WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 3, Issue 12, Dec., 2022

METHODOLOGICAL FEATURES OF STUDYING THE SECTION OF SYSTEMATICS - Bacillariophyta

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ABSTRACT

This article discusses the issues of methodological features of studying the systematics section of Bacillariophyta - Diatoms, the formation of theoretical knowledge and practical skills in conducting research in the field of taxonomy, ecology of algae, studying the cycles of their development, developing skills in conducting field and laboratory algological studies, using high-tech laboratory equipment in the course of solving scientific problems in the field of algology, the formation of professional training for independent scientific, research and pedagogical activities, the essence of modern methods for collecting quantitative and qualitative samples of planktonic, periphytic and benthic algae, laboratory processing of material, taxonomic and morphometric processing of samples.

Keywords: issues of methodological features of studying the systematics section of Bacillariophyta - Diatoms, the formation of theoretical knowledge and practical skills, theoretical principles, methods and methodological approaches to the study of populations and communities of macro- and microalgae, methods for collecting and primary processing of micro- and macroscopic organisms, their taxonomic, biometric processing.

INTRODUCTION

The purpose of the academic discipline "Algology" is the formation of the foundations of the systematics of algae, the creation of a fundamental level of knowledge, skills and abilities of the bachelors of the main stages and trends in the development, structure, distribution of algae of various departments. To master the discipline, competencies are required, formed in the framework of the study of the following disciplines: “Systematics of lower plants”.

The subject of study of algology is the morphological, anatomical and cytological organization of representatives of different divisions of algae, their way of life, developmental biology, production and trophic characteristics, ecosystem role, and economic significance. It also studies the relationship and cenotic connections of plant aquatic organisms of their populations and communities with each other, with other hydrobionts, abiotic components of the environment both in natural and laboratory conditions in order to establish the limits of their tolerance to the effects of changing habitat conditions.

In this regard, it is necessary to carry out the following tasks:

- The formation of theoretical knowledge and practical skills in the field of research in the field of taxonomy, ecology, Bacillariophyta - Diatoms, the study of their development cycles;
- To form the ability to conduct field and laboratory algological research, use high-tech laboratory equipment in the course of solving scientific problems in the field of algology.
- Formation of theoretical knowledge in the field of hydrobotany,
- familiarization with the main methods and directions of study of different departments of algae;
- Mastery of general scientific methods of system analysis of the structure of algae populations, biodiversity of algocenoses and algofloras.
- To give basic information on applied algology, in particular on the processes of anthropogenic destruction of algocenoses, the effect of toxicants on hydrobionts, the use of different types of algae for bioindication and biomonitoring of aquatic ecosystems.
- To give basic information about the artificial cultivation of algae in order to obtain laboratory cultures, commercial and sanitary mariculture; to form ideas about diseases and pathological conditions of mariculture objects.
- To form professional readiness for independent scientific, research and teaching activities.

Lectures are based on the study of the most important conceptual issues related to the topic of the discipline section and the topic of the lecture. It begins with a very brief explanation of the concepts and key concepts. Then separate questions of the lecture, the history of their study, the main essence are revealed in detail. At the end, a brief summary of the material presented at the lecture is given.

The purpose of conducting laboratory classes is to consolidate the knowledge of students obtained by them in the course of studying the discipline in lectures and

independently, as well as the formation of certain professional skills and abilities in the field of general and applied hydrobiology. Laboratory classes are conducted in the form of a survey on a given topic. Students are offered the opportunity to discuss a given topic in terms of using the acquired knowledge on practical experience in conducting laboratory studies of bachelors. Give examples from your own research experience. In the process of studying the discipline, independent extracurricular work of the student is provided in the form of information retrieval of materials for performing independent work and its analysis. Control over the implementation of independent tasks is carried out during the survey, testing, ongoing consultations.
As a result of studying the discipline, the student should know:

- Fundamentals of taxonomy, ecology, developmental biology, reproduction of the main groups of aquatic plant organisms;
- Theoretical principles, methods and methodological approaches to the study of populations and communities of macro- and microalgae;
- The essence of modern methods of collecting quantitative and qualitative samples of planktonic, periphytic and benthic algae, laboratory processing of material, taxonomic and morphometric processing of samples;

Be Able To:

– Apply methods of algological, biochemical, botanical and phytogeographic research;
- To predict processes - transformations of freshwater plant communities, their individual elements under changing environmental conditions.
- Analyze and objectively evaluate the data of morphological-anatomical, cytological, biochemical and other studies;

Own:

– Methodology for conducting algofloristic studies, analysis and generalization of the data obtained;
– Methods of collection and primary processing of micro- and macroscopic organisms, their taxonomic, biometric processing.
– Methods of taxonomic research, statistical analysis of quantitative data.

