IGNORED DAM-FISH ECOLOGICAL RELATIONS AND DAM MANAGEMENT ACTIVITIES RISK KNOWLEDGE CAPITAL – A PROTECTED AREA LOTIC ECOSYSTEM CASE STUDY (GURA GOLUMBULUI DAM LAKE, NERA/DANUBE WATERSHED)

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ABSTRACT

This work presents data on the fish identified in the lentic sector of the Golumbilor Lake and upstream and downstream lotic proximal sectors in two periods. The first is before ruthless management of the liquid and solid lake sediments (in 2022) and one after it (in 2023), presenting in a comparative way the modifications in the ichthyofaunal structure. The most striking change observed in the fish fauna of the downstream lake habitats is the replacement of fish species characteristic of lotic habitats with those typical of lentic habitats, which reflects the significant change in habitat characteristics due to this specific human impact.

RÉSUMÉ: Les relations écologiques négligées entre les poissons et les barrages ainsi que les activités de gestion des barrages mettent en péril le capital des savoir-faire – une étude de cas sur un écosystème lotique protégé (lac du barrage de Gura Golumbului, bassin versant de Nera/Danube)

Nous présentons les poissons capturés dans le secteur lénitique du lac Golumbilor et dans les secteurs lotiques proximaux en amont et en aval à deux périodes, l'une avant une gestion impitoyable des sédiments liquides et solides du lac (en 2022) et l'autre après (en 2023), en présentant de manière comparative les modifications de la structure de l'ichtyofaune. Les changements les plus marquants observés dans la faune piscicole des habitats lacustres en aval sont le remplacement de certaines espèces de poissons caractéristiques des habitats lotiques par des espèces caractéristiques des habitats lénitiques, un fait qui reflète le changement significatif des caractéristiques de l'habitat dû à cet impact spécifique de l'homme.

REZUMAT: Ignorarea relațiilor ecologice baraj-pești și a capitalului de cunoaștere legat de riscurile asociate activităților de management a barajului – studiu de caz al unui ecosistem lotic protejat (lacul de baraj Gura Golumbului, bazinul Nera/Dunăre).

Această lucrare prezintă datele despre peștii capturați în sectorul lenitic al Lacului Golumbilor și în sectoarele lotice proxime din amonte și aval în două perioade, una înainte de o gestionare brutală a debitelor lichide și solide lacustre (în 2022) și una după aceasta (în 2023), prezentând comparativ modificările ihtiofaunei. Cele mai frapante modificări observate în fauna piscicolă din habitatele din aval de lac este înlocuirea unor specii de pești caracteristici habitatelor lotice cu specii caracteristice habitatelor lenitice, fapt care reflectă modificarea majoră a caracteristicilor habitatului datorită acestui impact antropic specific.

INTRODUCTION

The ecological state of aquatic ecosystems is a fundamental aspect for environment and humans' health and well-being, which are affected in diverse ways by various crisscrosing natural and anthropogenic stressors that damage and diminish biodiversity and ecosystem structure and function (Błońska et al., 2024; Bănăduc et al., 2024, 2023, 2022).

Some high-risk environmental events are induced by humans sometimes due to the lack of know-how, sometimes ingnoring the existing know-how and even general or specific laws, including in protected areas (i.e. Natural Parks, National Parks, Natura 2000 sites, etc.), like in the case study presented in this paper. These research results are based on few years of monitoring study of the Miniş River fish fauna (Nera River Basin, Danube River Basin), accidentally surprising in this monitoring period an improper dam liquid and solid flows management event, specifically the sudden and complete discharge of sediments from the Golumbilor Dam lake (Fig. 1) into the downstream Miniş River sector.

The Golumbilor Lake anthropogenic reservoir was formed by damming the Miniş River. Located between the towns of Anina and Bozovici, the dam was built in 1985 for the water use of thermal power plant from Crivina and has a length of 750-900 m, a width of 150 m, a maximum depth of 15 m. Currently, this lake is a local tourist attraction, used for recreational activities including fishing. The lake is concessioned by a local investor.

