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THE MISSING LINK – LATE BRONZE AND EARLY IRON AGES SETTLEMENTS IN THE VICINITY OF THE GOGOLEWO HOARD DISCOVERY SITE

ABSTRACT

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The Gogolewo hoard is one of many assemblages of metal objects from the Late Bronze and Early Iron Ages that have been discovered in western Poland. Its composition is unremarkable, consisting of two sickles and a spear- or javelinhead, with no imports or unusual objects. Although it has been mentioned in several publications, it has never been thoroughly studied. This text focuses on this deposit because, according to archival information, it was discovered in a 'pile of stones'. For this reason, it was included in studies conducted as part of a project examining hoards found in such contexts. The article explores the relationship between Late Bronze and Early Iron Ages settlements and the cultural significance of the hoard's deposition site during this period.

Keywords: Late Bronze Age and Early Iron Age, Lusatian Urnfield cultures, settlement studies, cultural landscape, metal object hoards

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INTRODUCTION

The Gogolewo hoard was discovered in 1876 or 1877 on the slope of a hill in a 'pile of stones' by Stanislaw Czarnecki or, more precisely, on his estate (Waga 1933, 242). File 483, preserved in the Archiwum Naukowym Muzeum Archeologicznego w Poznaniu (Scientific Archives of the Archaeological Museum in Poznań), notes that the hill was the site of a windmill. Additionally, Szafrański (1955, 163) records that the hoard was found on the eastern slope of this elevation. The deposit included three artefacts: two sickles and a head of a javelin or spear, which Blajer (2001, 328) dates to HaA2 (*c.* 1100-1050 BCE).

The most intriguing detail about this hoard is that it was discovered in a 'pile of stones'. Metal object hoards from the Bronze Age and Early Iron Age are often associated with stones. These may be large boulders (*e.g.*, the Granówko hoard – Archiwum Działu Archeologii Muzeum Narodowego w Szczecinie (Archives of the Archaeology Department of the National Museum in Szczecin), File 182; Rosko Site 5 hoard – Cofcianka 1949) or stone pavings on which metal objects were deposited (*e.g.,* the Gdynia-Karwiny hoard – Dzięgielewski *et al.* 2019). Frequently, specific details are absent, with reports merely noting the presence of stones in the context of the hoard. It is not always clear whether these stones were placed there intentionally (*cf.*, Blajer 2001, 256, fig. 42, 311-374). Even when stones are a natural feature of the environment, their recurrent occurrence suggests a significant role in the deposition process, a detail that is often overlooked. The Rosko Site 47 hoard was discovered in a particularly unusual context, having been deposited within a stone and earthwork structure reminiscent of a megalith or barrow. However, no definitive dating of this structure has been provided beyond its apparent contemporaneity with the hoard (*cf.*, Maciejewski 2019). The Gogolewo hoard was selected for research in a project funded by the National Science Centre, Poland: 'A Biography of Late Bronze and Early Iron Age Hoards. A Multi-Faceted Analysis of Metal Objects Related to Monumental Constructions in Poland' (2021/41/B/HS3/00038), which is associated with studies on the phenomenon of such structures. Simply put, the project aims to determine whether the Rosko site 47 hoard is unique or represents a broader cultural phenomenon.

Information about stone structures or 'stone piles' and the details enabling the identification of hoard locations were essential for typifying cases for detailed research within the project (Fig. 1). The Kaliszany hoard, discovered in a stone and earthen structure. The Stołężyn hoard, also reportedly found in a 'pile of stones', was chosen for study. Another case is the Uścikówiec hoard, which, although not discovered in a stone structure (or at least with no record of it), shares several characteristics with Rosko, Kaliszany, and Stołężyn hoards. All these hoards are dated to HaB2-HaB3 (*c.* 950-800/750 BCE), originate from northern Greater Poland, and are large assemblages containing numerous artefacts in both Greater Poland's and Pomeranian styles. Additionally, they were all deposited on the borders of the ecumene or between areas of intense settlement (*cf.*, Maciejewski 2016). The Gogolewo hoard, in contrast, differs in several respects: it is smaller, was

deposited more than 200 years earlier, and comes from southern Greater Poland. Moreover, its relationship with the local settlement is not well understood. This article seeks to address this gap.

The exact discovery site of the metal objects from the Gogolewo hoard is unknown. Attempts to pinpoint the location relied on the aforementioned archival records and an analysis of historical maps (a fuller account is provided in another publication – Maciejewski *et al.* in press). Information from the Special-Karte von Südpreussen confirms that the windmill in Gogolewo was located on a hill south of the village. Similarly, the *Urmesstischblatt* Map of 1826, at a scale of approximately 1:25,000, shows the windmill's position south of the village and the land use surrounding it in the 1830s. By the time the hoard was discovered, the windmill no longer existed, though archival records suggest it remained a distinctive landmark. Analysis of Airborne Laser Scanning data and metal detector surveys did not reveal any relics of the structure, although two potential sites where the windmill may have stood were identified. Despite the lack of detailed information, this approximate location

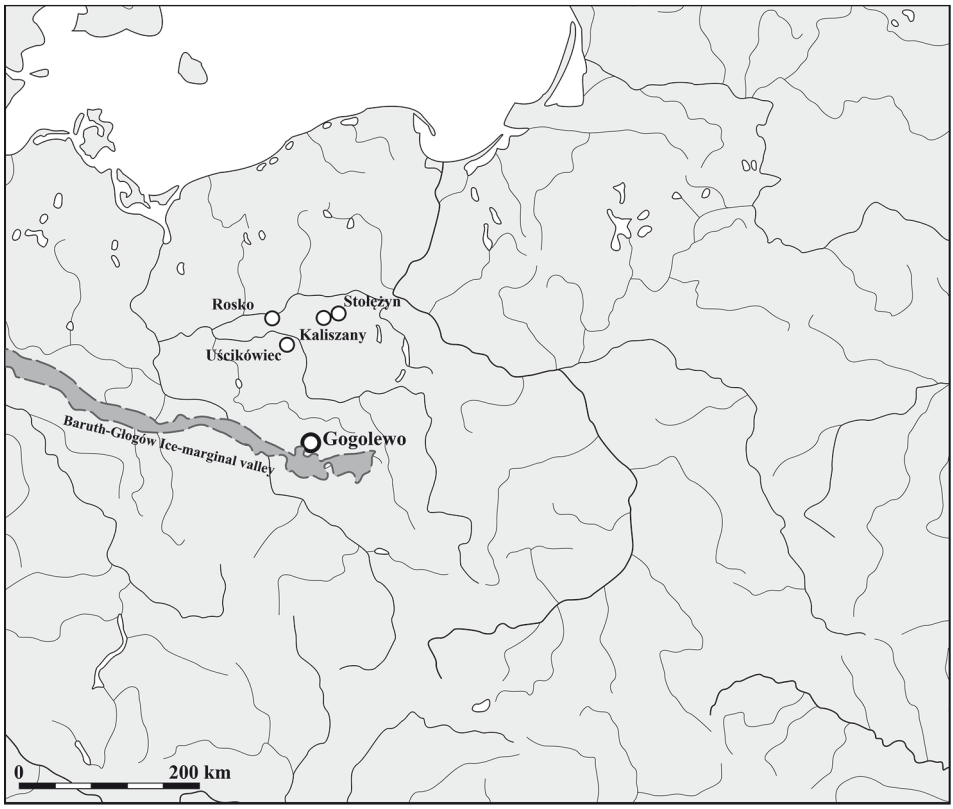

Fig. 1. Location of the Gogolewo hoard and other hoards investigated in the project and the Baruth-Głogów Ice-Marginal valley referred to in the text, according to Kondracki 2002. By the author

provides a basis for investigating the relationship between the site (or area) and Late Bronze and Early Iron Ages (LBA-EIA) settlement. It also allows assessing the hoard's significance within the local cultural landscape.

SOURCES AND METHODS

The research utilised publicly available resources for both archaeological and related environmental data. No field archaeological investigations (*e.g.*, non-invasive surveys or landscape-related studies) or palaeoenvironmental analyses were conducted. The aim was to identify settlement patterns around the hoard deposition site, comparable to studies of other hoards analysed in the project. The research relied on reference information about archaeological sites dated to the LBA-EIA and, more generally, the prehistoric period (PP). Information on generally defined PP archaeological sites was included, as it is highly likely that some may relate to the period under study. In addition, these sites reveal areas that may have been inhabited by communities from various prehistoric periods, suggesting the potential for different areas to have been settled by human groups operating within an archaic economic system. Moreover, they demonstrate that certain areas were surveyed by fieldwalking. The settlement points described primarily derive from the research of the Polish Archaeological Record (Archaeologiczne Zdjęcie Polski – AZP), supplemented by information from various publications presenting the so-called archival finds (*e.g.*, Jażdżewski 1926; Rajewski 1932; Durczewski and Śmigielski 1966). The studied zone is unevenly covered, with the northern part, belonging to the Gostyń district (in the pre-1975 administrative division), being much better explored. An additional search was conducted to supplement the catalogue with settlement points recognised after the AZP survey, obviously based on published information (for a complete list of source data, see: https://zenodo.org/uploads/14680958).

