

Abhandlung

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Research methodology of the *zolnik* (ash hill) at the Scythian cultural circle hillfort in Chotyniec

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Zusammenfassung: Der Artikel stellt die Methodik der archäologischen Forschung auf dem Hügel von Chotyniec im Südosten Polens vor. Neben anderen Elementen umfasste das Forschungsprojekt die Entdeckung und Untersuchung einer Befundgattung, die als *Zolnik* bezeichnet werden. Ein *Zolnik* ist ein einzigartiges Objekt, das als Kultort funktionierte und an dem Rituale in Form von Gemeinschaftsfesten durchgeführt wurden. Ähnliche Befunde finden sich in der Waldsteppenzone Osteuropas, die in der frühen Eisenzeit von der skythischen Kultur beeinflusst wurde. Die im Artikel vorgestellte Forschungsmethodik weicht deutlich von jener ab, die bislang in Bezug auf die Untersuchung von *Zolniks* angewendet wurde. Dies ist auf den Fokus auf die Identifizierung eines möglichst vollständigen räumlichen und funktionalen Kontextes sowie auf die Erstellung einer permanenten Grabungsdokumentation für weitere Analysen und Überprüfungen zurückzuführen. Besonderer Wert wurde auf eine genaue und detaillierte Befunddokumentation gelegt, die ohne die Anwendung und Implementie-

rung von Geoinformationssystemen nicht möglich gewesen wäre. Aufgrund seines innovativen Charakters soll der vorliegende Beitrag auch eine Diskussion darüber anstoßen, wie die vorgeschlagene Änderung der Methoden der *Zolnik*-Untersuchung umfangreichere Interpretationen erlauben. Dies gilt sowohl für funktionale als auch für chronologische Fragen, was wiederum zu einer umfassenderen Kenntnis und Rekonstruktion dieser Objektgattung führt.

Schlüsselworte: Forschungsmethodik, räumliche Analyse, räumliche Informationssysteme, frühe Eisenzeit, *zolnik*, skythisch

Abstract: The article presents the methodology of archaeological research on the hillfort in Chotyniec in south-eastern Poland. In addition to other elements, the research project included the discovery and examination of an object known as a *zolnik*. A *zolnik* is a unique object which functioned as a cult place where rituals took the form of communal feasts. Similar objects can be found among those located in the forest-steppe zone of Eastern Europe, which in the early Iron Age was influenced by the Scythian culture. The research methodology presented in the article deviates significantly from that used so far in relation to the investigation of *zolniks*. This is due to the focus on identifying the most complete spatial and functional context possible, as well as creating a permanent excavation documentation for further analysis and verification. Particular emphasis was placed on the accuracy and meticulousness of documenting the discoveries, which would not have been possible without the application and implementation of spatial information systems. Due to its innovative nature, the article is also intended to start a discussion about the way in which the proposed change in the methods of *zolnik* examination translates into greater interpretation possibilities. This applies to both functional and chronological issues, which in turn leads to a fuller knowledge and reconstruction of these objects.

Keywords: research methodology, spatial analysis, spatial information systems, early Iron Age, *zolnik*, Scythian

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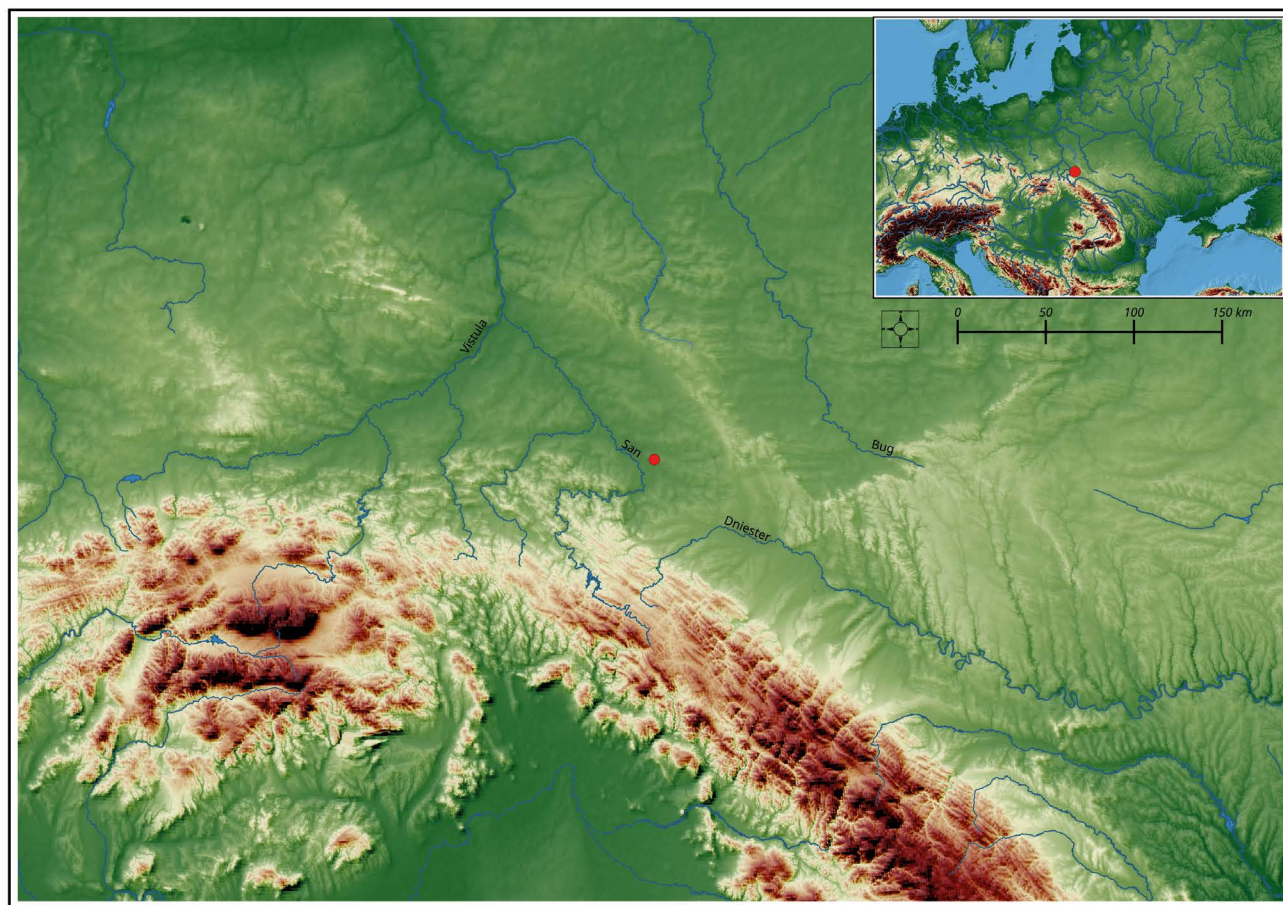


Fig. 1: Location of the Chotyniec hillfort (south-eastern Poland).

Introduction

The discovery of the so-called Chotyniec agglomeration of the Scythian cultural circle¹ is of great importance in the cultural and chronological interpretation of settlement processes on the border of Central and Eastern Europe in the early Iron Age. This cluster of sites consists of a centrally located hillfort (Chotyniec, site 1; Fig. 1) and other settlements in its vicinity. Beyond any doubt, the agglomeration of settlements can be related to the forest-steppe variant of a Scythian cultural circle. The sites mark the western border of the Scythian culture, as they are located at a fairly long distance (about 200 km) away from the previous border of the ecumene of the Scythian world. So far, the most important of the excavated objects is the *zolnik* (ash mound) from the Chotyniec hillfort. Its construction and content fully correspond to similar forms from the forest-steppe zone of Eastern Europe, i. e. the areas that

make up the Great Scythia. Research results and artefacts from the *zolnik* are systematically analysed and presented in various publications². Particular attention must be paid to the precise chronology of this site. We have a series of 17 radiocarbon dates as well as artefacts that can be dated quite precisely³. These consist of arrowheads, some types of pins and imported Greek ceramics – amphoras used for transporting wine, including a fully reconstructed vessel from the Klazomenai centre⁴. Stratigraphic observations are also important. Bringing all these elements together, it is possible to conclude that the *zolnik* was founded in the late 7th century BC and was functioning in the 6th century. The layering and some radiocarbon dates suggest that its younger functional phase (most of which was unfortunately destroyed before the excavation) can be referred to the 5th century BC or even later. The significance of the *zolnik* for

¹ Czopek *et al.* 2017; Czopek *et al.* 2018, 291–302; Czopek 2019.

² Burghardt 2020; Czopek/Krąpiec 2020; Adamik-Proksa/Ocadryga-Tokarczyk 2021; Czopek *et al.* 2021.

³ Czopek/Krąpiec 2020, 1606–1609.

