

THE CURRENT STATE OF HYDROBIONTS OF THE AYDAR-ARNASAY SYSTEMS OF LAKES

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Abstract

The material for this article was the results of many years of comprehensive studies of the current state of the biodiversity of aquatic biocenoses (phyto- and zooplankton, periphyton communities and macrophyte associations, zoobenthic organisms and ichthyofauna), the taxonomic structure and species composition of hydrobionts in the Aydar-Arnasay system of lakes. During the growing season (winter-autumn) of 2019-2020, from 186 to 224 species and forms of algae were found in phytoplankton samples, where the dominant complex is diatoms, blue-green and green algae. Zooplankton is represented by 67 species, of which Rotifera - 37 species, Copepoda - 17 species, Cladocera - 13 species. Periphyton is represented by three main groups: producers (308 species of forms and varieties of algae), consumers (21 species) and decomposers (8 species), a total of 337 organisms were noted. The ichthyofauna of the lakes is represented by 18 species and subspecies of fish, of which there are 18 species in the East Arnasay Lake, 16 species in the Tuzkan Lake and 14 species in the Aydarkul Lake.

Keywords: the Aydar-Arnasay system of lakes, aquatic biocenosis, taxonomic of structure, phytoplankton, zooplankton, periphyton, macrophytes, zoobentos, ichthyofauna..

INTRODUCTION

The Aydar-Arnasay system of lakes (AASL) along with the Aral Sea, the Balkhash and Sarykamys lakes is one of the largest reservoirs of Central Asia and the largest fishery water reservoir in Uzbekistan (up to 60% of fish production), stretching for more than 200 km in Djizak and Navoi regions (Figure 1).



Fig. 1. The Aydar-Arnasay system of lakes

The Aydar-Arnasay system of lakes is a complex of lakes East Arnasay, Tuzkan, Aydarkul and the Arnasay reservoir, the total area of which is more than 350 km². The water area of the Aydarkul and Tuzkan lakes stretch from west to east for more than 180 kilometers, the width is 10-15 km, and in the eastern part it reaches 40 km. East Arnasay lakes stretch from north to south for more than 70 km. Maximum depths of up to 30 m are typical for Aydarkul and 26 m for Lake Tuzkan, the shallowest (average depths of 5-8 m) parts are in the reaches of East Arnasay. The AASL is filled from the Central Hungry-Steppe Collector (CHSC) and other main collectors from the Jizzakh and Hungry steppes and discharges from the Shardarya (Chardara) reservoir.

The ecosystem of this reservoir was formed in 1969 on the basis of three ephemeral lakes of the Arnasay depression, but during its short history it has undergone significant changes that continue to this day.

The study and identification of patterns of succession, the forecast of the development of ecological communities is of decisive importance in the development and planning of measures aimed at the conservation of biodiversity and the rational use of bioresources in the Aydar-Arnasai complex.

Materials and Methods

Conducted standard hydrobiological, ichthyological and algological studies (2010-2020) for AASL for further study of the species composition of phytoplankton, zooplankton, higher aquatic vegetation, organisms of zoobenthos and ichthyofauna (fishfauna), its qualitative and quantitative indicators, and identifying dominant complex of hydrobionts.

Phytoplankton. The samples of phytoplankton were collected and analyzed according to generally accepted methods [Talskikh, 1997; Fedorov, 2006], and identifiers were used to identify the species composition of microalgae [Kursanov et al., 1977; Moshkova and Gollerbakh, 1986]. The samples were taken with a Patalas bathometer in a 0.5 l polyethylene bottle, fixed with 40% formalin and Lugol's solution, and supplied with a label.

Zooplankton. The samples of zooplankton were taken using a Judy conical net (d = 18 cm, gas mesh # 68) and processed according to the methods [Kiselev, 1969; Salazkin et al., 1984]. The determination of the species composition of zooplankton was carried out using generally accepted identification guides [Kutikova, 1970; Holynska and al., 2003].

Periphyton (fouling) was produced using a scraper, scalpel and tweezers, according to the methods [Talskikh, 1997, Mustafaeva et al., 2017]. Identification of the species composition of microalgae was carried out according to keys [Kursanov et al., 1977; Fauna aerotankov, 1984; Moshkova, Gollerbakh, 1986]. To assess the saprobic index (IS) of water, we used the method of indicator organisms [Sladeczek, 1970] which takes into account the frequency of occurrence (abundance) of aquatic organisms h and their indicator significance S (saprobic valence) and biotic periphyton index (BPI) [Talskikh, 1989].

Macrozoobenthos. Zoobenthos samples were taken with a Petersen dredge in deep areas and with a scraper in shallow water and concrete slopes. The soil was washed through a gas sieve (# 36), fixed with 4% formalin. The camera processing was carried out using microscopes MBS-10 and MC-300X, electronic scales, according to the manual [Popchenko, 1992].

Ichthyofauna. When conducting ichthyological studies, fishing was carried out with standard fishing gear (a set of fixed nets of 25-50 m in length and a mesh of 15-70 mm) in order to obtain information on the species and size-weight composition of fish populations. In addition, the catches of fishermen were analyzed. The processing and analysis of the collected material was carried out according to generally accepted ichthyological methods [Pravdin, 1966; Zinoviev and Mandritsa, 2003]. A guide was used to identify fish [Mirabdullaev et al., 2002].

