Methods, techniques and monitoring results regarding the sturgeon migration on Lower Danube *(monitoring period 2010-present)*

General Director of INCDPM

Eng. DEÁK György, PhD

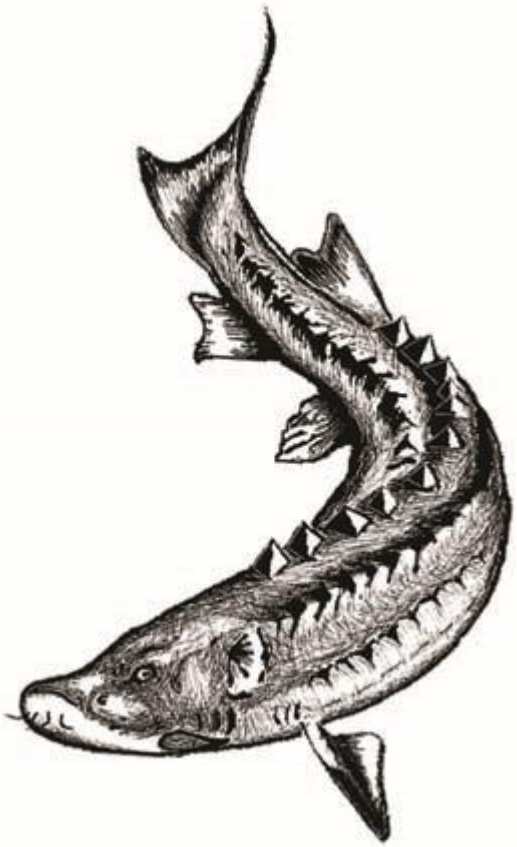
Head of Unit of Climate Change and Sustainable Development

Eng. Monica MATEI, Phd

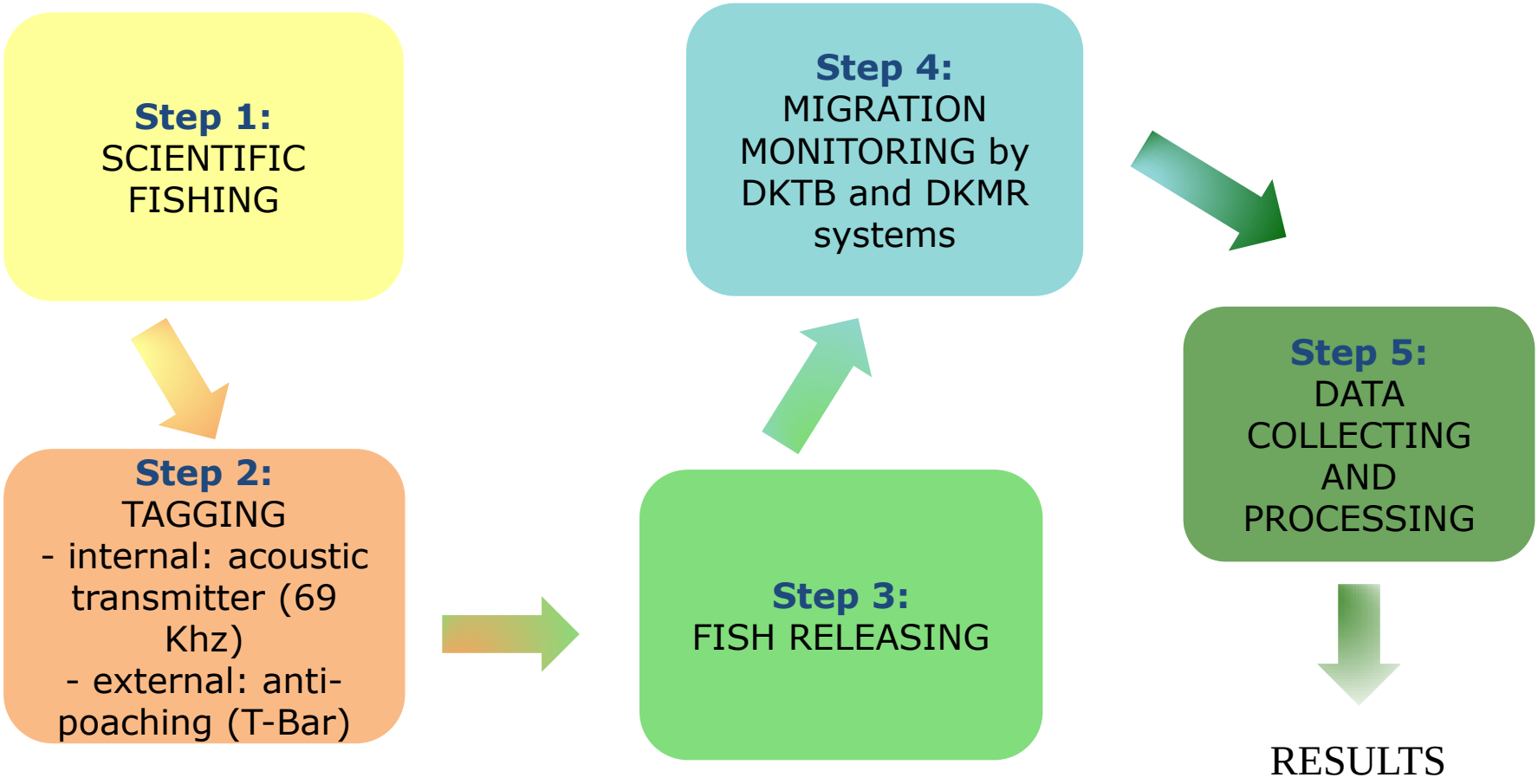
Bucharest, ROMANIA

Sturgeon migration monitoring purposes

- identification of species present in the Danube river
- determining migration periods and routes
- determining wintering, feeding and reproduction sites
- identifying of natural or anthropic jams for elaborate preventive solutions in order to ensure longitudinal connectivity of the river/ sturgeon migration routes
- identifying and reporting zones where illegal fishing activities of sturgeons take place.



Steps to monitor sturgeon migration



Step 1:
SCIENTIFIC FISHING

Year	No. of authorized days	Sturgeon species				Caught specimens
		Beluga	Russian sturgeon	Stellate	Sterlet	
2011	105	25	1	17	52	95
2012	97	13	0	36	7	56
2013	129	13	1	30	6	50
2014	60	4	1	44	3	52
2015	136	13	1	48	0	62
Total	**527**	**68**	**4**	**175**	**68**	**315**

Capturing and tagging sturgeon estimative periods

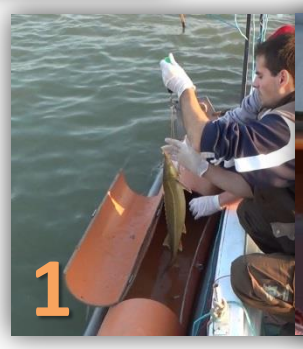
Nr. crt	Month/ Species	2011					2012					2013						2014			2015			
		VI	VII	X	XI	XII	III	V	VI	VII	XI	I	IV	V	X	XI	XII	III	IV	V	IV	V	X	XI
1	Beluga	0	0	2	18	5	5	3	0	1	4	1	0	0	4	6	2	4	0	0	2	1	3	7
2	Stellate	9	6	2	0	0	0	22	13	0	1	0	1	24	2	3	1	0	32	12	9	34	1	4

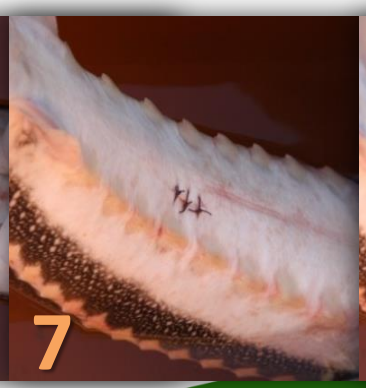
- November is most abundant month for beluga species
- April and May are the most abundant month for stellate species

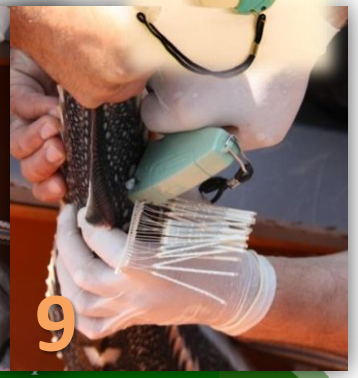
- ✓ Sturgeons can be captured almost every month of the year
- ✓ Considering that we were limited at 31% of fishing capacities by the ANPA, there is not a high confidence volume of data for determining the real frequencies of captures by months
- ✓ Also, the migration periods depends on the variations of hydrodynamic and climatic conditions.

Step 2: TAGGING
- internal: acoustic transmitter
- external: anti-poaching (T-Bar)

The entire procedure is assisted by a veterinary.







Step 3:
FISH RELEASING

Sterlet sturgeon

Russian sturgeon

Stellate sturgeon

Beluga sturgeon

Step 4:
MIGRATION
MONITORING

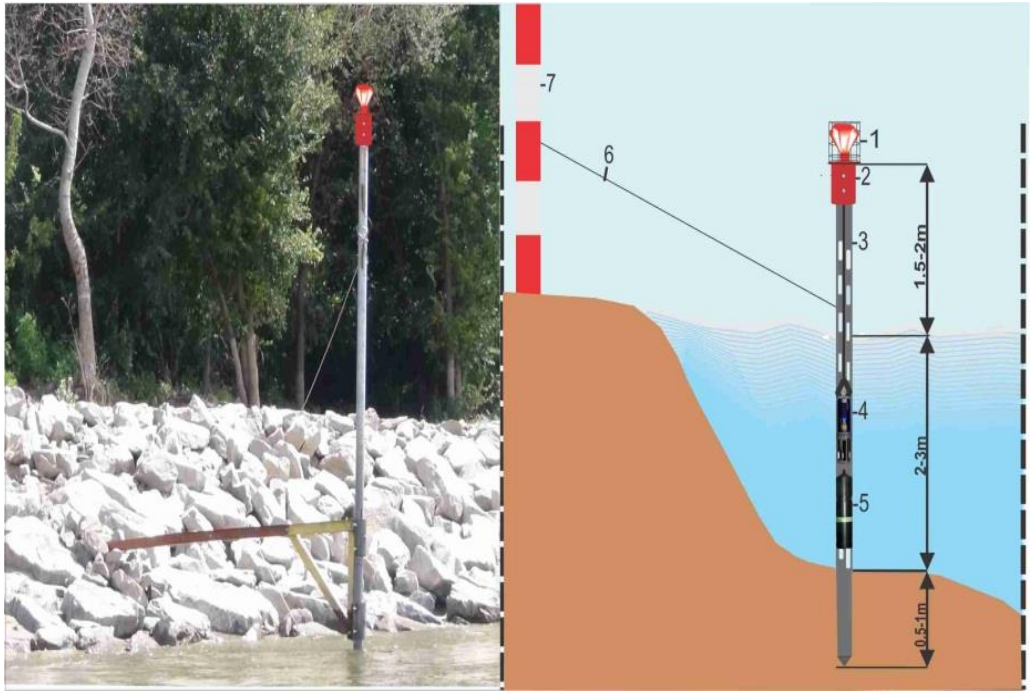
Sturgeons' monitoring using acoustic telemetry

The most efficient method for sturgeons` behavior monitoring in Danube hydrologic conditions is acoustic telemetry, method which can be applied using a mobile tracking device or and a reception station.

In both cases, the first step is to insert into the sturgeon specimen an acoustic transmitter which can emit an impulse at a known frequency that is recorded by the reception station or by the mobile device. Depending on the implanted sensors, information regarding date and time of detection, swimming depth, acceleration, water temperature and other parameters is recorded.

