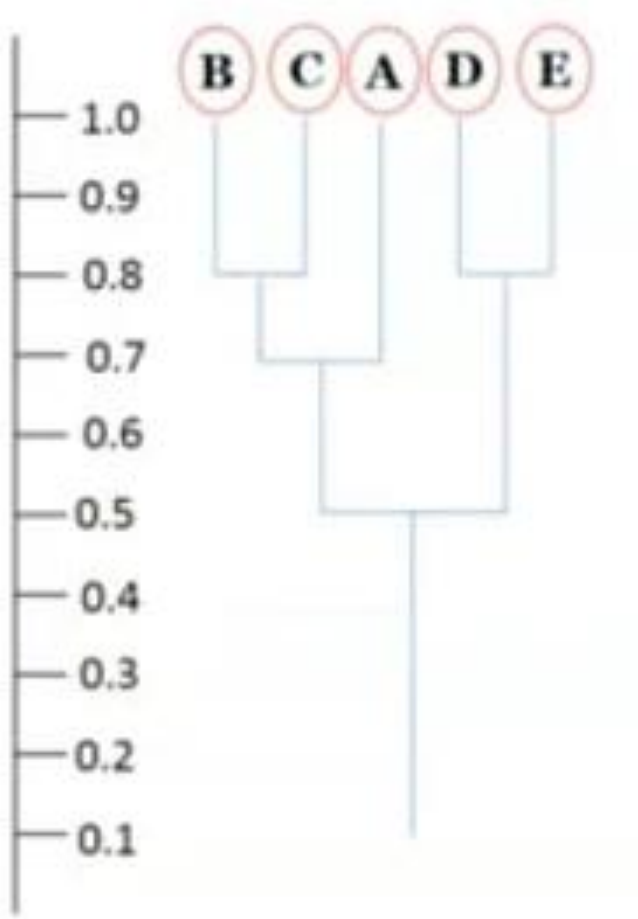
Characters

Species

	1	2	3	4	5	6	7	8	9	10
A	1	1	1	1	1	1	1	1	1	0
B	1	1	1	0	0	1	1	1	0	0
C	1	1	1	1	0	1	1	1	0	1
D	1	1	0	0	0	1	0	0	0	0
E	1	1	0	0	0	0	1	0	0	0

Taxa	A	B	C	D	E
A	-				
B	0.7	-			
C	0.7	0.8	-		
D	0.4	0.7	0.5	-	
E	0.4	0.7	0.5	0.8	-



Merits of Numerical Taxonomy

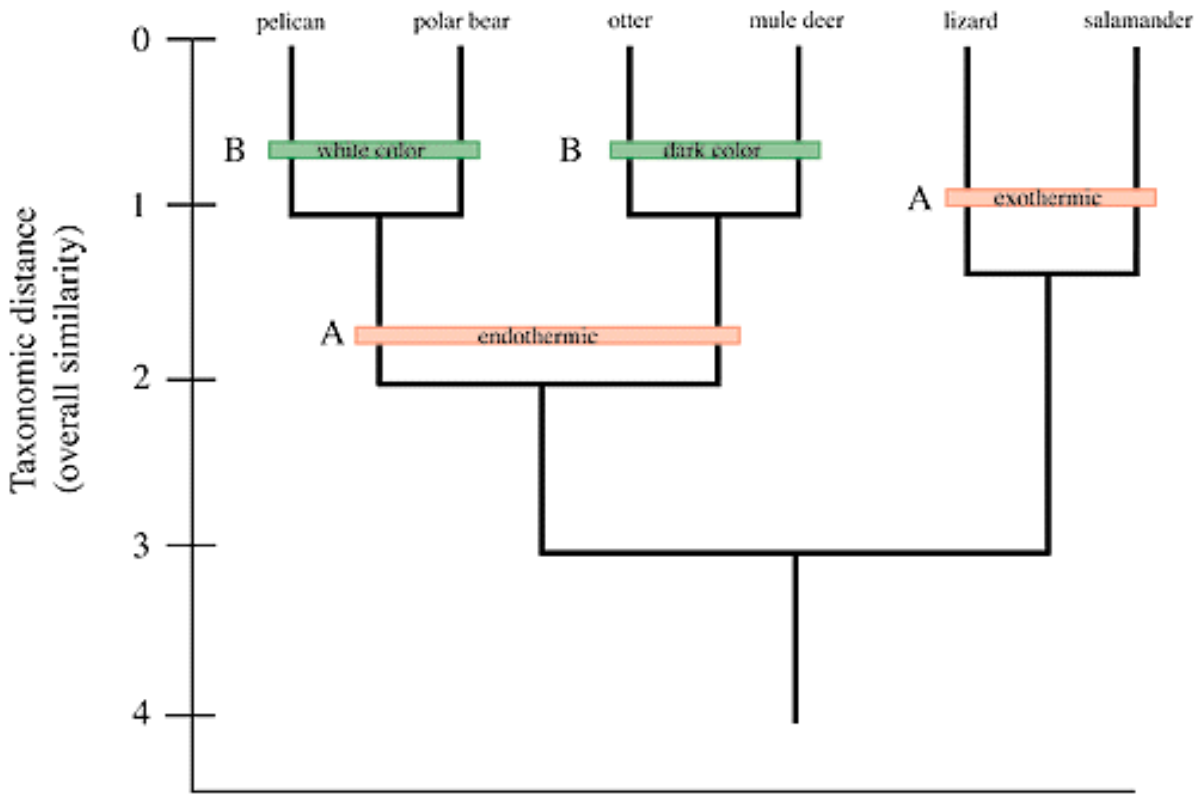
- **The data of conventional taxonomy is improved by numerical taxonomy as it utilizes better and more number of described characters.**