Situated within the Cheile Nerei-Beuşniţa National Park, ROSCI0031 and ROSPA0020, the lake transformed the natural lotic habitat into a lentic one (Fig. 1) over the years. Over time, the lake was accidentally or intentionally stocked with different non-native fish species, characteristic of lotic habitats (Figs. 2 and 3), which are replacing the local native species characteristic of the lotic upstream and downstream Miniş River sectors.

Figure 1: The lenitic habitat of Gura Golumbilor Dam Lake.

Figure 2: The lotic habitat of Miniș River upstream Gura Golumbilor Dam Lake.

Figure 3: The lotic habitat of Miniș River downstream Gura Golumbilor Dam Lake.

Ichtyofauna faces large-scale and significant negative impacts due to human activities and changes in their habitats (Bănăduc et al., 2022; Simić et al., 2022; Zare-Shahraki et al 2022; Curtean-Bănăduc and Bănăduc, 2020; Kar, 2019; Joy et al., 2018; Curtean-Bănăduc et al., 2018, 2014, 2007; Khoshnood, 2017; Kruk et al., 2017; Marić et al., 2017; Sosai, 2015; Telcean et al., 2011; Trichkova et al., 2009; Ureche et al., 2007; Curtean-Bănăduc and Bănăduc 2006; Afanasyev, 2003; Cordone and Kelly, 1961).

Among these factors, poor dam design, construction, destruction or/and the improper regular and/or accidental liquid and solid flows management are responsible for many of the negative impacts on fish all over the world (Bănăduc et al., 2020; Hudek et al., 2020; Song et al., 2019; Rumana et al., 2015; Soolutayo, 2012; Wang et al., 2011; Agostinho et al., 2008; Afanasyev, 2003; Barrella and Petrere, 2003; Radojković et al., 2019).

Rivers and streams drain water from land to sea and oceans and thus become the main path for transporting the products of continental weathering, increased phenomena by human-related activities, such as river impoundment and changes in land use, which all together alter the sediment load in rivers (Bănăduc et al., 2020; Tena et al., 2012). As a consequence, one of the fundamental issues with the operation of surface water resources is erosion and sediment transport, reducing the reservoir's useful life cycle and/or impacting the reservoirs by different ways (Othman et al., 2013). Reservoir storage capacity is often a direct consequence of erosion and sediment deposition (Othman et al., 2013).

Preserving the natural qualitative and quantitative sediment imputs and flow in any basin is crucial for water quality and the proper functioning of the aquatic ecosystem (Lele et al., 2024) in spite of some human activities with uncontrolled negative effects (Emadak et al., 2019). Sediments play an important role in transporting nutrients and dispersing contaminants within aquatic ecosystems (Schleiss et al., 2008; Taylor, 2007), but also their quality and quantity can transform habitats drastically. Acute and chronic happenings induce changes in the sediment load regime and can have major implications for downstream channel geomorphology; although impacts vary according to the size of the watershed, river and dam, position of the dam in the catchment, hydrologic regime, and channel morphology, as well as with the types of operations in the impoundment (Williams and Wolman, 1984). In some cases, dams can reduce sediment transport across varying spatial and temporal scales, often for an extended period and over considerable downstream distances, whereas in other cases impacts are apparent only in the reach immediately downstream of the dam (Brandt, 2000).

Accidental/accidental like due to the dam liquid and solid loads poor management or the drainage of the dam lake, induced sudden and significant quantities of sediments and ecosystemic drastic changes, impacting locally important conservation and economically significant, even endemic aquatic species, including fish. As a result of draining the reservoir, the bottom of the downstream riverbed can be completely covered by a thick blanket of mud for long periods of time, which significantly deteriorates the living conditions for aquatic organisms, including fish, as well as their trophic resources in downstream river sectors (Bănăduc et al., 2020).

Habitat quality is fundamental for fish, with the physical and chemical features of the aquatic system affecting their survival, growth, reproduction, and recruitment (Bozek et al., 2011). In this general circumstance, sediments accomplish a key part in the ecology of lotic ecosystems and on the fish community structure, diversity, and abundance.

This study identified and described, during an ichthyological research in the Miniș River basin area, the negative effect of a dam lake management related risky activity on the fish faunal structure in the adjacent lotic sectors of Golumbilor Dam Lake.

