Comprehensive Study of the Ashykol and Kumkol Lakes of Akmola Oblast of the North Kazakhstan

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Abstract

Environmental condition of the Ashykol and Kumkol lakes of Akmola oblast of the North Kazakhstan was studied. Hydrochemical and hydrobiological condition was explored. Diagrams reflecting general dependence of abundance and biomass of zoo-plankton from mineralization and transparency of water in the lakes of Akmola oblast

Keywords: lakes, zoo-plankton, biomass, specific abundance.

1. Introduction

Kazakhstan has huge potential for development of fish farming in inland water bodies. There are large numbers of small water bodies, at full fish farming development of which the fishing can be significantly increased at the territory of the Republic, except Aral sea, Balkhash and Zaisan lakes. Number of lakes of Akmola oblast can be related to these water bodies.

There is an issue on mass study of average and small water bodies of Kazakhstan for needs of fishing industry arises at this stage. First of all, it is concerned to lakes, which are situated nearby the big industrial cities, provision of their residents with the good-quality fish products shall be special concern of the State. The lakes of Korgalzhyn region of the North Kazakhstan can be related to such water bodies.

Actuality of the work is determined by insufficient exploration degree of fish farming potential of average water bodies of the North Kazakhstan.

The purpose of the work is to study the bio-production potential, estimate the fish farming value and prove the rational using of bio-resources of the Ashykol, Kumkol lakes of Korgalzhyn region of the North Kazakhstan.

Materials and methods of research. Hydro-chemical observations were conducted at one time with hydro-biological researches. The sampling was carried out from the surface and natural layers of water by the standard methods (Alekin, 1970). The structure and property of water were determined by two methods – titrimetric and colorimetric by the following methods (Shishkina, 1974).

Determination of oxidation is based on ability of permanganate potassium to oxidize the organic materials with sulfuric acid (Lebedev, Usovich, 1969).

Determination of aggregate content of calcium and magnesium is based on application of trilon of B-acid sodium salt of ethylene diamine tetraacetic acid (Alekin, 1973).

Collection of zoo-planktons was carried out by screening of 50-600l of water through the net of Epstein (with using

of mill gas No.70). Once in 10 days. 50l of water were screened. The samples were fixed by four percent formalin with addition. The number of sample, date, place of collection, volume of filtered water were marked on each sample of zoo-plankton (Kiselev, 1980; Жизнь пресных вод ... (Life of fresh waters), 1956). The samples were analyzed in the chamber of Bogorov for identification of taxonomic composition and count of zoo-plankton abundance (Жизнь пресных вод.. (Life of fresh waters), 1956) by the methodology of Bogorov-Genzen (it is quoted by: Moruzi etc., 2008). Determination of zoo-plankton organisms was conducted by determinants: Ye.F. Manuilova (1960), L.A. Kutikova (1970), V.M. Rylov (1930, 1948), Ye.V. Borutskiy (1931, 1960), Ye.V. Borutskiy etc. (1991), Определитель пресноводных беспозвоночных Европейской части СССР (Determinant of fresh water invertebrates of the European part of USSR) (1977), Определитель пресноводных беспозвоночных России... (Determinant of fresh water invertebrates of Russia) (1995, 1994), N.M. Koronchivskiy (2004).

The sediment was searched for record of large forms, as well as ovulating species. 50 specimens of each type of zoo-plankton were measured taking into account its developmental stage and sex, for determination of zoo-plankton production. It is specified (Galkovskaya, 1965, 2005; Kutikova, 1970; Dubovskaya, 1987), that filtration of biometrical samples through the net (in comparison with settling samples) leads to visible decrease of abundance and biomass, whereas the large movable crustaceans can avoid the fishing gears, and small rotifers and naupliuses Copepoda are not kept by gas with mesh more than 45 micrometer. Therefore, scaling factor 2.0; for crustaceans – 1.5 at abundance of not less than 1 thousand specimens/m³ was used during count of biomass for rotifers. Such method of count also neutralizes decrease of biomass of zoo-plankton that is caused by destruction of shell-less rotifers in fixed samples (Pavelyeva, 1972; Kozhova, Melnik, 1978).

Index of Shannon (Shannon, 1963) was used for estimate of species diversity, as it is considered to be most informative and convenient.

2. Results of the Researches

We conducted the monitoring researches of number of water bodies of Akmola oblast: Ashykol, Kumkol lakes for estimate of biological resources of small fresh water bodies of the North Kazakhstan. Their hydro-chemical condition, mineralization were studied, as well as classification of water bodies was conducted based on the trophicity. The species composition, abundance and biomass of zoo-plankton and benthos communities were revealed. Dependencies between separate parameters of hydrochemical condition and indicators which describe the well-being of aquatic organisms' communities are found. Theoretical calculation of fish capacity was made on the basis of obtained materials.

