Geomorphology and environmental history in the Drava valley, near Berzence

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Abstract

This geomorphological and environmental history case study aims at reconstructing the environmental conditions and the different ways of land use in the surroundings of Berzence in the Drava valley. The area's geomorphological evolution is examined with regards to the natural processes and the human impact that formed the landscape. The results indicate a tendency in the surface waters and underground waters for drying, mainly due to water regulation and canalization works. Findings from archaeological field walks, certified documents, and old maps are integrated in the reconstruction. Special attention is given to medieval fishing areas, iron processing sites and settlement structures.

Keywords: geomorphology, geoarchaeology, environmental history, Drava, Ždala, fishing, iron processing, water regulation

Introduction

The interaction between man and his environment in different historical eras can be better understood by getting acquainted with the landscape, which determines the lifestyle of its inhabitants in many respects, while bearing the traces of environmental impacts exerted by the society.

The human-environmental interaction has been studied in the Hungarian-Croatian border zone within three Hungarian settlements in Somogy County, Berzence, Somogyudvarhely, Gyékényes and two villages in Croatia, Gola and Ždala *(Figure 1).*

A current academic project aims at reconstructing the medieval settlement structure and the different ways of land use. The project involves explorations in four scientific disciplines: as historical study concerning a 14th century terrier describing the area in exceptional detail, data analysis of archaeological sites recorded during field survey, geoarchaeological studies based on pollen analysis of two samples, and a geomorphological survey. The

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Fig. 1. Location map of the study area. Viczián, I. – 1 = Drava plain; 2 = territories rising above the Drava plain with steep slopes; 3 = Hungarian-Croatian border; 4 = study area (*Figure 2*); 5 = area *of Figure 6*

aim of the present work is to describe the environmental (geomorphological, geological, hydrographical, hydrological) characteristics of the area, with special regards to environmental history, as well as to place these results into a historical-archaeological context.

A detailed geomorphological map of the area was prepared based on scientific publications and studies on geography, archaeology, history and local history, as well as using topographic maps, maps of the first to third military surveys, archive maps from the 18–19th centuries, georeferenced military aerial photographs from the last 60 years, and satellite images.

Geomorphological conditions

Although the publications dealing with the geomorphological conditions of the Drava river valley (Lovász, Gy. 1964, 1972; Bognár, A. and Schweitzer, F. 2005; Bognár, A. *et al*. 2009) typically concern large areas, mainly the entire territory of the Drava valley, they also provide fundamental conclusions regarding the geomorphological evolution of our study area. These studies have revealed that river channel variations and their effects on the geomorphic evolution are essentially determined by tectonic movements within the Drava valley. It was proven with geomorphological methods that a number of sub-basins exist in the Drava graben, characterised by multi-phase differential tectonic movements.

Two hydroelectric power plants were planned to be constructed on the Drava River in Croatia, in the immediate vicinity of our study area, one at Đurđevac (Gyurgyevác) (Jaskó, S. 1996) and another at Novo Virje (Sečen, V. *et al*. 2003). Both plans were eventually abandoned.

The current study area in the Drava valley is bordered on the north by the southern edge of the micro-region of Inner Somogy, defined by the settlements of Gyékényes, Berzence, Somogyudvarhely, while on the south by the Zsdála (Ždala) stream, also acting as the country border *(Figure 2)*.

The present landscape and the landforms were shaped predominantly by the Drava's fluvial processes in the late Pleistocene and during the Holocene phases. The area is geomorphologically divided into two different parts. The southern one belongs to the Central Drava valley microregion with distinctive fluvial landforms of the Drava from the late Holocene. The micro-region ends in a steep escarpment whose height is 8–10 m between Gyékényes and Berzence and 30 m between Berzence and Somogyudvarhely *(Photo 1)*. The sandy area of the Inner Somogy micro-region lies to the north of the escarpment. The changes of the Drava's channel configuration and the geomorphological evolution of the area were greatly determined by the different tectonic movements. The Drava valley narrows at the Zákány block then widens to the north into the study area, which tectonically corresponds to the Gyékényes–Gola sub-basin, and then it turns to the south approaching the escarpment at Bélavár.

The evolution of the alluvial fan in the Gyékényes–Gola sub-basin can be determined by three tectonically and geomorphologically successive periods (Lovász, Gy. *et al.* 2009) as follows. The earliest period was the end of the Pleistocene and the beginning of the Holocene, when the Drava flowed much further north, in the zone between the Zsdála stream and the scarp. The escarpment reflects the tectonic line at the boundary of the two micro-regions, the rising Inner Somogy and the subsiding Drava river valley. Besides, the lateral erosion of the Drava river has played a fundamental role in forming the scarp. The sandy sediments, which build up the escarpment, were also deposited by the meandering Drava and were partly reworked by the wind (Marosi, S. 1970). The second period was in the early Holocene, when the Drava basin was subsiding and the Zala Hills experienced uplift. The Drava has developed its alluvial fan and plain, providing the present geomorphological and geological character of the landscape. During the third period, in the second half of the

