

ABSTRACT

dissertation for Doctor of Philosophy (Ph.D.) degree in specialty 6D060700-
Biology

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"Study on biodiversity and systematic of algal flora of the Lake Alakol"

General description of the work.

The dissertation work is aimed at studying the diversity of algae in Lake Alakol and its modern taxonomy, the creation of genetic polymorphism of halophytic algae.

Relevance of the topic. Lake Alakol is an internal drainage salt lake located at the intersection of the borders of the Almaty and East Kazakhstan regions as well as on the Balkhash-Alakol plain. Lake Alakol is the second largest lake after Lake Balkhash in the Zhetysay region. It occupies the northeastern part of the Alakol region and stretches from the northwest to the southeast. Scientific data obtained from studies of the sustainability of aquatic ecosystems are of great importance. In Kazakhstan, there are rivers and lakes of aquatic plants and algae have not been fully studied (the Syrdarya, Ili, Irtysh rivers, Lake Zaisan, etc.). Recently, the study of biological diversity and its conservation has become the main problem in the field of nature protection in many countries. This is proved by the conferences held in Rio de Janeiro (1992), Johannesburg (2002) and Rio de Janeiro (2012).

At present, the study of the biological diversity of continental water bodies is one of the urgent areas of modern scientific research. It is known that one of the most important components of the aquatic ecosystem is algae, which are the main constituents of organic matter in water and provide oxygen to underwater organisms. In 1994, Kazakhstan became one of the states-supporters of biodiversity conservation, therefore, special attention was paid to the issues of nature protection and biodiversity conservation, in this regard, in 1997, the National Strategy for Biodiversity Conservation was adopted. The ichthyofauna and composition of invertebrates of Lake Alakol were fully studied by E. Krupoy and colleagues, and there is still no sufficient data on the algal flora of the lake, since research in this area not fully disclosed, So, at present, due to the increasing anthropogenic factor in the lake ecosystem, the definition biodiversity of algae and the creation of a modern taxonomy of the algal flora of this lake can be the basis for the relevance of the doctoral dissertation.

The aim of the work determining the species composition of algae in samples collected from Lake Alakol, bring them to modern taxonomy, bioindication assessment of the state of the lake water by analyzing their ecological groups and characterize the genetic polymorphism of charophyte algae.

Research objectives:

1. Study of biodiversity and taxonomy of the algal flora of Lake Alakol;
2. Comparative analysis of the species composition of the algae flora of Lake Alakol with other lakes in Kazakhstan;
3. Conducting bioindication of the algae ecology of Lake Alakol;

4. Determination of the prevalence and diversity of ecological groups of the algal flora of Lake Alakol;

5. Give a description the genetic polymorphism of harophytic algae using the Microsatellite loci;

Object of study. The main object of this work is the water and algae of Lake Alakol.

Scientific novelty of the research.

- In this work, the species composition of the algal flora of Lake Alakol has been studied for the first time, modern systematic groups of algae have been developed.

- For the first time, a comparative analysis performed of the species composition of the algae of Lake Alakol with the species composition of the algal flora of 42 other water bodies of Kazakhstan has been carried out.

- developed bioindication methods for the ecological indicators of algae in Lake Alakol, as a result, become known the water of the lake is suitable for the livig of diatoms algae .

- Distribution and diversity of ecological groups of algae flora of Lake Alakol were determined, as a result of which the main distribution points of the section of algae in the lake area are plotted on a 3D map.

- Using the metod of molecular genetic PCR, characterization of genetic polymorphism of Charophytic algae by microsatellite loci.

Scientific and practical significance of the work. The scientific and practical significance of the work is mainly preserving the diversity of algae in Lake Alakol, therefore, the species composition of lake algae was studied and a modern systematization of the identified algae species was developed. As a result of this modern taxonomy, algae species became known, which received new names. The list of specios composition and systematics of the algae of Lake Alakol is of great scientific and practical importance for monitoring the aquatic ecosystems of one of the country's largest reserves, the Alakol State Nature Reserve. And also, the possibility of using molecular genetic methods in the field of algology has been proven, new ways to classical systematics have been opened.

