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Historical Overview of Sturgeon Fishery in the Lower Danube River

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Abstract: Historical information about sturgeon fisheries along the Lower Danube is reviewed. Most of data come from manuscripts or diaries left by travellers. At the beginning of the 16th century, many of those who travelled to the Balkans and reached Dobrogea, Moldova, Wallachia or Transylvania described the local customs of people in these areas, including fisheries along the Danube River, noticing the richness of the fish and especially sturgeons. The species of the family Acipenseridae impressed with their unusual size but also with the special methods used by fishermen for capturing these large fish. The travellers wrote about the large number of captured sturgeons, methods of preparation of caviar, storing of caviar and fish and the places where fishermen merchandised their fish products.

Key words: Sturgeon, fishing, trade, large river, *Acipenser*, *Huso*, Black Sea

Introduction

The Danube River is the second largest river in Europe after the Volga River; it is 2,780 km long, passing through ten countries, four capital cities and has a medium discharge of 6,550 m^3/s before its inflow into the Black Sea (Diaconu et al. 1963, Gâștescu 1990). The Upper Danube River (UDR) is 1,060 km long and it lies between its springs and Devrin Gate or river kilometre (rkm) 1,800, the Middle Danube River (MDR) is 725 km long and it stretches between Devrin Gate and Baziaș (rkm 1,075). The Lower Danube River (LDR) is 1,075 km long and extends from Baziaș to the Black Sea (Diaconu et al. 1963). Historically, four migratory (anadromous) species of Acipenseridae, beluga sturgeon (*Huso huso*), Russian sturgeon (*Acipenser gueldenstaedti*), stellate sturgeon (*A. stellatus*) and common sturgeon (*A. sturio*) as well as two freshwater resident species of the same family, i.e. sterlet (*A. ruthenus*) and ship sturgeon (*A. nudiventris*), used to be present in the Danube River.

Herodotus wrote in the 5th century BC about the Danube River and other rivers that flow into the Black Sea, mentioning a "giant fish without bones" called Antacei (sturgeon) captured in the Dnieper River (Walker 1910). Later, Pliny the Elder (AD 23–79) wrote about a sturgeon, called by him "acipenser", which he said was the most prized fish (Giurescu 1964). Documents from the antiquity about fishing in the mouth of the Danube River are linked to the city of Histria. One document regarding the fishing rights of Histria is the letter by Flavius Sabinus, the governor of Moesia (year 50–57), addressed to the magistrates and inhabitants of the fortress, saying that the inhabitants of Histira are exempted from fishing fees. Sturgeons represented one of the most important fish resources for the Histrian inhabitants (Manea 1980). The sturgeons were considered special fish in the 14th and 15th cen-

turies, so special that they were imprinted on the emblem of some localities or appeared in the paintings of the time (Waidbacher & Haidvogl 1997, Haidvogl et al. 2014). Because the sturgeons migrated from the Black Sea to the Danube River far upstream, they were captured by fishermen from many settlements located along the Danube up to Central Europe. Some anadromous adult sturgeons used to migrate for spawning as far as rkm 2,375 to Regensburg, Germany (Hensel & Holcik 1997). The spawning grounds of sturgeons on the gravely bottom branches of the Danube River inland delta downstream Bratislava and sturgeons fishing sites upstream of Komárom in Hungary (rkm 1767), were famous during the Middle Ages (Balon 1968). In the 15th – 18th century, sturgeons were caught regularly in the Austrian Danube River, being still abundant at the Viennese fish market; most of the fish sold there were captured from the Hungarian Danube River side (Wsla Karl 1716). The migratory sturgeon species occurred until the 20th century in this stretch of the river, stories about their abundance in previous centuries were still frequent and described by the travellers (Wsla Karl 1716, Winter 1886). The Iron Gate (IG) gorges area was also very famous for its sturgeons fishing sites. In 1720, Marsigly reported that Turkish fishermen of the Ada Kaleh Island brought daily as many as 100 large beluga sturgeons captured in wooden pole traps installed in the IG gorges (Fig. 2) (Kohl 1841, Zirojević 1995). Cornelio Magni that travelled to Moldova in 1672 described sturgeon fishing as the most important activity form the Danube River; Cornelio said that he bought two beluga sturgeons during their trip, which weighted 32 kg (Holban et al. 1980). At the beginning of the 20th century, according to Antipa (1899), "due to the intense fishing of beluga sturgeon in the Lower and Middle Danube River, this species has always been exposed, their number dropped so much that it became a real rarity in Austria today".

Later, the fish migration in the Middle and Lower Danube River was disturbed due to the works done for improving the navigation on the river and the construction of the dams. Today, there are only four wild sturgeon species present in the LDR (three anadromous and one resident) and just one resident species in the MDR. The sterlet sturgeon that lives entirely in freshwater is still present in the Middle and Lower Danube River. The wild sturgeon stocks have been plummeted because of the unsustainable social, legislative, institutional and economic frameworks that led to the decline of sturgeon population that once sustained an important fish industry. Over-fishing, illegal practices, the lack of regulation, destruction and disruption of habitats has led to the rapid decline of sturgeon stocks in the Danube River (Graham & Murphy 2007, Năvodaru et al. 1998).

Materials and Methods

We reviewed data published in scientific articles, old journals or books written by travellers about their journeys on the Balkans (Fig. 1). Besides other things described in these texts such as local customs, religion, food, etc., these travellers wrote about fishermen and fisheries along the Danube River and its delta, including about the large amount of sturgeons captured by fishermen and caviar that was exported to other big cities.

