Assessment of Bastroe Channel possible impact on Lower Danube sturgeon migration

[1,2]Tiberius M. Danalache, [2]Alin M. Badilita, [2]György Deák, [2]Elena Holban, [2]Iustina Popescu, [2]Andreea Daescu, [2]Marius C. Raischi, [2]Gina Ghita, [1]Carmen G. Nicolae, [1]Stefan Diaconescu

[1] University of Agronomic Sciences and Veterinary Medicine of Bucharest, Bucharest, Romania; [2] National Institute for Research and Development in Environmental Protection, Bucharest - INCDPM, Bucharest, Romania. Corresponding author: T. M. Danalache, tiberiusdanalache@yahoo.com

Abstract. The hydrological constructions performed for Bastroe Channel may affect anadromous migratory fish, such as sturgeon. This paper aims to establish the possible environmental consequences in the Danube Delta Biosphere Reserve and adjacent coastal zone, determined by the Bastroe project. A continuous sturgeon migration monitoring was performed in the respective area using DKMR-01T monitoring system. The results, correlated with the informational volume that INCDPM already holds, showed that Chilia and Stambulul Vechi branches represent a sturgeon migration route. Therefore, if Chilia branch becomes an inert area regarding the possibility of sturgeon migration, in conjunction with the difficult situation from Sulina branch, the only migration route for sturgeon will remain Sfantu Gheorghe branch, thus being a possible major risk to reduce the migration possibility with almost 67%.
Key Words: acoustic telemetry, migration routes, new monitoring system, ultrasonic tagging.

Introduction. Despite the existence of studies and records on sturgeon species behavior, much information about key habitats and their migration routes is still missing (Deák et al 2014a). There are still huge gaps in knowledge of the behavior for the remaining four species of the Lower Danube River (Russian sturgeon - *Acipenser gueldenstaedtii*, Brandt & Ratzeburg, 1883; Stellate Sturgeon – *Acipenser stellatus,* Pallas, 1771; Beluga – *Huso huso,* Linnaeus, 1758; Sterlet sturgeon – *Acipenser ruthenus,* Linnaeus, 1758), being unclear which Danube branches the species in the *Acipenser* and *Huso* genera prefer for migration and which are the most suitable conditions for their feeding and breeding (Deák et al 2013). Given that the first three species are considered, according to International Union for Conservation of Nature - Red list of threatened species, extinction critically endangered and the fourth one is considered vulnerable, all of them decreasing during last decades (Munteanu et al 2013; Vasilean et al 2012) and being protected under the Convention on Trade in Endangered Species of Flora and Fauna (CITES), the interest on their behavior increased due to the high necessity of elaborating action plans for their conservation (Bartosiewicz et al 2008; Ludwig et al 2009; Peterson et al 2007).

Recent studies showed that at occurrence of high pressures on Danube River (Matei et al 2016) they have a high adaptation capability, evolving more rapidly than was known initially, but even so, they are sensitive to habitat conditions changes (Rabosky et al 2013). Low oxygen concentration, variable water and sediments quality, changes in river hydromorphology (caused by both natural phenomena and anthropic activities) are just some of the multiple factors that can affect the capability of the respective habitat to satisfy their needs, thus influencing their behavior (Shepherd 2013; Zahedi et al 2013; Nelson et al 2013; Ilie et al 2017; Radu et al 2016).

Large hydraulic works for a deep waterway on Chilia and Bastroe branches of Danube River, were started in 2004. The activities made by Ukraine in Bastroe project, supplemented by further work performed for the new waterway maintenance, generated from the early phase of the project adverse reactions at national and international level mainly from the environmental point of view. The dredging of Chilia branch including Bastroe Channel may have negative effects due to several causes:

i) dredged materials cause habitat loss or alteration of *Acipensaridae* species, which may influence especially the populations of *Acipenserides*;

ii) during dredging operations, larvae, juveniles and adults may be killed;

iii) the food for many fish species is destroyed because of zooplankton and phytoplankton alteration.