Results and discussions. It is found that temperature condition of inspected water bodies is favorable for development of sufficient level of natural food reserve in it. Summer temperature in the lakes of Akmola oblast was 19-25°C.

Transparency in explored lakes was specifically for eutrophic and highly eutrophic water bodies. Maximum transparency is pointed in Akmola oblast in the Ashykol lake – 61.33cm.

It is known that color of water is an indicator of its chemical and biological properties. The rate of color in the lakes shall at most 30°. The color of the Kumkol lake was slightly higher than normal – 32.33°, and color of the Ashykol lake to 28.67°.

Gas condition of explored water bodies during the whole period of research was at good level, oxygen deficiency was not observed. Difference between amount of oxygen of the surface and bottom was insignificant. Oxygen content of water surface in the Ashykol lake was at the average from 7.9 to 8.17; Kumkol – 8.87-8.10mg/l. The amount of oxygen of the surface of this lakes was slightly higher than bottom – in the Ashykol lake – 17.18, in the Kumkol – 37.56% accordingly.

In the period of our researches, the level of permanganate oxidation in inspected lakes was different. Oxidation of water of the Ashykol lake during three years was 4.33mg/l, and the Kumkol lake was lower by almost twofold and was over 2.33-2.67mg O₂/l. The higher level of oxidation was pointed in 2006 in the Aksuat lake – 4.67mg O₂/l. Correlation in the pair *oxidation – oxygen balance in the water* is negative ($r = -0.68$).

The number of biogenic elements in the water of explored water bodies was determined in course of researches and it is found that it did not exceed the norm.

Nitrates content in the Ashykol lake was 3.95mg/l in the year 2006, and there was a slight decrease in 2007. The largest number of nitrates in the Kumkol lake was 3.73mg/l in 2007. Nitrates content at the average in all lakes was at the level of 0.001mg/l.

The number of calcium in the water of lakes of Akmola oblast was slightly lower; the number of Ca⁺ ions at the

average was 9.8, in the Kumkol lake – 6.76mg/l.

SO₄ ions content in the water bodies of Akmola oblast in 2006-2007 was anywhere from 42.19 (Kumkol) to 45.14 (Ashykol) mg/l. Magnesium content in all water bodies was over 3.98-4.85mg/l equaling 4.05 for the Ashykol lake, and 3.98 for the Kumkol lake.

Explored fresh water lakes with low mineralization. At the average, the level of mineralization was 475.33mg/l for the Ashykol lake, and 338.64mg/l for the Kumkol lake.

It is found that during classification of the water bodies by the trophicity, the Ashykol lake is eutrophic, and the Kumkol lake is high-eutrophic on the basis of conducted researches. According to the classification of O.A. Alekin, the Ashykol and Kumkol lakes are belonged to the hydro-carbonate class, group of calcium of the first and second type.

Important indicator which determines the life of community in the water bodies is species composition or set of types and number of species of each type. The zoo-plankton was not differed with wealth of composition in the explored water bodies. It is agreed with literature data. As per A.G. Dikanskaya (1972), in planktofauna of the Shalkar-Bartaban lakes of the North Kazakhstan, the number of dominant species equaled to 6.

We found out 5 species of zoo-plankters in the Ashykol lake in Akmola oblast (*Daphnia cucullata* Sars., *D. longispina* M., *Ceriodaphnia* sp., *Diaptomus* sp., *Asplanhna priodonta* M.) and in the Kumkol lake – 9 species (*Daphnia cucullata* Sars., *D. longispina* M., *Acanthocyclops* sp., *Diaptomus* sp., *Bosmina longirostris*, *Moina brahami*, *Hexarthra miza* H., *Asplanhna priodonta* M., *Keratella quadrata* M.).

The abundance of zoo-plankton in the Ashykol lake in Akmola oblast is ranged from 176.8 to 187.5 thousand specimens/m³, at that, *Diaptomus* sp. dominated with average number of 65.47 thousand specimens/ m³ and with specific wealth of 35% (see the table 6). The number in the Kumkol lake varied over 66.63-72.23 thousand specimens/m³ annually. The community was dominated by two taxons. At that, the specific wealth of *Diaptomus* sp. was ranged from 60.8 to 62.7, and *Cyclops* sp. – from 37.6 to 39.1%.

Total biomass of zoo-plankton in different lakes was different drastically. Thus, the highest total biomass in the Ashykol lake was pointed in 2008 – 6.66, the lowest in 2007 – 5.84g/m³. At the same time, biomass of zoo-plankton in the Kumkol lake was ranged over 25-48.24g/m³ on the annual basis.