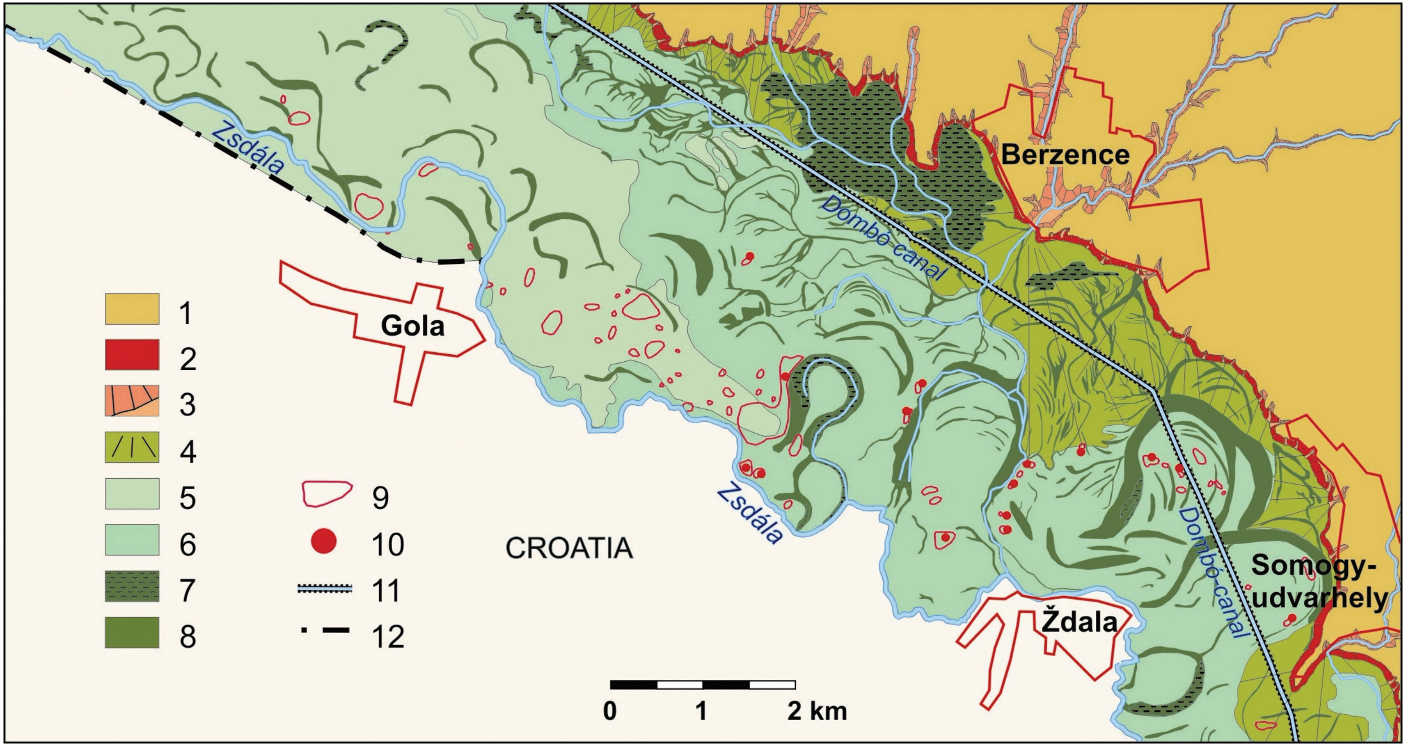

Fig. 2. Geomorphological map of the study area with archaeological sites from the Medieval Period. – 1 = alluvial plain with wind-blown sand forms; 2 = escarpment; 3 = stream valleys and gullies; 4 = alluvial fans; 5 = higher alluvial plain; 6 = lower alluvial plain; 7 = wetlands and marshy areas; 8 = low-lying paleochannels and channels of the perennial and ephemeral streams; 9 = archaeological sites from the Medieval Period; 10 = archaeological finds related to iron smelting activity; 11 = Dombó canal; 12 = Hungarian-Croatian border

Photo 1. Escarpment at Somogyudvarhely. Photo by Viczián, I. 2010

Holocene, the Drava abandoned its former channel by shifting further south, and obtained its current location (Lovász, Gy. *et al*. 2009).

Let us consider the geomorphological and environmental conditions of the study area from north to south. Since the environmental history studies did not touch in much detail the area of Inner Somogy, it will only be shortly dealt with here and its landforms are not shown in detail on the geomorphological map either. Samples from boreholes drilled on the margin of Inner Somogy near the escarpment were typically alluvial sand of the Drava with some intercalated layers of muddy, sandy and gravelly sediments. The area elevated in the Wurm and its surface were no longer formed by the main river, but primarily by the wind and the erosion of the streams shaping aeolian (wind-blown sand) and fluvial (gullies, erosional valleys) landforms (Lovász, Gy. 1964).

The escarpment, which forms the boundary between the two micro-regions, was developed in the late Pleistocene and early Holocene, when its profile was sapped and eroded by the Drava. The landforms of former river channels are quite recognisable at the foot and in the body of the scarp (*Figure 2*). Under the scarp, there are alluvial plains of low relief with streams that divide and flow in an intricately branching pattern. In some places they form wetlands and marshy areas. These areas had mostly been drained with the construction of the Dombó canal, but in other places the wetlands survived.

Flat alluvial fans are being deposited where the streams arriving from Inner Somogy enter the Drava valley at the foot of the scarp. It is their sediments that filled up partly or completely the late Holocene Drava channels. The neighbouring alluvial cones converge into a compound alluvial fan. In some places, marshy areas or fragments of former Drava channels are located between the fans.

The former 1 to 2 km wide swampy belt used to stretch along the escarpment. The wetland was supplied by the ground water from the alluvial fans and by the surface streams. The ground water level is still regulated by the Drava's regime. The wetland belt at the foot of the escarpment is dissected by the alluvial fans of the streams (Tekeres-berki, Lipéki and Vadaskerti streams at Berzence) flowing down from the north. The valleys and gullies of these streams provide a natural downward route from the settlements located at higher altitudes to the Drava valley. The surfaces of the major fans are higher than the surrounding territories, and they also mark the location of other possible routes across the wetlands.

The geomorphological and sedimentary features of the central Drava valley micro-region were basically affected by the fluvial evolution of the Drava and the subsidence of the basin in the early Holocene. The basin was predominantly filled up with gravelly fluvial sediments. Fragments of abandoned meanders and other relict landforms of the early Holocene floodplain can be seen in the area.