Although the consequences that can occur after the works are known, their long term impact on sturgeon species is still unknown (Deák et al 2013).

The aim of this paper was to determine the possible consequences on the *Acipenser* and *Huso* genera behavior and migration routes in Danube Delta Biosphere Reserve and adjacent coastal zone. In order to fulfill the aim, a new monitoring system based on acoustic telemetry technique was used. Even though there are a large variety of techniques for fish monitoring, because of the environmental challenging conditions from the Danube River, ultrasonic tagging technique is considered to have the highest efficiency (Heupel et al 2006; Cooke et al 2013; Woodley et al 2013; Roy et al 2014). This technique, combined with other tools fosters obtaining valuable information which can fill the actual gaps in knowledge (Deák et al 2014b).

Material and Method. In order to establish the four sturgeon species behavior and preferred migration routes, a continuous monitoring was implied from October 2011 to April 2014. The monitoring is based on a new technique that consists of tagging the specimen with an ultrasonic emitter which release signals (with information regarding water temperature and swimming depth) that can be recorded by the reception station (Badilita et al 2013; Raischi et al 2016). The caught specimen is immobilized through electronarcosis, receives local anesthesia (with lydocaine), is made a 2-3 cm ventral incision and the ultrasonic emitter is inserted into the abdominal cavity of the specimen. After these steps, a ventral suture is accomplished using a resorbable wire and antibiotic is sprayed (oxytetracycline). Besides the internal tagging, an external T-bar tagging of the specimen is performed in anti-poaching purposes and the specimen is released. Acoustic intermittent signals released by the emitter are recorded by VR2W reception stations which are incorporated into high efficiency monitoring system developed by the research team.

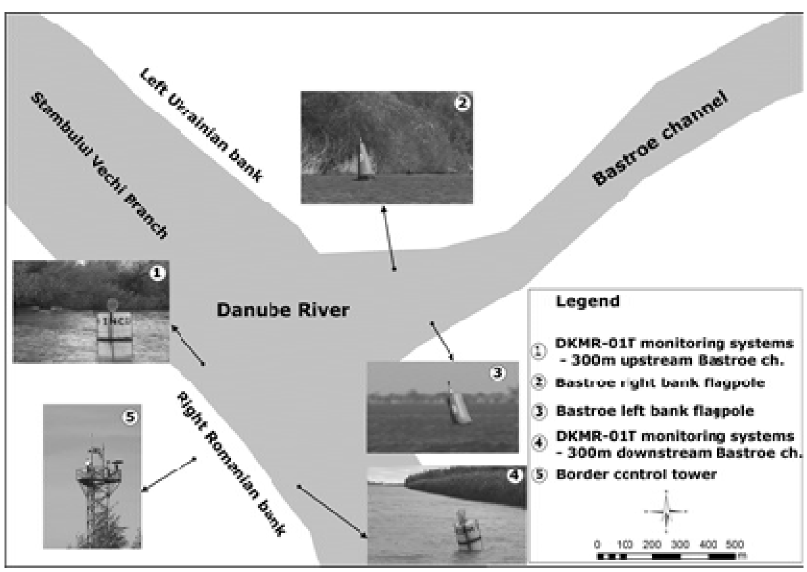

Figure 1. Study area (Deák et al 2013).

Two monitoring systems were positioned upstream and downstream the Bastroe Channel confluence (Figure 1), nearby the area where hydrotechnical works has been performed. DKMR-01T monitoring system (Figure 2) was used for obtaining useful information on sturgeon behavior and migration routes, which proved to have high efficiency because it hampers important data loss and does not depend on hydrologic conditions.

