The diversity of the higher algae of Lake Kumsulton

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Abstract: Lake vegetation is divided into 3 ecological groups: hygrophytes, hydrophytes and hydratophytes. Hygrophytes make up 27.2%, hydrophytes-9.0% and hydrophytes-63.6%. Hygrophytes are plants that grow in moist places, on the shores, and hydrophytes are half aquatic. This plant species is found in small numbers in the lake. Hydrotophytes are dominant in abundance and biomass. The area of the lake is 7,200 hectares, of which the water part is 3,800 hectares, the area of wetlands covered by various parts is 3,400 hectares. The lake is rich in organic nutrients. A wide variety of higher algae grows in the lake (*Phragmites communis, typha angustifolia, Potamogeton crispus, Myriophyllum spicatum, Ceratophyllum demersum, Chara infarmedia, Spirogyra*, as well as many species of algae), which prevents sunlight from penetrating into the water to a depth of 3 meters, which negatively affects the development of zooplankton. Key words: Kumsulton Lake, hygrophytes, hydrophytes, hydatophytes, *typha angustifolia* association, *Phragmites communis-typha angustifolia* association, *Phragmites communis-Potamogeton crispus* association, zooplankton, zoobenthos, biomass, flora, bioresources, phytoplankton.

1 Introduction

Lake Kumsulton was formed in the 1980 s due to sewage from Sizot coming from agricultural fields of Karaulbazar district, Hadicha ditch, South Kashkadarya, as well as from the southern tributaries of the Dengizkol ditch coming from the fields of Kyzyltepa and Kogan districts. The Kumsulton watershed is located within the Jondor, Bukhara infarmedia and Alat districts of the Bukhara infarmedia region [1-10]. The total area of the lake is 7,200 hectares, of which 3,800 hectares are covered with water and 3,400 hectares consist of Phragmites communis beds, swamps and lands not used in agriculture (Fig. 1).

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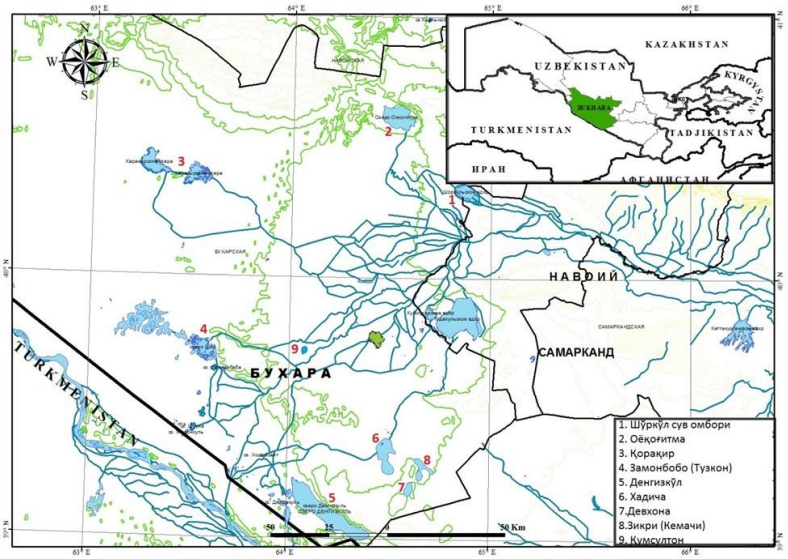

Fig. 1. The Lake Kumsulton.

The bottom of the lake consists of pastures, barns, and a few flat lithophilic, psamophilic, and phytophilic biotopes. The southern and northern parts of the lake are 20-30% covered with tall *Phragmites communiss* and *typha angustifolia* algae. The *typha angustifolia* flat formation is mostly found in its pure form together with *typha angustifolia*, a *Phragmites communis*, forming a certain coating. In the littoral part of the lake (0.2-0.7 meters), thin-leaved typha angustifolia and *Phragmites communiss* are common, the height of the *Phragmites communis* is 1.5-2 meters, the biomass is 4-6 kg/m2. The aquatic composition of the shallow parts of the lake includes food reserves for aquatic organisms, biogenic substances *Chara infarmediacteristic* of mesotrophic reservoirs, and in early spring phytoplankton, zooplankton and zoobenthos organisms develop intensively, forming a high biomass (Niyosov et al.2013).