The alluvial plain can be divided into two geomorphological units *(Figure 2)*. The area at a lower elevation is the *lower alluvial plain*. North of it, at a slightly higher position is the *higher alluvial plain*. Each of the relict floodplain landforms has distinct sediments. The abandoned channels are filled up by fine sediments (silt, clay), the point bars are built up by sandy gravel, while the scroll bars are characterized by sandy and silty sediments. The sandy sediments in the alluvial fans of the streams originate from Inner Somogy.

The *lower alluvial plain* lies at 114 to 119 m elevation above sea level (a.s.l.). The flatland is characterized by mostly filled up abandoned meandering channels of the Drava from the early Holocene and a series of slightly raised point bars and low-lying scroll bars. The northern part of the area lying below the escarpment is covered by the sandy deposits of the streams of Inner Somogy. The surface of the interconnected alluvial fans is dissected by perennial, ephemeral and paleochannels of the streams and forms a gentle slope towards the lower alluvial plain.

Abandoned meanders of the Drava are well recognizable in the lower alluvial plain, especially on the territory situated between the Zsdála stream and the settlements Berzence and Somogyudvarhely *(Figure 2)*. The location of the channels proves that during the early Holocene the Drava flowed further north than currently.

The flow directions of the streams were naturally adjusted to the Drava's former meanders before the Dombó canal was excavated. The meanders collected all the water within the area and led it into the Zsdála stream and the Drava river.

Remnants of former meanders are predominantly filled up. Wetlands can be found only on their lower lying areas. The ground water level has lowered over the past centuries significantly, resulting in a considerable shrinkage of wetlands (including forested swamps, marshes, riparian and lacustrine wetlands). The agricultural activity has played a significant role in the vanishing of the meanders *(Photo 2)*. The shallow depressions of the meanders disappeared, especially in those places where they have been deforested and become cultivated as arable lands.

A number of gravel pits have been operating in the study area. Gravel is exploited in large quantities from below the ground water level, which is quite close to the surface. Gravel deposited by the Drava during the early Holocene

Photo 2. The Zsdála stream bed (on the left) and a former meander surrounded by forest (in the background). Photo by Viczián, I. 2010

can be found everywhere in a wide zone along the river. Underground waters seep easily through the gravel sheet, their table matches that of the Drava. The areas lying at a lower elevation, especially the early Holocene meanders and plains are temporarily or permanently waterlogged, depending on the level of the Drava, even if the given area lies relatively distant, as far as 5–6 km from the river.

Before the water regulation measures the areas of the *lower alluvial plain* have been speckled with marshy, swampy spots; periodically large areas were waterlogged and expansive flood-plain forests were dominating the landscape.

Remnants of former meanders can also be found in the areas of the *higher alluvial plain*, although they are much less in number and much more filled up. Parallel to the Zsdála stream, which runs in former early Holocene Drava meanders or branches, remnants of the earlier sections of the Zsdála can be discovered. The mean altitude of the area is 119–122 m a.s.l., rising merely a few meters above the lower alluvial plain. Due to its higher position, the Drava's surface-forming impact became less significant than on the lower areas. Currently, aside from erosion, mass movement, deflation, and anthropogenic impacts, especially agricultural activities, play a predominant role in landform evolution of the area. The former meanders have been filled up gradually, whilst their wet, marshy remnants retreated to smaller areas. Rain water, temporary and permanent ground water springs, and shallow underground waters are drained off by a system of channels and valleys towards the nearby lower surfaces.

The *higher alluvial plain* had probably been differentiated from the lower lands already during the early Holocene. As a result of the rising of the Zala Hills, the streams flowing into the Drava from the north deposited significant amounts of alluvial sediment. Northwest of the case study area, but also affecting it, in the region of Zákány, alluvial fans of two torrent watercourses were formed, pushing the Drava bed to the south and blocking or partly filling up the previous meanders (Lovász, Gy. 1964). The *higher alluvial plain* turned into a high flood area terrace. The development of the territory at a higher elevation can only partly be explained by the process of alluvial fan formation. Similar multi-phase differential tectonic movements characterize certain parts of the young Gyékényes–Gola basin. Based on the geomorphological situation of the former riverbeds in the Drava valley area and the extent to which they are filled up, it can be assumed that the area enclosed by Berzence–Gola–Somogyudvarhely subsided more definitely than the areas lying northwest and west of it. The area of the lower alluvial plain belonged to the Drava's zone of influence for a longer time and its fluvial landforms are also more intact, than the meander ruins and filled-up oxbow lakes of the higher alluvial plain. The watercourse (today's Dombó canal) collecting the streams from Inner Somogy incised the valley at the foot of the escarpment and the alluvial fans lining it got deeper at the same pace, while simultaneously the former Drava meanders got filled up. The straggly network of streams, wetlands and marshlands diversified the landscape. Flat ridges, somewhat higher than their surroundings, and marshes with groves were found 1.5–3 km west-southwest of Berzence, along the Dombó canal.

Environmental history research based on the geomorphological conditions

Three approaches were applied during the environment reconstruction. One of them explored the *present environmental conditions* and the natural processes and phenomena owing to environmental changes. Another method examined the *human impact on the landscape* in the past centuries, inferring tendencies in environmental changes. The third approach attempted to integrate the results of the *archaeological research* and the data from *historical sources*.

Present environmental conditions

Regarding the area's present environment, it is obvious that the current settlements are typically situated at the edge of the escarpment and on the higher alluvial plain. There are no significant settlements on any of the deeper territories of the *lower alluvial plain*, dissected by meanders. At the border of the two different micro-regions, the settlements at the edge of the escarpment are generally found along stream valleys. Apart from the availability of water, the valleys provide other advantages, such as a viable access down to the Drava valley areas. In addition, alluvial fans built by the streams, being elevated above their surroundings, ensure a safe surface for transportation.

