Current Trends in Natural Sciences
Vol. 9, Issue 18, pp. 117-127, 2020
https://doi.org/10.47068/ctns.2020.v9i18.016
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

FINDINGS OF THE FISH INVENTORY WITHIN LOWER DANUBE RIVER FROM 2008 TO 2020

Tiberius Danalache [1,2], Elena Holban [1*], György Deák[1], Cosmin Parlog[1], Razvan Matache[1], Mihaela Cudalbeanu [1,3], Carmen Georgeta Nicolae[2]

[1] National Institute for Research and Development in Environmental Protection Bucharest, 294 Splaiul Independentei Blv, District 6, Zip code 060031, Bucharest, Romania
[2] University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blv., District 1, Zip code 011464, Bucharest, Romania
[3] "Dunarea de Jos" University of Galati, 47 Domneasca Street, Zip code 800008, Galati, Romania

Abstract
The Lower Danube River is an important river both as a navigation pathway that connects Western and Eastern Europe and as a natural environment providing the carrying capacity for a variety of important fish species. In the Lower Danube, the most complex studies on fish fauna inventory date back to Grigore Antipa and Petru Bănărescu. This current study aims to contribute to the updating of the knowledge base regarding the identification of the fish species from the Lower Danube River, using data from the monitoring campaigns undertaken by the expert teams of the INCDPM Bucharest as well as data collected form the literature.
The data collection methods for the fish inventory undertaken by the INCDPM Bucharest's experts consisted of two techniques depending on the ecological requirements of the investigated species: standardized method for electrofishing (SR EN 14011/2003) and drift netting.
A total of 66 species were identified on the entire Lower Danube River, representing 80.49 % of the baseline. The river stretch between Iron Gates II (rkm 853) and Danube Delta (rkm 0 – Black Sea) has the highest species richness with 53species. These represent 80.30 % of the total identified fish species of the Lower Danube .Both the river sectors Călărași – Isaccea (rkm 375-100) and the Danube Delta- Black Sea (rkm 100-0) had the highest number of species of Community interest – 22 fish species.
Further research is recommended in the area between the Iron Damn I and II where the newly formed lentic ecosystem requires more monitoring campaigns.

Keywords: fish inventory, Lower Danube, species richness

1. INTRODUCTION

The Danube River is the second longest river in Europe with a length of 2.857 km and a basin area of approximatively 817.000 km^2. The river begins in the Black Forest mountain ranges in Germany and enters the Black Sea with a mean annual discharge of 6.500 m^3/s. Due to its geographical position, the river is an important navigation route that connects Western and Eastern Europe.
The Danube River course has been divided into three main sections: the Upper Danube, the Middle Danube and the Lower Danube (Laszloffy, 1965; Velcea, 2001; Sommerhauser et.al., 2003; Baltălungă & Dumitrescu, 2008). The Danube enters Romania at Baziaș and flows for a distance of 1.075 km till it feeds into the Black Sea through the three distributaries that form the Danube Delta

*Corresponding author, E-mail address: holban.elena@yahoo.com

Current Trends in Natural Sciences
Vol. 9, Issue 18, pp. 117-127, 2020
https://doi.org/10.47068/ctns.2020.v9i18.016
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

(Chilia, Sulina and Sfântul Gheorghe). The river represents the shared border between Romania, Serbia, Ukraine and the republic of Moldova.

On account of the importance of the Danube River as the carrying capacity of the fish populations, in their work published in 1986, Tomescu and Gaboș mention the fact that 65 fish species were found on the Lower Danube from which 75% were of economic interest and subjected to commercial fishing.

A large part of the fish species that can be found in the Lower Danube are concentrated in the river`s delta area which, at the European level, forms an unique ecosystem complex listed as an UNESCO Biosphere Reserve and Heritage Site and a RAMSAR Wetland of International Importance. Regarding fish species distribution in the Danube Delta, previous research concluded 53 fish species can be found on the 3 main branches of the Delta with an additional 22 identified species in the coastal water bodies (Oțel, 2007).