⁴ Czopek *et al.* 2021, 166–167.

the interpretation of the whole Chotyniec hillfort research is difficult to overestimate for a number of reasons – relating to settlement patterns, culture, rituals and chronology. Apart from it, no similar series of artefacts has been found which could so accurately determine the chronology of the whole defensive complex.

Zolniks are objects typical of Eastern Europe from as early as the Bronze Age, and they gain special significance in the early Iron Age⁵. They are characterized by several important features that determine their uniqueness and very high scientific value, and hence this should be taken into consideration when choosing an appropriate method of field research. The most important features of zolniks include:

- A round or oval shape with a diameter ranging from several (e.g. Cirkuny: 14.5 m × 7.5 m)⁶ up to several dozen meters (e.g. Bielsk, zolnik no. 13 – approx. 60 m)⁷ with an average diameter of about 20–30 m⁸.
- Layered structure of the mound consisting of layers of burning and ash (amongst other things) covering the actual zolnik layers⁹, whereby sometimes reaching a height of several meters (e.g. 3.5m in Niemirov¹⁰).
- A presence of additional in-ground objects (embedded below the level of the zolnik's foundation) or functioning in the structure of the zolnik assembly¹¹.
- A very large accumulation of ceramic, metal and bone artifacts, usually the most useful for chronological studies in the context of the whole site.
- Frequent destruction of the upper parts of the original embankment, which means that they are now sometimes visible as completely flat objects.

Among the well-researched hillforts beside the Dnieper, Boh or Vorskla rivers, there is evidence of up to several dozen such objects on one site¹². Even though they are most often found in hillforts, they occur also in certain settlements. Also, the importance of zolniks results from their function. In older archaeological literature they were considered as places of accumulation of ash. Hence, they served both utilitarian and ritual purposes, as indicated by the paradigm of gathering fire-related discard. Newer studies

have emphasized their ritual significance, indicating that ceremonies held within them were related to the cult of the hearth and home, fertility¹³ and in honour of the dead (“solar-chthonic”)¹⁴, and they had the form of joint feasts. It can therefore be concluded that the interpretations of the zolniks are somewhat syncretic in nature, as they take into account both the discard-type of remains as well as intentional constructions and traces of rites¹⁵. It seems that much depends on how one examines and documents all of the elements that make up the structure and content of a zolnik. At this point it should be noted that the method of research and documentation of artifacts, layers and all contexts has a significant impact on the interpretation of zolniks. We will elaborate on this issue later in the article.

Due to their importance and potential for the discovery of exceptionally spectacular artifacts, zolniks have been most willingly studied by generations of archaeologists. Sometimes the barrow-like form of the mound suggested the existence of an underground grave¹⁶. In cases like these, the grid method was sometimes used for examination – four sectors separated by 0.5m wide balks. It is worth noting that using this technique a zolnik could be examined in its entirety. The case of the zolnik at the hillfort in Niemirov is very informative¹⁷. It was first examined in 1910 by Russian archaeologist Spicyn. Looking for a grave, he established three parallel trenches in the central part of the embankment (which was 20 m in diameter). The result was disappointing, as no funeral object was discovered. In the years 1946–1948 research was further conducted by Russian archaeologist Artamonov, and this time research focused on learning about the zolnik itself. It covered the periphery of the zolnik embankment and the area outside it, thereby the spatial context was captured. The zolnik at the hillfort in Motronin, examined by Ukrainian archaeologist Chwojka in 1899, was also explored using the narrow trench method¹⁸. Objects of this type in other sites were examined in a similar way (Fig. 2): in Bielsk¹⁹, Barcan²⁰, Cirkuny²¹, and Lazkivski Stavki²². A common feature of these studies were excavations in a limited area, chiefly focused on the central, most elevated part of the zolnik embankment. In

⁵ Gretchko 2010.

⁶ Pelyasthenko 2017.

⁷ Shramko 2016; 2017; Shramko/Zadnikov 2009; Zadnikov 2009; Zadnikov/Shramko 2009.

⁸ Kovpanenko 1967; Smirnova 1996; Bessonova/Skoryi 2001.

⁹ Shramko 2016.

¹⁰ Smirnova 1996.

¹¹ Kovpanenko 1967; Shramko 2016; Bessonova/Skoryi 2001.

¹² Kovpanenko 1967.

¹³ Gretchko 2010.

¹⁴ Bessonova/Skoryi 2001.

¹⁵ Gretchko 2010.

¹⁶ Liberov 1962.

¹⁷ Smirnova 1996, fig. 2.

¹⁸ Bessonova/Skoryi 2001.

¹⁹ Shramko 2016; 2017; Shramko/Zadnikov 2009; Zadnikov 2009; Zadnikov/Shramko 2009.

²⁰ Shramko 2003.

²¹ Pelyasthenko 2017.

²² Shramko/Zadnikov 2018; 2019.

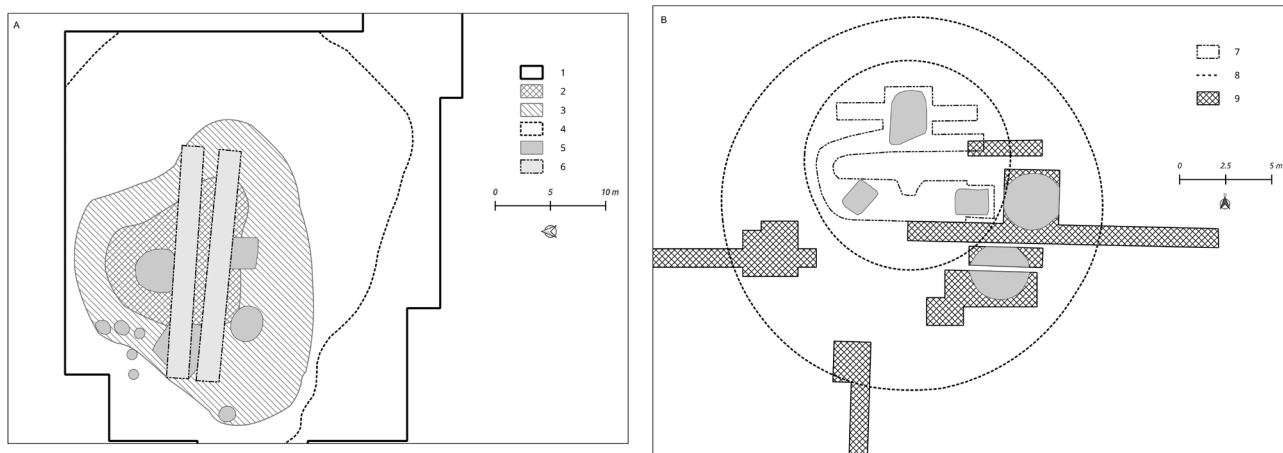


Fig. 2: Comparison of archival plans from zolnik research: A – zolnik no. 5, Bilsk hillfort (redrawn from Shramko 2006, Fig. 1); B – zolnik, Nemirov hillfort (redrawn from Smirnova *et al.* 2018, Fig. 57); 1 – scope of research, 2 – boundaries of A1 horizon, 3 – boundaries of A2 horizon, 4 – zolnik boundary, 5 – archaeological objects, 6 – excavations from 1906, 7 – zolnik boundaries according to A. A. Spicyn (Smirnova *et al.* 2018, Fig. 53; 57), 8 – zolnik boundaries after further research, 9 – archaeological excavations from 1947–1948.

most cases, the objects discovered were only partially examined, with exploration covering only 10%–80 % of the total zolnik surface. The objects that have been fully examined are exceptions – e. g. Cheremuchnoe, thanks to the fact that research started as excavations of a barrow²³, or research at the zolnik in Cirkuny, which was characterized by a small surface under examination – only 85 square meters²⁴.

In recent years, zolniks have constituted an integral part of a larger area of exploration, but no special research methodology has been applied to them²⁵. There is no detailed three-dimensional documentation (which, as will be seen later, is of particular importance) and at best artifacts are documented according to a 1 m × 1 m square grid²⁶. The method of fairly narrow trenches, oriented to one side, is only able to capture unidirectional profiles. Its only advantage can be producing a multiplied network of successive, identically oriented profile cuts.

In the next section of this paper the methods used will be presented, in addition to the summarized results of the excavation of the zolnik in Chotyniec. The field work of the excavation lasted for four consecutive research seasons between 2016–2019, and the most intensive works (due to their scope) were carried out in 2017–2018. Obviously, sites of this type can be examined with basic excavation techniques commonly used in archaeology²⁷, but they show

certain specificity which prompted us to write this article based on the field experience gained.