The area of the Drava valley seems like a homogeneous flatland, nevertheless the slight elevation differences and the various flood plain landforms may be significant from the viewpoint of environmental history. The research shed light on the fact that on the alluvial plains of the Drava valley, along with the surface streams and the position of the flooded areas, the level of ground water is the key factor in the human-environment interaction. The geomorphological study of the flatland plays a fundamental role in the environmental reconstruction, since even the slightest differences in few meter elevation of the various forms may determine whether the given area had been a lake, a swamp, an area with risk of inland waters or a safe surface suitable for building upon. The area's landforms are typically those of riverside flood plain, i.e. they are the remnants of an early Holocene wash land, and currently do not strictly belong to the zone of influence of the Drava river. The river runs far from the area as it has left its earlier beds and the floods do not have an immediate effect presently. Naturally, it continues to have a significant impact indirectly on the hydrogeographic conditions with changes of its water level, ground waters, and larger inundations.

Human impact on the landscape

The hydrographic situation of the Drava valley and the resulting environmental conditions have greatly been affected by the various water regulation and canalization works, gravel pits, river bend cuts on certain sections of the Drava, as well as by the construction of hydroelectric power plants and dams. Most obvious are the ponds that remain of the gravelpits. These are found south of Somogyudvarhely, while gravel production is still going on south of Berzence.

The area's hydrographic conditions have been shaped fundamentally by the creation of the Dombó canal. The First Military Survey map from 1784 does not show the canal, neither does it mark any arable lands (except for Udvarhelypuszta), only forests, meadows, groves and swampy, marshy spots. The canal was created at the very beginning of the 19th century (Szállási, S. 1936). The Dombó, running roughly parallel to the line of the scarp, collects the streams of the territory and flows into the Drava at Bélavár, south of Somogyudvarhely. The canal and its related drainage ditches collect and drain the territory's waters. Its creation made the average ground water level drop and drained the formerly marshy lands on the lower alluvial plain and on the alluvial fans of the streams at the foot of the scarp. It made the ground water risk areas at the foot of the scarp dryer, such as the groves, marshlands, alluvial fans and certain parts of the Drava's early Holocene meanders. The cultivation of the areas with persistent high ground water tables formerly, became much safer, although swamps are still found on smaller surfaces.

The Turkish traveller Evliya Çelebi (Cselebi, E. 1985), in his description of the siege of Berzence in 1664 mentions the former swamp lying along today's Dombó canal. He writes the following: a two-hour long swamp extends at the southeastern and western parts of the castle.

The canal appears on the Second Military Survey map prepared in 1859 as well as on a map from 1868, found in the National Széchényi Library, marked TK 1975 and entitled *Plot division map of the fields of Berzence market-town*. These maps also depict the changes in landscape use, showing that in the Drava valley area more ploughlands, forests, and cleared woodlands turned into agricultural use are found, usually divided into small plots. The meadows and grazing lands are mostly found near the scarp and along the Dombó canal.

This is the condition rendered also on the cadastral map kept in the Archives of Somogy County. The canal and the drainage works were created according to the socio-economical needs of the time, allowing for more arable land and ensuring grounds for the Barcs–Murakeresztúr railway, completed in 1868.

Aside from the changes in ground water conditions and land use, the Dombó canal's construction caused major changes in the system of surface streams. Previously, the extensive network of stream beds arriving from the north converged south of Berzence and flowed into the Zsdála stream via the early Holocene Drava meander, between the settlements of Berzence and Zsdála. Near the mouth is a spot named Postamalom (comprising present-day Ždala) appearing on the second military survey and in several other maps. The name Postamalom (meaning "Post mill") suggests a stream copious in water, suitable for driving a mill. Through the creation of the Dombó canal and the diversion of water, the amount of water from the streams arriving into the former Drava meander has significantly diminished, causing substantial changes in the environmental conditions of the territory. Similarly, the area's smaller watercourses have dried up.

Other canalization and drainage works have been carried out later on in the area west of Berzence as well as south of Csurgó at the foot of the scarp, on the marshy lands of the stream's valley.

Clearly, the canalization and water management initiatives of the past centuries prompted the area to dry up and the former watercourses to disappear. Other than the local impacts, the engineering interventions concerning the Drava have had a fundamental effect on the hydrogeographical condition of the examined area. During the most active period of the flood control and water regulation measures on waterways between 1805 and 1848, 62 bends were cut within 75 km on the section between the mouth of Mura to the Drava and the mouth of Drava to the Danube, which resulted in a shortening of the river's original length by 40%. Smaller cuts were performed later on, including bends on the Drava section within the examined area, namely at Botovo in 1981 and at Bélavár in 1980 (Sečen, V. *et al.* 2003). The shorter watercourse greatly increased the water's power and its bed has incised by several meters, depending on the specific section of the Drava. The ground water level of the Drava valley region is determined by the river's watercourse. The deepened Drava bed and its lower water level brought about a general decrease in the ground water level.

Since the shorter watercourse carries off the floods in a shorter time, the inundation periods have also shortened and the impact of the seepage into the soil and that of water supply have also lessened. The wetland habitat of the flood plains, the areas under temporary water coverage, and the ponds in the flood plains formerly under permanent or seasonal waterlogging stopped receiving the same amount of water during inundations. This has also decreased the ground water levels. The impact of the floods has been further diminished by human action.

The series of hydroelectric power plants constructed on the Drava balances the river's water regime, since large amounts of water are kept behind the dams. This has also caused the level of high stages to diminish and the drainage periods to shorten. The areas affected by flooding have also shrunk due to the construction of dikes. Dikes have been built on the left bank of the Drava in a length of 123.4 km, on the right bank in a length of 136 km, and along the tributaries in a length of 86.5 km (Sečen, V. *et al.* 2003). Dikes are also found in the vicinity of the case study area, between Botovo and Répás (Repaš) on both banks of the river.

The mutually reinforcing anthropogenic impacts on the river's dynamics caused a general decline in the ground water level. According to the water gauge of Botovo, the average water level of the Drava lowered 2 meters between 1876 and 1998. This is further proved by the average April ground water level measured south of the examined area, on the other side of the border in Répás forest. In 1900 the ground water flooded approximately 40% of the Répás forest territory, whereas since 1990 the ground water has not even reached the surface (Sečen, V. *et al*. 2003). Evidently, a similar process has taken place in the case study area.

