Mon23-227

Reduction of environmental impact during dredging

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SUMMARY

As for the impact of dredging works in the mouth of Bystre on the sturgeon status in the Danube River, it is established that there is no significant threat of negative environmental consequences for the population of Danube sturgeon and its volume as a result of dredging works in the mouth of Bystre. Besides, there are possibilities to form a system of measures of risk insurance to prevent the consequences, which are unlikely. The analysis revealed that the main one is the development of sturgeon aquaculture. Higher volume of fish farming will solve a number of problems, the main of which is preservation of the sturgeon population while meeting consumers` demand for fish. It is important to develop the aquaculture, which is able to meet the demand for fish without a threat to the biodiversity of natural water bodies as a result of fishing. Thus, the proposed measures for the further development of sturgeon aquaculture in Ukraine with the participation of partner states, including Romania, will allow solving the problem of the Danube sturgeon extinction. Lager volumes of sturgeon production with the subsequent stocking in the Danube River by all interested countries will provide conditions not only for the preservation of population, but also for its growth.

Introduction

The conducted research is relevant due to the current situation (threat to the grain deal) as the possibilities of cargo transportation through the mouth of Bystre with simultaneous Sulina channel's loading become even more relevant for the food security in the world. Romanian ports (Constanța) and the Danube River (the mouth of Sulina) have been used for cargo shipping, since the war began, as the the Black Sea was blockaded by the Russian Federation.

Method

In the analysis, general-scientific methods (analysis and synthesis, induction and deduction) and special methods of phenomena and processes analysis (abstraction, econometric and econometric-mathematical modelling) have been used.

Results

In recent years, the access to the Black Sea through the Ukrainian part of the Danube river has gradually lost its importance. For a long time, the Romanian channels - Sulina and Chornovoda-Constanța - have been considered the only acceptable direct pass between the Danube and the Black Sea. Previously, Ukrainian ports of Ust-Dunaisk, Izmail, and Reni (transit Danube - Black sea transportation) handled annually more than 1 million tons of cargo to Mediterranean ports and back. Those positions have been gradually lost due to the depth`s decrease, since there were no dredging works for a long time.

Dredging works in the mouth of Bystre have certain environmental consequences. We consider there is an opportunity to minimize risks or to propose measures to offset possible negative environmental impacts.

Negative experience of the end of the 19th century regarding the consequences of the Sulina channel's deepening, cannot be compared with the consequences of dredging works in the mouth of Bystre. The mouth of Bystre is a natural estuary, while during the Sulina channel's construction, the channel was straightened, as well as part of it was built by land. Therefore, the anthropogenic environmental impact during the Sulina channel's construction was much stronger than in the case of dredging works in the mouth of Bystre.

That is why we have studied the possibilities to offset the dredging works` impact and status of the sturgeon populations in the Danube.

The status of sturgeon populations in the world and in Ukraine in particular is far from satisfactory, therefore measures to reduce losses of these fish species are being taken both at the international and local levels.

Today sturgeon are protected both at the international and national levels. Ukraine has prohibited the commercial fishing of sturgeon in the Azov-Black Sea basin and inland waters, as well as sale of wild sturgeon caviar since 2000.

Sturgeon fishing is allowed in extremely small quantities, exclusively for reproduction, with special permits of the Ministry of Natural Resources of Ukraine. Besides, in 1999, Ukraine joined the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Black caviar can be produced only from sturgeon grown at special fish farms through aquaculture; moreover, appropriate marking should also be provided. At the same time, consumers demand rocketed for the delicatecy of sturgeon meat and black caviar.

We have analysed the state of sturgeon aquaculture development in Ukraine. Total catch analysis have been carried out, the results are shown in Figures. 1. Thus, as one can see, the enforcement of a

moratorium on commercial sturgeon fishing in the Azov-Black Sea basin and inland waters in 2000 significantly decreased volumes of fishing.

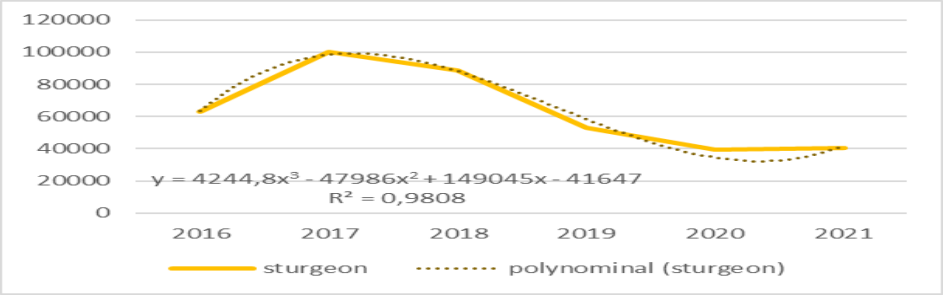

Figure 1 *Dynamics of catching of sturgeon species during 2016 – 2021st (by area)*

As it has been mentioned, the development of aquaculture, namely not only fishing, but fish farming as well, including the subsequent stocking of reservoirs, is important for sturgeons` preservation. Fig. 2, 3 were built according to the fishes production data. According to the data, during 2016 — 2017 the area of sturgeon fish production rose; since 2017, annual fall of production has been revealed; only during 2020 - 2021 it stabilized, but had low rates. The trend line analysis showed that during 2016 — the middle of 2018 the line matched the level of areas, however starting from the middle of 2018, production areas sharply dropped; only during 2020 - 2021 the rates balanced.