Results

Since the species of the family Acipenseridae are the largest and the most valuable fish of the Danube River, they have long attracted attention. Information on their fishing in the river indicates that in the past centuries the number of sturgeons used to be much larger than today. Beluga sturgeon have been captured throughout the entire LDR sector, from the mouth of the river to the Iron Gates, and then in the Middle Danube River up to Vienna. Stories by travellers also indicated that in some places sturgeon fishing used to be much more productive than in other places (Giurescu 1964). Nicolaus Olahus wrote in 1536 in his historical-literary books about the abundance of sturgeons (antacei) in the Danube. He described the way sturgeons were captured between Zemun (whose ancient settlement was known as *Taurunum*) and Bratistava (Latin name: *Posonium*) in many places where water was deeper (Gyongyver 1999). During November, the fishermen blocked the river by setting up many poles on the river bottom, making a wooden pole trap and leaving a small exit where they installed a net to collect fish. On the shore, other people made big noise with cannons to scare the sturgeons in order to lead them to fishermen's trap. Some of the captured sturgeons were more than 3.6 m long (Adam 1763).

Iron Gate Gorges Area

In 1653, Paul d'Alep describing the Iron Gates gorges area has stated that "every year in this whirlpool 70-80 ships are broken, the noise made by water is very loud and the ships are pulled upstream by people from the riverbanks using ropes. Sometimes,

Fig. 1. Lower Danube River (Iron Gate, Silistra, Galati, Chilia and Sfantu Gheorghe).

Fig. 2. Sturgeon fishing in the Iron Gate Gorge (from Marsigli 1726).

you can see large sturgeons and carps killed by these whirlpools" (Bulgaru et al. 1976). Later, in 1768 sturgeon fishing was very active in the Iron Gates region as the Austrian Johann Friedel observed during his travelling with the boat on the Danube River from Palanca Noua to Orsova: "In this part of the river, many monsters are caught" (Giurescu 1964). In his book, L.F. Marsigli (1658–1730) "Description of the Danube" left us a drawing (Fig. 2) with 11 fishermen at the IG gorges area; two of them fishing in the river using a sort of trap, two fishermen taking out from their boat two large fish similar to the beluga sturgeon, other four fishermen extracting caviar from a fish on a table and other three filling a barrel with caviar or salted fish (Marsigli 1726).

Silistra

Silistra (nowadays in Bulgaria) also used to be a good sturgeon fishing ground according to Conrad Jacob accounts (second half of the 17th century). Upon his arrival in Silistra, the Fazli-Pasa sent to his guest several big and fat beluga sturgeons captured from the Danube River (Conrad et al. 1937). Paul d`Alep described his visit to Silistra in 1653 where many fishermen used to catch sturgeons during the winter when the river was frozen; they cut holes into the ice and caught 120 kg beluga and Russian sturgeons. According to Paul d`Alep, once Melek-Ahmed Pasa of Silistra caught 70 big beluga sturgeons at the town. Usually soon after the sturgeon were captured, fishermen prepared the caviar

Fig. 3. Beluga and Russian Sturgeons at the Galati market around 1900 (from Antipa 1916).

in glass with salt and deposited the fish in the barrels. The production was exported it to Moldova, Don and even to Denmark. Along the Danube River, there used to be 2000 fishing places; in some of them, sturgeon merchants were making good money from this trade (Bulgaru et al. 1976).

Galati Harbour

The richness in fish of the Galati Harbour (Fig. 3) located on the Danube River also impresses Catholic Bishop Bandini, who in 1646 wrote: "Very large beluga and catfish are caught here; there's so much freshwater shellfish, fish and crayfish that you cannot believe it" (Giurescu 1964). At the Galati Harbour, the monks (in 1646) used to cover the windows with animal skins or swim bladder of beluga sturgeons caught in the Danube River (Neale 1818). The tasty fish caught in the Danube River and in other rivers of the area was served by governors during periods of fasting (Recordon 1821). John Newbery, travelling downstream the port of Galati at Reni (nowadays in Ukraine), described that the caviar was extracted from ovaries of the beluga sturgeon and the Russian sturgeon and separated from the membranes by passing it though a sieve. After extraction and separation, the caviar was salted according to the taste of the markets and deposited for three days into small barrels that had a hole, allowing the salted water to drain from the caviar barrels. After three days, the caviar was well cleaned, using freshwater, and deposited again in little barrels for draining. To speed the water draining process, they put big stones over the caviar. After further three days, the bottoms of the barrels were replaced with a new one and the caviar was ready for shipping (Newbery 1905).

The fisheries from the banks of the Danube River used to prepare caviar, salted fish and isinglass that were shipped to the Bucovina and Transylvania but also to further location such as Constantinople (Istanbul), where the fish was much appreciated for its taste (Laurencon 1822, Pascu 1944). At the Galati Harbour, Robert Bargrave considered that he found a lot of cheap fish; he bought one with 2 pence and fish was large enough to feed five or six persons. Sometimes fishermen captured very large beluga that had to be removed from the water together with the cage, in which the fish was kept alive, using six or eight oxen (Bargrave & Babinger 1936).