Water regulation measures resulted in a massive drop of the ground water level by several meters and in the disappearance or shrinkage of swampy, marshy lands and ponds both on the Drava and on the tributaries of the Zsdála. The areas formerly characterized by high ground water levels or temporary inundation became dryer. The environment has significantly transformed in the past few centuries due to human impact. Changes in the ecological conditions, such as the clearing of former woodlands and the intensified agricultural use also brought about essential changes in the Drava valley's flora and fauna and in the general outward appearance of the landscape.

Considering the present environmental conditions, geomorphological characteristics, anthropogenic impacts and the natural rate of sedimentation on flood plain forms, the picture of the Drava valley's medieval environmental condition becomes more articulated. It can be stated that the average depth of the ground water level in the area used to be less and the hydrographical situation has much been altered. In the Middle Ages the lower areas, typically the former Drava meanders and lowland, were covered by water, forming marshy lands and ponds. On the lower alluvial plain at the time of the Drava's flooding and during rainy seasons waterlogging appeared over large areas. Generally speaking, the lower areas offered adverse conditions for the establishment of permanent settlements. The elevated landforms of the higher alluvial plain were much more suitable to carry settlements, even though their lower parts also had marshy spots and were inundated. The belt encircling the escarpment on the south had extensive marshy, swampy areas and high ground water levels and uncontrolled ramifying watercourses weaved through it. The marshy belt was interrupted by the alluvial fans of larger streams. The streams and springs carried significantly more water than today, due to more abundant water supply, higher ground water levels and less filling up of waterbeds.

The question arises whether the Zsdála stream used to be a branch of the Drava during the Middle Ages and how much impact the Drava's floods had on the area. On several maps, found in the collection of the National Széchényi Library, the Zsdála stream appears as a branch of the Drava, for instance on the map TK 2149 from 1685, on TK 1119 from 1788 and on TK 1851 *(Figure 3)* from 1850. The area enclosed by the river and the stream is shown as Répás island on many maps. Hunfalvy, J. (1865) writes about the Drava: "… it often splits into several branches and embraces smaller or larger islands. … Among its largest islands are Répás island near Berzence, southeast of Novoszelló Légrád, …" The first military survey map from 1784 shows the

Fig. 3. Fragment of a map from 1850 showing the Zsdála stream as a branch of the Drava (OSZK – TK 1851)

Zsdála as a stream taking its source from the hills near Zákány. The same is illustrated on several other 18–19th century maps. It should be noted that the Zsdála stream used to run in an early Holocene Drava bed or branch and presumably it continued to be associated with the river during the second half of the Holocene as well. The heavily filled-up streambed today approaches the river by barely one kilometre near Gyékényes in the west. Several detailed archive maps present the Zsdála flowing into the Drava south of Zákány (from 1786: MOL S 12 Div 13 No 70:7 and 70:8, from 1793: MOL S 12 Div 13 No 237:1 and 237:2, from 1802: MOL S 12 Div 18 No 72:2 and 73:2, from 1822: MOL S 12 Div 12 No 24).

On the map from 1786 the "Einflus *(Einfluss)* der Sdalla Grabens" (the inflow of the Zsdála bed) appears with a small arrow, indicating the direction of flow towards the Drava *(Figure 4)*. Based on these, the water flowing into the formerly filled-up Drava bed probably reached the river partly south of Zákány and partly, continuing along today's Zsdála bed to the east, it flowed into the Drava at Bélavár.

After the exceptionally huge, destructive floods of the Drava, the water might have retreated to its earlier channels and a smaller portion of the flood might have been drained by the Zsdála. Whether there was a closer relationship between the two watercourses during the Middle Age remains an open

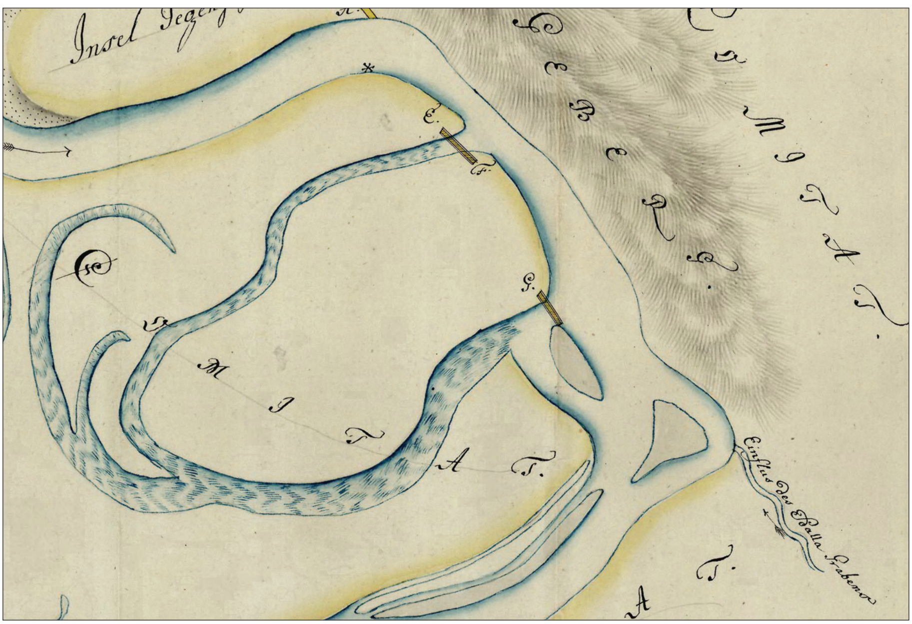

Fig. 4. Map from 1786 shows the connection of Zsdála and Drava at Zákány "Einflus *(Einfluss)* der Sdalla Grabens" = the inflow of the Zsdála bed (MOL S 12 Div 13 No 70:7)

question due to the lack of sufficient data. Nevertheless, one circumstance should be noted, namely that during the Drava's floods the river dammed up the Zsdála, strengthening the area's wetland nature and increasing the length of inundation periods.

