Interpreting Archaeological Features on the Wieprza River Floodplain, West Pomerania, Poland

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Abstract Application of remote sensing techniques in archaeology makes both the detection of new features and the rethinking of previous results possible. Additionally, integration of heterogeneous datasets provides better means of understanding past landscapes. However, similarities between anthropogenic structures and natural landforms hamper interpretation. In this paper, we present some interpretative difficulties related to the integration of data acquired by means of different prospection methods. We use a case study of the middle Wieprza River basin to discuss the role of archaeological pre-understanding and the challenging location of sites within a fluvial landscape. We demonstrate that distinction between natural and anthropogenic features is conditioned by the characteristics of the studied area and the capabilities of the applied methods to represent archaeological information.

Keywords Archaeology · Airborne laser scanning · Aerial reconnaissance · Interpretation · Floodplain relief · Wieprza River

Introduction

Settlement pattern and landscape studies in the middle Wieprza River basin (Fig. 1) have been ongoing since the 1980s (Rączkowski 1998), and several archaeological prospection methods have been applied in this area. Subsequently to field-walking surveys, aerial reconnaissance was employed (Rączkowski 1995), whereas a few sites were investigated by means of near-surface geophysics and terrestrial lidar

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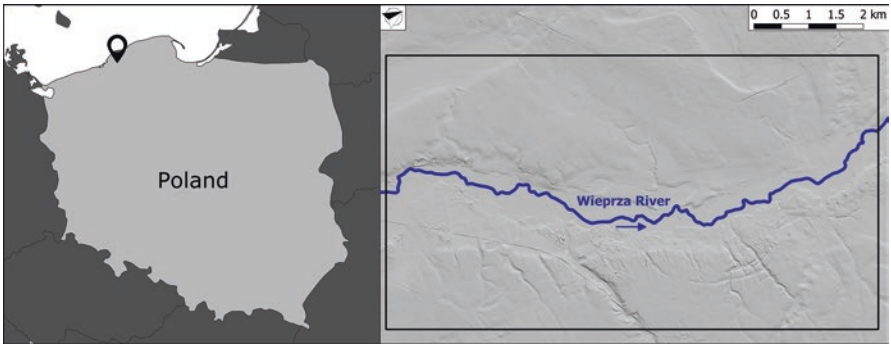

Fig. 1 Location of the study area

(Banaszek and Wróblewska 2013; Rączkowski et al. 2013). Additionally, airborne laser scanning (ALS) and satellite imagery served the interpretation on a landscape level (Banaszek 2015; Ruciński et al. 2015).

Noteworthy, the use of different prospection methods requires more than just a straightforward interpretation of isolated datasets. Instead of simply comparing the results, these numerous and heterogenic data have to be put together and contrasted (Rączkowski 2006; Salisbury et al. 2013). A divergence of outputs should not be taken as a reason to disqualify any particular method. Quite the opposite, such a situation should encourage archaeologists to seek deeper understanding of the applied procedures, and the processes of knowledge construction (Halliday 2013; Michalik 2014). In this position, we share the perspectives in contemporary archaeology, which are critical of the existence of any ultimate and conclusive method (Trigger 2007). Archaeological techniques are tied up with cultural discourse, and all should be understood as cultural activities and, thus, subjective approaches. Hence, a convergence of the results (interpretative outcomes) obtained by means of different methods does not confirm any ultimate 'truth'. Indeed, it may be no more than pure coincidence. Nevertheless, there is a difference between good and bad interpretation (Doneus and Kühteiber 2013).

In this paper, we demonstrate particular interpretative difficulties for the integration of various sources of archaeological prospection data. New, complex and distinctive datasets shed light on additional aspects of the analysed landscape; however, these give rise to a number of doubts, and a case study of the middle Wieprza River basin illustrates the problem. Although subsequent prospection methods provided new details concerning anthropogenic structures, we believe that archaeological pre-understanding is the lifeblood of any interpretation. Here, we discuss the challenging location of archaeological features within the fluvial landscape. We demonstrate that distinction between natural and anthropogenic features is conditioned by characteristics of the studied area as well as the capabilities of the applied methods to represent archaeological information. Thus, although individual objects are recorded within the analysed datasets, their recognition is a complex phenomenon.

