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S. Nurashov[1], A. Jiyenbekov[2], E. Sametova[1]

[1]«Institute of Botany and phytointroduction», Almaty, Kazakhsatan,
[2]Al-Farabi Kazakh national university, Almaty, Kazakhsatan.
E-mail: nurashs@mail.ru, zh-ai-ek@mail.ru, elyasam@mail.ru

BIODIVERSITY OF BLUE-GREEN (*Cyanophyta*) ALGAE OF ALAKOL LAKE AND ITS SYSTEMATICS

Abstract. In Kazakhstan there are many specially protected natural territories: nurseries, national parks, reserves, sanctuaries, wildlife areas, natural monuments, botanical gardens established for the preservation of biological diversity of the state. In many of those areas the scientists-florists conducted scientific research related to the inventory of vascular plants. Despite the substantial interest for the study of flora, the research into their diversity in various nature communities are insufficient, especially the flora of water reservoirs. The algae of water reservoirs remain studied to a small extent. Nevertheless recently we have conducted the study of algae flora in the specially protected natural territories of various regions of Kazakhstan.Earlier we published systematics and species diversity of diatoms of Lake Alakol.In the article, the authors provide research data's for the first time investigate of the algal flora of Alakol lake, which flows through 15 rivers (The Urzhar, the Katynsu, the Emelkuisa, the Yrgaity, the Zhamanty, the Zhamanotkel, the Tastu etc.). The found seaweeds were divided into: 1-systematic division, 1-clas, 5-orders, 9-families, 22-species and species belonging to 11-genures. Biodiversity of specially established types of seaweed has developed and modern taxonomy has been created. In the studied lake of the algae are found cosmopolitan species in different areas Most of the species listed here are of the plankton bacterial species and some species are of benthos.

Key words: algae, plankton, benthos, systematics, lake Alakol.

Introduction. Lake Alakol is a saline drainage lake located on the Balkhash-Alakol lowland, which is located on the border of the Almaty and East Kazakhstan regions, in the eastern part of the Balkhash-Alakol Basin.More than 15 tributaries flow into the lake, of which the main are the rivers Urzhar, Katynsu, Emelkysa, Ygrajty, Zhamanty, Zhamanotkel, Tasty.The area of the lake (with islands) is 2696 square kilometers. The volume of water is 58.56 cubic km. Length-104 km. Width-52 km. Average depth-22 m. The greatest depth is 54 m.The length of the coastline is 348 km.Together with the lakes Sasykkol, Uyaly, Zhalanashkol and others, smaller, forms the Alakol lake system.In the center of Alakol there are islands: Ulken, Kishkeni Araltobe, Belkuduk, etc. The climate of the coast is sharply continental. A complex wind regime is observed above the lake. The maximum wind speed over the northern parts of the lake reaches 40-50 m/s, over the southeastern and central 50-60 m/s. The most active winds in the autumn-winter period, when the wave height can be up to 2-2,5 m.

The duration of freeze-up is about 2 months (February-March). The largest thickness of ice is 0.8 m (in February). Melting ice-April-early May. The water temperature reaches +7+ 15^{0}C in late May. Mineralization of water in the water varies from 1.2 to 11.6 g/l. The composition of water is chloride-sodium and chloride-sulfate-sodium. In the waters of Lake Alakol, the high content of fluorine and bromine.In 1994, the Parliament of Kazakhstan ratified the Convention on Biological Diversity, thus affirming its desire to preserve the unique richness of nature. A real step towards the implementation of these documents was the creation in 1998 of the Alakol State Reserve(http://almatyregion-tour.kz).

In 2013-2015 we studied the algae flora of one of the barely studied high mountainous reservoir - the Rakhmanovskoye lake in the Katon Karagay state National natural park of the East Kazakhstan oblast for

he purposes of identification of their species diversity. As a result of research the algae composition of the lake Rakhmanovskoye was determined in which there are 249 species, varieties and forms of algae referred to four types 10 phyla, 25 orders, 45 families and 71 genera. Cyanoprokaryota-14, Chlorophyta-63, Bacillariophyta -1 7 1 , Charopyta – 1 [1-3].

