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Classification I

Brief historical notes:
<u>Folk taxonomies</u>- Local and cultural-based organization of the world. Especially important in plants.
<u>Aristotle and Theophrastus</u>- Animals based on reproduction and plants on cultivation, with an idea that there are essential features that identify groups.
<u>Linnaeus</u>- The current most widespread system is derived from him.
<u>Quinarians</u> and other numerical systems.

All of this happened well before Darwin's time, except for quinarianism that was contemporary. Darwin's work solidly put the process behind the pattern that was repeatedly found, the hierarchy (much to the dismay of the quinarianists). This paved the way for phylogeny-based classifications to predominate.

Phylogenetic Classification- a system of names implying relationships and consistent with a phylogenetic tree.

Classification may differ because of (1) local and global conventions used to go from tree to classifications/names or (2) a different phylogeny is used. The first is important in regarding efficiency of storage of information and information communication, while the latter has empirical and biological implications.

Phylogenetics-Systematics-Taxonomy-Classification-Nomenclature

Grouping and naming is the process of Classifying or Systematizing. Though the use terms varies, for many the whole process is taxonomy. These are not independent, but one can be testing or investigating one, while accepting others as untested background knowledge. We will treat nomenclatural rules separately and only note here that nomenclature is a very important scholarly activity, but not science.

What are we classifying?

Natural Kinds- Though debated, natural kinds are generally thought to be essentialistic and so rely on necessary and sufficient attributes, e.g. atomic number for elements and their derivative properties. Entities so recognized are not necessarily derived from a common process and are not time bound.

Artificial Convenience- Humans can and do devise categories and classifications of all sorts. Many are very useful, special purpose classifications and they need not be bound by time, use intrinsic attributes or rely on a common process. Ecological guilds or behavioral types are good

and useful examples. Though often hierarchical, these classifications are limited in scope and are not thought to represent real intrinsic properties of the entities classified they fall short of being a suitable for a universal biological classification.

Historical Individuals- As individuals these are entities that are time bound (have a beginning and an end) and are not defined by necessary and sufficient attributes (though attributes are the evidence for them and the means to recognize them). They are historical in that they are, or are composed of replicators and so have intrinsic ancestor-descendants relationships. Therefore, they are hierarchical by nature. Such names are proper nouns. Taxa are, or are hypothesized to be, monophyletic groups or species.

Generally, what makes a good classification?

All classifications balance tradeoffs in their basis and conventions.

Practical- Operationality, ease of use as a mnemonic, stability.
High information content- Efficient summary of what is known and can act as an effective medium for information transfer.

Predictive- Suggests the characteristic and relationships of unknown and unplaced entities.

Natural- in the sense that the entities being classified and their relationships are real in the sense that they are independent of our observations.

Reflects common process. Entities and their relationships are the result of and/or participate in a common generative process.

Quick review: Monophyletic group- All the descendants of a common ancestor.
Non-monophyletics groups- Paraphyletic group is a convex group that includes some but not all descendants of a common ancestor or polyphyletic group is a non-convex group that includes some but not all descendants of a common ancestor.

How global conventions alter the resulting classification:

Evolutionary systematist- Recognized an equal importance for anagenesis and cladogenesis. Gaps and therefor taxa, were established based on selected "important" characters and divergence. These are often presence/absence characters and so paraphyletic groups are by convention recognized. A mix of paraphyletic and monophyletic groups is thought to be desirable.

Pheneticists- Overall similarity frequently results in erroneous groups relative to a good phylogeny. Groups that are actually non-monophyletic may appear to be monophyletic based on symplesiomorphies or may be explicitly recognized as paraphyletic as that is considered a better summary of character data.

Cladists- Recognize only taxa that are, or are hypothesized to be monophyletic groups or species.

The Linnaean Hierarchy.

1. Expresses the relative position in a ranked system
2. Categorical ranks above species are not comparable except when sister taxa. The rank in and of itself has no biological meaning.
3. Species function or are hypothesized to function in processes and theories in such a way that they are comparable. All current classification systems hold this position.
4. Ranks must be memorized or explicitly listed.
5. Changes in ranks must be reflected in name suffix changes for regulated names
6. If one wanted to name all clades, this would require an inordinate number of ranks. But no one really does or wants to do this.

Some useful conventions for going from a tree to a classification.

Incertae sedis- used to indicate when a taxon is at a particular level or in a particular categorical rank, but its position there is uncertain.

Sedis mutabilis- used to indicate when a taxon is at a particular level or in a particular categorical rank and there is evidence for more than one possible relationship.

Uncertainty of monophyly- can be indicated using quotation marks. Lowercase informal names that are known to be paraphyletic also can be indicated this way. The latter are not included in a classification.

Fossils- Many contrivances have been suggested, but including them as normal taxa is best. Often they are indicated by a dagger " † "

Hybrids- "Genus x specific epithet" when this is the result of G. a x G. b. cross. Most common in botany.

Ancestor species and/or stem groups- can be indicated by putting the species or high taxon name in parentheses, e.g. Carabidae (*Protocarbus primus*). It is rare there is enough evidence to support such placements.