The Archaeology of the Wieprza Floodplain: Issues of Traditional Approaches

Polish archaeologists often recognise field-walking survey of ploughed land looking for artefacts as the most reliable prospection technique (Rączkowski 2011). However, the method has been barely used in fluvial areas, and even if it was, no significant results would have been expected for two reasons. Firstly, the complexity of the alluvial environment (Bridge 2005) seems to be a serious challenge, and a pedestrian survey in such unfriendly environs does not appeal to the researchers.

Secondly, if earthworks are not being recorded, only artefacts that could have been collected will allow archaeologists to define a site (Mazurowski 1980). However, no archaeological material is to be found on the ground surface unless either ploughing or other activities bring them to the top. Since many floodplains have not been cultivated recently, in this case it is only animal activities (e.g. molehills, rooting in turf by wild boar) and water system maintenance (drainage and riverbed regulation) that might bring the material to the surface. In most cases, though, the regulation took place some time ago, whilst dredging of the riverbed happens rarely. For instance, Wieprza River (Fig. 2) was regulated mainly between 1900 and 1920 (Florek 2002), long before the first pedestrian survey, which happened in 1981. Additionally, unlike ploughing, the character of water system maintenance is linear. Whilst molehills appear very often and in different places every year, their activity is also restricted and on a much localised scale. Therefore, encountering of archaeological finds on floodplains is less likely than in arable lands.

Even though several field-walking surveys in the middle Wieprza River basin purposely included the Holocene floodplain, no significant archaeological data concerning the fluvial environment have been acquired. As a result, only the numerous levelled sites that are scattered across the arable moraine uplands of the region have been detected along with abundant barrows located in the woodland. To date, in the immediate vicinity of the river, only two medieval complexes have been recognised (Fig. 3): a structure in Sławsko occupied between the tenth and fifteenth centuries AD

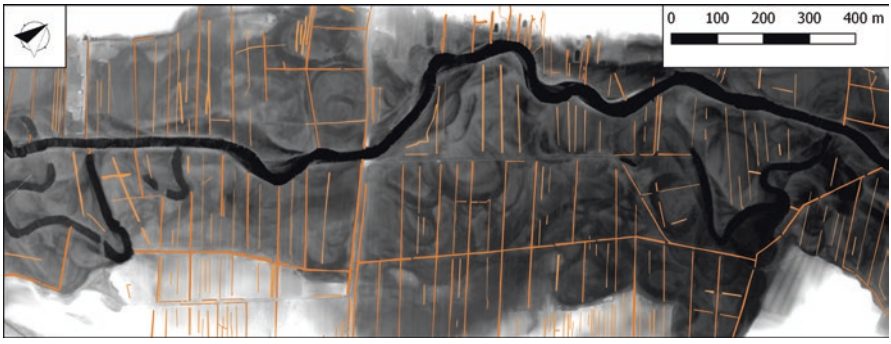

Fig. 2 Drainage brought order and regularity to the floodplain, with straightening of the Wieprza River major trunk stream