The Lake Markakol is a large water reservoir of Altay located in the mountainous gap (at the altitude of 1500 m above the sea level) in the territory of Markakol state natural reserve. The Markakol hollow is surrounded by the mountain peaks of Kurchumskiy and Azutau. As a result of algae related research in Markakol lake there were discovered 129 types of algae, referred to 3 orders: Bacillariophyta - 85, Chlorophvta -41, Cyanoprokaryota - 3. The basis of algae flora of Markakol lake create the diatomic algae (Bacillariophyta) represented by 85 species from 28 genera, 18 families, 12 orders and 3 phyla [4-9].

In 2013 we conducted algae research from rivers of Zhongar Alatau of Almaty region. As a result of processing algae samples in 2013 for Baskan river in the Zhongar Alatau of the State national natural park of the Almaty region there were discovered 37 species and types of algae referred to 3 orders: diatomic - 32, the green ones -3 and blue-green ones - 2. The basis of Baskan river is created by diatomic algae (Bacillariophyta), represented by 32 speices from 11 genuses, 7 families, 6 orders and 2 phyla. The genuses of Navicula (9), Cymbella (4), Gomphonema (4), Synedra (3), Fragilaria (3) are characterized as being most abundant in genuses [10-13].

The Big Chubachye Lake is the largest of the lakes of the State National Natural Park "Burabay" in the North of Kazakhstan. The average depth of the lake is 11.1 m, the maximal 33.3 m. At the lake there is a number of small islands. The lake is drain free. The water is used for the purposes for drinking potable water, for water supply for cattle and for various economic needs of Burab settlement. As a result of processing of collected samples of alg from the considered drain water reservoir in 2012-20 there were discovered 146 species and types of alg from diatomic division - 117 species, the green ones 11, the blue-green ones - 10; euglena - 2; dinophyta charophyta algae - 3 species [14-16].

Material and methods. The material of this article is elected 2016-2017. During the summer expedition time a species was collected from different points of the Alakol lake.Along the collection of algae, meteorological conditions of the water, air and water temperature were determined. The water depth is determined by the Sekki disk, water ph- universal indicator paper. The water temperature showed the sample at 22°C, and the water was Ph-7.5.In the course of the work, commonly known classical methods of hydrobotanics and algae were used (Jiyenbekov et al.). To determined of phytoplankton samples is a specific examination by M. Gollerbach and B. N. Polyansky, also by the method of N. P. Masiuk and others use Apshtain netting with diameter 45 cm is filtered by plankton grid number 76.The collected material was fixed there in 4% solution of formalin and 96% etanol [17-19]. During harvesting, the algae type, color, colony, etc. p. signs are logged. 26 algae samples from plankton, periphyton, and benthos were collected from the lake. Diatomic algae preparations are investigated by heating. Formalin-treated material is coated with glass and heated in the electric cooker. Organic cleaning of algae piglets is carried out by firing in strong acids [20-24].

In the identification of species, light microscope MBI-3 and binoculars were produced using a computer program with the binoculars Motic BA 400 microscope, and the size of the cells was obtained by using an ocular micrometer.

Results and discussion. As a result of processing algae samples collected from Lake Alakol, analysis of algae obtained from the lake was investigated and modern systematic groups were identified. They are as follows:

1-division (*cyanoprokaryota*), 1-klass (*Cyanophyceae*), 5–order (*Nostocales, Oscillatoriales, Chroococcales, Synechococcales, Spirulinales*) [25-26],9-family (*Nostocaceae, Microcoleaceae, Chroococcaceae, Microcystaceae, Gloeotrichiaceae, Merismopediaceae, Aphanizomenonaceae, Oscillatoriaceae, Spirulinaceae*), 11- genius (*Anabaena, Arthrospira, Chroococcus, Gloeocapsa, Gloeotrichia, Merismopedia, Nodularia, Trichodesmium, Oscillatoria, Spirulina, Nostoc*)the species belong to interdisciplinary forms with the following [27-28], 22 - species (Anagnostidis, 2001: 359-375; Berg, 1987: 97-103; Bourrelly, 1966: 551; Bruno, 1994: 369-373; Carmichael, 1990: 87-106; Edwards, 1992: 1165-1175; Gibson, 1982: 463-489; Gromov, 2000: 79) [29-31].