During our geomorphological field studies, moving along the Zsdála stream, the streambed's canal-like character was conspicuous. The watercourse runs between artificial ditches through lengthy sections, its deepened bed has played a certain role in draining the surrounding marshland. Based on the maps from the last centuries however, it can be maintained that its configuration and course have not changed significantly.

Archaeological research and historical sources

Finally, let us introduce briefly some of the preliminary results of the data analysis of written sources, early maps and of archaeological field walkings intending to illustrate the ways of wetland use and the relations between fishing activities and settlement strategies.

A document from 1377 divides certain territories of former settlements between three landowners (MOL DL 6419). The description mentions approximately twenty fishponds and fish traps, and gives a picture of the features characteristic of the settlement structure and landscape usage of a floodplain area.

In the following, those features of ponds and fishing places will be discussed that emerge from the source itself. The document refers to ponds usually as *piscina*, but the terms *geregye* and *strugh* are also frequently mentioned in the terrier. The term *strugh* is derived from the slavic word *struga*, meaning watercourse, or bend (Kiss, K. 1978). Referring to *geregye,* the document referres to it as *captura piscium*, meaning fish trap. The form of the often mentioned *geregye* is known from modern, ethnographic analogues *(Photo 3)*. It is the simplest type of barrier device built of pales, sods and soil and used in fisheries of shallow and sluggish waters of inundation areas. With the help of this weir, the water is closed in its full width, and the fishes that swim up into the oxbow lakes and meanders during the time of inundation can be closed and preserved for a long time (Belényesy, M. 1953; Szilágyi, M. 2001). According to the description of Mathias Bél from the 18th century, the fishermen drove the backwater backwards when it started to flow towards the river, and at the same time they built a barrier behind them, so the water filled with fish was funnelled to another place closed by the barrier (Bél, M. 1941).

Based on our source from 1377, the above-described or a very similar device is presumed to have existed on the inundation area of the Drava. During high stages the oxbow lakes and abandoned channels were flooded and as the water level fell, the *geregye* concentrated and funnelled fish to a

Photo 3. Barrier device built of wattle, used on sluggish water of the inundation area. Bés (Ung County). Photo by Bellon, T. 1986. (Szilágyi, M. 2001)

place, where they were caught at a later time. According to a reference from the document, during floods, entire fields or meadows got under water, where fishing appeared as an organised activity of the village community, aiming not to offend each other's interests: *"when the water overflows the meadow … serfs are not allowed to set up fish traps or other devices"* or elsewhere:*"in the forests all the serfs are obliged to set up fish traps at the same time"*.

Turning to archaeological data, nearly 90 sites have been recorded within the study area, dating from prehistory to the late Medieval Period. It can be seen at first look that it was a densely settled territory during the Middle Ages, even if settlements did not exist simultaneously. At the present stage of the field walkings, traces of two larger villages and several – presumably temporary – small settlements were found dating from the Medieval Period. Both of the large villages are situated along the Zsdála stream and most of the small sites lie near or next to the Zsdála or to one of the oxbow lakes or abandoned river channels. Regarding archaeological sites on the research area, two different patterns of settlements can be distinguished. On higher terrain (119–122 m), in the western–northwestern part of the area, sites have turned up more densely and evenly distributed, while sites of lower elevation (114–119 m) to the east–southeast are principally aligned along the meanders of abandoned rivers. Additionally, several sites from the Arpadian age on the lower terrain contained finds related to iron smelting activity, such as slags, iron blooms and pieces of tuyères *(Figure 5)*. The formation of bog iron is typical in reductive environments, in areas with high ground water level, swampy and marshy lands, just as this area used to be during most of the Holocene. The presence of iron-based industrial activity during the Arpadian age, where attention was focused on the exploitation of alluvial iron ores, demonstrates the further use of wetlands as a resource for activities other than fishing.

Where might have these ponds and fishing areas been? It should be noted that the whereabouts of sites described in the title deed documents cannot always be precisely identified and possibly several of them are found beyond the area of archaeological study and geomorphological mapping. In the territory of Inner Somogy, damming up the streams of the valleys, cutting into the surface ensure the creation of ponds. Such ponds still exist today near Berzence and north of it, on the Tekeres-berki stream as well as southeast of Csurgó.

On the territory of the Drava valley, the former meanders might have served as fish-ponds or barrage areas suitable for fishing. Among them those should be considered which lay at a lower elevation, had significant surface and underground water supply, but were not yet filled up. These conditions are true mostly in case of the meanders located between Gola, Berzence and Zsdála settlements: the double meander to the west and the meander to the east that once drained the water of the streams. A stream abounding in water used to run in the eastward meander until the construction of the Dombó canal. It used to collect the waters arriving from the north, and drained them into the Zsdála stream. The average ground water level being much higher than today, this important stream collecting the waters of the area supplied sufficient water for the meander. The position of the meander allows for damming up the mentioned stream.