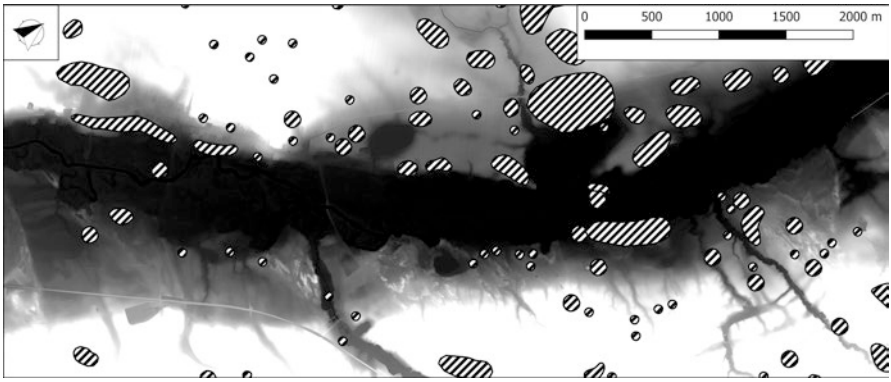

Fig. 3 Does this distribution of evidence for settlement in the middle Wieprza basin represent the remains of a settlement pattern or is it the result of field-walking prospection limits? The locations of archaeological sites as hatched polygons are shown against the background of an ALS-derived DTM. Notice the height difference between the Holocene floodplain (the darkest area), the Pleistocene terrace (greyish strips on the both sides of the Holocene plain) and the moraine uplands (white regions), and the varying disposition of archaeological sites across these zones

and a stronghold in Wrześnica of eighth and ninth/tenth century AD date (Łosiński et al. 1971; Rączkowski and Sikorski 1996). Yet, both these fortified sites had been archaeologically recorded already in nineteenth century (Skrzypek 2008), and, by means of field-walking survey, some archaeological finds have been identified only in one new location on the floodplain. Found upstream of the fortified site in Wrześnica, these were interpreted as the remains of an open settlement contemporary with the stronghold. A number of potsherds were discovered in molehills, whilst some others were collected from a layer of sand deposited on the surface from dredging which had taken place a few months earlier. Noteworthy, the finds were due to two independent factors: firstly, intensive and repeated investigation in the immediate vicinity of the stronghold, which eventually brought unexpected results; and secondly, the survey was luckily performed a short time after the occasional dredging. Thus, the discovery was caused by a combination of consistent research decisions (potsherds were identified because of regular surveys) and purely coincidental factors (the dredging conducted short time before the survey).

Due to the discovery, one should expect further archaeological evidence within the Holocene floodplain. However, the results of excavations that took place in the 1990s near the fortified site in Wrześnica to some extent explain the limitations of the field-walking surveys. Remains of a timber-paved road and a possible pier, which were found outside the stronghold, were clearly covered by a layer of flood deposits that accumulated since the Early Middle Ages, when the accelerating deforestation intensified soil erosion by water (Kaczmarzyk et al. 2008). The layer is omnipresent along the floodplain, including within the interior of the fortified site in Wrześnica. Its thickness is typically 20–60 cm, and unsurprisingly, it is greater wherever negative relief features (swales on point bars, palaeochannels, tributary channels and irregular depressions) are located. Silty sands were being deposited

due to frequent and presumably annual inundation of the Holocene plain (Florek et al. 1998), in a pattern that would have continued as a matter of routine if the river was not regulated. Today, only very occasionally do the gradually rising waters cover (in a non-violent manner) broader areas of the Holocene plain.

Alternative Approach to Prospecting the Fluvial Environment of Wieprza River

It is clear that further field-walking surveys are not going to bring any significant change in understanding the fluvial landscape. Both, the cultural and environmental factors, which were described above, cause that the traditional survey strategy is inappropriate for such an environment. Thus, the patterning of the evidence for past settlement in the middle Wieprza River basin (Fig. 3) is not a result of decisions made in the past. Rather it is the outcome of biased traditional data collection strategy (Cowley 2013). Therefore, a question has to be asked whether the use of remote sensing techniques would bring any improvement and recognition of features that not necessarily draw the attention of pedestrian prospection. After all, strong tradition of field-walking in Poland induces particular research interest, classification and terminology (Rączkowski 2005; Cowley 2016). On the one hand, there is a serious need to develop knowledge about the young fluvial landscape, which is traditionally marginalised. On the other hand, acquisition of new information, which would allow interpretation of multifaceted past actions on floodplains, is prerequisite.