Description of the method of examining the zolnik in Chotyniec – case study

From the very beginning of the planned archaeological research at the Chotyniec site, we recognized the importance of spatial information. Spatial data was applied to every stage from planning, implementation and interpretation of field research, through the full analysis of materials and multi-faceted reconstructions. It was necessary to integrate this type of data with ‘traditional’ elements of archaeological documentation. The Spatial Information System, also known as the Geographic Information System (GIS) is widely used in many fields of science – from humanities to social and natural sciences. In each of these (including archaeology) GIS is treated as a set of elements that create geo-informatic data and software. In order to obtain such data, appropriate equipment and an able user is required²⁸. In the course of the research presented here, various types of vector data was obtained or created. This included spatial, non-spatial (descriptive) and raster data, such as maps, plans, drawings and photographs.

²³ Liberov 1962.

²⁴ Pelyasthenko 2017.

²⁵ Shramko/Zadnikov 2019.

²⁶ Shramko 2003; Shramko/Zadnikov 2018; 2019.

²⁷ Barker 1993.

²⁸ Goodchild 2010; Jajdzewska/Urbanski 2013.

In addition to those mentioned above, the most basic and important feature in favour of using the Spatial Information System in archaeological research is the possibility of performing both simple and complex multifactorial spatial analyses and spatial statistics together with modelling²⁹. It can also be used for the simulating, and two- and three-dimensional visualization³⁰ of documented events in space. Therefore, two objectives are important here. These include, firstly, the creation of digital resources documenting the archaeological monuments and secondly, creating the materials for analysis. The latter are an important element in the attempt to reconstruct the examined objects and sites. This leads to the potential for building archaeological databases which are not only a 'record' of the excavations, but which also provide the opportunity to obtain new information after the completion of the fieldwork stage. These processes – exploratory data analysis through association, classification, serialization or grouping of data, allows one to perform both simple and complex analyses³¹. The use of the Spatial Information System in archaeology is usually considered an additional component, while in our case it was treated with equal importance – on par with "classical" archaeological methods. It constituted an important element joining all of the documentation with analytical tools, whereby helping to understand the events under examination.

As part of the activities already implemented – which are the subject of this article – as well as those planned in the future, we created a system consisting of geodata, hardware and software together with their users. Geodata used in the project primarily includes orthophotos, aerial photographs, scans of topographic maps and the results of terrestrial laser scanning³². They are collected by the Polish National Geodetic and Cartographic Resources³³, and are obtained through the Web Map Services browsing service (WMS – <https://www.ogc.org/standards/wms>) through the Central Office of Geodesy and Cartography in Poland (<http://www.gugik.gov.pl/>).

What is crucial for the whole task is the software. The first criterion was the choice between a free and closed license system. In our opinion, the latter type of programs may expose archaeological data to blocking due to the use of a restricted format over which the user has no control. On the other hand, such a decision is often considered problematic, mainly at the implementation stage. It should be noted that the use of GIS in archaeological research is often

considered to be highly specialized, inaccessible to archaeologists and requiring the use of closed software. The goal of our activities was to change this thinking, which, as the other examples of both construction-related and long-term research projects show, is possible and desirable³⁴. In addition to this, such a step guarantees durability, protection and access to data – a fundamental element of heritage. It also enables its future re-evaluation and reinterpretation. In this way, the important principle of documentation as the basic scientific source is applied³⁵. QGIS (<https://qgis.org/pl/site/>) was chosen as the basic program for collecting and analysing the spatial data. Its main advantages were openness, compatibility with many different types of data (such as DXF, CSV, SHP) and the ability to integrate additional modules such as SAGA GIS³⁶ and GRASS GIS³⁷. The last of these features has significantly expanded the capabilities of the program, almost eliminating the need to understand and use often very complex configurations in separate interfaces. Thus, an increased efficiency and effectiveness was obtained, especially in terms of 3D modelling and the use of advanced analytical modules. In the process of creating documentation, we used the following programs: for creating vector graphics – inkscape (<https://inkscape.org/>), raster graphics – krita (<https://krita.org/en/>) and gimp (<https://www.gimp.org/>), the libreoffice package (<https://www.documentfoundation.org/>), PostgreSQL database (<https://www.postgresql.org/>). All software works within the GNU/Linux Ubuntu operating system (<https://ubuntu.com/>).

The first important issue before starting actual archaeological research was to collect accurate spatial data. For this purpose, we made topographic measurements of the entire hillfort which became the basis for creating a digital elevation model (situational-altitude map). The second issue was to plan a research strategy for the hillfort, where the initial examination suggested considerable scientific significance combined with complexity and methodological complications. For this reason, we took drone shots of the entire hillfort area during early spring. To a large extent they enabled us to determine and assess the state of damage on the embankments. They also enabled us to view the original course of the embankments and location of the *zolnik* – legible as an oval with dark colour on the outside and light on the inside (Fig. 3).

After obtaining raw digital images, it was necessary to create their spatial link by registering the element (in whole or in part) in the selected coordinate system, which would

²⁹ Gaetan *et al.* 2010.

³⁰ Abdul-Rahman/Morakot 2008

³¹ Zapłata/Borowski 2013.

³² Soczewski 2018.

³³ Izdebski 2018.

³⁴ Costa *et al.* 2013; Orengo 2016.

³⁵ Perrin *et al.* 2014.

³⁶ Conrad *et al.* 2015.

³⁷ Neteler *et al.* 2012.



Fig. 3: The northern part of the hillfort with a visible *zolnik*.

then allow for their use in GIS systems. This process, known as georeferencing, refers to determining the transformation formula based on known and user-specified checkpoints and their equivalents on the map, and the accuracy of the fit is determined by the mean square error³⁸. The indicated checkpoints are selected on the basis of identical elements visible both in the terrain and on the map. It is important for these elements to be stationary and unchangeable over time (e. g. road crossings, drainage channels or building corners). Field points measured with GPS devices were also used. The process of fitting raster files (geo-references) is very important and was used both for digital photos as well as documentation plans and archived cartographic data. By creating digital documentation in the coordinate system, it was possible to impose it on geodetic measurements and publicly available geoinformation data, e. g. topographic maps made available in the WMS service. It also enabled us to perform calculations and measurements of the size and area of documented objects.

The next step was to design (determine) the are (is a unit of area commonly used in Eastern European archaeology; it is equal to 100 square metres [10 m × 10 m]), which is the basic reference for the spatial location of all portable and non-portable materials discovered during research. It

is particularly important in the case of extensive sites, such as the hillfort in Chotyniec, which is over 35 hectares. We used the algorithm available in the QGIS program, whereby creating a grid with 10-meter squares as a new vector layer. Its zero (0) starting point was located south-west of the hillfort (outside the proper site surrounded with embankments), and its range covered the entire area with a buffer of around 400 meters. The numbering of the ares was open and its concept was based on the coordinates of the Cartesian coordinate system for its corners. The designation of the N (north) and E (east) line was adopted, where the values of the N line increased as it moved northwards. Similarly, for line E, the numbering of ares increased eastwards (Fig. 4). An example number entry for a single are is: 38N/40E. This relatively simple system is characterized by very high flexibility, allowing for free extension of the research area in any direction without the risk of value duplication.

The primary task during the archaeological research was to make documentation of all the facts discovered that would be as full and accurate as possible. This is an obvious canon in field archaeology, given the destructive nature of any interference into the structures studied. As their repetition becomes impossible, the responsibility which falls on the technical aspect of research is even greater³⁹. The

³⁸ Urbański 2012.

³⁹ Perrin *et al.* 2014.

