

Activities for the restoration of the beluga population *Huso huso* (Linnaeus 1758) in the Azov Sea basin in 2020-2023

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Abstract. For a long period, the Azov Sea was the second largest reservoir in the world after the Caspian Sea in terms of sturgeon fish reserves and catches. However, it has now lost its status as one of the most productive water bodies. Anthropogenic transformation of the natural hydrological regime of the main sturgeon spawning water bodies in the Azov basin (a dam on the Don River was built in 1952 and on the Kuban River in 1973) led to the almost complete loss of natural spawning. As a result, the number of sturgeons in the Azov Sea has decreased to critically low levels, leading to a fishing ban since 2000. The fishing of beluga *Huso huso* (Linnaeus 1758) (*Acipenser* Bonaparte 1831) in the Azov Sea was banned even earlier – in 1985. In 2001, the Don Sturgeon Hatchery was commissioned in the Azov Sea basin, with the main task of artificially reproducing sturgeon and releasing them into the Don River. The purpose of this work was to analyze the activities for the restoration of the beluga population in the Azov Sea during the period from 2020 to 2023. Over the course of 2020-2023, a total of 994,107 million juvenile beluga of factory origin were released into the Azov Sea basin.

1 Introduction

Sturgeons are fish of the Northern Hemisphere, whose evolutionary history spans more than 100 million years. This group of fish includes 28 species [1] (Mahmoud, Kazemi, Donskaya, 2001) For a long period, the Azov Sea was the second-largest reservoir in the world after the Caspian Sea in terms of sturgeon fish reserves and catches [2,3] (Boldyrev, 2017). The fishery was based on three species: stellate sturgeon *Acipenser stellatus* Pallas, Russian sturgeon *A. gueldenstaedtii* Brandt et Ratzeburg, and beluga *Huso huso* (Linnaeus 1758) [4] (Rekov & Chepurnaya, 2018), in addition to two other species that were

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occasionally encountered: the relatively rare ship sturgeon *A. nudiventris* Lovetsky 1828 and sterlet *A. ruthenus* Linnaeus 1758. [3]

The anthropogenic transformation of the natural hydrological regime of the main sturgeon spawning water bodies in the Azov basin (a dam on the Don River was built in 1952 and on the Kuban River in 1973) led to the almost complete loss of natural spawning. [5] For example, naturally occurring Russian sturgeon larvae were last recorded in 1994. Additionally, excessive fishing (so-called "illegal, unregulated, and unreported") has significantly contributed to the depletion of the sturgeon population. [6,7] (Falahatkar, Poursaeid, Shakoorian, Barton, 2009)

Sturgeon stock in the Azov and Black Seas decreased in 1990-s mostly due to illegal catch. (pic. 1.) In the period of 2010-2023 fishing control became stricter and this reduced the stress placed on aquatic bioresources. Meanwhile the Don Sturgeon Hatchery gained momentum for reintroduction of sturgeons. Due to this, there is now a diverse range of age groups in the sturgeon population. The control catch is dominated by sturgeons that are 5 years old (up to 81 %), but there are also reports of 10-year-old sturgeons.

