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PILOT VALIDATION SYSTEM OF BREEDING HABITATS OF STURGEON SPECIES

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Abstract

This research is a necessity given the importance of conserving and protecting aquatic ecosystems, as well as declining species, especially sturgeon species. Given that these species are considered vulnerable and critically endangered according to IUCN Red List rules and because there is currently insufficient data to prove their possible breeding habitats, the main purpose of this research on the invention is to obtain a data volume of the utmost importance with regard to the areas meeting the breeding criteria of these species. Thus, it describes a pilot installation for validating the breeding habitats of sturgeon species located on the Lower Danube. At the same time, this invention has the following aims: to identify and validate possible breeding habitats, to facilitate the collection of biological material in order to verify the risk of infection with AcIV-E or other viruses, and to validate the fact that sturgeons perform their reproductive cycle within their natural habitats.

***Keywords**: Sturgeon; Breeding; Habitats; Roe; Analysis*

Introduction

Sturgeons are species of fish dating back about 200 million years to the Early Cretaceous [1].They belong to the order Acipenseriformes and are grouped into 6 genera. These species are also considered to exhibit a pronounced characteristic of adaptability to different environmental conditions and various climatic changes [2, 3]. Natural stocks of sturgeons in the Black Sea and Danube are affected by the capture of a considerable number of individuals from the river. As fishing activities have intensified [4, 5], fish population, but especially sturgeon populations are in sharp decline, which has led to the need to address national and international legislative measures banning fishing of these threatened species. Despite these regulations, illegal fishing activities have continued, exacerbating the decline of sturgeon populations, making it necessary to implement restocking programmes with juvenile sturgeon from aquaculture systems. Also, restocking with juveniles from aquaculture is a conservation measure that has been quite widely used [6].

Sturgeons, although they have had the ability to adapt to climate change over hundreds of millions of years [7], in the last century have been facing a dramatic decline [8]. At present on the Lower Danube of the six native sturgeon species [6], only four of these sturgeon species could be identified still breeding on the river, namely beluga (*Huso huso*), sterlet (*Acipenser*

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ruthenus), stellate sturgeon (*Acipenser stellatus*) and Russian sturgeon (*Acipenser gueldenstaedtii*) [9]. Studies show that the decline of sturgeon populations in the Lower Danube River started as early as 1940, when there were no hydro-technical constructions, suggesting that other factors such as overfishing and/or poaching may have triggered the decline [10].

It is also important to note that the recovery of natural sturgeon stocks is a lengthy process, as these species have a long life span and reach sexual maturity after many years of existence. Also, these species after reaching sexual maturity, females do not spawn annually [11]. According to [8], sturgeons are sexually mature at different ages depending on the species and the characteristics and conditions of the habitats in which they live. These species have the ability to produce and spawn millions of eggs, which they spawn in a freshwater environment, generally in spring-summer, thus they increase the survival rate of the species [12, 13]. It has also been found that approximately 20% of a female's body mass is represented by roe [14].

The introduction of measures to protect breeding habitats is a globally accepted solution to improve conservation status. The Lower Danube is one of the few areas where sturgeons grow and breed naturally [15].

So far, the research activity carried out by the expert teams of the National Institute for Research and Development for Environmental Protection (INCDPM) Bucharest, Romania has consisted in tagging these species and actively monitoring them to determine their migration, feeding, hibernation and breeding behaviour, thus determining certain habitats on the Lower Danube River. Therefore, the aim of this pilot system is to validate the sturgeon breeding habitats identified during the monitoring activities, respectively in the literature, on the Lower Danube section, respectively to facilitate the collection of biological material (roe) in order to analyze it in specialized laboratories to determine the possibility of infection with the AcIV-E virus, respectively other viruses.

