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NATURE CONSERVATION, ECOLOGY AND LANDSCAPE HISTORY STUDIES ON FLOODPLAIN FORESTS OF DANUBE ISLANDS

Ph.D. thesis

Szilvia Ádám

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The doctoral school

Name: Doctoral School of Environmental Sciences

Research field: Environmental Science

Head: Dr. Erika Csákiné Michéli, cMHAS
university professor
Szent István University
Faculty of Agricultural and Environmental Sciences

Supervisor: Dr. Péter Csontos, D.Sc.
scientific advisor
Institute for Soil Sciences and Agricultural Chemistry
Centre for Agricultural Research

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Approval of
Head of Doctoral School

Approval of
Supervisor

INTRODUCTION AND OBJECTIVES

The Danube is the most international river in the world, and Europe's second largest as well. Today many stretches of the whole river are directly influenced by dams. The Hungarian stretch has remained as free flowing, which is a unique value, but during the last centuries many other artificial interventions harmed the river causing significant effects on its islands and their habitats. In Hungary less than 3% of the former fluvial forests preserved till present; this shows the scale of the harmful interventions and land use changes.

The human presence along the Danube and on its islands is almost as old as the age of the islands. In ancient times the human activities and settlements were adapted to the natural circumstances. In dry climate periods they moved closer to the river, which provided drinking water, food etc., while in periods with much precipitation they moved far from the flooded area.

Smaller dikes already had been built during the Roman age, but adaptation to the natural floods had been more typical for a long time. Since the 18th century the territorial need for agricultural land use started to increase significantly. The built of the flood prevention dike system along the Danube resulted in a narrower floodplain. The traditional land uses of the natural habitats which remained on the flood protected area were changed onto intensive land use forms (arable lands, tree plantations), the riverside was occupied by settlements and industries which need direct connection to the river. Due to these processes the previously wide ranged floodplain vegetation is concentrated now only on the islands and on the narrow flooded riverbank areas.

The distribution of the floodplain habitats decreased significantly, their remnants have been affected by river regulation interventions since the second half of the 19th century. The purpose of the river regulation works were (1) flood protection to let the high amount of water pass through the river as rapidly as possible; (2) navigation route development to ensure the width and depth navigation parameters in bottleneck sections during longer periods of the year; and (3) to avoid ice floods by the removal of those natural obstacles (gravel bars, islands) which potentially stop the pass of the broken ice. Gravel bars and islands were removed by dredging, and regulation infrastructures were built to lead and keep the water in the navigation route channel part of the main flow. The most usual structures are the groynes, the parallel structures and the rock-fill dams.

As a result of the continuously improving navigability, the waterway traffic increased. Besides several other harmful effects, the navigation contributes to the spread of invasive alien species, that cause massive degradation of natural habitats.

Other significant problem is caused by the intensive riverbed erosion in the main flow and the water level deepening due to the consequences of the lack of sediment, which are the results of the hydropower plants as sediment traps. According to the results of the recently finished Danube Sediment project, the large Gabčikovo hydropower plant and reservoir blocks 60% of the sediment input, which sediment input has already been reduced by the chain of the upstream plants. The riverbed erosion of the Hungarian section additionally intensified by large volume of commercial dredging between the 1960s and 1990s. The water level deepening can be followed on the measured water level curves.

The establishment of the islands is a result of complex continuous abiotic and biotic processes. The riverbed formation of the Danube is the result of a long term fluvial process, the cumulative effects and the interactions of the natural processes and artificial interventions with the extreme climate conditions are causing so massive negative effects which were never been experienced before. All these effects are endangering the wide-ranged ecosystem-services of the living Danube and its floodplain.

The artificially induced hydrodynamic processes are responsible for the current state of the river and its patterns. The sustainable management of the Danube should not be implemented without the deep knowledge of these long-term consequences. Investigations about the above mentioned aspects are very useful to lay down the basis of the responsible management measures.