The other area that can be considered suitable for fishing is the double meander that lies 500 m west of the previous one. Currently, there is a gravel pit on the site of these meanders. The joint meanders did not have any watercourses arriving from far away. Nevertheless, the higher ground water level, the alluvial plain lying at a higher elevation, the ground water springs in the meander and certain circumstances allowed for enough water to be supplied from the Zsdála stream to have a permanent water surface here in the form of two ponds. When the nearby stream was dammed up (for instance, near the former Postamalom area) further water supply was possible. The southern meander is shown as a pond called "N(agy) Gerend" (today's Kis- and Nagy-Gerendai-dűlő) on a map from 1851, found in the collection of the National Széchényi Library (no. TK 1851, *Figure 3*). The area is still a marshland with alder groves. One of the two large villages, discovered during the archaeological fieldworks is located in the territory named Lankóc-puszta

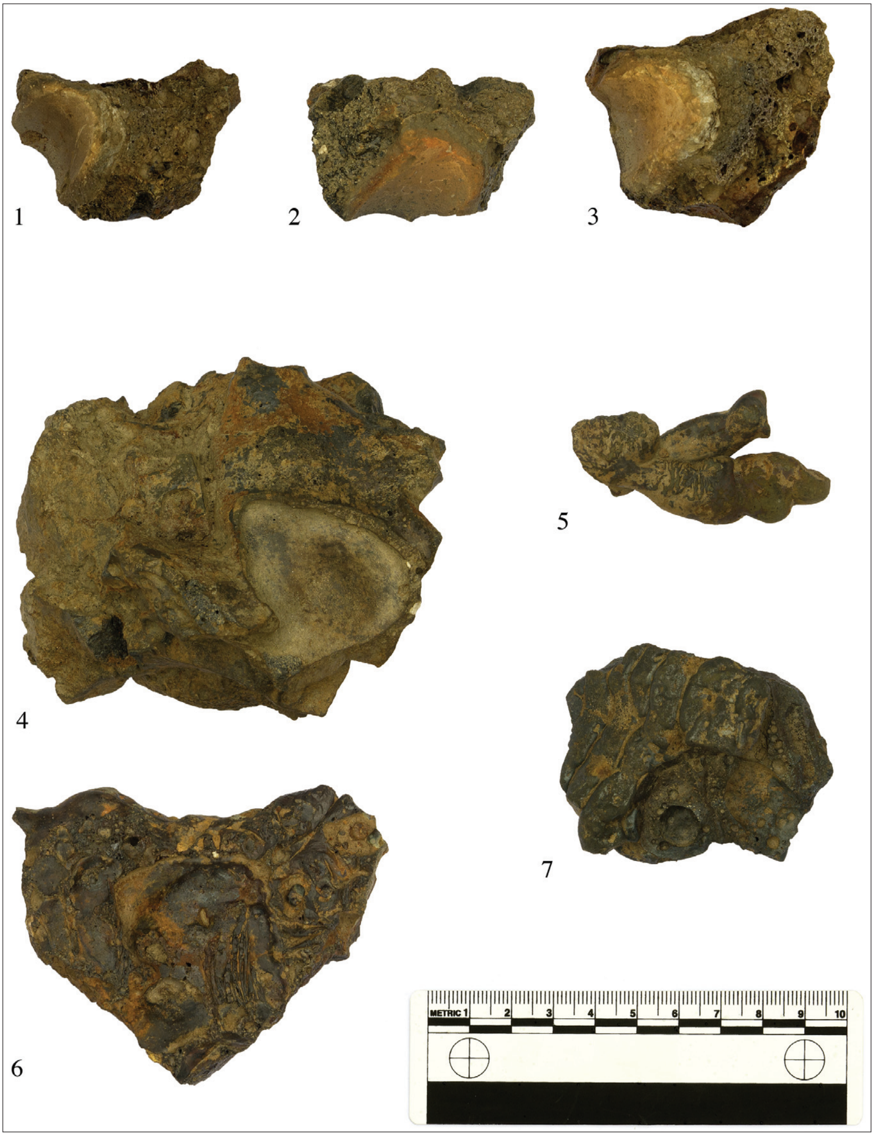

Fig. 5. Pieces of tuyères embedded in slag (1–3); pieces of slag (4–7). Photo by Zatykó, Cs.

on the northwestern part of the study area. The site can be identified with the medieval settlement of Lankóc, which is mentioned in written sources, and was inhabited from the Arpadian Era to the late Middle Ages. The other large village expands from the Zsdála stream to the double meander nearby.

Fig. 6. Traces of a medieval settlement within the township of Berzence on a satellite photograph. *Source:* Google Earth 2008

It contains finds mainly from the 15th–16th centuries in its southern part and potteries from the 12th–14th centuries in its northern area. A satellite image of the site *(Figure 6)* indicates a large brick building traced during the field walking, with lines of streets and a road leading towards an oxbow lake on the east (today's pebble quarry). Smaller ponds might have formed at the foot of the escarpment on plains without an outlet and in the other meanders, although these are less probable.

Summary

This geomorphological and environmental history case study was aimed at reconstructing the medieval environmental conditions. A detailed geomorphological map of the area was prepared to provide basic information about the environment and possible land use of the specific archaeological sites. The analysis and assessment of human impact on the environment in the past centuries helped to get a picture about the changes in environmental conditions. The most significant transformations with a tendency for drying occurred primarily in the surface waters and underground waters. Gaining knowledge about the geomorphological features as well as on the natural and human-induced processes made it possible to reconstruct the hydrographic conditions of the period and the possible methods of land use.

On the one hand, geomorphological research has provided support to the preparation of archaeological field work, interpretation of the results from historical investigations, and the reconstruction of environmental conditions and land use during the different historical periods. On the other hand, the results of archaeological and historical research can contribute to the geomorphological studies considerably and provide essential data regarding the environmental conditions and changes.

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REFERENCES

Belényesy, M. 1953. A halászat a XIV. században. (Fishing in the 14th century.) *Ethnographia* 64. (1–4): 148–165.

Bognár, A., Lovász, Gy. and Nagyváradi, L. 2009. A Dráva-völgy bilaterális geomorfológiai kutatásának legújabb eredményei. (Bilateral geomorphological research of the Drava valley. Contemporary results.) In *Környezetünk természeti-társadalmi dimenziói.* Eds. Szabó-Kovács, B., Tóth, J. and Wilhelm, Z. Pécs, IDResearch Kft.–Publikon Kiadó, 29–38.

