''बेटी बचाओ, बेटी पढ़ाओ''

JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

Faculty of Education & Methodology

Faculty Name - JV'n Dr. Abinash Parida (Assistant Professor)

Program - M.Sc. Zoology Semester

Course Name - Biosystematic, Ecology & Biodiversity

Session No. & Name - 1.2 (Name of the Session):
Concept of Taxonomy

Academic Day starts with –

- Greeting with saying **'Namaste'** by joining Hands together following by 2-3 Minutes Happy session, Celebrating birthday of any student of respective class and **National Anthem**.

Lecture Starts with-

- Academic Day ends with- National song' Vande Mataram'

CONCEPT OF TAXONOMY

Taxonomy, in a broad sense the science of classification, but more strictly the classification of living and extinct organisms—i.e., biological classification. The term is derived from the Greek taxis ("arrangement") and nomos ("law"). Taxonomy is, therefore, the methodology and principles of systematic botany and zoology and sets up arrangements of the kinds of plants and animals in hierarchies of superior and subordinate groups. The term first proposed by the

Swiss originated botanist August in Pyramus de Candolle in 1813 for the plant classification. He used the term in his famous book—Theory elementaire de la botanique (Elementary Theory of Botany). So taxonomy is the arrangement of the plants and animals on the basis of some laws.

According to Simpson (1961), taxonomy is the theoretical study of classification, encompassing its foundations, guiding principles, methods, and regulations. Taxonomy, according to Ernst Mayer, is the study and application of classifying living things. Taxonomy is the study of classification.

"The practise of recognising, naming, and ordering tax a into a system of words consistent with any kind of relationships among tax a that the investigator has discovered in nature," according to Kristofferson (1995), is the definition of taxonomy. Generally speaking, superficial categorization of living things develop according to necessity. Any crawling object, such as a snake, earthworm, intestinal parasite, or dragon, has been referred to, respectively, by the Anglo-Saxon phrases worm and fish. There are more anatomical distinctions between a shellfish and a starfish than there are between a bony fish and a man, despite the fact that the terms shellfish, crayfish, and starfish all include the term "fish." There are many different types of vernacular names. The English robin (Erithacus rubecula) is not the American robin (Turdus migratorius), for instance, while the mountain ash (Sorbus) only superficially resembles a real ash.

However, biologists have made an effort to examine every living thing as thoroughly, leading them to create a systematic taxonomy. Cross-referencing and information retrieval are made easier by using a formal classification as the foundation for a nomenclature that is largely consistent and understood globally.

When it comes to biological classification, the terms TAXONOMY and SYSTEMATICS are used in a variety of ways. According to American evolutionist Ernst Mayer, "taxonomy is the theory and practise of classifying

organisms," while "systematics is the science of the diversity of organisms"; the latter, in this sense, has significant interactions with evolution, ecology, genetics, behaviour, and comparative physiology that taxonomy need not.

The process of taxonomy involves two distinct steps:

(i) Correct recognition and definition of the organisms and their relationships and

(ii) Application of suitable designations for the organisms and to different groups which

include them.

The former is called classification which includes study of characters and grouping of individuals while the latter is termed as nomenclature.

History

People who are surrounded by nature frequently have a thorough understanding of the local fauna and flora that is significant to them. They are also frequently familiar with many of the broader groups of living creatures (such as fishes, birds, and mammals). However, their knowledge is based on necessity, and they hardly ever make generalisations.

However, the ancient Chinese and Egyptians made some of the earliest attempts at formal, albeit constrained, classification. A list of 365 kinds of medicinal plants found in China served as the foundation for later hydrological investigations. Although the fabled Chinese monarch Shennong, who lived around 2700 bce, is said to have authored the catalogue, it was most likely composed during the start of the first millennium. Similar descriptions of various medicinal plants, together with instructions on how to utilise them to treat ailments and injuries, can be found in ancient Egyptian medical papyri dated between 1700 and 1600 BC.