In the total biomass of the Ashykol lake, *Daphnia longispina* (lim 3.26-3.47g/m³) was prevail. The lowest biomass had *Cyclops* sp. – at the average 0.42g/m³. Absolute dominance of group of organisms jointed as *Cyclops* sp. – 85.75-90.6% was observed in the Kumkol lake, biomass of other taxons was significantly lower.

We have calculated the index of species diversity of Shannon during hydro-biological inspection of the lakes of Akmola oblast (Kumkol, Ashykol). It was 1.81 for the Ashykol lake, 0.95 for the Kumkol lake.

Due to that transparency and mineralization of water essentially influence on development of zoo-plankton, we conducted the estimate of this dependency.

We have tried to reveal dependencies between the different parameters describing physical and chemical quality of water (mineralization, transparency), and parameters describing state of zoo-plankton communities (abundance, biomass).

Dependency between transparency and abundance is even more visible, increase of abundance of zoo-plankters is observed during decreasing of transparency (picture 1) Water transparency of the Kumkol lake was 46cm in 2007, abundance was at the level of 70.30 thousand specimens/m³. There is a reduction of transparency to 46cm and increase of abundance to 72.23 thousand specimens/m³. In 2008, transparency increased again and there was reduction of abundance of zoo-plankton communities to 66.63 thousand specimens/ m³.

Relation between biomass of zoo-plankton and water transparency reflected on the picture 2 has non-distinct nature.

Picture 1 Dependence of abundance of zooplankton on water transparency of the Kumkol lake

Picture 2 Dependence of biomass of zooplankton on water transparency of the Kumkol lake

We have studied dependency between the mineralization of water and abundance of plankton organisms. Increase of water mineralization on 4.69% in the Ashykol lake in 2007 led to reduction of abundance of organisms from 184.03 to 176.8 thousand specimens/m³, and at decrease of mineralization in 2008 to 449.73mg/l, the abundance of zoo-plankton increased to 187.5 thousand specimens/m³ (see the picture 5). However, in the Kumkol lake in the year 2007, at increase of mineralization to 352.98mg/l or to 7%, abundance of zoo-plankton increased slightly – to 72.23 thousand specimens/m³ (2.8%), and at decrease of mineralization in 2008, abundance of zoo-plankton reduced to 66.63 thousand specimens/m³ or to 7.75% toward 2007 year. Perhaps, non-compliance of processes occurred in different water bodies is a reflection of the fact that factors not studied by us have an effect on interrelation between water mineralization and abundance.

However, negative interrelation was pointed during development of diagrams reflecting general dependence of abundance and biomass of zoo-plankton on water mineralization in the lakes (picture 3).

Study of the pair of *water mineralization – biomass of zoo-plankton* testified that at increase of water mineralization of the Ashykol lake from 449.73 (2006) to 475.67mg/l (2007), the reduction of biomass of zoo-plankton from 6.58 to 5.84mg/m³ is pointed, and at decrease of mineralization from 449.73mg/l, biomass of zoo-plankton rose to 6.66mg/m³. However, at increase of the level of water mineralization in the Kumkol lake in 2007 (toward 2006), total biomass of zoo-plankton rose twofold (picture 4).

However, negative interrelation is revealed independent from the water body during development of diagram reflecting the interrelation of water mineralization and biomass of organisms.

Clear feedback is revealed during overlay of diagrams reflecting abundance dynamics of zoo-plankters and water transparency upon each other. Thus, in 2006, the level of water transparency of the Ashykol lake was 62cm, at that the abundance of zoo-plankton organisms was 181,80 thousand/m². In 2007, reduction of water transparency was observed to 3cm, at that abundance rose to 3.9 thousand/m². In 2008, depth of transparency was 63cm, abundance of organisms at that achieved 182.37 thousand/m². Tendency for biomass and transparency are same.

Dependency between transparency and abundance even more visible in the Kumkol lake. Water transparency of the Kumkol lake was 46cm in 2007, abundance, at that, was at the level of 70.30 thousand specimens/m³. In 2007, transparency reduced to 46cm, at that, rising of abundance is pointed to 72.23 thousand specimens/m³. In 2008, transparency was increased again and abundance of zoo-plankton communities was reduced to 66.63 thousand

specimens/m³.

Correlation coefficient between indicators was calculated for confirmation or refutation of dependencies established by us, as well as for estimate of the level of interrelation.

In the result, negative correlation was revealed in most character pairs. In the pair of *mineralization-abundance* for Akmola oblast $r = -0,97$. Analogue tendency is revealed for the pairs *transparency – biomass* $r = -0,88$.

It is known that many properties of living organisms are under the influence of conditions of external environment. It is found that highly veridical influence of amount of mineral substances in the water on biomass of zoo-plankton communities – 94%, whereas influence of transparency on biomass was over 49%.

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