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Miklós Zrínyi's Efforts in Strengthening the Military Defenses of Međimurje, Hungary

József Padányi[1] · **József Ondrék**[2]

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Abstract

Knowledge of the terrain and its use are essential for successful combat. This paper highlights the importance of these facts through the deeds of general Miklós VII Zrínyi (1620—64). His efforts to strengthen the defense of Međimurje resulted in a complex defense system that actively used the terrain to its advantage, established primarily for the protection of the Kakonya Crossing. The selection of the location of Novi Zrin, its strengthening, and the construction of the Zrínyi Ditch all prove that he was thinking of a complex system, and actively used the terrain to his advantage.

Keywords Zrínyi · Novi Zrin · Ottoman Empire · Military defense · Hungary · Battlefield archaeology

Following the end of the Thirty Years' War in 1648, the Hungarian estates relied on Vienna to take action against the Ottoman Empire. Nonetheless, neither the political nor the economic environment made such actions feasible. Among the political figures of the era emerged Miklós VII Zrínyi (1620-64) as a leader. Being an excellent military leader, a poet, a public organizer, and a politician, his merits were recognized by the Habsburgs and he later became the first Hungarian general in the Imperial Army. Zrínyi strongly advocated for a more active defence policy against the Ottomans and the establishment of a standing army. A remarkable example of his initiatives was the construction of Novi Zrin and its surrounding defence elements in 1661, which were located on territories under the nominal control of the Ottomans.

✉ József Ondrék
ondrek.jozsef@uni-nke.hu

József Padányi
padanyi.jozsef@uni-nke.hu

[1] Head of the Doctoral School of Military Engineering, National University of Public Service, Budapest, Hungary

[2] Doctoral School of Military Sciences, National University of Public Service, Budapest, Hungary

With the help of battlefield archaeological tools and methods, the authors attempt to identify, excavate, and display the remains of this border defence system. This paper showcases selected results of a 15-year-long research project that highlights Zrínyi's knowledge of the terrain and how to use it for successful combat. The authors based their research on previously published and globally acknowledged research materials, including the work of Scott (1994), Haecker and Mauck (1997) or Négyesi (2010).

Introduction

Miklós VII Zrínyi is not a known figure of European military history. During the course of his renowned Winter Campaign in 1664, he intruded deep into enemy territory, took numerous strongholds and burned down the bridge at Eszék (nowadays Osijek, Croatia), a vital component of the Ottoman supply network. The 25,000-strong force led by him concluded the campaign with minimal casualties. The outstanding success of his Winter Campaign was widely celebrated all around Europe; the French king (Louis XIV) sent him a substantial amount of money, and the Spanish king (Philip IV) made Zrínyi a knight of the chivalrous Order of the Golden Fleece. His fame is best illustrated by the fact that a large, English language publication of his military achievements had already been published during his lifetime in London in 1664 under the overly complex title of: *The Conduct and Character of Count Nicholas Serini, Protestant Generalissimo of the Auxiliaries in Hungary, the most Prudent and resolved Champion of Christendom. With his Parallels Scanderbeg Ö' Tamberlain. Interwoven with the principal Passages of the Christians and Turks Discipline and Success, since the Infidels first Invasion of Europe, in the year 1313.*

His efforts made for the defence of Međimurje, and a masterful job of using the terrain to his advantage show that he must have possessed the most cutting-edge military science knowledge available and that he applied the lessons learned from contemporary conflicts in Europe. One of the most significant military leaders of the era was Raimondo Montecuccoli who, as documented in his literary works, also incorporated the advantages of the terrain in his battle plans and strategies. His main areas of expertise were fortifications and their siege.

The Importance of the Terrain in Early Works of Military Science

A short overview on the importance of the terrain is useful. Ancient Chinese writers had already started to systemize the most important laws of warfare 2,500 years ago. Sun Tzu, in his groundbreaking work, *The Art of War,* mentions the importance of the terrain on 45 occasions, which clearly underlines the significance he attributed to this factor. In fact, Sun Tzu grants the question of terrain its own chapter, stating that:

> The natural formation of the country is the soldier's best ally; but a power of estimating the adversary, of controlling the forces of victory, and of shrewdly calculating difficulties, dangers and distances, constitutes the test of a great general. He who knows these things, and in fighting, puts his knowledge into practice, will win his battles. He who knows them not, nor practices them, will surely be defeated. We may distinguish six kinds of terrain, to wit: (1) Accessible ground; (2) entangling ground; (3) temporizing ground; (4) narrow passes; (5) precipitous heights; (6) positions at a great distance from the enemy (Sun Tzu, X/1 and 21-22).

The Methods of the Sima (also known as *The Marshal's Art of War*) also mentions the terrain: "Using the advantages of the terrain entails guarding the dangerous passes and glens (The strategically important locations)" (Zsolt, T. and Sándor, P. S. 2018:14). It is a general characteristic of these early works that they deal with the terrain and the weather together. This indicates that the authors were seasoned military professionals who had first-hand experience and knew the importance of these two factors.

It is clear that ancient Chinese military literature considered it vital to understand and use the terrain to one's advantage, while pointing out the possible dangers. The same applies to other classical authors, such as Vegetius, someone that Zrínyi himself regarded highly. He used the Roman's ideas both in his own works on military theory and in practice as well.

Vegetius dealt with the importance of the terrain on multiple occasions:

"In the first place, he should have an exact description of the country that is the seat of war, in which the distances of places specified by the number of miles, the nature of the roads, the shortest routes, byroads, mountains and rivers, should be correctly inserted" (Hahn 1963).

Vegetius allocates a separate chapter to the passage of rivers, which provided Zrínyi with many valuable lessons, especially when taking the location of his lands — in Međimurje — into consideration. Without listing all the river crossing lessons of Vegetius, one nevertheless has to be highlighted, as it was vital for Zrínyi to know:

> As the enemy generally endeavours to fall upon an army at the passage of a river either by surprise or ambuscade, it is necessary to secure both sides thereof by strong detachments so that the troops may not be attacked and defeated while separated by the channel of the river. But it is still safer to palisade both the posts, since this will enable you to sustain any attempt without much loss. If the bridge is wanted, not only for the present transportation of the troops but also for their return and for convoys, it will be proper to throw up works with large ditches to cover each head of the bridge, with a sufficient number of men to defend them as long as the circumstances of affairs require (Hahn 1963:805, 809).

Zrínyi acquired knowledge on military science from two sources. On the one hand, it was the result of conscious preparation that included procuring and processing all the known and available works on military science at that time. On

the other hand, it came from a lifelong process of collecting and — most importantly — evaluating actual warfighting experiences starting from his childhood and continuing throughout his entire life. As far as theory is concerned, it is well known that his personal library stood out among other collections of his time. Its thematically ordered military science section (titled *Militares*), contained 34 items (including a manuscript) and 64 books in 1662. Other sections of his library also featured military titles (Hausner 2008:77).

The Location of Međimurje and the Importance of Its Defence in the Seventeenth Century

In the first half of the seventeenth century, continental European history was largely shaped by the Thirty Years' War (1618–48). Enormous devastation, depopulated regions, millions of dead, and centuries-long political and territorial divisions were left behind. All this havoc can be explained by the financing and supply of armies at the time, and the practice of placing immense burdens on the civilian population. A long-term impact of the Thirty Years' War is that the costs of the growing number of mercenary armies compelled certain administrative and financial changes that eventually led to the establishment of absolute monarchies and the maintenance of standing armies in peacetime throughout Europe (Fig. 1). The tactical evolution during the war as well as the growing number of soldiers contributed to the long-waited defeat of the Ottoman Empire at the end of the seventeenth century. The military developments of the era included the tactical changes due to the rapidly increasing popularity of firearms, the growing number of soldiers and the supply challenges this growth had caused, the development of fortifications, and the shift in military strategic thinking (Roberts 1995:13–36).