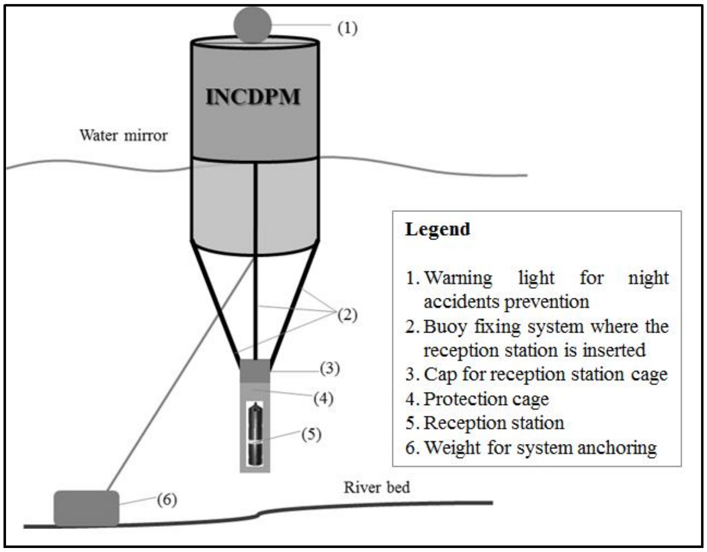

Figure 2. DKMR-01T monitoring system (Deák et al 2013).

Results and Discussion. In 2013, during autumn migration 4 beluga males (codes 6S12, 6S14, 6S21, 6S22), tagged in November and released on Bala branch, migrated downstream towards Black Sea on Chilia branch at Bastroe Channel confluence.

The 6S12 beluga specimen, weighting 105 kg, was caught, tagged and released when water temperature reached 15.5^{o}C. After ultrasonic and anti-poaching tagging it migrated downstream, being detected at km 65, 57, 43 and 3,5 on Borcea branch, at km 182 on Old Danube and on Chilia branch at the Bastroe Channel confluence (when water temperature reached 13.5^{o}C at detection moment) (Figure 3). The available data do not reveal specimens' return for spawning in 2014.

The 6S14 beluga specimen, weighting 85 kg, was caught, tagged and released when water temperature was 15.5^{o}C. It followed the same migration route as the previously presented one on Bala branch and on Chilia branch at the Bastroe Channel confluence (when water temperature reached 14.3^{o}C at detection moment) and did not return in 2014 (Figure 4).

The 6S21 beluga specimen, weighting 81 kg, was caught, tagged and released when water temperature reached 12.4^{o}C. During its downstream migration, was detected at km 43 and 3.5 on Borcea branch, km 186 and 182 on Old Danube and on Chilia branch at Bastroe Channel confluence (when water temperature reached 14.3^{o}C at detection moment). In 2014 the specimen migrated upstream in spawning purposes, being recorded in March at km 182, 186 and 200 on Old Danube and on Caleia at km 9 (Figure 5). These results showed that the specimen overcame the bottom sill constructed in this area for the navigation conditions improvement.

The 6S22 beluga specimen, weighting 90 kg, was caught, tagged and released when water temperature reached 10.4^{o}C. During its downstream migration, was detected on Bala branch, Borcea branch km 65 and 43, Old Danube km 186, Cravia branch and Chilia branch at Bastroe Channel confluence (when water temperature reached 7.4^{o}C at detection moment) and did not return in 2014 (Figure 6).