Experimental part

Materials

In the realization of the experimental pilot, a series of materials were used, which are presented in the constructive order, having in round brackets, the structural-functional milestones involved in its realization:

- external hard aluminum metal frame that supports the installation (1);
- folding plexiglass sides (2);
- flat plywood board covered with pexiglas (3), consisting of three structural components: the support layer, made of durable modeling material made of multilayer wood (3a), the drainage layer of hard aluminum metal mesh (3b) and the abrasive layer of felt grip (3c);
- circular holes or drainage holes (4);
- stainless steel hinges (5);
- hard aluminum floating clamps (6);
- hard aluminum anchor support (7);
- hard aluminum anchor legs (8);
- hard aluminum floats necessary to support and operate the component parts of the installation (9, 10 and 15);
- stainless steel connecting rods and polymer ropes (11, 12 and 14);
- hard aluminum anchor post (13).

The materials are annotated chronologically according to the graphical sketches in figures 1 and 2.

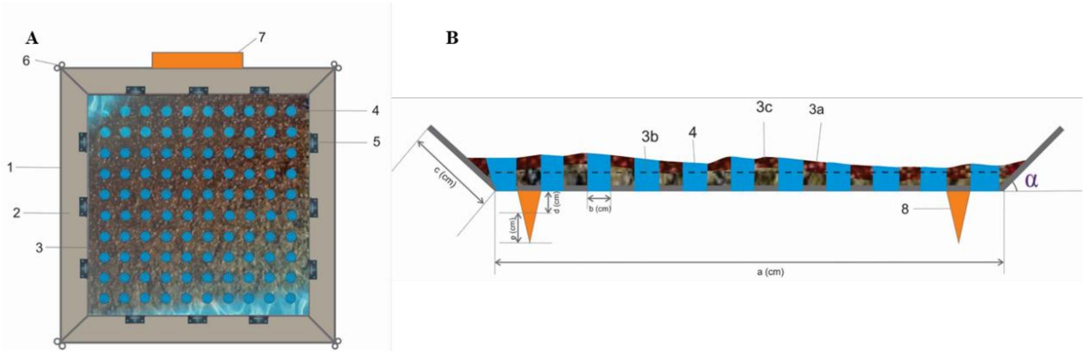

Fig. 1. The pilot system used by INCDPM researchers:
A. *Basic structure of the pilot system;*
B. *Construction elements of the pilot system - Cross section*

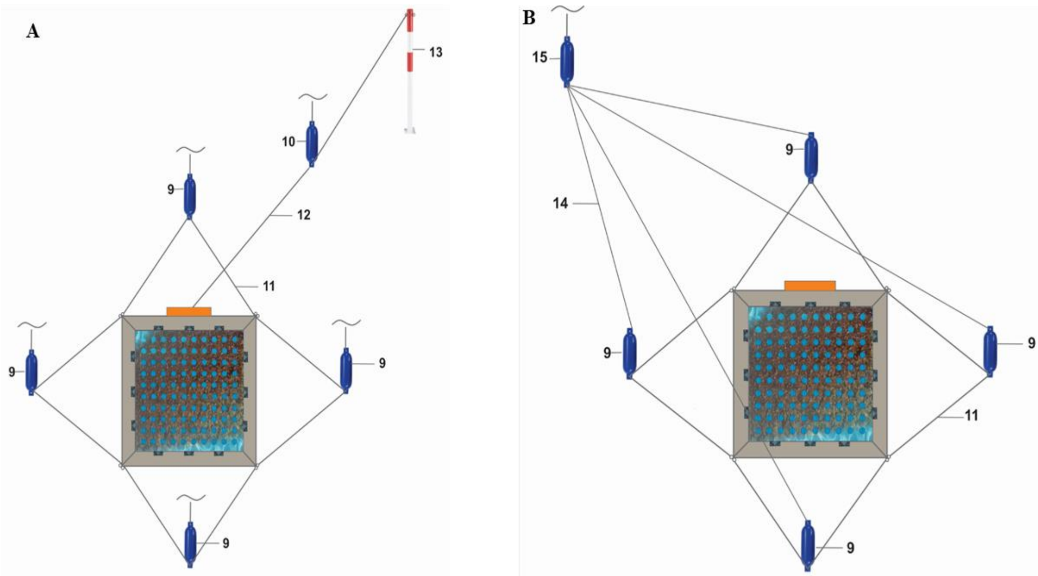

Fig. 2. Construction elements of the pilot system - *Ensuring control during use- (A;B)*

Methods

At the current level of research, the pilot system is in the final phase of ex-situ design and mathematical simulations, thus its design methodology, as well as the methodology for deployment and use *in situ*, will be detailed.