In 1663, the Austro-Turkish War made an end to a several decade-long peace in the region. This was a rather fragile peace as conflicts in the border region were common between the border fortress guards and the Ottoman troops. Miklós VII Zrínyi, in addition to the experiences gained during the Thirty Years' War, came into conflict with the Ottomans on a regular basis as his estates were located along the border. His main estate, Međimurje, was on the border of the two empires, hence it was constantly harassed by Ottoman raiders. His remaining letters prove that Zrínyi was involved in a conflict with the foreign raiders almost every month. Apart from protecting his own wealth, his efforts made for the reinforcement of the defence of Međimurje also helped to protect the nearby Christian settlements as well as the peace of Austrian hereditary lands (Fig. 2).

It is also noteworthy that the seventeenth century marks a significant development of postal routes and with that came the rise of printed press and leaflets. The successful Winter Campaign of Zrínyi illustrates the rapid spread of information across Europe thanks to printed materials.

Fig. 1 Europe in the seventeenth century, Međimurje marked with red arrow. Source: worldhistory.50webs.com

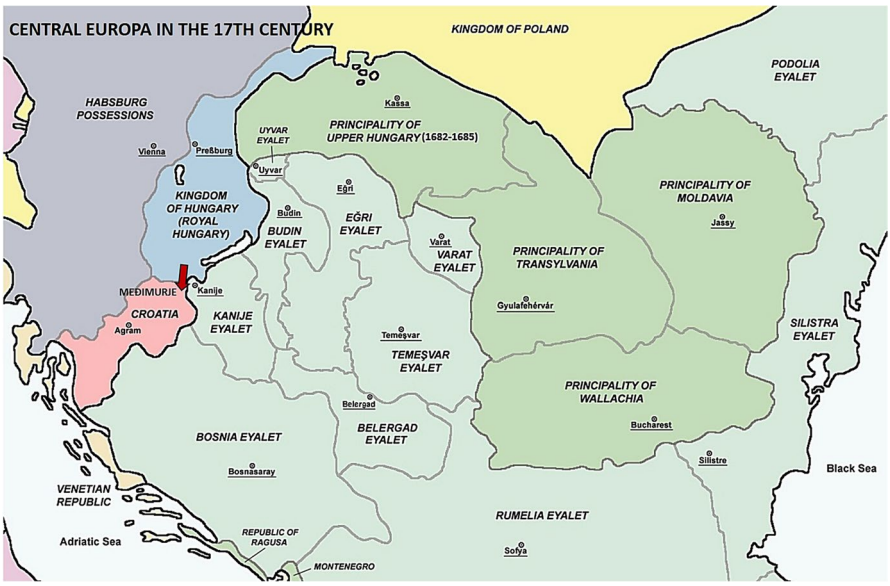


Fig. 2 Location of Međimurje between the two empires. Source: Wikipedia

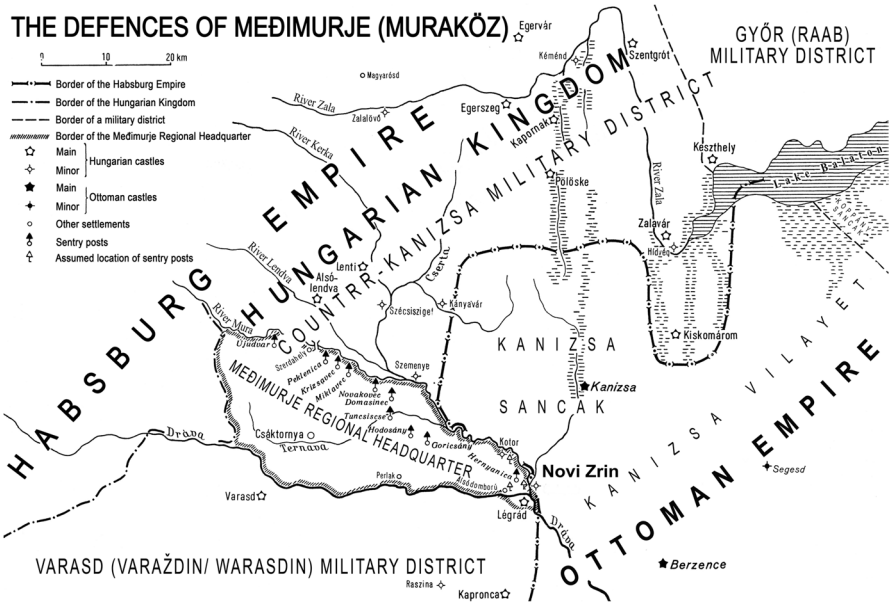


Fig. 3 Međimurje in the seventeenth century

Using the Terrain for the Defense of the Kakonya Crossing and the Lands in Međimurje

The Zrínyi (Zrinski) family moved its seat to Csáktornya in 1546, and since that time, the defense of Međimurje received special attention in the life of the family. Firstly, the permanent quarters of the family were here, and secondly, the income from Međimurje covered the expenses of the family. It was a rich and highly lucrative agricultural area that grew nicely under the protection of the Zrínyi family. Thus, it is not a coincidence that the expanding Turks regularly tried to either capture it, or at least tax it, while the house of Zrínyi did everything in their power to defend it. Međimurje was, for almost one and a half centuries, the scene of the family's struggles. During this time, eight members of the Zrínyi clan served as rulers of this land. The following presents the efforts of the general and poet Miklós VII. Zrínyi (1620—64, Nicola Zrinski) to protect his beloved "Island" (Međimurje) from Ottoman attacks (Fig. 3).

Of all his defense efforts, the work undertaken to defend and control the Kakonya Crossing and trade route are to be showcased, since it foreshadowed the idea of a complex obstacle system — sufficient for its time. It is certain that his efforts and parts of this mutually supporting obstacle system were the ones that defended this rich region, so desired by the Turks as well. It is worth noting that current military science also deals with the importance of complex obstacle systems suited to the terrain. The fundamental aim of such systems is to cause losses for the enemy, hinder its movement, and direct it to favorable locations for the defenders, while also hampering its ability to react, as stated in the applicable

Fig. 4 The border of Međimurje between Légrád and Kotor with the sentry posts. A section from the map of Spalla in 1670. Source: Hungarian National Archives

Engineering Support Doctrine published by the Engineering Command of the Hungarian Defense Forces in Budapest in 2000.

The defense of this region had a higher, strategic aspect to it as well. Loosing Međimurje to the Ottomans would have opened a direct road for them toward Styria (Steiermark). Thus, it is not a coincidence that the Styrian nobility provided regular support for the Zrínyis in the defense of the region. The importance of the territory was also further enhanced by the capture of the castle at Kanizsa (Großkirchen) by the Ottomans, with which they expanded their sphere of influence and threatened Međimurje across the River Mura. The most dangerous section was between Légrád (Legrad) and Kotor (Kotoriba) since this was the shortest route back to Kanizsa for the Turks after a raid. They knew very well that it was not enough to loot the region; they also had to make it back home.

Zrínyi knew this just as well, and it is not a coincidence that he paid particular attention to this section of the River Mura. He maintained seven sentry posts at the section between Légrád and Kotor, built Novi Zrin and a redout on the right bank of the River Mura, while he also created the Zrínyi Ditch as yet another obstacle between his lands and the Ottomans. With the combination of natural and human-built obstacles, he closed off a 7 km-long section (as the crow flies) between the two minor settlements. Due to the whimsical flow of the River Mura, the actual length of this river section could have been up to twice the current length. Zrínyi also placed sentry posts further along the river, thus increasing the effectiveness of his defense system. Fig. 4 clearly illustrates the location of sentry posts protecting the border between Légrád and Kotor.