The survey covered nine AZP zones, from 66-27 in the north-west to 68-29 in the south-east. The zone where the hoard was most likely discovered lies in the centrally located zone 67-28. In total, it is approximately 3,600 km^2 (Fig. 2). Data provided by the National Institute of Cultural Heritage (Narodowy Instytut Dziedzictwa – NID) in .shp file format (case number: DDC.441.1.2023.BN) and information available on the institution's map portal (https://mapy.zabytek.gov.pl/nid/) were used. Extensive evaluation of the reliability and suitability of these resources is planned for the future. According to the information provided, the validity of the file mentioned above is 10 July 2023. The AZP surveys were conducted in 1980, 1982, 1983, and 1994, with six zones surveyed by the same team, ensuring a relatively homogeneous dataset regarding fieldwork methodology, the delimitation of archaeological sites, and the chronological classification of retrieved artefacts. Additionally, most of the site was theoretically available for fieldwalking survey, apart from relatively large woodland areas in the north-west of the study zone (Fig. 3).

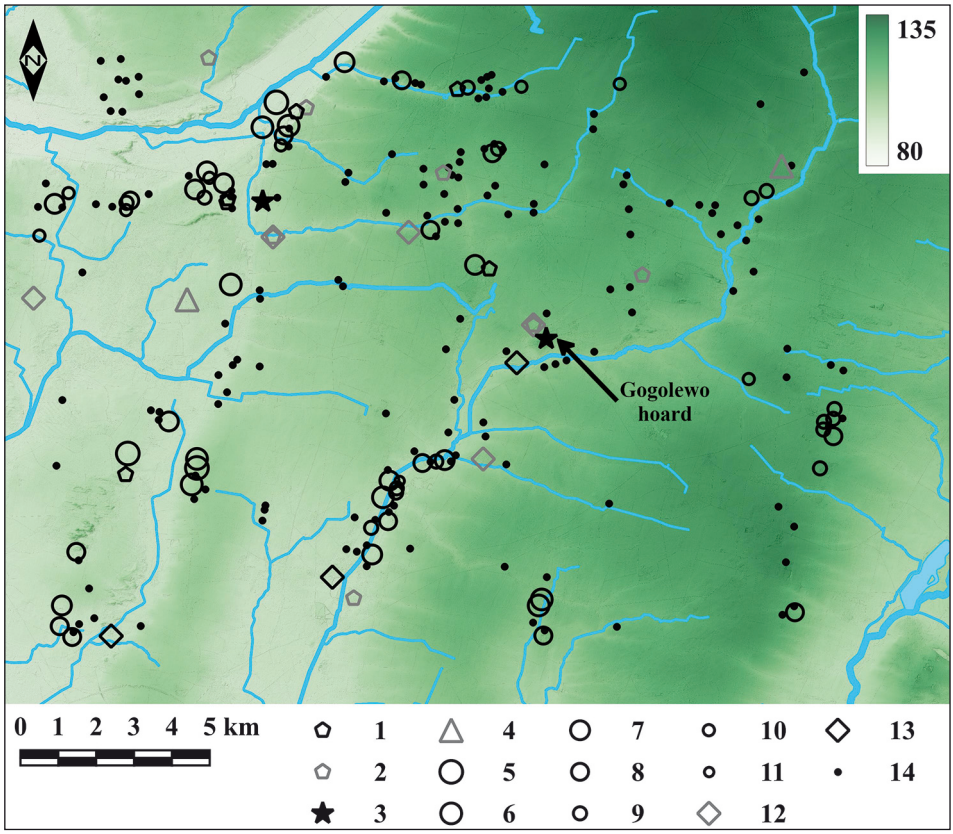

Fig. 2. Late Bronze and Early Iron Age settlement around the Goglewo hoard discovery area. Legend: 1 – cemeteries of known location, 2 – cemeteries of unknown location, point in the centre of the village, 3 – hoards, 4 – probable cemeteries of unknown location, 5 – settlement points known from field-walking surveys, over 50 potsherds, 6 – settlement points known from fieldwalking surveys, 21–50 pot-sherds, 7 – settlement points known from fieldwalking surveys, 11–20 potsherds, 8 – settlement points known from fieldwalking surveys, 6–10 potsherds, 9 – settlement points known from fieldwalking surveys, 4-5 potsherds, 10 – settlement points known from fieldwalking surveys, 2-3 potsherds, 11 – settlement points known from fieldwalking surveys, 1 potsherd, 12 – settlement points known from archival records and literature, with unknown function and location, 13 – settlement points known from archival records and literature, with known location and unknown function, 14 – settlement points dated to prehistory. By the author

Neither resource contained records (so-called KEZAL cards – Karta Ewidencji Zabytku Archeologicznego Lądowego – Record Card of an Inland Archaeological Site) of surveys conducted after the completion of the AZP programme. The absence of more recent cards may suggest that either no significant construction project has occurred in the zone in recent years, they have fortuitously bypassed archaeological sites or have gone unreported, or entries have not been added to the NID databases. Regardless of the underlying reason, the collected dataset was considered representative of settlement trends during the study

period. On the other hand, it is virtually impossible to create a complete source record corresponding to any sphere of human activity in prehistory (*cf.*, Urbańczyk 1981). Information on the number of settlement points, their basic statistics, and the results of the nearest neighbour analysis are presented in Table 1.

Table 1. Number of analysed settlement points divided by methods of obtaining information on them. data necessary for nearest neighbour analysis and their occurrence density

Settlement points	No	Observed average distance (m)	Expected average distance (m)	Nearest neighbour indicator	Settlement points / m^2
all	246	-	-	-	0.068
exact location known	228	427.200	597.184	0.715	0.063
fieldwalking surveys	216	446.397	613.548	0.728	0.06
fieldwalking surveys: LBA-EIA archaeological sites	59	688.359	1163.240	0.592	0.016
fieldwalking surveys: PP archaeological sites	157	542.693	716.655	0.757	0.044

The research methodology was tailored to the specifics of the available source material, not only concerning the Gogolewo hoard site but also addressing broader settlement analyses from the LBA-EIA, primarily based on fieldwalking survey results. For such sources, the AZP survey results enable the outlining of general settlement processes and preferences in the selection of settlement sites. However, it is challenging to accurately present the dynamics of these processes. This difficulty arises partly from the inability to precisely date artefacts recorded during fieldwalking surveys. Even when dating is feasible, assuming that a few potsherds from the surface – some of which may lack distinctive characteristics – represent the entire assemblage risks overinterpretation. Additionally, although the number of archaeological sites from the described period is considerable, only a small proportion have been methodologically investigated, and even fewer have undergone rigorous scientific analysis. Consequently, definitions found in various catalogues cannot always be regarded as reliable. A more extensive critical analysis of the sources documented in the AZP, with references to discussions in numerous other scientific publications, has been presented previously (Maciejewski 2016, 24-26; Baron *et al.* 2019, 104-108; Stolarczyk *et al.* 2020, 248-260).

The proposed analytical framework includes analyses of the relationship between the settlements and relevant environmental elements, as well as geostatistical analyses utilising Geographic Information System (GIS) tools. These analyses comprise Kernel Density Estimation (KDE), performed using the heatmap algorithm in QGIS, nearest neighbour analysis (also employing the relevant QGIS function), and visibility analysis (using the Visibility analysis plug-in – Čučković 2016). The effectiveness of this methodological set

has been demonstrated in several publications (Maciejewski 2016; 2017; Baron *et al.* 2019; Stolarczyk *et al.* 2020; Blajer *et al.* 2022) and has since been further refined and developed.

As described in numerous papers and books, a crucial part of the reasoning is the state of the research on general settlement trends in the LBA-EIA. This includes critiques of particular perspectives on the topic and reflections on the importance and specificity of the landscape within the humanities, particularly in archaeological research (summarised and organised in Maciejewski 2016, 51-72).

Among the sources used to outline natural landscape, the following were particularly important: terrain relief (visualised using the most up-to-date data provided by the Head Office of Geodesy and Cartography – GUGiK with a resolution of at least 1 m (obtained using the Pobieracz danych GUGiK plug-in for QGIS); hydrological network (visualised using data provided by the Wody Polskie baza WMS plug-in for QGIS and the 'Mapa podziału hydrograficznego Polski w skali 1:10 000' (the Map of hydrographic division of Poland in the scale 1: 10 000), as well as generalised vector maps of potential natural vegetation (Matuszkiewicz and Wolski 2023). Additionally, the division into geographical mesoregions proposed by Kondracki (2002) was considered, with corrections, and presented in digital format (Solon *et al.* 2018).

Regarding palynological studies, the analysed area and most of southwestern Poland are, unfortunately, a true *terra incognita* (Nalepka 2004, 417-421, fig. 107). Isopod maps and other broader findings are a good reference point in this case. These indicate that the areas of southern Greater Poland were thickly populated during the LBA-EIA (Ralska-Jasiewiczowa 2004, 407). Notably, during the so-called Late Holocene (between 5000 and 2500 BP), forest complexes resembling contemporary ones were established, while the range of various species has remained relatively unchanged since then (Ralska-Jasiewiczowa 2004, 407). Similarly, the soils have not undergone significant changes over the last 3,000 years, either (Mierzwiński 1994, 46). The studied zone lies beyond the range of the last glaciation, outside the area where numerous lakes exist today and were located in prehistory; thus, the processes of their disappearance did not significantly impact settlement (Kalinowska 1961).

