The role of ichthyopathological observations in the industrial reproduction of sterlet for the tasks of release into the Kuibyshev reservoir

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Abstract. The features of the industrial reproduction of sterlet in the Middle Volga region are considered. The necessity of further increasing the volume of production and release of juvenile sterlet to the Kuibyshev reservoir is shown. An increase in the relevance of research works in the field of sturgeon ichthyopathology has been noted. The importance of carrying out ichthyopathological observations is shown both for ensuring the stability and efficiency of production, and for preserving the natural population of sterlet in the Kuibyshev reservoir. The article considers the relative novelty of ichthyopathology as a science and the discrepancy between normative legal acts regulating ichthyopathological observations in Russia. The industrialization of aquaculture forms is shown. The emergence of new sturgeon diseases specific to high-intensity fish farming was noted. The results of experiments on the use of inorganic drugs for the treatment of sturgeon nutritional diseases are presented.

1 Introduction

Construction of a cascade of hydroelectric power plants and the formation of reservoirs on the river Volga had a huge impact on the economic condition of the region. The same significant impact was exerted on the living conditions of aquatic organisms living in the Volga river. These changes were characterized by an increase in trophy in the water areas of the formed reservoirs, which led to an increase in catches [1, 2].

At the same time, the composition of catches also changed - the proportion of small afish increased, and the number of valuable commercial species decreased. For most sturgeon species, one of the most valuable fish species in the Russian Federation, the construction of reservoirs has become especially important. Since the majority of sturgeons are anadromous species, they lost the opportunity to climb the Volga to their historical spawning grounds. The sterlet turned out to be the only resident representative of sturgeon, which is capable of permanent existence and reproduction in the conditions of the reservoir. After the regulation of the Volga, the catches of sterlet have been steadily decreasing and, at the moment, it has practically no commercial value. The objectives of directed changes in the ichthyocenosis of reservoirs, the high value of sturgeon and the need to preserve and maintain the natural population formed the basis for the development of industrial sturgeon breeding. Artificial reproduction of sterlet at the moment is closely related to the technologies of intravital production of reproductive products, year-round keeping in the basin in recirculating aquaculture systems (RAS), preparation of producers for reproduction by controlling temperature conditions and injecting gonadotropic drugs. Rearing and keeping fish under RAS conditions is associated with a number of significant differences from life in the natural environment, such as an high stocking density, feeding with artificial feed, difference of the chemical composition and microflora. The risk of massive infectious, parasitic, as well as the development of nutritional diseases specific to such conditions increases significantly. In addition, in the tasks of rearing juveniles for subsequent release into natural reservoirs, it is necessary to ensure the preparedness of these juveniles for natural conditions and feed.

2 Material and research technique

In the course of the work, the analysis literature data on the state of the ichthyopathological situation on sturgeon farms and the results of our own research, carried out in 2018-2019 at the sturgeon industrial farm and the recirculating aquaculture systems of the Department of Water Bioresources and Aquaculture, FSBEI HE KSPEU.

3 Results and discussion

Research into the reproduction of sterlet to preserve its abundance in catches began in the beginning of 20th century [3]. At that time, a sterlet breeding plant was built, equipped with incubation devices of that time. Over the past years, the commercial value of the species

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has grown, but the catches of sterlet have been constantly decreasing (Fig. 1). The creation of the Kuibyshev reservoir marked the gradual disappearance of other sturgeon species from the region, which also increased the value of the local sterlet and the commercial load on it. At the moment, the sterlet is listed in the Red Books of the Russian Federation and most regions adjacent to the Kuibyshev reservoir. The rules for its catch are strictly regulated. There are a number of conservation programs in place.

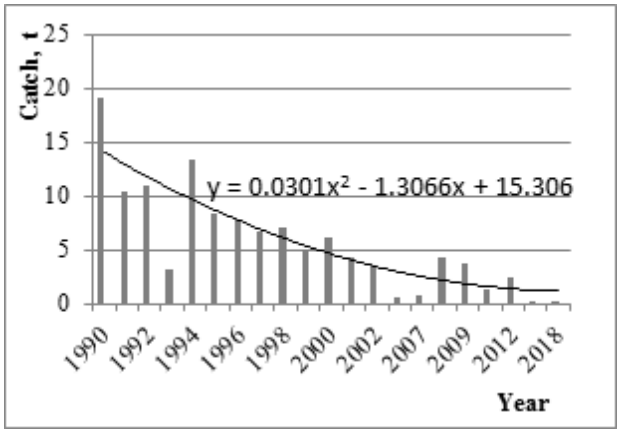

Fig. 1. Dynamics of catches of sterlet in the Republic of Tatarstan according to official statistics.

