

Abstract

General characterization of the work. The thesis presents the results of research on the state of populations of common carp (*Cyprinus carpio* Linnaeus, 1758) from three large fishery reservoirs of southeastern Kazakhstan.

Actuality of the theme. Actuality of the theme. The carp is a valuable commercial fish throughout its range [1-5]. Changes in the population structure are an important indicator of the success of adaptation of the species to the habitat conditions in a water body. Over a half-century period, commercial carp stocks have declined markedly as a result of IUU fishing [4,6-8]. Rational approaches to the conservation of carp stocks in natural water bodies cannot be realized without a clear understanding of its population characteristics [9,10]. In this regard, the study of its population characteristics under the conditions of constantly increasing anthropogenic load is of great importance in the conservation of commercial abundance and intraspecific diversity. The study of individual morphobiological traits in the course of ichthyomonitoring studies allows us to determine the direction of changes, identify some population differences and timely develop measures for the introduction of rational fishing to prevent damage to both the population of carp and other hydrobionts [11]. On this basis, the study of ecological and biological features of carp populations from lakes Balkash, Alakol and Kapshagai reservoir in order to assess their qualitative structure and develop appropriate recommendations for the conservation of commercial stocks is of significant scientific and practical interest.

Objective of the study. Study ecological and biological features of carp and assess the status of populations from Kapshagai reservoir, lakes Balkash and Alakol.

Tasks of the research. In accordance with the purpose of the work the following tasks were formed:

1. Describe physical-geographical, climatic and hydrological-hydrochemical features of the studied fishery water bodies of southeastern Kazakhstan;
2. Study the natural food base and identify differences in the biomass of the main groups of food organisms (phytoplankton, zooplankton and zoobenthos) in the studied reservoirs;
3. Study the population structure and dynamics of age and size composition of carp in the three water bodies under study;
4. Analyze the variability of morphobiological parameters of carp from the three studied reservoirs;
5. Study multi-year dynamics of fishing in connection with potential biotic and abiotic factors limiting the number of carp in lakes Balkash, Alakol and Kapshagay reservoir;
6. Develop recommendations on preservation and increase of carp abundance in lakes Balkash, Alakol and in Kapshagay reservoir.

Object of study. Carp (*Cyprinus carpio* L., 1758) in the Balkash-Alakol basin: lakes Balkash, Alakol and Kapshagay reservoir.

Research methods. Hydrological, hydrochemical, hydrobiological, ichthyological, morphometric, statistical and GIS methods were used in the course of research.

Scientific novelty of the dissertation work. The dissertation work is a generalization of own, foundation materials and literature data on biology, morphology, peculiarities of population structure of carp from lakes Balkash, Alakol and Kapshagay reservoir.

The results of hydrochemical composition of waters of three large water bodies of South-East Kazakhstan are presented by the principal component method (PCA). On the basis of the obtained results the differences of water bodies on the content of biogenic elements, permanganate oxidizability, hydrogen index, dissolved oxygen and mineralization are determined.

For the first time on the basis of complex ichthyologic research the results of analysis of population structure of carp are given, indicating that the core of reproducing herd are younger age groups with relatively low fecundity in comparison with older age generations, the number of which remains low due to their overfishing.

The results of food competition of carp and potential competitor fish in lakes Balkash, Alakol and Kapshagay reservoir are presented for the first time. Tension of food competition is clearly marked with bream in Lake Balkash and Lake Alakol. At the same time competition with roach in Kapshagay reservoir has increased, which probably in the future can only lead to increased competition for similar food components - macrophytes and mollusks.

For the first time the influence of potential predators and competitor fish on the formation of modern population structure of carp was assessed. Influence of asp and catfish on representatives of peaceful fish species - carp and bream remains partial due to low abundance and diversity of food objects in water bodies.

In the dissertation work the results on comparative morphology of three populations of carp in the Balkash-Alakol basin are reflected for the first time. Phenotypic differences in carp individuals from three populations were revealed, which is caused by differences in habitat conditions in the three studied reservoirs.