This current study is of particular importance because, in Romania, the most complex studies on fish fauna inventory date back to Grigore Antipa (1909) and Petru Bănărescu (1959). Consequently, at present, the exact number of fish species that can be found in the inner waters of Romania is unknown. Moreover, there are knowledge gaps on the state of their populations as a consequence of changes in the Danube River`s course from the last decades.

This study aims to contribute to the updating of the knowledge base regarding the identification of the fish species from the Lower Danube River course, using data collected form the literatures as well as data from the monitoring campaigns undertaken by the expert teams of the INCDPM Bucharest. The monitoring campaigns have included scientific fishing campaigns on the Danube River to identify the fish communities as well as determining the behavior during migration of the sturgeon species using ultrasonic transmitters (Deak et al., 2014) and the patented receiver stations DKTB and DKMR-01T.

The main objective of this study is to evaluate the species richness of the entire Lower Danube River course and compare the results with the baseline from the literature (Marsilius, 1726; Heckel and Kner, 1858; Balon et al., 1986; Gomoiu and Munteanu, 1991; Gomoiu et al., 1995; Schiemer et al., 2003).

2. MATERIALS AND METHODS

In situ data collection methods by the INCDPM Bucharest's experts consisted of two techniques:

1. **Scientific fishing using drift netting**

Fishing using drift netting was practiced especially for the species belonging to the Cupleidae and Acipenseridae families, whose capturing by use of electrofishing is almost impossible because of the species` ecological requirements. In the case of species belonging to the Acipenseridae family, capturing using electrofishing method is not possible because of their preferred swimming depths of 15-20 m, while in the case of Clupeids the usage of electrofishing is not suitable because the species swim in the middle of the channel, very close to the water surface. Consequently, drift netting tools such as trammel nets and gill nets were used for the monitoring these species. These tools have the capacity to float on the water surface or near the river bed.

2. **Scientific electrofishing**

Electrofishing is based on the interaction of the electric current produced by an approved apparatus and the nervous system of the fish species. As in other vertebrates, the nervous system of fish species functions by transmitting electrical impulses. The goal of the electrofishing method is to

*Corresponding author, E-mail address: holban.elena@yahoo.com

Current Trends in Natural Sciences
Vol. 9, Issue 18, pp. 117-127, 2020
https://doi.org/10.47068/ctns.2020.v9i18.016
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

produce interferences between the neural system and the central nervous system, thus obtaining an involuntary effect of fish swimming toward the anode.
During scientific electrofishing only direct current (DC) is used which can be transmitted as impulses and does not led to fish mortality. Sometimes, especially in the case of juvenile fish, casualties can happen, but in general electrofishing is a non-lethal sampling method.
Since, on large waterways, illegal fishing is taking place that uses electric current that causes serious lesions to the fish`s organism (often times leading to death), it is most important that the differences between the different utilized methods is presented hereby. Poaching of fish is done by using alternative current (AC), while scientific fishing uses DC which has a short and reversible effect on fish`s behavior and physiology.
Moreover, scientific electrofishing is a standardized method of fishing (SR EN 14011/2003) which is utilized worldwide due to its demonstrated efficiency during field inventories, conservation state evaluation and management fishing to control the fish stocks, remove sick fish and invasive species. This method is also the standard sampling approach for the biological assessment or water bodies used by the Water Framework Directive (Directive 2000/60/EC).
In order to update the database from the field surveys done by INCDPM Bucharest`s experts, information from the monitoring campaigns that were undertaken in order to fulfill the obligations of the provisions of the Water Framework Directive and were extracted and collated from the literature. These data were made available by the International Commission for the Protection of the Danube River (ICPDR) through their Joint Danube Surveys (JDS) 2 and 3 (Joint Danube Survey 2: Final Scientific Report, 2008; Joint Danube Survey 3: Final Scientific Report, 2015). These monitoring campaigns contain a fish fauna monitoring component in order to evaluate the ecological quality of the Danube River and to highlight the impact of anthropogenic alterations to the aquatic ecosystems. With these additional data from the ICDPR, it has been possible to extend the time period of analysis of the fish fauna to 15 years, from 2005 to 2020.
The results of the fish inventory were classified by dividing the river into four river sectors of interest. This was made following the methodology of Sommerhouser et al. (2003), and is the same methodology used by the ICDPR in their surveys.
All data analyses and graphs were made using Microsoft Excel 2013.