Aerial Reconnaissance: Improved Understanding and Further Bias

Several observer-directed aerial reconnaissance campaigns have covered the study area, yet only a limited number of archaeological features have been identified. These poor results are due to several independent factors. Firstly, nearly all flights took place in late June and July. In general, at this time variegation in crops due to vegetation stress should already be noticeable, whilst harvest yet not started. However, due to its proximity to the Baltic Sea, the study area enjoys a relatively mild climate, and usually damp summers (Table 1). Hence, the occurrence of cropmarks in such conditions is less likely (Cowley 2015). Secondly, poor postglacial Pomeranian soils are vastly uncultivated, whilst crop types, which are resistant to stress, are often planted in the arable lands (Wilson 2000). Thirdly, even if some faint marks occurred, they might be omitted since observer-directed reconnaissance was being undertaken, and oblique photographs were taken only if the archaeologist had observed any marks from the air (Palmer 2005; Rączkowski 1999). In this context, all of the identified cropmarks are situated within arable uplands, whilst no

Table 1 A comparison of the soil moisture deficit that was registered in the middle Wieprza River basin and maximum values noted in the same time (May 21 – July 20) in Poland. © Institute of Soil Science and Plants Cultivation in Puławy (http://www.susza.iung.pulawy.pl/KBW accessed October 6, 2016)

Year	Soil moisture deficit values in the study area (mm)	Maximum value of the soil moisture deficit index in Poland (mm)
2016	> −50	−179 to −170
2015	−119 to −110	−179 to −170
2014	−139 to −130	−189 to −180
2013	> −109 to −100	−129 to −120
2012	> −50	−119 to −110
2011	−109 to −100	−179 to −170
2010	−169 to −160	−239 to −230
2009	> −50	−69 to −60

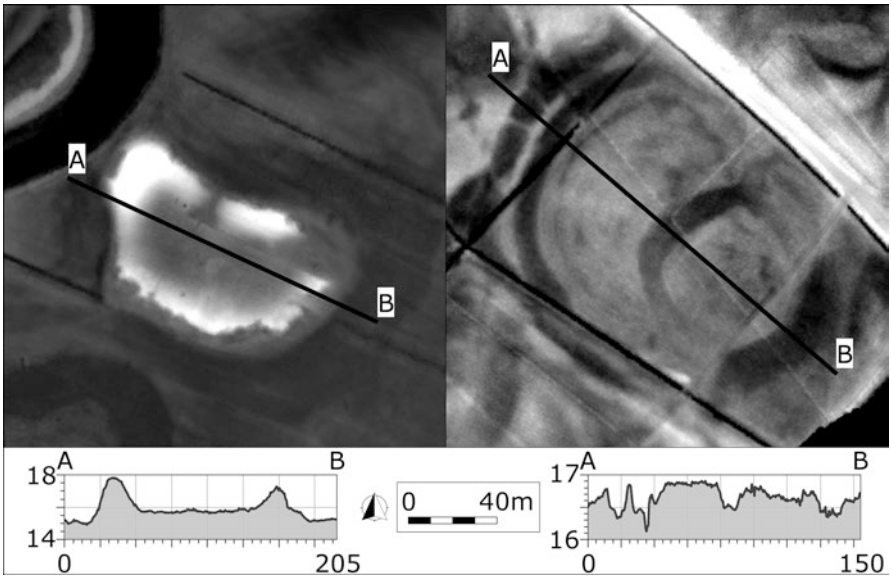

Fig. 4 Remains of the fortified site in Września embankments are clearly visible against the negative relief of Wieprza River floodplain, whereas in Sławsko only slight relief differences are to be noticed. ALS-derived DTM, profile distance and height in metres

new sites were detected across the damp and grassy fluvial environment. Nevertheless, being recorded earlier, the two strongholds located within the floodplain were photographed from the air.