The installation shall be made of Plexiglas-type material and shall consist of a fixed flat plate (3) of length a = 2.1m and four hinged side parts (2) of length a = 2.1m and width c = 0.25m, embedded on the outside in a metal frame (1).

Three layers shall be superimposed on the fixed flat plate (3): the support layer (3a), necessary to simulate the natural substrate; the drainage layer (3b), to ensure the drainage of water during the handling of the installation in order to reduce the effect of hydrostatic pressure; and the abrasive layer (3c) necessary to maintain the biological material on the fixed plate.

After assembly, the system shall be provided with water drain holes (4) of diameter b = 10 (cm), arranged at equal distances from each other and obtained by uniformly cutting the three layers and the flat Plexiglas plate. The holes may be lined with felt-type material with mesh diameters calculated to allow water to drain without loss of biological material.

To ensure that the four sides are folded down, the installation shall be provided with hinges (5). The folding of the sides at an angle $\alpha = 45°$ shall be necessary to ensure that the collected biological material is retained when the installation is lifted.

Anchoring of the system in the area of use shall be by means of the anchoring bracket (7) and the four anchoring feet (8), one at each corner of the flat plate. The four anchoring feet have the double role of fixing the installation in the bed of the bed with d (cm) and of eliminating the suction effect by maintaining a distance of e (cm) between the bed of the bed and the base of the flat plate.

Using the Global Positioning System (GPS) and the information base obtained from previous bathymetric measurements, the appropriate location of the pilot system will be determined. The bathymetric measurements will be necessary to obtain a picture of the morphology of the area and to know in detail the hydrodynamics in the sector where the pilot system will be located.

Once the location area has been established, the pilot system will be transported by boat and launched into the aquatic environment by means of the chocks (11), fixed at one end to the clamps (6). Once the system has been secured to the bed of the water, the other ends of the buoys (11) will be attached to the support floats (9), which will help to identify the position of the installation throughout the period of use. Given the difficult hydrological conditions of the Danube (high water flows and velocities, weather conditions leading to frequent level fluctuations), for additional securing of the system, the anchoring support (7) will be tied to the bank anchoring post (13) by means of the shackle (12).

After the time needed for spawning, known from previous research carried out by INCDPM Bucharest, the pilot system will be extracted from the benthos to collect biological material. The recovery of the equipment will be carried out with the help of the boats by identifying the float (15) and handling the hulls (14), which will be operated by means of a pulley. When retrieving the system from the water, the drive speed will be controlled and maintained in the range 0.03 – 0.05cm/s to safely retrieve the collected samples.

Results and discussion

As previously mentioned, at the current stage of the research, the design concept of the pilot system was developed, and a patent based on it was registered at the State Office for Romanian Inventions [16].

Initially, a series of easily procured and processed materials were chosen, which allowed the realization of a reliable experimental pilot, easy to use in the *in situ* study of sturgeons in their habitat.

Involving this mobile constructive system, research will be continued in order to use it for the *in situ* study in order to determine and validate the breeding habitats of sturgeon species in the Lower Danube river. With the help of this installation, a series of important data on the ecology of sturgeons will be collected and, last but not least, collecting biological material for examination.

Conclusions

The National Institute for Research and Development for Environmental Protection (INCDPM), Bucharest, has a unique national and global database on ultrasonic telemetry monitoring, respectively through its own monitoring systems of sturgeon species, as well as essential data on their behaviour resulting from intensive monitoring on the Lower Danube River. Thus, through this research which resulted in the design and patenting of a breeding habitat validation system, it is intended to collect new data on breeding habitats, sturgeon breeding behaviour and to corroborate with existing data.

At the same time, the described pilot system will also facilitate the collection of biological material for examination to determine the possibility of viral infection.

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