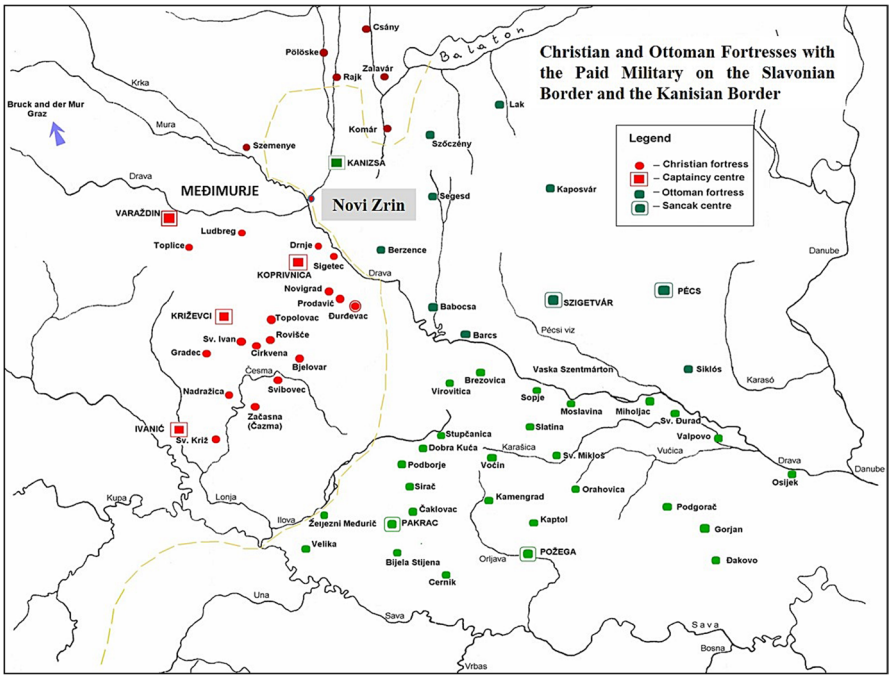


Fig. 5 The location of Novi Zrin as part of the border fortress system between the two empires

The following section will review the design and relationship of individual elements of the system both with each other and with the terrain, as well as the key steps and methods of the research.

Results of the Field Research on the Border Defence System

Novi Zrin

One of Miklós Zrínyi's greatest assets was his initiative mindset. Although this was a common quality among border fortress captains, Zrínyi stood out from his contemporaries. The example to showcase his excellence was in finding the location of Novi Zrin, and the construction of the fortress. To provoke the enemy, the fortress was built on the left bank of the River Mura, which at that time was under Turkish rule. The location chosen by Zrínyi had multiple purposes: it blocked the movement of the Ottoman garrison toward Kanizsa and it protected both Međimurje and the Austrian hereditary lands. Overall, the construction of the fortress was not a self-serving decision, but it was rather a thought-out action on both tactical and strategic levels (Fig. 5):

"If a captain does not know the tricks of the land he will achieve little of his objectives ... One must know the ebb and flow of peaks and glens, the spread of meadows, the passage of forests and the twists and turns of waters" (Zrínyi 2003:328).

This remarkable passage written by Miklós Zrínyi himself alludes to the fact that knowledge of the terrain is indispensable for successful fighting. The track record of Zrínyi as a general shows that he did not only write about the terrain, but also knew it, and most importantly used it to his advantage. One of the most successful examples of this is the construction of Novi Zrin, where even the place he chose as location for the fortress shows his aptitude. Throughout the centuries, many have examined the location of Novi Zrin from various different perspectives with all its advantages and disadvantages. In the case of this current study, those scrutinies that deal with the defense efficiency of the fortress and its surroundings in a comprehensive manner are of particular interest. As the contemporary and eyewitness Paul I, Prince Esterházy of Galántha, writes: "A deep ditch separates it from the hill that is next to it. There is a lake to the north created by immense work. To the east and to the south — to where Međimurje is — it is surrounded by the River Mura." (Esterházy 1989: 162). This resulted in the fact that despite the large number of besieging Turks, they simply could not access the fortress at once. The siege was narrowed down to a 250 m-wide zone that allowed the defenders to concentrate their forces on this narrow section and achieve the greatest possible destruction. Research in the field, conducted by the authors and other associated experts, supports this fact, and many siege artifacts were unearthed in this area.

The first mention of the construction dates to July 1661 (Zrínyi 2003:725 and 761). According to the available contemporary sources, Zrínyi had examined and taken possession of the high ground at the confluence of the River Mura and the Kanizsa Creek, under the nominal control of the Ottomans in May. Kecski Castle once stood on this land. Since Kecski was essentially a sidekick to Miklós IV Zrínyi, the great-grandfather of Miklós VII Zrínyi, he considered the territory to be "almost his," and started the construction of the fortress as a private landlord. This is probably also connected to the construction of this strongpoint that in May of that year, he ordered the production of ten cannons in Vienna. On July 5, 1661, it already had three bastions completed, and according to István Vitnyédi, the right-hand man of Zrínyi, the final completion of the fortress had only been a few weeks away (Fig. 6).

The irregularly shaped fortress that consisted of earthworks with a palisade on top originally housed a garrison of 300-500 soldiers, but was further expanded with an outwork (lunette) and a dry ditch by 1664. (The exact date of its construction is not yet known, but on the other (right) bank of the River Mura a bridgehead redoubt able to accommodate 50 people was also built and the two structures were connected by a bridge over the river.) (Fig. 7).

With the construction of the fortress, Zrínyi strived to achieve multiple aims. He wanted to strengthen the defenses of Međimurje and the river crossing at Kakonya. Furthermore, he wanted to establish a base from which he could start working on the recapture of the castle at Kanizsa, while he could also use Novi Zrin as a starting point when launching further military operations into Ottoman-owned territories. Next to these benefits, it also blocked Turkish communication lines to Kanizsa, and prevented long-distance raids by the Ottomans. The fortress dominated the area and controlled the Légrád—Kanizsa trade route. In the end, it was captured and was razed to the ground by the Ottomans in 1664. Its one month long siege proved that

Fig. 6 Scale model of Novi Zrin including the fishing lake and the redoubt. Source: authors' photograph

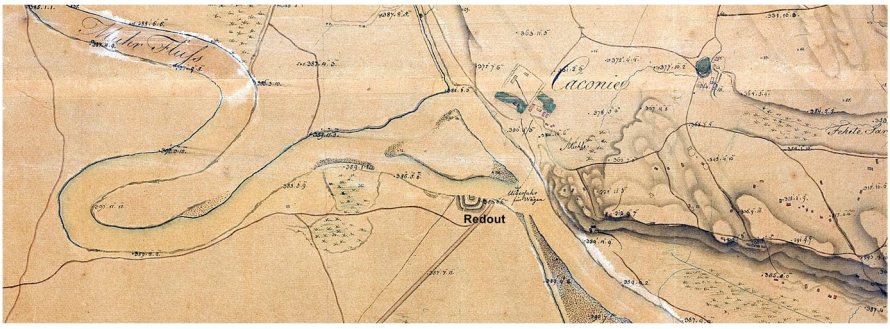


Fig. 7 Remains of the redout as depicted by a survey in 1810. Source: Kriegsarchiv k7k 209. Vienna

its capture took considerable time and blood; thus, it could not have been a weak fortress.

The fishing lake created around the fortress proved to be a major counter-mobility obstacle that made the life of the besiegers more difficult. Estimations based on LIDAR 3D laser scanning surveys show that the volume of the lake was over 56,000 m^3. It is a considerable number even if it is known that owning to the terrain, the creation of the lake did not require as much digging as in regular cases. Its delaying and hindering effect was significant in any case (Fig. 8).