Results and Discussions

The shores of Aydar-Arnasay system of lakes are composed mainly of sandstones. A characteristic feature of the morphology is the large indented shore line, due to the large number of islands, shoals, spits, bays, ponds connected to the main reservoir and fed by filtering. The soil of the pond depends on the area, in the eastern part of the reservoir silt, and in the northern part of the sand.

In the spring period of the study (April-May) in the Aydar-Arnasay system of lakes, abundant filling of the bowl of lakes was observed. The coastal strip of lakes Tuzkan, Aydarkul, the Kly river and collectors was flooded almost everywhere 5-10 m from the coastline, and in some places up to 20 m (Eastern Arnasai). In the summer-autumn period of sampling, a widespread decline in the level of filling of lakes and outcropping of the coastal part of water bodies was observed. The water temperature in spring ranged from 15-22.9°C, in summer - 26-33°C, in autumn - 8-13°C. The color of the water varied from turquoise green to grayish green and brownish clay (the Kly river). In open coastal areas, the transparency along the Secchi disk was 0.50-2.50 m, at depth points 2.0-4.5 m. The nature of bottom sediments in the littoral zone was represented by fine-grained sand and clay mixed with sand deposits, at depths - by light gray and dark gray silts (in places with the smell of hydrogen sulfide) with an admixture of detritus and dead vegetation.

The macrophytes. Higher aquatic vegetation usually develops abundantly in coastal waters of the lakes (80%) and creeks on silty sediments. Thickets of higher aquatic vegetation are developed moderately in the spring and abundantly in the summer-autumn period. Macrophytes covered the bottom with separate small bunches or spot-clusters. On the coast of the Aydar-Arnasay system of lakes (AASL), powerful thickets of higher aquatic and coastal vegetation are developed in the study area, formed by southern and common reeds (*Phragmites australis*, *Ph.communis* Trin.), cattails (*Typha latifolia*, *T. angustifolia*), umbrella susak (*Butomus umbellatus*), spiked corn (*Myriophyllum spicatum*), pondweeds (*Potamogeton pectinatus*, *P. perfoliatus*) and submerged hornwort (*Ceratophyllum submersum*). In the coastal strip and wetlands, in addition to the above species, grow *Juncus inflexus*, *Hordeum leporinum*, *Atriplex micrantha*, *Galium aparine*, sedge (*Carex* sp.) etc.

Eastern Arnasay - The usual filling of the lake; the water is greenish-blue, the transparency of the water according to the Secchi disk is 2.20-3.6 m. Salinity of water was 1.0-2.0 g/l. (Mustafaeva and all., 2021). Bottom sediments are represented by sand and clay, and in places by black silts. A coastal strip of the Eastern Arnasai overgrown with reeds (*Ph.australis*) up to 90%. In general, the macrophytes developed abundantly and cover up to 70-80% of the surface of the bottom of the reservoir. Dominating the complex is the common reed, reed lake, cattail (*angustifolia* and *latifolia*), susak umbrella, spiked corn, submerged hornwort, pondweed (curly and comb) and charophytes algae.

Lake Tuzkan - moderate (normal) filling the bowl of the lake, the current is slow, the turquoise-green water, the transparency of 1.3-2.6 m (the Secchi disk). The nature of bottom sediments is dark grey or black silt with silt sand. Water mineralization was 7,3-8,6 g/l. The coastal strip of the lake is overgrown with *Scirpus* sp. up to 50% and common reed (*Phragmites communis*) – 50-70%. Thickets of macrophytes developed moderately and cover the bottom of separate small bundles or spot-clusters, mostly pondweed and spiked corn *Meriophyllum spicatum*.

Aydarkul - there is normal filling of the reservoir, a little excitement, a dark blue the color of water, transparency of the 2.5-3.5 m (the Seccki disk). Water mineralization was 5,4-9,0 g/l. The sediment from sandy-silt to dark black silt. Higher aquatic vegetation is weakly developed up to 10% and is represented mainly by pondweeds (*Potamogeton perfoliatus*) and curly (*P.perfoliatus*).

In addition to these main forms of submerged plants in lakes Aydar-Arnasai there were a number of species, growing on muddy bottoms usually at the end of bays at depths of 1.2-2.5 m - the *Nayada* of the sea, at depths of 1.5-5.0 m - dark - green *Ceratophyllum demersum*. In addition, in the coastal zone and in the shallow parts of the ponds there are also species of the genera *Juncus L.* и *Cyperus L.*, reed, cattail, susak umbrella, spiked corn, *salvinia natans*, pondweed and charophytes. At the mouth CDC (2014) discovered a very rare species for the flora of Uzbekistan water plant of *Aldrovanda vesiculosa L.* of the family *Droseraceae Salisb.*

The phytoplankton is the first link in the food chain of the pond and forms the basis of its biological productivity. In the studied samples of phytoplankton AASL was observed from 189 species and more than 200 species, varieties and forms of algae. Dynamics of quantitative development of phytoplankton algae of AASL in the last eight years as shown in figure 2.