Type of Alakol lake algae

#	Name of species	#	Name of species
1	*Anabaena cylindrica* Lemmermann	12	*Nodulariaharveyana*Th. ex Bornet&Flahault
2	*A. oscillarioides* Bory ex Bornet & Flahault	13	*N. spumigena*Mertens ex Bornet&Flahault
3	*Arthrospirajenneri* Stizenberger ex Gomont	14	*Nostoc linckia* Bornet ex Bornet&Flahault
4	*Chroococcus minutus* (Kützing) Nägeli	15	*N. zetterstedtii* Areschoug ex Bornet&Flahault
5	*C. tenax* (Kirchner) Hieronymus	16	*Oscillatoria princeps* Vaucher ex Gomont
6	*C. turgidus* (Kützing) Nägeli	17	*O. sancta* Kützing ex Gomont
7	*Gloeocapsa turgida* f. *subnuda* (H.)Hollerbach	18	*Spirulina labyrinthiformis* Gomont
8	*G. violacea* Kützing	19	*S. major* Kützing ex Gomont
9	*Gloeotrichia intermedia* (Lemmermann) Geitler	20	*S.subsalsa* Oersted ex Gomont
10	*Merismopedia glauca* (Ehrenberg) Kützing	21	*Trichodesmium lacustre* Klebahn
11	*M. punctata* Meyen	22	*Trichormus variabilis* (Kütz.Bor.&Fl.) Kom. & Anag.

Figure 1 – *Oscillatoria princeps* Vauch

Figuure 2 – *Chroococcus tenax* (Kirch.) Hier

Figuure 3 – *Gloeotrichia intermedia* (Lemm.) Geit

Conclusion. Discussing the results, many water reservoirs, alga flora of river lakes in our country have been studied, including the Caspian Sea, Syrdarya, Ili, Baskan and Sarkand, Shar and Kokpekty rivers and algal flora and algal biological diversity of the Alakol lake were not investigated by the country's algal specialists. One of the main objectives of the UN Conference on Biodiversity Conservation, adopted in 1992 in Rio de Janeiro is to preserve biodiversity in the environment and prevent the disappearance of species. The algal diversity of the lake is the basis for this goal. The Kazakh Fisheries Research Institute and the Zoology Research Institute have not studied of Alakol Lake Algapholics by hydrobiotes and ichthyofauna.

During our special algaeological investigations, several times this scientific expedition was built. Algae samples from the northern, southern and south-western parts of the lake were removed and the second part was mixed with 4% solution of formalin and 96% solution of ethanol. A microscopic analysis was carried out to determine the types obtained in the laboratory and the study revealed the varieties of diatomaceous algae and its modern taxonomy. Moreover, we have seen in the study that the Alcohol content of some parts of Lake Alacol Lake is very rich. But in recent years, it can be seen that anthropogenic impact on the stability of lake ecosystems and biodiversity linked to the transformation of the lake into a tourist destination. In this article, the authors regulate the stability of the lake water biota, which is the wealth of algaflora. Consequently, it saves the gaseous, salinity of the water, Ph-levels, mineral composition, and biotic content.

С. Б. Нурашов[1], А. К. Джиенбеков[2], Э. С. Саметова[1]

[1]РМК «Ботаника және фитоинтродукция институты», Алматы, Қазақстан,
[2]Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан