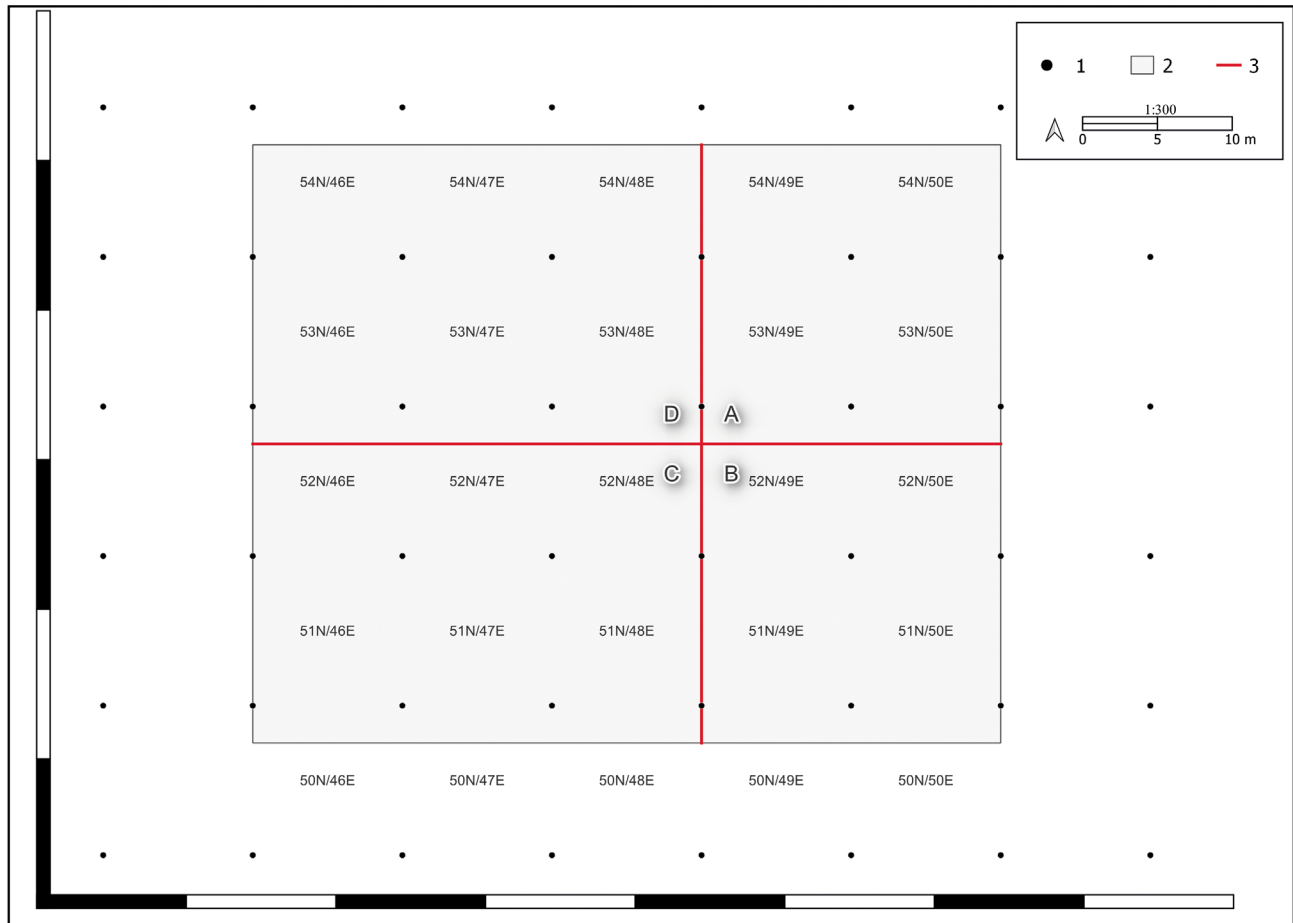


Fig. 4: Designation of the measuring grid (10m squares – ares) used during archaeological excavations of the *zolnik* at the hillfort in Chotyniec: 1. corners of ares; 2 – excavated ares; 3 – main perpendicular cuts, dividing the *zolnik* into quarters A–D.

most important aspects include the spatial registration of all discovered materials. This applies to both objects and layers as well as mobile artifacts. This process would not be possible without the use of RTK GNSS receivers (Real Time Kinematic Global Navigation Satellite Systems) and total stations, which instantly determined the location of each monument in a coordinate system in three dimensions (x, y, z). Thanks to the QGIS program, the spatial layout of the acquired materials could be reviewed on an ongoing basis and we were able to use their interpretation to modify our research strategy.

The next level of documentation consisted of digital photos which were taken with both traditional cameras and (from 2018 onwards) a drone. The latter method was particularly important in the process of conducting excavations and subsequent interpretation of the results obtained. Pictures were always taken after exploration of each level of the archaeological layers (Fig. 5). Then the photographs were subjected to geo-referencing – an inscription in the coordinate system and the designated are grid. As a result,

we obtained subsequent horizontal cuts – cross-sections through the examined structure of the *zolnik*. It also provided a real-time view of structures, objects and layers which were not always legible from the level of exploration and which allowed us to make or modify particular research decisions. Documentation on a smaller scale, more ‘traditional’ in character, was carried out both in order to illustrate and consolidate all of the discovered structures, as well as to make photogrammetric documentation. In order to eliminate the distortion and apply metric features, particular elements within the frame were measured using a total station. They subsequently served as control points for geo-referencing the photograph. On the basis of the geo-reference one can make accurate drawings of elements discovered in the field, often very complex ones, e. g. layers of ceramics and bones. Undoubtedly, the advantage of this approach is the accuracy and precision of the work, which is independent of (often adverse) conditions in the field, but requires much more care in the exploration of discovered structures and the quality of photographic documentation.

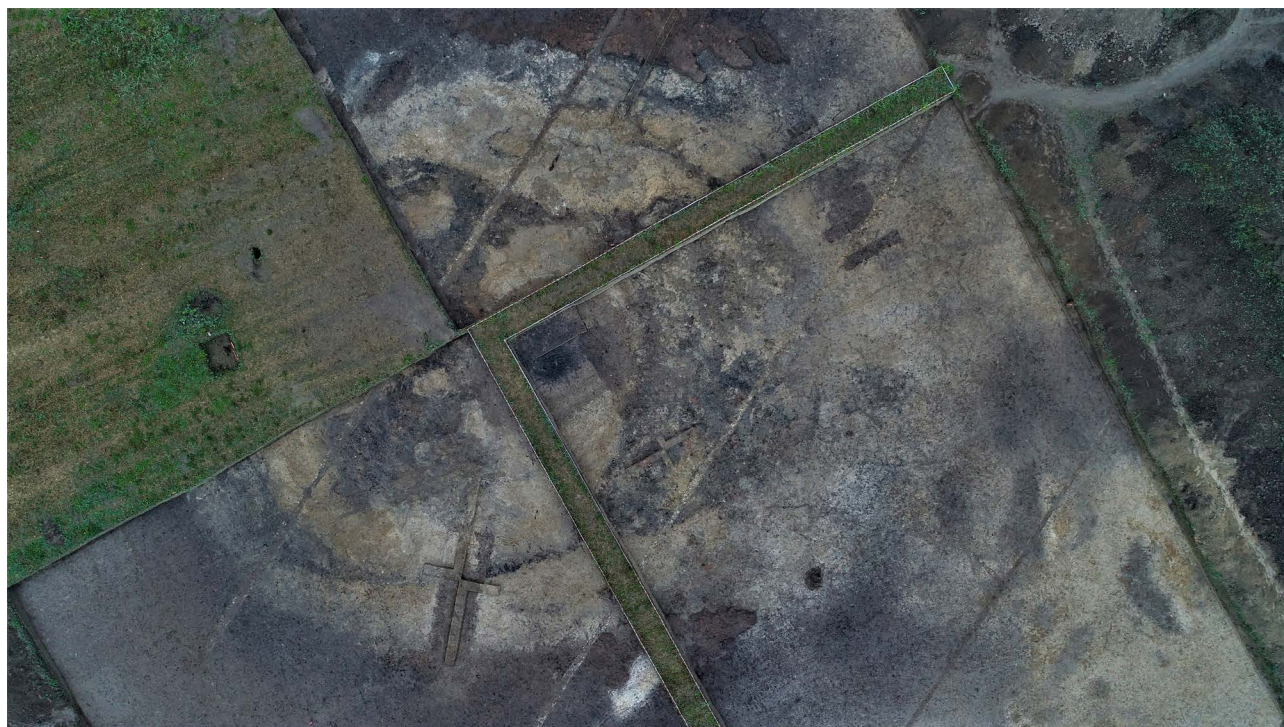


Fig. 5: Photographic documentation of the *zolnik* during exploration (drone photograph).

Its additional advantage is designing plans and figures ready for publication.

Standard drawing documentation was also prepared, both for entire levels and individual objects. In terms of the whole site, documentation was based on a designated grid, where each is divided into four quarters. All drawing documentation was vectorized (using Inkscape) and on the basis of the grid it was exported to QGIS. It is worth noting that the vectorization process of paper drawing documentation is a major qualitative advancement. The use of this method of creating drawings allows its free scaling without the risk of losing readability or quality. In addition to this, the system used to save vector data in .svg format is considered one of the most useful in long-term file storage⁴⁰.

The entire documentation process presented above, namely spatial data gathered from field measurements, digital photographs taken in various angles, photogrammetry and vectorized drawing documentation became subsequent layers in QGIS. Each of these layers was supplemented with additional content such as tables, databases or attributes. This resulted in a documentation system which was multi-faceted, and the tool for its management became the central source for obtaining information. One of the most important features of this system is the efficient search, com-

ination, and display of specific data, consciously selected by the user in real time. Any such action can also be both easily and quickly saved and exported to the selected file type: e. g. site plans in a graphic format (SVG, TIFF, PNG, PDF etc.) and raw files (e. g. in ESRI SHP, CSV format) or databases.