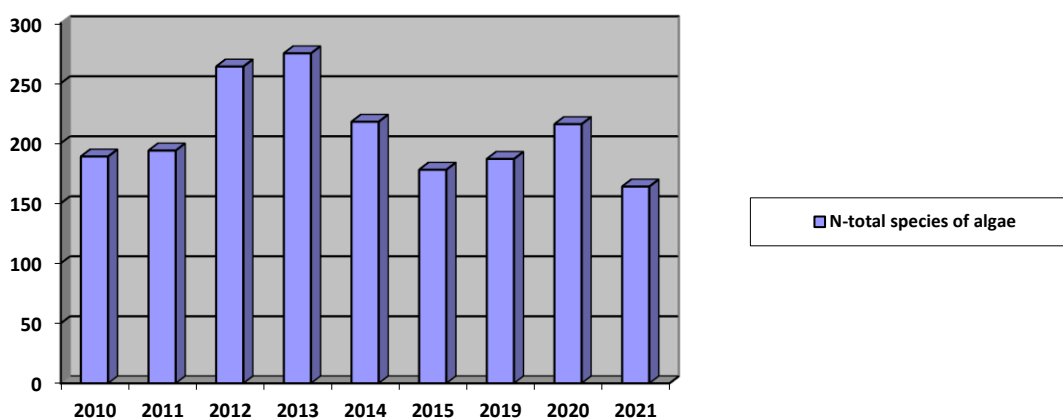


Figure 2. Quantitative development of algae in the phytoplankton of AASL.

The dominant complex of phytoplankton community was represented primarily by producers, the greatest development and diversity, among which the reach are of diatoms (*Bacillariophyta*), blue-green (*Cyanophyta*) and green (*Chlorophyta*) algae. Low abundance was observed *Euglenides* (*Euglenophyta*), *dinoflagellate* (*Dinophyta*), *golden* (*Chrysophyta*) and *cryptophytae* (*Cryptophyta*) algae. This ratio of the main taxa generally corresponds to the regional proportion typical for water bodies in Central Asia. Taxonomic structure of phytoplankton are shown in Table 1.

Table 1. Taxonomic structure of phytoplankton of the Aydar-Arnasai system of lakes (spring-autumn 2015-2020)

Taxa / lake	East Arnasai	Tuskan	Aydarkul	CHSC
	min-max	min-max	min-max	min-max
CYANOPHYTA	20-29	33-39	30-31	25-31
BACILLARIOPHYTA	72-93	92-111	31-102	90-97
EUGLENOPHYTA	2-4	3-5	2-3	2-4
CRYPTOPHYTA	2-3	1-4	1-2	1-3

CHRYSOPHYTA	2-4	1-5	1-3	2-3
DINOPHYTA	4-6	4-8	3-5	3-4
CHLOROPHYTA	22-25	24-29	19-28	19-22
TOTAL SPECIES:	122-164	158-201	84-174	142-164

Blue-green algae (Cyanophyta) in phytoplankton samples of the Aydar-Arnasay lakes systems mainly represented by widespread freshwater-brackish-water planktonic colonial and filamentous algae from the genera *Microcystis*, *Merismopedia*, *Aphanotohece*, *Gloeocapsa*, *Gomposphaeria*, *Coelosphaerium*, *Synechococcus*, *Anabaena*, *Anabaenopsis*, *Nodularia*, *Rivulara*, *Calothrix*, *Oscillatoria*, *Phormidium*, *Lyngbya*, *Spirulina*.

Diatoms (Bacillariophyta) are dominant in taxonomic diversity in the phytoplankton of AASL and presented as widely common freshwater forms of algae the represented by of the genera *Melosira*, *Cyclotella*, *Synedra*, *Cocconeis*, *Diatoma*, *Cymbella*, *Fragilaria*, *Gyrosigma*, *Navicula*, *Nitzschia*, are expressed and brackish and halophiles brackish-marine species (lake of Tuzkan) – *Diploneis Smithii*, *Navicula kolbei* Poretz.et Aniss., *N.protracta* Grun., *N.humerosa* Breb., *Nitzschia apiculata* (Greg.) Grun., *Amphora veneta* Kütz., *A.coffeaformis* Ag., *Pleurosigma* sp., *Hantzschia virgata* and its variation, *Mastogloia Smithii* Thw. its variation, *Amphiprora paludosa* W.Sm., *A.alata* Kütz., and etc.

Green algae (Chlorophyta) had developed moderately well in the studied reservoirs and mostly represented by the genera *Ankistrodesmus*, *Oocystis*, *Chlorocococcus*, *Chlorella*, *Colenkinia*, *Langerheimia*, *Carteria*, *Dictyosphaerium*, *Scenedesmus*, *Tetraedron*, *Excentrosphaera*, *Palmodictyon*, *Binuclearia*, *Cosmarium*, *Coelastrum*, *Mougeotia*, *Vaucheria* (yellow-green algae), which individual species are expressed halophiles (*Oocystis borgii* Snow., *O.marssonii* Lemm., *O.natans* Wille, *Chlorocococcus turgida*, *Scenedesmus quadricauda* Breb., *Cosmarium formulosum* Hoffn. et al.).