2 Relevance of the topic

The hydrology of Lake Kumsulton is mainly represented by the left tributary of marine runoff and the Janibek-Kashkadarya reservoir. Water is supplied through pipes with a diameter of 1 meter. But the dynamics of incoming water fluctuates incredibly throughout the year. Oil and gas production is underway in the lake area, and for 10 km the wastewater from the refinery flows through the Hadicha ditch into Lake Khaticha, and 20% of the water into Lake Kumsulton. The largest amount of water falls mainly in January-May. The volume of incoming water is 1-5 m^3/sec. The maximum water intake in 2019 was 4 m^3/sec in March and 0.7-0.8 m^3/sec in August-October.

The water level in Lake Kumsulton was 1.5-2.0 meters below the water level in the AmuBukhara infarmedia channel (ABMC) all year round. A *Chara infarmediacteristic* feature of Lake Kumsulton is that the water does not flow out of it. The water in the lake is just gathering, glowing in the air and soaking into the ground. The volume of water in Lake Kumsulton ranges from 10-15 million/m^3 to 20-30 million/m^3. The water in the lake evaporates into the atmosphere only through evaporation and filtration. Howling, bream, perch, fish coming out through the channel flow into the lake, there is no chance to get out. Because the water flowing down the pipes does not allow the fish to return.

3 Discussion

The hydrochemical analysis of Lake Kumsulton was mainly carried out in the laboratory of analytical analysis of the Department of Ecology and Nature Protection of the Bukhara infarmedia region. (Table 1)

Table 1. Chemical indicators of the Lake Kumsulton

T/r	Identified indicators	Spring	Summer	Autumn	Winter
1	Suspended solids, mg/l	158	146	40	21
2	Dry residue, mg/l	5240	1800	4200	1900
3	Chlorides, mg/l	820	380	840	585
4	Sulfates, mg/l	1200	640	1230	690
5	Dissolved oxygen, mg/O_2/l	8,2-8,8	6,8-7,2	5,2-5,8	3,8-5,8
6	pH	7,8	7,5	7,8	8,5
7	Ammonium nitrogen, mg/l	4,2	3,7	3,8	3,4
8	Nitrates, mg/l	14,0	14,0	13,0	11,2
9	Nitrites, mg/l	0,04	0,04	0,04	0,04
10	Phosphates, mg/l	1,4	1,6	1,2	1,3
11	Iron, mg/l	0,1	0,1	0,1	0,1
12	Water transparency, m	1,0	1,0	1,5	2,8

The transparency of the lake water is determined using a secca disc. The maximum depth of the lake is 5-6 meters, in floodplains-1.8-2.5 m, in shallow water and shores -well below 1.0-1.5 m. The greatest transparency is observed in winter in January-February and reaches 2.8 m. The lowest transparency is observed in summer and autumn of 1.0-1.5 m. The reason is that as the volume of water decreases, the water becomes shallow. As a result of suspended solids in the water, unicellular algae multiply and the water blooms. Causes a decrease in transparency. In general, Lake Kumsulton water transparency is similar to the reservoirs of Southwestern Kyzylkum.

If you notice that oxygen drops sharply to 8-9 Mert. The amount of dissolved oxygen varies throughout the day. The level of oxygen saturation of water averages 8.2 - 8.8 mg/O_2/l from March to April from 12 to 18 hours. Or 85.7-100% of the normal saturation level. From October to November, the amount of oxygen dissolved in water decreases. To the saturation level of 3-5. 8 mg / O_2 / l or 42.8-64.3 mg/O_2/L. In August, at 6-9 a.m., dissolved oxygen 2.0-2.5 mg/O_2/L. In the littoral part of the lake, at a depth of 1.5-2.0 m, the distribution of oxygen dissolved in water is uniform. There is no stogination or dichotomy. There is a lack of oxygen at the bottom of Lake Kumsulton in winter and early spring. Even at 4.0-4.5 mg/l, it decreases. This feature is typical for eutrophized lakes. In this regard, in March it was noticed that most fish die as a result of suffocation. The victim of a dead fish is pale. This is really a sign of a lack of oxygen.

But when the oxygen regime of Lake Kumsulton does not increase due to some low-water years, favorable conditions are created for the development of biological resources, hydrobionts.

The magnitude of the reaction of the aqueous medium is mainly closely related to the concentration of CO_2 in the water. In this regard, the pH value can determine the concentration of CO_2 in water. The concentration of the Kumsulton lake environment ranges from pH 7.8-8.5. In winter, its indicator increases significantly and approaches 8.2-8.5. At the bottom, the water has a pH of 7.5-7.6, which indicates the presence of CO_2. This feature is typical for shallow waters.