Bognár, A. and Schweitzer, F. 2003. Geomorphological and Tectonical Problems of the Drava River Plain in Croatia (Right Bank). In *Pollution and Water Resources*. Ed. Halasi-Kun, G. J. Columbia University Seminar Proceedings. XXXIII–XXXIV. 1999–2003. Studies of Environmental Protection in the Carpathian Basin. Pécs, Hungarian Academy of Sciences, Department of Earth Sciences, 339–351.

Cselebi, E. 1985. *Evlia Cselebi török világutazó magyarországi utazásai 1660–1664. Berzence vára.* (Evlia Chelebi, Turkish world traveller's journeys in Hungary, 1660–1664. The castle of Berzence.), Budapest, Gondolat, 555 p.

Hunfalvy, J. 1865. *A magyar birodalom természeti viszonyainak leírása*. (Description of the Natural Conditions of the Hungarian Empire.) Pest, Magyar Tudományos Akadémia, 240 p.

Jaskó, S. 1996. Folyóvízi lerakódások a Dráva mentén. (Fluvial deposits along the Drava river.) *Hidrológiai Közlöny* 76. (1): 41–45.

Kiss, L. 1978. *Földrajzi nevek etimológiai szótára*. (Etymological dictionary of geographical names). Budapest, Akadémiai Kiadó, 208–209.

Lovász, Gy. 1964. *Geomorfológiai tanulmányok a Dráva-völgyben.* (Geomorphological studies in the Drava Valley.) MTA DTI Értekezések, 1963. Akad. K. pp. 67–114.

Lovász, Gy. 1972. A Dráva–Mura vízrendszer vízjárási és lefolyási viszonyai. (Surface run-off of the Drava–Mura drainage system.) Budapest, Akadémiai Kiadó, 158 p.

Lukács, K. 1941: *Bél Mátyás "Tractatus de re rustica Hungarorum" c. munkája és "Magyarország halairól és halászatáról" szóló fejezetének ismertetése*. (Máthias Bél's work: "Tractatus de re rustica Hungarorum" and a review of its chapter "The fish of Hungary and their fishing".) MTA Biológiai Kutatóintézet Munkái 13. Tihany, MTA Biológiai Kutatóintézet, 109–165.

Marosi, S. 1970. *Belső-Somogy kialakulása és felszínalaktana.* (Formation and morphology of Inner Somogy) Földrajzi Tanulmányok 11. Budapest, Akadémiai Kiadó, 169 p.

MOL: Magyar Országos Levéltár (National Archives of Hungary.)

Sečen, V., Mičetić, S., Jurić, V., Bojčetić, Č., Heček, N. and Ekinović, S. 2003. *Novo Virje Hydroelectric Power Plant Multipurpose System Environmental Impact Study. Transboundary Environmental Impact Assessment.* Espoo Convention, Supplementary material 3. Zagreb, Elektroprojekt Consulting Engineers, 79 p.

Szállási, S. 1936. *Berzence nagyközség szociográfiája*. (The sociography of Commune Berzence.) Doctoral Dissertation, Manuscript, Budapest, Néprajzi Múzeum Ethnológiai Adattár No. 4523. 174 p.

Szilágyi, M. 2001. Halászat (Fishing). In *Magyar Néprajz II.* Ed. Paládi-Kovács, A. Budapest, MTA Néprajzi Kutatóintézet – Akadémiai Kiadó, 104–146.

Hungary in Maps

Edited by
Károly Kocsis and Ferenc Schweitzer

Geographical Research Institute Hungarian Academy of Sciences
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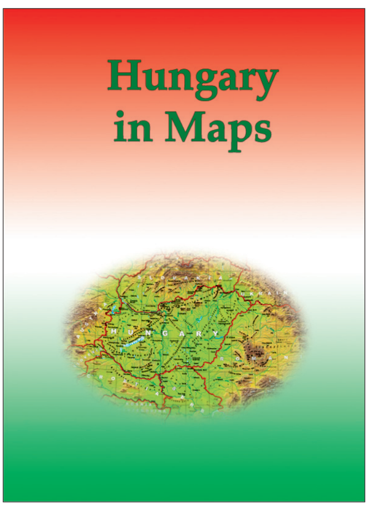
'Hungary in Maps' is the latest volume in a series of atlases published by the Geographical Research Institute of the Hungarian Academy of Sciences. A unique publication, it combines the best features of the books and atlases that have been published in Hungary during the last decades. This work provides a clear, masterly and comprehensive overview of present-day Hungary by a distinguished team of contributors, presenting the results of research in the fields of geography, demography, economics, history, geophysics, geology, hydrology, meteorology, pedology and other earth sciences. The 172 lavish, full-colour maps and diagrams, along with 52 tables are complemented by clear, authoritative explanatory notes, revealing a fresh perspective on the anatomy of modern day Hungary. Although the emphasis is largely placed on contemporary Hungary, important sections are devoted to the historical development of the natural and human environment as well.

In its concentration and focus, this atlas was intended to act as Hungary's 'business card', as the country's résumé, to serve as an information resource for the sophisticated general reader and to inform the international scientific community about the foremost challenges facing Hungary today, both in a European context and on a global scale. Examples of such intriguing topics are: stability and change in the ethnic and state territory, natural hazards, earthquakes, urgent flood control and water management tasks, land degradation, the state of nature conservation, international environmental conflicts, the general population decline, ageing, the increase in unemployment, the Roma population at home and the situation of Hungarian minorities abroad, new trends in urban development, controversial economic and social consequences as a result of the transition to a market economy, privatisation, the massive influx of foreign direct investment, perspectives on the exploitation of mineral resources, problems in the energy supply and electricity generation, increasing spatial concentration focused on Budapest in the field of services (e.g. in banking, retail, transport and telecommunications networks), and finally the shaping of an internationally competitive tourism industry, thus making Hungary more attractive to visit.



This project serves as a preliminary study for the new, 3rd edition of the National Atlas of Hungary, that is to be co-ordinated by the Geographical Research Institute of the Hungarian Academy of Sciences.