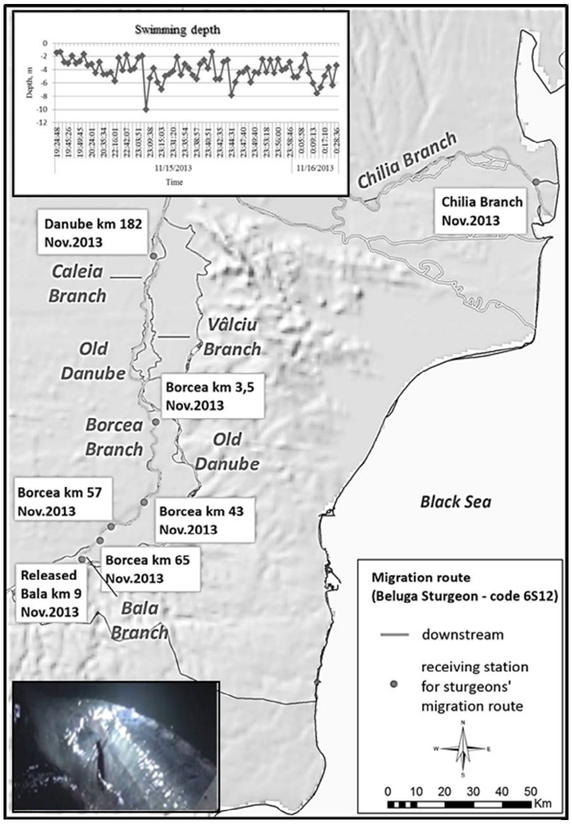

Figure 3. Migration route and swimming depth of beluga sturgeon – code 6S12.

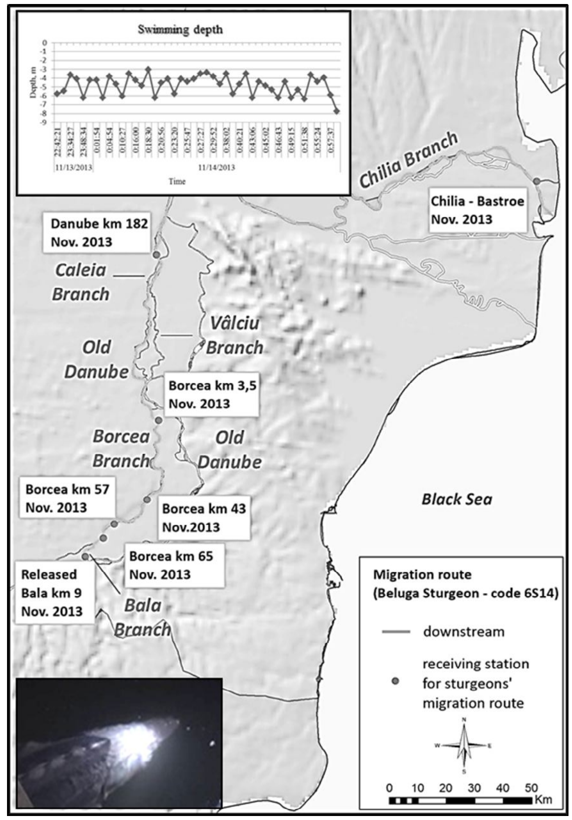

Figure 4. Migration route and swimming depth of beluga sturgeon – code 6S14.

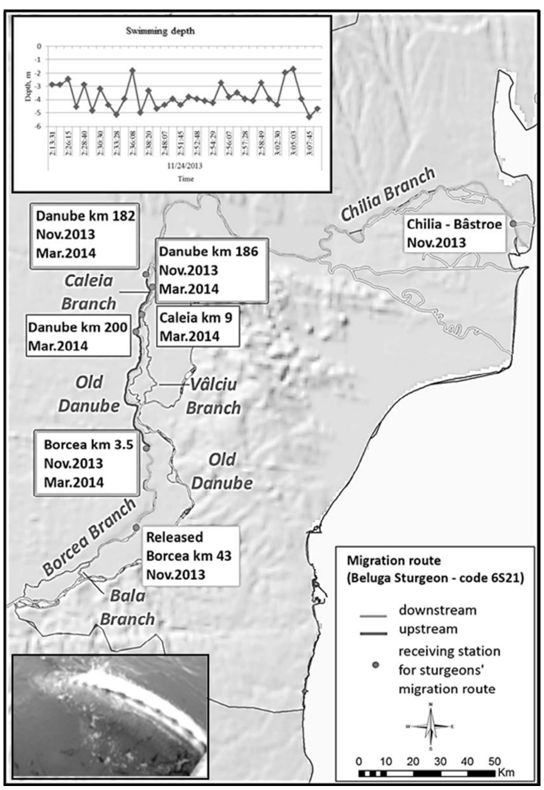

Figure 5. Migration route and swimming depth of beluga sturgeon – code 6S21.