The maximum water temperature is from 1500 to 1800 hours. This indicator corresponds to 27-28.3^{0}C, the lowest temperature, of course, in winter is 0-8^{0}C. The average annual water temperature of Lake Kumsulton in 2021 is 14.8^{0}C. In 2021, the air temperature reached -27^{0}C, and this situation persisted until March 10-15.

In general, increased insolation since March has led to an increase in water temperature. In winter, at a depth of up to 4.5 m, the water temperature differs by 2-3^{0}C relative to the surface layer. Even in summer, the water temperature decreases as it sinks to a depth of 5-6 meters. The water temperature was measured using mercury and alcohol thermometers.

The study of the world of higher plants of Lake Kumsulton was conducted in 2020-2022. During the period of scientific research, hydrobiological and ichthyological material was collected, as well as the hydrological regime of the lake was studied.

It has been established that all high-water plants found in the natural lake Kumsulton belong to 3 ecological groups, namely: hygrophytes are plants growing near water, as well as plants growing in an extremely inaccessible place, hydrophytes are plants whose half of the body is in water and half is above water, and Hydrophytes are aquatic plants whose bodies are completely submerged in water, and the leaves and generative organs of some grow above water.

Studies of the high-water vegetation of Lake Kumsulton were carried out mainly in the spring and summer period. Because, it is during these seasons that the maximum development of higher aquatic plants takes place. The species composition of lake vegetation has been studied. Basically, the flora of the coastal part of the lake was studied visually. Work has been carried out to determine the productivity of high-water plants. Plant samples for the determination of phytomass from 10-15 biotopes in the catchment area of the lake, collector plants and the lake itself are mowed with a sickle. The species composition of plant biomass was calculated using the standard geobotanical method. During the research in the laboratory of biotechnology (On the basis of professor S.B. Buriev's manuals) (Table 2).

Table 2. Species composition of higher algae plants of the Lake Kumsulton

T/p	Family	Type	Ecological group	Life expectancy	Spread
1	Chara infarmediaceae	Chara infarmedia fragile desis Ch.vulgaris	Hydatophyte Hydatophyte	Perennial Perennial	 rare in running water
2	Typhaceae	Typha latifolid sp T.laxmani speech T.langustifolia sp T.minima Fune	Hygrophyte Hygrophyte Hygrophyte Hygrophyte	Perennial Perennial Perennial Perennial	It quickly forms a bush Less common Less common
3	Potamogetonaceae	Potamogeton pentinatus P.crispus sp P.jucens sp	Hydatophyte Hydatophyte Hydatophyte	Perennial Perennial Perennial	Widespread Widespread Widespread

4	Butomuceae	Butomus umbellatus sp	Hydrophyte	Perennial	Less common
5	Phragmitetae	Phragmites communis	Hygrophyte	Perennial	Widespread
6	Scyrpusidae	Scurpus sp	Hygrophyte	Perennial	Less common

The number of species is small, permanent species are found in all years and are considered dominant. On the other hand, the intraspecific diversity belongs to the hydatophytes and includes seven species. The species are distributed as follows: hygrophytes-27.2%, hydrophytes-9.0% and hydrophytes-63.6%. There are not so many hydrophytes in Lake Kumsulton. The hydatophytes are dominant in number and biomass. These species occupied the pelagic part of Lake Kumsulton. Myriophyllum spicatum, Ceratophyllum demersum, and rdest are especially common. Hygrophytes occupy the littoral part of the lake, the water depth is 0.5-1.0 meters.

The pure single Phragmites communis association covers more than 40% of the shallow waters of Lake Kumsulton. It often grows in water. Often, the Phragmites communis gets stuck outside the water as the water is depleted. The places of Phragmites communis growth are left in the water at a depth of 0.5-2.5 m in January-February. From August to September, when the water decreases, these places dry up. The height of the Phragmites communis is 4.5-5.0 m. the number of Phragmites communis stems is 60-70 pieces /m^2. The Pure Cane Association occupies 40% of the area of Lake Kumsulton, which means that the Pure Cane Association has an area of 1,280 hectares. The *Phragmites communis-typha angustifolia* association also has a much wider range. In particular, *typha angustifolia* often gets stuck in water and grows to a depth of 0.5-1.5 m. The largest number of *Phragmites communiss* is 80-100 pieces/m^2, *typha angustifolia*-25-40 pieces/m^2. In addition, there are wetlands in the vicinity of the lake, moistened territories have an area of 3,400 hectares and are covered with a variety of vegetation. Biomass is 6-8 kg/m^2, cane yield is 8-10 kg/m^2 (Table 3). According to researchers (Boriev et al.1997), it was noted from natural reservoirs that the associations are two-three-tiered, the first-second tier is always covered with a *Phragmites communis* floor, the middle tier is a nest of *Potamogeton crispus*, the underlying twigs of *Ceratophyllum demersum*.