The Zrínyi Ditch

A number of articles have been published about the fieldwork at Novi Zrin in recent years. The authors have showcased the history of the fortress from its construction until its 1664 siege, the results of archival and in the field research, and the role it played in the defense of Međimurje. Separate articles dealt with the various illustrations of the fortress, particularly those by Holst, Raimondo Montecuccoli and Paul I, Prince Esterházy of Galántha. On the map by Paul I, Prince Esterházy of Galántha, a ditch (henceforth referred to as the Zrínyi Ditch) can be found. Yet, in spite of extensive publishing on Novi Zrin, a close scrutiny, the interpretation of its role, and identification of the exact location on the ground of the aforementioned ditch have never been attempted before (Fig. 9). The following material aims to fill this void by proving the existence of the Zrínyi Ditch and attempting to identify its location in the field.

Using river and marshlands as defensive obstacles was a widely used practice in seventeenth-century Hungary. The same idea was applied in the case of the River Mura and Kanizsa Creek as well. The sentry positions placed along the banks of the river and defending the crossings — together with the terrain — created such a combination that slowed down, made it more difficult, and in many cases hindered unobserved Ottoman raids. The strength of a fortress or a sentry post was not only defined by its defense works, but also by its position on the terrain.

The basic idea behind the creation of the Zrínyi Ditch is that the River Mura delivered sufficient quantities of water to supply and swell Kanizsa Creek. This helped the area to grow swampy, maintain a constant flow of water, and slow down crossings that in turn gave time to the defenders to regroup their forces at the right place. If the movement of troops is concluded in time, they may attack the enemy while crossing the water, which gave them invaluable tactical advantage. Riverbanks were constantly watched and occupied if needed for these exact same reasons. One of the most well-known military victories of Miklós Zrínyi is connected to such an occasion. On November 27, 1663, he managed to crush an Ottoman force attempting to cross the River Mura in a day-long battle. Time was an important component of this victory. They managed to discover the place where the attackers were crossing the river and surprise them still in the water:

> Once, one of the sentry posts signaled the appearance of the enemy by firing off a mortar. I proceeded there at once, but by the time I arrived, two thousands of them had already crossed the river and noticed me. ... there was nothing else to do, but to inspire the soldiers as best as I could and to attack the enemy. ... after loosening all their arrows — which covered us almost entirely — fear had descended upon them and started to run towards the River Mura. In the river, they bumped head-on into the Tartars, and in the ensuing confusion they congested so much that they could neither swim or escape, nor defend themselves (Zrínyi 2003:725, 761).

The water level of the River Mura and the velocity of the water were always determining factors in this region. There are multiple Zrínyi plans known, which were affected and influenced by the water level of the river or its freezing. The

Fig. 8 LIDAR survey at Novi Zrin and its surroundings. The fishing lake is indicated by the striped area ▶

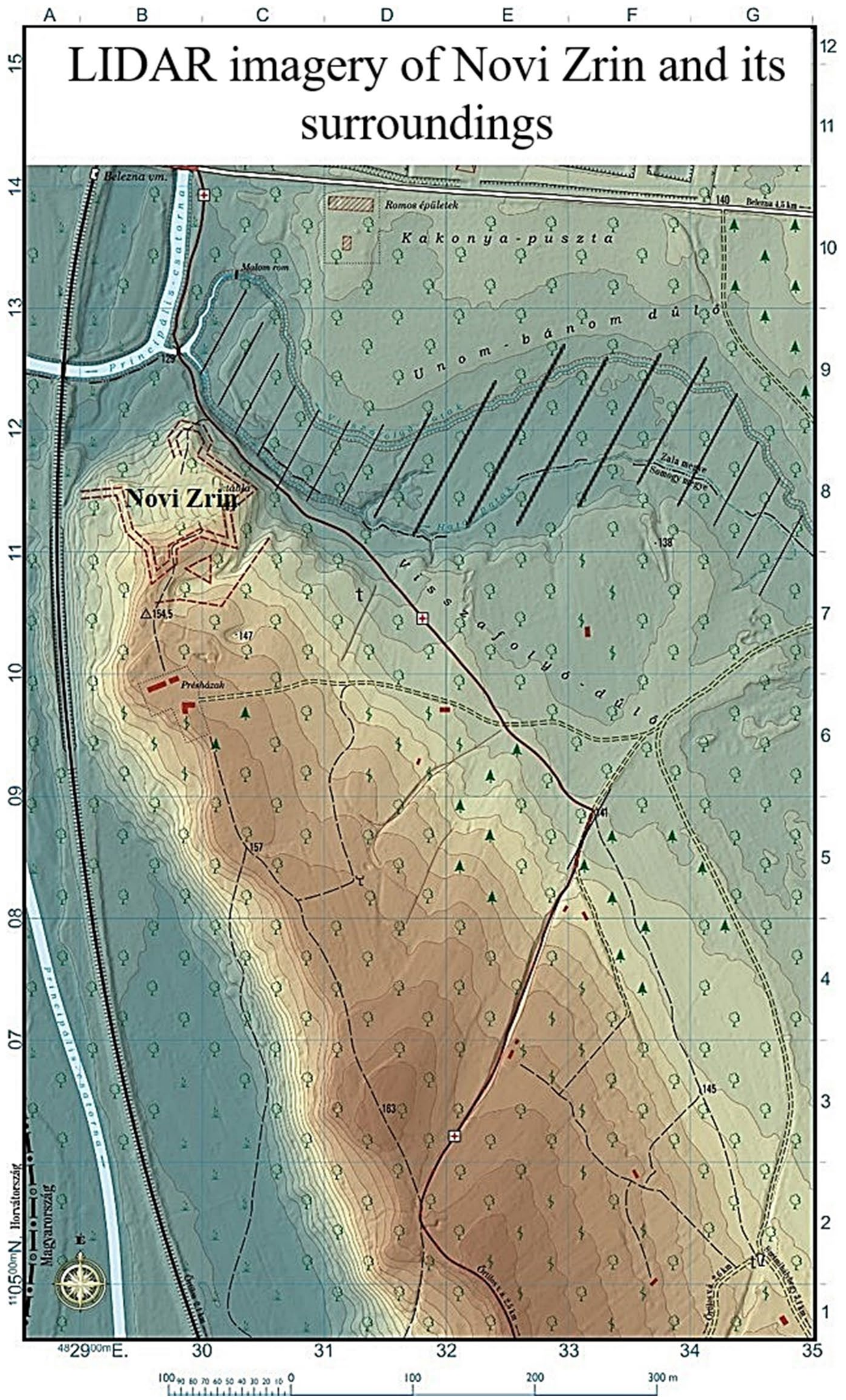
Ottomans knew the dangers of the River Mura as well, and tried to plan every crossing thoroughly, equipped with mobile bridge materials or leather crafts. However, to construct such floating devices they required time and preparation. Cattle used for the leather crafts had to be slaughtered, skinned and their skin sown together. Four of these leather air tanks were tied together to a wooden structure and, when used as rafts, would carry as many as 20-25 people (Ludovika Akadémia Közlönye 1891:1277).

Looking at the terrain between the River Mura and Kanizsa Creek (currently called the Principális Canal) — in the public administration area of Murakeresztúr today — one is able to see that connecting the two waters required expert knowledge. The gradient of the terrain is difficult to define. To determine with fifteenth–sixteenth-century tools how much work was required to lead water from the River Mura over to the creek, or whether the whole undertaking was possible in the first place, could only be undertaken by means of experience. It is thus clear that only someone local, with extensive knowledge of the terrain and of the water regime of the river could devise such a plan. It comes as no surprise that — following an initial inspection by his grandfather in 1578 — the completion of this long cherished duty fell on the shoulders of Miklós Zrínyi.