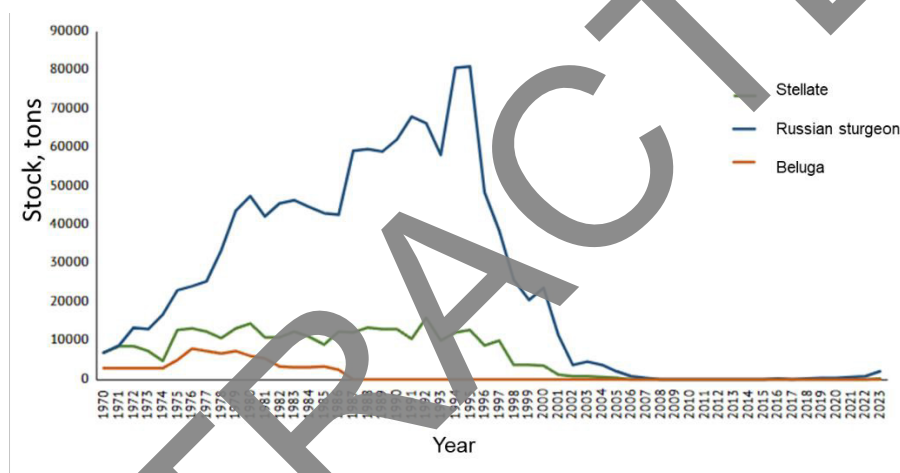


Fig. 1. Sturgeon stock in the Azov Sea basin [5]

The stock levels of 1970 can be achieved with full control of the Sea of Azov and releasing of young sturgeon from the hatchery. (pic 2) The problem of sturgeon reproduction has a significant role of age diversity inside a population. With almost full decrease of beluga that sexually matures from 8 to 16 years there is very important to have accurate and non-invasive methods for sexual structure monitoring. Reintroduction activities should be corrected using this information. [8, 9, 10].

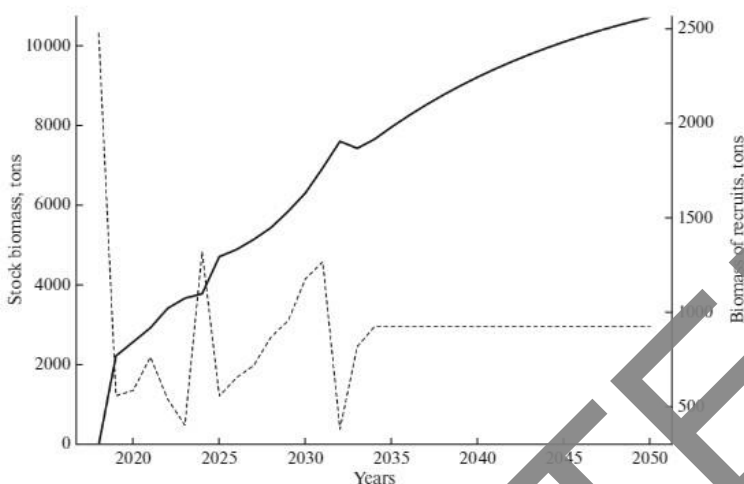


Fig. 2. Outcomes of prognostic dynamic model for stock biomass (—) and recruitment biomass (- -) of Russian sturgeon *Acipenser gueldenstaedtii* in the Sea of Azov according to the baseline scenario, 2018—2050 [8]

The system of sturgeon hatching on the Don Sturgeon Hatchery is classical and it's standardized. (Fig. 3) [11]

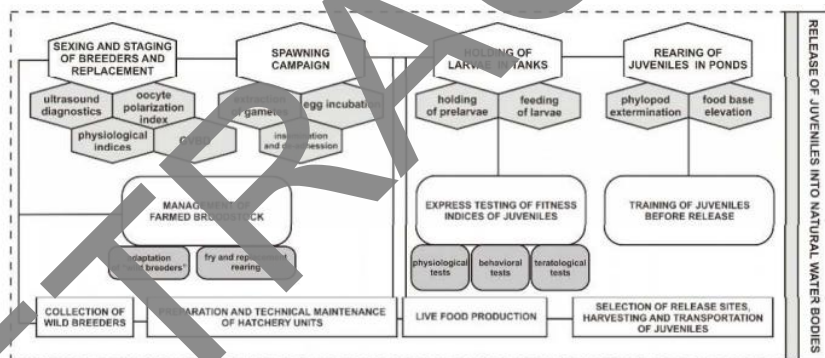


Fig.3. Sturgeon hatching scheme [11]

As a result of the above, the number of sturgeons in the Azov Sea decreased to critically low levels, leading to a fishing ban since 2000. [4] The most acute problems of stock restoration are expressed concerning beluga, whose fishing in the Azov Sea was banned even earlier (since 1985), and the species is currently listed in the Red Book of the Russian Federation. [12] It is difficult to assess the current stock of beluga due to the critically low number of individuals in the population, which have ceased to appear in accounting catches (Table 1). The last quantitative assessment of the beluga population in the Azov Sea was carried out in 1987, when it was estimated at 198 thousand individuals. [5]