The objectives of this study are:

- to gain knowledge about the islands of the Hungarian Danube stretch between Vének and Budapest with priority attention to the landscape history and historical land uses of the islands,
- to compile the human interventions that have affected the islands and their floodplain forests during the last centuries,
- to think over the interactions and consequences of the negative effects,
- to gather the recent threats affecting the floodplain forests, and give recommendations for their future management.

According to the studied references I laid high emphasis to increase my knowledge about the hydrodynamics and geomorphological processes of the Danube as a living fluvial system; the physical infrastructure works induced processes both in time and space; the floodplain forest associations described from Hungary; and also their successional processes.

MATERIALS AND METHODS

The study area is the islands of the Danube stretch between Vének (1797 riverkilometer = rkm) and Budapest (1648 rkm). During the study I divided the 149 rkm long stretch into 3 sections as it is also used in literature sources.

1. Vének – Komárom (1797-1766 rkm) – 31 rkm
2. Komárom – Esztergom (1766-1721 rkm) – 45 rkm
3. Esztergom – Budapest (1721-1648 rkm) – 73 rkm

During the landscape historical investigations, I studied the Hungarian geographical researches and references (Fodor, Deák, Dóka, Jankó) to collect the list of potential mappings about the Danube from island point of view. The first map (the *„Tabula Peutingeriana"*) where the Danube is presented by a line is dated back to the Roman Age. During the 14th century some portolan maps also appeared, but the first geographically „good" and really useful map about the Danube originated from the end of the 17th century. This is the *Danubius Pannonico Mysicus* created by Luigi Ferdinando Marsigli. Without aiming to give an exhaustive list here, other important geographical references were the county maps by Mikoviny and Lipszky, the navigation map of Bänhöltzel and Pasetti, the first technically developed Danube mapping, the military surveys, the river regulation maps, plans, the maps for water sports, the topographical maps, and the aerial and satellite photos.

During the searching work of the available maps and surveys I visited the following institutions: Map Archive of the Military History; National Archives of Hungary; Danube Museum; Special Library of Water and Environmental Protection; libraries and second-hand bookshops. During the years of writing the dissertation, the online Hungaricana (Hungarian Cultural Heritage Portal), Mapire (Historical Maps Online) and Fentrol.hu (Online Aerial Photo Archive) were established, which contribute a lot to the remote access to a huge amount of sources.

As part of the general landscape historical research I analysed visually 29 mappings from the last 250 years. Finally, I presented only the analysed results of 10-10 mappings about each sections, which followed each other in 20-30 interval years. To describe the actual state of the islands on the maps I created a new category system from the perspective of the islands and the affected artificial interventions. Each category was coloured differently to make easier the understanding of the changes in time and space. The first category is the **(1) gravel bar**, which presence on a map depended on the purpose of the mapping and also on the water level, therefore, uncertainty appeared. Beside this weakness they are still useful, because many times the presence proves that the gravel bar which is the basis of the island was formed more than hundred years ago. When the pioneer woody vegetation is established on a gravel bar the **(2) real island** is born, which size and shape will be formed by the local hydrodynamic conditions. When the island's side-arm is closed by a rock-fill dam as a physical obstacle, the hydrodinamics of the side-arm is changing, the flow of the water is decreasing and inducing siltation. When the silting-up process is in the early phase I call it **(3) island with closed side-arm**. When the silting-up is in intermediate phase, which means that the side-arm partly dry out when the water level is very low, I call it **(4) island with drying out side-arm**. When the silting-up is in advanced phase and the island practically becomes part of the riverside, I call it **(5) one-time island**. I used an additional category for those islands which side-arm had been physically closed but it has been recently re-opened, which are called **(6) island with re-opened side-arm**. I summarized the results by sections, analysed the circumstances of the changes, and built an island-cadastre on the basis of the results.

I made detailed historical investigations on some islands from each sections with the use of many other references: local and cadastral maps, more civil and military aerial photos, and many archive references from medieval codes, Archives of the Benedictine Archabbey of Pannonhalma, archaeological papers, libraries of counties, towns and institutions, Local History Collections etc.