Aristotle, who practically created the science of logic, of which categorization was a component for 2,000 years, was the first great generalizer in Western classification. Aristotle appears to have studied the ocean and marine life extensively while he was on the island of Lesbos because the Greeks were constantly in contact with them. He mentioned many different natural groups in his writings, but his ranking of them from simple to sophisticated was not an evolutionary one. But he was far ahead of his time in categorising invertebrate creatures into distinct subgroups and was aware that whales, dolphins, and porpoises were not fish but had mammalian characteristics. Of course, he was unable to deal with the minuscule forms of life as he lacked a microscope.

Up to the 19th century, the Aristotelian method dominated classification. He basically proposed that in order to categorise a living thing according to its nature—that is, what it truly is, as opposed to superficial similarities—it is necessary to examine numerous specimens, discard variable characteristics (since these must be unintentional and not essential), and establish constant characteristics. The essence of the living thing—what makes it what it is and cannot be changed; the essence is, of course, immutable—can then be stated using these to construct a definition. The Greeks were enthralled by mathematics, particularly geometry, which serves as the model for this process. Since its definitions were flawless and its inferences from axioms were assured, regardless of whether a perfect geometrical object could ever be produced, mathematics looked to them to be the type and example of perfect knowledge. However, the Aristotelian method used to study living things does not proceed by deduction from established and well-known axioms, but rather by induction from observed examples, which does not result in the discovery of an unchanging essence but rather in a lexical definition. Although it offered a method for trying to characterise living things via meticulous analysis for centuries, it ignored the diversity of living things. It is interesting that

empiricists, who did not believe in an essence of each, were among the few in the mid-19th century who comprehended Charles Darwin's ORIGIN OF SPECIES.

For 1,400 years, neither Aristotle nor Theophrastus, his botany student, had any significant successors. Around the 12th century, botanical publications required for medicine started to include realistic plant images, and some even started grouping related plants together. Encyclopaedists also started to combine some modern observations with conventional wisdom. The treatise on human anatomy by Andreas Vesalius was published in 1543, and the first university botanic garden was established at Padua, Italy, in 1545, during the first blooming of the biological Renaissance.

Work in zoology and botany blossomed after this. The systematic knowledge that was then available was compiled by John Ray in the late 17th century, along with helpful classifications. In 1703, he distinguished between monocotyledonous and dicotyledonous plants, identified the actual affinities of whales, and provided a practical description of the species concept, which had already evolved into the fundamental unit of biological taxonomy. He used practical observation to modify the Aristotelian logic of classification.

Levels of Taxonomy

There are three levels of taxonomy corresponding with three periods of taxonomy:

(i) Alpha taxonomy:

The level of taxonomy by which species are characterized and naming of the species is done.

(ii) Beta taxonomy:

The level of taxonomy by which the arrangement of species in their natural system of

categories is made.

(iii) Gamma taxonomy:

The level of taxonomy which deals with the intra specific variations and evolutionary sequence and also a causal interpretation of organic diversity.

Mayer and Ashlock (1991) have divided the taxonomy into two levels:

(i) Micro taxonomy:

The level which deals only the problems related to species.

(ii) Macro taxonomy:

The level which deals with the problems and principles of higher taxa (from subgenus and above) only.

Mayer and Ashlock (1991) recognize three schools of macro-taxonomy such as:

(i) Phonetics (or Numerical taxonomy),

(ii) Cladistics (Phylogenetic systematics) and

(iii) Evolutionary taxonomy (or Evolutionary systematics).

(i) Phenetics (or Numerical taxonomy):

It is an effort to categorise species based on general traits as opposed to their shared evolutionary history. On the basis of similarities and differences, phenetics aids in the drawing of phyletic lineage (connection). Pheneticists do not rely on plesiomorphic and apomorphic primitive and derived features.

(ii) Cladistics (Phylogenetic systematics):

The term "cladistics" refers to taxonomy, which ranks and categorises species based on their "recency of common descent." According to this idea, the location of branching nodes on the evolutionary tree determines the animal's category status.

Taxa with wholly derived (synapomorphic) shared characteristics descended from a single ancestor. Identification of monophyletic lineages or clades is accomplished by phylogenetic analysis. 'Clade' was first used by Julian Huxley in 1958, while 'cladistic' was coined by Cain and Harrison in 1960.