The study of the diversity of the algal flora of Lake Alakol and the determination of the dominant species of algae, bioindication assessment of the state of the lake water, by analyzing their ecological groups, testifies to the scientific and practical significance of the dissertation work.

The results of the research work are used in the training of specialists in biology and ecology in higher educational institutions of the country, in the preparation of textbooks, reference books and demonstration manuals in institutions for the protection of nature and the environment, as well as in the creation of a database on algae in general.

Basic principles put forward during the defense

1. Diversity of algae of Lake Alakol and its modern taxonomy;
2. Obtaining indicators of comparative analysis of the species composition of algae of Lake Alakol with the flora of algae of other lakes in Kazakhstan;
3. Carrying out a bioindication method in the ecology of algae of Lake Alakol;
4. The results of the distribution and diversity of ecological groups of the flora of algae of Lake Alakol are presented;
5. Characterization of genetic polymorphism of Charophytic algae through microsatellite loci;

The main results and conclusions of the study

The main results and conclusions of the study are divided into the following 5 groups:

1. The species composition of the algal flora of Lake Alakol was first studied and developed using the database "Algaebase (Guiry and Guiry, 2018)" in the development of modern systemic groups of algae. As a result of our research work, 208 species of algae from Lake Alakol were identified, belonging to 5 divisions, 11 classes, 29 orders, 51 families, 83 genera, of which 12 species are variations and intraspecific forms of algae. In the course of the study, it was found that when determining the species composition of algae in lake water, diatoms come out in the first place, which have 145 species and intraspecific forms. At the subsequent sites, 22 species and intraspecific forms of blue-green algae were recorded, 20 species of charophyte algae, 15 species of green algae and 6 species of euglena algae were identified. Calculation of the standard deviation showed that the species composition of the algae of Lake Alakol, although rich in division, class, and orders, is somewhat less in species composition. Polymorphic comparative analysis showed that the Ssp / Sp Index of Lake Alakol (1.06), that is, it is very close to the regional algal flora of Turkey (1.09) and Israel (1.09). At the same time, some of the British Isles (1.15), Georgia (1.19) Ssp / Sp Index are somewhat close, while the states of Central Europe (1.21), Mongolia (1.36), Belarus (1.42) and Poland (1.48) turned out to be far from the indicators of Lake Alakol.

2. A comparative analysis of the species composition of the algae of Lake Alakol with the flora of algae in 42 water bodies of Kazakhstan has been carried out. Comparative floristic analysis in comparison with statistical programs showed that the first method is more objective in determining the similarity of floristic algae individuals and for different ratios of lake sizes and salinity levels. Studies have shown that there is a wide variety of algae in large lakes such as Alakol, Balkhash and Shardara, as well as in freshwater lakes with low salinity, since these three lakes have the same salinity concentration and the same area. The summation of intersections of dendrites, statistically generating the studied flora, testifies not only to the volume of the lake, but also to the influence of the salinity class on the general diversity of flora and the diversity of diatoms. The results of the study showed that the species of blue-green algae are most common in lakes of the 1-st salinity class, but in some cases they are found in lakes of the 2-nd and 3-rd salinity classes. Based on the data presented, we have established that the size and salinity of the lakes are

important for the wide distribution of the species composition of the algal flora in Kazakhstan.

3. Bioindication to the ecology of 208 species of algae identified in Lake Alakol was carried out, where it was found that benthic and plankton-benthic species of algae are dominant, but in some cases soil species are also found. Depending on the temperature of the water, on Alakol, the species of algae found in temperate and warm water are much higher, and vice versa, there are few eurythermal species. The analysis of water saturation with oxygen showed that if the species found in a weakly flowing or poorly oxygenated environment predominate in lake water, then there are very few algae species in well-oxygenated waters. Despite the predominance of alkalophilic and indifferent ecological groups of algae in the water, the pH level of the water of Lake Alakol has a slightly alkaline environment. Due to the low salinity of the studied lake, depending on the salt concentration, indifferent species of algae prevail in the water.