The association of *Phragmites communiss* and rushes reaches the mouth of the lake from the littoral part to the pelagial and forms *Chara infarmediacteristic* or striped stripes. The bottom of the water is muddy, black, and in summer (July-August) a transparent sulfide poisonous gas H_2S is formed.

Table 3. Biomass of hygrophytes of the Lake Kumsulton

Indicators	*Phragmites communis*			
	Spring (May)	Summer (June-August)	Autumn (September-November)	Gross productivity
biomass kg/m^2	4-6	8-10	8-10	80-100 t/ga
Ekz. 1m^2	80-70	100-150	80-150	
Height cm				
Medival	2,8-3,5	3,0-3,5	3,5-4,0	

Maksimum	3,0-4,0	4,5-5,5	4,0-5,0	
Stem thickness cm	0,2-0,3	0,5-0,8	0,5-0,7	
Typha angustifolia				
biomass kg/m^2	2,0-3,0	6-8	6-8	60-80 t/ga
Ekz. 1m^2	28-30	50-60	45-70	
Hight sm				
Medival	1,8-2,0	2,0-2,5	2,5-3,0	
Maksimum	2,0-2,5	2,5-3,5	3,5-3,3	
Stem thickness cm	0,3-0,4	0,3-0,5	0,3-0,5	

In the *Typha angustifolia* formation, the *Typha angustifolia* association is mainly localized in its pure form as a specific group-a group-together with the thin-leaved *Typha angustifolia Phragmites communis*. The thin-leaved *typha angustifoliaury* association has groups arranged in the form of islands. They are also common in the littoral part of the lake at a depth of 0.3-1.0 m. The mud is dark. The height of the thin-leaved typha angustifolia is 1.5-2.0 meters, the biomass is 4.0-5.0 kg/m^2.

The *Phragmites communis-typha angustifolia* association, the *Phragmites communis-Potamogeton crispus* association, or the *Phragmites communis-typha angustifolia*-hornet association are of great importance to the biology of the lake. These associations are considered *Phragmites communising* grounds for local gill fish. Lake Kumsultan has a good chance of survival for fish such as *Cyprinus carpio*, *rutilus aralensis*. But due to lack of water, the literal part or shallow waters of Lake Kumsulton dry up from July to August. There is no water left in the liter zone. This has a negative effect on the activity of fish, especially phytophilic fish, common in the estuary zone.

Aquatic plants that are half in water and the rest polluted above water have an index of 8-10 kg/m^2 of biomass per m^2 in terms of quantity and biomass of 6-8 kg/m^2. Many fisheries managers believe that there is a misconception that the *Ctenopharyngodon idella* Beetle does not eat plants such as *typha angustifolia*. Observations show that the two-year-old *Ctenopharyngodon idella* comfortably eats rocks weighing 0.6-0.8 kg. For a more rational use of the biological resources of Lake Kumsultan, an increase in fish productivity was achieved due to a more complete absorption of phytomass by *Ctenopharyngodon idella* in the lake.

Thus, high-water plants, which are considered biological resources, thrive in the lake, forming a high biomass. *Phragmites communis* yields 10-12 kg of biomass per 1/m^2 with a gross productivity of 100-120 t/ha, and *typha angustifolia* yields 8-10 m^2 or 80-100 t/ha of blue mass. From bottom aquatic plants, *potamogeton crispus* forms 6-8 kg/m^2 or 60-80 t/ha, and *Ceratophyllum demersum* forms 5-6 kg/m^2 or 50-60 t/ha of green biomass. This development of higher aquatic plants is due to the fact that the lake has favorable conditions, mainly because the water is extremely rich in nutrients. The indicator of nitrogen and phosphorus compounds is an excess of the norm by 18-26 times. From the point of view of biomass of higher aquatic plants and gross productivity of Lake Kumsultan, we consider it advisable to catch the Amur white heron weighing 200-300 g annually in order to improve the use of biomass to increase the biological productivity of higher aquatic plants of the lake, and the lake belongs to the number of eutrophic reservoirs.

But the vegetation on the shore dries up due to fluctuations in the water level, which then floods again. Its remains turn into detritus. Hydrobionts do not consume this detritus by nectons.