For the first time with application of cross-correlation method the complex estimation about influence of various factors on the state of commercial catches of carp and other fish species of water bodies of South-East Kazakhstan was carried out. Cross-correlation method allowed to determine the time of action of a factor on the basis of exclusion or minimization of other factors (confidence interval), affecting the relative abundance of carp throughout the fishing development in these reservoirs.

For the first time, the impact of IUU fishing on the abundance of three carp populations was assessed based on the minimum sustainable volume and predicted biological capacity of water bodies.

For the first time, on the basis of cartographic methods the main places of spatial distribution of carp in the water areas of lakes Balkash, Lake Alakol and Kapshagay reservoir were determined. Inter-annual and inter-seasonal data of net catches of carp were visualized.

Theoretical significance of the work. The presented materials supplement and clarify the known data of previously published works. The modern statistical methods used allow to accurately identify the impact of certain factors excluding the influence of other factors, to identify phenotypic differences, to systematize the data of abiotic and biotic indicators. New data on the population structure of carp can be used for further observations of their condition and to improve the quality of catch forecasting.

Materials of the thesis can be used in the courses «Private Ichthyology», «Fisheries Ichthyology» and «Zoogeography of Fishes».

Practical significance of the work. The results obtained make it possible to identify regularities in the population dynamics, which should facilitate the construction of verified prognostic models (in populations or in the whole ichthyofauna), the preparation of short-term and long-term population forecasts and the development of the most effective measures to regulate fishing. The main statements for defense.

The main points for defense.

1. Changes in abiotic environmental parameters (hydrogen pH, water temperature regime, mineralization level, content of biogenic elements) of habitat in the studied water bodies are described.
2. The revealed trends of changes indicate a decrease in size-weight indices, reduction of abundance in older age groups and decrease in reproductive potential of carp populations in all three fishery reservoirs from the moment of introduction to the present time.
3. Morphological divergence of external features in carp populations from three reservoirs indicates differences in habitat conditions (different hydrological and temperature regimes, bathymetry, fishing pressure, forage base, etc.).
4. The influence of the main food competitor of carp - bream was preserved in Lake Balkash and Lake Alakol. The index of food similarity for carp from Kapshagai reservoir indicates high competition with roach and less with bream, which in case of increase in the number of the former can aggravate the existing ecological and biological status of carp in this reservoir.
5. Hydrological regime formed in fishery reservoirs influences the dynamics of carp abundance with a time lag of several years (Lake Balkash - 6 years, Kapshagay reservoir - 4 years). The identified time intervals of water level or water

discharge impact are not constant and serve as a model for determining the presence of this factor.

6. Predatory fish pressure on carp populations in all three study reservoirs is relatively low, due to low numbers of catfish and asp due to intensive fishing. Of much greater importance are competitive relations with such peaceful fish species as bream and roach.

Personal contribution of the author. The author directly participated in the collection of field and stock materials, biological and morphometric analyses of fish, mapping, statistical processing of the obtained data, analyzed, summarized and presented the results.

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Approbation of the work. The results of research and the main statements of the dissertation were reported and presented at various international scientific conferences: International Scientific Conference of Students and Young Scientists «Farabi Alemi» (Almaty, Kazakhstan, 2023, 2024), materials of the International Conference dedicated to the 90th anniversary of RSE «Institute of Zoology» (Almaty, Kazakhstan 2024), materials of the conference collection Central Asia Scientific Journal (Almaty, Kazakhstan 2023), materials of the International Scientific and Practical Conference to the 90th anniversary of the Balkhash branch of «Fisheries Research and Production center».

Publications. On a theme of dissertation 11 scientific works are published, including 6 theses in materials of the International scientific-practical conferences, 4 articles in journals «Vestnik KazNU» «Vestnik ZKTU named after Zhangir khan», «Central Asian journal of researches of water resources», included in the list of Science and Higher Education Quality Assurance Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan, 1 article in a journal of bibliographic base Scopus («Egyptian Journal of Aquatic Research»).

Structure of the dissertation. The thesis is set out on 187 pages and contains 95 figures and 49 tables. The work consists of an introduction, 3 main chapters, conclusion and list of references. The list of literature contains 275 sources, 70 of them in foreign languages.