Considering the tasks of the directed formation of the ichthyofauna of the Kuibyshev reservoir and the return of the sterlet to its commercial status, that is, the restoration of the local population to the state before it was included in the Red Book, annual releases of at least 8.6 million juveniles are required, and to achieve the desired share in catches - 57 million [4].

The increase in the production of juvenile sterlet is due not only to the tasks of releases, but also to the demand for fish seed in the domestic market. The increase in production volumes is associated with the creation of new sturgeon enterprises and an increase in the efficiency of the existing ones. The trend towards the industrialization of fish farming, which is observed both in Russia and abroad, increases the relevance of conducting ichthyopathological studies of valuable aquaculture objects, as well as the importance of the full use of the data obtained in production.

Ichthyopathology remains a relatively new science, for example, the first studies of viral diseases in fish began in 1985 [5]. Diseases of sturgeon differ into infectious, bacterial, fungal, invasive by the nature of infection, in addition, non-infectious diseases are distinguished, among which alimentary diseases play an important role - disorders of the body's functioning associated with nutrition and digestion.

In the development of sturgeon breeding in central Russia, a key role is played by full-cycle farms capable of producing fish seedlings both for the needs of farms and for releases into natural water bodies. The work of such farms is associated with keeping fish in conditions differing from natural. In conditions of a high density of fish juveniles, artificial maintenance of the environment parameters and feeding with artificial feeds, not only the risk of the diseases grows, but also their consequence.

Intensification of aquaculture leads to an ever greater distance from natural growing conditions. This leads to the appearance of new, previously not observed diseases. An important issue that we face at fish-breeding enterprises is the correct diagnosis of diseases and, as a consequence, the choice of appropriate measures to combat them. Significant harm when growing young sterlet can be caused not only by viral diseases, but also by alimentary diseases. According to our observations, the correct diagnosis of such diseases as dropsy, gas-bubble disease and tympania (Fig. 2) often becomes a difficult task for a novice fish farmer. At the same time, these diseases can pose a significant threat to the fry herd and require the use of various methods of combating them.

Fig. 2. Affected young sterlet: from left to right: dropsy, gas-bubble disease, tympania.

The main features uniting these diseases are abdominal distention, impaired coordination of movement, and the inability of juveniles to sink to the bottom. It is possible to accurately identify the disease only with ichthyopathological studies. Dropsy is caused by the accumulation of large amounts of fluid in the abdominal cavity and usually does not affect the internal organs. Gas bubble disease manifests itself in the accumulation of gas in the internal organs, under the skin, in the eyes and on the gills (Fig. 3). In this case, gases come from outside and are due to their excess content in the environment. When tympanic occurs, bloating occurs in the gastrointestinal tract and associated swim bladder due to the accumulation of gas formed by the microflora. Tympania is usually observed in juveniles weighing from 1 to 100 g. Tympania, due to its low popularity, is often confused with gas bubble disease, however, in case of mass diseases, it is not difficult to find differences. Gas bubble disease manifests itself on most individuals contained in a gas-saturated environment for several days, gas bubbles are noted not only in the digestive tract, but also, first of all, on the branchial lobes. According to our observations, the manifestation of tympanic symptoms, like dropsy, has an individual and more prolonged character. Despite

this, tympania, during rearing, causes the death of up to 10% of individuals. Gas, in this case, is found only in the gastrointestinal tract and the swim bladder communicating with it.

Fig. 3. Air bubbles during microscopy of gill lobes and fins.

Measures to combat these diseases are fundamentally different, gas-bubble disease requires modernization of the water supply and water treatment system, elimination of equipment malfunctions that lead to saturation of water with gases from the air. Dropsy and tympania are caused by the unsatisfactory state of the fish, unfavorable hydrochemical conditions, inadequate quality of feed and feeding regime, and are often found together. To eliminate the latter requires a revision of the biotechnology of cultivation and an improvement in the quality of the water used.

In modern fish farming, the main method of combating these diseases is to prevent their occurrence and timely eliminate their causes. Technologies for treating affected individuals are poorly developed and, as a rule, do not give significant results. We have carried out work on the development of a method for the treatment of young sterlet affected by typania. One of which is tympania of sturgeon fish. This disease is an alimentary one and is associated with the feeding regime and feed. It manifests itself in the form of dysbiosis, expansion of the gastrointestinal tract and swim bladder in juvenile sturgeon (Fig. 2). Tympania occurs with qualitative and quantitative changes in the normal intestinal microflora [6, 7]. Possible causes of pathological changes include the use of poor-quality, unbalanced feed, prolonged feeding of juveniles with artificial feed [8]. A similar problem has been successfully solved for agricultural mammals [9], ut the applied methods cannot be used for fish.