Sturgeon migration monitoring system type DKTB

- ✓ luminous warning lamp (1),
- ✓ metallic cap with special closing system - ø 15-20 cm; (2),
- ✓ protective metal tube provided with openings for water passage (3),
- ✓ station for ultrasonic signal reception(4),
- ✓ equipment for monitoring water level and quality(5),
- ✓ cable for fixing the reception station(6),
- ✓ bank anchorage pillar (7).



The most important advantages of DKTB monitoring system:

- ➢ eliminate the risk of lossing the information
- ➢ can be mounted easily in the banks
- ➢ causes no difficulties on carrying out fishing activities or navigation
- ➢ presents easily activities on downloading data
- ➢ may include multi-parameter water quality equipment including equipment for determining the level variations.

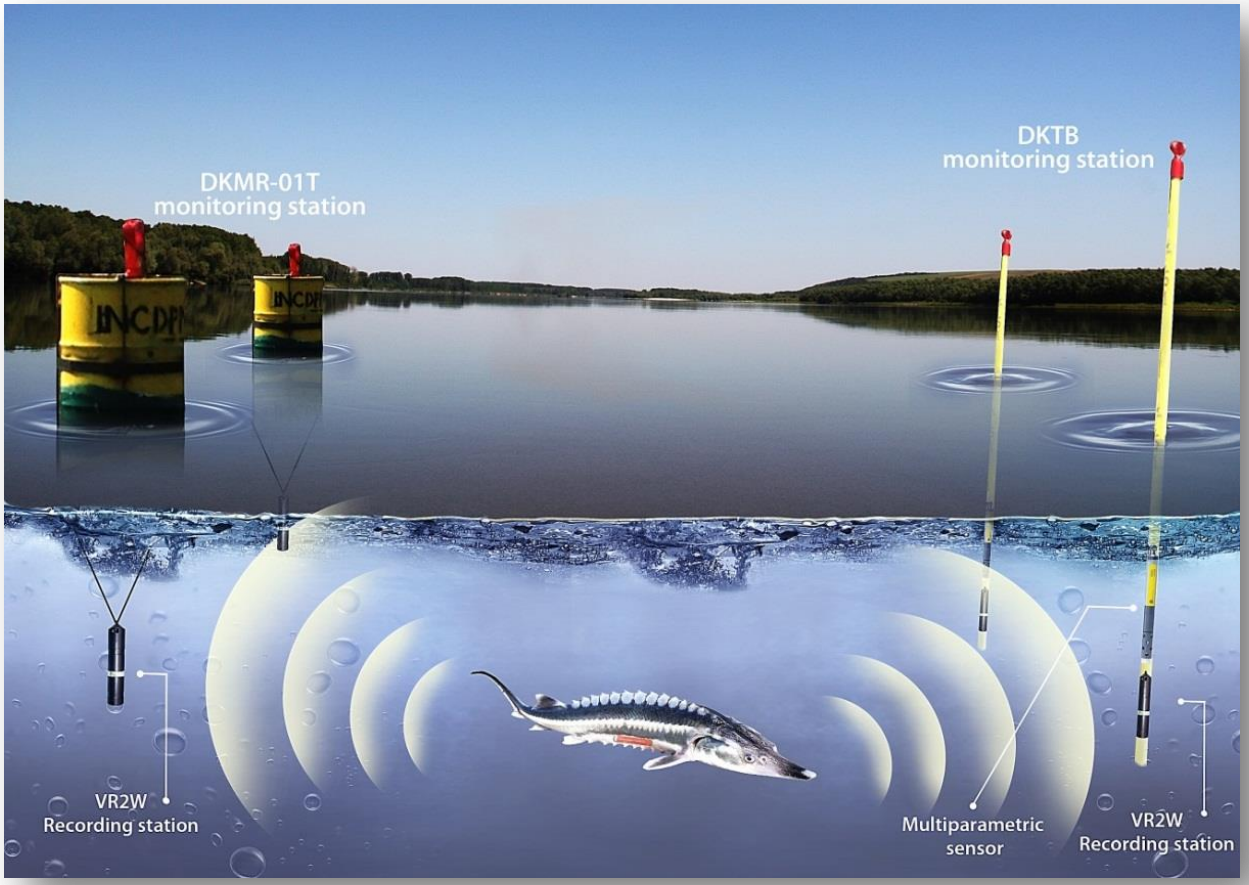
DKMR-01T Monitoring System of sturgeon migration

- ✓ warning system of bright red light (1)
- ✓ floating tank out of metal (2)
- ✓ link system between the tank and pipe protection of concrete iron (3)
- ✓ protective cap with closure system (4)
- ✓ protective pipe provided with slots for water passage (5)
- ✓ reception station of ultrasonic signals (6).

The most important advantages:

- ➢ eliminate the risk of lossing the information
- ➢ can be mounted easily in the banks
- ➢ not entangled in fishing or sailing
- ➢ presents easily activities on downloading data
- ➢
- ➢ may include multi-parameter water quality equipment.

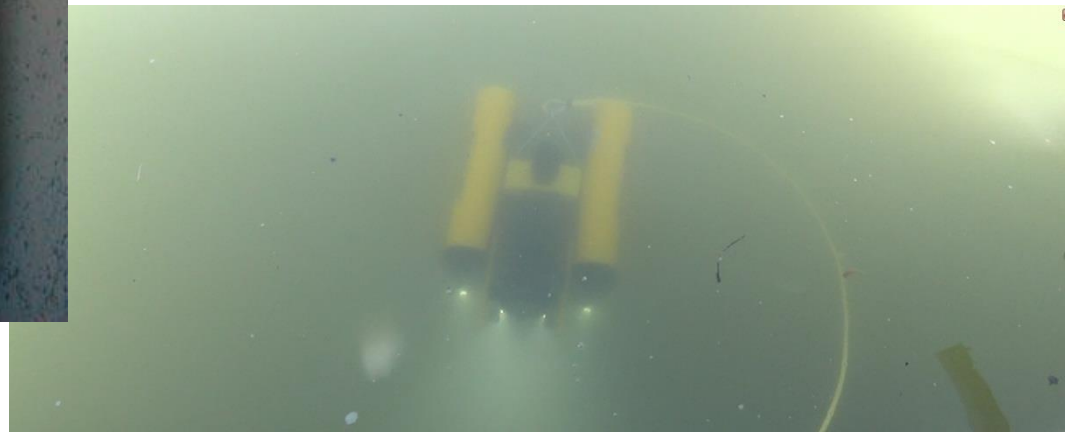
Sturgeon monitoring migration by creating the detection gates of the ultrasonic signal



Active monitoring of sturgeon species

VR100 ultrasonic device for specimens tagged

Used especially for determining wintering, feeding and reproduction sites and for monitoring the marked sturgeons from boat.



Remote operated vehicle (ROV) – does not depend on ultrasonic tagging

Allows underwater filming.

Step 5:
DATA COLLECTING
AND PROCESSING

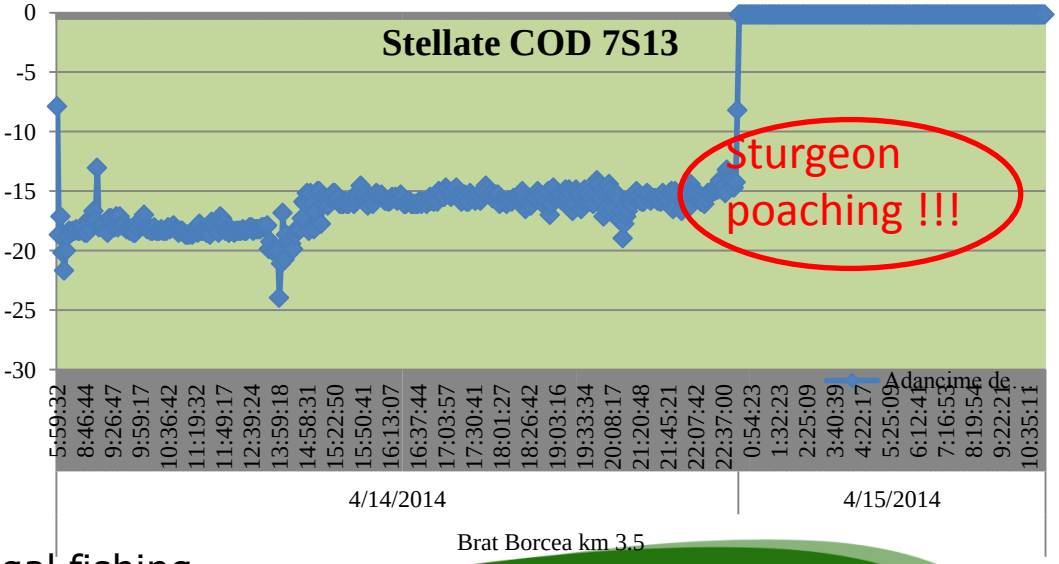
At this moment, INCDPM has the largest and unique informational volume regarding sturgeons' migration on Lower Danube at European level.

Possible risks in monitoring achievement

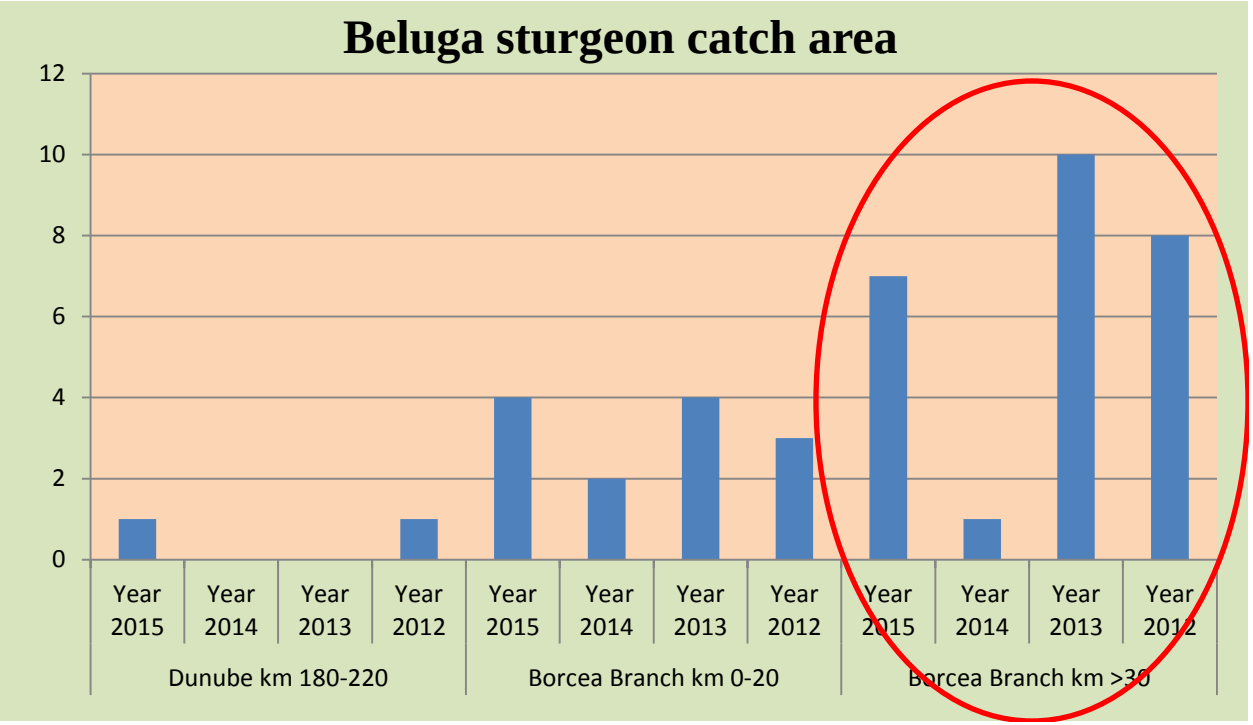
- destruction
- vandalism
- theft
- illegal fishing.