The Content of Lectures

DEPARTMENT DIATOM ALGAE (BACILLARIOPHYTA, DIATOMEAE)

Forms are predominantly small, rarely large, free-floating or attached, of different colors. Small forms are usually invisible to the naked eye or are distinguishable only in mass growths in the form of clusters of thin threads, balls, pillows, plates, scales,

grains, etc. Large forms are in the form of thick, sometimes branched threads, bushes and cords that do not show a whorled structure (only some forms with whorled branches, but then they are slimy to the touch, not impregnated with lime and colored olive green).

Cells with a silica bivalve shell - a shell, usually preserved after calcination in a fire. The valves are bilaterally symmetrical or radial, with a complex structure (striated, punctate, etc. in appearance). Forms are unicellular or colonial; their mass accumulations are yellowish-brownish.

Type Bacillariophyta - Diatoms - a fairly ancient group of algae. Single fossil forms are known from the Jurassic deposits (Lias), and in the Cretaceous deposits they are already found in a large number of species. Cretaceous diatoms are very perfect in their structure. This suggests that already before the Cretaceous period, they had gone through a long evolutionary path.

In fact, the identification of diatoms is not particularly difficult, provided that the material is carefully prepared technically, which requires some time. The species characteristics of diatoms are so clear that the possibility of errors in their identification is very small. The study of diatoms is carried out in preparations with solid media, and this has the great advantage in that it makes it possible at any time to check the desired species in the preparation. Therefore, collections of preparations of diatoms are of the same great scientific value as herbaria for the study of macroscopic algae and higher plants.

Diatoms are an independent, highly organized type of algae that does not have direct family ties with other algae in the current geological period. Despite the absence of outward similarity, signs of the internal organization of diatom cells bring them closer to Chrysophyta and Xanthophyta (Heterocontae) (the commonality of pigments, assimilation products, the presence of silica in the shell, and other smaller features).

Silica armor (theca) consists of silicon oxide hydrate (Si02 + H20), close to opal, and, apparently, is devoid of organic matter. It is transparent, thin, usually fragile, and only in some species, which have a very thin shell, is slightly elastic. The armor, or theca (theca), is similar in structure to the box; it consists of two independent halves, which are pushed one into the other by the edges, like the doors of a box. The outer half of the armor, corresponding to the lid of the box,

The taxonomy of diatoms has been studied since the thirties of the last century. In parallel with the study of their morphology, attempts were made to systematize them. As a result, many systems arose based on three principles: 1) the structure of cells and colonies (Agard, 1830, 1832; Smith, 1853-1856), 2) the shape and position of chromatophores in the cell (Pfitzer, 1871 ; Petit, 1877; Merezhkovsky, 1901, 1903) and

3) the morphology and detailed structure of the armor (Kützing, 1844; Rabenhorst, 1853; Grunov, 1860; Van Geyrk, 1896; Schutt, 1896; Karsten, 1928; Gustedt , 1930, 1927-1937).

The systems of the first two types, in which researchers tried to build a natural system of diatoms on the same principles that were used to build systems of other algae that do not have a shell, did not justify themselves, because the shape of chromatophores and colonies very often depends on the habitat, and in one Planktonic and benthic species of the same genus have different colony structures and chromatophore shapes. Systems of the third type, based on the signs of the structure of the shell, its structure and suture system, which are closely related to the physiology (nutrition and respiration) of the cell, showed that the structure of the shell is the main feature on which to build a natural phylogenetic system of diatoms . This system is also of great value in the sense that fossil diatoms can be included in it, which is extremely important for the completeness of the phylogenetic system of diatoms. The most complete and sustained system of modern diatoms belongs to Gustedt (1930, 1927-1937), and at present it is generally recognized. He took Schutt's system as a basis and supplemented it. Attaching great systematic importance to the structure of the valves and the structure of the suture (studied in detail by him), he created a real natural phylogenetic system in which individual groups are related to each other.