The fact that the valley has favorable conditions for defense was known at the time. Captain of Bajcsavár (a local stronghold near Kanizsa) Miklós Malakóczy raised the attention of the military leadership to previous ideas about leading water from the River Mura to Kanizsa Creek via an old lock or possibly a ditch, an expensive but not unfeasible task. The report indicates that the expertise of an expert, knowledgeable in the flow of water is requisite to determine the efficiency of the plan. From the letter of Malakóczy, it is also known that in the autumn of 1578, and in the company of György (IV), Zrínyi himself went to see the location, but they could not really do anything due to the reeds and water there (Kelenik 2012: 20).

Measurements conducted under the course of this research match the data of the professional literature. They show that the mean stage velocity of the river may reach over 2 m/s, meaning more than 7 km/h. Crossing at such high velocity is dauntingly difficult let it be on horseback, swimming, or via some kind of propelled watercraft. Crossing when the velocity is over 2.7 m/s is unpredictable, one can be swept away by the force of the water. Furthermore, crossing such a fast-flowing river is not considerably easier at winter either. On the one hand, such rivers are slower to freeze, and even if they do, the ice has to reach a certain thickness so that it may be safely crossed. Carts require at least 16 cm, cavalry at least 15 cm, and infantry at least 9 cm of consistently frozen ice (Hungarian Ministry of Defense 1955:325).

All these indicate that crossing the River Mura posed a serious challenge to anybody. If it is not frozen, time spend in the water increases, and it is difficult to estimate where exactly the other bank is reached. At such speeds, a swimming human manages to cover 10 m a minute, while a boat covers 30-50 m. The situation is made more difficult by the whimsical flow of the river, and the relatively low number of vessels available for crossings. It is clear to see, that all the circumstances above


LIDAR imagery of Novi Zrin and its surroundings
Novi Zrin
Kakonya-puszta
Romos épületek
Malom rom
Unom-bánom dűlő
Principális-csatorna
Zala megye
Somogy megye
Vissafolyó-dűlő
Présházak
154,5
147
157
163
141
145
138
140
129
Belezna vm.
Horvátország
Magyarország
A
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30
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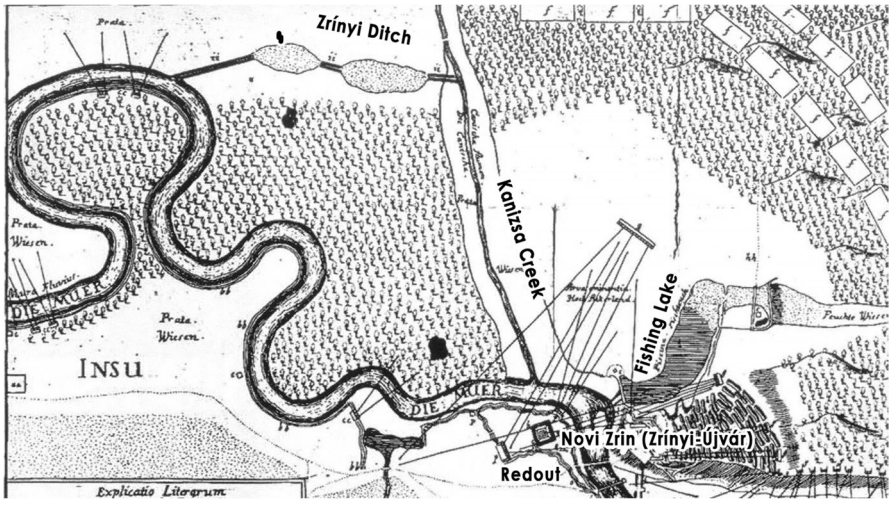

Fig. 9 The Zrínyi Ditch and other obstacles on the illustration by Paul I, Prince Esterházy of Galántha

favored the defenders on the banks, and both Zrínyi and the Turks knew and used that.

Little is known about Kanizsa Creek from this time. Contemporary illustrations show that the valley of the creek must have had great stopping power. Not necessarily because of the level of water in it, but more due to its swampy nature. The left bank of the creek between Kollátszeg and Novi Zrin is a high ground with a 10-15 m difference at places. The right bank is practically the same height as the floodplain of the River Mura and the river itself. Due to this, the flooding of the River Mura should have regularly reached Kanizsa Creek in this area. Backwaters and previous curves of the River Mura are still visible near Kanizsa Creek. The bed of Kanizsa Creek reaches 2-4 m in depth and 10-12 m in width.

The Role and Location of the Zrínyi Ditch

Modern warfare theories still contain sections about military engineering obstacle systems, and a part of these could be a strongpoint, which acts like a junction in a greater barrier. This combined section of the barrier is set up in accordance with the terrain and natural obstacles to close off important lines of communication.

In the case of Novi Zrin, it is fair to talk about such a barrier — comprised of all the natural as well as human-built obstacles — and consider the fortress as a junction on this aforementioned barrier. Its purpose was the defense of the militarily and economically vital crossing at Kakonya. The fortress itself, the redout on the opposite bank of the River Mura, the artificial fishing lake, the sentry posts set up along the river, and the ditch connecting the River Mura to the Kanizsa Creek may all be considered as obstacles. We know about the ditch both from the map made by Holst — it is in the upper left section of the map, connecting the River Mura and the Kanizsa Creek — and also from the letter of István Vitnyédy (Vitnyédi 1871:195):

> I have arrived here today, late; and have heard many news about the events that had started here since I had left. May God allow the successful completion of these. Our lord is in good health, and all he thinks about is how to harm the Ottomans. For this, he dug a huge ditch at Novi (Zrin) to take water from the Mura (river) and the Kanizsa (creek). All this work in the forest is going to aid Novi (Zrin), and more than 2000 people worked on it, all from Međimurje.

This remarkable primary source is well worth further scrutiny, especially two of its statements. The first is the date. The letter is dated April 8, so the work had started at the end of March or the beginning of April. At that time of the year, the frozen ground thaws and agricultural work restarts. Spring sowing regularly started when the ground thawed and farmers could not expect prolonged freezing temperatures anymore. This work usually started on Saint Joseph's Day (March 19) and finished on Saint George's Day (April 24), when the sowing of corn started.

The second interesting remark by Vitnyédy is about those 2,000 workers. This seems like a significant number even at first glance, but turns into an especially high volume when compared to the entire population of Međimurje at the time, which was around 32,000 people. If only males work at the site — due to their greater physical strength — and the average household contained five people at that place and time, then the number is a quite large ratio. Every third male must have been working on the construction of the ditch. Moreover, it occurred at a time when their natural place should have been on the fields, planting the crops for the next harvest season. One could wonder, what initiated Zrínyi to make this daunting decision and take away the working hands from the fields, while he also had 500-1,000 people simultaneously at Novi Zrin. It is also known that he lacked the sufficient number of workers, because the February 27, 1662, decision of the Croatian Sabor (parliament) ordered neighboring Varasd and Körös to continue helping with the construction. "Two workers, equipped with axes and other tools were ordered to the construction from every house(hold)" (Kalsan 2014:109). The fact that Novi Zrin and the Zrínyi Ditch were under construction simultaneously shows how their aims coincided; namely the complex defense of the crossing at Kakonya. Ordering such a large workforce to the area further underlines this assumption.

However, one could ask why it was that urgent for Zrínyi go on with the construction so hastily? The most probable assumption could be based on the water regime of the River Mura. The water regime of the river has two maximums: the primary one in May—June, and the secondary one in November. Thus his aim must have been to finish the construction before the spring flooding in order to use the rising water level to fill up the ditch. Zrínyi had to successfully balance the management of the construction between various factors, such as the frozen soil, the spring flooding, and agricultural work.