Monitoring system destroyed

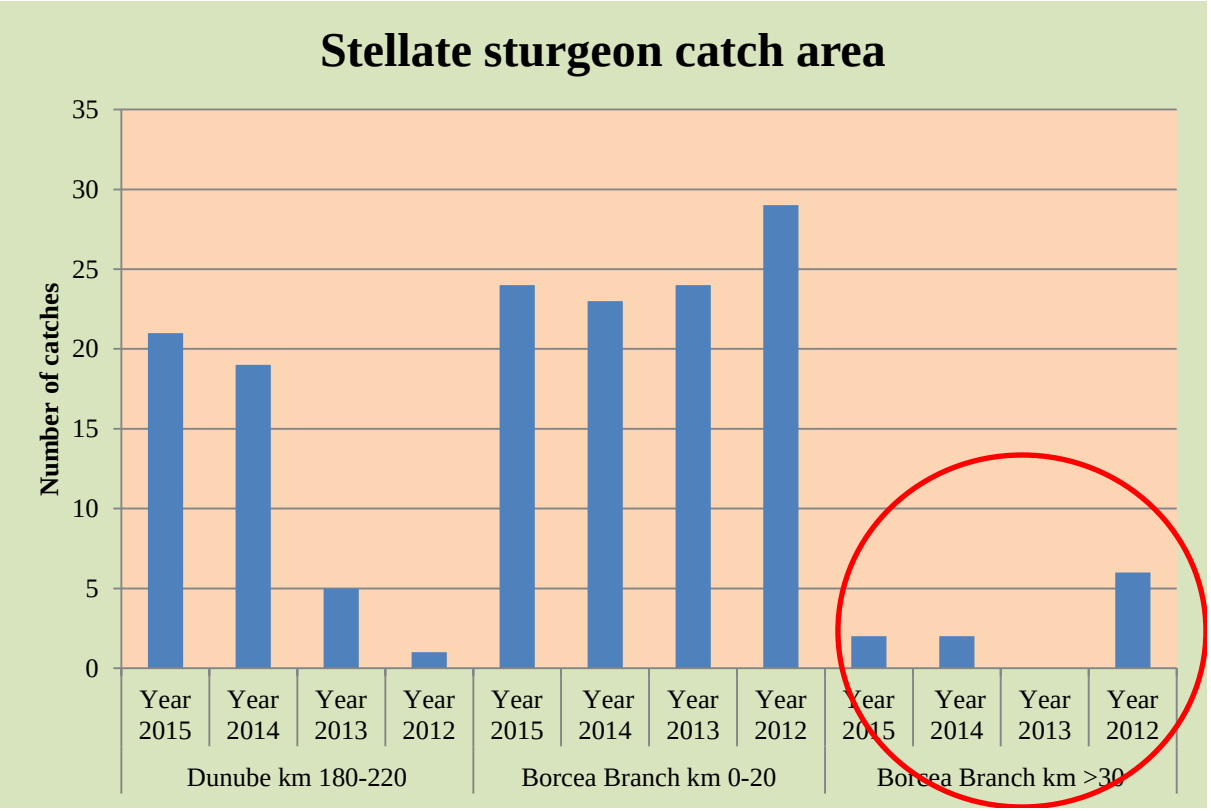
Abandoned tags in bottles coming from illegal fishing



Results of monitoring migration on the Lower Danube

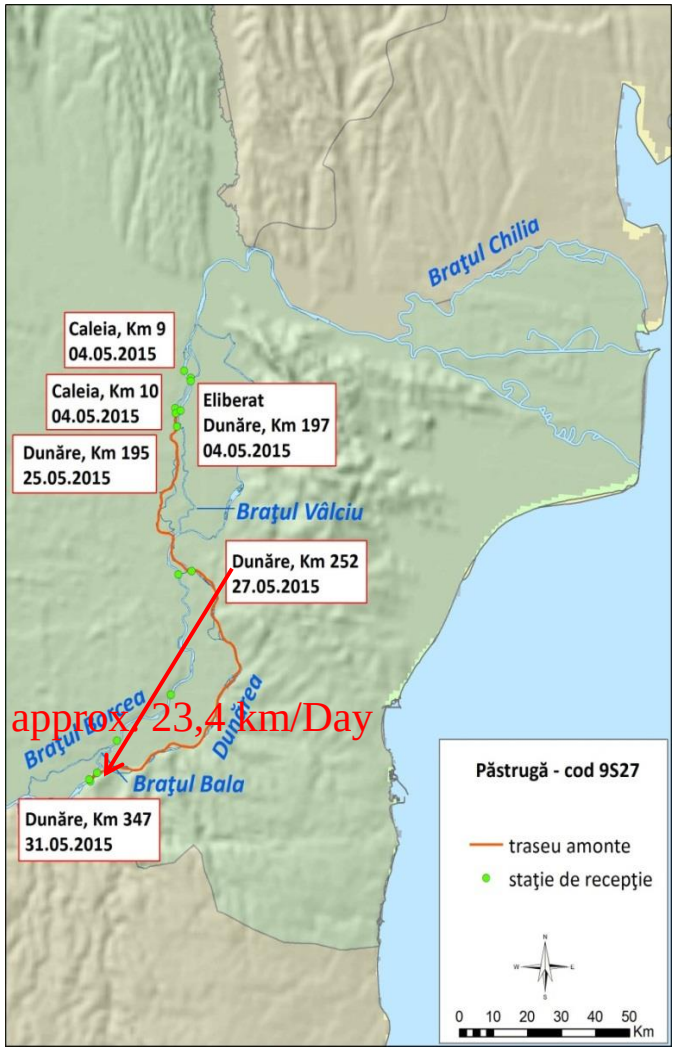


Large number of Beluga species, upstream of Borcea Branch - km 30

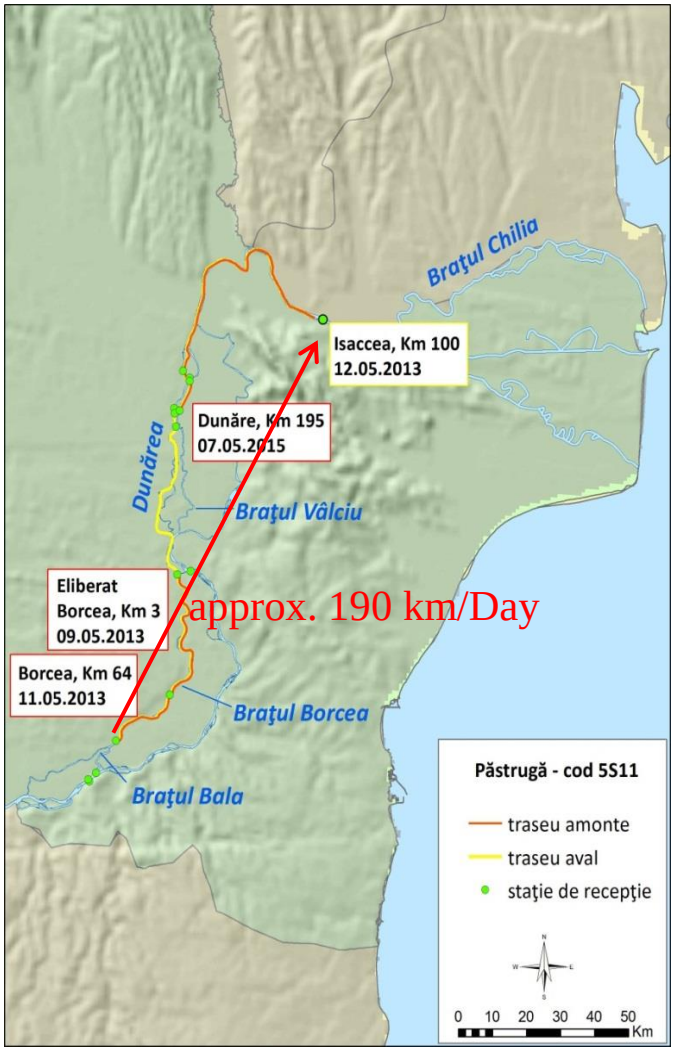


Small number of Stellate species detected upstream of Borcea Branch - km 30

Swimming examples for different types of sturgeon migration routes



Upstream



Downstream

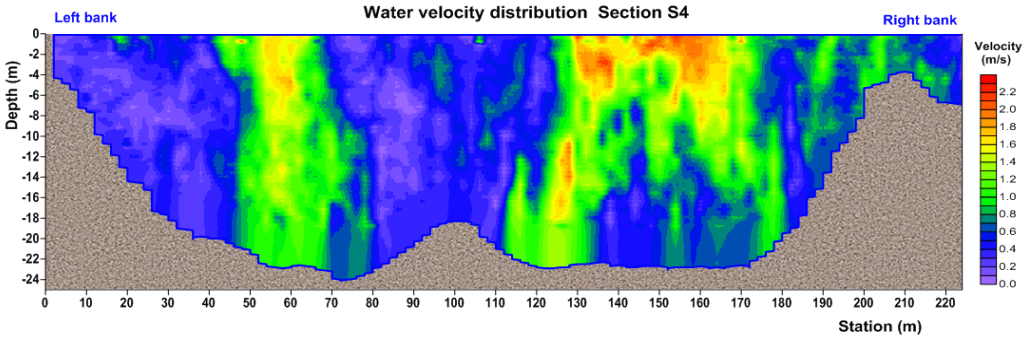
Sturgeons that have passed the bottom sill on Bala Branch

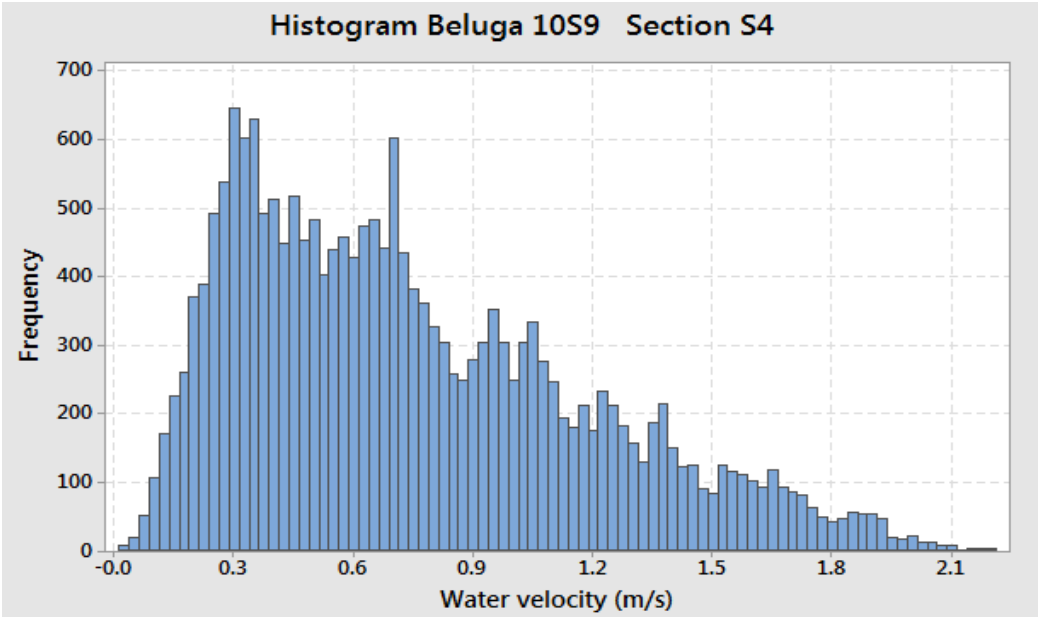
No.	Species	CODE	Tagged day	Release area	Date of passing the bottom sill	Flow [m^3/s]	Average water velocity [m/s]
1	Beluga	6S11	31.10.2013	Borcea km 50	12.03.2014	3860	2.25
2	Stellate	7S43	08.05.2014	Bala km 9.8	20.05.2014	5650	1.96
3	Stellate	7S47	11.05.2014	Bala km 9.8	18.05.2014	5300	2.15
4	Stellate	7S22bis	15.04.2014	Bala km 9.8	26.05.2014	5780	1.81
5	Beluga	3S33	24.05.2012	Borcea km 57	08.11.2014	4600	2.53
6	Russian	9S19	02.05.2015	Borcea km 43,5	27.05.2015	3545	2.50
7	Beluga	10S6	02.11.2015	Borcea km 0	12.11.2015	2540	2.10
8	Beluga	6S22	26.11.2013	Bala km 9,8	12.11.2015	2540	2.10
9	Beluga	10S9	09.11.2015	Borcea km 43	13.11.2015	2540	2.10
10	Beluga	10S12	13.11.2015	Borcea km 43	15.11.2015	2300	2.16