Notably, the data concerning the relief, water network and Kondracki's regionalisation (2002) remain up-to-date, requiring no further commentary. By contrast, the map of potential natural vegetation not only corresponds to contemporary conditions (for both soil and climate) but is also idealised, as it assumes no human influence. Hence, its validity for representing different periods in prehistory is somewhat questionable. These maps do, however, offer the advantage of presenting information in a way accessible to traditional communities – for instance, indicating that deciduous forests with rich undergrowth signify fertile soils, regardless of how these soils are classified today. Moreover, in other areas, comparisons between pollen profile analyses and maps of potential natural vegetation show a convergence of results (for example, in the Carpathian Foothills – Blajer *et al.* 2022, 172-182). Therefore, it is worthwhile to use such maps, albeit with appropriate caution.

NATURAL LANDSCAPE

There are practically no lakes in the analysed zone. At the same time, the river network is quite dense and consists of smaller watercourses and larger rivers: the Rów Polski (which was initially a natural watercourse), Masłówka, Dąbroczna, and Orla (Fig. 4). They all belong to the Barycz River basin and flow south or south-west towards the terrain depressions associated with the Głogów-Baruth Ice-Marginal Valley (Fig. 1). The Digital Elevation Model (DEM) suggests that many more similar small watercourses may have existed initially (Fig. 4).

Most of the analysed zone falls within the Kalisz Heights, with a smaller portion located in the Leszczyńska Heights. Both regions are part of a belt of uplands characterised by an undifferentiated landscape and favourable conditions for agriculture. To the south lies the aforementioned ice-marginal valley, with a significant terrain depression – the Żmigród Basin (Kondracki 2002, 156-158, 165). In prehistory, this area was swampy and

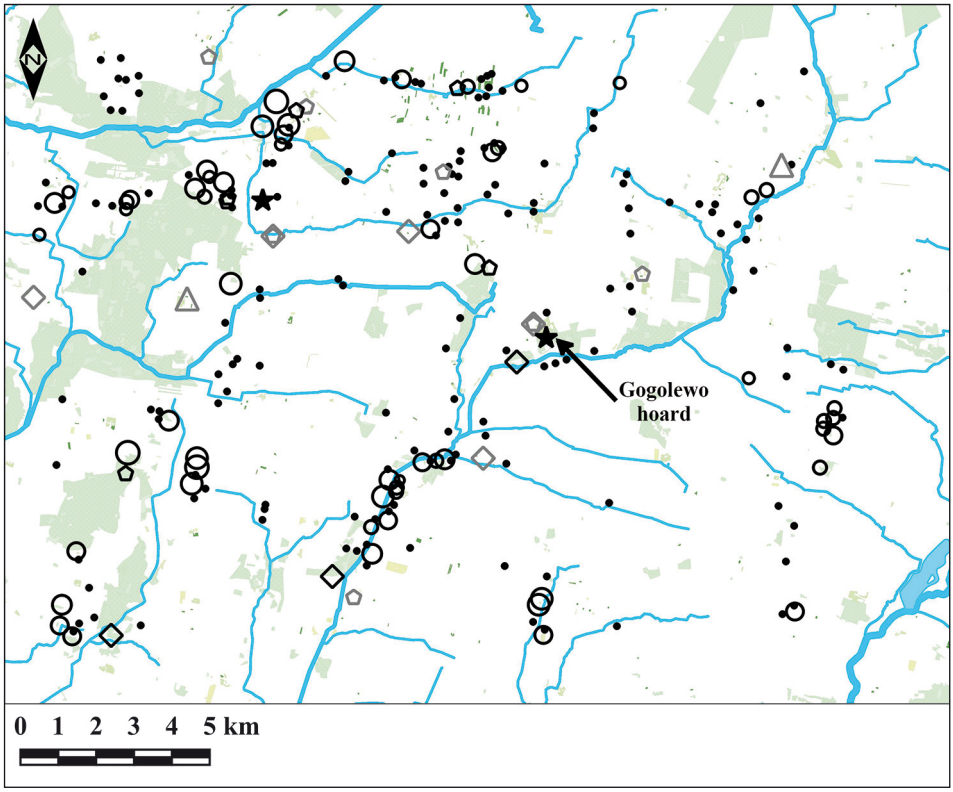

Fig. 3. Forests and wetlands – unavailable for fieldwalking surveys. Based on the Database of Topographic Objects – BDOT10k – www.geoportal.gov.pl. By author

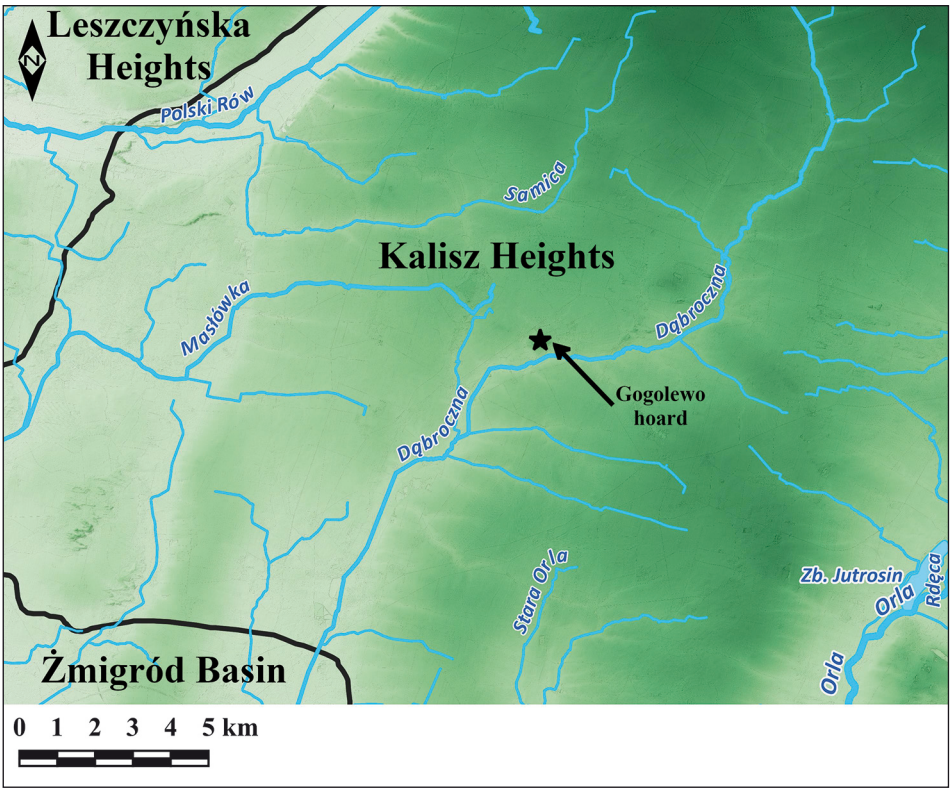

Fig. 4. Physical-geographical mesoregions based on Kondracki 2002 with corrections by Solon *et al.* 2017, featuring the most prominent watercourses and localities mentioned in the text. By the author

likely posed a barrier to settlement and communication (*cf.*, Baron *et al.* 2019). To the north of the upland area lies a region shaped by the last glaciation, characterised by an area of lake districts (Kondracki 2002, 156).

The map of potential natural vegetation (Fig. 5) has been simplified to highlight areas of high value for horticultural crops (*e.g.*, riparian and alder forests) and more extensive crops, such as cereals (*e.g.*, various oak-hornbeam forests). It also shows areas of lesser value for such crops (*e.g.*, fertile beech forests), which are not present in the analysed zone, and areas of low suitability for crops (*e.g.*, pine forests) (for a discussion of forest complexes, see Maciejewski 2016, 177-180). Good agricultural conditions are a notable feature of this area, as it might have been dominated by oak-hornbeam forests and riparian forests, with alder forests in the river valleys. Small areas may have been covered by forests growing on soils of low agricultural value, located in the west and associated with the Rów Polski valley. The soils in this region provide evidence of fluvioglacial processes (Kondracki 2002, 157).