(iii) Evolutionary taxonomy (or Evolutionary systematics):

The Darwinian theory underlies the entire idea. This idea holds that every valid taxon descends from a common ancestor, but that similar traits of a biological domain do not always involve a shared ancestry.

A branch of biological classification known as the evolutionary or Darwinian classification uses phylogenetic relationships and general similarity to classify species. In this kind of taxonomy, taxa are valued more highly than individual species.

Usually taxonomists agree to divide the taxonomy into two types:

(i) Classical taxonomy and

(ii) Neo-taxonomy or experimental taxonomy.

(i) **Classical taxonomy:** Classical taxonomy, often known as orthodox taxonomy, is the most traditional type of taxonomy. It has to do with describing, naming, and categorising animals and plants according to their morphological characteristics (connected to external characteristics like genitalia, anatomy, embryology, and karyotype; etc.).

(ii) **Experimental taxonomy or neo-taxonomy:** It is connected to genetic research based on a shared gene pool for a taxon and has proven useful in differentiating between two taxa. Data collection for morphology is done using some contemporary techniques. In order to investigate the fine structures that are useful in morph taxonomy, electron and scanning electron microscopes are used on several types of invertebrates, such as protozoans, helminthes, and arthropods.

The closely related two current aspects in taxonomy are taken into consideration,

such as:

(i) Biochemical taxonomy and

(ii) Cytological taxonomy.

(i) **Biochemical taxonomy:** It deals with taxonomic traits discovered through chemical investigation of peptides, nucleic acids, amino acids, and sugars in proteins, hormones, and enzymes.

The amino acid sequences of proteins change in many organisms and are useful for classifying various species. Enzymes, hormones, nucleic acids, amino acids, and other constituent bio-molecules are studied using a variety of approaches that aid in systematics.

In the study of systematics, several techniques are used to examine the chemical components, including immunological, chromatography (paper chromatophy and column chromatography), and electrophoretic method. Two distinct taxa are distinguished using the immunological data. Pigeons and primates are categorised using the blood group genes.

Chromatography is a variety of techniques for the separation of complex liquid mixtures, such as biological fluids (such as amino acids, steroid, carbohydrate,

etc.), that pass through a column of adsorbing material (such as paper, magnesia), where the mixture's components are adsorbed in separate layers.

This technique is applied in various groups of arthropods, snails and the data is very much helpful in animal systematics.

(ii) Cytotaxonomy : It focuses on taxonomic traits discovered through cytological investigations. The study of relationships and chromosomal counts as a basis for classification of organisms is known as cytotaxonomy, a subfield of taxonomy. The location of the centromere is a crucial aspect of chromosome structure that aids taxonomic research.

Periods of Taxonomy

(i) **First period:** This period may be extended from the time of Aristotle (384-322 B.C.) to Linnaeus (1707-1778). In this period Linnaeus strongly introduced binominal nomenclature for plants and animals and followed Aristotelian and Democritus principle in classification of animals. He also first introduced the hierarchic system of classification both in plants and animals following class, order, genus and species categories.

(ii) Second period: In this period the evolutionary classification was introduced by Charles Robert Darwin (1809-82) and variation among the organisms is the main force in evolution which was discussed extensively. Darwin published his famous book "On the Origin of Species by Means of Natural Selection" in 1859.

In his book the theory of evolution by natural selection was his own creation although based on the work of Lamarck, Cuvier (1768-1832) and Erasmus Darwin (1731-1802), the grandfather of Charles Darwin. This theory helped a lot to the systematic zoology. E. Darwin's book Zoonomia (1794) presented the laws of organic life. He suggested the struggle for existence in Zoonomia which was elaborated by Charles Darwin.

(iii) Third period: This period includes the development of modern taxonomy which started about 1930. The study of genetics and population biology was started with typical taxonomy.

This period is remarkable with the publication of New Systematics by J. S. Huxley in 1940, intra specific variations were studied and the science of population genetics was started in 1908 by G. H. Hardy and W. Weinberg who independently discovered a principle concerned with the frequency of genes (alleles) in a population in the light of evolutionary theory.