Fig. 4. Sterlet juveniles on an industrial sturgeon farm with tympanic signs.

We used simethicone as the main agent for eliminating tympanic symptoms. Simethicone is a chemically inert polymer of methylsiloxane containing about 5% silicon dioxide. It has surface-active properties and the ability to reduce the surface tension at the liquid / gas interface, which makes it difficult to form gas bubbles, and also promotes their fusion and destruction of foam in the intestine, as a result of which the released gas is absorbed or excreted naturally under the influence of intestinal motility. These drugs are of inorganic origin, chemically inert and are not absorbed into the body. At the same time, they made it possible to reduce the gas pressure in the internal organs and, despite the symptomatic nature of the treatment, reduce the mortality of juveniles with obvious signs of the disease.

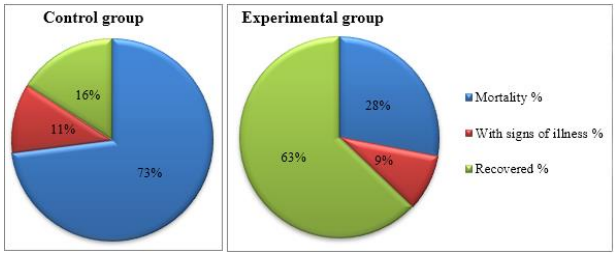

Fig. 5. Results of experiments on the use of simethicone-containing agents in the treatment of tympania in juvenile sterlet.

In the course of the study, a series of experiments was set up to study the possibility of treating tympania in juvenile sterlet using simethicone-containing agents with various methods of use. For the experiments, sterlet juveniles, 5.5 months old, weighing from 8 to 40 g were used. Each experiment lasted 10 days. Sterlet juveniles of one spawning were used for the tests. For each experiment, 6 groups of juveniles with signs of the disease were prepared, 40 pieces each. All specimens used had clear signs of the disease. The drug was administered by two methods: exposure of fish in a solution of a simethicone-containing drug for 5 days and direct injection of the solution into the oral cavity. The latter method is laborious and not applicable in industrial environments. Various methods of treatment and action in a mixture with an antispasmodic were tested. The averaged data from the experimental results is shown in Figure 5.

The experiments have shown the possibility of treating young sterlet with signs of tympania with simethicone-containing preparations. Despite the symptomatic nature of the treatment, it made it possible to significantly reduce the mortality of juveniles with obvious signs of the disease by more than 40% (Fig. 5). In recovered individuals, no relapses or worsening were observed.

4 Conclusion

The prevention of fish diseases is under the control of specialists from fish breeding enterprises, who must maintain contact with state veterinary inspectors who control the import and export of fish seed and

marketable fish, agree on plans for preventive measures, and notify in case of fish mortality. Their activities are regulated by the Law of the Russian Federation dated May 14, 1993 No. 4979-1 "On Veterinary Medicine" (as amended on 08/02/2019) and the "Collection of Instructions for Combating Fish Diseases". At the same time, the authors note that the materials regarding the prevention of diseases and the development of methods to combat them are morally outdated [10, 11].

The need to ensure the stability of the operation of sturgeon farms, reduce the costs and risks associated with diseases and mortality of fish, increase the survival rate and adaptability to the natural conditions of released juveniles, determines the great importance of ichthyopathological studies and observations for the development of sturgeon breeding. Timely ichthyopathological observations allow not only to reduce the risk of dangerous viral diseases, but also to increase the survival rate of juveniles, improve their well-being through effective measures to prevent and combat nutritional diseases of the sterlet. Ichthyopathological observations make it possible to judge not only the state of fish, but also the work of the technological line for its production, the quality of the biotechnology of cultivation. The data obtained in the course of observations allows us to make the necessary adjustments and improve production efficiency [12, 13, 14].

Our experiments have shown the effectiveness of using inorganic simethicone-containing preparations in the fight against tympania of sturgeon fish. The developed methods make it possible to increase the survival rate of juvenile sterlet when grown for release [15,16]. The development of vaccines for fish and the use of modern biotechnological methods are needed [17, 18].

An increase in production volumes, intensification of aquaculture methods without proper control over the epizootic state of broodstock and released juveniles, the creation of an effective research base and a personnel reserve in the region, can lead to negative consequences for both economic entities and the natural population.

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