MATERIAL AND METHODS

The presence/absence of fish in Miniș River and Golumbilor Dam lake was determined by electrofishing (Hans Grassl IG 600TL) (Fig. 4), in time (45 minutes)/effort unit, from every two-three km length river sector, from the river springs to its confluence with the Nera River. A total of 18 sampling stations (Fig. 5), each 100 meters in length, were surveyed. After quick visual identification, the sampled fish were released in the habitat of origin.

Figure 4: Scientific fishing using the electronarcosis method (electrofishing).

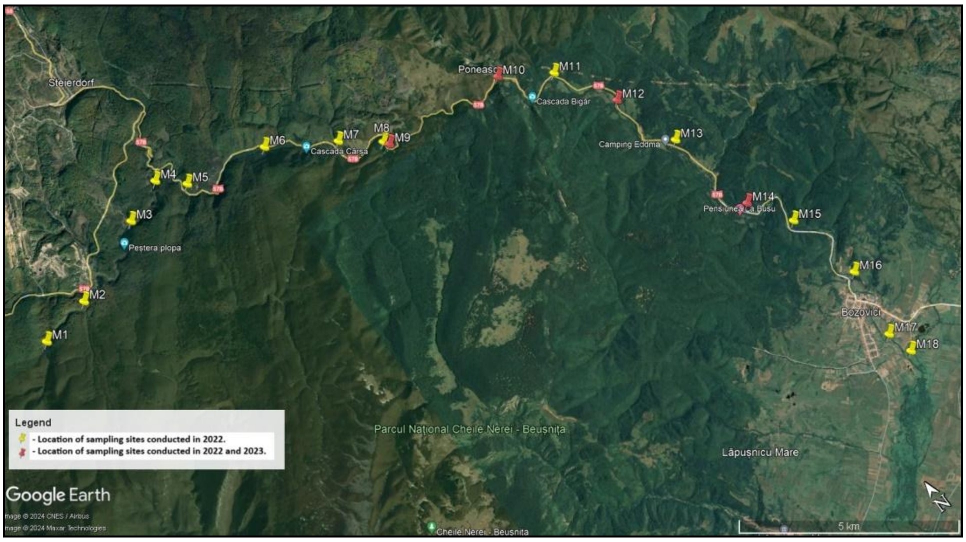

Figure 5: Sampling stations on Miniș River.

RESULTS AND DISCUSSION

This paper specifically presents the fish species identified in the lentic sector of Golumbilor Lake, as well as in the upstream and downstream lotic proximal sectors, during two distinct time periods, one before the ruthless management of the liquid and solid lake sediments (in 2022) and one after it (2023), presenting in a comparative way the modifications in the ichthyofaunal structure (Tab. 1)

This research exposed the significant negative effect of the studied dam lake's inappropriate liquid and solid flows on the downstream lotic ecosystems. The results contribute to the knowledge base on the negative potential impact of improper management of dam lakes, which is a precondition for informing decision-making for these lakes by investors, stakeholders, and managers. More knowledgeable judgments and choices can assist more well-adjusted reactions and the drifting of coordinated policies, strategies and actions to meet the problems of human-nature interrelations and aquatic biodiversity loss, in a more integrative approach, in this manner avoiding significant negative changes to lotic ecosystems.

The most striking change observed in the fish fauna of the downstream lake habitats is the replacement of fish species characteristic of lotic habitats with those typical of lentic habitats (Tab. 1).

Table 1: The fish species sampled before and after the improper management of the sediments of Gura Golumbilor Dam lake upstream of the lake (Fig. 2), in the lake (Fig. 1), and downstream of the lake (Fig. 3); B (before) – 2022, A (after) – 2023.

