Biological bases of classification of the plant world

Plan

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Classification, Taxonomy, and Systematics . Etymologically, the terms systematics and taxonomy have virtually the same meaning, and in Greek taxonomy means "to put in order" and systematics means "to arrange together". The term taxonomy (as systematic botany, meaning "arrangement of organisms in an elementary classification") was coined by Carl Linnaeus (1751).

In the early 19th century, botany was primarily a descriptive science. Scientists were concerned with describing plant traits and grouping organisms according to those traits. This ordering of organisms into (hierarchical) groups based on their similarities or differences is called classification, and the process of ordering is called classification. The product of classification is a system. There are three main types of classifications: Artificial - for the most part early classification systems based on a few convenient features, and usability (e.g., Linnaeus). Natural - based on sets of traits, seeking to reflect the natural relationships between organisms or taxa. Phylogenetic - using all known criteria to interpret the phylogeny (evolution) of a taxon.

The term Systematics was introduced by the Swiss botanist de Candolle (1813) and denoted the theory of plant classification. Later the term became more widely used for methods and principles of classification of any groups of organisms. For example, Ch. Darwin (1859) considered the terms taxonomy and systematics as synonyms. And nowadays some botanists consider taxonomy and systematics as synonyms, by some they differ.

However, the term systematics has a broader meaning than taxonomy . Here are a few definitions. In modern botany, systematics is "the science of the types and variety of organisms and the relationships among them" (Simpson, 1961; Stevens, 1994) or "the science of the diversity of organisms" (Mayr, 1969), "the study of biological diversity" (Wilson, 1985). Systematics studies not only the diversity of organisms, but also the causes of that diversity and the ways in which it occurs. Systematics includes taxonomy and nomenclature and is expressed in classification (system).

Classification is the arrangement of objects (organisms, species, etc.) on the basis of common properties, the grouping of organisms in a hierarchical system. Taxonomy - theoretical basis of classification, rules based on which taxa are arranged in the system. Taxonomic keys and - a method of analysis based on the features obtained during classification, but it should be remembered that keys themselves are not classification systems.

After groups of organisms have been classified, these groups must be given names. The choice of names for groups of organisms and the rules for choosing those names is called nomenclature. Nomenclature is governed by the International Code of Botanical Nomenclature.

Let us consider some more terms: Definition (identification) - assignment of an individual specimen to an already classified and named group (organism to a species, species to a genus, etc.). If an organism has not been previously classified (assigned to a known group of organisms), the organism is described, named according to the rules of nomenclature, and then assigned to an already known group.

Description - a listing of features (usually morphological) of organisms or groups of organisms. Diagnosis - a short comparative description emphasizing those features that separate a taxon from its close relatives of the same rank, is given, as a rule, when describing new species (genera, etc.). The diagnosis, in accordance with the rules, indicates affinity and relationships - some degree of presumed genetic or evolutionary proximity, usually expressed in morphological similarity.

Systematics is one of the branches of biology that aims to describe all the current diversity of plant species and their evolution. And this is very important in the light of the study of biodiversity on the planet, the preservation of which is now one of the main problems. In addition, systematics is closely related to other sciences. The development of such sciences as genetics, plant anatomy and morphology, evolutionary teachings, paleontology is unthinkable without knowledge and development of systematics. The importance of taxonomy for modern biology can be expressed in the words of the famous Russian botanist, expert in taxonomy, A.L. Takhtajian "Taxonomy is both the foundation and the crown of biology, its beginning and the end".

As we have already noted, systematics is the science of types and diversity of organisms and the relationships between them. However, as we know, taxonomy operates, as a rule, not with specific organisms, but with "taxa" - species, genera, families, etc.

Systematics has developed a system of concepts and terms, its own language used to classify organisms. Like any system used for classification, this system is hierarchical, that is, it consists of a number of subordinate units. The term "taxon" is used in systematics to denote systematic units of any rank, which was adopted at the International Botanical Congress in 1950.

Levels of Hierarchy

The main taxonomic levels are highlighted in yellow.

Regnum
Subregnum
Divisio (Phyllum)
Subdivisio
Classis

Subclassis
Superordo
Ordo
Subordo
Familia (Fam.)
Sublamilia .(Subiam.)
Tribus (Trib.)
Subtribus (Subtrib.)
Genus (Gen.)
Subgenus (subgen.)
Sectio (sect.)
Subsectio (subsect.)
Series (ser.)
Subseries (subser.)
Species (sp.)
Subspecies (subsp.)
Varietas (var.)
Subvarietas (subvar.)
Forma (f.)
Subforma (subf.)

Usually in zoological nomenclature it is accepted to name a Pyllum and in botanical nomenclature – Divisio.

Taxon is an object of study in taxonomy. Like a species, a taxon is both a category (rank or level in the hierarchical classification) and a specific group of organisms. Taxa are hierarchical nadindividual levels of biota (parts of biota) isolated in the process of evolution and characterized by a certain stability in time and space before a critical period in the history of each particular taxon. Any taxon (including species) is characterized by the sum of morphophysiological traits and a certain range.

The smallest taxonomic category is species.