3. RESULTS AND DISCUSSIONS

The previous studies that were consulted and their associated data indicate that in the timeframe 1726 and 2003, at the level of the entire river course, 102 total fish species have been identified. In order to establish a baseline, the distribution of the fish species was done on three Danube River sectors: Upper Danube River (rkm 2497 – rkm 1794) – 61 species, Middle Danube River (rkm 1794-rkm 941) – 74 species and Lower Danube (rkm 941 – rkm 0) – 78 species. Because our study area spanned from rkm 1074 to the mouths of the Danube River, the literature baseline was extended to a total of 82 fish species.
Table 1 presents the fish fauna presence divided into four sectors that are representative of the different ecological characteristics of the Lower Danube.
The findings in table 1 have been acquired from the field campaigns undertaken by the INCDPM Bucharest`s experts during the time period between 2001 and 2020 (INCDPM, 2011-2018; 2009-2019 – Core Program; 2014-2015; 2015-2017) and from the data collected from the literature (Schiemer et al., 2003; Joint Danube Survey 2: Final Scientific Report, 2008; Joint Danube Survey

http://www.natsci.upit.ro
*Corresponding author, E-mail address: holban.elena@yahoo.com

Current Trends in Natural Sciences
Vol. 9, Issue 18, pp. 117-127, 2020
https://doi.org/10.47068/ctns.2020.v9i18.016
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

3: Final Scientific Report, 2015; Deak et al., 2017; Danalache et al., 2017; Danalache et al., 2019; Zamfir et al. 2019).

During 2020, the INCDPM Bucharest experts have performed field trips in order to survey the ichthyofauna from the Borcea branch area, the Old Danube (rkm 375-252), the Danube-Black Sea Channel, the area adjacent to Cernavodă City and the Epurașu branch identifying a total of 11 fish species. The small number of identified fish coincided with high water turbidity, a phenomenon that increases the electrical conductivity of the water thus lowering the efficiency of electrofishing. An additional explanation of the low number of fish present species was the high water temperature from the shore areas, which may have caused the fish to retreat into deeper waters.

The waters of the entire Lower Danube River can be considered to have a high species riches with a total of 66 species being identified (80.49 % from the baseline).

Table 1. Characterization of the fish fauna of the Lower Danube River in the sectors between rkm 1075 and 0. Sources: ICPDR 2007; 2013; INCDPM, 2011 – 2020

Fish species	Baseline 1726 - 2003	Baziaș – Iron Gates I (rkm 1072-943)	Iron Gates II - Călărași (rkm 853-375)	Călărași - Isaccea (rkm 375 - 100)	Danube Delta-Black Sea (rkm 100-0)	Entire Lower Danube River
Abramis ballerus	■	■	■			■
Abramis brama	■	■	■	■	■	■
Abramis sapa	■	■	■	■	■	■
*Acipenser gueldenstaedtii**	■		■	■	■	■
Acipenser nudiventris	■					
*Acipenser ruthenus**	■		■	■	■	■
*Acipenser stellatus**	■		■	■	■	■
Acipenser sturio	■					
Alburnus alburnus	■	■	■	■	■	■
*Alosa immaculata**	■			■		■
Alosa maeotica	■					
*Alosa tanaica**	■		■	■	■	■
Ameiurus nebulosus	■	■		■		■
Anguilla anguilla	■					
*Aspius aspius**	■	■	■	■	■	■
Atherina boyeri	■					
*Barbus barbus**	■	■	■	■	■	■
Benthophiloides brauneri	■		■	■	■	■

*Corresponding author, E-mail address: holban.elena@yahoo.com

Current Trends in Natural Sciences
Vol. 9, Issue 18, pp. 117-127, 2020
https://doi.org/10.47068/ctns.2020.v9i18.016
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