Species no.	Upstream lake habitat characteristics	In the lake habitat characteristics	Downstream lake habitat characteristics
–	Substrate composed of gravel, cobble and sand. Substrate covered with organic matter. Abundant riparian vegetation, in favorable condition predominantly consisting of trees, shrubs, and herbaceous plants. Stable banks, with no signs of erosion.	Substrate composed of silt and sand with aquatic vegetation. Riparian vegetation specific to the lentic ecosystem, predominantly composed of reeds and herbaceous plants, surrounded by trees. Stable banks, with no signs of erosion. The lotic ecosystem was transformed into a lentic one by damming the river with a concrete dam approximately 20 meters high. Species characteristic of stagnant aquatic ecosystems are present, including invasive species. The dam is equipped with non-functional fish ladders.	Substrate composed of boulders, rocks and gravel. The riparian habitat in favorable condition. Abundant riparian vegetation, predominantly consisting of large trees, shrubs, and herbaceous plants. Stable banks, with no signs of erosion.

Table 1 (continued): The fish species sampled before and after the improper management of the sediments of Gura Golumbilor Dam Lake upstream of the lake (Fig. 2), in the lake (Fig. 1), and downstream of the lake (Fig. 3); B (before) – 2022, A (after) – 2023.

Species no.	Upstream the lake fish species	In the lake fish species	Downstream the lake fish species
3	B-*Phoxinus phoxinus* A-*Phoxinus phoxinus*	B-*Carasius gibelio* A-*Carasius gibelio*	B-*Barbus balcanicus*
3	B-*Phoxinus phoxinus* A-*Phoxinus phoxinus*	B-*Carasius gibelio* A-*Carasius gibelio*	B-*Barbus balcanicus*
3	B-*Barbus balcanicus* A-*Barbus balcanicus*	B-*Pseudorasbora parva* A-*Pseudorasbora parva*	B-*Gobio obtusirostris* A-*Gobio gobio (*sin. *Gobio obtusirostris)*
3	B-*Barbus balcanicus* A-*Barbus balcanicus*	B-*Pseudorasbora parva* A-*Pseudorasbora parva*	B-*Gobio obtusirostris* A-*Gobio gobio (*sin. *Gobio obtusirostris)*
2	B-*Salmo trutta fario* A-*Salmo trutta fario*	B-*Phoxinus phoxinus* A-*Phoxinus phoxinus*	B-*Phoxinu phoxinus*
3	B-*Squalius cephalus* A-*Squalius cephalus*	B-*Leucaspius delineates* A-*Leucaspius delineatus*	B-*Alburnoides bipunctatus*
3	B-*Squalius cephalus* A-*Squalius cephalus*	B-*Leucaspius delineates* A-*Leucaspius delineatus*	B-*Alburnoides bipunctatus*
3	B-*Squalius cephalus* A-*Squalius cephalus*	B-*Leucaspius delineates* A-*Leucaspius delineatus*	B-*Alburnoides bipunctatus*
3	B-*Rutilus rutilus* A-*Rutilus rutilus*	B-*Squalius cephalus* A-*Squalius cephalus*	B-*Squalius cephalus*
2	–	B-*Rutilus rutilus* A-*Rutilus rutilus*	B-*Rutilus rutilus* A-*Rutilus rutilus*
2	–	B-*Ameiurus nebulosus* A-*Ameiurus nebulosus*	B-*Barbatula barbatula*
1	–	–	A-*Pseudorasbora parva*
1	–	–	A-*Carassius gibelio*

The construction of a dam transforms a free-flowing lotic sector of the Miniș River into a lentic habitat, favoring impoundment-dwelling fish species that free-flowing sectors may not naturally support. This lake is actually a sediment trap, retaining sediments which, under a wrong management, can negatively influence the downstream lotic sectors fish habitats.

This impoundment changed the landscape of the Miniș River basin, fragmenting the watershed and regulating its water and sediment flow. This relevant factor significantly impacts river ecosystems, moderately affecting the conservation of migratory fish species and the connectivity among different fish populations under normal water and sediment management conditions. However, these impacts become far more pronounced under mismanagement scenarios, as demonstrated in this study.

Management activities to reestablish healthy populations of lotic fish species, after such inappropriate human induced events, are usually very complex in terms of time and resources requirements. As such, these types of actions should be avoided whenever possible. Qualitative and quantitative analysis of the tradeoffs between a lakes' benefits for human uses and fish population recovery related to dam lake water management and decision-making is almost lacking.