In the case of Września, the preserved ramparts are relatively straightforward to interpret (Fig. 4), whereas in Sławsko no significant earthworks can be observed today. However, one should expect some relief features, whilst a former princely seat is being investigated, and slight remains of an annular structure (Fig. 5a) were identified in the 1960s (Łosiński et al. 1971). In July 1996, intensive precipitation

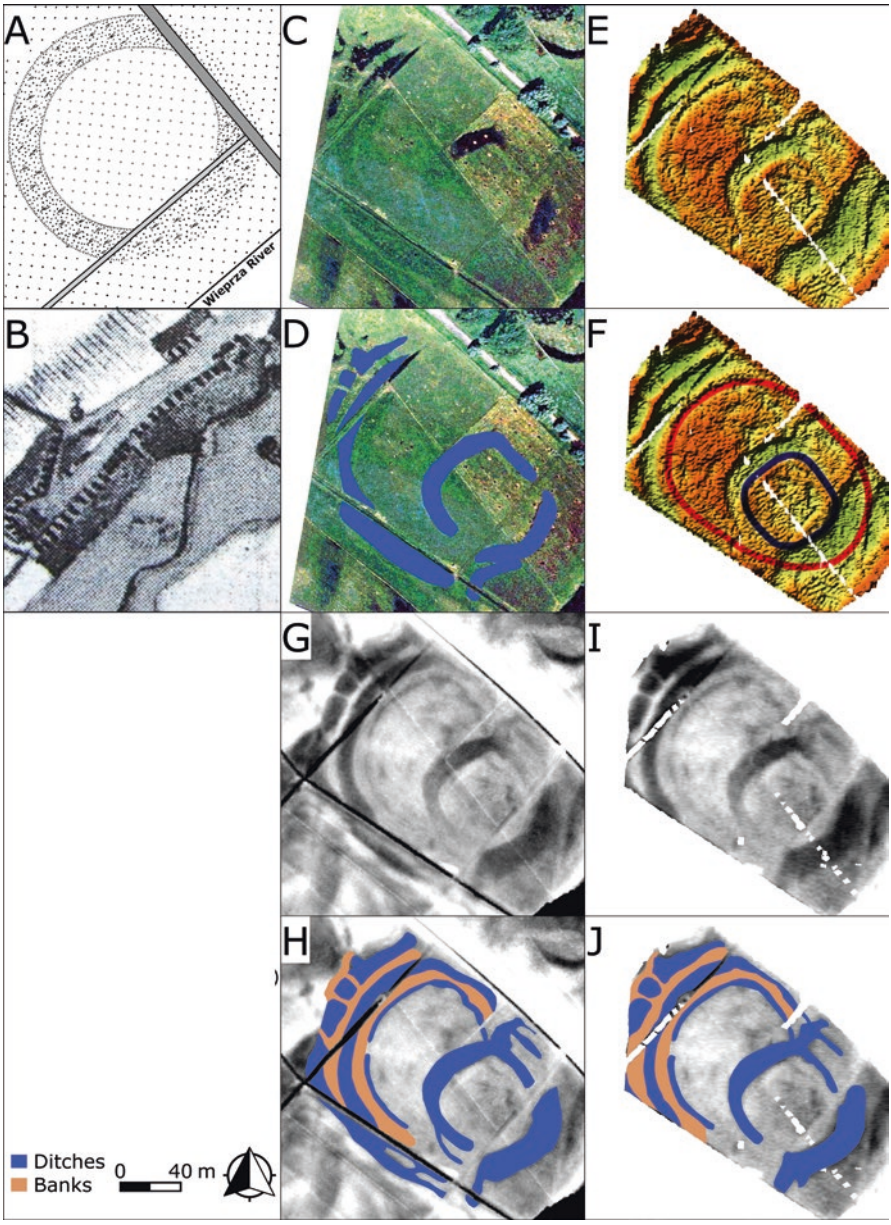

Fig. 5 Different approaches to the site in Sławsko resulted with alternative interpretations. (**a**) Site extent (Łosiński et al. 1971). (**b**) Double ramparts illustrated on the Schmettausches Karten (out of scale). (**c**, **d**) Rectified oblique aerial photography and its interpretation. (**e**, **f**) The 2011 DTM and the site extent interpretation (Rączkowski et al. 2013). (**g**, **h**) ALS-derived DTM and its interpretation. (**i**, **j**) Reprocessed and reinterpreted 2011 DTM