During the floristical investigations I followed the nomenclature of the plant determination book of Király (2009), while in case of habitat types I used the General National Habitat Classification System (ÁNÉR) of Bölöni et al. (2011); associations follow the Red Book of Borhidi & Sánta (1999). The compilation of species was recorded in a database of tables that show further literature data as well. I used the results and publications of Balázs Kevey to interpret the succession processes that are typical in floodplain forests.

The GIS measures, georeferencing and layouts were created by the use of **ESRI ArcGIS 10.4.1 for Desktop** software. The series of maps presenting the changing processes of the island were edited by **Photoshop CS3** software. The database featured tables (island cadastre, floristical database and the result of the general landscape investigations) were created with **Microsoft Excel** software.

SUMMARY OF THE RESULTS

During the general landscape history studies I identified 122 islands on the 149 rkm long river stretch based on mappings of the past 250 years. These islands have never existed together in one moment, but all of them have been an island for a shorter or longer period between the 18th and the 21st century. There are big differences in their size and thus, their ecological role differs as well. The size of an island is a snapshot value, therefore, I used size categories (Table 1).

Table 1. Island size categories

Category	Size
Tiny	0-1 ha
Small	1-5 ha
Medium	5-15 ha
Great	15-1000 ha
Giant	1000+

53 of the 122 islands are medium or great sized. These islands can be permanently followed during the history, I call them as „stable" islands. There is 1 giant, the Szentendrei island, while I identified 40 islands as small and 28 as tiny. The tiny ones usually established around the great islands, or behind regulation structures, and are usually short-lived as real islands.

The 53 „stable" islands lists every old islands that had already existed before the water regulation works, but only 6 of them exists today as real islands, i.e., a mere 11%. Except for the youngest and smallest among them (Csitri island, 5.7 ha), all of them are currently used as urban (Vízivárosi, Óbudai, Margit) or holiday islands (Helemba, Szürkő) and thus, their habitats reflect the effects of anthropogenic land uses. Even they are partly modified with severe disturbance, they still play an irrecoverable role as ecological corridors. Their extended biologically active green surfaces highly increase the urban biodiversity within the built-in areas (birds, bats etc.). Their ecosystem services are outstanding as well. The main aim is to preserve their green surfaces, ban their further building-in, improve their habitats, and preserve their direct connection to the Danube.

Almost every island that are in a close-to-natural state and less disturbed are affected by structures, their side-arm shows different levels of silting-up, which endangers their subsistence in case of remaining without intervention. The side-arm of two "stable" islands (Nagy Léli, Kompkötő) have partly been re-opened recently, which is of utmost importance.

There are currently 7 real islands among the 40 small ones. All of them have established or were re-born during the 20th century. The latter process means that 2 current small islands had been great islands in the past, but they temporarily disappeared after ruining back to gravel bars, and have only re-developed for the second half of the 20th century (Ambó and Kecske islands), showing the changes in the hydrodynamics. The remaining 5 small real islands (Zsidó, Törpe, Zebegényi, Újmarosi, Mezítlábas) developed from gravel bars; this process well demonstrates the joint role of natural hydrodynamics and artificial human interventions in the 20th-century processes of the fluvial system. Their gravel bar basis has already existed in the 19th century, well before the water regulation works (Újmarosi island is questionable). They have established to be real islands as a consequence of riverbed erosion and water level deepening, as their surface has become (almost) constantly above the water level. The anthropogenic effects played role in their development via accelerating the natural processes. While the gravel basis of the tiny islands was created by the locally changed hydrodynamics due to regulation structures and thus, they are rather of secondary origin.

Altogether 13 islands disappeared from this river section (eg. Lídia, Visegrádi, Fürdő, Szobi) as a consequence of dredging, or changed hydrodynamics. The Helemba bar and the Szobi island still exist in the form of gravel bars in the middle of the riverbed, therefore, they can develop to be islands in the future, the others have no chance.