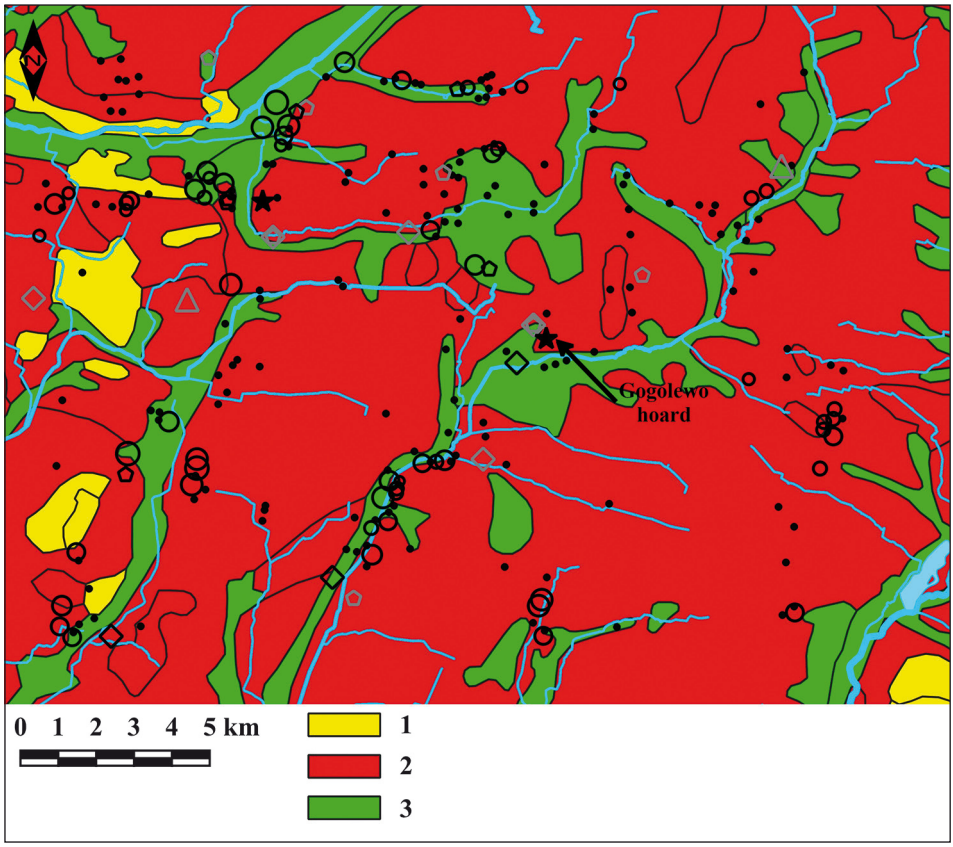

Fig. 5. Simplified map of potential natural vegetation based on Matuszkiewicz and Wolski 2023. Legend: 1 – forest complexes growing on soils of low agricultural value (*e.g.*, pine forests), 2 – forest complexes growing on soils of high value for extensive cultivation (*e.g.*, oak-hornbeam forests), 3 – forest complexes growing on areas of high value for intensive cultivation (*e.g.*, riparian forests). By the author

SETTLEMENT

The settlement points are visualised in the subsequent cartograms (Figs 2-3 and 5-15) with a division into sites known from fieldwalking surveys. The cartograms also include settlement points with an assigned function (*e.g.*, cemeteries) or those whose function is unknown, where the information – usually very scarce – originates from archives or pre-AZP publications. For example, a cemetery identified through an accidental discovery, later verified during the AZP survey, where 12 potsherds were found, is marked in the same way as other sites known only from fieldwalking surveys where 11 to 20 potsherds were discovered (Fig. 2 – legend). In this case, the categorisation does not fully reflect the

scientific value of the settlement point but aligns better with the visualisation of the KDE analysis results.

Cemeteries hold the most significant scientific value for the analysed period, as they were central to local communities in various ways (*cf.,* Mierzwiński 1994, 17). There are at least 15 cemeteries and four presumed cemeteries within the study zone. Two of these were identified through fieldwalking surveys, revealing burnt bones and potsherds. The two necropolises at Karzec Sites 2 and 8 are located so close to each other that they are likely remnants of a single cemetery. In addition to the two probable cemeteries identified during the AZP survey and the two necropolises in Karzec, five more cemeteries have been located, one of which is associated with the Pomeranian culture. Most of these necropolises are situated in the northern part of the analysed zone, which may reflect a higher settlement intensity during the analysed period, a greater familiarity with the archival data from this area, and the current state of research. The cemetery at Rogowo Site 1, investigated during rescue excavations in 1959 and 1962, received a more detailed study. However, the research and its subsequent publication notably covered only a small part of

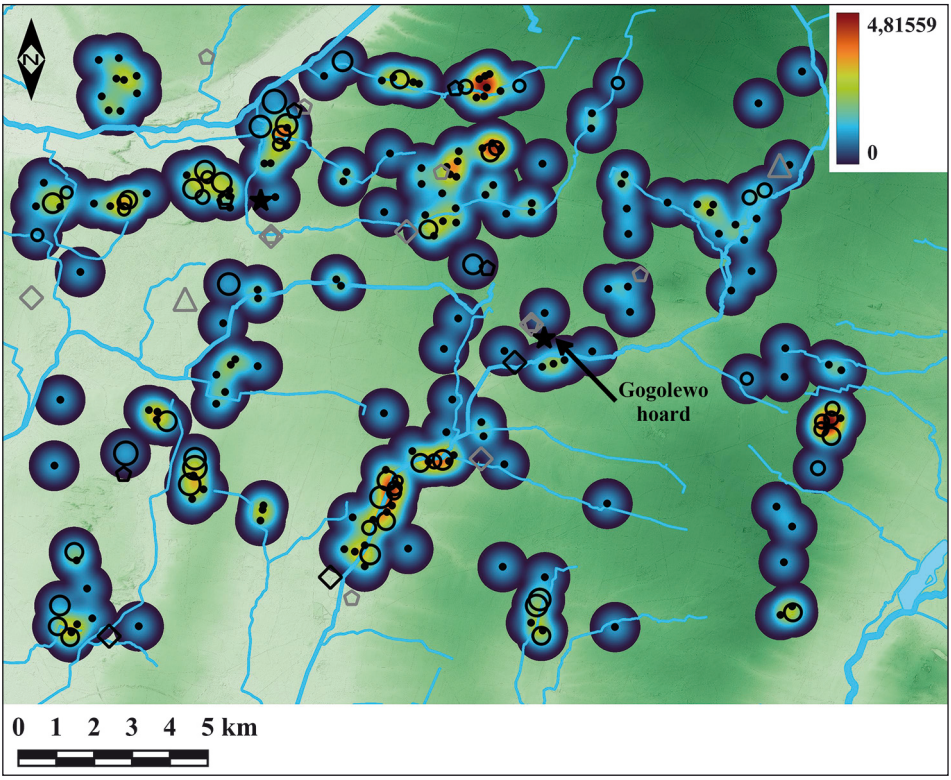

Fig. 6. Visualisation of the Kernel Density Estimation analysis results for all settlement points known from the fieldwalking survey, circle radius 669.5955 m, weights not considered. By the author

the cemetery (Durczewski 1961; 1963). Similarly, part of the evidence from Karzec Site 2 was published, but the article was labelled 'Part I', lacked analysis and summary, and the remaining parts were never printed (Śmigielski 1965). The Pomeranian culture cemetery at Pudliszki Site 3 was fully described, including all discovered graves. At the same site, settlement features associated with this taxon were identified, but these remained unpublished despite the author's declaration (Lipińska 1967). The Lusatian Urnfield cultures (LUC) cemetery investigated by Kostrzewski during the interwar period (Pudliszki Site 10) was described in a lengthy article in the popular science magazine 'Z otchłani wieków' (Nowak 1935). Still, its exact location cannot be determined today. For other cemeteries, only very general information is available, and their dating cannot be regarded as reliable.

Three settlements are known from the surveyed zone. One presumed settlement is associated with an early medieval hillfort (Pudliszki Site 1). Previous test excavations have not confirmed the presence of a fortified LUC settlement at this location ('Atlas Grodzisk'). A second settlement has also been identified in this locality (Pudliszki Site 5). In earlier literature, the site was associated with LUC based on fieldwalking surveys (Malinowski

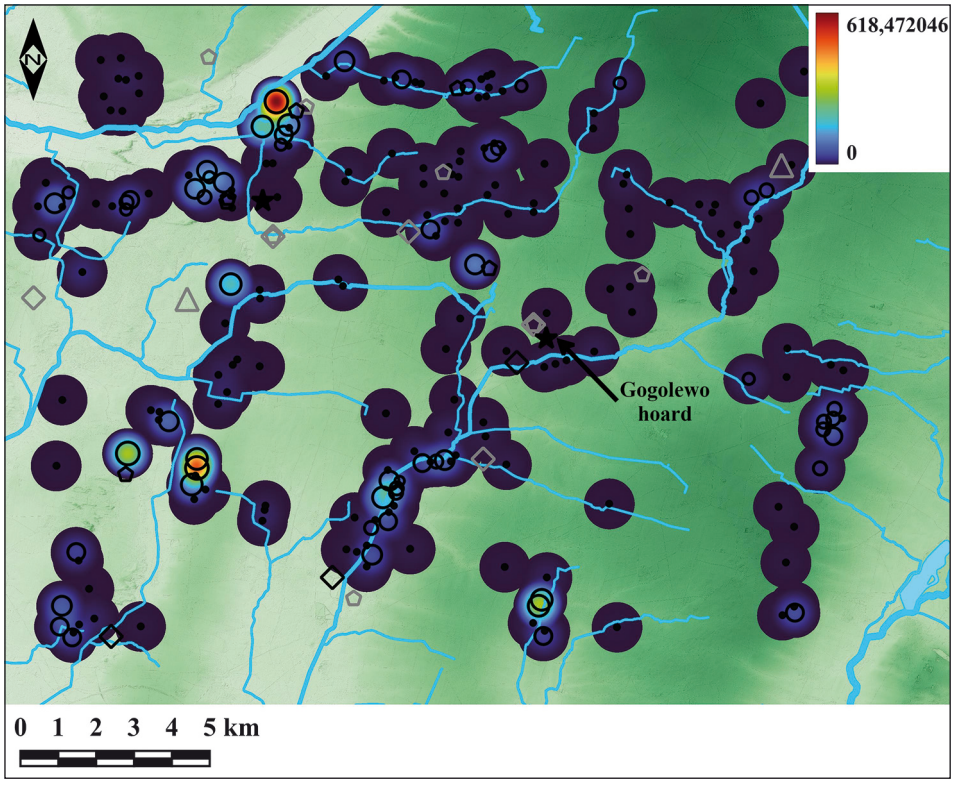

Fig. 7. Visualisation of Kernel Density Estimation analysis results for all settlement points known from fieldwalking surveys, circle radius of 669.5955 m, weights considered. By the author