The description provided by Vitnyédi clearly indicates that the ditch led water from the River Mura to Kanizsa Creek. With that in mind, the question of how the terrain, and more importantly its gradient, influenced the shape and the depth of the ditch? If seen from above on a map, the gradient between the river and the creek is hard to determine. Based on maps, there is no elevation difference between the River Mura and Kanizsa Creek, and they are only 3 km away. The

fact that the terrain has no significant downward gradient is further underlined by the contour lines at 131.25 m in most parts of the village of Kollátszeg. Knowing the gradient, one could ask the question of how much work it must have taken to construct the Zrínyi Ditch? From the description cited earlier, it is also know that Zrínyi ordered 2,000 men from Međimurje to work there. Military engineering manuals state the standard for earth extraction by hand at 0.3 m^3/hr, and if all hands were working at the same time, they could move 600 m^3 earth per hour. It is 2.86 m^3 of earth that has to be moved per linear meter when using these data. On the map, the length of the ditch is 1,410 m, thus the total volume of earth that was required to be moved was 4,032 m^3. Based on this calculation, 2,000 men could theoretically finish the ditch in around seven hours.

Seeing the ditch in the terrain, it becomes clear that its stopping power did not only lay in its existence, but also in its making the surrounding land swampy and in the thick, impenetrable vegetation around it. It is important to note that a ditch with the same permeability as Kanizsa Creek was required to ensure the constant supply of water. (The creek is 12 m wide and 4 m deep.) When the equation is recalculated with this in mind, a significantly higher volume emerges: 32 m^3 of earth per linear meters and 45,120 m^3 for the total length. For the same amount of workforce, under the same conditions (2,000 men at work simultaneously for ten hours a day) it would have meant 75 hours of hard labor, thus more than one week of tenuous work. Determining the exact size of the ditch is not possible today, but instrumental measurements may provide some results, as described below.

The next question to answer is where did the ditch started and in which direction it went. Even with all the maps currently available, it is impossible to exactly determine where the River Mura flowed in the seventeenth century. It is clear to see on the maps that the river constantly changed its bed, creating newer and newer curves, and discarding old ones. Later, human interference is significant too, as the Kollátszeg settlement developed, and a railway line was constructed in the nineteenth century. These later interferences were the ones that caged the previously unbridled River Mura.

The First Military Survey shows this section of the River Mura, and it also clearly indicates the branch of the river, and the ditch starting out from it (Fig. 10). Furthermore, the other end of the ditch is unequivocally connected to Kanizsa Creek. It is also worth noting that there are no other ditches on the map between Murakeresztúr and Kakonya that connect the two watercourses. Moreover, there is another vital identification point on the map. This is a bridge over the ditch at the edge of Kollátszeg, on the road from Murakeresztúr to the settlement.

The Third Military Survey (1869—87) illustrates the ditch and its size markedly, while also showing that Kollátszeg, the settlement was established on the inner bank of a backwater (Fig. 11).

An aerial photograph of the area was made in 1960, and it shows the various backwaters and the structure of Kollátszeg clearly (Fig. 12). Clearly visible in the aerial footage are the previous beds of the River Mura, the two, natural riverbeds very close to each other, and the various artificial ditches and canals.

Fig. 10 The result of the First Military Survey. Source: mapire.eu

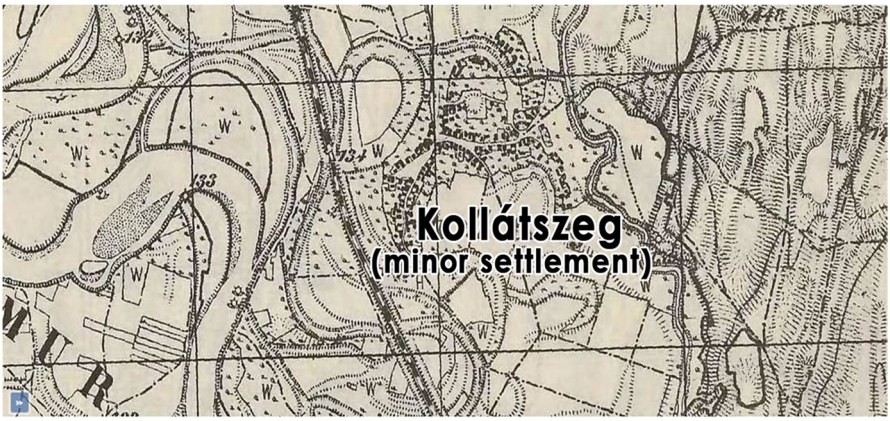

Fig. 11 The result of the Third Military Survey. Source: mapire.eu

Researching the Zrínyi Ditch on the Terrain

Looking at the structure of Murakeresztúr, and especially at the formerly independent Kollátszeg settlement as part of it, one may easily recognize that the houses stand along higher elevation roads. This is typical for settlements, which are in flood prone areas. The elevated ground running along the left bank of Principális Canal is the former bank of the River Mura, while the flat land to its west was aggraded by the river with silt. Due to the relatively high flow rate, the changing level of discharge and the high amount of silt, the river changes its bed rather frequently. Yet, the location of the village shows that there are such higher laying areas inside the potential floodplain, which are avoided by the river and are only flooded in

Fig. 12 Aerial footage from 1960. Source: Military History Institute and Museum, Budapest

extreme cases. The northern part of Murakeresztúr is situated next to an east—west road. From its western end, an approximately 1 km long, north—south road leads to Kollátszeg. This road runs along the edge to a higher lying area that is to the west, all the way to the River Mura. The surface is relatively consistent here; there are no signs of previous riverbeds. On the other hand, there are three backwaters along an east—west axis near Kollátszeg. Since the river could not move the stable soil of the higher ground in the north, it took a turn at Kollátszeg to the east. Over time, it filled it up, and subsequently moved in a westerly direction, where it took a turn again. This was later filled up by floods as well, and the river moved even further west. The northern extent of these loops was the edge of the higher ground mentioned before. Further analyzing the terrain, it can be stated that from Novi Zrin, the furthest away point on the map, where the River Mura and Kanizsa Creek may be connected is at Kollátszeg. When determining the location of the Zrínyi Ditch, the fact that water from the River Mura has to elevate the level of water in the creek is barely one factor to be considered. Of equal importance is holding the forested area between the two waterways and hindering access to that land from the north by the ditch itself. The current ditch, which connects the River Mura and Principális Canal runs along the edge of the northern, elevated area, which indicates that the architect sought to move the canal as north as possible. The western section of the ditch follows the line of a riverbed of former backwater, and then turns to the south into the River Mura.

Looking at the contemporary illustration by Paul I, Prince Esterházy of Galántha, one could identify the ditch at Kollátszeg as the Zrínyi Ditch just by its structure. However, the question arises, whether it is possible that a canal dug in 1662, and only serving its original purpose for two years had last such a lasting mark on the

terrain that it is still identifiable? When Novi Zrin was destroyed, the ditch was also doomed to be filled up. Though, there are good reasons behind it including conservation. The bed and the dam of the fishing lake to the east of Novi Zrin is still recognizable, and the former bed of the River Mura is where the Principális Canal (Kanizsa Creek) flows today. Thus, searching for traces in the terrain is not against all odds, if one knows how to look.

Previous research has already established that the illustration by Prince Esterházy of Galántha is not merely a sketch, but that he strived to illustrate every object on the map with the highest accuracy. In other words, every object on his map looks the way it was, because that is the way in was at the time of the illustration. It is then safe to assume that he did not simply phantasizs a ditch somewhere between the River Mura and Kanizsa Creek, but that he accurately depicted how it looked. In researching the location of the ditch, one does not only look for another construction of Zrínyi, but also validates the authenticity of the map by Esterházy. Furthermore, looking at the accuracy of the depiction of the Zrínyi Ditch is interesting from the point of view of source criticism as well. Since it is far away from the fortress and did not play a role in the siege, it would be acceptable if its depiction contained some inaccuracies.