One of the most successful, is the definition of A.L. Takhtajian (1984): species is "a system... united by common features..., a common origin and a common geographical range and sufficiently clearly separated from closely related species both by a set of features and by isolating barriers".

Firstly, species is a fundamental category in the taxonomic hierarchy, since every specialist, regardless of his/her specialization, deals with species; any other taxonomic category is defined and described on the basis of species. Thus a genus is a group of species; a subspecies is part of a species.

Secondly, a species is the basic structural unit in the system of living organisms, a qualitatively isolated form of living matter, the basic unit of the evolutionary process. Depending on the concept adopted, defined as "the smallest natural population permanently separated from any other by a certain discontinuity in series or biotypes" (du Rietz, 1930) (typological species). The aggregate of populations of individuals capable of interbreeding with the formation of fertile offspring, inhabiting a certain range, possessing a number of common morpho- and physiological traits and types of relations with abiotic and biotic environment; and - separated from other similar groups of individuals by almost complete absence of hybrid forms (biological species).

A species is subdivided into a number of smaller categories of subspecies - ecological and geographic races. In this case, the smallest taxonomic unit will be considered not a species, but a subspecies . Variation is a set of individuals of one species characterized by certain inherited traits, but showing no clear geographic or ecological confinement. Forms are usually groups with particular morphological differences (usually one trait).

All categories of rank above species are collective taxonomic categories, presumably related by kinship (presumably natural, monophyletic groups). Thus, a genus is composed of species united by kinship, a family is composed of genera, etc.

Species are grouped into genera, as a rule, on the basis of morphological similarity. A genus may be polytypic if it contains many species, oligotypic if it contains a small number of species, and monotypic if it contains one species. An example of polytypic genera is the genera Begonia or Poa, monotypic is the genus Ginkgo, which has only one relict species G. biloba.

It is customary to use certain suffixes when writing Latin names of taxa, indicating the rank of the taxon:

Taxon	**Suffixes**
Kingdom	No definite suffix
↑	
Division	phyta/spermae
↑	
Class	nae/opsida
↑	
Order	ales
↑	
Family	aceae
↑	
Genus	No definite suffix
↑	
Species	No definite suffix

The next taxonomic category is family (familia). Family is the smallest category of higher taxa, which unites groups of genera (or one genus, if the family is monotypic). The name of a family is given by assigning to the main genus the ending - aceae . For example, Asteraceae - Compositae, Chenopodiacaea - Marecaeae, Bromeliaceae - Bromeliaceae.

Next is the order (ordo). The name of the order is formed with the ending - ales. An order unites groups of related families, thereby making it possible to order the families. Examples of orders are Malvales, Asterales, Myrtales.

An order is followed by a class (classis). Classes are very large taxonomic categories, so there are few of them. The names of classes of higher plants are formed by the ending - opsida . For example, there are two classes of the angiosperms: Magnoliopsida - dicotyledons, and Liliopsida - monocotyledons.

Classes are grouped into divisions (divisionis), with the ending - phyta . For example, Magnoliophyta is the flowering or the covered plants.

Then the classes are grouped into suborders with the ending - bionta (Embryobionta - higher plants).

The highest category is the kingdom - Plantae, that is, plants.

The modern system of living nature allows for the existence of at least four kingdoms (animals, plants, fungi, bacteria). If we take into account the newest subdivision of prokaryotes, this number increases to six, and if we add the sometimes singled out Protista (protozoa) to seven. Some scientists single out up to 10 or more kingdoms of living nature.

In this course, we will review the following taxonomy:

1. Superkingdom Procariotes (Procaryota). Organisms without a formalized cell nucleus.

1. Kingdom Archaebacteria. Methane-forming anaerobic chemosynthetic bacteria.

2. The Bacteria kingdom. Various groups of anaerobic and aerobic heterotrophic prokaryotes, less frequently autotrophic chemosynthetic bacteria and bacteria capable of anoxygenic (without oxygen liberation) photosynthesis.

3. The Oxyphotobacteria kingdom. Autotrophic aerobic prokaryotes capable of oxygenated photosynthesis. These include cyanobacteria and chlorooxybacteria.

2. Eucaryotes (Eucaryota) Organisms that have a formalized cell nucleus.

1. Animal kingdom. Heterotrophs, feeding chiefly by ingestion of solid food, more rarely by adsorption (absorption of liquid food). Dense cell membrane is absent. Typically di-ploid organisms.

2. Fungi. Heterotrophs, absorb food by absorption. Usually has hard cell membrane. Haploide or dikaryontic (bicore organisms).

3. Plant kingdom. Autotrophs, feeding by synthesis of organic and inorganic materials from sunlight. Photosynthesis is oxygenic (with liberation of oxygen). There is a dense cell membrane. Alternation of diploid and haploid generations is characteristic; diploid organisms predominate more often.

Modern systematics is a rapidly evolving science that builds systems of the organic world using genetic analysis (DNA analysis). However, textbooks cannot keep up with the flight of scientific thought, so we will learn systematics the old-fashioned way for now.

This figure shows one of the current systems of the organic world based on genetic analysis. But since we are at the very beginning of the accumulation of information about the DNA of organisms, this system will be revised many more times.

I.V. Zemlyanskaya