Chilia Fortress

The Chilia Fortress is located on the Danube River bank on the Chilia branch. The fortress used to be well known for its fishing grounds, where large amount of sturgeons were captured. There lived Lipovans and Cossacks, known to be very good sturgeon fishermen, which usually were fishing for the governors of the area (Karaczay 1818, Iakovenko 1828). In 1653, during his journey through Moldova and Dobrogea, Paul d'Alep travelled from Galati downstream the Danube River; before reaching the Chilia Fortress, he passed close to fishing grounds where the fish was caught for the governors of the area, using wooden pole fish traps (Figs. 4 and 5). He related that all around Chilia, the Tatars villages had fourteen wooden pole fish traps for catching fish, especially sturgeons. The poles were stuck into the river bottom in such way that the fish would be guided to a narrow part of the trap. The poles (c. 12,000 poles) were sharpened like a spear and stuck into the river bottom, aligned in such way

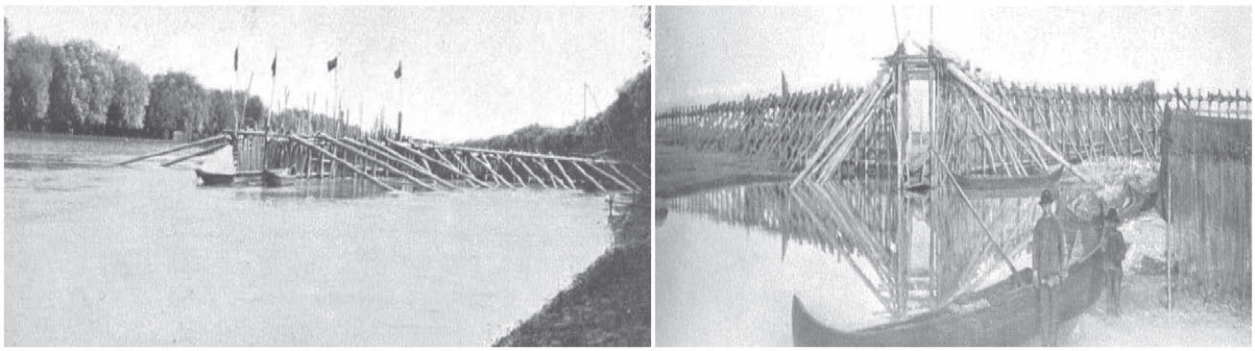

Fig. 4. Wooden pole traps constructed by shucking poles in the bottom of the river (from Antipa 1916).

so to guide the fish into the trap (Bulgaru et al. 1976, see Figs. 4 & 5). In the middle of the river, there was a space for the boats to pass. At the end of the poles row where the trap was narrow, the fishermen installed a net made of vine offshoot. When the winter was coming all the structures installed in the river were dissembled, and mountains of poles could be seen on the riverbanks. Usually the fishermen brought new poles for maintaining the wooden pool fish traps from Isaccea Town (Giurescu 1964). The Jesuit monk Mancinelli described that as soon as you entered the Danube River from the sea, on the both sides of the river there were wooden forks stuck in the ground with beluga sturgeon flesh in it for drying. In Chilia, fishermen from the villages around used to sell fish and caviar very cheap and five big beluga sturgeons with could be purchased for just three shillings (Neale 1818, Mancinelli 1586, Bachi 1621, Ionescu 1904). Paul Rycaut, during his trip through the Balkans in 1660-1666, witnessed that the Danube River was full of tasty fish. The fishermen were catching beluga sturgeon (Husones) in different periods of the year and they used to store the captured fish. He has mentioned that "one well known fishing place is located on Chilia branch, where the fishermen are catching many sturgeons, which are salted and exported". He also mentioned that there were ships coming from Constantinople to buy sturgeons and caviar, which was salted and deposited into barrels for shipping (Holban et al. 1980).

Sturgeons catches, sizes and trade

The largest known beluga sturgeon was captured at the mouth of the Danube River by fishermen from St. Gheorghe Village and weighted 1,161 kg (Antipa 1909). Larger beluga sturgeons were captured in the Volga River at Saratov in 1869 (1,251 kg) and at Sarepta in 1913 (1,451 kg; see Seeley 1886). Describing the fisheries from the Sfantu Gheorghe branch, Antipa described that the most of the captured beluga sturgeon weighted about 100-250 kg, but sometimes the fishermen captured larger sturgeons weighing 590 kg. In 1890, at Sfantu Gheorghe was caught a beluga sturgeon of 882 kg that had 126 kg of caviar (Fig. 6). Several hundred years earlier (in 1653), writing about the length of the sturgeons and caviar extraction, Paul d'Alep mentioned that usually, the captured beluga sturgeons had the length of 5 to 6 m. When he spoke about the weight of the caviar extracted from large beluga sturgeons he said that "from each sturgeon belly, they extract five to ten "Scales, balances" of the caviar, "cântare" (in Romanian) or kantar (in Turkish). One kantar having about 57 kg, meaning that according to Paul d'Alep 's estimation you could extract over 280 kg of caviar from one large beluga sturgeon (Bulgaru et al. 1976). Knowing that the gonad index (GI) for sturgeons is 20-30% of the body mass (Lazu 2008), we could conclude that a fish should weight around 2,000 kg, to be able to extract such a large quantity of caviar. Paul d'Alep wrote that between September and December, the fishermen usually caught up to 700 beluga sturgeons (Bulgaru et al. 1976). During his trip, Paul d'Alep bought one sturgeon weighting 100 kg and he employed a butcher who extracted the caviar that was salted and dried by putting it between two boards and pressed with heavy rocks. Nothing was lost, the skin, cartilage, fat were salted and deposited in the barrels. When they wanted to eat some salted beluga, they boiled water into a pot with onion and saffron and then added the fish (Bulgaru et al. 1976).