Autumn 2015 campaign

Beluga 10S9

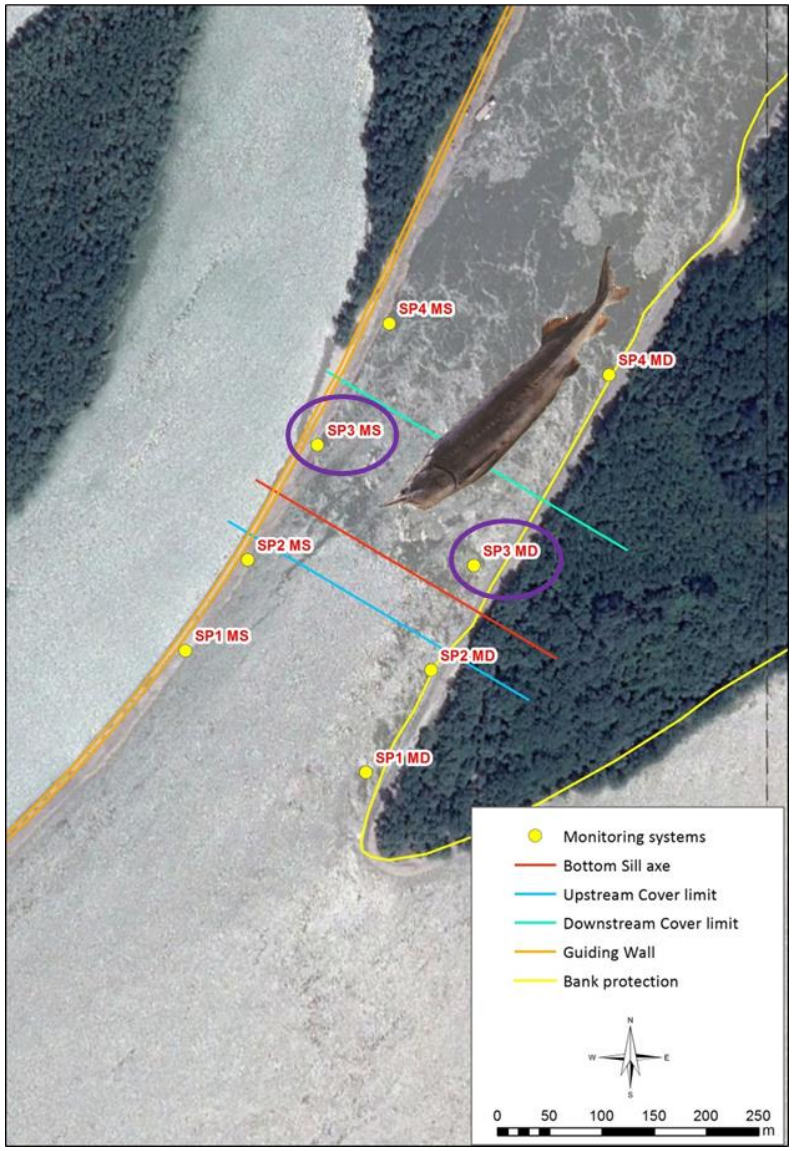
Period of detection: 5:21 – 15:37/h
Swimming depths: 2.27 – 24.25 m



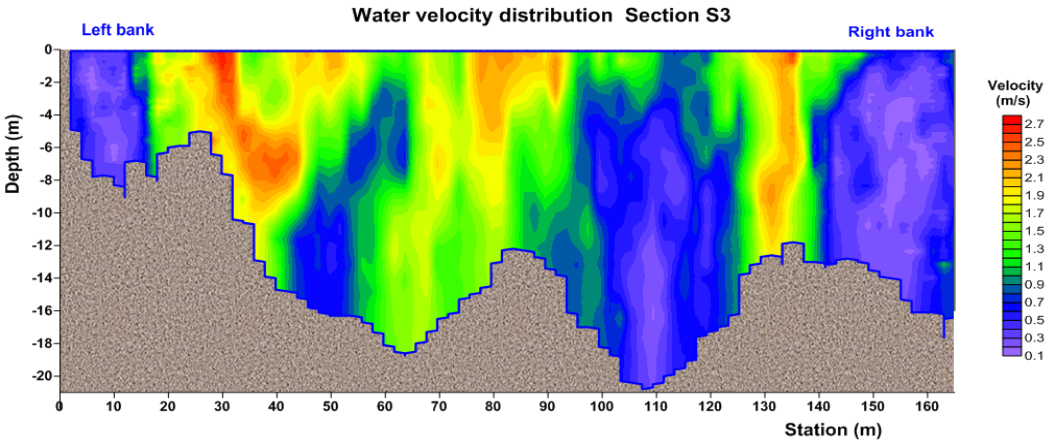


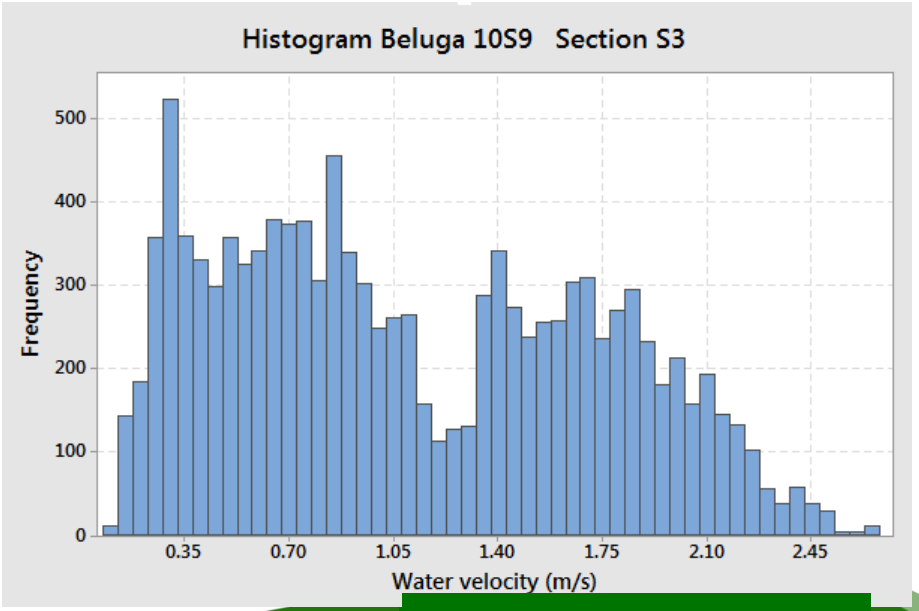
Autumn 2015 campaign

Beluga 10S9



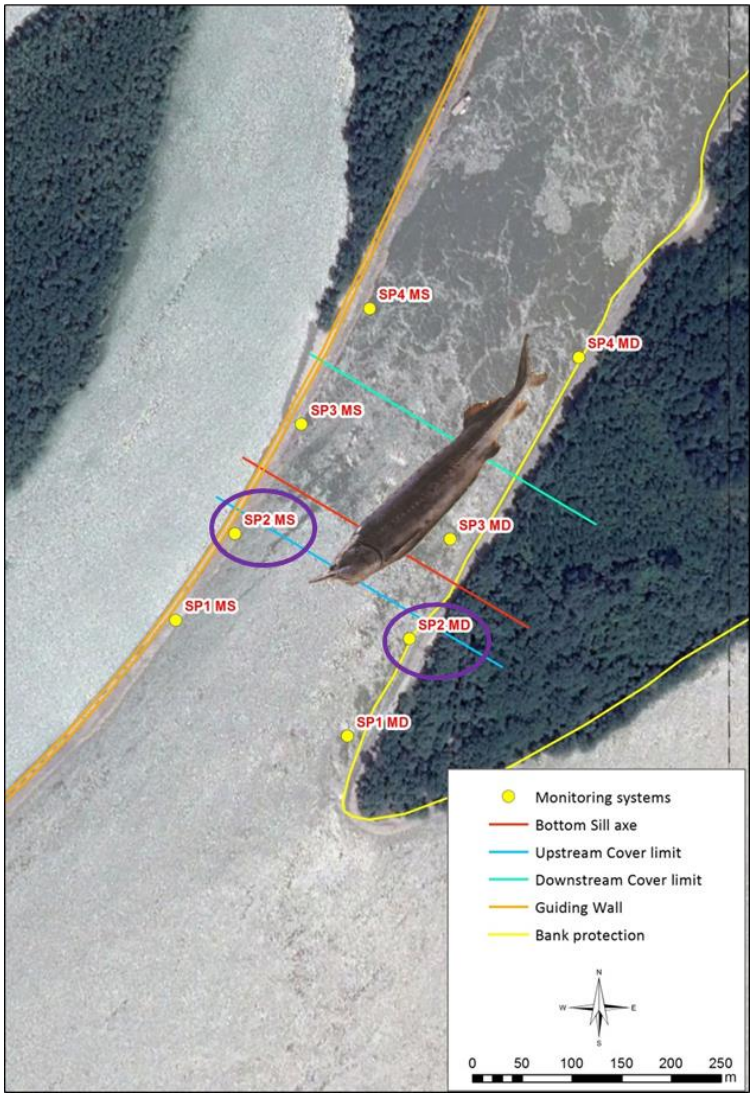
Period of detection: 17:39 – 18:38/h
Swimming depths: 2.57 – 20.16 m