Collecting Soil Samples on Site

On the sketch, one can see that between the River Mura and Kanizsa Creek there are two irregular elliptic shapes that are connected to the river and the creek by three straight lines. These lines are the dug ditches, but the irregularity of the two shapes shows that these are not artificially constructed objects. The ditch at Kollátszeg, which connects two backwaters, has the exact same structure. It is entirely logical that the two waterways had to be connected where they are closest to each other and where the existing backwaters could be utilized. Two are at Kollátszeg, and their use saved considerable toil, workforce, and time as. It is safe to state that the Esterházy map shows the ditch at Kollátszeg. The question to decide was the location of the ditch that started from the River Mura, because its traces are not overtly visible on the terrain today. This had to be found during field research.

In the course of the first field research, an indentation was noticed in the northwestern river wall of the western backwater. On closer examination, it was identified as either the point where the western canal once joined the backwater, or it is simply a ramp where vehicles crossed. Wheel tracks were indeed found on site, but its current use as a driveway could be secondary, and it is still possible that this was originally the location where the western canal joint the backwater. The 1:10,000 scale map of the area and aerial photography both show traces of a ditch between the indentation and the River Mura. Under the right circumstances, there is indeed a longitudinal indentation visible in the ploughed field, under the edge of the higher ground. Whether it is a ditch can be proved using multiple test trenches, hoping that traces of earlier spade work may be found in the cross-section of the ground. This method however was not possible, and a different solution had to be found. Along a

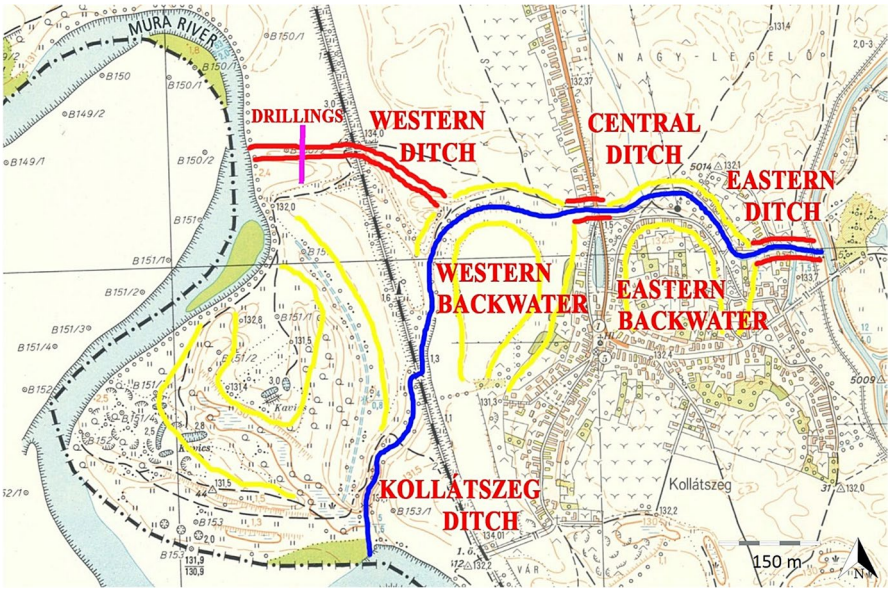

Fig. 13 The location of the ground sample drillings. Source: authors

50-m-long line ground sampling drillings were conducted, the unearthed soil was analyzed, and conclusions were drawn from them (Fig. 13).

The line of drilling went in a north—south direction, starting from the higher ground on the north and going in a southbound direction, thus taking samples from both the suspected ditch and from its supposedly southern bank. The top layer of the ground was uniformly covered in mould, approximately up to 50 cm deep in the northern elevation, and raising to up to 100 cm deep in the ditch. There was a strong clayey impermeable layer underneath that. This layer was drilled in the ditch on one occasion and blue clay was found underneath. The depth of the impermeable layer indicates that the ditch like inclination on the surface indeed signals a more than 1 m-deep ditch. On the other hand, the edge of the southern bank of the ditch could not be unequivocally determined as the erosion of the River Mura clearly left its mark here. At the same time, two drillings — 5 m apart — in the bottom of the ditch unearthed 100 cm of mould, and beneath it a 5-10 cm thick layer of loose, yellowish river sand over the impermeable layer. This indicated that in a narrow corridor — namely in the ditch — water was flowing constantly for a while, but it stopped and the ditch filled up overtime.

Looking at its history, the ditch served its intended purpose for two years, at which time it was also probably maintained. Due to its location, erosion affected its southern bank, and as its maintenance stopped after 1664, water slowly eroded the southern bank, creating a periodically flooded, flat land in the direction of the western backwater.

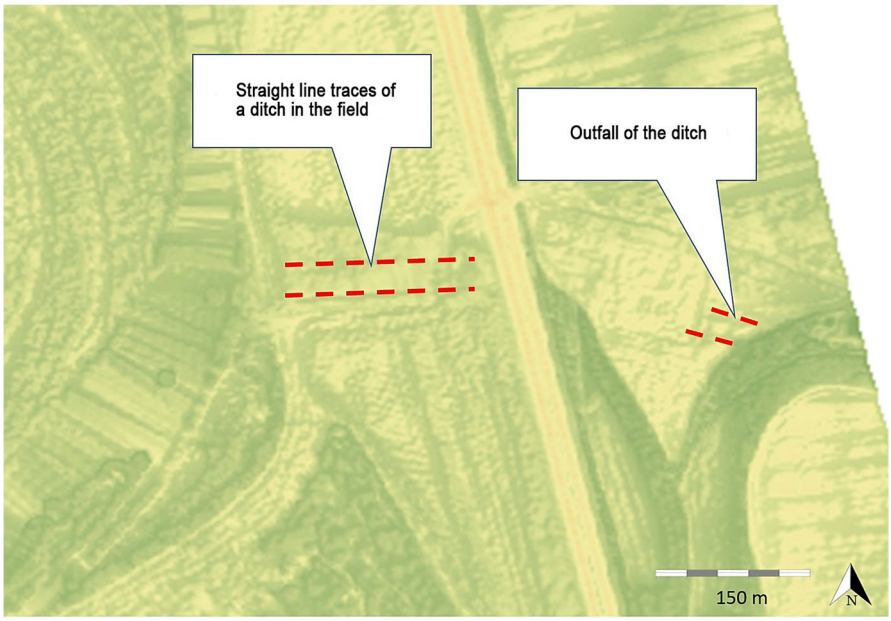

Fig. 14 The LIDAR survey of the sought-after section of Zrínyi Ditch. Source: West—Transdanubian Water Directorate

LIDAR Measurements

As the descriptions above already illustrate, great emphasis is placed on the evaluation of the micro terrain when tracing the location of the ditch. Early on in the research, it was decided that, if the sufficient financial resources are available, a LIDAR survey of the area was to be conducted as well. This method had greatly helped the research at Novi Zrin in the past. Evaluation of the LIDAR further underlines the previous assumptions (Fig. 14). The staff of the West-Transdanubian Water Directorate, which had already surveyed the area with LIDAR technology, kindly provided the images.

