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Influence of Acclimation to the Cold Water on Growth Rate of Russian Sturgeon Juveniles (*Acipenser gueldenstaedtii*, Brandt & Ratzenburg, 1833)

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Abstract

In this study, sturgeon juveniles (*Acipenser gueldenstaedtii*) were reared in open heated water at 18-22 ºC in hatchery conditions. Before they were transported to the Sakarya River, they had been acclimated directly and gradually from the heated water to the cold water (in 12.8ºC) tanks. During this study, condition factor, specific growth rate, feeding behaviour and mortality of sturgeon juveniles were investigated

At the end of the study, live weight gains of sturgeon juveniles increased, but condition factor was decreased. No mortalities were recorded at two experimental groups.

After the adaptation period of the experiment, in order to restore for sturgeon juveniles populations on the Black Sea coast of Turkey, sturgeon juveniles were released safely into the Sakarya River in 27 March 2001. This species could be good candidate for aquaculture in brackish waters owing to the recent success in artificial reproduction.

Key Words: Russian sturgeon, *Acipenser gueldenstaedtii*, acclimation, restocking

Introduction

In 1996, Russian sturgeon was classified as endangered species in Appendix II of the Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) together with Acipenseriformes. The CITES database lists the current distribution of *A. gueldenstaedtii* as: Azerbaijan, Bulgaria, Georgia, Iran, Kazakhstan, Romania, Russian Federation, Turkey, Turkmenistan, Ukraine (Anon., 2000).

Russian sturgeon is found in the rivers running to the Azov Sea (Don, Kuban), the Black Sea (Danube, Dniepr, Bug, Dniestr, Rioni, Ingura, Sakarya, Kızılırmak, Yeşilırmak, Çoruh) and the Caspian Sea (Volga, Ural, Kura, Terek, Sulak) (Artyukhin and Zarkua, 1986; Çelikkale, 1988; Geldiay and Balık, 1988; Edwards and Dorosov, 1989; Hensel and Holcik, 1997; Öztürk, 1998).

Stocks of sturgeons are dramatically decreasing, particularly in Eurasia; the world sturgeon catch was nearly 28,000 tons in 1982 and less than 2,000 tons by 1999. This decline resulted from overfishing and environmental degradation such as; accumulation of pollutants in sediments, damming of rivers, and restricting water flows, which become unfavourable to migration and reproduction. Several protective measures have been instituted for example, fishing regulation, habitat restoration, juvenile stocking, and the CITES listing of all sturgeon products including caviar. Hopefully, this artificial production will contribute to a reduction of fishing pressure and lead to the rehabilitation of wild stocks (Billard and Lecointre, 2001).

In general, little is known about the mechanisms of osmatic hemoostasis in sturgeons. Some Russian species seem to have a narrow range of euryhalinity (Natochin *et al*., 1985; Shelukin *et al*., 1990). Unfortunately, information concerning the biology of this species in the Black seaside of Turkey are scarce.

The objective of this study was to: (1) Sturgeon juveniles (approximately 4-5 g and age of 2.5 months) which were pre-adapted and non-adapted had been examined in the cold water, before they were transferred to the Sakarya River and (2) mortality, condition factor and live weight gain of fish were investigated after the experimental period.

Materials and Methods

Fertilized eggs of sturgeon (*A. gueldenstaedtii)* were brought from Russian Federation, Krasnodar Research Institute of Fisheries, on 12. 01. 2001. Hatching started on 13.01.2001. Eggs were hatched out and free embryos, larvae and 0+ juveniles were reared under heated water (t= 18-22ºC, O_2 = 8.0 mg/l) in the Istanbul University Fisheries Faculty, Sapanca Inland Fish Research and Applied Station. Sturgeon juveniles were acclimated gradually and directly from heated water to cold water. The temperature of Sakarya River in releasing time of juvenile sturgeons was about 13ºC. Experimental temperature of cold water (12.8ºC) was chosen because of natural conditions of the river in March. And then, the fish were individually weighted and measured before being placed in the cold water. Initial average body weight of sturgeon was 4.77±0.55 g (mean ± SD). First group (two replicate, 30 sturgeons/tanks) was transferred directly (non-adaptation) from the rearing rectangle fiber-tanks to the experimental tanks (0.6x2.9x0.4 m). The second group was put in the plastic bags which has 18-22ºC rearing temperature. When the water temperature in plastic bags and the water temperature in experimental tanks were equaled, pre-adaptation time lasted for 40 minutes. After this, sturgeon juveniles were released from the plastic bags into the experimental tank.