Besides the general landscape history investigations, I summarized the detailed history of cca. 30 islands (belonging to 13 groups), all of them being unique and exciting, as there are no two similar ones. I managed to find data even about the establishment of some "stable" islands, or looked back into the past 1000 years. Unfortunately, there are some islands where the last years of existence could be determined as well. More than half of the "stable" islands have already been existing as early as the 11th to 15th century. Among the 3 observed sections, there are medieval mentions (in official documents) for 77% of the islands between Komárom and Esztergom, being a sign of riverbed stability of this section.

Based on the literature processed during general and detailed landscape history studies, I prepared a figure to show the distribution in time and intensity of the pressures on the Danube with anthropogenic origin in the past 2000 years. Physical interventions mix with services and other direct or indirect effects on this Figure 1; my main aim was to visualize the time factor.

Intensity of the effects that modify the system show massive increase during the past 150 years. Two peaks can be seen, namely the years after 1867 (Austro–Hungarian Compromise), and after the 2nd world war. So many factors affected the Danube in these two periods (and partly still today) that have never been faced by the fluvial system during its long history. We strongly have to consider the cumulative effect of these pressures as well as their interactions. Knowing them and their consequences is inevitable in order to manage them as factors that endanger the Danube as an ecological system with a holistic approach.

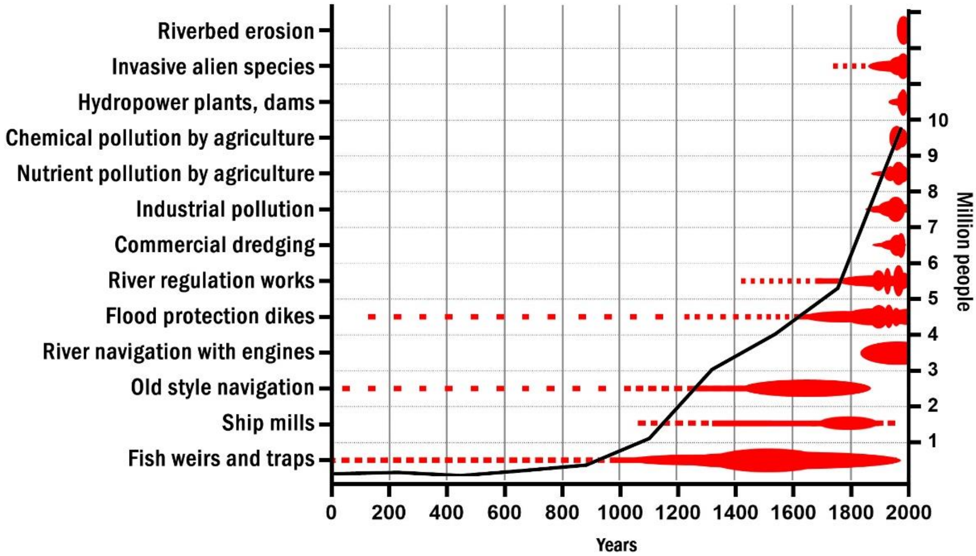

Figure 1. Distribution in time and intensity of anthropogenic pressures that affect the Danube, and Hungary's population (continuous line) during the past centuries

Besides the above-mentioned effects, various land uses and their changes have strongly affected the state of the habitats on the islands. Previous non-intensive land uses (ie., pasture, hayfield, orchard, forest) were changed onto intensive tree plantations after the 2nd World War, especially on those areas that were covered by white poplar stands (*Senecioni sarracenici–Populetum albae*) and black poplar stands (*Carduo crispi–Populetum nigrae*) before. Both the foliage level and the grass level of these tree plantations are poor in plant species, and the disturbance during their planting opened floor for invasive alien species, while the species characteristic for valuable marshlands and floodplain forests have totally disappeared. This alteration in species pool is definitely significant in case of those plantations that cover previous marshlands and wet hayfields. Moreover, the cultivars and hybrids used by intensive forest management (*Populus × canescens, P. × euramericana*) may hybridize with native tree species (*Populus alba*, *P. nigra*) and this results transitional forms, which endangers the genetic stock of native floodplain forest species.