On the whole, the different types of local fish communities found reveal different specific compositions, showing altered ecological status of the aquatic habitats after the impact of the dam lake liquid and solid flows mismanagement.

All such dam lakes must implement specialized liquid and solid flows management and fish monitoring systems to check and balance the local stakeholders management decisions and activities.

REFERENCES

1. Afanasyev S. O., 2003 – About the ecological consequences of the destruction of the Kakhovska HPP Dam: transcript of scientific report at the meeting of the presidium of NAS of Ukraine, September 6, *Visnik Nacional Noi Academii Nauk Ukrai Ni*, 11, 71-80, DOI: 10.15407/visn2023.11.071. (in Ukrainean)
2. Afanasyev S. A. 2003 – Reaction of the biota of mountain rivers to valley pollution releases, *Hydrobiological Journal*, 39, 2, 3-11.
3. Agostinho A. A., Pelicice F. M. and Gomes L. C., 2008 – Dams and the fish fauna of the Neotropical region: impacts and management related to diversity and fisheries, *Brazilian Journal of Biology*, 68, 4, DOI: 10.1590/S1519-69842008000500019.
4. Barrella W. and Petrere Jr. M., 2003 – Fish community alterations due to pollution and damming in Tietê and Paranapanema rivers (Brazil), *River Research and Applications*, 19, 1, 59-76.
5. Bănăduc D., Curtean-Bănăduc A., Barinova S., Lozano V. L., Afanasyev S., Leite T., Branco P., Gomez Isaza D. F., Geist J., Tegos A., Simić S. B., Olosutean H. and Cianfaglione K., 2024 – Multi-interacting natural and anthropogenic stressors on freshwater ecosystems: their current status and future prospects for 21st century, *Water*, 16, 1483, 1-46, DOI: 10.3390/w16111483.
6. Bănăduc D., Marić S., Cianfaglione K., Afanasyev S., Somogyi D., Nyeste K., Antal L., Koščo J., Ćaleta M., Wanzenböck J. and Curtean-Bănăduc A., 2022 – Stepping stone wetlands, last sanctuaries for European mudminnow: how can the human impact, climate change, and non-native species drive a fish to the edge of extinction? *Sustainability*, 14, 13493, 1-39, DOI: 10.3390/su142013493.
7. Bănăduc D., Voicu R. and Curtean-Bănăduc A., 2020 – Sediments as factor in the fate of the threatened endemic fish species Romanichthys valsanicola Dumitrescu, Bănărescu and Stoica, 1957, *Transylvanian Review of Systematical and Ecological* Research, 22.2, 15-30.
8. Bănăduc D., Barinova S., Cianfaglione K. and Curtean-Bănăduc A. 2023 – Editorial: Multiple freshwater stressors-Key drivers for the future of freshwater environments, *Frontiers in Environmental Science*, 11:1143706, 1-3, DOI: 10.3389/fenvs2023.1143706.