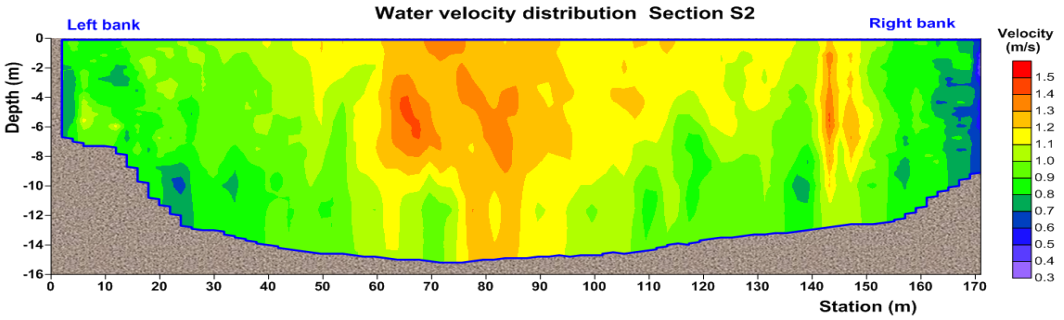
Autumn 2015 campaign

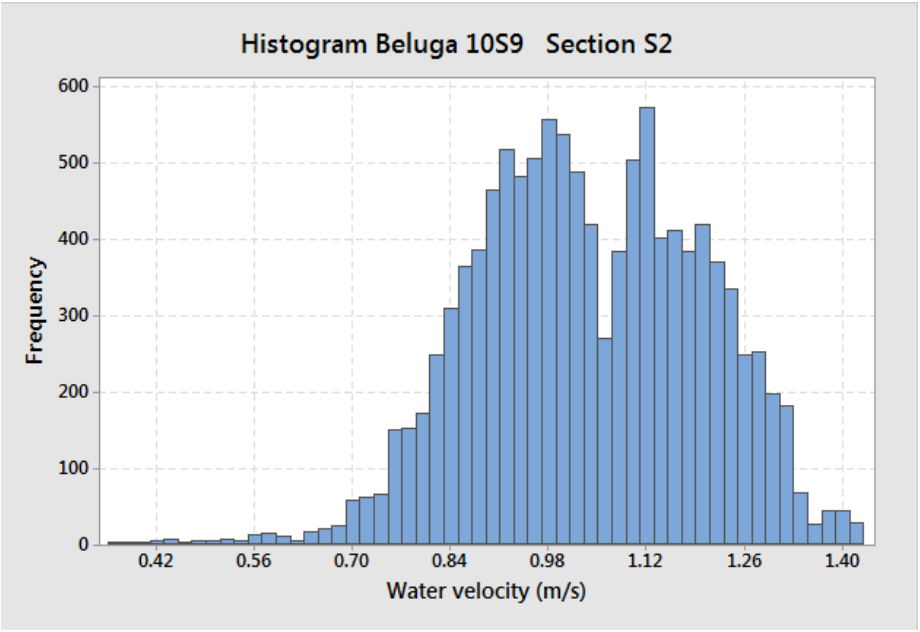
Beluga 10S9



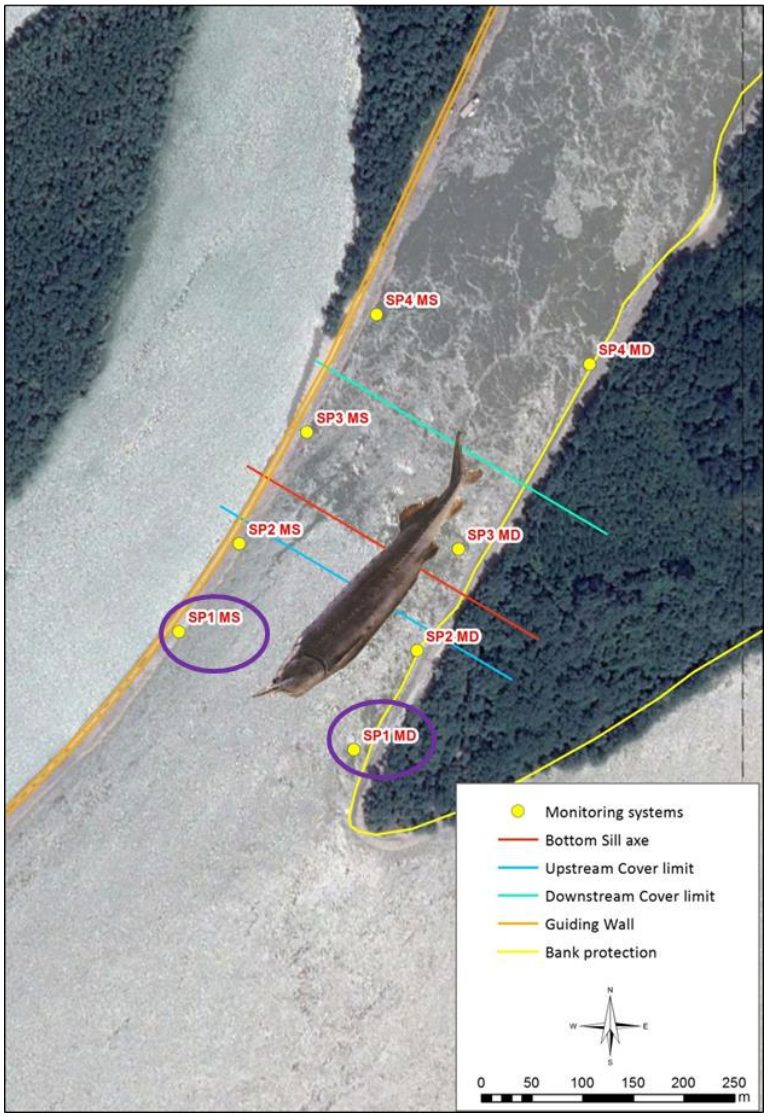
Period of detection: 19:28 – 19:30/h

Swimming depths: 10.30 – 12.58 m

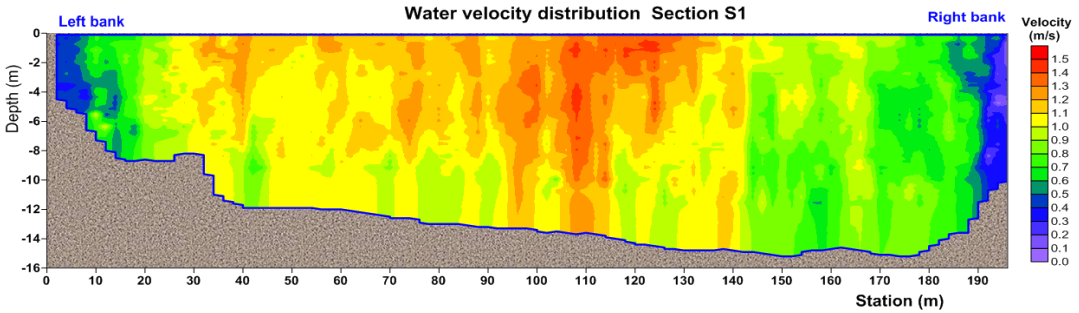


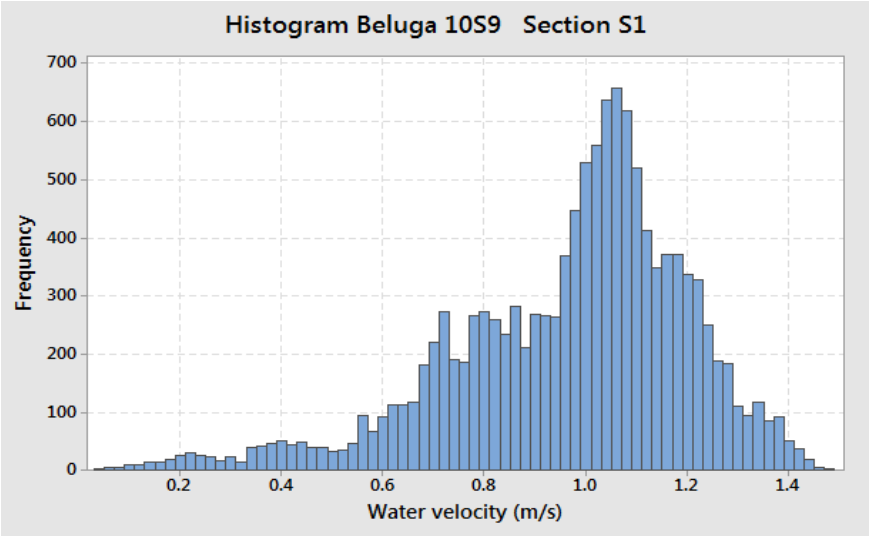


Autumn 2015 campaign
Beluga 10S9

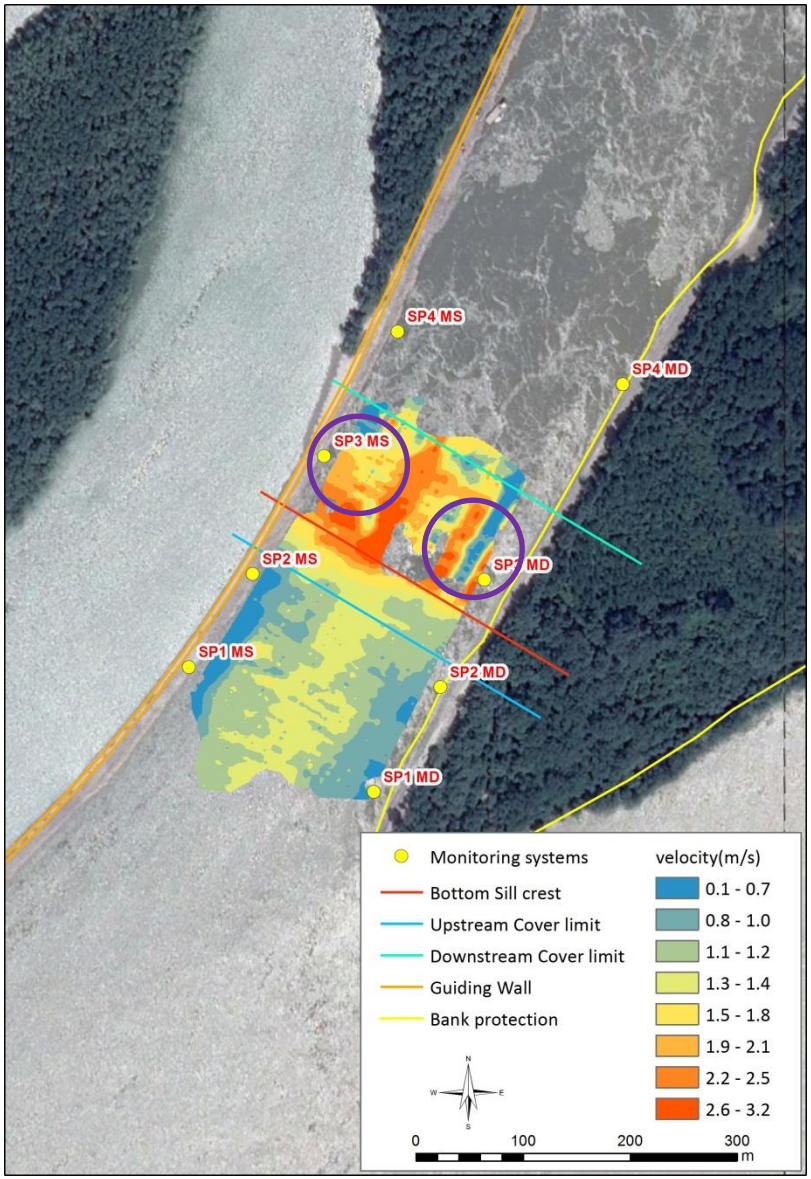


Period of detection: 19:34 – 19:38/h
Swimming depths: 7.42 – 10.91 m





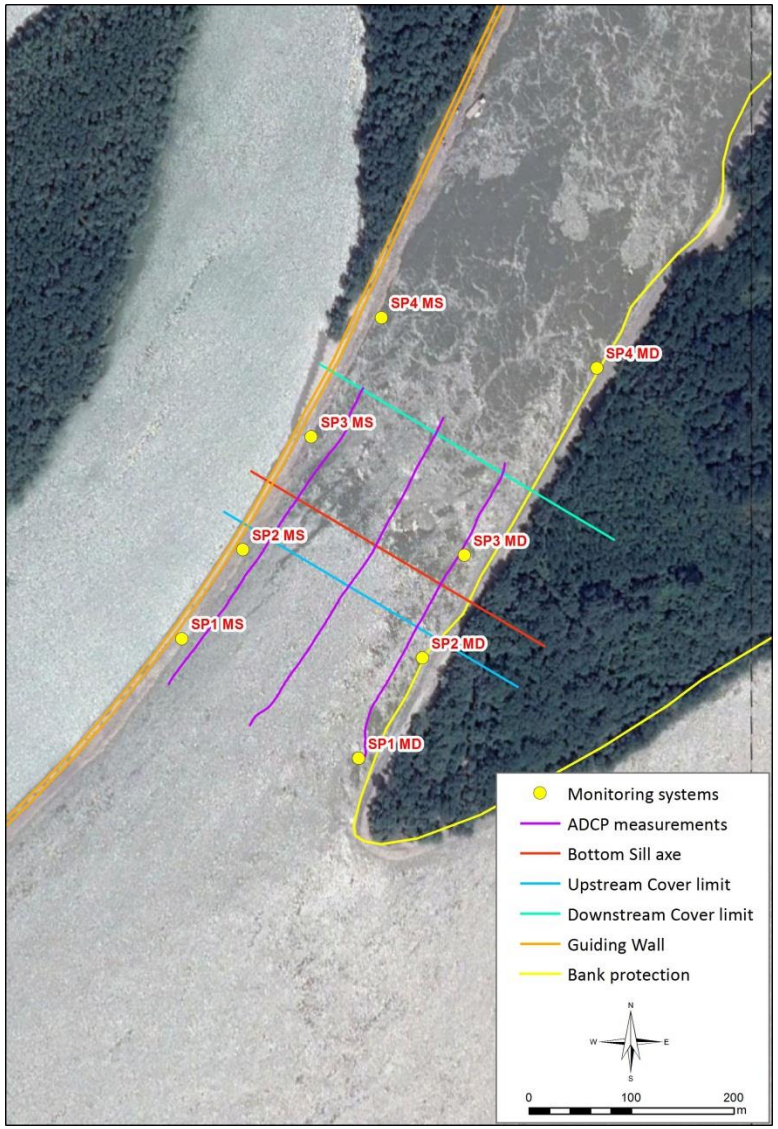
Autumn 2015 campaign
Beluga 10S9



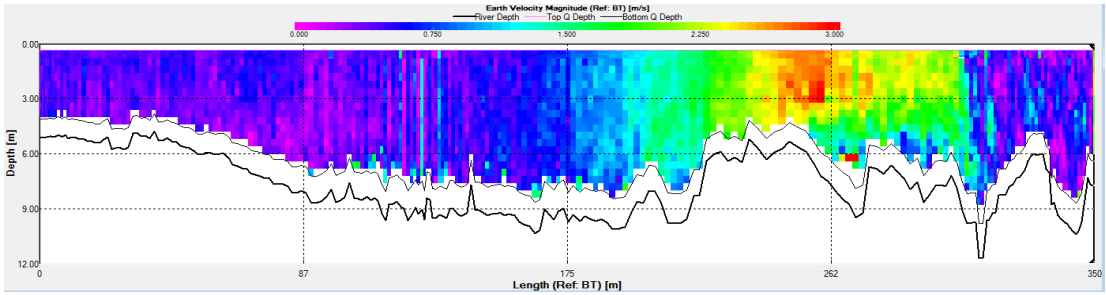
Hydrodynamic and climate conditions vs. the migration routes

Distribution of water velocities at a depth of 4-5 m in the bottom sill from Bala Branch

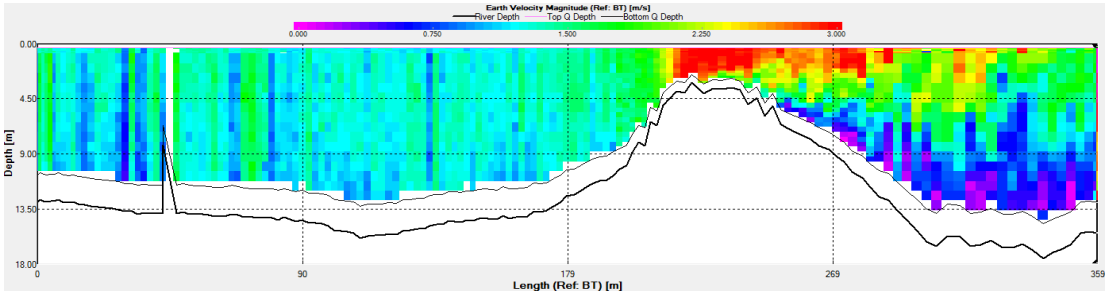
The average depth of the crest was 4.5 m.