Benthophilus nudus					■	■
Benthophilus stellatus	■		■		■	■
Blicca bjoerkna	■	■	■	■	■	■
Carassius carassius	■	■	■			■
Carassius gibelio	■	■	■	■	■	■
Chalcalburnus chalcoides	■					
Chondrostoma nasus	■	■	■	■	■	■
Clupeonella cultriventris	■					
*Cobitis elongata**			■	■	■	■
*Cobitis elongatoides**	■		■	■	■	■
*Cobitis taenia**			■	■	■	■
Ctenopharyngodon idella	■					
Cyprinus carpio	■	■	■	■	■	■
Esox lucius	■	■	■	■	■	■
*Eudontomyzon mariae**	■		■	■	■	■
Gasterosteus aculeatus	■					■
*Gobio albipinnatus**	■			■		■
*Gobio gobio**	■		■		■	■
Gobio kesslerii	■					
*Gymnocephalus baloni**	■		■	■	■	■
Gymnocephalus cernuus	■		■	■	■	■
*Gymnocephalus schraetser**	■	■	■	■	■	■
*Huso huo**	■			■	■	■
Hypophthalmichthys molitrix	■					

*Corresponding author, E-mail address: holban.elena@yahoo.com

Current Trends in Natural Sciences
Vol. 9, Issue 18, pp. 117-127, 2020
https://doi.org/10.47068/ctns.2020.v9i18.016
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

Hypophthalmichthys nobilis						
Ictalurus punctatus						
Knipowitschia cameliae						
Knipowitschia caucasica						
Lepomis gibbosus						
Leucaspius delineatus						
Leuciscus borysthenicus						
Leuciscus cephalus						
Leuciscus idus						
Liza aurata						
Liza saliens						
Lota lota						
Misgurnus fossilis						
Mugil cephalus						
Neogobius eurycephalus						
Neogobius fluviatilis						
Neogobius gymnotrachelus						
Neogobius kessleri						
Neogobius melanostomus						
Neogobius syrman						
*Pelecus cultratus**						
Perca fluviatilis						
Percarina demidoffi						
Perccottus glenii						
Platichthys flesus						
Proterorhinus marmoratus						
Proterorhinus semilunaris						

*Corresponding author, E-mail address: holban.elena@yahoo.com

Current Trends in Natural Sciences
Vol. 9, Issue 18, pp. 117-127, 2020
https://doi.org/10.47068/ctns.2020.v9i18.016
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

Pseudorasbora parva	■	■	■	■	■	■
Pungitius platygaster	■					
*Rhodeus amarus**		■	■	■	■	■
Rhodeus sericeus	■					
*Romanogobio kesslerii**			■	■	■	■
*Romanogobio vladykovi**		■	■	■	■	■
Rutilus rutilus	■	■	■	■	■	■
*Sabanejewia balcanica**	■			■		■
*Sabanejewia bulgarica**	■		■		■	■
Salmo labrax	■					
Sander lucioperca	■	■	■	■	■	■
Sander volgensis	■			■	■	■
Scardinius erythrophthalmus	■	■	■	■	■	■
Silurus glanis	■	■	■	■	■	■
Syngnathus abaster	■		■	■	■	■
Squalius cephalus			■			■
Tinca tinca	■	■	■			■
*Umbra krameri**	■				■	■
Vimba vimba	■	■	■	■	■	■
*Zingel streber**	■		■	■	■	■
*Zingel zingel**	■			■	■	■
Total	**82**	**33**	**53**	**53**	**53**	**66**
Species of Community interest		**5**	**17**	**22**	**22**	**24**

Analyzing the distribution of the fish species from the Lower Danube (Figure 1 below), an increase in the number of species from upstream to downstream can be observed. The river stretch between Iron Gates II (rkm 853) and Danube Delta (rkm 0 – Black Sea) has the highest species richness. In each river sector, 53 fish species are identified. These represent 80.30 % of the total identified fish species of the Lower Danube. This high species richness may be explained by the presence of a large amount of heterogeneous habitats in that area.
Both the river sectors Calarași – Isaceea (rkm 375-100) and the Danube Delta- Black Sea (rkm 100-0) had the highest number of species of Community interest – 22 species. The Danube River still

