Release of sterlet (lat. Acipenser ruthenus) in the Kuibyshev reservoir is an important task for the development of aquaculture

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Release of sterlet (lat. Acipenser ruthenus) in the Kuibyshev reservoir is an important task for the development of aquaculture

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Abstract. The development of hydropower and the creation of reservoirs of the Volga cascade had an impact on the state of populations of sturgeon species of fish, while creating incentives for improving the biotechnology of their reproduction and cultivation. This period is characterized by the desire and technical and technological capabilities to restore the number of sterlet in the Kuibyshev reservoir. Release of sterlet can be conducted not only in the vicinity of potential spawning grounds, but also in the feeding areas. Taking into account the possibilities of long-term development of the Kuibyshev reservoir with the directed formation of ichthyofauna and planning of sterlet catches in the volume of 480 tons, annual releases of juveniles with a mass of 3 g in the amount of 57 million pieces are required. The analysis shows the need to organize significant production of sterlet juveniles for stocking the Kuibyshev Reservoir.

Introduction

The development of aquaculture in the world is one of the most important priorities of our time. The growth of the population, the increasing press on the environment, the requirements for quality of life, and, consequently, the consumed protein products make the trend of growth of aquaculture production in the world steady. The prerequisites for the successful implementation of aquaculture tasks in Russia are a significant number of inland waters and their quality. Since the beginning of the twentieth century, the problems of the development of fish industry have been closely linked with the development of energy [1, 2].

In 1931, the working hypothesis of a comprehensive scheme for the use of the Volga for energy and transport purposes was developed, various projects for the construction of hydroelectric power stations were put forward, however, among them there were no projects that took into account the whole complex of problems that were considered in the complex scheme for the use of the Volga. In the subsequent period, the problem of the "Great Volga" was solved by creating a cascade of reservoirs: the Upper Volga (1944), Ivankovsky (1937), Uglich (1939-1943), Rybinsk (1940-1949), Gorky (1955-1957), Cheboksary (1981), Kuibyshev (1955-1957), Saratov (1967-1968), Volgograd (1958-1960 gg.), Kamsky (1954-1956 gg.), Votkinsky (1961 -1964 gg.), Nizhnekamsk (1978) [1]. At the same time, with the solution of energy problems, were the foundations of nowadays problems of aquaculture, connected both with changes in the hydrological and hydrochemical characteristics of the reservoir, and with the problems of directed formation of ichthyocenosis and reproductive problems, primarily for sturgeons.

The catches in the largest reservoirs of the Volga cascade at the beginning of the 21st century are presented in the Table 1 from [3].

Table 1. Catches of fish in the largest reservoirs of the Volga cascade, thous. tons.

Reservoir	1995	2000	2001	2002	2003	2004	2005	2006	2007
Rybinsk	1.4	1.5	1.6	1.7	1.0	1.3	1.04	1.0	1.1
Kuibyshev	3.2	2.8	2.7	2.7	2.0	1.94	2.11	2.62	2.7
Saratov	0.8	0.5	0.7	0.8	0.6	0.67	0.6	0.69	0.7
Volgograd	1.0	1.0	1.3	1.3	1.5	1.69	1.72	2.17	2.05

The construction of reservoirs assumed their fishery use by methods of pasture aquaculture. Historically, the formation of ichthyocenoses was based on the fish resources of the Volga River. It was also planned to introduce valuable species of fish, the reproduction of which was to be handled by regional fish breeding and spawning-growing economies.

Results and discussion

The current state of pasture aquaculture at the hydropower object - the Kuibyshev Reservoir

When planning fish catches in the Kubyshevsky reservoir, the main attention was paid to bream, carp, pike perch, pike and sturgeon fishes (Table 2) [4].

Table 2. Catches (%) in the Kuibyshev Reservoir.

Species	In 1950 it was planned	2014	Quotas for the catch in 2017,	
			tons	%
bream	35	23.7	785.6	22.85
carp	15	1.2	29.2	0.84
pike perch	10	5.4	224	6.52
pike	8	0.1	19.2	0.56
sturgeons	2	0.02	5.9	0.17
other	30	69.58	2374.2	69.06
Catch	*20-24 thous. t.*	*4196.8 t.*	*3438.1 t.*	*100*

Other species had to provide 30% of catches. The current state of catches in comparison with the planned indicators is presented in the Table 3. Data on catches indicate an increase in the proportion of low-value fish in the recent period. If in 2010 low-value species accounted for 53.4% in catches, in 2014 for 64.8%. Analyzing the planned indicators for catches in the Kuibyshev reservoir, it can be noted that the planned harvest of sterlet was 480 tons. Actual catches of sterlet in the beginning of the XXI century varied about 0.850 tons.