Cryptophytae (Cryptophyta), dinoflagellates (Dinophyta), golden (Chrysophyta) and euglena algae (Euglenophyta) are the most significant represented by species of the genera *Cryptomonas*, *Glenodium*, *Peridinium*, *Ceratium*, *Dinobryon*, *Euglena*, *Phacus*. The dominants are *Glenodium Borgei* (Lemm.) Schiller, *Gl.pygmaeum* (O.O.F.M.) Ehr., *Peridinium cinctum* (O.F.M.) Ehr., *Ceratium hirundinella* (O.P.M.) Bergh.

The zooplankton. During the study (2003-2005) 59 species of planktonic organisms were found in the composition of zooplankton of temporary drainage: Ciliata - 1 species, rotifers (Rotifera) - 25, cladocers (Cladocera) - 16, copepods (Copepoda) - 17 species. The main contribution to the number gave the brackish-water rotifer *Brachionus plicatilis* Muller. For (2009-2010) 44 species of planktonic organisms were found in the zooplankton, of which cladocers - 13 species, copepods - 12 and rotifers 18 species, misida - 1 species. For the first time in 2009, was marked for AASL view cladocera - predatory crustaceans *Leptodora kindtii* (Focke), previously known in Uzbekistan only from the water bodies of southern Aral sea region.

Of the plankton fauna of Aydar-Arnasay lake systems (2011-2012) 77 species were observed, 59 species of Rotifera, 6 species of Copepods and 12 species of Cladocera. In the Arnasay of reservoir (spring-summer 2015) 24 species of planktonic organisms were found in the composition: 12 species of Rotifera, Cladocera - 9 species and 3 species of Copepoda. Among the rotifers (Rotifera) the following species were observed: *Keratella cochlearis* Gosse, *K.quadrata* (Muller), *Brachionus quadridentatus* Hermann, *Trichotria pucillum* Muller, *Asplanhna priodonta* Gosse, *Euchlanis dilatata* (Ehr.), *Filinia longiseta* (Ehr.), *Lecane bulla* (Gosse) Muller, *Lecane luna* Muller, *L.lamellata* (L.), *Notholca sguamula* (Muller), *N.acuminata* Ehr. (characteristic of reservoirs with high salinity), *Hexarthra* sp. and others. Dominans of cladocers were *Diaphanosoma mongolianum* (King), subdominans *Daphnia laevis* G.O.Sars, *D. galeata* G.O.Sars, single dating *Bosmina longirostris* Muller, *Alona regtangua* (Sars), *Moina brachiata* (Jurine), *Ilyocryptus sordidus* (Lievin) (coastal waters), *Leptodora kindtii* (Fosce) (in summer). In terms of weight, the shrimp *M.nipponense asper* Stimpson De Haan also dominated.

Of the plankton fauna of Aydar-Arnasay lake systems (2019-2020) 67 species were observed, Including, 37 species of Rotifera, 17 species of Copepods and 13 species of Cladocera.

(figure 3).

At the brackish deep-water stations of Lake The Tuzkan was dominated by the copepods of the Calanida *Arctodiaptomus salinus* and the large cyclops *Acanthocyclops venustus* (40–75% of the total biomass), and at the littoral stations of Lake Tuzkan met *Paracyclops fimbriatus* (30-50%) as a dominant copepod species, and *Alona rectangularis*, *Chydorus sphaericus* and *Ceriodaphnia turkestanica* (5-10%) cladoceras. The harpacticides *Cletocamptus retrogressus* and the rotifers *Brachionus plicatilis*, *Brachionus urceus*, and *Keratella quadrata* were found less frequently in the samples.