*Corresponding author, E-mail address: holban.elena@yahoo.com

Current Trends in Natural Sciences
Vol. 9, Issue 18, pp. 117-127, 2020
https://doi.org/10.47068/ctns.2020.v9i18.016
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

has an impressive amount of wetlands. Moreover, the unique complex of aquatic ecosystems present in the Danube Delta is listed as UNESCO World Heritage site. In terms of the number of identified species in this river sector, the results of our study match the results reported by Oțel (2007).

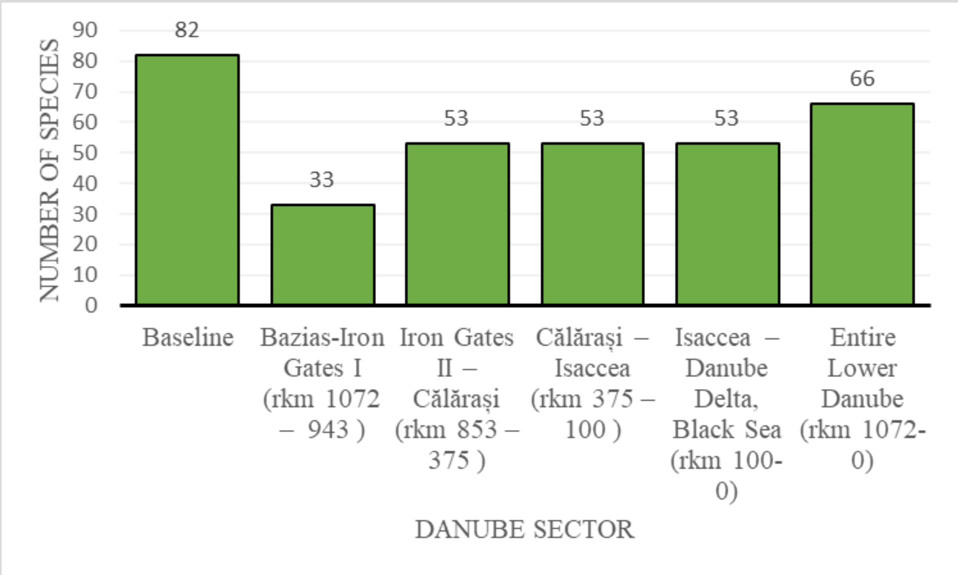

Figure 1. Distribution of fish species on the Lower Danube River course (2005 – 2020)

In his study, Ioniță (1995) highlights the cyprinid character of the novel lentic ecosystem of the Lower Danube from rkm 943 and rkm 853 (between the Iron Gates I and II). A limitation of our study is that this sector was not investigated by the INCDPM Bucharest. The literature study (Ioniță,1995; Joint Danube Survey 2: Final Scientific Report, 2008; Joint Danube Survey 3: Final Scientific Report, 2015) shows that the changes caused by the two damns caused a disequilibrium in the fish fauna of the area, capturing in general cyprinid stagnophil species and rheophil-stagnophil species like *Carassius gibelio*, *Abramis brama* and *Alburnus albur*us. The interruption of the migration routes for reproduction has led to a decline in the population sizes of species of recreational and commercial interest like *Barbus barbus* and *Acipenser ruthenus*, species that can sparsely be found upstream of the constructions.

4. CONCLUSIONS

The information that were hereby presented are comprised of data collected from the INCDPM Bucharest studies between 2011 and the present which were collated with data extracted from other relevant studies form the literature regarding the Lower Danube River course.
The data collection methods used by INCDPM Bucharest are similar to the ones used by other researchers which evaluated the fish fauna of the Lower Danube: drift netting in the main channel and electrofishing techniques were used.
A total of 66 fish species were identified on the entire Lower Danube. The results highlight that, to date, 80.49 % of the fish species identified in the reference period of 1726-2003 are still present on the Lower Danube River course.
The findings of this study show the fact that the highest species count (53 species) is found in the

*Corresponding author, E-mail address: holban.elena@yahoo.com

river sector spanning from the Iron Gates II to the Black Sea. This can be explained by the fact that this sector did not experience strong hydromorphological alterations and the environment may be more heterogeneous. Furthermore the two rivers sectors Călărași- Isaccea and Danube Delta contain 22 fish species of Community interest.