caused the increase of the water level and highlighted various negative relief features within the floodplain as watermarks, and amongst palaeochannels of Wieprza River, the moats surrounding the princely seat got submerged (Fig. 5c, d). Whilst in the air, a small annular part of the stronghold was detected next to the Wieprza River. Due to its regularity, and thus similarity to the structure that had been documented nearly 30 years earlier, initially, it was assumed that the earlier archaeologists had misinterpreted the site location. However, later, during a desk-based assessment, features that were not perceived during the flight were derived from the photograph. Additional ring, most likely representing second moat, was attached to the central part of the site (Rączkowski 2008). It seems that, at least partially, a double ditch had surrounded the adjoining segment, since two parallel curved dips located westwards were under water when the photograph was taken.

Apparently, it is the larger enclosure that was partially identified during the 1960s survey, and, at the time, it was assumed that the missing section created a circle. Whilst only the smaller enclosure was identified during the aerial reconnaissance, luckily, the photograph included the remnants of the second segment of the fortified site. Since the outer moats in the west were not perceived from the airplane, identification of the entire site extent was a matter of a coincidence. If the photograph of the small part was taken from another angle, it might have not included the western ditches. Noteworthy, in the 1990s, analogue cameras were in use, and thus, the number of photographs that were taken during a single flight was limited, and each shot had to be legitimated. If the photograph did not include the outer moats, the site would be still understood as a simple, annular feature. Moreover, based on the photography, it could be assumed that earlier archaeologists had misinterpreted site location. In this case, deceitfully, the 'objective' photographic evidence could gain power over the enigmatic results of the interpretative mapping undertaken in the 1960s (Rączkowski 1999).

A few years later, previously inaccessible historic maps were analysed. Although no topographic features were noticed in Sławsko, when Messtischblätter map was created (1897), a simple, elevated and annular form is clearly visible on an Urmesstischblätter map (1831), with an earlier chart (Schmettausches Karten, 1767–1787) showing that additional, adjoining ring of ramparts was still observable (Fig. 5b) in the second half of the eighteenth century (Hinkel 1959). Therefore, interpretation of the photograph was confirmed by information derived from historic maps.

Tradition in Power

Discovery of the adjoining ring in Sławsko raises issues regarding data collection strategy and knowledge construction process. Firstly, one should ask whether the site would have been registered at all, if the remains of the ramparts had not been observable in nineteenth century. Analysis of historic maps shows that early archaeologists had noticed the elevated structure within the floodplain shortly

before it was levelled. At the time, available prospection methods were used to a limited extent, and researchers paid attention either to distinguishable earthworks or to sites located in arable lands, which were often incidentally detected by farmers (Trigger 2007). Therefore, it is very likely that the stronghold would not have been identified if the ramparts had been levelled before first archaeologists penetrated the area and/or the local community had not informed the researchers about the once existing earthworks. As a result, the survey conducted in the 1960s (Łosiński et al. 1971) would also presumably omit the indistinct site. The reasons are twofold: Polish archaeologists have not developed skills required to undertake elaborate topographic survey, as presented by, e.g. Gannon (1999), and the floodplain had not been studied for decades due to the limitations of traditional approach. Noteworthy, no archaeologist was present during the regulation of Wieprza River, what explicitly show the power of research tradition and its impact on the range of questions which may be approached (Rączkowski 2005).

Secondly, one should ask whether aerial photographs of the watermarks would have been taken if the site had not been registered in nineteenth century. Instant interpretation, which characterises observer-directed aerial reconnaissance and causes taking photographs of the spotted marks, limits acquired data (Verhoeven and Sevara 2016). In the case of site not being registered, unless the flight director had immediately identified the moats, there would be no photographs to assess afterwards. Since submerged remains of former moats are nearly indistinguishable from other negative relief features within the floodplain, detecting them from the air is a challenge (Fig. 6). After all, the moats were constructed most likely by rearrang-

Fig. 6 Complexity of negative relief features within floodplains is challenging for observer undertaking aerial reconnaissance. (Photograph by W. Rączkowski)

ing palaeochannels, and the second segment was not identified during the flight, yet whilst the aerial photography sorties were interpreted. Area coverage could provide photos for desk-based assessment and thus eliminate the pitfalls of subjective visual experience, which characterises observer-directed aerial reconnaissance (Verhoeven and Sevara 2016); however, in case of Pomerania, such attempts have never been made.