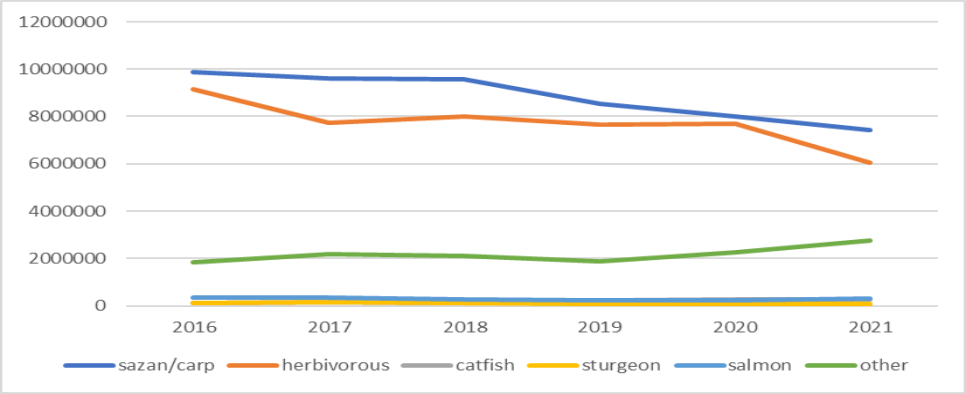

Figure 2 *Dynamics of aquaculture cultivation of such species of fish as sazan/carp, herbivores, catfish, sturgeon, salmon and others during 2016 - 2021 (by area)*

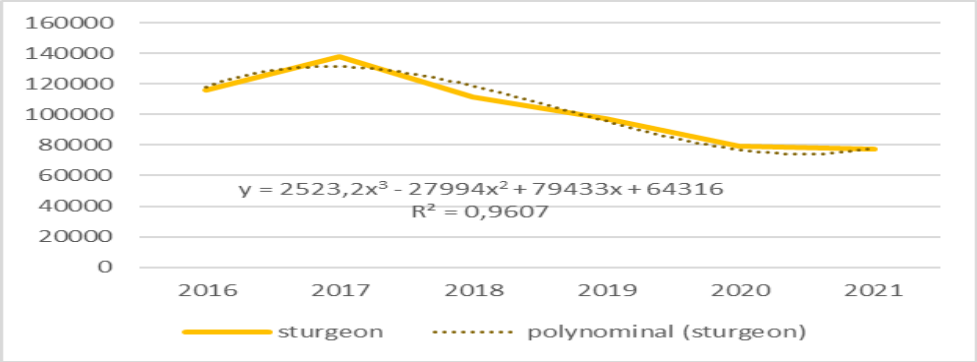

Figure 3 *Dynamics of aquaculture cultivation of sturgeon species during 2016 – 2021st (by area)*

In order to understand better fish farming and fishing analysis, one should compare these rates. To do this, corresponding charts (Figure 4) were made. Sturgeon and salmon are caught much less than other fish species in Ukraine.

The conducted comparison indicates the absence of threat trends, since the dynamics of fish production and fishing are completely identical. Besides, the volume of catch is smaller than the volume of production. This gives grounds for modelling promising rates of fish production, which will allow to simultaneously increase production possibilities (if necessary) and fishing (Figure 5).

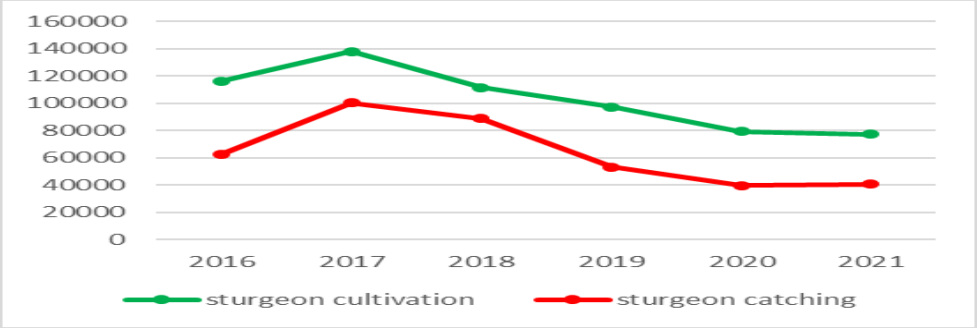

Figure 4 *Comparison of cultivation and catching of sturgeon species during 2016 – 2021st (by area)*