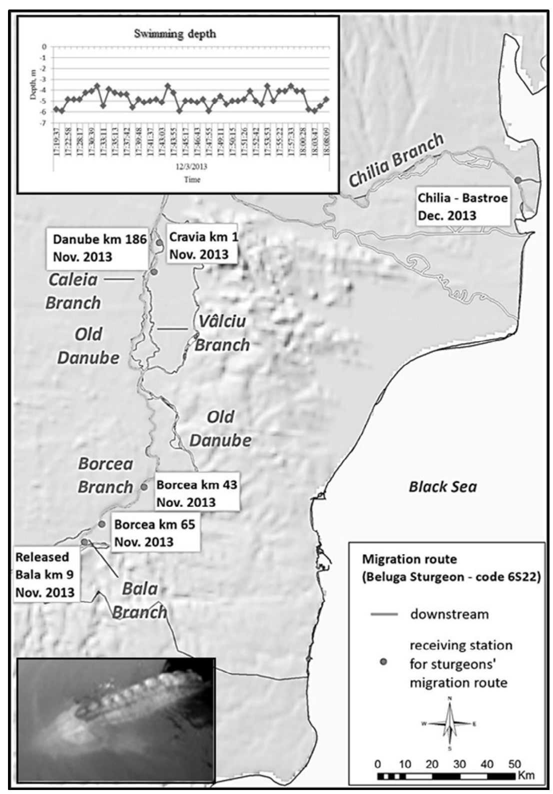

Figure 6. Migration route and swimming depth of beluga sturgeon – code 6S22.

During 2011 autumn campaign, was caught, tagged and released on Borcea branch a stellate sturgeon male specimen - code 2S5 - weighting 6 kg. After releasing, the sturgeon migrated downstream to the Black Sea. Given that in March 2014 it was detected on Chilia branch (Figure 7), there should be taken into account the possibility for the specimen to spawn downstream km 182 on Old Danube, due to the average temperature on Chilia branch at Bastroe Channel confluence in March 2014 which was 14.6^{o}C., value at the lower limit of the optimal spawning interval 15-23^{o}C (Reinartz 2002).

The 3S48 stellate sturgeon male specimen, weighting 5 kg, was caught, tagged and released on Borcea branch at km 7. The data reveals that a distance of 60 km from the releasing place to first recording on Caleia branch was traveled in 8 days, at the detection moment, the water temperature being 26^{o}C, value above the spawning optimal temperature 15-23^{o}C (Reinartz 2002). Given that, afterwards, the same specimen traveled a distance of 100 km in 2 days, there is a high possibility that it spawn on Borcea or Caleia branch, immediately after releasing (Figure 8).

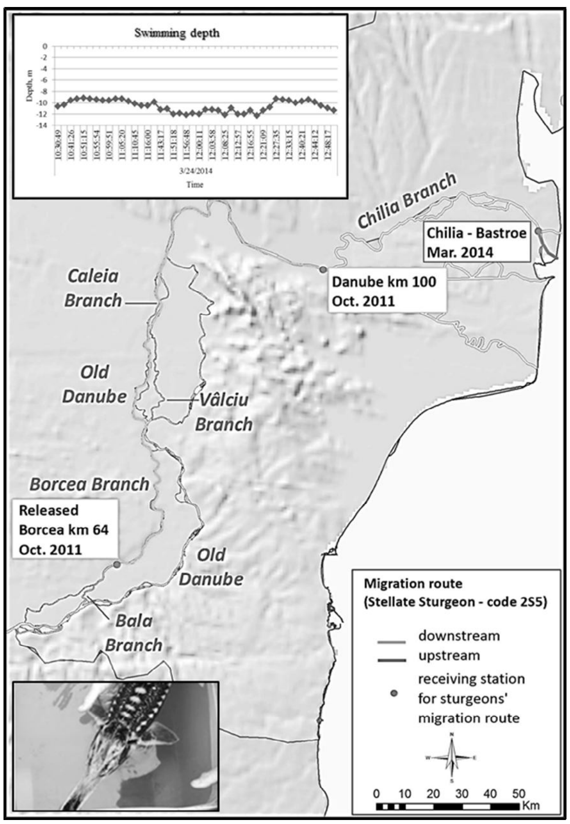

Figure 7. Migration route and swimming depth of stellate sturgeon – code 2S5.