Table 3. Catches (%) of valuable and low-value fish species in the Kuibyshev Reservoir.

Species	2010	2014	Quotas 2017	Species (lat.)	2010	2014	Quotas 2017
	% in catches				% in catches		
Valuable species				***Low-value species***			
sterlet	0.04	0.02	0.17	Blicca bjoerkna	16.7	17.2	22.31
carp	1.59	1.23	0.84	Ballerus ballerus	11.3	14.4	16.99
catfish	0.57	0.19	0.26	Rutilus	9.1	12.0	7.50
pike perch	5.82	5.38	6.52	Pelecus cultratus	4.8	5.1	3.40

Ending of table 3

pike	0.80	0.11	0.56	Sander volgensis	2,9	3.1	3.32
burbot	0.24	0.31	0.46	Perca fluviatilis	2.5	5.1	4.13
bream	31.06	23.7	22.85	Carassius	3.0	4.5	2.33
silver carp	0.08	0.07	0.06	Abramis alburnus	3.1	3.4	5.09
				Clupeonella		2.93	1.54
				Aspius aspius		0.60	0.73
				Leuciscus idus		0.36	0.47
				Cyprinidae		0.45	0.47

The tendency of decline in the number of valuable fish species in the Kuibyshev reservoir was clearly revealed by the 2000s [2, 4] (Table 3). In the catches it was noted not only an extremely small number of sterlets (Table 4), but also pike, catfish and others (Table 3), at the same time the number of low-value and weedy species of fish has grown.

Table 4. The fishing stocks and the total allowable catches (TAC) of sterlet in the Kuibyshev reservoir [5].

Species	Catch, t 2014	Fishing stock, t						TAC, t 2016
		Years						
		2009	2010	2011	2012	2013	2014	
Sterlet	0.9	79	82	89	89	83	83	8
Total fish	1285.4	16016	16618	14459	16648	16671	15894	2623.0

As can be seen from the data given (Table 3, 4), in connection with the reduction of the stock of sterlet, it is necessary to carry out works to reproduce it and obtain juveniles for release into the reservoir.

Sterlet - as an important object of reproduction for pasture aquaculture on the Kuibyshev reservoir.

Special place belongs to sterlet in the composition of the fish population of the Volga and Kama rivers and, respectively, of the Kuibyshev and Nizhnekamsk reservoirs. It is the most valuable species in the ichthyofauna of the region. Prefers areas with a rapid current, does not make large migrations, benthophagus. Sterlet spawns at the end of May - early June on sites with a rapid current.

Works on the study of sterlet in the Middle Volga region were carried out as far back as 1913-1916 [6, 7]. Caviar was taken from mature fluid females, it was incubated in apparatuses at the demonstration plant at the Kazan City Museum. The yield of artificially produced fry was 66.9%. Thus, at the beginning of the 20th century, the basis for the artificial reproduction of sterlet was created for the first time in Russia in the territory of modern Tatarstan.

Since sterlet is included in the Red Book of the Republic of Tatarstan, and the characteristics of the producers of this fish in recent years are close to those of the previous period (Table 5), there are objective prerequisites for the organization of work on its reproduction. For the organization of release of juvenile sterlet, it is necessary to estimate the total amount of need for juvenile sterlet in the Kuibyshev Reservoir

Table 5. Average sizes (cm) of mature sterlet.

Gender	Volga river [8]	Kuibyshev Reservoir				
		[9]		[5]		
		1966-1969	1973-1974	1990-1993	1998-2009	2010
Females	47.6	47.4	52.4	47.2	47.1	47.4
Males	42.4	42.1	47.6	43.9	44.8	44.9

Coefficients of replenishment of the fishing stock (commercial return) from caviar, larvae, young sterlet in the reservoirs of the Volga cascade are given in Table 6 [10].

Table 6. Coefficients of replenishment of the fishing stock (commercial return) of sterlet for the reservoirs of the Volga cascade [10].