The field documentation process itself and the information it provides is only the first stage of the project. The next stage, which we have already partly begun elaborating upon, is analysis and description. One of the simplest procedures that can be considered a preliminary analysis of spatial data is its visualization, i. e. the use of diverse symbolization and classification of vector data (points, lines and polygons). It should be noted that this process can be performed, repeated and visualized in many ways, both using symbols and colours depending on the needs and legibility of the effects obtained. What is particularly valuable here is the presentation of the data obtained in the context of the attributes assigned to them – e. g. qualitative or quantitative. This allows us to search for patterns in distribution, identify unique values (different from others), and attempt to identify relationships and spatial connections between data. Just reviewing the acquired data and its symbolization indicates the existence of spatial relationships. One of the most distinctive relationships is the ratio of materials discovered within the *zolnik*: daub (burnt lumps of clay) and animal bones. The latter occupied the central part of a smaller area and were limited by the former. An additional

⁴⁰ Niven 2009; Costa 2013.

advantage of simple visualization processes therefore, is the possibility to display data in a 3D format (e. g. using SAGA GIS) or create complementary graphs.

The vector data within the project consisted of point, line and polygon (area) features. All of the data was able to be freely displayed and modified as described above. With reference to the discussed project, point data usually consists of the measurements of artifacts or samples taken, whereby lines are used to mark profile cuts, and polygons refer to discovered objects and layers.

The next level of analysis is referred to as spatial queries, i. e. determining which objects meet the criteria we are interested in. This operation is possible thanks to the attribute table related to vector data. The table can be freely created and modified both at the level of QGIS and in external programs (e. g. MS Access or PostgreSQL). In addition to spatial (x, y, z) data, it is possible to add other logical information. A good example of additional information is a questionnaire of artifact features which can be created after the completion of excavations. It includes, for instance, ceramic objects, specifying the way they were made (wheel-thrown, hand-made) or daub – its weight, colour or observed construction imprints. On this basis, it is possible to perform Structured Query Language (SQL) queries. For example, we can use the SQL expression to select from the entire database collected during research, only the lumps of material with a weight exceeding 50g. In this way, we can obtain a subset of objects that meet the given criterion, which can then be saved as a separate vector layer. It is also possible to define more complex queries consisting of many criteria, e. g. bowls decorated with holes below the rim, belonging to a specific technological subgroup.

The QGIS program also allows for a simple creation of new attribute values based on those already in existence, combining various tables with data (e. g. from subsequent research seasons) and calculating vector layers, such as the surface of examined objects, layers, line length or the number of point events per designated area. The analytical possibilities offered by the software are definitely richer and it is impossible to describe all of them here. Previously, we elaborated on only those that are simple to use and considered elementary in archaeological research. Undoubtedly, their quantity in the current project will increase over time together with the development of data obtained during the research. Databases which are still being developed are of great importance here for each category of discovered sources, both portable and non-portable. It is important to note however, that the process of using GIS software does not end at the stage of field research, and its importance as the main element of the research procedure is maintained at subsequent stages.

Height measurements and aerial photographs confirmed the existence of a small elevation with an intense, dark surface colour. It stood out from the closest surroundings. Consequently, we made the decision to examine the object in the same way as classic barrows, i. e. using the quarter method. The entire hypothetical *zolnik* was divided into four quarters, oriented according to directions of the world: A – NE part, B – SE part, C – NW part and D – SW part of the *zolnik* (Fig. 4). Although the numbering within the grid provided the necessary accuracy of documentation and inventorying of historic material, in order to maintain the integrity of the *zolnik*, both in the field and at the interpretation stage, it proved more convenient to number individual quarters of the entire site. Quarter A was excavated first in 2017, of a total area of 400 m². Its main E-W and S-N profiles were halves of the main profile cuts of the whole *zolnik*.

During exploration it turned out that the *zolnik* was a stratified object, hence for the full documentation of the layers we established several additional profile cuts. Due to the round outline of the range of layers, which in a single quarter of the *zolnik* had the shape of a 1/4 slice of a circle, the layers were determined on the basis of the secant of the angle formed by two sides of the quarter, with the vertex in the centre of the whole object. The significance of these auxiliary cuts was twofold. Firstly, it was possible to verify the stratigraphic systems observed within the main profile cuts, i. e. at the boundary of the excavation (1/4 of the *zolnik*). Secondly, a dense network of profiles made it possible to observe smaller structures (horizontal and vertical) throughout the entire site (Fig. 6). After examining the ‘pilot’ part of the *zolnik*, it was clear that the only method adequate to the significance and size of the object was the examination of larger surfaces and exploration of well-distinguishable natural layers. This was accomplished during the next research season, in 2018. The excavation established at that time included three successive ‘quarters’ of the *zolnik* (B, C, D), which were simultaneously explored, maintaining profile balks between quarters B – C and C – D. They made it possible to complete all of the main profiles of the *zolnik*. In these parts, in addition to observations already made during the previous excavation season, some new problems occurred. We found in-ground objects that make up the *zolnik* ‘architecture’. They were explored and documented in a traditional way, removing subsequent layers within parts of the separated structures so as to obtain the opportunity to document the profile and observe the context of the object in relation to individual layers of the *zolnik*. Another serious problem in some parts of the *zolnik* was the accumulation of a large number of animal bones, forming almost a layered system. They were not placed in

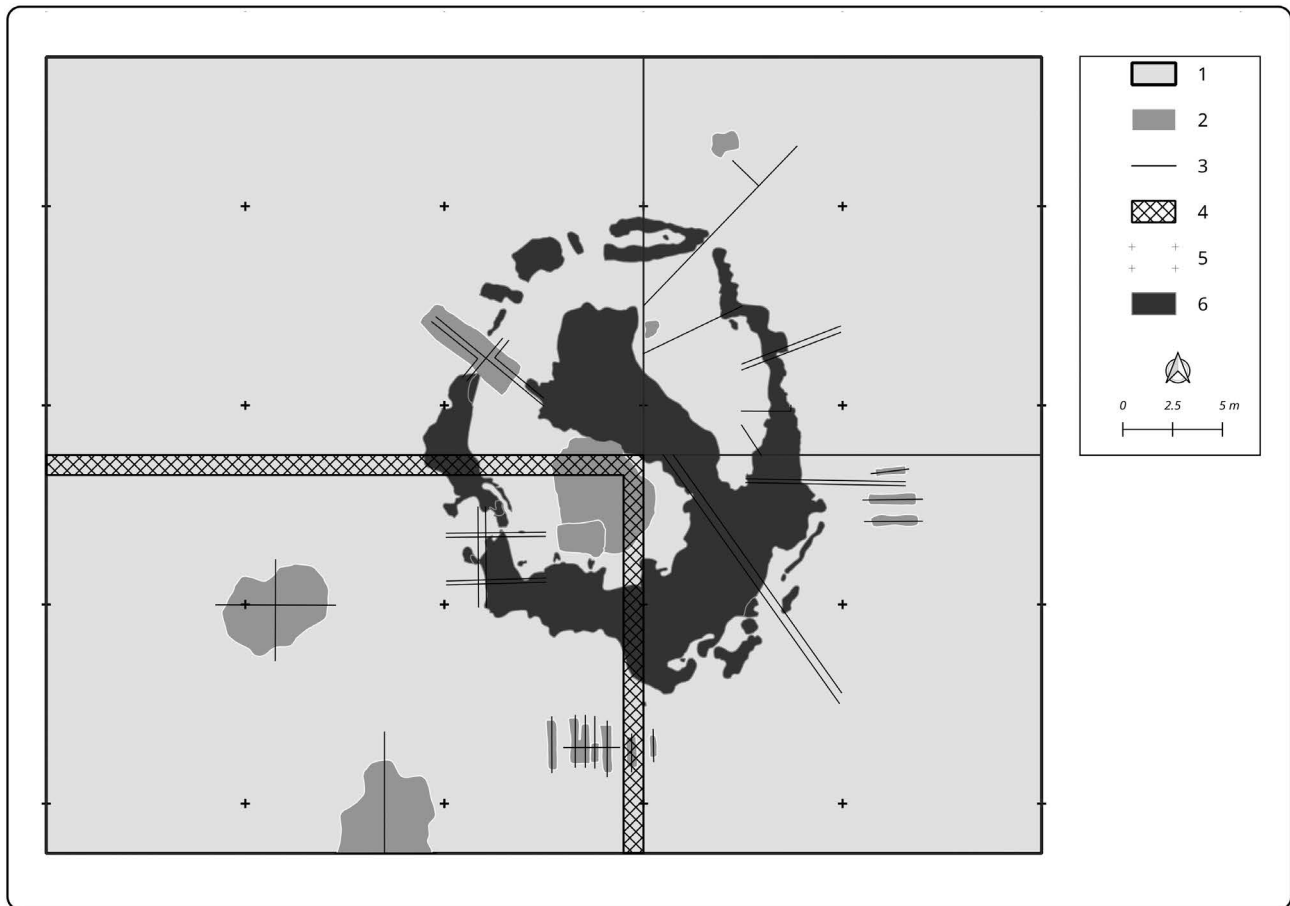


Fig. 6: Vector drawing of one of the exploratory levels of the *zolnik*: 1 – scope of research; 2 – archaeological objects; 3 – profile cuts; 4 – main profile; 5 – square grid (ares); 6 – proper *zolnik* layers.

anatomical order. They were documented just like other discovered artifacts, i. e. three-dimensionally, while drawing documentation encompassed the entire layer. On the outskirts of the *zolnik*, mainly within the B quarter, a cluster of daub was also found, forming a compact system about 30–40 cm thick. We did not manage to examine this part in 2018 and it was explored in 2019.