4. The distribution and diversity of ecological groups of algal flora of Lake Alakol was revealed, as a result of which the main points of distribution of algal divisions in the lake zone were plotted on a 3D map. In the Koktuma region south of the lake, the most common species of diatoms, charophytes and green algae, and the water temperature in this area of the lake is warmer than in other regions, and lower in Ph-level. And in the northern part of the lake in the Kamyskala zone, a high diversity of species of cyanobacteria (blue-green algae) and euglenal algae was revealed. The ecological map of the trophic state of the lake shows that the lake in the center is oligotrophic, and the Koktuma region is mesotrophic; it has been established that eutrophic species begin in the Kamyskala region, and in the Koktuma zone at the confluence of the Zhamanty River into Lake Alakol, the maximum concentrations of oligoeutrophic indicators are concentrated. Groups of autotrophic feeding in the lake are expressed by the concentration of species near Akshy, indicators of heterotrophic feeding are also determined in the Akshy area. However, the indicators of the predominant heterotrophic type of feeding are found in the southern part of the lake near Koktuma.

5. Characterization of the genetic polymorphism of charophytic algae using microsatellite loci was developed by molecular genetic PCR. In order to study the genetic polymorphism of charophytic algae, 99 samples were selected. Of these, 7 samples of Kazakhstani harophytic algae and 92 harophytic algae from the herbarium collection of the Institute of Evolution of the University of Haifa. Next, a genomic DNA molecule was isolated from the selected algae and their quality and concentration were determined. All selected 99 charophytic algae were found to be suitable for the polymerase chain reaction. In studies to determine the polymorphism of algal species, the following types of primers were selected: (Chcan A9, Chcan A19, Chcan A6 and Chcan A1).

Personal contribution of the author to the work. The author of the work in the course of fulfilling the assigned research tasks: - conducted a review of literary sources, studied the object of research using the selected methods in the field and laboratory conditions, summarized and processed the results obtained, made a full contribution to the writing and presentation of the thesis.

Scientific work refers to the individual work of the author and is not associated with funded scientific projects. When performing scientific work, the expeditionary and laboratory equipment of the Institute of Botany and Phytointroduction was used, with funding from the Al-Farabi Kazakh national university after performed bioindication, comparative floristic analyzes of the algal flora of Lake Alakol, the molecular genetic section was performed at the University of Haifa (Israel), the Institute of Evolution.

Approbation of work. The results and main provisions of the dissertation were reported and discussed at many international scientific conferences:

- "Conservation and sustainable use of gene pool of plant world in Eurasia at the present stage" international scientific conference (Turkey, Antalya, 2016);

- Materials of the international scientific conference of students and young scientists "Farabi Alemi" (Kazakhstan, Almaty, 2019);

- VII International scientific-practical conference "GLOBAL SCIENCE AND INNOVATIONS, CENTRAL ASIA", Kazakhstan, Nur-Sultan (Astana), September 28, 2019

- Materials of the international scientific conference of students and young scientists "Farabi Alemi" (Kazakhstan, Almaty, 2020);

Publications. According to the results of the dissertation research, the author published 11 scientific articles in various publications; of which 3 articles in journals included in the Web of Science and Scopus databases, 1 article in foreign journals of the RSCI system, 3 articles in republican scientific journals of the list of the Committee for Control in Education and Science of the Republic of Kazakhstan, 4 theses in collections of materials of international scientific conferences.

Thesis structure. The dissertation includes definitions, designations and abbreviations, an introduction, a literature review, an object and research methods, a discussion of the results, a conclusion, a list of 147 references and 3 applications. The research paper of 128 pages has 11 tables and 44 figures.