Fish were maintained at 12.8ºC and 9.89 mg/l dissolved oxygen and in daylight photoperiod. Feeding was done once a day with 1.2 mm size commercial granular trout feed (BioAqua, Turkey). The proximate composition of the diet was 8.21% moisture, 46.86% crude protein, 11.30% crude lipid, 1.57% crude fiber, and 10.01% ash.

The experiment was carried out from 5 March to 19 March 2001 for two weeks. Mortality was recorded daily. The condition factor was calculated by using Fulton's factor of condition, Weight (in gram)x10^5 / Total Length^3 (in mm) (Prokes *et al*., 1997). According to Dabrowski *et al*. (1985) specific growth rates were calculated by using the following formula; SGR (%day^{-1}) = 100 (ln W_t – ln W_0) / t. Where the SGR is specific growth rate, W_t and W_0 represent final and initial mean body weights and (t) the growing periods in days.

Data are reported as mean ± standard deviation. The level of significance was present at $P<0.05$. Differences in groups were compared statistically by means of ANOVA and Students t-test (Zar, 1974).

Results

Sturgeon juveniles were held at 12.8 ºC temperature in a adaptation tanks before releasing them to the Sakarya River. Table 1 was given both groups initial and final weight, length and condition factor during the adaptation period.

The mean condition factor decreased slowly during the experiment and was no significant differences between the groups ($P>0.05$).

At the end of the trial, specific growth rate was found the same as in-group A (pre-adaptation) and in-group B (non-adaptation) (Table 1). And also the trial showed us the same result in terms of rational live weight gain (64%).

Fish mortality was not occurred between the groups during the cold-water adaptation period (Table 1). It observed that with the decreased water temperature, food intake and movement of fish also decreased.

In Table 2, it was given the physico - chemical parameters of water that is the point released them into the Sakarya River. This area is approximately 5

Table 1. Initial and final growth parameters and mortality of the experimental groups (n=30).

	Group A (Pre-adaptation)	Group B (Non-adaptation)
Initial of Trial		
Weight (g)	4.77±0.55	4.95±0.55
Length (cm)	9.37±0.45	9.93±0.36
Condition Factor(K)	0.58±0.05	0.50±0.05
Final of Trial		
Weight (g)	7.84±0.50	8.12±0.63
Length (cm)	11.3±0.61	12.07±0.81
Condition Factor(K)	0.54±0.06	0.47±0.06
Specific Growth Rate(SGR)	3.31	3.30
Live Weight Gain (g)	3.07	3.17
Rational Live Weight Gain	64.4	64.0
Mortality(%)	-	-

Table 2. Physico -chemical parameters of water where they were released into the Sakarya River.

Parameters	Releasing Point	River Mouth
Temperature	13.9ºC	13.6ºC
D.O.	10.1 mg/L	10.8 mg/L
pH	7.5	7.5
Suspandid Solid	300 mg/l	300 mg/l
PO_4-P	2.92 µg/L	3.09 µg/L
NO_2-N	1.48 µg/L	1.42 µg/L
SO_4^{-2}	83.18 mg/L	87.26 mg/L
Total Hardness	7.12 µEg/L	7 µEg/L
Chl.a	0.011 µg/L	0.011µg/L

km inland side from the Sakarya River estuary. Temperature, dissolved oxygen and pH in the river were found approximately equal to the hatchery conditions.