The exploration of the daub layers on the entire surface of the *zolnik* was conducted with precise measurement of individual lumps, and only after they were being separated, they were described in terms of arrangement *in situ*, colour and possible construction-related or other imprints (e. g. traces of white dye on smooth external surfaces). Each lump was weighed. The material and documentation prepared in this way formed the basis for multidirectional statistical analyses. It should also be noted that within this cluster we created two profile cuts with an aim to record the relationship between the daub, the *zolnik* layers and possibly the undisturbed soil.

Obtained research results

It should be noted that as a result of the aforementioned methods of exploration and documentation of the site, we have a fairly complete picture of the positioning (and initial depositing) of artifacts as well as the creation and organization of the *zolnik* area. According to the studies published to date, this is the first such case.

On the basis of stratigraphic observations, we can distinguish several separate units in the *zolnik* structure (Fig. 7). We observed that this structure began with preparation ('levelling') of the original surface of grey clay, where traces of burning fire *in situ* were recorded (rituals?). The next stage was the construction of a conical embankment made of yellow clay, which formed a kind of primary usable surface. It was covered with *zolnik* layers, which were formed by the accumulation of remains of burning (shredded charcoals). In this way, the *zolnik* layer, permanent in space, was created. It was covered with a level of yellow, sandy clay that could be interpreted as an intentional cover

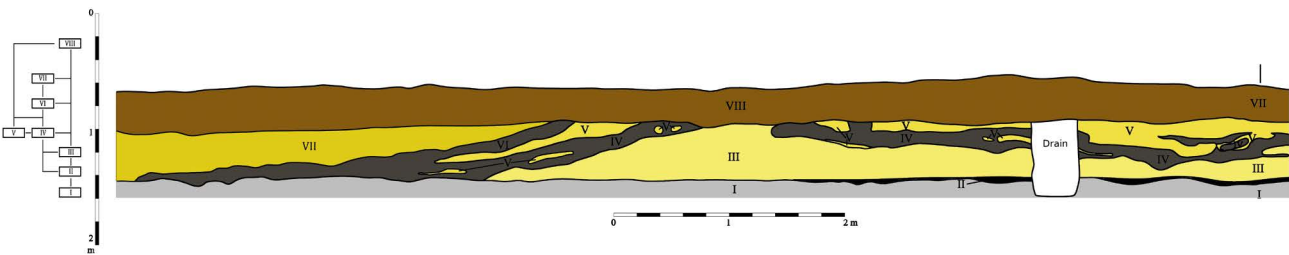


Fig. 7: Drawing documentation of part of the main profile with Harris Matrix (1989): I – gray layer of clay; II – the sub-zolnik layer – site preparation; III, V, VII – sand constituting the foundation of the proper zolnik and separating subsequent phases of the site use; IV – older zolnik layers; VI – younger zolnik layers; VIII – modern humus.

layer. Above it we recorded traces of modern agricultural works. Careful observations of the surface of the zolnik layer and its curvature on the constructed cone clearly indicate that originally there was yet another, younger layer of the zolnik, located on top of the yellow layer covering the older part of the zolnik. Unfortunately, it is almost completely destroyed.

Among the objects registered within the zolnik, the ‘central’, large oval object with dimensions of about 6.2 m × 4.7 m and a depth reaching below 1.4m, deserves particular attention. This type of pit filled entirely with the zolnik layer is known from other Scythian cultural circle hillforts, for instance, in objects from Bielsk (with dimensions of 6.5 m × 3.25 m and depth of 1.65 m)⁴¹ and Motronin (with an area of 28 m²)⁴². In addition, a longitudinal (5.5 m × 1.7 m) shallow pit (up to about 0.4 m) was registered in the zone with the lowest density of portable remains, and it can be interpreted as a kind of entrance to the interior of the zolnik. Another important object is a place on the usable surface within the older layer (C quarter), which can be identified as a hearth or even a type of furnace. In turn, distinctly separate areas covered with yellow clay⁴³ (cf.) can be interpreted as a trace of a specific, single ritual event. In two places on the edges of the zolnik (B and C quarters) we

recorded barely legible traces in the form of soil discoloration on horizontal arrangements of beams, placed parallel to one other and directed with a longer axis towards the centre of the zolnik.

Discovered artifacts represent a diverse and very numerous set (Table 1), in which daub, pottery and animal bones dominate. Their general analysis is presented elsewhere⁴⁴, and the whole is currently being prepared in its entirety for a monographic publication.

Caution! The individual numbers are real total station measurements. In most cases, their number equals the number of artifacts (e. g. bronze, iron). In the case of mass sources, the number of artifacts is higher, because in the case of pottery or bone groups, one measurement may correspond to more than one artifact.

A great number of interesting artefacts of high cognitive value were found in the zolnik layers. First of all, we should mention fragments of Greek amphoras – apart from the already mentioned vessel from the Klazomenai site – there are parts of amphoras from other Ionian workshops (e. g. grey pottery from Lesbos) and others⁴⁵. A very numerous group of ornaments is represented by objects made of bronze (pins⁴⁶, necklace, ring, buttons), glass and stone (beads), and even gold (fragments of bent plates). Militaria

Tab. 1: Chotyńiec, site 1. Particular groups of artifacts in the zolnik layers.

Research	Hand-made pottery	Wheel thrown pottery	Bronze	Iron	Bone (+ other)	Animal bones	Daub
2017	7027	5	24	10	6	957	7109
2018	8511	192	123	40	12	4905	21039
2019	2718	9	4	2	1	10	28776
TOTAL	18 256	206	151	52	19	5872	56924

⁴¹ Shramko 2016.

⁴² Bessonova/Skoryi 2001.

⁴³ Bessonova/Skoryi 2001.

⁴⁴ Czopek 2019.

⁴⁵ Czopek 2019, 126–130.

⁴⁶ Adamik-Proksa/Ocadryga-Tokarczyk 2021.

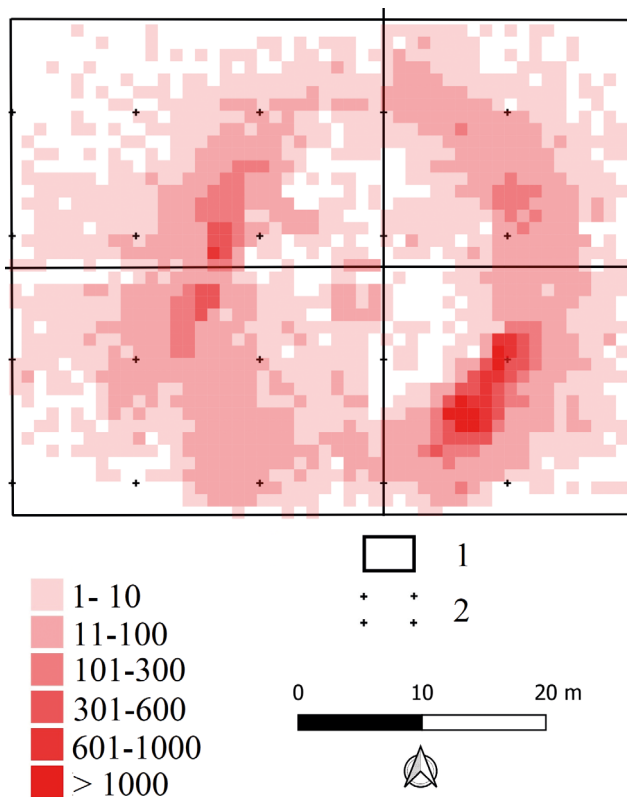


Fig. 8: Daub density per m², 1 – scope of research; 2 – square grid (ares).

consist of a series of 38 arrowheads, mostly made of bronze, but also of bone and iron⁴⁷. Hand-made pottery is very interesting, and the most characteristic artefacts here include pots with plastic skirting and holes under the edge, large vase-shaped vessels and bowls with edges bent towards the inside of the vessel and holes not fully punctured from the inside. This variety and quantity of artefacts required special attention at the exploration and documentation stage.