Additional research is needed regarding the updating of the national database and closing knowledge gaps in the evolution of the fish fauna, especially in the area between the Iron Gates I and II. Further research studies might explore the characteristics of the novel ecosystem which has resulted from river damning.

5. ACKNOWLEDGEMENTS

This study was financially supported by the Ministry of Education and Research. They are the beneficiary of the project PN 19 43 02 01.3 Study regarding the inventory of danubian fish fauna from Baziaș till the Black Sea and the National Institute for Research and Development in Environmental Protection - INCDPM Bucharest, responsible for the monitoring of environmental factors within the project.

6. REFERENCES

Antipa, G. (1909). *The ichthyological Fauna of Romania*, Bucharest: "Carol Göbl", Institute of Graphic Arts, Bucharest.

Balon, E.K., Crawford, S.S., Lelek, A. (1986). Fish communities of the upper Danube Germany, Austria prior to the new Rhein-Main-Donau connection. *Env. Biol. Fish.*, 15, 243-271.

Baltălungă, A.A., Dumitrescu, D. (2008). The Role of the Danube River as the Main Waterway of Central and South Eastern Europe. Geopolitical and Economic Aspects. *Romanian Review on Political Geography*, 1, 57-66.

Bănărescu, P. (1964). *Fauna Republicii Populare Române, Pisces – Osteichthyes (pești ganoizi și osoși)* (Vol. 13, pp.01-958). București: Academiei R.P.R., București.

Danalache T. , Badilita A. M., Deak Gy., Holban E., Popescu I., Daescu A., Raischi M.C., Ghita G., Nicolae C.G., Diaconescu, S., „Assessment of Bastroe Channel possible impact on Lower Danube sturgeon migration", Aquaculture, Aquarium, Conservation & Legislation – International Journal of the Bioflux Society, 2017, 10(5), 1011-1018.

Danalache T., Deak Gy., Holban E., Raischi M., Zamfir S., Boboc M., Matei M., Parlog C., Fronescu D., Cristea A., Nicolae C.G., „Studies regarding the state of Alosa immaculata (Bennet, 1983) migrating population into the Lower Danube River", AIP Conference Proceedings 2019, pp. 020072-1 – 020072-7.

Zamfir S., Deak Gy., Danalache T.M., Georgescu P.L., Raischi M.C., Cristea A., Oprea L., Luminaroiu L., „Impact of temporary loss of connectivity in the Epurasu Branch and its effects on the composition and distribution of ichtyofauna", AIP Conference Proceedings 2019, pp. 020075-1 – 020075-9.

Deak Gy., Badilita A. M., Danalache T., Tudor M., „The use of acoustic telemetry for providing an insight into sturgeons' behavior and migration routes on Lower Danube", Journal of Environmental Protection and Ecology, 2014, 15(3), 954-964.

Deak, G., Raischi, M.C., Badilita, A.M., Danalache, T., Cristea, A., Holban, E., Zamfir, A., Boboc, M.G., Matei, M., Uritescu, B., Boaja, I., Stefan, D., Tudor, G. (2017). „Actual status, pressures and preserving perspectives of sturgeon species from Lower Danube River", Presented at *the 8th International Symposium on Sturgeon (ISS8)*, Vienna.

Gomoiu, M.T., Munteanu, I. (1991). Some Problems Concerning the Danube Delta Fish Fauna, *Mediul Înconjurător [The Environment]*, 2, 11-13.

Heckel, R., Kner, R. (1858). *Die Süsswasserfische der Österreichischen Monarchie mit Rücksicht an die angrezenden Länder* [The freshwater fishes of the Austrian monarchy, processed with regard to adjacent countries] (pp.1-338). Leipzig: Engelmann, Leipzig.