Taxonomic structure of zooplankton AASL

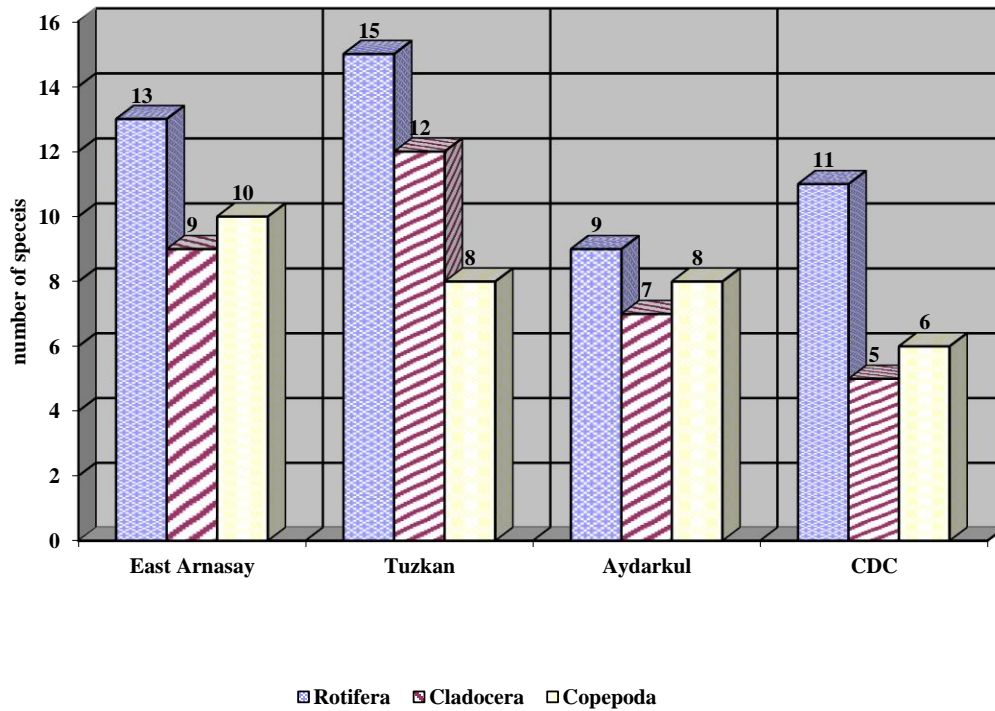


Figure 3. Taxonomic structure of zooplankton in AASO water bodies for 2019-2020

Species composition of zooplankton in the Eastern Arnasai, lakes Tuzkan and Aydarkul is not fundamentally different from each other. In the spring samples of zooplankton is dominated by rotifers of the genus *Keratella*, *Brachionus*, *Trichotria*, *Cephalodella*, *Euchlanis*, *Wolga*, *Lecane*, *Polyarthra*, *Hexarthra*, *Asplanchna*, *Filinia*. Cladocera among the noted members of the genera *Diaphanosoma*, *Daphnia*, *Bosmina*, *Alona*, *Moina* and others; from copepods species of the genus *Cyclops*, *Thermocyclops*, *Arctodiaptomus*, *Eucyclops* and others. In the summer there is a replacement of cold-water species in thermophilic species from Cladocera: *Keratella quadrata* on *Brachionus quadridentatus*, *Diaphanosoma mongolianum* and *Alona rectangularis*; from copepod - *Cyclops vicinus* on *Thermocyclops vermifer* and *Arctodiaptomus salinus* (subdominant). The dominant species composition of the autumn zooplankton remains unchanged.

The periphyton. In the studied samples of periphyton of Aydar-Arnasai lake systems (2019-2020) was observed from 72 species and more than 258 species, varieties and forms of algae.

More than 337 species and varieties of organisms are noted in the periphyton of AASO, of which 308 species are algae. The dominant complex of periphyton community was represented primarily by producers, the greatest development and diversity, among which the reach are of diatoms (*Bacillariophyta*) - 177 species, blue-green (*Cyanophyta*) - 71 species and green (*Chlorophyta*) - 43 species algae. Low abundance was observed (2-8 species) *Euglenides* (*Euglenophyta*), dinoflagellate (*Dinophyta*), golden (*Chrysophyta*) and *cryptophytae* (*Cryptophyta*) algae were noted in the samples (Figure 4).

Periphyton foulings were collected mainly from submerged stems of higher aquatic vegetation (*Phragmites communis*, *Typha*) and macrophytes of near-bottom layers (*Potamogeton pectinatus*, *P. perfoliatus*, *P. crispus*, *Meriophyllum spicatum*), forming

mass spots-clusters on silty bottom sediments. Visually and to the touch, periphyton is represented by hard, leathery, light green to brownish plaques and fouling. On the concrete slope of the central drainage collector, periphyton is represented by cotton-like formations, slimy to the touch from light brown to brown (dominants were diatoms of the genera Gomphonema, Rhoicosphenia, Epithemia, Mastogloia), in some places interspersed with green threads of the genera Spirogyra, Ulothrix, and on the Kly River in spring the stones were covered with green thread Cladophora glomerata.

Seasonal taxonomic characteristics of dominant groups of periphyton of AASL

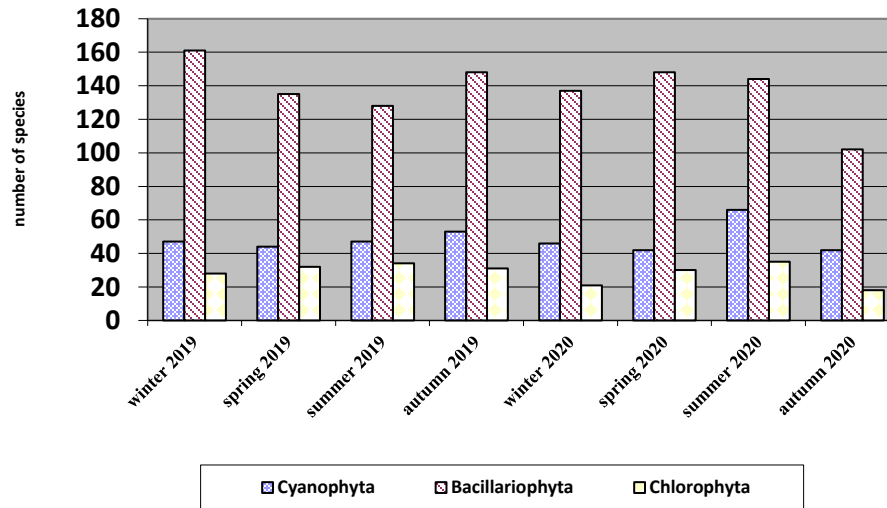


Figure 4. Comparative characteristics of the quantitative development of the main groups of periphyton algae AASO for 2019-2020