1955, 17-18). However, Durczewski (1977) attributed the pottery discovered during the 1973 test excavations to the Tumulus culture, thereby dating the entire complex accordingly. Another excavation conducted in 1993 covered a larger zone, and this time, the study's author linked the pottery to the HaC phase and possibly even the final phase of the Bronze Age. These findings were supported by radiocarbon dating (Lasak 1995). It should be noted that the pottery manufacturing technology of the Middle Bronze Age (MBA) and the LBA–EIA did not differ significantly. Therefore, it is likely that the site was also used during the MBA, as the Pudliszki site is known for its graves from this period (Kowiańska-Piaszykowa 1966). The last settlement is the aforementioned Pomeranian culture settlement, also located in Pudliszki.

Another category of highly valuable archaeological finds, particularly in the study of settlements, consists of hoards. Alongside the Gogolewo hoard, the Ziemlin hoard is also known from the analysed zone. It comprises three artefacts and is dated to HaB2–HaB3 (Durczewski and Śmigielski 1966, 110; Blajer 2001, 354). Notably, the detailed deposit location of this hoard is known.

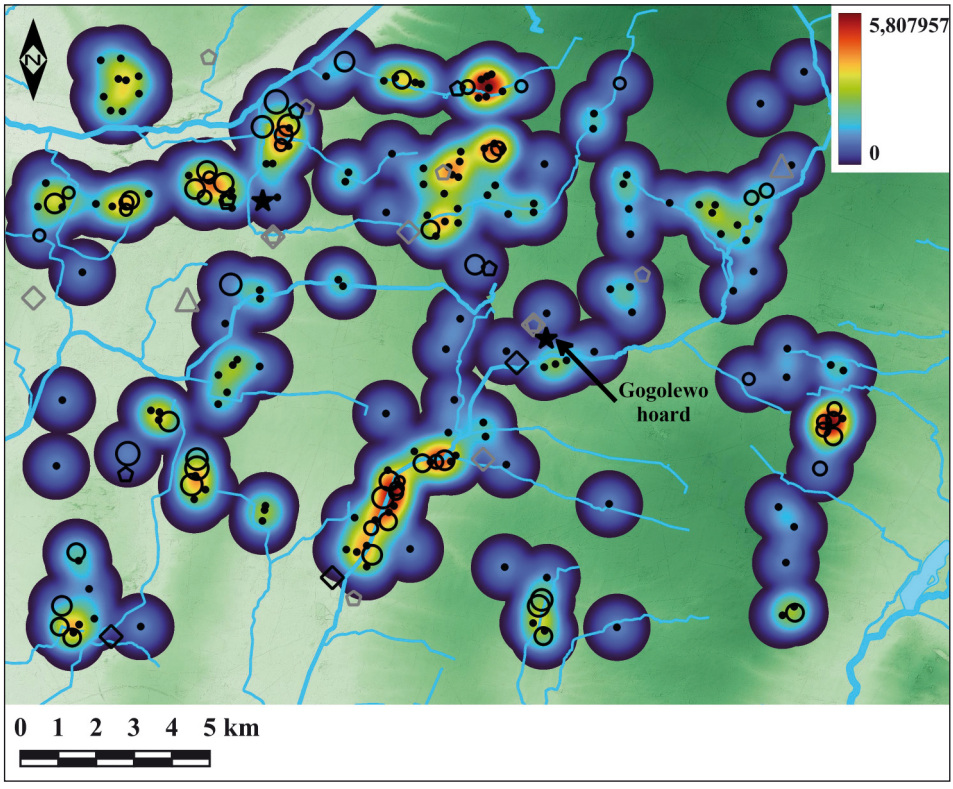

Fig. 8. Visualisation of Kernel Density Estimation analysis results for all settlement points known from fieldwalking surveys, circle radius of 892.794 m, weights not considered. By the author

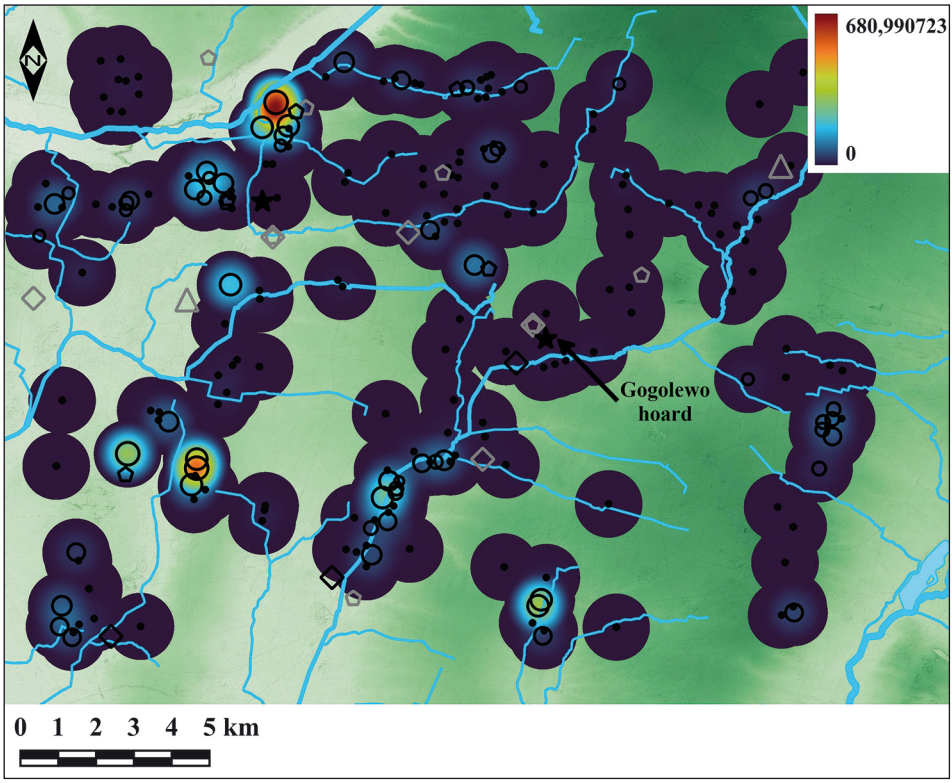

Fig. 9. Visualisation of Kernel Density Estimation analysis results for all settlement points known from fieldwalking surveys, circle radius of 892.794 m, weights considered. By the author

Settlement points identified or verified during the AZP fieldwalking surveys constitute the most numerous group. They are mostly generally dated to the PP (Table 1) and are marked with the same symbols on the settlement maps (Figs 2, 3 and 5-15). Sites identified through fieldwalking surveys and dated to the LBA-EIA were visually differentiated. The size of the symbol corresponds to the number of discovered potsherds.

In summary, few settlement points have a known function, and no more detailed information about them is available. Their distribution across the study zone appears random, with more sites likely located in areas that have been researched more intensively. This may be the case for the Pudliszki area, where several barrow cemeteries are known. At least some of them can be dated to the MBA (Kowiańska-Piaszykowa 1966). Numerous settlement points associated with the LBA-EIA are also found there, including settlements, fortified settlements, and those linked to the Pomeranian culture.

Both LBA-EIA and PP settlements are located along watercourses (Fig. 2). Notably, LBA-EIA settlement points are concentrated in several areas. Firstly, along the tributaries of the Rów Polski, including the Samica, approximately in the vicinity of Pudliszki. Three

additional agglomerations are located in the south of the analysed zone. Settlement points are concentrated on the Dąbroczna River north of Miejska Górka up to Gostkowo; further west on to the Zakrzewski Rów and the smallest agglomeration, furthest to the east, along the Stara Orla River near Konary. A final, relatively small complex is located in the east of the analysed zone, near the village of Płaczkowo and is not associated with any contemporary watercourse or reservoir.

These observations, combined with the map of potential natural vegetation, clearly show that most settlement points dated to both the LBA-EIA and PP are situated at intersections of areas covered by multi-layered, multi-species broadleaf forests (oak-hornbeam) and riparian forests (of various compositions) occurring in watercourse valleys. The exception is the aforementioned agglomeration near Płaczkowo. The LBA-EIA settlement avoided more extensive areas potentially overgrown by riparian forests, such as those along the Dąbroczna River near Gogolewo and the Samica River near Chwałkowo. However, PP settlements are marked in these areas, indicating that they were accessible for field walking (Figs 4 and 5).