9. Bănăduc D., Simić V., Cianfaglione K., Barinova S., Afanasyev S., Öktener A., McCall G., Simić S. and Curtean-Bănăduc A., 2022 – Freshwater as a sustainable resource and generator of secondary resources in the 21st century: stressors, threats, risks, management and protection strategies, and conservation approaches, *International Journal of Environmental Research and Public Health*, 19, 16570, 1-30, DOI: 10.3390/ijerph192416570.
10. Bozek M. A., Haxton T. J. and Raabe J. K., 2011 – Walleye and sauger habitat, chapter 5, 133-197, in Biology, management, and culture of Walleye and Sauger, American Fisheries Society, Barton B., (ed.) ISBN: 978-1-934874-22-6.
11. Błońska D., Janic B., Serhan Tarkan A., Piria M., Bănăduc D., Slovák Švolíková K., Števove B., Lappalainen J., Pyrzanowski K., Tszydel M. and Bukowska B., 2024 – Physiological responses of invasive round goby (Neogobius melanostomus) to environmental stressors across a latitudinal span, *Biological Invasions*, Springer, DOI: 10.1007/s10530-024-03387-2.
12. Cordone A. J. and Kelly D. W., 1961 – The influences of inorganic sediments on the aquaticlife of streams, *California Fish and Game*, 47, 2, 189-228.
13. Curtean-Bănăduc A. and Bănăduc D, 2020b – Human impact effects on Târnava River basinaquatic biodiversity (Transylvania, Romania), 425-437, in Human impact on Danube watershed biodiversity in the XXI century, Bănăduc D., Curtean-Bănăduc A., Pedrotti F., Cianfaglione K. and Akeroyd J., (eds), ISBN 978-3-030-37241-5, ISBN 978-3-030-37242-2, DOI: 10.1007/978-3-030-37242-2, 107 illustrations in colour, Springer International Publishing, first edition, 437.
14. Curtean-Bănăduc A., Didenko A., Guti G. and Bănăduc D., 2018 – Telestes souffia (Risso,1827) species conservation at the eastern limit of range – Vişeu River basin, Romania, *Applied Ecology and Environmental Research*, 16, 1, 291-303.
15. Curtean-Bănăduc A., Bănăduc D., Ursu L. and Răchită R., 2014 – Historical human impacts on the alpine Capra Stream macroinvertebrates and fish communities (southern Romanian Carpathians), *Acta Oecologica Carpatica*, 7, 111-152.
16. Curtean-Bănăduc A., Bănăduc D. and Bucşa C., 2007 – Watersheds management (Transylvania/Romania): Implications, risks, solutions, 225-238, in Strategies to enhance environmental security in transition countries, Hull R. N., Barbu C. H. and Goncharova N., (eds), NATO Science for peace and security series C-Environmental Security Series, Springer, DOI: 10.1007/978-1-4020-5996-4_17, ISSN 1971-4668, ISBN 978-1-4020-5994-0.
17. Brandt S. 2000 – Classification of geomorphological effects downstream of dams, *Catena*, 40, 4, 375-401.
18. Curtean-Bănăduc A. and Bănăduc D., 2006 – Ampoi River watershed management planelements proposal, *Acta oecologica – Studii şi Comunicări de Ecologie şi Protecţia Mediului*, XIII, 1-2, Edit. Universităţii "Lucian Blaga" din Sibiu, 166-140.
19. Hudek H., Žganec K. and Push M., 2020 – A review of hydropower dams in Southeast Europe – distribution, trends and availability of monitoring data using the example of a multinational Danube catchment subarea, *Renewable and Sustainable Energy*, 117, 109434, DOI: 10.1016/j.rser.2019.109434.
20. Song C., Omalley A., Roy S. G., Barber B. L., Zydlewski J. and Mo W., 2019 – Managing dams for energy and fish tradeoffs: What does a win-win solution take? *Science of The Total Environment*, 669, 833-843, ISSN 0048-9697, DOI: 10.1016/j.scitotenv.2019.03.042.
21. Wang L., Infante D., Lyons J., Stewart J. and Cooper A. 2011 – Effects of dams in river networks on fish assemblages in non-impoundment sections of rivers in Michigan and Wisconsin, USA, *River Research and Applications*, 473-487.
22. Soolutayo V. 2012 – Effects of human activities on the biodiversity of a tropical man made lake, *Transylvanian Review of Systematical and Ecological Research*, 14, 175-186.
23. Singh Rumana H., Jeeva V. and Kumar S., 2015 – Impact of the low head dam/barrage on fisheries – a case study of Giri River of Yamuna Basin (India), 119-138, *Transylvanian Review of Systematical and Ecological* Research, 17.2.