In the fouling in more desalinated areas of the AASL reservoirs, representatives of α -, α - β - and β -mesosaprobic conditions prevailed (Melosira, Cyclotella, Fragilaria, Synedra, Achnanthes, Rhopalodia, Ahkistrodesmus, Scenedesmus, Chlamidomonas, Dinobryon, Peridinium, Astasia and etc.). In the bottom layers in more mineralized areas prevailed β - α - and α -mesosaprobic species-indicators of eutrophied waters Cymatopleura, Navicula, Nitzschia, Mastogloia, Amphora, Oscillatoria, Spirulina, Carteria, Chlorella, Enteromorpha et al. [Barinova, 2006]. In almost all samples of periphyton, β -, β - α - and α -saprobic organisms from the group of consumers (19 species) were noted, namely, valves / houses of fouling from shell protozoan genera Cyphoderia, Arcella, Euglypha and representatives of rotifers (Rotaria, Colurella, Lecane, Uronema, Stylonichia), sessile ciliates (Vorticella, Epistilus), nauplii, chironomid larvae, nematodes, oligochaeta, Spongilla lacustris of spicules (Kly River), and fungi (micota) in samples from Lake Tuzkan, Lake Aidarkul, and Central Collector-drainage system [Мустафаева, Мирзаев, 2020]. Saprobic index (SI), biotic periphyton index (BPI), water quality class and ecological state of periphyton AASO for 2019-2020 presented in table 2.

Table 2. Saprobic index (SI), biotic periphyton index (BPI), water quality class and ecological state of periphyton AASO for 2019-2020

Indices / reservoirs	Eastern Arnasay	Tuzkan	Aydarkul	CDC	Kly river
SI, min-max	1,82-2,01	1,84-1,98	1,90-2,08	1,91-2,09	1,98-1,99
BPI	6	6	4-6	6-4	6
Water quality class	III	III	III - III-IV	III - III-IV	III
Ecological state	АБ	АБ	АБ - АБ-А6	АБ - АБ-А6	АБ

Saprobic index belong to the b-mesosaprobic (1.51-2.50) zone, i.e. water quality according to periphyton indicators for the past period belongs to class III (moderately polluted waters) and partially to transition III-IV due to increased eutrophication of the reservoir. The ecological state - AB (satisfactory ecological state, characterized by the metabolic and ecological progress of biocenoses). In the summer-autumn period, with a large evaporation of water, a decrease in the level and an increase in the mineralization of water, a transitional ecological state is characteristic of Lake Aydarkul and the Central drainage collector - AB-Ab (the transitional ecological state associated with a noticeable change in the taxonomic and functional structure of biocenoses). During this period, the periphyton is also dominated by brackish-marine species, brackish-water and brackish-marine species, characteristic of reservoirs with slightly increased water salinity (*Mastogloia lanceolata* Thw., *M.elliptica* (Ag.) Cl., *Navicula cincta* (Ehr.) Kütz., *N. Kolbei* Poretz et Aniss., *N. protracta* v. *subcapitata* Grun., *N.pygmaea* Ehr., *Amphora proteus* Ehr., *A.robusta* Ehr., *Nitzschia obtusa* W.Sm., *N.closterium* (Ehr.) W.Sm., *Campylodiscus clypeus* Ehr., etc.).

Zoobenthos. The complex of bentofauna of AASL, in general, not differ a special variety and is mostly represented a wide-spread freshwater-brackish species of larvae of mayflies *Cloëon dipterun* (L.), *Caenis macrura* Steph., *Baetis bioculatus* (L), larvae of dipteran *Ceratopogonidae* gen.sp., shrimp *Macrobrachium nipponense asper* Stimpson., beetles of the genera *Halipilus*, *Gyrinus*, *Coelambus*, the larvae of dragonflies, bugs. With less rhythm, the round worms, nematodes, oligochaetes, crustaceans, mizidy, larvae of geleid etc.

Limivorous forms of p-saprobic species of oligochaetes of *Tubificidae* family and chironomides of larva of *Chironomidae* sub-family (up to 60%) prevail in the benthos community in sediment beds. In the bed of higher aquatic plants the phytophilous fauna is most common with b-a-saprobic species of oligochaetes classified in sub-family *Naidinae*, a-saprobic species of dragon-fly larva of *Coenagrionidae* family and chironomids of genus *Tanytarsus* and mizidy, shrimp and of mayflies of genus *Baetis*, *Caenis*. The quantitative indices of the development of macrozoobenthos AASL in the summer of 2015 fluctuated in the Eastern Arnasai from 41.5 to 725 mg/l, and in lake Tuzkan - from 500 to 6416 mg/l. In terms of weight, the shrimp *M.nipponense asper* Stimpson also dominated.