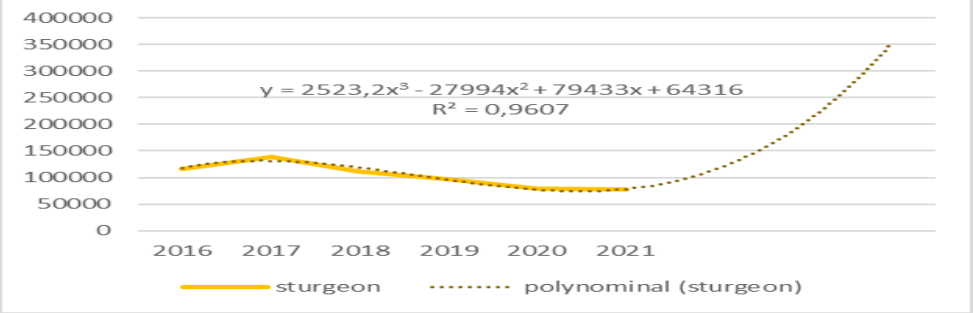

Figure 5 *Forecast of sturgeon cultivation (by area)*

Sturgeon fish production at the commercial rate makes it possible to obtain black caviar of the same quality as from wild sturgeon. Fresh fish could become an additional marketable product, as it is obtained in the process of brood stock raising by dividing it into males and females, as well as culling those growing slow. In fact, as of 2021, sturgeon production decreased compared to 2016. Therefore, it is possible to increase sturgeon farming by larger area of production. When modelling, we have used a polynomial trend line with initial conditions of a gradual increase in sturgeon farming areas - three times the level of 2016. Natural sturgeon reserves are small due to water pollution and overfishing. Therefore, the cultivation of sturgeon aquaculture can change the situation, but it is possible only by balancing production and harvesting.

As for the impact of dredging works in the mouth of Bystre on the sturgeon status in the Danube River, it should be noted that there is no significant threat of negative environmental consequences for the population of Danube sturgeon and its volume as a result of dredging works in the mouth of Bystre. Besides, there are possibilities to form a system of measures of risk insurance to prevent the consequences, which are unlikely.

The analysis revealed that the main one is the development of sturgeon aquaculture. Higher volume of fish farming will solve a number of problems, the main of which is preservation of the sturgeon population while meeting consumers` demand for fish. Amid the growing demand for animal proteins, the aquaculture can meet the demand as it is a highly efficient food production system and has clear environmental advantages over other forms of animal food production. Moreover, consumers in the developed countries prefer aquaculture products, because they believe that they are of higher quality and more valuable thanks to ecological conditions of their cultivation unlike species caught in the polluted water bodies.

It is important to develop the aquaculture, which is able to meet the demand for fish without a threat to the biodiversity of natural water bodies as a result of fishing.

Ukraine has sufficient capacity to solve the task. Most sturgeon species are produced by fish farms located in Zaporizhzhia, Cherkasy, Odesa, Chernivtsi and Kyiv regions. The development of sturgeon farming in Ukraine in recent years is also associated with the development of recirculating aquaculture, and to a lesser extent with the development of cage fish farming.

The experience of the WWF-Ukraine project aimed at the sturgeon populations reproduction in Ukraine can be considered positive. In particular, according to the National Action Plan for Sturgeon Conservation in Ukraine in 2021 on the International Danube Day 10,000 specimens of freshwater sterlets were stocked in the Danube River. At the same time, the Danube stocking population was genetically confirmed and tagged for its further tracking.

The possibilities of the EU project LIFE Boat 4 Sturgeon running to 2030, will be used to solve the tasks. As part of the project, 10 partners from Austria, Romania, Bulgaria, Hungary, Slovakia, Slovenia and Ukraine will work together along the Danube river basin to stabilize Danube sturgeon populations - beluga, sevryuga, freshwater sterlet, Danube sturgeon and Russian sturgeon. The project aims to establish two living gene banks with mother stock in Austria and Hungary, genetic mating schemes, release of young of all 4 species juveniles and a standardized monitoring scheme, which will be accompanied by large-scale actions and cooperation with fish protection authorities, representatives of local authorities and fishermen at the Danube river .

There are also opportunities to attract European funds through the Interreg NEXT Black Sea Basin Programme focused on certain Black Sea countries, such as Bulgaria, Romania, Ukraine, Greece, Turkey and all territories of Moldova, Georgia and Armenia. Total financing is from 250 to 1,500 thousand euros, implementation terms from 18 to 30 months. The above-mentioned programme includes research of of coastal and marine areas` integrated management, use of innovative technologies for sustainable fishing and ecological aquaculture, etc. It will also be appropriate to use the recreational potential of the specified areas, as shown in the studies of the Theoretical Substantiation of Modeling of Recreational Systems (*Arhipova et al., 2022*) and Theoretical Substantiation of Modeling of Recreational Systems (*Arhipova et al., 2022*).

We agree that there is a migration of sturgeon through the Chilia branch, but the aquaculture of sturgeon fish, namely their production and release in the Danube river, will prevent minimal threats.

Conclusions

Thus, the proposed measures for the further development of sturgeon aquaculture in Ukraine with the participation of partner states, including Romania, will allow solving the problem of the Danube sturgeon extinction. Lager volumes of sturgeon production with the subsequent stocking in the Danube River by all interested countries will provide conditions not only for the preservation of population, but also for its growth.

Acknowledgements

S. Shvydka was funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03- 03-V01- 00029

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