Within the *zolnik*, we recorded 81,480 total station measurements (Table 1). The exact locations (horizontal and vertical) of all artifacts allow the use of various statistical methods in their analysis (Fig. 8), among which χ^2 tests are most widely used. This method finds a number of applications in archaeology. Most frequently it is used for analyses concerning pottery where numerous series of materials need to be compared, or where it is necessary to check if there are statistically significant differences between the two categories studied⁴⁸. However, this test can also be used in analyses regarding the numerical distribution of the par-

ticular groups or classes of artifacts in objects and layers⁴⁹. It is important that the χ^2 test works for both measurable and non-measurable data⁵⁰. It is useful in studying the homogeneity of material distribution on the surface of the *zolnik*, as well as checking for the existence of correlations between various features of historic material (e. g. features of pottery). Another useful statistical method is the Odds Ratio plot, which aims to show the chance of an occurrence of a given phenomenon in group A relative to group B⁵¹. In the case of the *zolnik*, it was used to calculate the chance of appearance of daub of a given colour in a particular layer of the *zolnik*, or the chance of having a construction type of daub on particular parts of daub cluster. Kruskal Wallis and U-Mann Whitney⁵² tests proved useful in capturing the correctness in terms of the size (weight) of the daub, as well as the thickness of the walls of pottery. The former was used for many variables, the latter when only two were considered. We used them with an aim to check if the differences in median distribution were statistically significant. The last method used in the analysis of material from the *zolnik* was the dendrite method for cluster analysis, where the distance measure was Person's r , and the agglomeration method was complete linkage⁵³. These plots were used, among others, in the creation of technology groups for pottery.

The arrangement of ceramics, bones and daub indicates an intentional arrangement on a plan similar to a regular circle. We can draw such a conclusion thanks to the documentation of all the findings (Fig. 9 and 10). Other categories of artifacts, e. g. metal objects either as a collective system, or as individual groups (e. g. arrowheads, pins) can be represented in this way. The same applies to all samples taken that are easily identified in space and within a particular layer.

Careful observations during the exploration of the *zolnik*, as well as the use of aerial photographs (which was important due to the size of this object) enabled us to distinguish several important objects that created a specific 'zolnik' architecture. Above all, the layer of daub remains mysterious. It seems that these are remains of the structure (round building) surrounding the entire object. In the place where only a few fragments were registered there was an entrance, which is confirmed by the presence of an elongated in-ground object.

⁴⁹ Barceló 2018.

⁵⁰ Taylor 1997.

⁵¹ Szumilas 2010.

⁵² Fletcher/Lock 1994.

⁵³ Stanisiz 2007.

⁴⁷ Burghardt 2020.

⁴⁸ Bellanger *et al.* 2008.

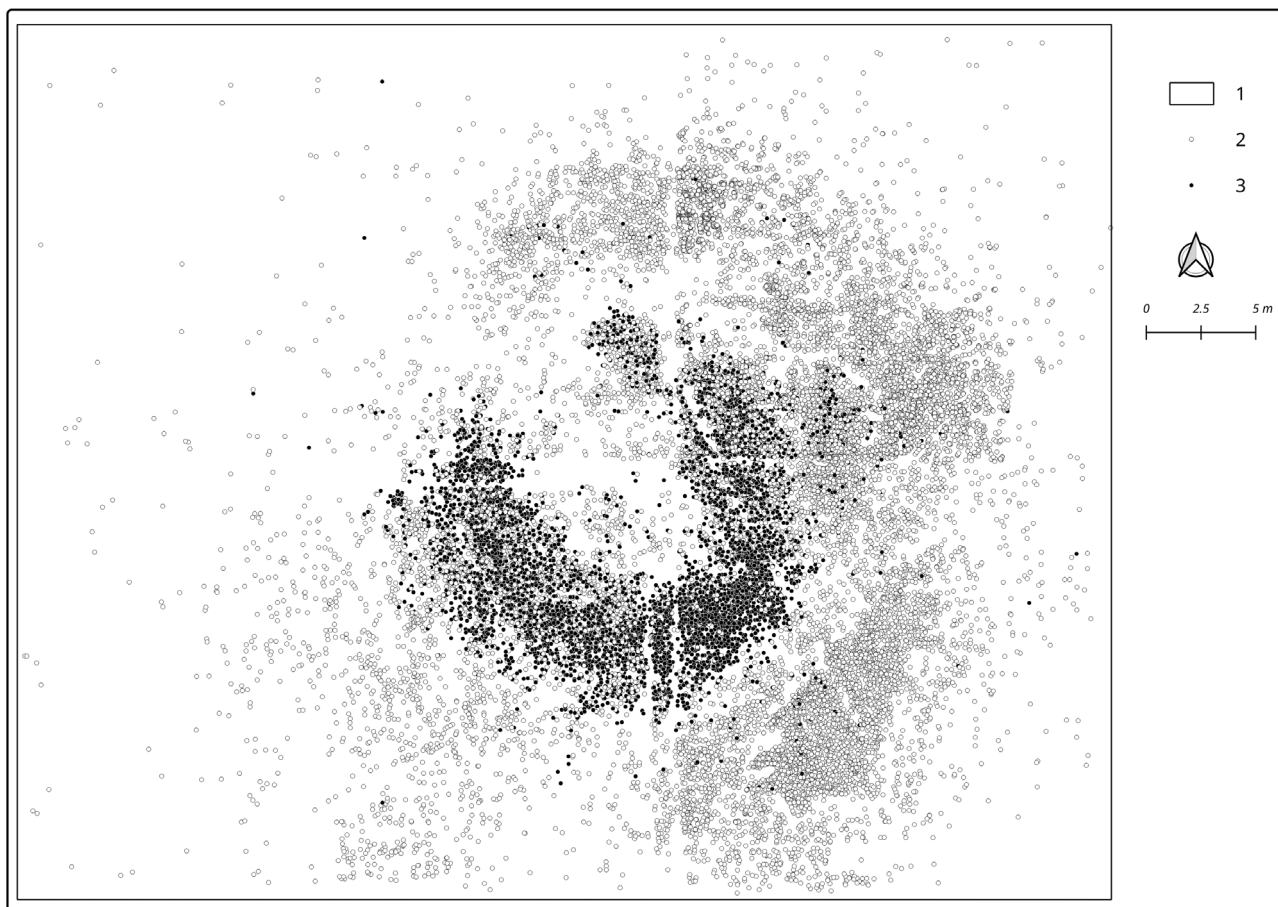


Fig. 9: Documentation of selected monuments: 1 – scope of research; 2 – pottery; 3 – animal bones.

Discussion

The applied research procedure and the selected method of research of the *zolnik* in Chotyniec differed from the previous methods of examining such objects in the Scythian cultural circle. The most commonly used method from the very beginning of systematic excavations was the examination of *zolniks* through either a single or multiplied and parallel excavations. These excavations were quite narrow, even being referred to as trenches⁵⁴. These excavations allowed for profiles to be captured and documented, even in a spatially multiplied arrangement. However, they were not conducive to a wider understanding of the entire surface of the *zolnik* and its surroundings. Hence, other research projects appeared – even as supplementary to older projects – which aimed at the exploration of larger areas. For example, on *zolnik* no. 13 in the western Bielsk hillfort⁵⁵

a large excavation was established, divided into a grid of squares with a side length of 1m and marked with numbers (vertically) and letters (horizontally). Such separated units were important for exploration and documentation.

It can therefore be concluded that experience gathered to date indicates two basic methods of examining *zolniks* (Fig. 11). The first option concerns long trenches, parallel to each other, that subsequently cut through the entire object, although they are not always planned in this way. At the same time, we recommend their width to be somewhat larger than the predominantly used 1–2 m. If we choose this method, then consistently subsequent, parallel and even adjacent trenches should have the same direction, so that they can cover the entire surface of the *zolnik*. It is important to document not only profiles parallel to each other, but also perpendicular to the axis of the trenches. The concern here is primarily about maintaining the continuity of observation and comparability of research results, even in relation to the second of the recommended methods. This can be ensured by having at least one main profile through the centre of the embankment, documented in each of the

⁵⁴ Smirnova 1996; Smirnova *et al.* 2018; Bessonova/Skoryi 2001.

⁵⁵ Shramko 2016.