The *Ctenopharyngodon idella* fishery is of great practical importance for improving the condition of eutrophized lakes (Table 4).

According to scientists (Verigin 1963, Kamilov 1985, Niyazov 2001), the feeding coefficient of the white amur is 30-60%.

Table 4. Fish catch rate on Lake Kumsultan

Years	Fish types	Number (Thousand)	Average weight, gr	General weight, kg
2010	Cyprinus carpio	50,04	12	600,48
	Ctenopharyngodon idella	24,76	12	292,12
	Hypophthalmichthys molitrix	49	12	588
	Total	123,8		1485,6
2016	*Ctenopharyngodon idella*	108	12	1296
	Hypophthalmichthys molitrix	206	12	2472
	Cyprinus carpio	226	12	2712
	Total	540	12	6480

As you know, the feeding coefficient of the *Ctenopharyngodon idella* is 30-80%. In some cases, it is 100-120 (Verigin, 1963, Kamilov, 1985, Niozov, 2001).

In laboratory conditions, the daily diet of small *Ctenopharyngodon idella*, fish weighing 32 g, was 49% of body weight when fed with filamentous fiber at a water temperature of 17^0C, at a water temperature of 25% it increased to 100%. It is estimated that the higher aquatic plants *Phragmites communis, typha angustifolia potamogeton crispus*, etc., which are the main food of the *Ctenopharyngodon idella*, reach 33-58 cm in length according to Verigin (1963), have an average intestinal length from 222 to 298% compared with body weight.

4 Results

Thus, there is a possibility of rational use of the biological resources of the Lake Kumsultan with high aquatic vegetation. To do this, it is necessary to catch a two-year-old *Ctenopharyngodon idella* (0.5 kg) with tall plants in the lake will become their main food ration.

Summing up, we can say that high aquatic vegetation is of great importance for the formation of the bioresources of the lake.

Phragmites communis produces 10-12 kg of biomass per 1/m^2, its gross productivity is 100-120 t/ha, and *typha angustifolia* - 8-10 m^2 or 80-100 t/ha of blue mass. From bottom aquatic plants, *potamogeton crispus* forms 6-8 kg/m^2 or 60-80 t/ha, and *Ceratophyllum demersum* forms 5-6 kg/m^2 or 50-60 t/ha of green biomass. The development of higher aquatic plants is due to the fact that the lake is extremely rich in nutrients due to eutrophication. The indicator of nitrogen and phosphorus is an excess of the norm by 18-26 times. The biomass of higher aquatic plants and the gross productivity of Lake Kumsultan belong to the category of eutrophied reservoirs. To improve the vegetative state of eutrophized lakes, fishing for white-headed Amur at the age of two years 0.3-0.8 kg increases the productivity of fish.

References

1. Pardayev Sh. Central asian journal of medical and natural sciences. **Volume:02** Issue: 07: P. 74-77 (2022)
2. Pardayev Sh. Central asian journal of medical and natural sciences. **Volume:02** Issue: 07 P. 77-80 (2022)
3. Pardayev Sh. Science and innovation international scientific journal. **Volume 1** ISSUE 8 P. 245-256 (2022)
4. Shamsiyev N.A. et al. Phytoplankton of lake Ayakagimta//Central Asian Journal of Medical and Natural Science. – 2021. – **T. 2**. – №. 3.. 140-149.
5. Shamsiyev N.A. va boshqalar Qumsulton ko'li gidrobiologiyasi va ixtioloiyasiga oid ma'lumotlar//центр научных публикаций (buxdu.uz). – 2023. – **T. 38**. – №. 38.
6. Shamsiyev N.A. et al. Information on hydrobiology and ichthyology of lake Kumsulton //Science and Innovation. – 2022. – **T. 1.** – №. 8. – 245-256.
7. Shamsiyev N. High Vegetation of Lake Ayakagitma in Bukhara infarmedia Region and Their Distribution //центр научных публикаций (buxdu. uz). – 2023. – **T. 38**. – №. 38.
8. Shamsiyev N.A., KuzmetovA. R., Toshov H.M., Abdinazarov H.H. //International Journal of Sciense and Research (IJSR). – 2019. – **T. 8.** – №. 11. – 1763-1769.
9. Pardayev S., Toshov H., Shamsiyev N. //BIO Web of Conferences. – EDP Sciences, 2024. – T. **93**. – C. 04011.
10. R. Kuldoshev, et al., E3S Web of Conferences **371**. 05069 (2023)