The ichthyofauna of the Arnasai lakes in the first years of flooding (1963-1965) consisted of only 16 species of fish found in the Syr Darya and Sanzara Rivers. In the 1970s, the ichthyofauna of AASL consisted of 25 fish species. Later, in connection with the creation of a lake-commodity fishery on Aidar-Arnasay, the ichthyofauna was replenished with cultivated species: white and motley silver carp, grass carp, carp and crucian carp. In 1998-2000, 26 species and subspecies of fish were established in the lakes of the Aidar-Arnasay system, of which 16 species (subspecies) are the main commercial fish, 8 species (subspecies) are endemic to Central Asia [Gafurov et al., 2001]. Occasionally there are amur snakehead, pike asp (*aspioleucius ecocinus*), *silurus glanis* Linnaeus, *esox lucius*, *hypophthalmichthys molitrix* (Valenciennes), pike. The most diverse is the family of *Cyprinidae*, which includes 8 species (subspecies). From At present, according to our data, the modern ichthyofauna of AASL consists of 14 species and subspecies of fish belonging to 7 families. Of the 7 species are commercial species - 4 (*Rutilus rutilus aralensis* Berg., *Carassius auratus gibelio*/goldfish (Bloch), *Cyprinus carpio* Linnaeus, *Stizostedion lucioperca* L.), yielding up to 96% of the total catch. the composition of the ichthyofauna ocellated, such species as raso fish (*Pelecus cultratus*), *shemaya aralensis*, *gorchak* disappeared. The current composition of the ichthyofauna of AASL, were noted the habitat of 18 species and subspecies of fish belonging to 7 families.

As can be seen from Table 3, in the lakes of the Aidar-Arnasay system, 16 species are currently noted for Lake Tuzkan, 18 species for Lake East Arnasay, and 14 species for Lake Aydarkul. The richest is the *Cyprinidae* family, which includes 12 species (subspecies).

Table 3. The current state of fisherfauna Aydar-Arnasay systems of lakes (spring-autumn 2019-2020)

	Family, species, subspecies	East Arnasai	Tuskan	Aydarkul
Family ESOCIDAE				
1.	<i>Esox Lucius</i> (Linnaeus, 1758)	+	-	-
Family CYPRINIDAE				
2.	<i>Aspius aspius iblioides</i> (Kessler1872,)	+	+	+
3.	<i>Abramis brama orientalis</i> (Berg, 1949)	+	+	-
4.	<i>Carassius auratus gibelio</i> (Bloch1782,)	+	+	+
5.	<i>Chalcalburnus chalcoides aralensis</i>	+	+	+

	(Berg, 1923)			
6.	<i>Cyprinus carpio</i> (Linnaeus, 1758)	+	+	+
7.	<i>Hemiculter leucisculus</i> (Basilewsky, 1855)	+	+	+
8.	<i>Hypophthalmichthys molitrix</i> (Valenciennes, 1844)	+	+	+
9.	<i>Gobio gobio lepidolaemus</i> (Kessler, 1872)	+	+	+
10.	<i>Pelecus cultratus</i> (Linnaeus, 1758)	+	+	+
11.	<i>Rhodeus ocellatus</i> (Kner, 1866)	+	+	-
12.	<i>Rutilus rutilus aralensis</i> (Berg, 1916)	+	+	+
13.	<i>Scardinius erythrophthalmus</i> (Linnaeus, 1758)	+	-	+
Family SILURIDAE				
14.	<i>Silurus glanis</i> (Linnaeus, 1758)	+	+	+
Family POECILIIDAE				
15.	<i>Gambusia holbrookii</i> (Girard, 1859)	+	+	+
Family PERCIDAE				
16.	<i>Sander lucioperca</i> (Linnaeus, 1758)	+	+	+
Family GOBIIDAE				
17.	<i>Rhinogobius similes</i> (Gill, 1859)	+	+	+
Family CHANNIDAE				
18.	<i>Channa argus warpachowskii</i> (Cantor, 1842)	+	+	-
	Total of species (subspecies)	18	16	14

Commercial fish species include: carp, Aral roach, silver carp, Aral asp, bream, pike perch, snakehead, catfish, pike. Of the low-value species, one can note the sabrefish, the Aral shemaya, and the rudd. Of the weed species, there are quite numerous thorny belly, gambusia, and rhinobius.

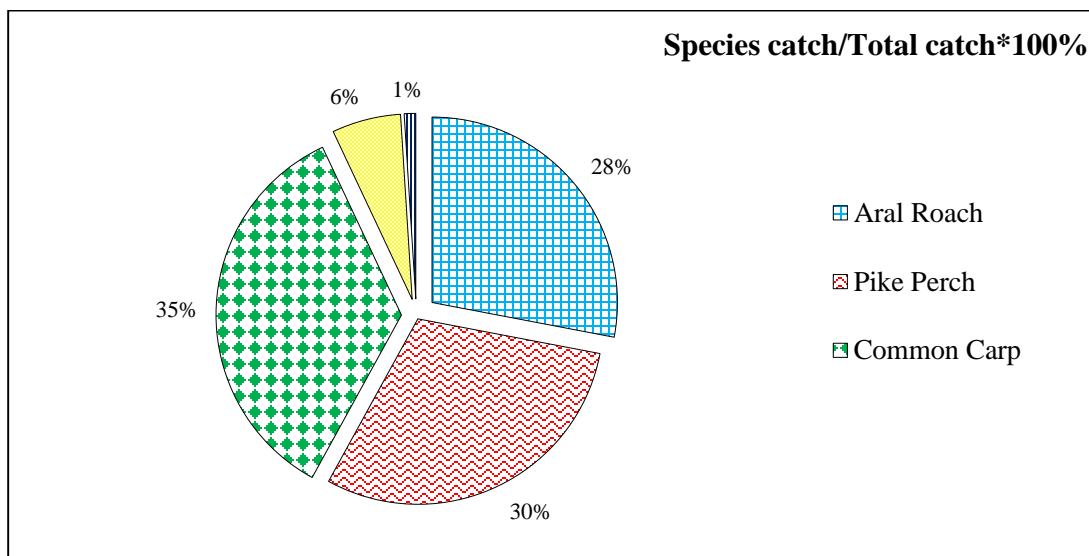


Figure 5. Percentage share of fish species in AASL of experimental catches in 2019-2020