According Francois De Pavie (1563–1611), many beluga sturgeons were caught at the mouth of the Danube River. They were so large that one beluga was enough to load a single mule. The fishermen used to catch them for their caviar, which usually was prepared and delivered to Greece and other counties

Fig. 5. Fishing with wooden pole fish traps at Braila (from Kunike 1826).

(Iorga 1895). Carol Guébhart in his book "Memories from Moldova" (1842) wrote about the streams of Moldova that flew into the Danube River, which provided large quantities of fish, including sterlets. The fishermen brought beluga sturgeons of 4.5 – 6 m form the Danube River to the cities of Moldova (Callimachi 1947). Other zoologists and naturalists described sturgeons as reaching lengths of 6-7.3 m (Giurescu 1964). Vaillant wrote about the fish from the Danube River saying that the species of Acipenseridae were very large, especially beluga sturgeons; he gave the example of the Giurgiu Town where the fishermen usually captured sturgeons of 2.7 m (Vaillant 1844). Niccolo Barsi related that "at a distance of a mile from Chilia was a fishery where you could find all kinds of the Danube fish which was sold at very small pierces, especially beluga sturgeon and catfish. Every morning you can find at least 1000 fresh beluga and catfish lying on the bank, which was salted after the caviar was extracted. That is why people are coming from Constantinople, Poland, Hungary, Moldova and other countries here to buy fish here because it is very cheap" (Giurescu 1925). During the 15th - 19th century, those who travelled along the banks of the Danube River were amazed by the low prices of the sturgeons and their caviar, but this was changed at the beginning of the 20th century. Antipa wrote in his book "*Ichthyological fauna of Romania*" that the beluga sturgeon was the most valuable fish that lived in the Danube River; just one adult female with caviar could worth as much as five pairs of oxen (Antipa 1909).

The sturgeons of tributaries of the Danube River

During the spawning migration, some sturgeons entered the Danube River tributaries and migrated for long distances in these rivers. In 1778, Benko József wrote that the sturgeons migrated from the Danube River into the Tisza River and then into the Mureș River (Giurescu 1964). Sturgeon captures were also reported in other tributaries of the Danube River, for example Felice Caronni that travelled in Transylvania found a lot of sturgeons and other fish species in the Tarnava River close to Sibiu (Caronni 1812). In the Cris River catches of common trout, chub but also sturgeons had been registered (Muller & Ackner 1865). In the past, catches of sturgeons were common in all the tributaries of the Danube River (Cernovodeanu 1996).

Sturgeon fishing in Romania after 1900

Fishing in Romania around 1900 was based on royal decree no. 3904 from October 10, 1896 and published in " Monitorul Oficial " no. 153 (Legea pescuitului 1896). For the first time, this law regulated fishing in Romania and established the ownership of the Romanian government on fish resources. Before this law, the fishing rules had been established by the Wallachian rulers and were not uniform. For example, the ruler "Mircea the Elder" established the fishermen duties from the Danube River area with a decree in 1409. By this decree, it was established that the fishermen had to capture beluga sturgeons for three days, every year for the ruler (Giurescu 1964). The 1896 law introduced a ban on fishing between April and May for sturgeons, to ensure that fish spawning in the Danube River was not affected. The 1896 law led to an increase in reported sturgeon captures and had a positive impact on sturgeon populations. Interestingly, more than 100 years earlier, there had been a concern for building fish passages in the areas with dams. The law stipulated that the

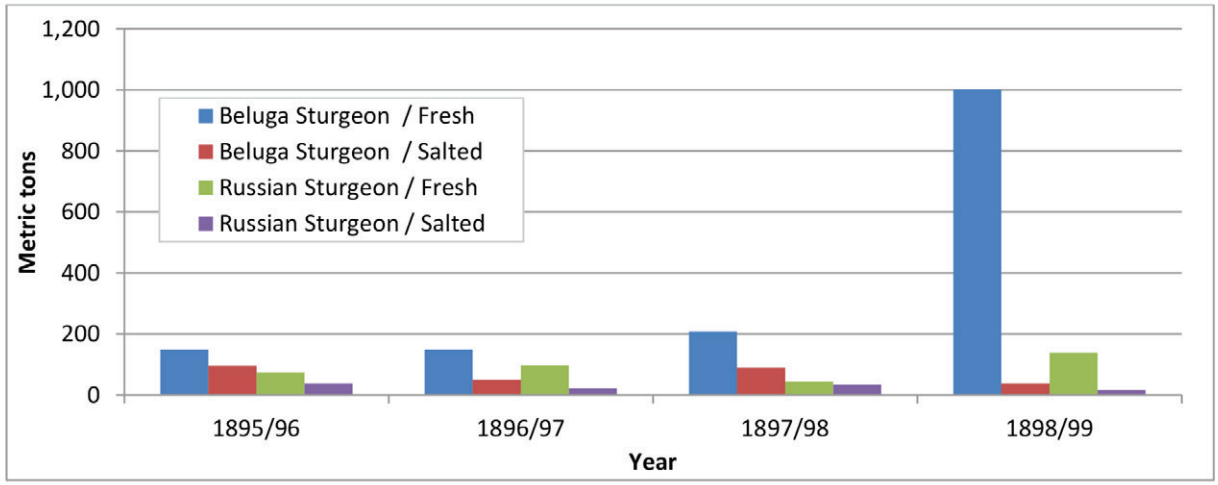

Fig. 6. Catches of sturgeon in the mouth of the Danube River in 1895-1899 (from Antipa 1899).