Ioniţă, V. (1997). Aspecte privind impactul sistemului hidroenergetic şi de navigaţie Porţile de Fier asupra mediului înconjurător [Aspects regarding the impact of the Iron Gates hydropower and navigation system on the environment], *Revista Energetică [Energetical Magazine],* 11, 401-535.

*Corresponding author, E-mail address: holban.elena@yahoo.com

Current Trends in Natural Sciences
Vol. 9, Issue 18, pp. 117-127, 2020
https://doi.org/10.47068/ctns.2020.v9i18.016
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

Lászlóffy, W. (1965). Die Hydrographie der Donau. Der Fluss als Lebensraum [The hydrography of the Danube. The river as a living space]. In: R. Liepolt, ed. *Limnologie der Donau [Limnology of the Danube]* – *Eine monographische Darstellung [A monographic representation]*. (Vol. 2, pp.16-57). Stuttgart: Schweizerbart, Stuttgart.

Liška, I., Wagner, F., Slobodník, J. (eds.). (2008). *Joint Danube Survey 2: Final Scientific Report* (pp. 1–242). Vienna: International Commission for the Protection of the Danube River, Vienna

Liška, I., Wagner, F., Sengl,M., Deutch, K., Slobodník, J. (eds.). (2015). *Joint Danube Survey 3: Final Scientific Report* (pp. 1–242). Vienna: International Commission for the Protection of the Danube River, Vienna

Marsilius, A.F. (1726). *Danubius pannonico-mysicus, De piscibus in aquis Danubii viventibus [Fish in the Danube River]*, (Vol. 4, pp.1-89). Amsterdam: Uytwerf & Changuion, Amsterdam.

Oțel, V. (2007). Fish atlas from Danube Delta Biosphere reserve (pp.148-264). Tulcea: Danube Delta Technology Information center, DDNI, Tulcea.

Schiemer, F., Guti, G., Keckeis, H., Staras, M. (2003). Ecological Status and Problems of the Danube River and its Fish Fauna: A Review In R.L.Welcomme,T. Peter, *Proceedings Of The Second International Symposium On The Management Of Large Rivers For Fisheries* (Vol.1, pp. 273–299). Phnom Phen: Food and Agriculture Organization of the United Nations, Phnom Phen.

Sommerhauser, M. (2003). Strengthening the Implementation Capacities for Nutrient Reduction and Transboundary Cooperation in the Danube River Basin. UNDP/GEF Danube Regional Project.

Tomescu, N., Gaboş, M. (1989). Hidrobiologie [Hydrobiology]. Cluj: Univ.Babeş Bolyai.

Velcea, V. (2001). *Geografia fizică a României [Physical geography of Romania]*, Sibiu: Edit. Univ. Lucian Blaga, Sibiu.

***European Commission (2000). Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for community action in the field of water policy, *Off. J. Eur. Communities*.

***INCDPM Bucharest (2014 – 2015). *Studies for achieving shore protection of wetland area Divici-Pojejena*, Financed via IPA Cross-Border Cooperation Program Romania-Republic of Serbia.

***INCDPM Bucharest (2015 – 2017). *Mapping and assessment the ecosystem services of Divici-Pojejena wetland and identification of their contribution to economic sect*ors, Financed via SEE Grants 2009-2014.

***INCDPM Bucharest, Contract no. 06N/2009 (2009-2015) (Core Program MADED) – PN 09 06 03 66 - Monitoring of wild sturgeons in Romania in the perspective of species and habitat conservation (PN 09 06 03 66.1: Evaluation of the best means and techniques for sturgeon monitoring; PN 09 06 03 66.1 supplemental: Analysis of the influence of ultrasonic tags on the behavior of sturgeon juveniles; PN 09 06 03 66.2: The influence of hydrological and hydrochemical factors on the reproductive behavior of sturgeons), 2015, beneficiary National Authority for Scientific Research and Innovation.