Table 1 – Population and biomass of *Huso huso* (Linnaeus, 1758) in Azov Sea in period 1970-2014. [5]

Period	Population, million	Biomass, thousand tons
1970-1980	0,2	1,4
1981-1990	0,2	2,0
1991-2014	0	0

Great sturgeon *Huso huso* (Linnaeus, 1758) is a representative of the family Acipenseridae Bonaparte, 1831. The beluga is a migratory species, the adult stage of life is spent in the sea, the juvenile stage - in fresh water in rivers. [11] (Bani, A., Tabarsa, M., Falahatfar, B., & Banan, A. (2009) Puberty comes in 12-14 years for males and in 16-18 for females and fertility is on level of 0,2-1,6 million eggs. Mature fishes are obligate predators. The habitat includes Adriatic, Black, Azov and Caspian seas. [14]. At the moment great sturgeon is in NE status in Adriatic Sea [15] (Antognazza et al. 2021). Some specialists consider that in Azov Sea the only way to restore great sturgeon is reintroduction from other basins. [4, 16]

2 Materials and Methods

In the Azov Sea basin, work on artificial reproduction and release of sturgeon species into the Don River began in 1958 (in connection with the construction of the Tsimlyansk reservoir in 1952), and starting in 1963, on the Kuban River (related to the creation of the Krasnodar reservoir). Artificial reproduction became the main source for sturgeon fish recruitment, completely compensating for the natural decline, and supporting the sturgeon fishery in the Azov Sea until the 1980s. The beluga *Huso huso*, despite the decline in its population, continued to be used for artificial reproduction in hatcheries. The collection of beluga spawners was carried out during the fishery for catching juveniles of the stellate sturgeon *Acipenser stellatus* and Russian sturgeon *A. gueldenstaedtii* using fish-traps, seine nets, and drift nets in the Don River, Sea of Azov, and Taganrog Bay. However, due to the critically low number of beluga in the Azov Sea, from 2000-2020, artificial reproduction was stopped due to the lack of spawners.

In 2001, the Don Sturgeon Hatchery was commissioned in the Azov Sea basin, with the main task of artificially reproducing sturgeon and releasing them into the Don River. In 2020, a program to restore the beluga population in the Azov Sea was resumed. The basis for this was the import of fry of the Volga beluga, genetically close to the Azov population, from the Caspian Sea basin. The fry were kept in the Don Sturgeon Hatchery, where they were grown to the stage of juveniles, and later released into the Don River. Over the period from 2020 to 2023, a total of 994.107 million juvenile beluga of factory origin were released into the Azov Sea basin (Table 2).

3 Results

The dynamics of beluga release into the Azov Sea basin from 1958 to 2023 is presented in Table 2. A significant decrease in the number of released juveniles in 2001 is associated with

a general crisis in the sturgeon industry, the cessation of the use of wild sturgeon spawners, and the beginning of the restructuring of the sturgeon hatcheries, as well as the implementation of stricter requirements for product quality. The resumption of the beluga release program from 2020-2023 has resulted in the release of almost one million juvenile beluga into the Don River annually. This large-scale release of juveniles should ensure the restoration of the beluga population in the Azov Sea. (pic.3, 4)