government might require to the owner of the dams that blocked the course of the rivers / streams to build fish passage to ensure fish migration (Legea pescuitului 1896). The law also stipulated a fishing ban, 30 m upstream and 30 m downstream of the built-up fish passage. Later in 1974 a new law was given "Fisheries Act" that banned sturgeon fishing in front of the mouths of the Saint Gheorghe branch, and Sulina branch up to 5 km in the Black Sea and a 2 km wide corridor, 1 km on each side of these two branches. In front of the Chilia branch, the forbidden fishing corridor width was 1 km south of the axis of the arm. It was also banned sturgeon fishing throughout the year, with hooks lines in the Danube River, including its arms. From March 15 to May 15 it was forbidden to fish the sturgeons in the Black Sea sector and in the Danube River up to the mouth of the Prut River. The 1974 law was valid until 19 April 2001, when was repealed and replaced by a new law 192/2001. Because the very low catches of sturgeons resulting from the fishing indicated the risk of the Danube sturgeons to be extinct, in 2006, Romania introduced a total ban on sturgeon fishing in the Danube River and Black Sea for 10 years, period which was extended in 2016 for another five years. This total ban on fishing for sturgeon in the Danube River for commercial purposes was followed by the other Lower Danube River countries (Ukraine, Bulgaria and Serbia). Since 1994 Romanian Danube Delta Biosphere Reserve has been conducting research to improve the migratory sturgeon population status from the Danube River. The sturgeon conservation efforts continued in the years that followed. Progress has been made in terms of research; there have been done telemetry studies, behaviour studies and genetics studies, that aimed to identify the habitats used by sturgeon species and a better understanding of the behaviour and distribution of sturgeon populations in the Lower Danube River and Black Sea (Holostenco 2013, Kynard 2002, Onără 2011, Paraschiv 2004, Suciu et al. 2004, 2005, 2002, 2013, 2016). The sturgeon restocking program was implemented in 2005–2015 as an additional measure to support the sturgeon population of the Danube River, when half a million young of the year (YOY) from all four wild sturgeon species were restocked in the river (Cristea 2016, Holostenco et al. 2019, Iani et al. 2019).

Discussion

The presence of beluga sturgeon in the Middle Danube River was relatively common, fishing being a common occupation for the inhabitants that lives along the river banks. The archaeological excavations in the settlements from the Iron Gates area revealed many prehistoric sturgeon remains, demonstrating that sturgeons have been caught since ancient times (Bartosiewicz & Bonsall 2004). During the fifteenth – nineteenth century, travellers related that the prices of the sturgeon's products especially the caviar was cheap, but this was changed with the time, the beluga sturgeon became the most valuable fish which lives in the Danube River (Antipa 1909). The caviar was a very popular in the Russian tradition, and Tsars establish their exclusive authority in the caviar trade, this fact may contribute to the high price of these products (van Uhm & Dina 2016). The caviar has turned into a delicacy of Russian Tsars exclusive enjoyment, but Russians were not the first to process caviar, the ancient Egyptians, Greeks, and Persians mentioned the caviar in theirs

writings (Arsenault et al. 2008). In 1583-1585, the Italian Sivori travelled in "Wallachia" where he has seen the "infinity of beluga sturgeons" captured in the Danube River; Niccolo Barsi also wrote that in the fortress of Chilia he has seen thousands of sturgeons captured by the fishermen every day. Later the Austrian General Marsigli wrote in 1690, that the fishermen usually bring on the Ada-Kaleh island (IG area close to Orsova) "50, 60 and sometimes 100 beluga sturgeons" daily, and the French consul Peyssonel related in 1762, that " the Chilia's main wealth is represented by beluga sturgeon fishing". In the same time the Austrian Johann Friedel related in 1768 about Orsova saying: "In this part of the river, many beluga sturgeons are caught". However, with the time the negative effects of overfishing have begun to be seen in the reduced number of captured sturgeon in the Danube River (Giurescu 1964). In 1835, J. de Hagemeister finds that beluga sturgeon is "much less abundant and in small quantities" in the Danube River (Giurescu 1964). Decrease in sturgeon catches was much more obvious at the end of the 19th century and early 20th century (Antipa 1909, Otel 2007). Not only the number of captured sturgeon has fallen, moreover two sturgeon species have become increasingly rare. The common sturgeon became extremely rare at the beginning of the 20th century, 1-3 specimen was captured per year, and ship sturgeon has also become a rarity, both species disappearing after 1960 (Otel 2007). The sturgeon catches in the Danube River and at the mouth of the Danube River branches Chilia, Sulina and Saint George, have also fallen, from an average of 214 t per year between 1953 and 1973, when it varied from 134 t (in 1970) to 279 t (in 1954), catches declined in 1996 to less than 5 tons (Otel 2007). After 1977 the decline was almost continuous, the short recovery of the catches in the early 1980s was due to the increase in fishing effort. All three anadromous sturgeons (beluga, Russian and stellate sturgeon) species that are still present today in LDR, are Critically Endangered according International Union for Conservation of Nature (IUCN) ver 3.1 (2001) (IUCN 2017). Also, according to the IUCN, the sterlet is a vulnerable species. Beluga, stellate sturgeon and the sterlet are also listed in the protected species list of the Bern Convention, Appendix III. As most of sturgeon species are long-distant migrants and live both river and marine habitats during different parts of their live cycles, protection and population recovery measures have to be implemented on a wide regional scale in order to be effective. The survival of sturgeon species as basis for a sustainable fishery depends on efficient protection of their essential habitats for wintering, spawning in the river as well as feeding habitats. Knowledge of their migration routes and timing are prerequisite for establishing adequate prohibition periods to ensure critical levels of recruitment from natural spawning, needed for a sustainable fishery.