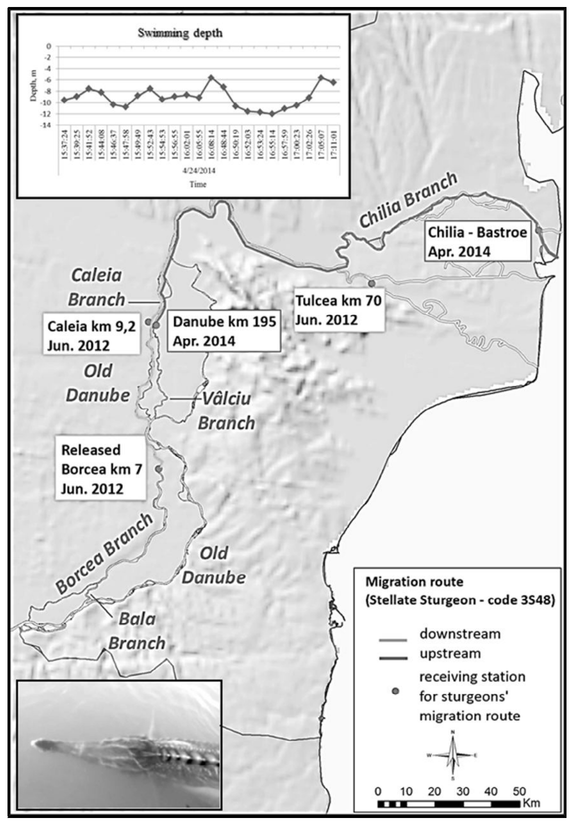

Figure 8. Migration route and swimming depth of stellate sturgeon – code 3S48.

The observed behavior is characteristic for sturgeon species that return into the sea after spawning periods, being in accordance with the scientific literature, except for the migration months. While some authors wrote that several months are specific for migration, during this work was observed that sturgeons migrate during the whole year, depending only on water temperature and on hydrodynamic conditions, being emphasized an apparition frequency variation.

Moreover, the statement found in previous works regarding sturgeon species swimming depth (Reinartz 2002) was confirmed. The data emphasized that sturgeon specimens swim downstream at low depths (in the area with the highest water velocity for a faster movement), while, during upstream migration, they swim at higher depths (where the water velocity is lower) (Figure 9).

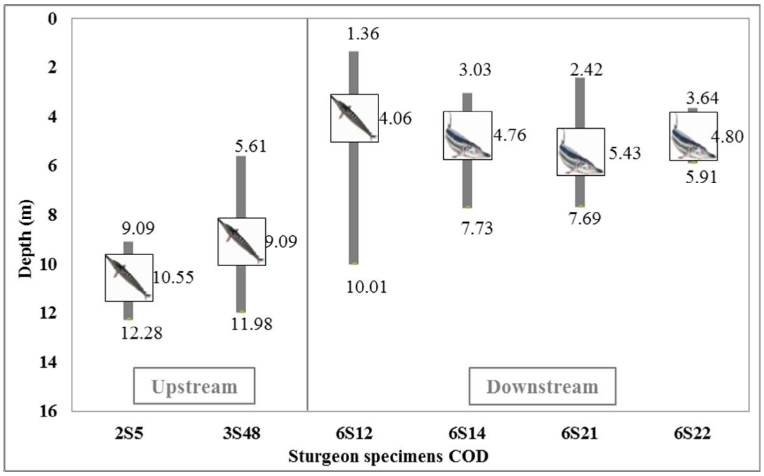

Figure 9. Average, minimum and maximum swimming depth for the recorded specimens.