- **The data are collected from a variety of sources, such as morphology, chemistry, physiology, etc.**

- **As numerical methods are more sensitive in delimiting taxa, the data obtained can be efficiently used in the construction of better keys and classification systems, creation of maps, descriptions, catalogues, etc. with the help of electronic data processing systems.**

Merits of Numerical Taxonomy

- Numerical taxonomy has in fact suggested several fundamental changes in the conventional classification systems.
- The number of existing biological concepts have been reinterpreted in the light of numerical taxonomy.
- Numerical taxonomy allows more taxonomic work to be done by less highly skilled workers.



Demerits of Numerical Taxonomy

- **The numerical methods are useful in phenetic classifications and not phylogenetic classifications.**

- **The proponents of “biological” species concept, may not accept the specific limits bound by these methods.**

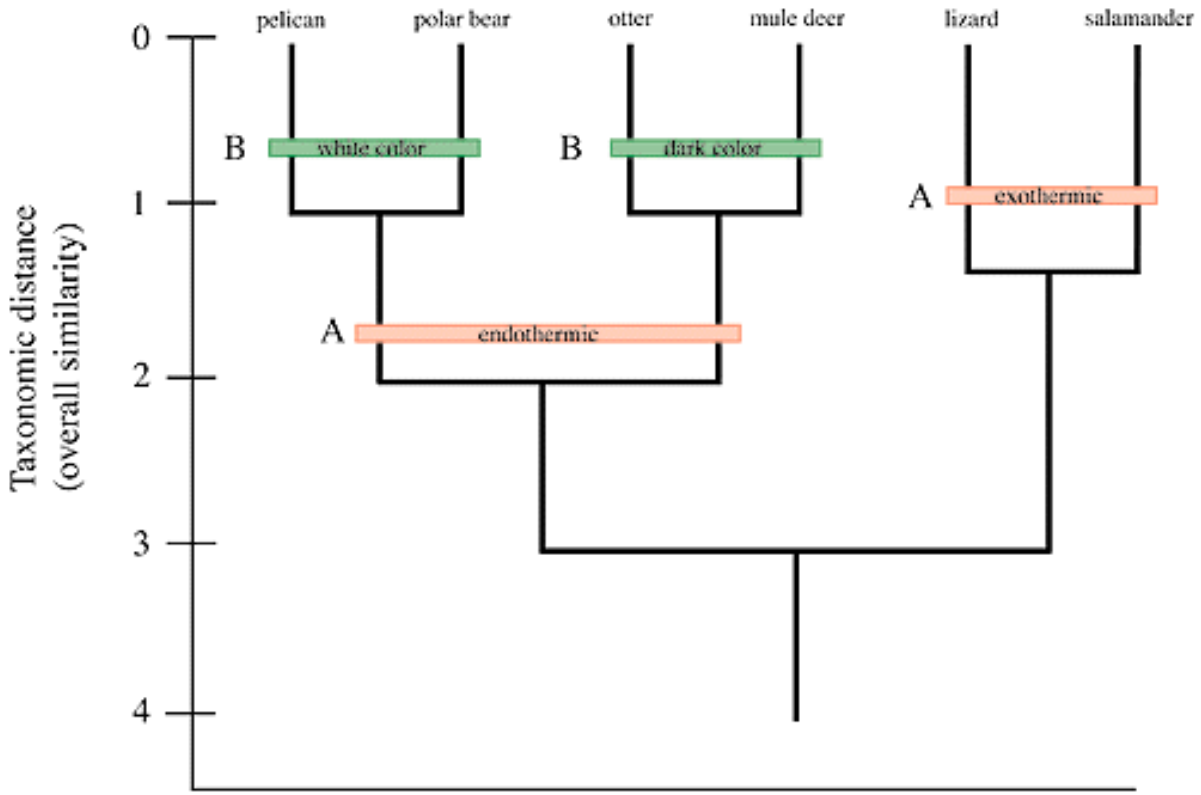
- **Character selection is the greatest disadvantage in this approach. If characters chosen for comparison are inadequate, the statistical methods may give less satisfactory solution.**

Applications of Numerical Taxonomy

- **Study of similarities and differences in bacteria, other micro-organisms and several animal groups.**

- **Delimitation of several groups**

- **Phytochemical data from seed protein and mitochondrial DNA RELP studies has been numerically analyzed by Mondal et al. to study the interspecific variations among eight species of cassia L .Based on the results of electrophoretic patterns, the degree of pairing affinity (PA) or similarity index was calculated.**



Thank You