Discussion

Due to the water pollution of the river, reservoir building on the spawning grounds became inaccessible for migrating of sturgeon. Russian sturgeon *A. gueldenstaedtii* is extremely rare and was included in the Black Sea Red Data Book in 1999. Öztürk (1998) reported that sturgeon species decreased in the Turkish Black Sea coast (Sakarya, Kızılırmak and Yeşilırmak Rivers). Total catching from the Sakarya River fell from 16 tons in 1980 to 3 tons in 1996.

The Sakarya river and its delta are the most important areas in terms of sturgeons spawning migration. The temperature regime of Sakarya River changes from 7 to 22ºC during the seasonal aspects. The natural reproduction of Russian sturgeon decreased in the Sakarya River after the dam construction, water pollution and uncontrolled over fishing. Increasing loads of communal wastes and effluents from primary and secondary industries are negative effects on the river ecosystems. From time to time, the discharge of toxic chemicals from plants caused death of fish species in the Sakarya River and negatively impacted sturgeon feeding in the Black Sea.

Presently, 29 to 32 million juvenile (1-3 g) are released in the Sea of Azov (Chebanov and Savelyeva, 1999) and 67 million in the Caspian Sea including 10 million from Iran (Ivanov *et al*., 1999). Kokoza (1999) stated that 9 hatcheries are still operating on the Volga, releasing 55-60 million juveniles of *Huso huso, A. gueldenstaedtii* and *A. stellatus*. Changes in release technologies have also occurred. In 1992, only 15% of juveniles were transported and released directly onto their feeding grounds in the Caspian Sea compared to 40-50% at the end of the 1970s (Levin, 1995). Now changes in stocking practice are under way. Rearing time in ponds is limited to 15 days, when the fry have consumed most of the available live food and are released into lagoons, with a gradient of salinity (0 to 5‰), and enough benthic and planktonic food supplies. Juveniles are placed in large enclosures (200 m^3) for about one day to adapt to new environment (after release the young fish stay immobile for a few hours and are very vulnerable to predators). Other parameters, such as climatic and hydrological conditions, are also taken into account when stocking (Chebanov, 1998).

The result of the cold-water adaptation experiment showed that the condition factor of pre-adaptation and non-adaptation of sturgeon juveniles decreased although there was not mortality. This study revealed that Russian sturgeon juveniles were very tolerant against to cold water. It is observed that food intake decreased with the cold water temperature. Also, movements of fish were slow down.

The South of Black Sea coast is the habitat of *A. gueldenstaedtii* can be found in both rivers and the sea. After the spawning, sturgeon juveniles migrate to the Black Sea in July when they have to be 6-10 cm length and in 2-6 g weight (Slastenenko, 1955). *A. sturio* downstream migration of juveniles begins in July, at an age of not less than 60-75 days. After reaching to the river mouth their length and weight varies between 5-6 cm and 5-5.9 g, respectively (Dobrovici and Holcik, 2000).

In this study, sturgeon juveniles (approximately 4-5 g and age of 2.5 months) were released safely to the Sakarya River in March after the adaptation period.

Due to the decrease in the sturgeon stocks in The Black seaside of Turkey, the sturgeon catch is restricted since 1971. This restriction was intended to prevent the decrease in stocks in order to avoid that fish are being caught generally during their migration, the restriction of the catch continued. In some year's only *Huso huso* bigger than 140 cm were caught. The purpose of this restriction was to increase the stocks. But, this long-term restriction did not help to recover the sturgeon stocks. The increase in stocks was not as expected. And during this period artificial production has not been realized. In order to enhancement of natural sturgeon stocks we are focus on sturgeon subjects in Turkey for last a few years. Artificial reproduction of Russian sturgeon, protection in the sea during fattening and in the river during spawning migrations is probably the only way to ensure a rapid, significant increase in sturgeon stocks. In order to preserve sturgeon stocks, it will be necessary to coordinate efforts of all countries surrounding the Black Sea to achieve an international control of illegal fishery and produce juveniles annually from hatcheries. Thus, it is going to be considerable changes in the distribution of the sturgeon on the Black Sea costal area in Turkey.

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