Conclusions. The monitoring results showed that 6 sturgeon specimens form *Acipenser* and *Huso* genus passed during their migration on Chilia branch at the Bastroe Channel confluence, therefore this is a sturgeon migration route. If Bastroe Channel will be maintained as navigation channel, the impact on sturgeon migration may become catastrophic due to water flow redistribution and due to sediment movement. If Chilia branch will no longer be used by sturgeons, in conjunction with the difficult situation from Sulina branch where the increased navigation hampers their migration, the only migration route for specimens protected under the Convention on International Trade in Endangered Species of Flora and Fauna (CITES) will remain Sfantu Gheorghe branch, thus being a possible major risk to reduce the migration possibility with almost 67%. Therefore, further monitoring and research actions are imperatively required in order to warn when there will be noticed an additional risk on one of these species, together with elaborating solutions for eliminating the risks associated to this project.

Acknowledgements. This work is based on research founded by the Sectorial Operational Programme Transport of the Romanian Ministry of Transport according to project agreement POS-T 2012/3/3/004, code SMIS 37136, coordinator: River Administration of the Lower Danube Galati and by the Ministry of Environment and Climate Changes through the contract no. 140/2013 "Study regarding the quality monitoring of the physical-chemical and biological components from Danube Delta and the adjacent coastline considering the transboundary impact of the Bastroe Channel, during 2010-present, and the environmental consequences analysis in the Danube Delta Biosphere Reserve and in the adjacent coastline determined by the Bastroe project".

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Received: 19 May 2017. Accepted: 01 September 2017. Published online: 09 September 2017.
Authors:
Tiberius Marcel Danalache, University of Agricultural Sciences and Veterinary Medicine Bucharest, Romania, Bucharest, 011464, B-dul Marasti 59; National Institute for Research and Development in Environmental Protection, Romania, Bucharest, 060031, Splaiul Independenţei 294, e-mail: tiberiusdanalache@yahoo.com
Alin Marius Badilita, National Institute for Research and Development in Environmental Protection, Romania, Bucharest, 060031, Splaiul Independenţei 294, e-mail: alin.badilita@incdpm.ro
György Deák, National Institute for Research and Development in Environmental Protection, Romania, Bucharest, 060031, Splaiul Independenţei 294, e-mail: gyorgy.deak@incdpm.ro
Elena Holban, National Institute for Research and Development in Environmental Protection, Romania, Bucharest, 060031, Splaiul Independenţei 294, e-mail: elena.holban@incdpm.ro
Iustina Popescu, National Institute for Research and Development in Environmental Protection, Romania, Bucharest, 060031, Splaiul Independenţei 294, e-mail: iustina.popescu@incdpm.ro
Andreea Daescu, National Institute for Research and Development in Environmental Protection, Romania, Bucharest, 060031, Splaiul Independenţei 294, e-mail: andreea.daescu@incdpm.ro
Marius Constantin Raischi, National Institute for Research and Development in Environmental Protection, Romania, Bucharest, 060031, Splaiul Independenţei 294, e-mail: marius.raischi@incdpm.ro
Gina Ghita, National Institute for Research and Development in Environmental Protection, Romania, Bucharest, 060031, Splaiul Independenţei 294, e-mail: gina.ghita@incdpm.ro
Carmen Georgeta Nicolae, University of Agricultural Sciences and Veterinary Medicine Bucharest, Romania, Bucharest, 011464, B-dul Marasti 59, e-mail: carmennicolae19@yahoo.com
Stefan Diaconescu, University of Agricultural Sciences and Veterinary Medicine Bucharest, Romania, Bucharest, 011464, B-dul Marasti 59, e-mail: diacstefan@yahoo.com

How to cite this article:
Danalache T. M., Badilita A. M., Deák G., Holban E., Popescu I., Daescu A., Raischi M. C., Ghita G., Nicolae C. G., Diaconescu S., 2017 Assessment of Bastroe Channel possible impact on Lower Danube sturgeon migration. AACL Bioflux 10(5):1011-1018.