First pioneer habitats on riparian zones of islands and gravel bars where the surface becomes dry are willow scrubs. Two associations may appear, depending on the ecological factors of the site (ie., the gravel bar surface), and the sediment that builds up the island's riparian zone. Purple willow scrubs (*Rumici crispi–Salicetum purpureae* association) evolves on gravel covered surfaces characterized by extreme water regime. Such surfaces were typical on the riparian zone of the islands along the main flow, and upper zones of the side-arm bank on the islands. On the contrary, almond-leaved willow scrub association (*Polygono hydropipero–Salicetum triandrae*) develops on silty and sandy surfaces, which is typical along side-arms, mainly in their lower riparian zone. As a consequence of closing the side-arm, previously gravel covered surfaces of the riparian zone of the side-arm have been recently covered by smaller sediments of sand or silt, and thus, the *Rumici crispi–Salicetum purpureae* association only appears on the bank of the islands along the main flow. However, many erosion protection structures were built along the riparian zone which are blocking the development of continuous stands, and therefore, the next successional stage (black poplar stands) cannot evolve. Almond-leaved willow (*Salix triandra*), the dominant species of almond-leaved willow scrub stands (*Polygono hydropipero–Salicetum triandrae*) becomes rare as well; its consociation with white willow (*Salix alba*) are more typical, or the white willow stands (*Leucojo aestivi–Salicetum albae*) grow directly on the bank without any scrub association. A possible reason for this might be the deepening water-level and drying of bank zone along the side-arm.

Well-stated poplar groves can hardly be found; only small fragments and edges remained. Only one stand of the successional stage leading towards riparian mixed hardwood forests was found, dominated by European white elm (*Ulmus laevis*). Considering the riparian softwood forests, only willow groves cover a remarkable rate, endangered by the same factors as the other alluvial associations, ie., lowering water level and invasive alien species (its intense depends on the distance from the bank, more distance means less water and more invasive).

However, if the damages are not irreversible, alluvial associations have a definitely good regenerative potential. They are able to regenerate after stabilizing the ecological factors (eg. water level, hydrodynamics, soil parameters), if there are propagules of the species. Such sources for regeneration might be the floods that transport propagules from the vegetation of the upper river sections, or the seed bank, and less degraded refugees of the tributaries. Moreover, my landscape history studies showed that there are some patches on every island that were not affected by intensive management. Although they were affected by altered ecological factors as well, but their species stock still preserves more species of the once natural habitats than the abandoned crop fields and intensive tree plantations. These patches regularly cover the edges of the islands, part of which served as routes when towing ships before steamboats become prevalent; this is why their vegetation had regularly been cut back since as early as the 13th century. Keeping these edge zones 'clean' was abandoned more than 100 years before the big land use changes in the second half of the 20th century, and the time passed since then was enough for the habitats of these edge zones to regenerate.

Summing up the floristical data of the studied islands resulted in a database of 446 plant species. An average of 30 to 80 species was detected per island, but those islands that host wet meadows and marshes give home for twice or even three times more species. We found 21 nature protected and 4 other rare plant species during our field studies; out of them 8 protected and 4 other rare are new for the online Hungarian vascular flora database in 20 mapping quadrates.

CONCLUSIONS AND RECOMMENDATIONS

The consequences of the interventions that affected the river cannot be separated from the state of the islands. The effects, threats of the interventions are summarized in Table 2 with special attention to their interactions that may result in more severe effects.

Table 2. Effects and threats affecting the islands as the result of human interventions.