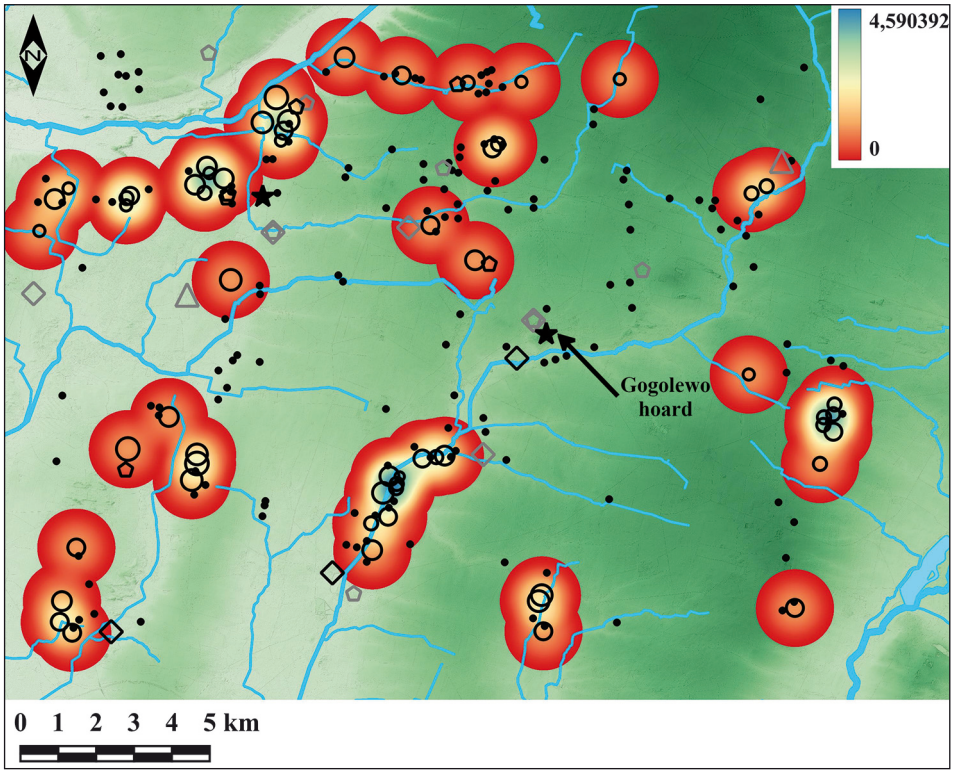

Fig. 10. Visualisation of Kernel Density Estimation analysis results for Late Bronze Age and Early Iron Age dated settlement points known from fieldwalking surveys, circle radius of 1032.5385 m, weights not considered. By the author

GEOSTATISTICAL ANALYSES

KDE analyses can be described as statistical-graphical methods. They are based on the nearest-neighbour principle but allow for more complex studies. KDE is a non-parametric method used to estimate population distribution (not just the dispersion of points on a plane but also other data) and is employed across different scientific disciplines. Additionally, KDE analysis allows for the continuous examination of relationships between data points. The most critical parameter is the search radius around each data point, within which values are assigned to individual grid squares. These squares, which divide the entire study zone, receive higher values the closer they are to the centre(s) of the circle(s). These squares can be compared to the pixels on a screen, and their size also affects the analysis results, which are represented as coloured patches. Another critical factor is the shape of the curve describing the decrease in values assigned to grid squares as the distance from the centre of the circle increases (Jażdżewska 2011, 8, 9; Żurkiewicz 2015, 123; geodose). The analysis

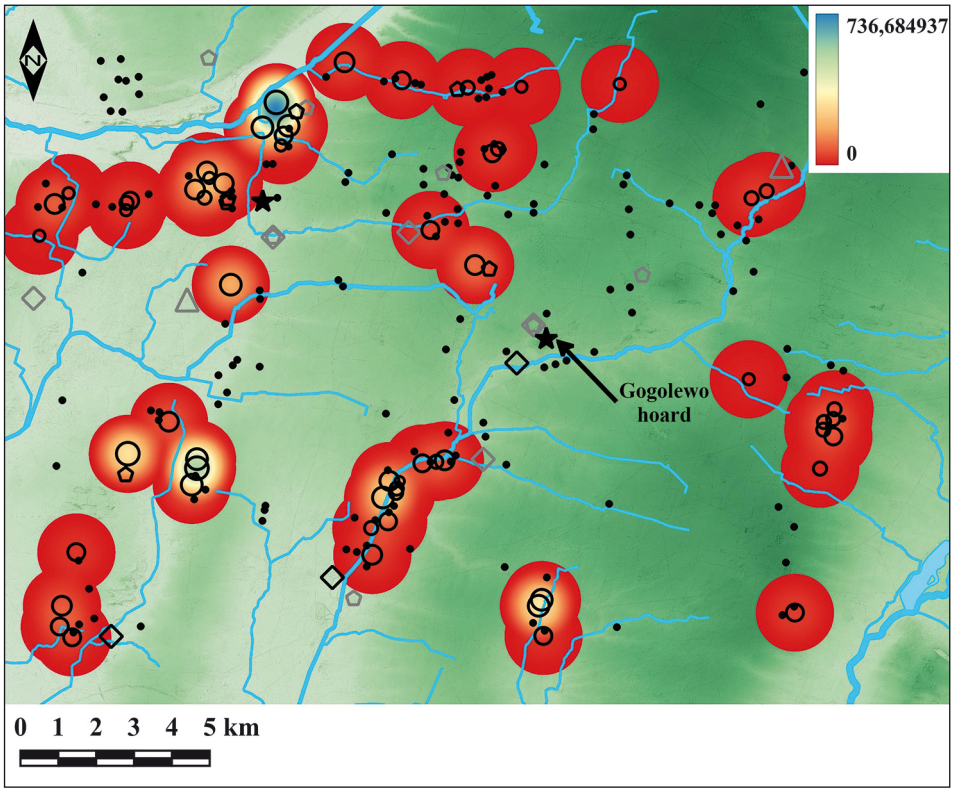

Fig. 11. Visualisation of Kernel Density Estimation results for Late Bronze Age and Early Iron Age settlement points known from fieldwalking surveys, radius of circle 1032.5385 m, weights considered. By the author

was conducted using QGIS software and the Heatmap algorithm. The search radius was set to 1.5 to 2 times the mean observed distance between the data points. Surveys were carried out for all archaeological sites known from fieldwalking surveys (radii: 669.5955 m and 892.794 m) and for LBA-EIA-dated archaeological sites known from fieldwalking surveys (radii: 1032.5385 m and 1376.718 m). The grid square size was 1 m, and the curve used was Quartic (a fourth-degree polynomial).

Analyses were performed both without weights and with weights. The weights were calculated as the product of the number of potshards found at a given archaeological site and an information value assigned according to dating: 5 for LBA-EIA, 3 for probable LBA-EIA, and 1 for PP. The weights for sites with assemblages of different dates were summed (*e.g.*, 3 LBA-EIA potsherds and 6 PP potsherds yield a weight of 3*5 + 6*1 = 21). These approaches enable the observation of different relationships: visualisations without weights reflect the density of settlement points, while those using weights (as products of

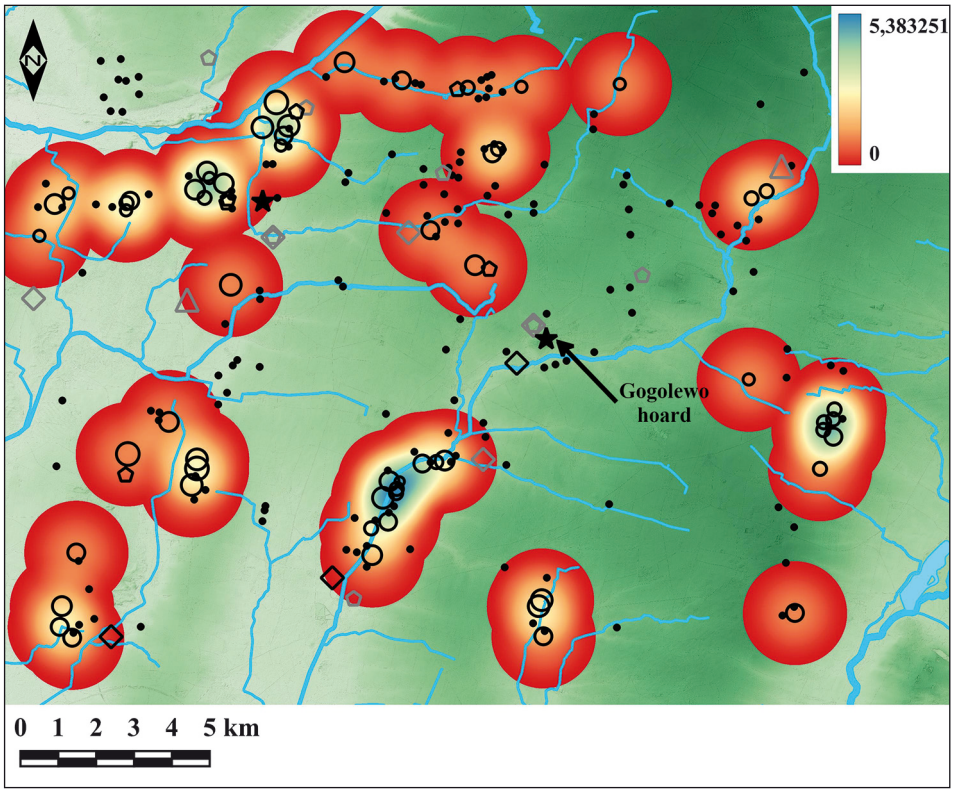

Fig. 12. Visualisation of Kernel Density Estimation analysis results for Late Bronze and Early Iron Age settlement points known from fieldwalking surveys, circle radius of 1376.718 m, weights not considered. By the author

artefact numbers and information value) incorporate information on the frequency of discovered sources (pottery fragments) and their dating.