References

Adam F. K. 1763. Nicolai Olahi Hungarie liber I. Origines Scytharum et Chorographica descriptio Regni Hungarie. Nicolai Olahi HUNGARIE liber II. Atila sive de initiis Atilani per Pannonanis Imperii et rebus bello ab eodem gestis, Vindobonnae.

Antipa G. 1899. Legea pescuitului si rezultatele ce le-a dat. Institutul de Arte Grafice si Editura „Minerva" Bucuresti 1899, Strada Regala 6, (Hotel Union)

Antipa G. 1909. Ichthyological Fauna of Romania (in Romanian), Institutulde Arte Grafice "Carol Göbl" Bucuresti: 251–254.

Antipa G. 1916. Pescăria si pescuitul in Romania, Academia Romania, Publicațiunile fondului Vasile Adamachi Tomul VIII. – No. XLVI, Librariile Socec& Comp., C. Sfetea, Pavel Suru, Viena Gerold & Comp., Berlin R. Friedlaender & Sohn. , Lipsca O. Harrassovitz, pp. 340–344.

Arsenault N., Christopher R., Allegra A. & Rachel M., 2008. Explorers, Traders & Immigrants: Tracking the Cultural and Social Impacts of the Global Commodity Trade. Hemispheres The International Outreach Consortium at the University of Texas at Austin http://www.utexas.edu/cola/orgs/hemispheres/

Bachi A.D.L. 1621. Scelta de curiosita letterarie, inedite o rare da secolo XIII al XVIII, in "Appendice alla collezione di opere inedite o rare, diretta da Giosuu Carducci" no. CCXXXI. de Viaggio a Constantinopoli Tommaso Alberti (1609-1621), Bologna, presso Romagnoli dall'Acqua.

Balon E. K. 1968. Von dem Schicksal des Hausens, der anderen Störe und weiterer Donaufische. In: Balon E. K. (Ed.): Einfluß des Fischfanges auf die Fischgemeinschaften der Donau. Archiv für Hydrobiologie, Suppl. 34 (Donauforschung III) (3): 228–249.

Bănărescu M. P. 1964. Fauna Republicii Populare Romîne, Volumul XIII. Pisces - Osteichthyes (pești ganoizi și osisi). Editura Academiei Republicii Populare Române, București

Bargrave R. & Babinger F. R. 1936. Un voyageur anglais dans les pays roumains du temps de Basile Lupu, Bucuresti. An. Acad. Rom., Mem. sect. ist. 17: 1–155.

Bartosiewicz L & Bonsall C. 2004. Prehistoric fishing along the Danube. Antaeus (Budapest) 27: 253–272.

Bulgaru D., Stoicescu M. M., Decei A. & Mustafa A. M. 1976 Calatori străini despre Tarile Romane Vol VI. Academia de Ştiinţe Sociale si Politice a Republicii Socialiste Romania, Institutul de Istorie " N. Iorga"; Editura Ştiinţifica si Enciclopedica Bucureşti.

Callimachi S. 1947. Pagini inedite despre Moldova. Insemnarile unui calator strain din intdia parte a veacului al X1X-lea, Bucure§ti, 1947, pp. 9–39.

Caronni F. 1812. Mie osservazioni locali, nazionali, regionali, annquarie sui Valacchi, specialmente e Zingari transilvane, Milano.

Cernovodeanu P. 1996. Un exposé sur les Principautés Danubiens pendant la période du Règlement organique par le colonel Ivan Botianov. In: Miscellanea in honorem Radu Manolescu emerito, Bucuresti, pp. 297–318.

Conrad J. & Babinger F R. 1937. Hildebrandt`s Dreifache schwedische Gesandtschaftsreise nach Siebenburgen, der Ukraine und Constantinopel (1656-1658). Leiden, 23 p.

Cristea V. 2016. Evaluarea supraviețuirii și răspândirii în Marea Neagră a puilor de sturioni din specii amenințate critic, lansați în Dunărea inferioară România (2013–2015). http://www.ddni.ro/sturgeons/images/Files/rapstprpilot2013.pdf)

Diaconu C. & Nichiforov I.D. 1963. Zona de varsare a Dunării. Monografia hidrologică. CSA – Institutul de Studii și Cercetări Hidrotehnice (ICSH) Bucureşti, pp. 9–11.

Gâştescu P. 1990. Fluviile Terei. Ed. Sport – Turism, Bucureşti, pp. 79–84.

Giurescu C. C. 1925. Le voyage de Niccolò Bassi en Moldavie (1633). Mélanges de l'école roumaine en France, Part I, pp. 295-330.

Giurescu C. C. 1964. Istoria Pescuitului si a pisciculturii in Romania, Vol. 1. Din cele mai vechi timpuri pina la instituirea legii pescuitului (1896); Editura Academiei RPR, Bucuresti.

Graham L. J. & Murphy B. R. 2007. The Decline of the Beluga Sturgeon: A Case Study about Fisheries Management. Journal of Natural Resources & Life Sciences Education 36: 66–75.

Gyongyver A. 1999. Ungaria. Atila – Traducere, editie bilingva. Institutul European, Iasi.