Intervention	Effect, threat	Affected islands
flood protection dikes	• narrowed floodplain, increasing flood peaks • higher surfaces of the islands are also flooded • the successional transition and evolvement to hardwood forest is stopped	**all islands**
⬍	the water level fluctuation is increasing due to both narrowed floodplain and riverbed erosion which contribute to the spreading of eurytopic invasive alien species which leads to degradation of habitats	
upstream hydropower plants, dams **and**	• lack of sediment • riverbed erosion, water level deepening • new greater gravel bars and islands have not been established only those bars are rising up which basis is originated before the regulation works • the islands without stabilized riverbank are expanding in upstream direction with or without tiny pre-islands and their moving makes their side-arm even more narrow, by the end of the process they become the part of the riverside soon	
regulative or commercial dredging	• local or longer sectioned riverbed deepening • gravel bars and islands were removed which would stop the pass of the broken ice or situated inside the navigation route	**13 islands disappeared**, **+more** „dredged" islands
⬍	• the surface of some greater islands were also dredged for gravel excavation purposes, their habitats were destroyed or are still very degraded • the changed hydrodynamics also destroyed island	
built of regulation infrastructures: **rock-fill dams to close side-arms, parallel structures, groynes**	• silting-up and drying out of the side-arms • there is no water recharge in low water periods, the remained water is stagnant, eutrophication • the original riverbed material (gravel, sand) is not arriving to the side-arms • the ecological factors changed (soil parameters, water regime of the site) • the originally gravel covered surfaces transformed to silty surfaces, • the composition of the species changed, the successional transition has accelerated, changed	**61 island with closed side-arm:** 21 great 15 medium 25 small

stabilized riverbank	• the naturalness state of the river sections is degraded • the potential range of the riparian habitats (e.g. willow scrubs) narrowed between the stoned banks • limited riverbank dynamics and lateral erosion	**all medium** and **great islands**
land use change **tree plantations**	• transformation of natural habitats • tree plantations instead of traditional, non-intensive floodplain management (pasture, hayfield, orchard, floodplain forest) • tree plantations are poor in species • cultivars and hybrids are used by intensive forest management may hybridize with native tree species, which endangers the genetic stock of native floodplain forest species	
⬍	most if the listed interventions open the floor to the spread of invasive alien species: ○ carried by boats or vessels, ○ carried by the materials were used to build dikes or regulation structures, ○ with the planted trees, ○ by all of the activities with the disturbance of the island's surface	mostly **medium** and **great islands**
spread of invasive alien species	• where traditional floodplain management were done before but it is stopped • because of the changes in the ecological factors ○ silty surfaces instead of gravel ○ water level deepening ○ accelerated and changed successional process ○ eutrophication in the side-arm ○ increased water level fluctuation	

In general, a river intends to reach a dynamic equilibrium between erosion and sedimentation by sediment transport. The dynamic equilibrium does not mean passivity, but rather refers to the stability of the active processes. Nowadays the morphology of the fluvial system is formed by both natural hydrodynamics and artificial interventions which scale is hardly estimated and has unpredictable, long-term consequences.

I summarized the importance of the real islands in 9 paragraphs, and made 11 recommendations for the management measures of the islands. Additionally, I proposed 5 islands to designate as national or local nature protection areas by law.

The key for the regeneration and long-term conservation of the floodplain forests is the reduction of the effects of the existing regulation structures beside to avoid any new harmful intervention.

NEW SCIENTIFIC RESULTS

1. I made thorough landscape history investigations on the islands of the main flow between Vének and Budapest (149 rkm long Danube section), compiled an island cadastre (122 records), and presented their transformation processes (divided into 3 sections) in tables.
2. Based on the literature sources that originate from various historical ages and sciences I compiled those effects with anthropogenic origin that affect the studied Danube section, and presented their intensity and distribution in time.
3. The anthropogenic effects on the Danube and its islands hit their peaks during the past 150 years. One massive peak is the consequence of the thorough water regulation and flood protection interventions after 1867 (Austro–Hungarian Compromise), another is caused by land use changes after the 2nd world war.
4. Due to anthropogenic effects, a mere 11% of the islands (that evolved provably at least 500 to 600 or even 1000 years ago) exists today as real islands, i.e., surrounded by water.
5. During the past 100 years new islands (with a surface greater than 1 ha) have established only via emerged gravel bars due to riverbed erosion; their gravel bar basis has already existed before the water regulation works. They cannot grow due to lack of sediment. They connect to the terrestrial riverside during 30 to 80 years, depending on the width of the side-arm. New gravel bars can be deposited only in case of changed flows or behind regulation structure; thus, we cannot expect the development of any great islands now or in the near future.
6. Summing up the vascular plants' data on the studied islands (collected during field studies and literature review) resulted in a floristical database of 26 islands, containing 446 plant species with the time of observation, 21 of them being nature protected and 4 other rare plant species; out of them 8 protected and 4 other rare species are new for 20 locations of flora-mapping quadrates.
7. Closing of the side-arm had serious effects on the ecological factors of the islands. The evolvement of previously typical associations (e.g. almond-leaved willow scrub, purple willow scrub) is limited or not usual in their original site, the successional transition has accelerated and changed.