The results of the KDE analyses (Figs 6-13) confirm the previously described clusters of settlement points associated with the LBA-EIA and provide a more detailed picture. The sites along the Zakrzewski Rów are distinctly divided into two agglomerations. In all analyses, the application of weights significantly emphasises the importance of the settlement cluster near Pudliszki. Interestingly, the cluster along the Dobroczna River is very prominent in the visualisations of the KDE analyses without weights, but does not exhibit high KDE index values when weights are applied. Conversely, the two clusters along the Zakrzewski Rów are equivalent in the unweighted analyses but diverge when weights are introduced, with higher values observed for the northern agglomeration.

Additionally, the results of the nearest-neighbour analysis (Table 1; for a description of the method, see, *e.g.*, Maciejewski 2016, 135, 136) consistently show a tendency towards settlement clustering. This tendency is strongest for settlement points dating to the LBA-EIA rather than for those dated to both the LBA-EIA and the PP.

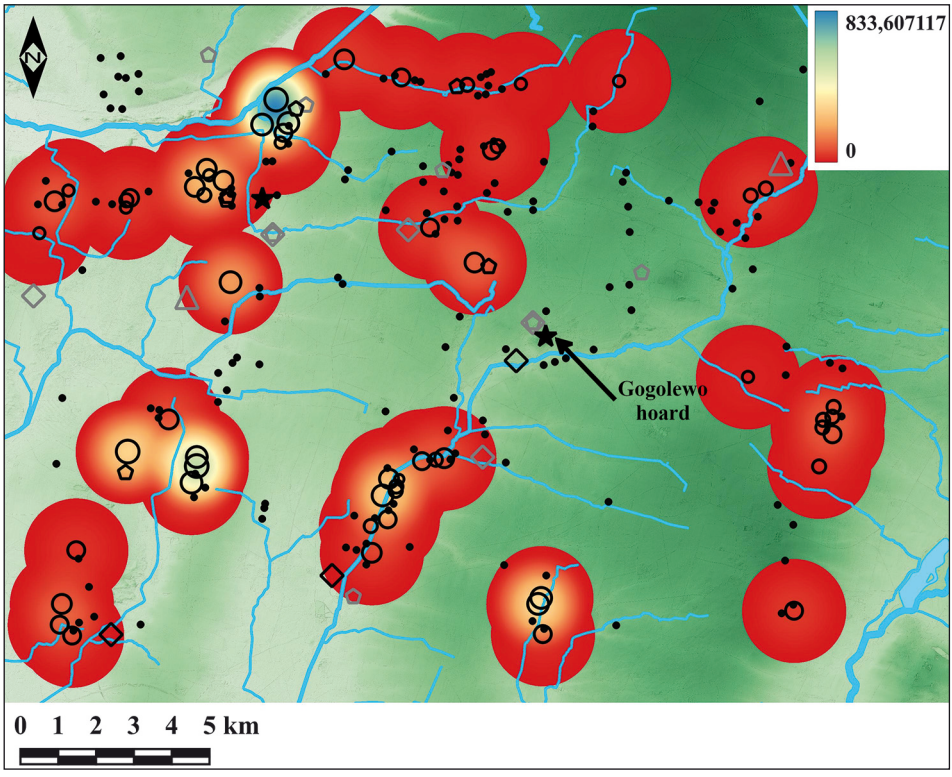

Fig. 13. Visualisation of Kernel Density Estimation analysis results for Late Bronze Age and Early Iron Age settlement points known from fieldwalking surveys, circle radius of 1376.718 m, weights considered. By the author

POTENTIAL VISIBILITY ANALYSES

Potential visibility tests are a method with notable limitations, which have been thoroughly discussed in prior studies (Wheatley and Gillings 2000; Zapłata 2011, 298, 299). A key drawback of these tests is their reliance on contemporary data. The accuracy of the digital elevation model is also critical. While the model is highly accurate in this case, the automatic removal of buildings, plants, and other features may introduce distortions in certain areas. From a survey methodology perspective, the high variability of results depending on the analysed location must also be considered. Sometimes, shifting the point where the potential observer is assumed to stand by only a few metres can significantly impact the analysis results. When conducting visibility analyses, it is essential to remember that the calculations are based solely on the terrain's relief. As a result, the study does not account for numerous natural (*e.g.*, forests, scrub) and cultural (*e.g.*, prehistoric buildings) landscape elements. Reconstructing vegetation from 3,000 years ago would, of course, be problematic, yet its substantial impact on visibility from a site is undeniable.

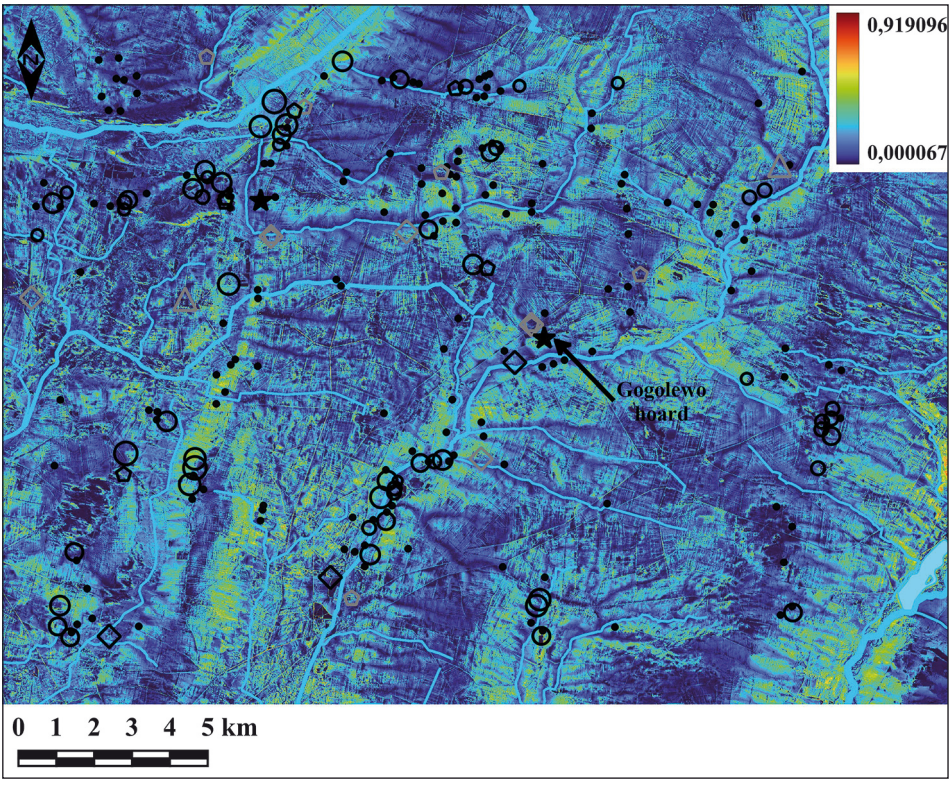

Fig. 14. Visualisation of the potential visibility analysis results, incoming views variant. By the author

The same applies to man-made landscape elements from that period. Achieving accurate results would require detailed documentation from field surveys of all sites within the study zone. Moreover, the fact that an algorithm indicates a site was once visible does not guarantee that an observer would have noticed it. Furthermore, the analysis inherently assumes optimal weather conditions – no rain, fog, darkness, or glare from the sun. All these factors underscore that, in archaeology, we can only refer to such analyses as potential visibility tests.