Index	Juveniles sterlets with weight (g)							
	1.5	3.0	5.0	10.0	11-20	21-30	31-40	41-50
Coefficient of commercial return	3.0	5.5	5.9	6.7	7.5	9.1	10.7	12.8

Currently, the harvest of sterlet in the Kuibyshev reservoir is prohibited.

With the organization of juvenile releases, the restoration of the number of sterlet to a scale permitting the organization of the fishery, its probable fishing length will be 42 cm with an absolute length of 48 cm. It should be noted that in studies before the regulation of Volga river [8] mature sterlet was encountered with an absolute body length of more than 33 cm. The majority of mature individuals were characterized by an absolute length of 42-53 cm. The size composition of the sterlet nowadays presented in Table 7.

Table 7. The size composition of sterlet in scientific research catches in the Kuibyshev reservoir [5], %.

Catch year	Size of fish, sm													N, ex.	Average length, sm
	15 – 20 – 25 – 30 – 35 – 40 – 45 –50 –55 – 60 – 65–70 - 75 - 80														
2009	1.1	16.9	21.4	19.4	22.7	12.7	2.8	1.5	1.0	0.2	0.1	0.1	0.1	320	36.6
2010	1.2	16.0	20.7	19.3	22.1	12.3	3.5	2.6	1.2	0.3	0.2	0.1	0.1	210	36.9
2011	1.6	16.4	20.9	19.9	21.8	12.6	3.7	2.6	1.1	0.2	0.2	0.1	0.1	225	37.3
2012	2.0	16.0	21.6	19.2	22.4	12.0	3.3	1.5	1.0	0.5	0.3	0.1	0.1	310	37.5
2013	1.9	16.1	20.8	19.6	22.1	12.5	3.1	1.8	1.2	0.4	0.3	0.1	0.1	240	37.4
2014	1.6	16.3	20.6	21.7	19.4	12.5	3.4	2.7	1.2	0.1	0.3	0.1	0.1	220	37.2

The conducted studies of the size and age composition of sterlet have revealed that sterlet has a length of more than 48 cm at the age of over 9 years. These are mature individuals. In the catches they make up 5.8 - 8.0%.

Taking into account that the actual fish catches in the Kuibyshev reservoir in the last period did not exceed 4 thousand tons with the ratio in the sterlet catch of 2%, the desired catch could be 80 tons. Taking into account that the actual fish catches in the Kuibyshev reservoir in the last period did not exceed 4 thousand tons with the ratio in the sterlet catch of 2%, the desired catch could be 80 tons.

Fishery calculations show that it is necessary to provide 72 tons of commercial sterlet by the means of artificial reproduction. With an average weight of 0.5 kg, its number is 144 thousand exemplars. Taking into account the annual natural mortality calculated according to P.V. Turin [11] and the coefficient of fishing return of 5.5% (Table 6), it will be necessary to issue 8587.3 thousand units. Thus, the annual requirement for the production of sterlet juveniles with a weight of 3 g in an amount of 8.6 million exemplars can provide for the catch of a commercial sterlet about 80 tons in 10 years. Release of sterlet can be conducted not only in the vicinity of potential spawning grounds, but also in the feeding areas. Taking into account the possibilities of long-term development of the Kuibyshev reservoir with the directed formation of ichthyofauna and planning of sterlet catches in the volume of 480 tons, annual releases of juveniles with a mass of 3 g in the amount of 57 million exemplars.

Conclusions

The development of hydropower and the creation of reservoirs of the Volga cascade had an impact on the state of populations of sturgeon species of fish, while creating incentives for improving the biotechnology of their reproduction and cultivation. This period is characterized by the desire and technical and technological capabilities to restore the number of sterlet in the Kuibyshev reservoir. The annual need for the release of sterlet juveniles with a weight of 3 g in the amount of 8.6 million exemplars can provide catch of the commodity sterlet about 80 tons in 10 years. Выпуски стерляди могут проводиться не только в районе потенциальных нерестилищ, но и в местах нагула рыб. Taking into account the possibilities of long-term development of the Kuibyshev reservoir with the directed formation of ichthyofauna and planning of sterlet catches in the volume of 480 tons, annual releases of juveniles with a mass of 3 g in the amount of 57 million pieces are required. The analysis shows the need to organize significant production of sterlet juveniles for stocking the Kuibyshev Reservoir.

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