АЛАКӨЛ КӨЛІНІҢ КӨК-ЖАСЫЛ (*Cyanophyta*) БАЛДЫРЛАРЫНЫҢ АЛУАНТҮРЛІЛІГІ ЖӘНЕ ОНЫҢ СИСТЕМАТИКАСЫ

Аннотация. Қазақстанда көптеген ерекше қорғауға алынған табиғи аймақтар кездеседі: питомниктер, ұлттық саябақтар, қорықтар, жабайы табиғи аймақтар, табиғат ескерткіштері, ботаникалық бақтар мемлекеттің биологиялық әртүрлілігін сақтау үшін құрылған. Осы салалардың көбінде флорист ғалымдар тамырлы өсімдіктерді түгендеуге қатысып, ғылыми зерттеулер жүргізді. Өсімдіктерді зерттеуге үлкен қызығушылық болсада да, әртүрлі табиғатты қорғау қауымдастықтарында олардың алуан түрлілігіне байланысты зерттеулер, әсіресе, су объектілерінің флорасын зерттеу жеткіліксіз. Су балдырларының құрамын зерттеу төменгі деңгейде қалып отыр. Дегенмен альголог ғалымдар Қазақстанның түрлі өңірлерінің ерекше қорғалатын табиғи аумақтарында балдырлар флорасын зерттеу жұмыстарын жүргізді. Осыған дейінгі мақаламызда Алакөл көлінің диатомды балдырларының алуантүрлілігі мен систематикасын жариялаған болатынбыз. Бұл мақалада авторлар 15 өзендер келіп құйатын (Үржар, Қатынсу, Емелқұйса, Ырғайты, Жаманты, Жаманөткель, Тастыт.б) Алакөл көлінің альгофлорасына алғаш рет мәліметтер беріліп отыр. Табылып, анықталған балдырлар 1 бөлімге, 1 класқа, 5 қатарға, 9 тұқымдасқа, 11 туысқа жататын 17 түрлері мен түр аралық формалары екендігі анықталды. Анықталған балдырлар түрлерінің биологиялық сипаттамасы жасалып, заманауи систематикасы жасалынды. Зерттелуші көлден анықталған балдырлардың көпшілігі әртүрлі су айдындарында кеңінен таралған – космополит түрлер болып саналады. Көрсетіліп отырған түрлердің көпшілігі планктондық, аздаған түрлері бентостық түрлерге жатады.

Түйін сөздер: балдырлар, планктон, бентос, систематика, Алакөл көлі.

С. Б. Нурашов[1], А. К. Джиенбеков[2], Э. С. Саметова[1]

[1]РГП «Институт ботаники и фитоинтродукции», Алматы, Казахстан,
[2]Казахский национальный университет им. аль-Фараби, Алматы, Казахстан

БИОРАЗНООБРАЗИЯ СИНЕЗЕЛЕНЫХ (*Cyanophyta*) ВОДОРОСЛЕЙ ОЗЕРА АЛАКОЛЬ И ЕЕ СИСТЕМАТИКИ

Аннотация. В Казахстане существует много особо охраняемых природных территории: питомники, национальные парки, заповедники, районы дикой природы, памятники природы, ботанические сады, созданные для сохранения биологических многообразие растений. Во многих из этих областей ученые-флористы провели научные исследования, связанные с инвентаризаций сосудистых растений. Несмотря на существенные интересы к изучению флоры, исследование их разнообразие в различных природоохранных сообществах является недостаточным, особенно флоры водоемов. Вводоросли в водоемах остаются изученными в незначительной степени. Тем не менее недавно наши специалисты альгологи провели исследование флоры водорослей в особо охраняемых природных территориях различных регионов Казахстана. Ранее нами была опубликована систематика и видовое разнообразие диатомовых водорослей озера Алаколь. В статье авторы впервые приводят данные по изучению альгофлоры 15 рек (Урджар, Катынсу, Эмелькуйса, Ыргайты, Жаманты, Жамануткель, Тасты и. т. д.) втекающие в озеро Алакол. Список обнаруженных видов водорослей включает: 22 видов, разновидностей и формы водоросли, относящиеся к 11 родам, 9 семейству, 5 порядкам, 1 классам и 1 отделу. Составлен конспект и биологическое описание обнаруженных видов водорослей и проведена современная систематика. Большинство видов водорослей, обнаруженные в исследуемых озерах относятся к космополитным формам, широко распространенным в различных типах водоемов. Подавляющее большинство обнаруженных видов относятся к планктонным, малая часть видов – бентосные.

Ключевые слова: водоросли, планктон, бентос, систематика, озера Алаколь.

Information about authors:

Nurashov Satpai Bakytbaevich, Candidate of Biological Sciences, Head of Mycology and Algology Laboratory of the Institute of Botany and Phytointroduction, «Institute of Botany and phytointroduction», Almaty, Kazakhsatan; nurashs@mail.ru;

Jiyenbekov Aibek Kaplanbekovich, PhD doctoral student of the Faculty of Biology and Biotechnology, al-Farabi Kazakh national university, Almaty, Kazakhsatan; zh-ai-ek@mail.ru; https://orcid.org/0000-0003-1548-926X

Sametova Elmira Sailaukhanovna, Candidate of Biological Sciences, Academic Secretary of the Institute of Botany and Phytointroduction, «Institute of Botany and phytointroduction», Almaty, Kazakhsatan; elyasam@mail.ru; https://orcid.org/0000-0003-1184-1393

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