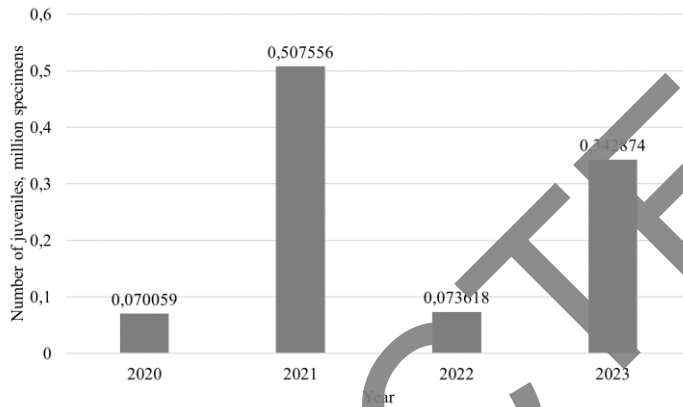


Fig. 3. Released great sturgeon *Huso huso* (Linnaeus, 1758) (yearlings) quantity in Asov Sea basin in 2020-2023, million



Fig. 4. Great sturgeon *Huso huso* (Linnaeus, 1758) yearling before release to the Don River from the Don Sturgeon Farm (photo by Alexey Malinovkin, June 2023)

All the released juvenile beluga are of artificial origin and were produced at the Don Sturgeon Hatchery from broodstock that were reared at the facility "from egg to egg."

In 2020, five female belugas participated in the breeding activities, but only two of them produced high-quality gametes. In 2021, 22 females matured, of which 11 produced eggs of

fish farming quality. In the 2022 spawning campaign, 32 mature female belugas were used. [17]

The low indicators of artificial reproduction of beluga juveniles in 2022, despite the large number of females used, were due to the presence of first-time spawning females in the broodstock, which produced eggs of low fish farming quality. As a result, there was a low fertilization rate, significant mortality of fertilized eggs during incubation, and various disturbances in embryonic development were observed. [17]

All the released juvenile belugas had an average body weight of over 3 grams, which is the minimum biological standard for releasing beluga into natural water bodies (Table 2).

Table 2. –The average weight of great sturgeon *Huso huso* (Linnaeus, 1758) yearlings released to Azov Sea basin in 2020*2023

Year	Weight, g
2020	4,26
2021	3,18
2022	6,75
2023	9,52

It is worth noting that the potential capacity of the Azov Sea allows for the release of significantly larger volumes of juvenile beluga. Based on the availability of food resources, the maximum permissible volume of beluga release into the Azov Sea basin has been determined to be 2.3 million individuals.

The ongoing activities are insufficient to create a perspective for the restoration of the beluga population in the Azov Sea. During monitoring of bycatch of sturgeon fish in the coastal part of the Azov Sea while fishing with stationary fishing gear (seine nets with a mesh size of 35 to 45 mm) in the autumn period, 15 beluga individuals were recorded, which accounted for 4% of the total number of analyzed sturgeon. [12]

Compared to the Black Sea beluga population, instances of its capture are more frequently recorded than those of the Azov population. It has been noted that along the Black Sea coast of Crimea, small immature beluga individuals are increasingly being registered, which is most likely a consequence of beluga reproduction in Romania and Bulgaria. [13, 18]

For example, in Romania, the release of juvenile beluga into the Danube River was over 12,500 individuals in 2006, 15,130 individuals in 2007, and 20,000 individuals in 2008. [13]. Moreover, between 2014 and 2017, ichthyological examinations analyzed 56 individuals that were confiscated from poachers in the Tarkhankut Peninsula area of the Republic of Crimea. A biological analysis revealed that the fish length ranged from 87.0 to 219.0 cm, and their weight from 2.3 to 69.0 kg. One beluga individual, seized in September 2017, had a body weight of over 200 kg. [18]

Thus, the ongoing activities related to the artificial reproduction of beluga *Huso huso* (Linnaeus, 1758) are an important link in the restoration of the entire ecosystem of the Azov Sea. Despite the fact that almost 1 million juvenile beluga with a body weight of over 3 g were released into the Azov Sea basin during the 2020-2023 period, there are still no prospects for the restoration of this valuable species' population. Additional research is required to improve biotechnology for reproduction, as there are still many unresolved issues in managing beluga broodstock, such as refining the timing of female and male maturation

under natural and controlled water temperatures, determining the sex of fish at an early age, obtaining physiologically viable offspring using optimal feed formulations, etc. [17]

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