Changes in biological indicators of the silver bream *Blicca bjoerkna* at the upper part of the Volga stretch of the Kuybyshev reservoir in connection with the anthropogenic impact

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Abstract. In recent years, the silver bream of the upper part of the Volga stretch of the Kuibyshev reservoir maintained a tendency to reduce the average size and weight indicators. Given the good availability of food and the fact that in the area under consideration, commercial fishing of this species has not been carried out in recent years, it can be assumed that changes in biological indicators are caused by a significant impact of anthropogenic impact in the form of individual and poaching fishing. It is necessary to strengthen control measures for such types of fishing.

1 Introduction

The «Big Volga» plan, which began in the 1930-s, was supposed to solve transport, irrigation and energy problems, as the most important for the industrial development of the country. This plan involved the construction of dams, hydroelectric power stations and locks for shipping on the Volga River. The issues of fisheries in the framework of this plan were not considered, possible harm to aquatic organisms was perceived as an inevitable loss, necessary against the background of the general industrial growth of the country. As part of the plan, in October 1955, the damming of the Volga River, necessary for the operation of the hydroelectric power station, was completed, and the filling of the Kuibyshev reservoir began [1]. The formation of the reservoir led to significant changes in the habitat of fish in the area and affected their biology.

The ecosystem of aquatic hydrobionts in reservoirs changes over time and goes through various stages. Since the mid-1980s, the ecosystem of the Kuibyshev reservoir under the influence of increasing anthropogenic impact has passed into a period of destabilization, which disrupts the relationship of hydrobionts with the environment [2].

However, some fish species, in particular, the silver bream *Blicca bjoerkna*, were able to adapt to the changed conditions.

For example, the Kuibyshev reservoir is characterized by significant fluctuations in the water level in the spring, which negatively affects the reproduction of most fish species.

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Spawning at the silver bream begins later, in late May or early June, which, together with the plasticity in the choice of spawning sites and spawning substrates, avoids the adverse effects of spring fluctuations in the water level. Thus, the rates of linear and weight growth of the silver bream in 2005-2007 tended to increase, compared with the indicators of the Middle Volga in the 1950s and the period of relative stabilization of the reservoir (1980s), which showed a relatively prosperous state of its population [3].

Perhaps a role was played by the fact that the nature of the diet of the silver bream is a typical benthic and is able to eat shellfish, in particular, representatives of the genus *Dreissena*, which form significant reserves of biomass, poorly used by other fish species [4].

In 2009-2012, there was a tendency to decrease the proportion of large fish of older ages, as well as a decrease in growth rates, compared to previous years [5].

In 1973-2012, silver bream accounted for 6.1% to 25.3% of the total fish catch in the Kuibyshev reservoir.

This species is considered a low-value fish due to its small size, but in the framework of amateur fishing it is in demand and is caught by amateur fishermen in significant quantities.

In the second decade of this century, there was a tendency to increase the number of this species in net catches [5].

This species in the Kuibyshev reservoir in recent years has been in the first place, among others, for production in the recommended catch mode (RV) [6].

2. Materials and methods

The materials of the control catches of the Kazan (Volga Region) Federal University were used. The catch was carried out in the Volga stretch of the Kuibyshev reservoir at the same research site using set nets with mesh sizes of 24-65 mm. In 2017-2019, the work was carried out in the summer-autumn period, in 2020 – in the summer period. From 2017 to 2020, 40 fishing effort were made and 197 individuals were caught. The results were compared with the data of previous studies performed using similar methods in this area of research in the period 2009-2012. Generally accepted methods were used in the research [7, 8, 9, 10]. The age of the fish was determined by the spines of the first rays of the dorsal fin and scales.

3. Results and discussion

In 2017-2020, the range of body length fluctuations ranged from 11 to 24 cm, with average values from 17 to 19 cm, and in 2009-2012 - from 6 to 28 cm, with average values from 15 to 17 cm. Body weight in 2017-2020 ranged from 35 to 400 g, with an average of 140 to 186 g, and in 2009-2012-from 10 to 360 g, with an average of 95 to 126 g. The analysis of the age composition shows that in 2017-2020, individuals aged from 2+ to 11+ years were found in the catches. Dominated fish at the age of 4+ – 7+ years old. In 2009-2012 the age composition was also represented by individuals aged from 2+ to 11+ years, but age classes prevailed 5+ – 7+ years. In 2020, the largest individual was caught for the period 2017-2020 (body length-27 cm, weight-500 g, at the age of 14 years). This artifact is not included in our calculations. It should be noted that in 1959-2008, the range of biological indicators and the average values over the years in silver bream were higher than in 2009-2012 and in the period under consideration: body length varied from 8 to 35 cm, with average values from 16 to 28 cm, body weight ranged from 20 to 500 g, with average values from 101 to 170 g. The age composition was represented by individuals aged from 2+ to 10+ years, with a predominance of age classes 3+ – 8+ years [11].

When analyzing changes in body length and weight by age from 2017 to 2020, there was a decrease in these indicators in the main dominant age groups: 4+, 5+ and 7+ years. At the

age of 6+ years in 2018, compared to 2017, these indicators increased slightly, by 0.1 cm and 6 g, in 2019 – decreased by 1 cm and 24 g, and in 2020 - again increased slightly, by 0.8 cm and 29 g.

Thus, we believe that in 2017-2020, the trend of reducing the size and weight indicators, which was outlined in 2009-2012, has continued.

Previous studies in this area have shown that a similar situation is observed in the pikeperch *Sander lucioperca*. For this species, a decrease in the values of size and weight indicators was also revealed against the background of simplification of the age structure in the direction of rejuvenation. Thus, according to the control catches of the Kazan (Volga Region) Federal University, in 2009-2018, the basis of catches was small immature or first maturing individuals. The share of older individuals in the catches was small. This pattern is typical for fish with a short life cycle and was not previously typical for pikeperch [12].

Given the fairly good food supply and the fact that in the area under consideration, commercial fishing of this species has not been carried out in recent years, it can be assumed that changes in the biological parameters of the silver bream in the upper part of the Kuibyshev reservoir are caused by a significant impact of anthropogenic impact in the form of amateur and poaching.

4. Conclusions

In the upper part of the Volga stretch of the Kuibyshev reservoir according to the materials of 2017-2020. the basis of the catches of the silver bream was represented by relatively small mature individuals at the age of 4+ – 7+, with low mass values. We believe that in 2017-2020. The silver bream of the area under consideration has maintained a downward trend in size and weight indicators, which was outlined in 2009-2012. Against the background of a fairly good food supply and the absence of commercial fishing in this area of the silver bream, this suggests a significant impact of anthropogenic impact in the form of amateur and poaching fishing on the biological indicators of the silver bream. It is necessary to strengthen control measures for such types of fishing.

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