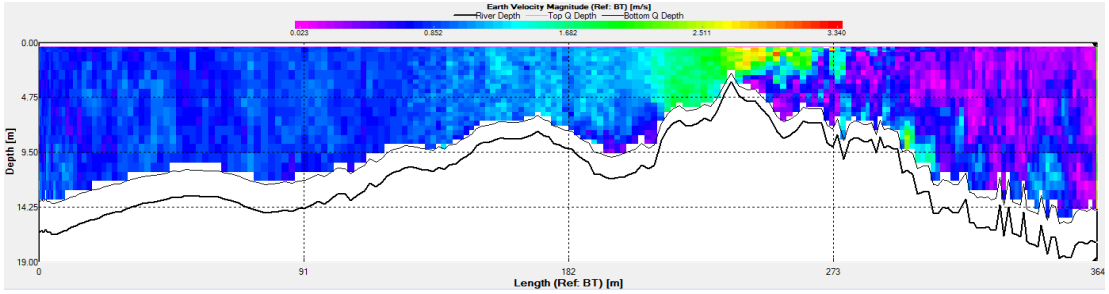
ADCP measurements above the bottom sill



Bala branch, left bank



Bala branch, center



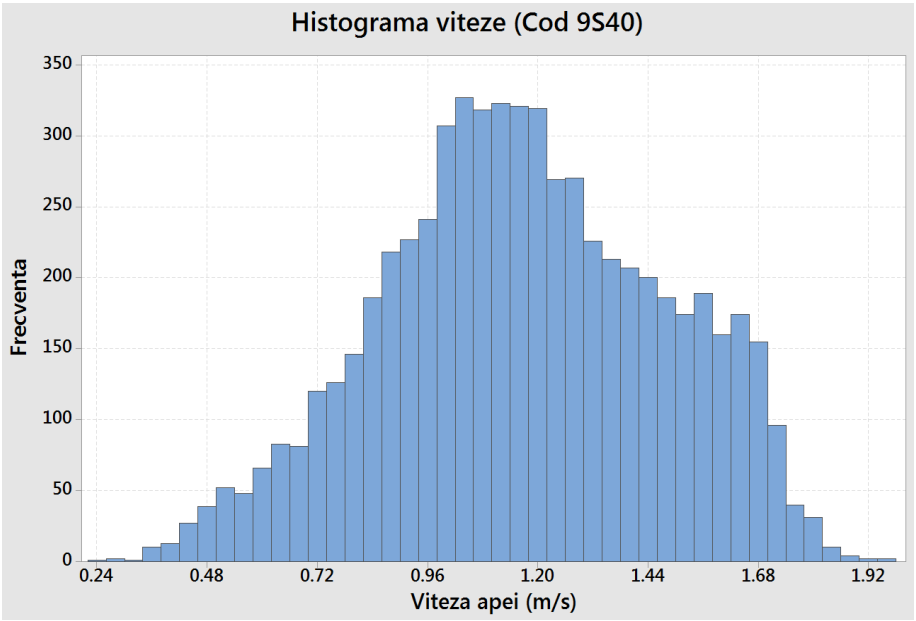
Bala branch, right bank

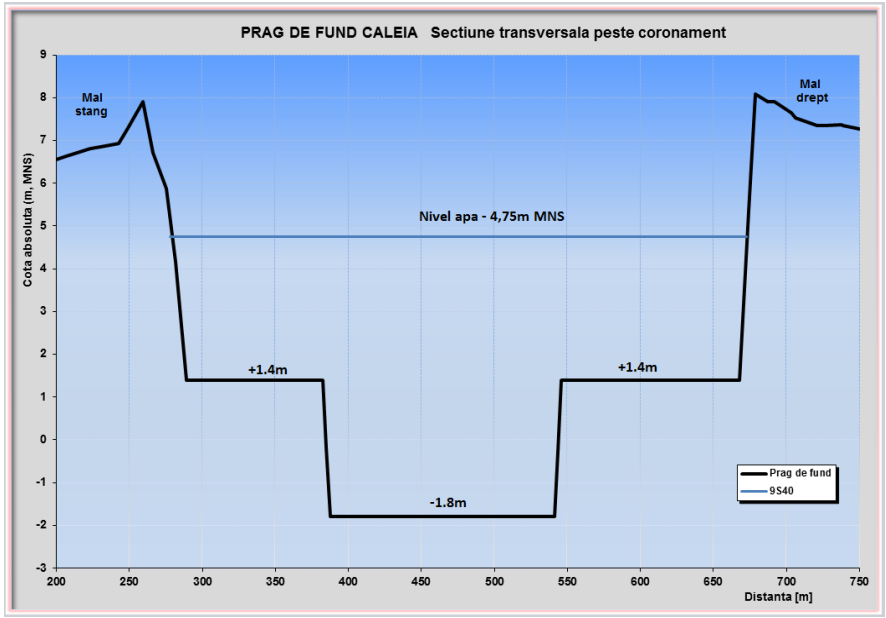
Sturgeons that have passed the bottom sill on Caleia Branch

Nr. Crt.	Species	CODE	Tagged day	Release area	Date of passing the bottom sill	Flow [m^3/s]	Average water velocity [m/s]
1	Beluga	6S21	15.11.2013	Borcea km 43	08.03.2014	3200	1.29
2	Beluga	7S1	19.03.2014	Borcea km 43	22.04.2014	2726	1.25
3	Stellate	7S25	22.04.2014	Borcea km 4	20.05.2014	4265	1.44
4	Stellate	7S30	26.04.2014	Caleia km 9	29.04.2014	3930	1.32
5	Stellate	7S15bis	13.05.2014	Caleia km 9	15.05.2014	4680	1.52
6	Beluga	6S14	05.11.2013	Bala km 9.7	08.12.2014	3060	1.28
7	Stellate	9S40	06.05.2015	Danube km 197	28.05.2015	3590	1.4