LIST OF PUBLICATIONS IN THE TOPIC OF THE DISSERTATION

Full article in international journal with impact factor

Á. Malatinszky, **Sz. Ádám,** E. Falusi, D. Saláta, K. Penksza (2013): Climate change related land use problems in protected wetlands: a study in a seriously affected Hungarian area. Climatic Change 118 (3-4): 671-682. (IF: 4,622) DOI: 10.1007/s10584-012-0689-9

Arcticles in Hungarian language in scientific journals

Ádám Sz., Penksza K., Malatinszky Á., Csontos P. (2009): A Koppánymonostori-sziget kialakulása és tájtörténete. (The formation and landscape history of the Koppánymonostori island.) Tájökológiai Lapok (Hung. J. Landscape Ecology) 7(2): 349-360.

Ádám Sz., Penksza K. (2009): A Koppánymonostori-sziget részletes botankai vizsgálata és vegetációtérképe. Természetvédelmi közlemények, 15: 493-503.

Ádám Sz., Malatinszky Á. (2012): A Szőnyi-szigetcsoport tájtörténete és vegetációja. Természetvédelmi Közlemények 18: 15-23.

Full articles in foreign language in conference proceedings

Ádám Sz., Csontos P., Kucsák M., Falusi E., Turcsányi G. (2008): Forest associations developed on alluvial soil on two Danube islands, Cereal Research Communications, Proceedings of the VII. Alps-Adria Scientific Workshop, Stara Lesna (Slovakia), pp. 1063-1067

Sz. Ádám, Á. Malatinszky (2013): Botanical values and conservation activities on the islands of the Hungarian Danube section. In: Zh. H. Vardanyan et al. (2013): Biodiversity and Wildlife Conservation Ecological Issues. Proceedings of International Conference of Young Scientists (Armenia, Tsaghkadzor, 3-5 May 2013), Institute of Botany of National Academy of Sciences, Republic of Armenia, Yerevan, pp. 14-17. (ISBN 978-99941-2-831-0)

Abstracts in foreign language in conference book-of-abstracts

Sz. Ádám, Á. Malatinszky, P. Csontos, K. Penksza, E. Falusi, J. Házi (2009): Effects of human induced landscape changes on the vegetation of a Danube island in Hungary. Book of Abstracts, 2nd European Congress of Conservation Biology, p. 151. (ISBN 978-80-213-1961-5)

Abstracts in Hungarian language in conference book-of-abstracts

Ádám Sz. (2008): A Koppánymonostori-sziget részletes botanikai vizsgálata, tájtörténete, vegetációtérképe és összehasonlító elemzése, V. Magyar Természetvédelmi Biológiai Konferencia Absztraktkötete, Nyíregyháza, 2008. november 6-9. p. 105.

Ádám Sz., Malatinszky Á. (2011): A Szőnyi-szigetcsoport tájtörténete és vegetációja. VII. Magyar Természetvédelmi Biológiai Konferencia Absztraktkötete, Debrecen, 2011. november 3-6. p. 49. ISBN 978-963-318-169-0

Ádám Sz., Malatinszky Á. (2012): Florisztikai adatok a Duna egyes szigeteiről. Aktuális Flóra- és Vegetációkutatás a Kárpát-medencében IX. c. konferencia összefoglalói. Kitaibelia 17(1): 69. ISSN 1219-9672