Total fish catch according to AASL

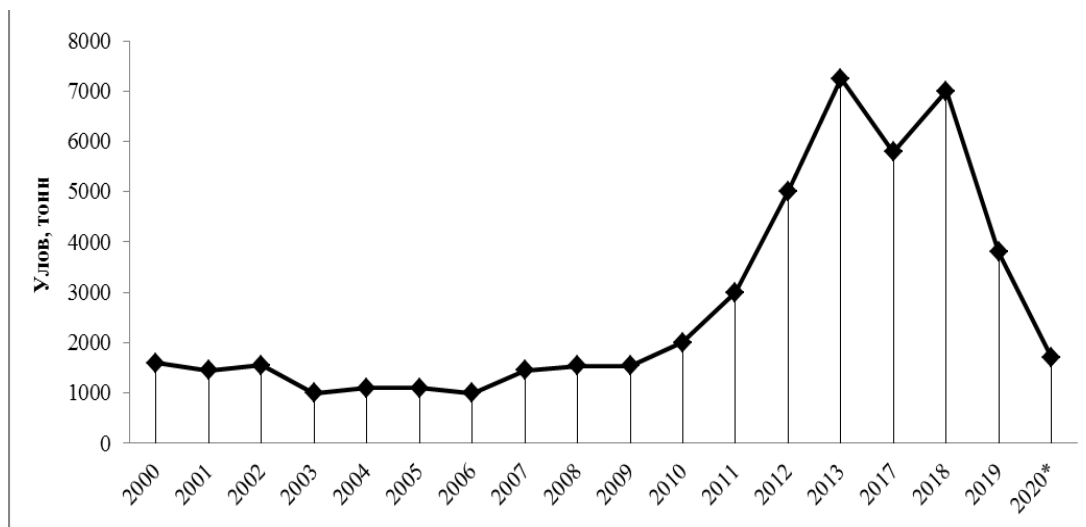


Figure 6. The graph shows the total fish catch in tonne by AASO for 2000-2020 (*August)

In 2017, fishing teams caught 5,789 tons of fish. In 2018, more than 7,000 tons. In 2019 - 3804.3 tons. In 2020, as of August, 1700 tons of fish.

However, in recent years, the Aidar-Arnasay system of lakes has been characterized by a deterioration in the relative water supply of reservoirs with fresh water, which leads to an increase in water salinity (due to evaporation of water from the surface of the reservoir and discharge of collector-drainage water) and, as a result, a reduction in the natural reproduction of a number of commercial species fish (Figure 6).

Conclusions

Based on the complex research carried out and the results obtained, it can be noted that the AASL ecosystem has undergone significant changes throughout history, continuing to this day. Formed in the late 1960s as a freshwater reservoir, the AASL in the following decades has steadily become solitary, i.e. became a brackish water body. This causes different in depth changes in the composition, of structure and ecological state of aquatic biocenoses: the qualitative and quantitative composition of hydrobionts decreases, along with eurybiont species of organisms, the specific ratio of brackish and brackish-water-marine forms of organisms increases.

- An analysis of the ecological characteristics of the discovered organisms shows that most of the discovered species of the communities of the AASO water bodies are widespread in temperate conditions, have a wide ecological valence and belong to the mesosaprobic zone of pollution, which is subdivided into β - and α -mesosaprobic subzones.

- The quality of water in the studied reservoirs according to the indicators of periphyton corresponds mainly to class III, which corresponds to moderately polluted waters and transitional class III-IV, which is associated with an increase in mineralization.

Biotic periphyton index (BPI) - 6 points, SI - 1.83-2.06, ecological state - from AB to transitional AB-AB. Meanings of letter symbols: AB – satisfactory ecological state, characterized by metabolic and ecological progress of biocenoses; AB-AB is a transitional ecological state associated with a noticeable change in the taxonomic and functional structure of biocenoses.

- The complex of phytophilic benthic fauna of AASO is represented mainly by freshwater-brackish-water species of β -, β - α -mesosaprobic conditions: shrimps, mysids, oligochaetes of the Naidinae family, chironomids of the fam. Orthoclaudiinae, beetles, mayfly larvae, dragonflies, midges, molluscs. The basis of the benthic fauna are mainly organisms of α - and α -p-saprobic conditions - oligochaetes of the fam. Tubificidae and chironomid larvae of the fam. Chironominae are characteristic of highly eutrophicated waters.

- At present, according to our data, the modern ichthyofauna of AASL consists of 18 species and subspecies of fish belonging to 7 families.

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