The department of diatoms (Bacillariophyta) has more than 20 thousand (more than 1265) species in Uzbekistan. These are photoautotrophs of microscopic size, with an exclusively cocoid thallus, having integuments in the form of a silica shell. The shell tightly adjoins the plasmalemma and consists of two parts: the epithecus and the hypotheca. Their systematics, cytological and morphological organization, ecology, geographical distribution, biodiversity". The structure of the thallus, pigments, reserve substances, reproduction, distribution and ecology. Features of the structure of the cell. Traffic. Division into groups. main representatives. Melosira, Pinnularia and others.

The taxonomy of diatoms is based on the morphology of the shell and, above all, the nature of the arrangement of structural elements (areoles, alveoli) on the valves. In addition, some features of reproduction, the nature of the habitat and other criteria are taken into account. This allows you to establish family relationships between taxa within the department, which includes 2 classes: Centriophyceous and Pennatophyceous.

Coccoid and colonial structure of diatoms. cytological organization. The presence of a silicon shell, its internal and external structure, as the basis for the taxonomic division of diatoms. Reproduction of diatoms. Planktonic and benthic diatoms. Geographic

diversity of the diatom flora, their role in the formation of geological sediments and their dating. Practical use of diatomites. Prospects for the use of diatoms in the electronics industry. Cytological organization of cerate algae. Sculptural shell as the basis for the taxonomic division of representatives of the department. Numbering rules and descriptions of shell shields. Participation in the formation of freshwater plankton.

The main concepts of the theme: silica shell, shell, valve, scutellum, sculpture, sculptural elements, positive buoyancy, sporulation cytokinesis, saxitoccin. Cyst, dormant stage.

Questions for self-control:

1. Ecological role of diatoms and ceracic algae.
3. Practical significance of diatoms.
4. Biodiversity and distribution of representatives of groups.

The content of laboratory classes

Occupation. Division Diatoms (Bacillariophyta)

The department of diatoms (Bacillariophyta) has more than 20 thousand (more than 1265) species in Uzbekistan. These are photoautotrophic tubulocrysts of microscopic size, with an exclusively cocoid thallus, having covers in the form of a silica shell. The shell tightly adjoins the plasmalemma and consists of two parts: the epithecus and the hypotheca.

Materials and equipment. Algae bottles, MBR-1E microscopes, permanent preparations, dissecting needles, Petri dishes, tweezers, glass slides and coverslips, water bottles, pipettes, filter paper.

Purpose: To get acquainted with the general characteristics and representatives diatoms. To study the features of the life cycles of algae of the department Bacillariophyta.

Methodology for the study of diatoms.

The collection of diatoms does not require the use of any special technique and is carried out by the usual methods used to collect other algae - plankton and benthos. For the purposes of taxonomy, when collecting diatoms, the material is fixed. The quality of the fixative does not really matter here, because only the shell is examined in diatoms. Any fixatives are suitable: formalin, alcohol, blue vitriol, etc., of which alcohol is the best, since it thickens the mucus and thus protects the colonies from decay. Diatom benthos - epiphytes, fouling of stones and various objects, bottom films, etc. - in the absence of dishes and a fixative, can be dried using the usual herbarium method, as macroscopic algae are dried.

For cytological studies, the following fixatives are used: a one percent solution of osmic acid, a one percent solution of chromic acid, Fleming's chromoacetic acid (composition: 70 cm3 of 1% chromic acid, 5 cm3 of glacial acetic acid, 90 cm3 of distilled water) and Buen's fixative (composition: 15 cm3 of a saturated solution of picric acid, 5 cm3 of formalin and 1 cm3 of glacial acetic acid).

Morphological and partly cytological studies in some cases are best done on a living cell. So, for example, chromatophores are best studied in a living cell, in which the nucleus is also clearly visible. Cell division and auxospore formation should also be observed on living material.

An aqueous solution of methylene blue is used to stain living cells; in a solution of 0.001 g per liter of water, cells live during the day, stronger solutions serve to stain mucus and volutin. Volyutin turns blue in a reddish-violet color (without coloring, it is almost indistinguishable from oil). Various dyes are used to stain fixed cells, but they should only be used for fine cytological studies. The nucleus is stained with hematoxylin, hemalaun and eosin, chromatophores - with Delafield's hematoxylin and acid fuchsin, pyrenoids - with hematoxylin, safranin, eosin and methyl orange, Buechli drops (volutin) - with hematoxylin and bismarckbrown. Drops of oil are colored dark brown with 1% osmic acid, red with Sudan III and dissolved in ether, chloroform, gasoline, xylene and alcohol. Mucus is stained with all aniline dyes in the appropriate colors: safranin, methyl blue, methyl violet, gentian violet, bismarckbrown, and so on.