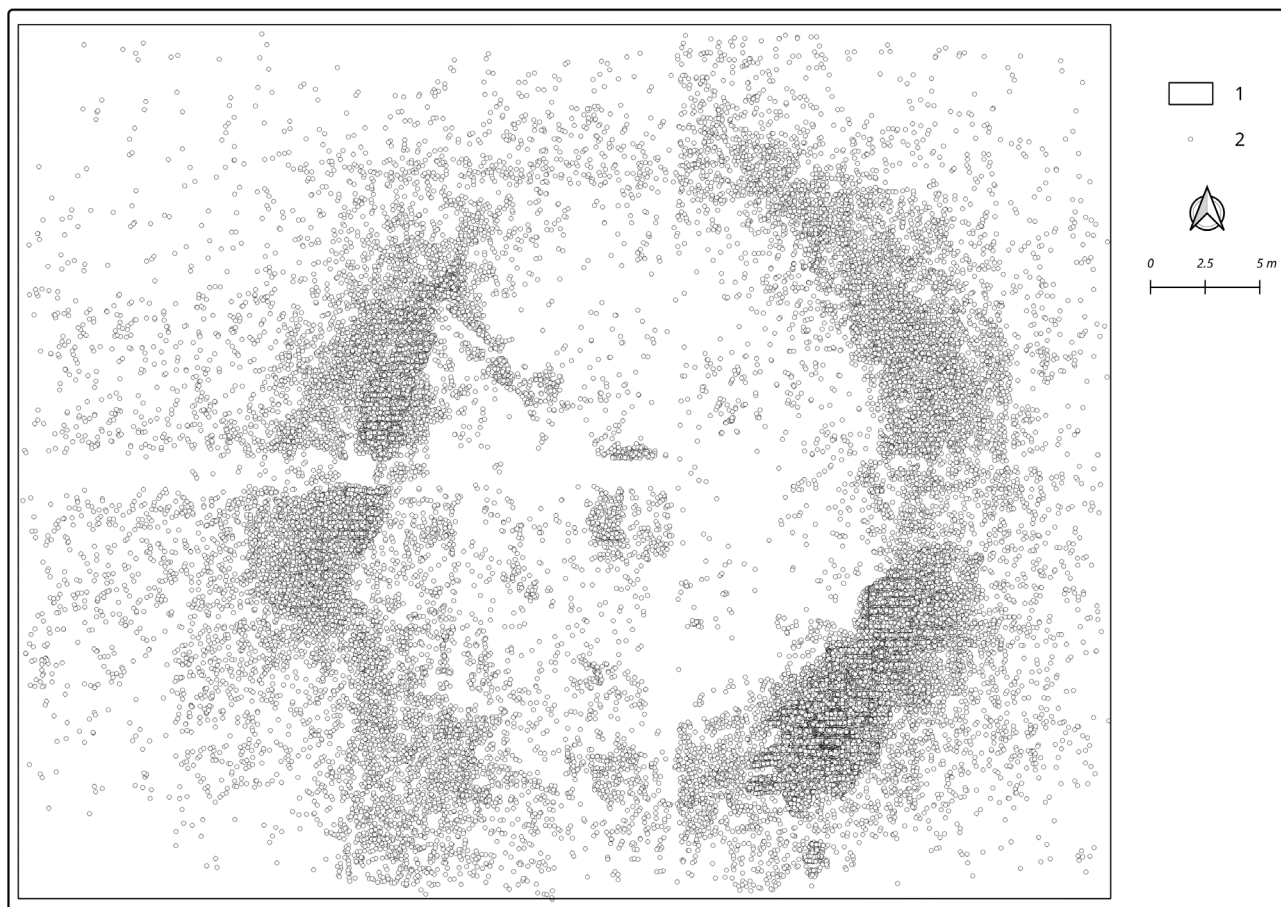


Fig. 10: Documentation of selected monuments: 1 – scope of research; 2 – daub.

trenches along the same axis. The second method, used in Chotyniec and described above, can be considered a derivative of classic barrow excavations (quarter method⁵⁶), dividing the *zolnik* into four quarters. The basic assumption is a holistic examination of the object and obtaining two intersecting vertical sections (profiles), which are the basic information to understand the stratigraphy. They are supplemented with additional profiles, depending on the situation found and the objects discovered. The role of profiles has been emphasized many times because of the specificity of *zolniks*, for which the stratigraphy is the most important. It concerns the layers themselves, but also concerns the need to capture their mutual relations. During the research in Chotyniec, one of the most important issues was the problem of the maximum surface of the burnt layer (known as the *zolnik* layer), and the overlapping two layers of identical structure and content in this part, while elsewhere (in the central part of the object) they did not interact with each other and were separated by a yellow clay ‘spacer’.

To decide on the exploration method, appropriate conclusions should be drawn from stratigraphic observations. In this case, it was seen as a mistake to remove mechanical levels without registering and maintaining the integrity of structurally homogeneous *zolnik* layers, which are a model example of the need to explore the so-called natural layer. The *zolnik* from Chotyniec, as a multi-layered object, perfectly submits to the methodology of examining stratified sites, including the construction of model diagrams – matrices⁵⁷. They serve as both an illustration and an analytical tool (Fig. 7).

Regardless of the method chosen, there are some common features that result from the specific character of *zolniks*. It is absolutely necessary to consider:

- detailed, preliminary diagnosis with the design of the elevation plan of the site;
- the creation of a measuring matrix (e. g. are grid) before exploration, enabling the inclusion of the *zolnik* in the entire site;

⁵⁶ Harris 1989.

⁵⁷ Harris 1989, 29–39.

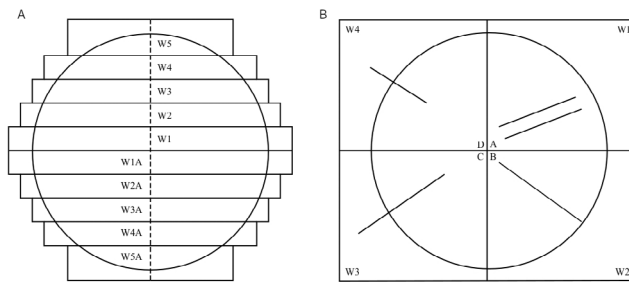


Fig. 11: Diagram illustrating two basic methods of holistic examination of zolniks: A – parallel, long excavations covering the whole object; B – quarter method, with main vertical cross-sections and possibly additional auxiliary profiles and excavation using the layer method appropriate for stratified objects.

- the need for a holistic examination of the zolnik, regardless of its size and complex stratigraphic relations, which may require many years of research (the zolnik in Chotyniec was examined during three excavation seasons, between 2017–2019);
- careful observations enabling separation and proper documentation of individual facts. It is recommended not to approach the task routinely, because each zolnik is different; previously the lack of such an approach led to shallow interpretation and treatment of such objects as debris of ‘ash mounds’;
- due diligence in documenting all sources, which is clearly seen in the documentation from Chotyniec;
- the use of advanced numerical techniques that – as the example from Chotyniec illustrates – facilitate work, but also provide great analytical potential;
- selection of the exploration method based on the conclusions resulting from stratigraphic observations;
- discovered sources, diversified in terms of quantity and type, call for interdisciplinary (e. g. zoological or molecular) analyses, which involves the need to collect as many samples of object fills and layers as possible;
- complex stratigraphy and organization of the interior of zolniks clearly suggest that they can be multiphase objects, which should be confronted with absolute dating⁵⁸;
- reconstruction of the zolnik embankment after the excavation, which is particularly important for hill forts which stand out in space.

These recommendations, resulting from field experience in Chotyniec, should be treated as a model reference. It is known, however, that archaeologists in the field must take into account the specifics of the site being examined, and

sometimes also numerous difficulties and independent conditions (e. g. availability of the area for research). Another issue is the state of destruction of the objects, which should be taken into consideration when deciding on the appropriate research strategy.

Conclusion

The remarks and descriptions of examples from the Chotyniec research presented above make it clear that research of zolniks should be carried out in accordance with principles (or a method) that allow the obtainment of as complete a source of information as possible. The goal of the employed method should not only be to explore the dedicated research areas and extract the artifacts found there, but to capture all possible contextual relations. The sum of all information should answer questions about the chronology (the time of the function of the zolnik), its internal character and, above all, its function.

It is therefore important to introduce research mechanisms and procedures that ensure the quality of research. This undoubtedly entails the following factors: the time needed to carry out the research (much longer than it could be assumed in the case of field studies conducted according to ‘traditional’ methods), proper training of people participating in all stages of the project, and finally the costs of research. It all leads to a constant improvement of their quality (“quality assurance”)⁵⁹, without which it is easy to imagine a situation in which it is necessary to repeat the study or worse, the source information is irreversibly lost. The case study analysed above clearly illustrates the need for extremely thorough field observations supported by exploration performed with both precision and appropriate documentation techniques at all stages of the project.

Our final conclusion is that the change in the method of examining zolniks allows for their extended interpretation – they can no longer be seen as ‘mounds of ash’ (accidental deposition of discarded objects) but carefully prepared places where cyclical ceremonies took place. Thus, we are potentially dealing with the hallowed ground in its broadest sense. In such situations, even the smallest and seemingly insignificant artifact, ground object, or even a single contextual observation can have meaning in both a functional and chronological interpretation. Therefore, the overriding principle of conducting excavations in the field is the accuracy of exploration and meticulousness in documenting all discoveries.

⁵⁸ Czopek/Krąpiec 2020.

⁵⁹ Banning *et al.* 2016.

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