Magnetometer Research

The same area where field research and ground sampling drillings were conducted was also surveyed using magnetometric technology in May 2018. This method is especially ideal for areas that had been largely undisturbed, and it is also well suited for finding artificial objects, such as ditches. A Sensys MXPDA magnetometer system with Fluxgate inclinometers was employed for this task. During the survey, the sensors were placed 50 cm apart from each other and the distance between the measuring points amounted to 10 cm, resulting in data that has a spatial accuracy of 1-3 cm. On order of the research group at the National University of Public Service, the exact measurements were executed by experts from the Archaeological Directorate

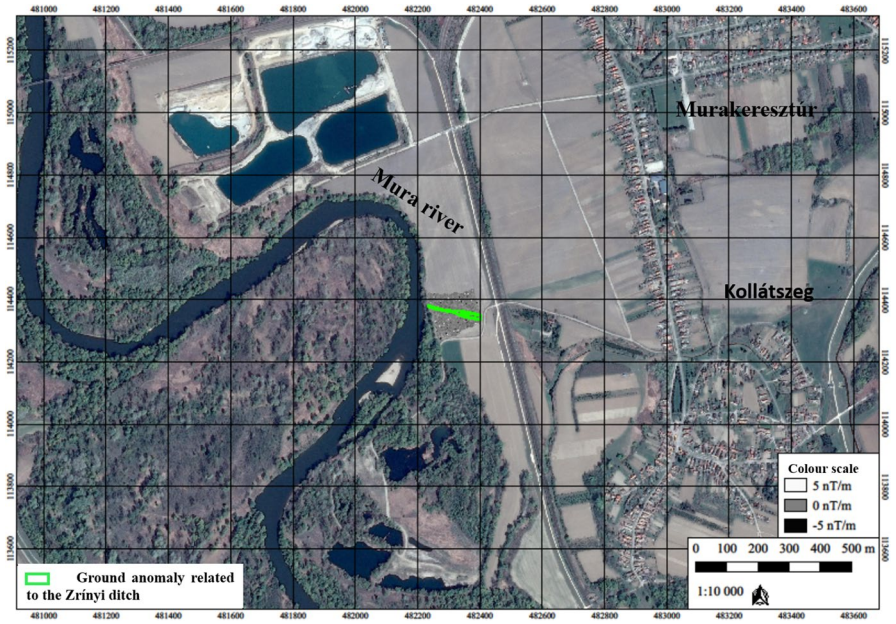

Fig. 15 The surveyed area using magnetometric technology. Source: Archaeological Directorate at the Buda Castle Estate Development and Operation Office

at the Buda Castle Estate Development and Operation Office. Fig. 15 shows the location of the surveyed area, including the path of the Zrínyi Ditch.

The results clearly reveal a northwestern—southeastern, approximately 175 m long, linear, ditch-like anomaly that has an approximately 85 m-long section at its southeastern part, where it separates into two parallel lines (Fig. 16). Its cross section is 5-9 m on average, and its depth cannot be determined using this picture. The phenomenon continues further in both directions, over the edge of the measured area. Its northwestern edge must have joint the River Mura flowing there, but this section could not be measured due to the dense fauna on the river bank. In the southeastern direction, the line surely runs toward the railway line and beyond that, but here the question arises of how much the leader earthworks, such as the construction of the railway line, have disturbed.

Based on the detailed historical record above, the topography of the land and the results of field research (including the ground sampling drillings), this anomaly on the picture may be identified as the northwestern section of the Zrínyi Ditch with much certainty. On the other hand, it is current indeterminable whether the paralleled lines observed on the southeastern section of the ditch are the results of the original 1662 construction. Both are possible scenarios, but the later one is suggested by the Esterházy illustration, as there is only one ditch there, and it is not impossible to consider that the already existing ditch was later augmented by another, probably for drainage reasons. Additional excavations would be required to determine this and to also further specify the measurements of the ditch (or ditches). One or more perpendicular cross-sections would provide further valuable data.

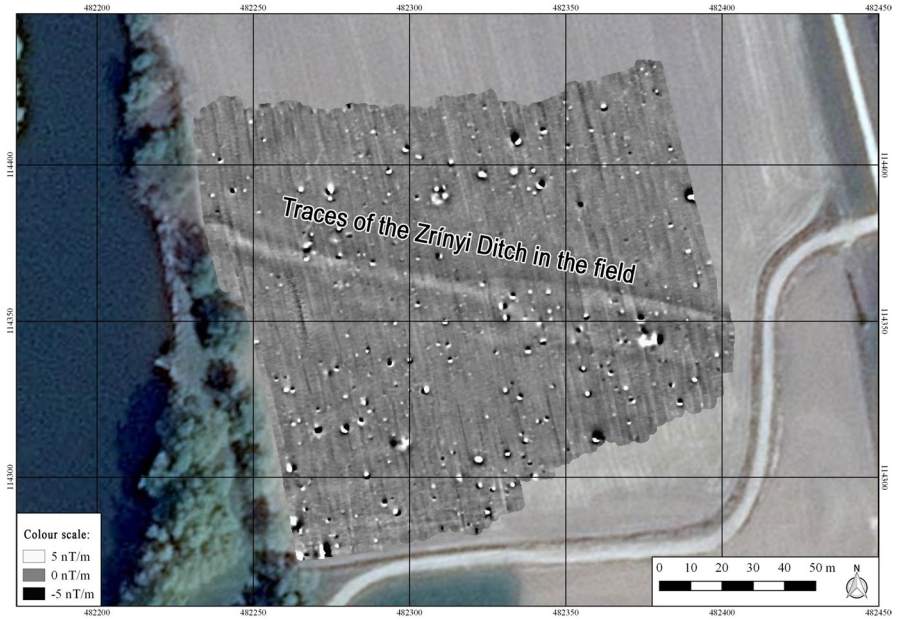

Fig. 16 The supposed location of the Zrínyi Ditch on the terrain. Source: Archaeological Directorate at the Buda Castle Estate Development and Operation Office

Summary

Military science in the seventeenth century was greatly shaped by the military developments and the European wars of the era. The Thirty Years' War, the Austro-Turkish Wars, and the border conflicts gave significant experiences to the military, as new methods and equipment were introduced all across Europe. The Hungarian border was no exception to that where Miklós Zrínyi was constantly fighting with the Ottoman troops. The military actions of Zrínyi can be divided into three main groups. The first group includes the defence of the region and the security measures taken against potential Turkish raids. The second group consists of the quick and mostly unexpected counterattacks during defense. Last but not least, the third group contains the carefully prepared, large-scale attacks. When analyzing Zrínyi's military actions in the context of the defence of Međimurje, the above groups are all represented.

Miklós Zrínyi was an outstanding soldier of his time, who earned his fame not only on the battlefield, but also in the field of military theory. His great efforts to strengthen the defense of Međimurje resulted in a defense system established for the protection of the Kakonya Crossing, and the border section between Légrád and Kotor. The location of Novi Zrin, its strengthening, and the construction of the Zrínyi Ditch all prove that he was thinking of a complex system, and actively used the terrain to his advantage. This latest research identified an important part of this system, the Zrínyi Ditch.

Historical records preserved the memory of the deed Miklós Zrínyi (Nikola Zrinski) when in 1662, he connected the River Mura with Kanizsa Creek via a ditch. Paul I, Prince Esterházy of Galántha, has illustrated these ditches, but it is also visible that two natural water catchment areas were also incorporated into the system. When examining the GIS materials of the area, one can recognize the remains of the Zrínyi Ditch as still existing at Kollátszeg. Even today, it still connects the river and the creek, and traverses two adjacent backwaters, of which the eastern one is only recognizable from the street structure of the settlement.

The current lines of the ditch on the western side do not match with those drawn by Esterházy. Therefore, employing field research methods, it was shown that this section of the Zrínyi Ditch has been filled by now, but it still has recognizable features both on the ground and in the micro terrain of the area.

The significance of this research is the fact that the ditch is only the second work — after Novi Zrin — inside Hungary that is directly connected to Miklós Zrínyi. This construction also proves that Zrínyi was far ahead of his time even in this field. He recognized and utilized the potential of the terrain, and this way, he increased the efficiency of the defenses of his beloved country.

The research and the methodology used are in line with the international trend of following an interdisciplinary approach. The joint application of archaeology, battlefield archaeology, remote sensing, field survey, archival research, and cartography opens up new directions and opportunities. Researching the border defence system of Međimurje—including the discovery of the Zrínyi Ditch—was the realization of these opportunities.

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Declarations

Conflicts of Interests The authors declare that they have no conflict of interest.

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