The material processing technique for the determination of diatoms is rather laborious and consists of two stages: removal of the protoplast by chemical treatment of the sample and preparation of the preparation in a solid or liquid medium with a high refractive index. The removal of the protoplast requires the following processes: 1) washing the sample from the fixative, 2) removing water-insoluble carbonic salts by the action of HC1, and 3) burning the protoplast by boiling in strong acids. In practice, this is done as follows.

one). A part of the sample is taken, large foreign particles (sand, pebbles, shells) are removed by soaking, the sample is precipitated by centrifugation, the fixative is carefully sucked off with a pipette with a balloon and a rubber bulb. Washing is repeated 2-3 times depending on the amount of material and the capacity of the centrifuge tube. Simultaneously with the removal of the fixative, salts dissolved in water are removed, therefore, especially thorough washing of the material taken from brackish and saline water bodies is required, since the remaining salts during further processing can crystallize and interfere with the study of the fine structure of the armor.

2). To remove water-insoluble carbonic salts, the precipitate, washed from the fixative and soluble salts, is treated with 10% HCl (in a centrifuge tube) with slow heating to boiling. Then the material is washed in distilled water by repeated centrifugation until traces of acid are completely removed (litmus test). The need to remove carbonic acid (yula) is caused by the fact that these salts, upon further boiling of the material in acids, will precipitate, clog the material and spoil the preparations.

3). Removal of organic matter is carried out by boiling in strong acids. Pure strong (fuming) H2SO4 is carefully poured into the precipitate, washed from HC1 and, if possible, dehydrated. The mixture is poured into an Erlenmeyer flask and boiled in a sand bath in a fume hood for 10-20 minutes, and with a large amount of material 30-50 minutes. If the solution does not decolorize, it is necessary to throw a very small crystal of KNO3 (or NaN03) into the brightened boiling solution, this increases the oxidation energy and the precipitate soon becomes decolorized

Thus, the quality of the medium is of great importance for revealing the finest structure of the armor. The preparation medium must meet the following requirements:

1) have a high refractive index, 2) be completely transparent, do not become cloudy, do not crystallize, do not shrink or crack over time, 3) be bright, otherwise the possibility of obtaining satisfactory micrographs of objects is excluded.

Tasks

1. Get acquainted with the systematic position of the objects of study.

Write down the systematics:

Eukaryotic kingdom - Eucaryota
Kingdom of tubulocristates - Tubulocristates
Division Diatoms - Bacillariophyta.
Class Coscinodiscophyceae - Coscinodiscophyceae
Melosiral order – Melosirales
Melosira genus - Melosira sp.
Class Bacillariophyceae (Suture) - Bacillariophyceae
Order Navicular - Naviculales
The genus Pinnularia - Pinnularia sp.
The genus Navicula - Navicula sp.

2. On a preparation prepared in the usual way with a small magnification of the microscope, consider and sketch the thread of melozira. At high magnification, study the structure of the cell.

3. Study and draw the pinnularia in two positions: side-fold and from the girdle. In the drawing from the side of the sash, mark the S-shaped seam, three knots, ribs along the edge of the sash; in the figure from the side of the girdle, designate two valves - the epithecus and the hypotheca. Also draw the structure of the pinnularia cell, indicating the nucleus, 2 lamellar chromatophores, vacuole and pectin shell. Find and draw pinnularia in the stage of vegetative propagation.
4. Examine and draw the navicula from the side of the sash, mark the seam, nodules, ribs.

Questions for self-control

1 Describe the division Bacillariophyta.
2 What classes are diatoms divided into and by what
sign? Name the main representatives of the classes.
3 Describe the structure and life cycle of melozira
4 Describe the structure and features of the course of the life cycle of pinnularia.
5 "General characteristics of algae departments" (Bacillariophyta department):
BUT). General characteristics of the department of diatoms
B). Characteristics of the class Coscinodiscophyceae (Coscinodiscophyceae), the main representatives of the class
AT). Characteristics of the class Fragilariophyceous, or Seamless, (Fragilariophyceae), the main representatives of the class
G). Characteristics of the class Bacillariophyceous, or Suture, (Bacillariophyceae), the main representatives of the class.

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