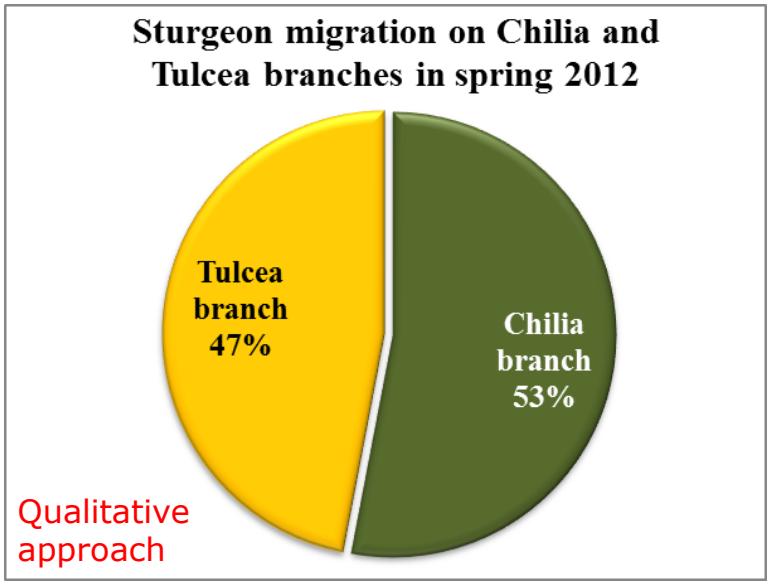
Stellate 9S40

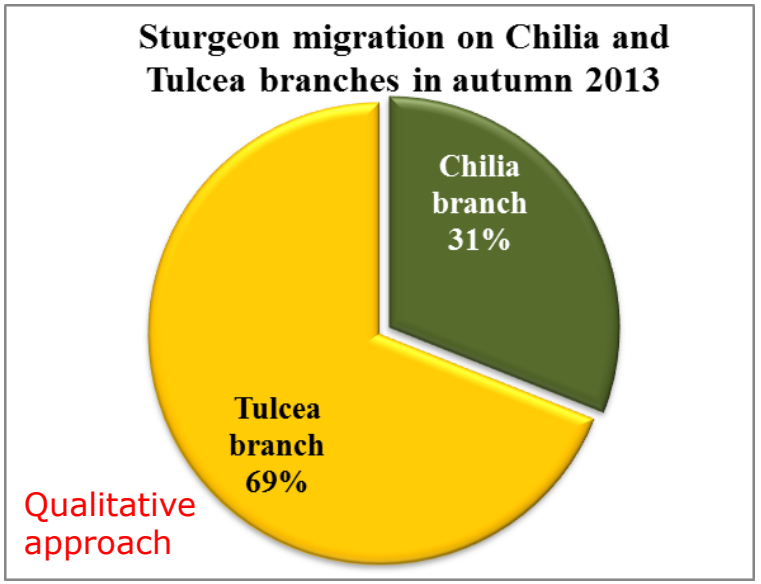
Species	CODE	Release date	Release area	Date of passing the bottom sill	Flow [m^3/s]	Average water velocity [m/s]
Stellate	9S40	06.05.2015	Danube km 197	28.05.2015	3590	1.4

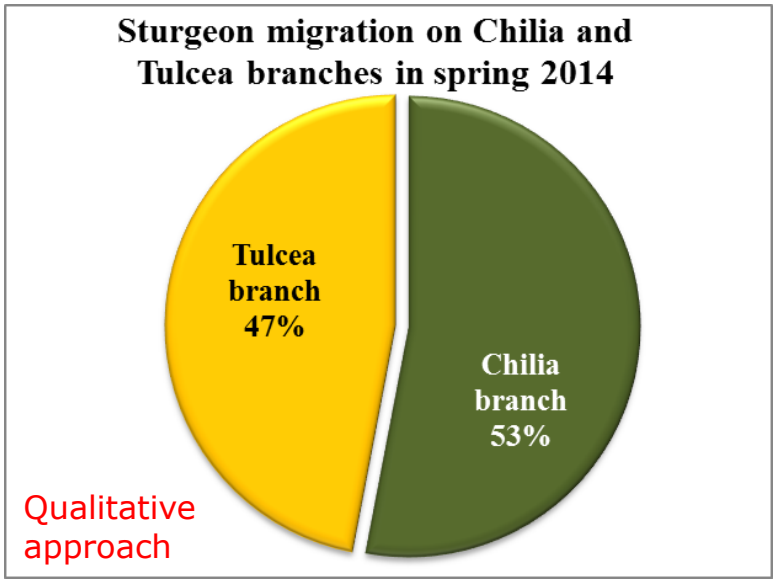




Project proposal to extend the monitoring in the Danube Delta







Regarding the ultrasonic tagged specimens, the receivers' recordings showed that in the spring of 2012, 53% of the specimens that migrated towards the Black Sea used Chilia branch, while during 2013 autumn the percentage decreased at 31% and in 2014 spring reached again the value of 53%.

Project proposal to extend the monitoring in the Danube Delta

Nr. Crt.	COD	Tagging period	Species	Sex	Records Chilia branch	Migration type
1	2S5	A. 2011	Stellate sturgeon	male	24.03.2014	↗
2	3S48	S.2012	Stellate sturgeon	male	24.04.2014	↗
3	5S9	S.2013	Stellate sturgeon	male	04.05.2014	↗
4	6S11	A. 2013	Beluga	male	02.05.2014	↗
5	6S12	A. 2013	Beluga	male	15-16.11.2013	↙
6	6S14	A. 2013	Beluga	male	13-14.11.2013	↙
7	6S21	A. 2013	Beluga	male	24.11.2013	↙
8	6S22	A. 2013	Beluga	male	03.12.2013	↙
9	7S1	S. 2014	Beluga	male	07.05.2014	↙
10	7S28	S. 2014	Stellate sturgeon	male	23.06.2014	↙
11	7S32	S. 2014	Stellate sturgeon	male	01.05.2014	↙
12	7S33	S. 2014	Stellate sturgeon	male	24.06.2014	↙
13	7S42	S. 2014	Stellate sturgeon	male	13.05.2014	↙

Spring migration 2014 (Returns tagging sturgeon in 2011, 2012, 2013)

Autumn migration 2013 (Tagging sturgeon in 2013)

Spring migration 2014 (Tagging sturgeon in 2014)

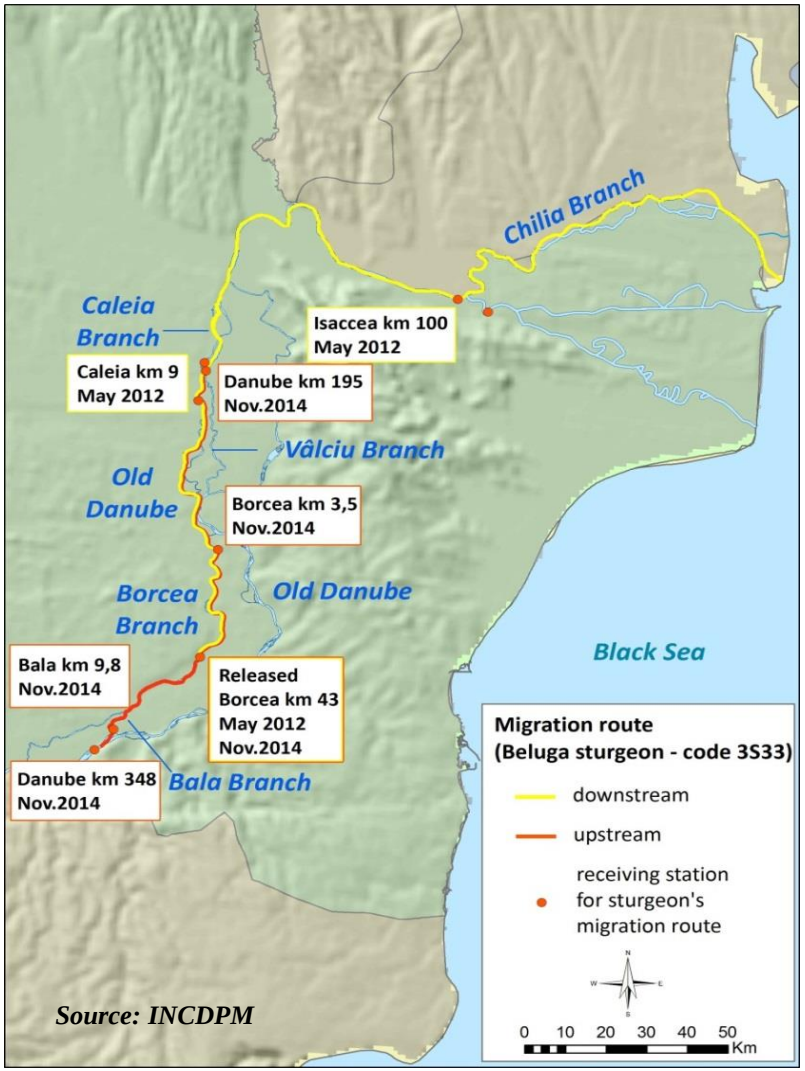
A.	= autumn
S.	= spring
↗	= upstream migration
↙	= downstream migration

The data are based on the captured and ultrasonic tagged sturgeons from Calarasi-Braila sector.

Project proposal to extend the monitoring in the Danube Delta

Example of necessities to extend the monitoring project

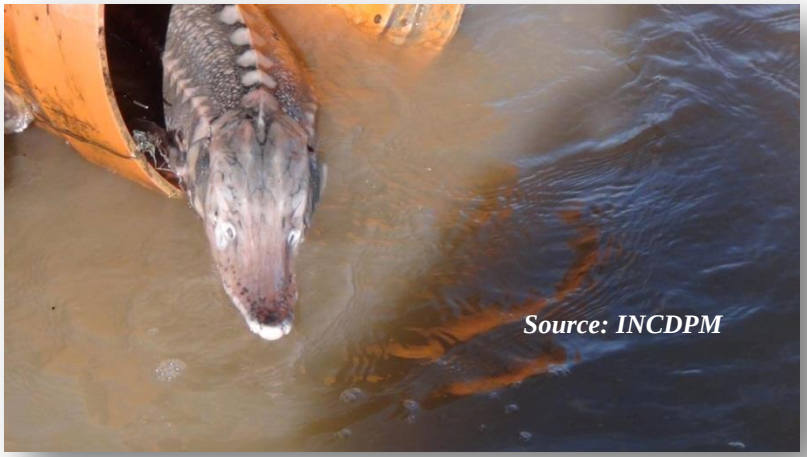
- ✓ The specimen of beluga with the code 3S33 beluga was marked in May 2012, on the Borcea branch, at km 43
- ✓ After breeding, data interpretation indicated that the specimen descended into the Black Sea on the Chilia branch
- ✓ During the fall 2014 the specimen returned on the section monitored after only two years and a half, and passed the obstacle of the Bala branch in November.

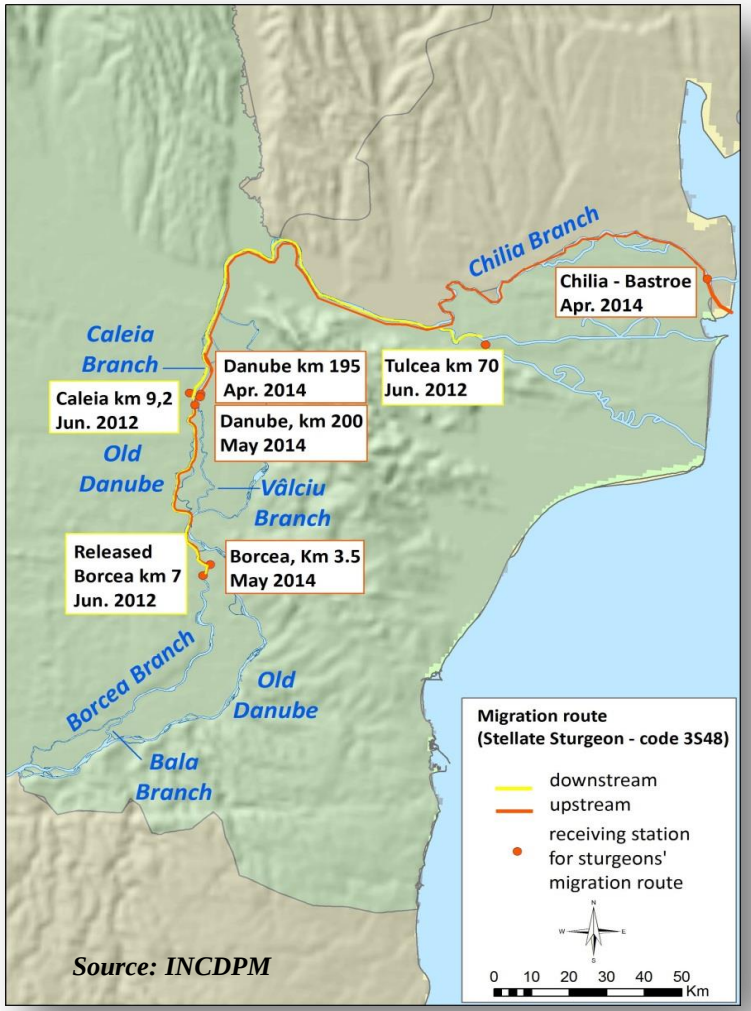


Project proposal to extend the monitoring in the Danube Delta

Example of necessities to extend the monitoring project

- The Stellate sturgeon specimen code 3S48 was tagged in June 2012 and released on Borcea branch
- After releasing, the specimen migrated downstream, last time being registered by the monitoring system located on Tulcea branch
- Interesting is that the specimen has returned for a new cycle of reproduction after about two years from tagging in 2014