24. Lele R. F., Diminescu M. A., Ouedraogo I., Dăncilă A. M., Pelede S., Emadak A. and Lompo M., 2024 – Granulometry Assessment of Lom Pangar Dam Sediments (East-Cameroon), *Journal of Geoscience and Environment Protection*, 12, 6.
25. Tena A., Batalla R. J. and Vericat D., 2012 – Reach-scale suspended sediment balance downstream from dams in a large Mediterranean river, *Hydrological Sciences Journal*, 57, 5.
26. Othman F., Sadegh Sadeghian M., Ebrahimi F. and Heydari M., 2013 – A study on sedimentation in Sefidroud Dam by using depth evaluation and comparing the results with USBR and FAO methods, 2nd International Conference on Environment, Energy and Biotechnology, IPCBEE, 51, 9, DOI: 10.7763/IPCBEE.
27. Emadak A., Acayanka E., Nchimi Nono K., Kamgang Youbi G., Laminsi S. and Fotie Lele R., 2019b – Physicochemical water quality assessment of the Lom River before the commissioning of the reservoir of the Lom Pangar hydroelectric dam in the East Region of Cameroon, in 4th Edition of Water, Energy and Environment (WEE), Congress, 1-11.
28. Radojković N., Marinović Z., Milošković A., Radenković M., Đuretanović S., Lujić J. and Simić V., 2019 – Effects of stream damming on morphological variability of fish: case study on large spot barbell Barbus balcanicus, *Turkish Journal of Fisheries and Aquatic Sciences*, 19, 3, 231-239, DOI: 10.4194/1303-2712-v19_3_06.
29. Taylor M. P., 2007 – Distribution and storage of sediment-associated heavy metals downstream of the remediated rum jungle mine on the east branch of the Finniss River, Northern Territory, Australia, *Journal of Geochemical Exploration*, 92, 55-72, DOI: 10.1016/j.gexplo.2006.07.005.
30. Joy M. K., Fote K. J., McNie P. and Piria M., 2018 – Decline in New Zealand's freshwater fishfauna: effects of land use, *Marine and Freshwater Research*, 70, 114-124, DOI: 10.1071/MF18028.32.
31. Kar D., 2019 – Wetlands and their fish diversity in Assam (India), *Transylvanian Review of Systematical and Ecological Research*, 21.3, 47-94.
32. Khoshnood Z., 2017 – Effects of environmental pollution on fish: a short review, *Transylvanian Review of Systematical and Ecological Research*, 19.1, 49-60, DOI: 10.1515/trser-2017-0005.
33. Kruk A., Ciepłucha M., Zięba G., Błońska D., Marszał L., Tybulczuk S., Tszydel M. and Penczak T., 2017 – Disturbed fish fauna zonation as an indicator of large-scale human impact: A case study (2011-2012) of the large, lowland Warta River, Poland, *Journal of Applied Ichthyology*, 33, 2, 174-18.
34. Marić S., Stanković D., Wazenbök J., Šanda R., Erös T., Takács A., Specziár A., Sekulić A.,Sekulić N., Bănăduc D., Ćaleta M., Trombitsky I., Galambos L., Sipos S. and Snoj A., 2017 – Phylogeography and population genetics of the European mudminnow (Umbra krameri) with atime-calibrated phylogeny for the family Umbridae, *Hydrobiologia*, 792, 1, 151-168.
35. Trichkova T., Stefanov T., Milen Vassilev M. and Zivkov M., 2009 – Fish species diversity inthe rivers of the north-west Bulgaria, *Transylvanian Review of Systematical and Ecological Research*, 8, 161-168.
36. Telcean I. C., Cicort-Lucaciu A. Ș., Sas I. and Covaciu-Marcov S. D., 2011 – Romanichthys valsanicola is still fighting! *North-Western Journal of Zoology*, 7, 2, 111211, 334-338.
37. Ureche D., Battes K. and Stoica I., 2007 – Ichthyofauna actual state in the upper and midcourse of the river Argeş hydrographical basin, *Analele Ştiinţifice ale Universităţii "Alexandru Ioan Cuza" Iaşi, seria Biologie Animală*, 53, 73-82.
38. Sosai A. S., 2015 – Illegal fishing in southern Mannar Island coastal area, *TransylvanianReview of Systematical and Ecological Research*, 17.1, 95-108.
39. Schleiss A., De Cesare G. and Althaus J. 2008 – Reservoir sedimentation and sustainable Development, Book of Abstracts, CHR Workshop Erosion, Transport and Deposition of Sediments, CONF, 23-28.
40. Williams G. P. and Wolman M. G., 1984 – Downstream effects of dams on alluvial rivers, Washington D. C., US Geological Survey Professional Paper 1986, Phillips J. D. 2001, Sedimentation in bottomland hardwoods downstream of an east Texas dam, *Enviromental Geology*, 40, 860-868.