Haidvogl G., Lajus D., Pont D., Schmid M., Jungwirth M. & Lajus J. 2014. Typology of historical sources and the reconstruction of long-term historical changes of riverine fish: a case study of the Austrian Danube and northern Russian rivers. Ecology of Freshwater Fish 23: 498–515.

Hensel K. & Holcik J. 1997. Past and current status of sturgeons in the upper and middle Danube River. In: Sturgeon biodiversity and conservation. Dordrecht: Springer, pp. 185–200).

Holban M., Alexandrescu M. M., Bulgaru D, Munteanu V. & Curtov E. 1980. Calatori straini despre Tar ile Romane. 7. Editura Stiintifica si Enciclopedica Bucuresti.

Holban M., Alexandrescu M. M., Bulgaru D., Cernovodeanu P. & Totoiu I. 1983. Calatori straini despre Tarile Romane. 8. Stiintifica si Enciclopedica Bucuresti.

Holostenco D., Onără D. F., Suciu R., Honţ Ş. & Paraschiv M. 2013. Distribution and genetic diversity of sturgeons feeding in the marine area of the Danube Delta Biosphere Reserve. Scientific Annals of the Danube Delta Institute 19: 25–34. doi: 10.7427/DDI.19.04.

Holostenco D. N., Ciorpac M., Paraschiv M., Iani M., Honț Ș., Taflan E., Suciu R. & Rișnoveanu G. 2019. Overview of the Romanian Sturgeon Supportive Stocking Programme in the Lower Danube River System. Scientific Annals of the Danube Delta Institute 24: 21–43 doi.org/10.7427/DDI.24.04

Iani I. M., Paraschiv M., Honţ Ș., Holostenco D., Tošić K., Taflan E., Suciu R., Georgescu P. L., Iticescu C., Țopa C., Murariu G. & Ciorpac M. 2019 A glimpse of a better future for the Danube's flagship species - first return of stocked sturgeons into the river. Scientific Annals of the Danube Delta Institute 24: 31–40. https://doi.org/10.7427/DDI.24.04

Iakovenko I. 1828. [Present situation of the Turkish principalities of Moldova and Romanian lands, and the Russian region of Bessarabia.] Petersburg, 298 p. (In Russian).

Ion B. 1946. Apulum. Buletinul Muzeului Regional Alba Iulia 2. 1943-1945.

Ionescu M. D. 1904. Dobrogia in pragul veacului al XX-lea. Atelierele Grafice I.V. Socescu, Strada Berzei, 59 p.

Iorga N. 1895. Acte şi fragmente cu privire la istoria românilor. Adunate din depozitele de manuscrise ale Apusului de Neculai Iorga şi publicate cu sprijinul Munisterului de Instrucţie Publică. Bucureşti: Imprimeria statului. Vol. 1.

IUCN 2017. The IUCN Red List of Threatened Species. Version 2017-1.

Karaczay von F G. 1818. Beitraege zur Europaeischen Laenderkunde Die Moldau, Wallachey, Bessarabien and Bukowina Neuste Darstellung dieser Lander, nebst Kupfern verschiedene Trachten derselben vorstellend, Wien: Anton Strauss

Kohl J. G. 1841. Reisen in Siidrussland. Zwetter Theil. Beflarabien – Zur Charakteristik der ponttschen Steppen. Die Kararten, Dresden, Leipzig.

Kunike A. 1826. Der Hausenfang bey dem Dorfe Tufeschty. Wallachay. Lithographie von Adolph von Kunike nach Ludwig Erminy und A. Saar. Aus: Adolph Kunike: Zwey hundert vier und sechszig Donau-Ansichten. Wien.

Kynard B., Suciu R. & Horgan M. 2002. Migration and habitats of diadromous Danube River sturgeons in Romania 1998–2000. Journal of Applied Ichthyology 18(4-6): 529–535.

Laurencon F. G. 1822. Nouvelles observations sur la Valachie, sur ses productions, son commerce, les moeurs et les coutumes des habitants et sur son gouvernement, suivies d'un précis historique des événements qui se sont passes dans cette province en 1821, lors de la révolte de Theodore et de l'invasion du prince Ipsilanti, par un témoin oculaire, Paris, 128 p.

Lazu D., Patriche N., Talpes M., Cristea V. & Metaxa I. 2008. Sturionii din Romania. Editura Excelsior Art, 310 p.

Legea Pescuitului 1896. Legea asupra Pescuitului promulgata prin Inaltul decret regal No. 3904 din 7 Oct. 1896 si publicat in "Monitorul Oficial" No. 153 din 10 Octombrie 1896 si Regulamentul ei promulgata prin Inaltul decret regal no. 2668 din 14 Iulie 1897 si publicat in "Montitorul oficial" No. 109 din 15 August 1897 si cu rectificarile din "Montitorul oficial" No. 110, 17 August 1897. Minisetrul Agriculturii si Domentiilor.

Manea I. G. 1980. Sturionii biologie, sturionicultura si amenajari sturionicole. Ed. Ceres Buc.

Mancinelli G. 1586. Vita del padre Giulio Mancinelli della Compagnia di Gemí scritta da lui medesimo, per commandamento de Superiori, pel papa, translated in Hurmuzaki, 11, Bucuresti, pp. 1–115.