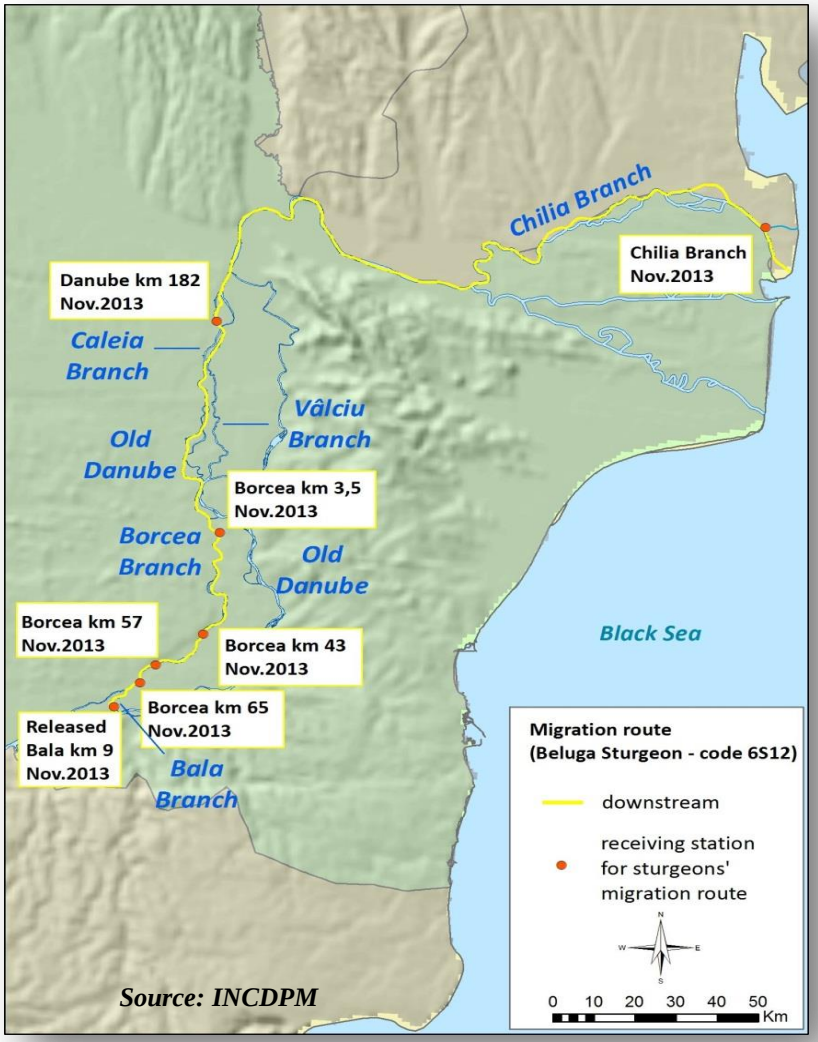




Project proposal to extend the monitoring in the Danube Delta

Example of necessities to extend the monitoring project

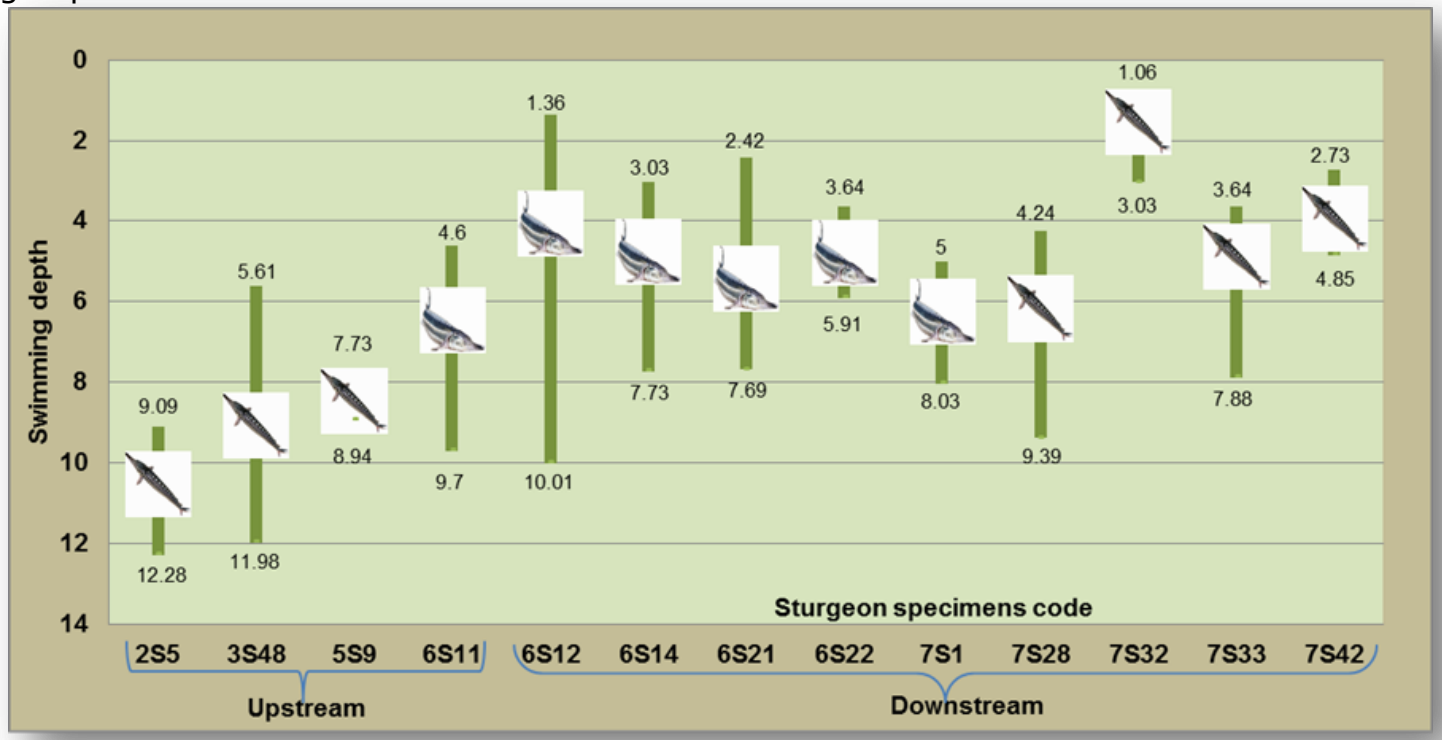
- The Beluga specimen with the code 6S12 was tagged in November 2013 and released on Bala branch
- After release, the specimen migrated downstream to the Black Sea
- Being recorded in the last phase by the two monitoring systems located on Chilia branch.



Project proposal to extend the monitoring in the Danube Delta

Preliminary results - need to be clarified the distribution of no. of sturgeons which migrates on each branch of Danube Delta

- ✓ The graph presented below highlights the sturgeon specimens that passes through Chilia branch for both upstream and downstream migration
- ✓ For downstream swimming depth it can be seen a minimum value of 1.06m, while for downstream swimming depth the minimum value is 4.6 m.



Conclusions

- ✓ In the period 2010-present they were captured and ultrasonic/"anti-poaching" tagged for monitoring 315 species of sturgeons: beluga, sturgeon, stellate sturgeon and starlet for determining their migration routes. **So, INCDPM has the largest and unique informational volume regarding sturgeons' migration on Lower Danube at European level**
- ✓ INCDPM, based on the experience accumulated *in situ,* developed two monitoring systems (DKTB and DKMR) whit the purpose to reduce/eliminate the lose of informational volumes referring on sturgeons migration (time detection, swimming depth and water temperature)
- ✓ Also, INCDPM developed a tagging procedure and technique **assisted by a veterinarian** so as to assure **minimal stress** for the captured specimens including the training of authorized fisherman's
- ✓ **Was demonstrated** by INCPM team that sturgeons can be scientific fished in the whole period of the year and that the frequency of the maximum captures by months are strongly dependent on hydro-dynamic and climatic variations conditions
- ✓ **Was demonstrated** also that the bottom sills from Caleia and Bala Branches located in the Lower Danube does not stop until present the sturgeons migration routes. By monitoring post-construction two more years for Caleia branch and 4 more years for Bala branch (in accordance with EU requests), INCDPM team will **eliminate the risks of longitudinal connectivity interruption** by elaborating also preventive solutions in case of necessity
- ✓ Based on the last results referring on the passing the bottom sill from Bala Branch by the Beluga specimen (code 10S9), in the present INCDPM team install more monitoring gates systems (DKTB and DKMR), so as to determine the capacity of sturgeons swimming against the water current knowing that **does not exist worldwide *in situ* data in this respect.**

Recommendations

Based on the preliminary informational volume was demonstrated that sturgeons use Clilia branch for migration routes to and from the Black Sea, and on the fact that there was performed a preliminary distribution in terms of the annual number of sturgeon ultrasonic tagged between Chilia and Tulcea, **INCDPM recommends the following:**

- ✓ Ensuring on the monitoring period the longitudinal connectivity on the two bottom sills (from Caleia and Bala branches), obtaining the fishing scientific authorizations throughout the entire period of monitoring considering that INCDPM owns funds from the project entitled *"Monitoring the environmental impact of the works regarding the improvement of the navigation conditions on the Danube River between Calarasi and Braila, km 375 and km 175"*
- ✓ **The expansion of the monitoring project on the entire Danube Delta to perform the number of sturgeons distribution map depending on migration routes**
- ✓ Expanding research on dependence of intense sturgeon migration periods on climatic and hydrodynamic conditions

Recommendations

- ✓ Achieving an integrated monitoring system platform based on numerical modeling corroborated with 3D/2D bathymetric measurements, respectively monitoring stations/gates of sturgeons migrations so as to be performed a clear and scientific fundamental evidence at the level of Danube river countries on sturgeon situation as an indicator of the ecological status of the river; based on numerical prognosis performed, preventive solutions can be developed to reduce/eliminate the risk of interruption of longitudinal connectivity of the Danube river/ the sturgeon migration routes, also evaluation the impact of climate change phenomena on the sturgeon migration routes.

NATIONAL INSTITUTE FOR RESEARCH AND DEVELOPMENT IN ENVIRONMENTAL PROTECTION

Bucharest, ROMANIA

Webpage: http://incdpm.ro/production/en
E-mail: incdpm@incdpm.ro
Phone: +40213052600

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http://incdpm.ro/production/ro/proiecte/proiecte-in-derulare/21-proiecte/proiecte-in-derulare/110-monitorizarea-impactului-asupra-mediului-a-lucrarilor-de-imbunatatire-a-conditiilor-de-navigatie-pe-dunare-intre-calarasi-si-braila-km-375-si-km-175