***INCDPM Bucharest, Contract no. 06N/2009 (2009-2015) (Core Program MADED) – PN 09 06 03 54 - Research on the quantitative assessment of the consequences of variability of levels on the Danube on groundwater and soil in adjacent land areas, in characteristic sections (PN 09 06 03 54.2: Characterization of the ichthyofauna on the Epuraşu branch in the spring season and definition of the sector importance as an area suitable for the reproduction and growth of fish juveniles; PN 09 06 03 54.3: The seasonal spring-summer influence of the hydrotechnical works on the ichthyofauna dynamics on the Epuraşu branch), 2015, beneficiary National Authority for Scientific Research and Innovation.

***INCDPM Bucharest, Contract no. 06N/2009 (2009-2015) (Core Program MADED) – PN 09 06 01 13 - Research on the direct and indirect effects of the discharge of a thermally charged effluent into the Danube (PN 09 06 01 13.1 Seasonal evolution of the fish communities composition on the cooling water discharge channel from the Cernavoda Nuclear Power Plant and at its confluence with the Danube, as a result of the effluent with thermal load), 2013, beneficiary National Authority for Scientific Research and Innovation.

***INCDPM Bucharest, Contract no. 39N/2019 (Core Program RESCMANS) – PN 19 43 02 01 - Evolution of sturgeon populations and Danube ichthyofauna in the context of the changes in the course of the Danube from the recent decades (PN 19 43 02 01.1. Evolution of the condition of ultrasonically tagged sturgeon specimens to present and identification of disturbing factors of the conservation status of wild sturgeon populations; PN 19 43 02 01.2. Identification and validation of a method for determining the age of sturgeons), 2019, beneficiary Ministry of Education and Research.

***INCDPM Bucharest, Contract no. 43N/2018 (Core Program MADED) – PN 18 26 04 01 - Studies on migratory species of fish (ultrasonically tagged sturgeons, Pontic shad) on the lower Danube in order to improve

*Corresponding author, E-mail address: holban.elena@yahoo.com

https://doi.org/10.47068/ctns.2020.v9i18.016
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

conservation (PN 18 26 04 01.1. Study on migration and identification of the populations status of Alosa immaculata (Pontic shad) in the Lower Danube; PN 18 26 04 01.2. Monitoring the migration routes of anadromous migratory sturgeons on the Lower Danube. Case study: Danube bifurcation in the Izvoarele area; PN 18 26 04 01.3. Elaboration of measures to improve conservation status and create preliminary sustainable management for the sustainable exploitation of species), 2018, beneficiary Ministry of Research and Innovation.

***INCDPM Bucharest, Contract no. 48N/2016 (Core Program MEVAS) – PN 16 04 04 01 - Research on improving the conservation status of sturgeon populations in existing natural habitats in the Lower Danube, using ultrasonic telemetry methods (PN 16 04 04 01.1. Analysis of sturgeon migration routes in the Danube, Brăila-Călărași sector; PN 16 04 04 01.2 Identification and assessment of sturgeon habitats in the Lower Danube; PN 16 04 04 01.3. Study on water quality assessment in areas of interest within migration routes), 2016 – 2017, beneficiary National Authority for Scientific Research and Innovation.

***INCDPM Bucharest, Contract no. 48N/2016 (Core Program MEVAS) – PN 16 04 04 02 - Research on the behavior of sturgeon species migrating for breeding on the Lower Danube (PN 16 04 04 02.1. Monitoring the behavior of juvenile sturgeon produced under aquaculture conditions on the Lower Danube; PN 16 04 04 02.2. Research on the influence of variations in Danube flows on sturgeon species migration), 2016-2017, beneficiary National Authority for Scientific Research and Innovation.

***INCDPM Bucharest. Intermediate Reports 1-17, (2011-2018). Project „Monitoring of environmental impact of the works for improvement of the navigation conditions on the Danube between Calarasi and Braila, km 375 - km 175", beneficiary Galati Lower Danube River Administration.

***SR EN 14011/2003, Water quality. Sampling of fish with electricity.

*Corresponding author, E-mail address: holban.elena@yahoo.com