Marsigli F. L. 1744. Des poissons du Danube. Deuxieme Partie. Des poissons de riviere et de mer. Chapitre I. De diverses especes D'Antacées. In: Description du Danube depuis la montagne de Kalenberg en Autriche, jusqu'au confluent de la riviere Jantra dans la Bulgarie: Contenant des observations geographiques, hydrographiques, histoiques et physiques (traduit du latin). Tome quatrieme, La Haye, Chez Jean Swart, pp. 31–38.

Marsigli L. F. 1726. Danubius Pannonico-Mysicus, observation ibus geographicis, astronomicis, hydrographicis, historicis,

physicisperlustratus. Vol. 6. Amsterdam–The Hague.

Muller M. I. & Ackner F. R. 1865. Die Römischen Inschriften in Dacien. Wien.

Năvodaru I., Staras M. & Banks R. 1998. Management of the sturgeon stocks of the Lower Danube River system. In: Proceedings of the The Delta's: state-of-the-art protection and management. Conference proceedings, Tulcea, Romania, pp. 229–237.

Neale A. 1818. Travels through some parts of Germany, Poland, Moldavia and Turkey. London.

Newbery J. 1905. Two Voyages. In: Samuel Purchas "Hakluytus Posthumus or Purchas his Pilgrimes, Contayning a history of the World in sea voyages and lande travells by Englishmen and others". 8. Glasgow, pp. 459–460.

Onără D., Holostenco D., Paraschiv M. & Suciu R. 2014. Preliminary genetic variability of Lower Danube River young of the year (YOY) beluga sturgeon *Huso huso* (Linnaeus, 1758) using mtDNA markers. Journal of Applied Ichthyology 30: 1286–1289.

Onără D., Suciu R., Paraschiv M., Iani M., Holostenco D. & Taflan E. 2011. Contributions to understanding the spawning ecology of beluga sturgeons in the Lower Danube River, Romania. International conference on conservation, recovery and sustainable use of Danube river sturgeons. Tulcea, Romania.

Oţel V. 2007. Atlasul peştilor din Rezervaţia Biosferei Delta Dunării. Centrul de Informare Tehnologică Delta Dunării. Tulcea, 481 p.

Paraschiv M. & Suciu R. 2005. First results of marking and recapturing young of the year beluga sturgeons (*Huso huso*) in the Lower Danube River. Scientific Annals of the Danube Delta National Institute for Research and Development, pp. 75–82.

Pascu S. 1944. Petru Cercel fi Tara Românească la sfârșitul sec. al. XVI-lea. Cluj, pp. 135–277.

Recordon F. 1821. Lettres sur la Valachie ou Observations sur cette province et ses habitants, ecrites de 1815 a 1821 avec la relation des derniers evenenements qui y ont eu lieu, par F.R . Paris.

Seeley H. G. 1886. The fresh-water fishes of Europe. A history of their genera, species, structure, habits, and distribution. London et al.: Cassell & Co.

Suciu R., Onara D. F., Paraschiv M., Holostenco D. & Hont S. 2013. Sturgeons in the Lower Danube River. Danube News 28: 10–16.

Suciu R., Onara D. F., Paraschiv M., Holostenco D., Hont S., Stefanov T., Rosten C. & Hawley K. 2016. Danube beluga sturgeon monitoring: genetic population structure and migration patterns. Danube News 33: 8–10.

Suciu R., Suciu M. & Paraschiv M. 2005. Contributions to spawning ecology of beluga sturgeons (*Huso huso*) in the Lower Danube River, Romania. Extended Abstract of ISS 5 General Biology – Life History – CITES – Trade & Economy. Ramsar, pp. 309–311.

Suciu M., Paraschiv M. & Suciu R. 2004. Biometrics characteristics in young sturgeons of the Danube River. Scientific Annals of the Danube Delta Institute 10: 147–150.

Suciu R. 2002. Recent information about the status of naturally sustaining population of beluga sturgeon (*Huso huso*) of the N-W part of Black Sea and Lower Danube River. Report to U.S. Fish and Wildlife Service, Danube Delta National Institute, Tulcea, 18 p.

van Uhm D. & Siegel D. 2016. The illegal trade in black caviar. Trends in Organized Crime 19: 67–87.

Vaillant J. A. 1844. La Roumanie ou Histoire, Langue, Littérature, Orographie, Statistique des Roumains. Vol. II, III, Paris.

Waidbacher H. & Haidvogl G. 1997. Fish migration and fish passage facilities in the Danube: past and present. In: Jungwirth M., Schmutz S. & Weiss S. Fish migration and fish bypasses. Oxford: Fishing News Books, pp. 85–98.

Walker L. J. 1910. Theories of Knowledge: Absolutism, Pragmatism, Realism. Stonyhurst philosophical series. London et al.: Longmans, Green & Co. https://maritain.nd.edu/jmc/etext/walker.htm

Winter G. 1886. Niederösterreichische Weistümer 1. Teil Das Viertel unter dem Wiener Wald. Wien: Braumuller.

WSLA Karl VI. 1716. Wiener Stadt- und Landesarchiv. Vienna city Archives, 2.8.11 A1.1 Akten FischerInnung, Mappe I.

Zirojević O. 1995. Der Fischfang auf der Donau während de Tűrkenzeit. In: Spaţiul cultural al Dunării mijlocii şi inferioare. Tradiţii şi perspective ale convieţuirii. Muzeul de Istorie Caraş-Severin, Institut für Donauschwäbische Geschichte und Landeskunde Tübingen, Universitatea Babeş-Bolyai Cluj-Napoca, Reşiţa, pp. 415–421.

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