Visibility analyses were performed in QGIS software using the Visibility Analysis plugin and the Visibility Index module – Čučković 2016; zoran-cuckovic). Calculations were based on a Digital Elevation Model (DEM) with a 10 × 10 m grid. Other available modules were not utilised due to the uncertain location of the hoard, which does not influence the results for the Visibility Index. The analysis involved calculating two coefficients: the number of points from which a given location is visible (incoming views) and the number of points visible from that location (outgoing views). Here, a 'point' is defined as a 10 × 10 m square, represented as one pixel in the visualisation. Key parameters included the radius

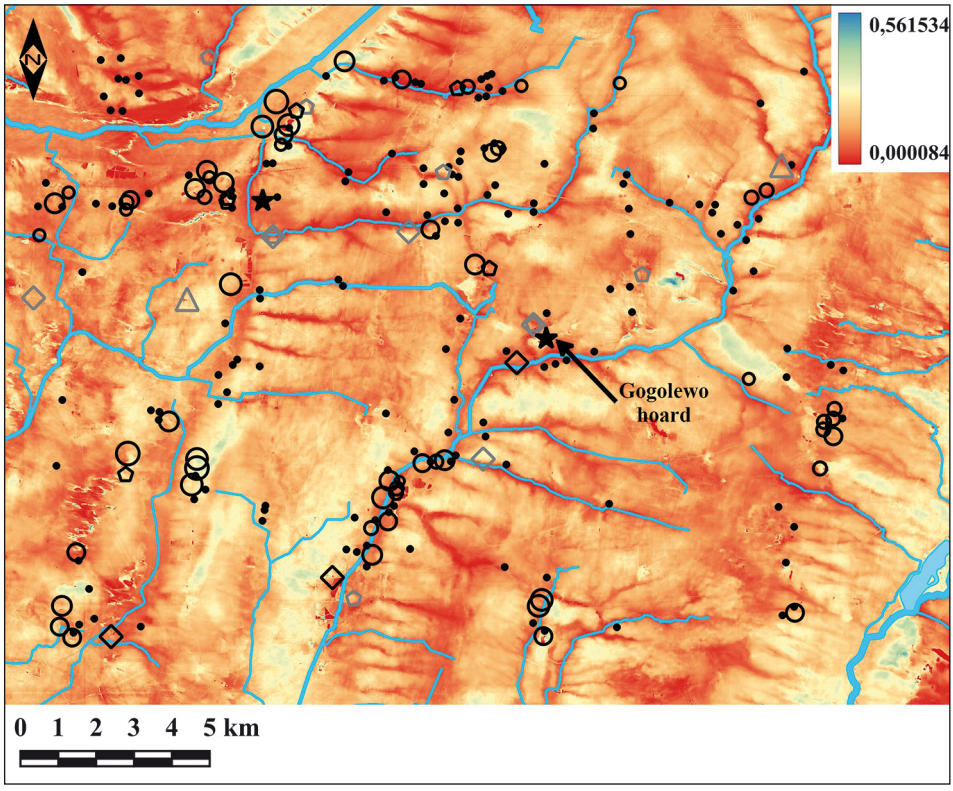

Fig. 15. Visualisation of the potential visibility analysis results, outgoing views variant. By the author

of analysis (set to 3 km, considering that human vision can discern shapes up to approximately 1.6 km) and the observer's height, set at 1.6 m.

The results (Figs 14-16) reveal that both the windmill elevation and the slope where the hoard was deposited were prominent vantage points, clearly visible from the surrounding landscape.

THE MISSING LINK – THE GOGOLEWO HOARD IN THE LANDSCAPE

The research presented here is another attempt to embed hoards of metal objects in the LBA-EIA landscape. It contributes to understanding settlement preferences, available resource usage, and how communities imbue places and areas with meaning – goals central to settlement and landscape studies. In this context, this research has an advantage. Of the discovered hoards, which, after all, are the potential study cases, only a small proportion (around 20%, *cf.*, Maciejewski 2016) can be precisely located in the field. As a result, research into hoards often alternates between thickly populated areas and peripheral areas. The settlements in the analysed zone can unequivocally be classified as peripheral. To the south, settlement activity associated with the Barycz River was notably more intensive, particularly during the Bronze Age and probably in the Early Iron Age. Similarly, more

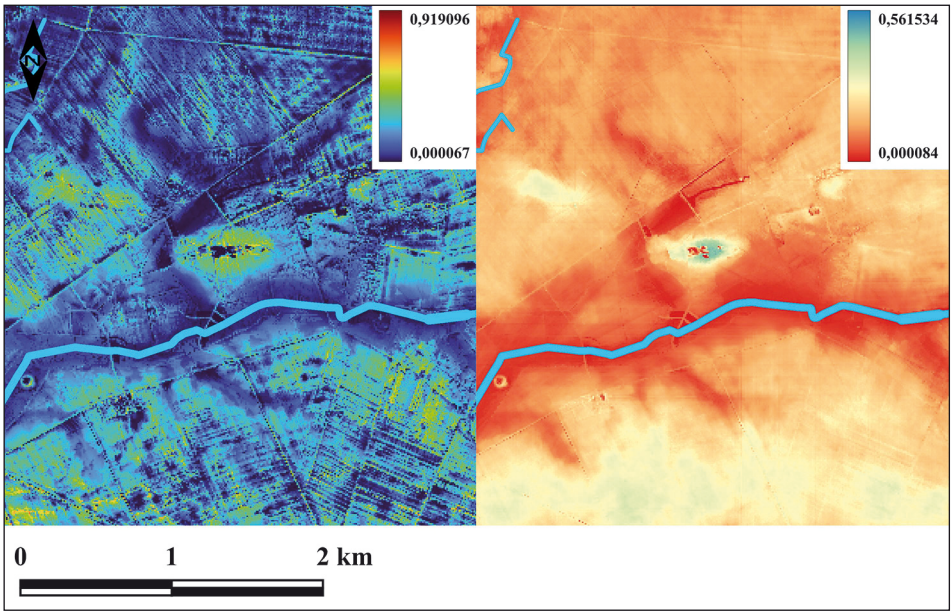

Fig. 16. Visualisation of the potential visibility analysis results for the elevation, where the Gogolewo hoard was discovered, incoming views variant on the left, outgoing views variant on the right. By the author

settlement points are recorded in the north. A glance at the map published by Lasak (1996, map 1; 2001, 384-414) clearly illustrates this pattern.

Settlement studies based on fieldwalking survey results typically reflect the peak demographic and cultural development period of the studied communities, in this case, HaB and HaC. The Pudliszki area, in particular, was densely populated during the MBA. Indeed, defining a separate 'Pudliszki culture' has even been proposed, highlighting the specificity of Greater Poland's MBA sources (Gardawski 1979, 47-49). However, the studied zone lacks settlement points from the early LUC, corresponding to BrD and HaA1, unless the dating of the Kawcze cemetery – about which information is very general – is considered reliable (Malinowski 1961b, 277). Kurnatowski (1966) mentions two archaeological sites, Rawicz and Wymysłów, among the few settlement points located near the zone under analysis. Additionally, remains of a settlement were discovered during rescue excavations along the planned route of the S5 expressway. Pottery from this site exhibits characteristics of both the Tumulus culture and the early LUC (Anioła *et al.* 2018). Archaeological sites in the study zone dating to a later period, corresponding to the chronology of the hoard, are scarce, and those identified lack reliable chronological data.

A review of the cartograms (Figs 2-15) indicates that the hoard was deposited along a boundary running roughly from west to east. This observation aligns with findings in other regions (Maciejewski 2016; 2017; Baron *et al.* 2019; Stolarczyk *et al.* 2020; Blajer *et al.* 2022) and across Europe more broadly (Bradley 2017). Notably, there are some LBA-EIA archaeological sites within Gogolewo, including a cemetery, though its precise location remains unknown. PP settlement points have also been discovered in the area. Furthermore, the AZP for Zone 67-28, where Gogolewo is situated, was conducted by a different research team compared to most zones analysed in this paper. However, as no significant discrepancies are evident, it isn't easy to attribute the current state of the source base to this difference in survey teams.

The examination of the second hoard found in the zone – the Ziemlin hoard – suggests that it was also deposited along the boundary of the densely populated area around Pudliszki. Its deposition site is adjacent to other archaeological sites from the studied period. A similar yet clearer example is the Granówko hoard (Maciejewski 2016, 110-112). This indicates that archaeological sites within a single locality do not preclude the possibility that the hoard was placed at the edge of a populated area.

It is worth noting that the map of potential natural vegetation for this site points to a relatively extensive area covered by riparian trees, suggesting a wetland environment. Similar areas, such as those along the Samica River, also remained unpopulated during the LBA-EIA.

The so-called 'state of the research' often serves as a convenient rationale for archaeologists to support or dismiss arguments. This reasoning also applies here, allowing us to propose that, based on the current research stage, the Gogolewo hoard was likely deposited between two emerging settlement areas of LUC communities. However, it is challenging to determine

whether the hoard is more closely associated with the northern or southern group of these settlements. The interpretation of such a location should consider the potential cultural significance attributed to boundaries and metal objects (Maciejewski 2016, 155-172).

The topographical distinctiveness of the hoard's location, combined with its proximity to an elevation overlooking the river and its likely expansive floodplains, appears highly significant. This terrain feature was visible from many points in the surrounding area, potentially serving as a landmark and vantage point. The choice of location was likely deliberate. An intriguing question arises as to whether the hoard site was associated with an earlier structure, such as an MBA grave, or whether the 'pile of stones' was intentionally created to emphasise the site's uniqueness. Unfortunately, this question remains unanswered, as determining the exact location of the former stone structure and its investigations would be necessary. This location could not be identified despite extensive desk research and fieldwork.

This study expands our understanding of hoards deposited within monumental stone structures. It also adds to the record of hoards placed within the physical landscape. By comparing known settlement data from the LBA-EIA with information on the potential natural environment and considering the cultural significance of space, this site can be interpreted within the broader context of the cultural landscape.

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