Thirdly, the case study of the stronghold in Sławsko clearly shows the immense potential of archaeological information kept in the archives (Cowley and Stichelbaut 2012). The adjoining ring of ramparts is marked on historic maps; however, the information could be derived only after the access to these resources was opened. Noteworthy, many archives are still inaccessible, and the ongoing declassification will undoubtedly trigger further discoveries (Fowler 2016). The historic maps demand critical examination (Kiarszys 2016), yet undoubtedly, archives should be assessed whenever possible (Burks 2010).

Geophysical Prospection and Topographic Survey: Site Level Approach

In 2011, the strongholds in Sławsko and Września were surveyed by means of Bartington 601 dual fluxgate gradiometer and Magmapper G858 caesium magnetometer combined with a GPS RTK unit (Rączkowski et al. 2013). Geophysical and height data were used to determine location, depth, character and preservation state of the remains, and based on these, the site's structure was interpreted. A new linear feature running parallel to the external moats was identified in Sławsko (Fig. 5e, f), and it was assumed that it limited the site in north and west. In general, the survey confirmed information derived from aerial photographs; however, it is discussed in the following section that the collected height data were partially misinterpreted.

Airborne Laser Scanning: Total Area Coverage Approach

ALS survey, which was undertaken for archaeological purposes in 2012 (Table 2), included arable lands and pastures, Wieprza River floodplain and woodland (Banaszek 2015). For the first time, a total area coverage approach substituted selective data collection strategies. Although the resulting dataset is not truly bias-free, its subjectivism is constant since laser beams do not discriminate cultural and natural aspects of the landscape (Banaszek 2014). As a result, beside areas, which were accessible for pedestrian surveys, and the selected parts of the land that were photographed from the air, the topography of the entire study area was examined.

Clearly, there are many factors that determine the way, in which airborne lidar data are being examined (Opitz and Cowley 2013). The interpretation results from a tension between the analysed data, eyes, mind, accumulated knowledge,

Table 2 Characteristic of the ALS survey and data

Survey date	April 26, 2012
Sensor	Riegl LMS-680i
Aircraft	Vulcanair P68 Observer
Flying height (m a.g.l.)	950
Laser frequency (kHz)	360
Wavelength (nm)	1550
Strip overlap (%)	60
Mean point density – last echo (pts/m^2)	12.15
Gridded derivatives resolution (m)	0.5

professional experience and research design, whereby working with ALS derivatives demands also a level of understanding the roles of data acquisition, processing and visualisation, as well as skills in reading the topography (Palmer 2013; Mlekuž 2013; Kokalj et al. 2013). Although developing best practices in dealing with airborne lidar data is important (Kokalj and Hesse 2017), to understand interpreter's background and to improve observation skills are equally required.

Noteworthy, in the case of middle Wieprza River basin, reading the ALS-derived digital terrain and surface models (DTM and DSM, respectively) was structured by previous approaches and prospection results that were discussed above. This fundamentally affected the interpretation, though such impact is unavoidable. If known to the interpreter, registered archaeological sites that are covered by airborne lidar force particular approach. Therefore, round barrows that were identified earlier in woodland drew immediately attention of DTM reader, whilst arable lands, where sites identified mainly due to field-walking surveys, were unsuccessfully examined in pursuit of earthworks. Needless to say, strongholds situated on the banks of Wieprza River were in the centre of interest.

Alike in the case of other prospection methods, the presence of well-preserved ramparts in Wrześnica decidedly makes them stand out against other features of the floodplain whilst interpreting ALS-derived DTM (Fig. 4). Thus, identification of the site does not demand serious interpretative skills. In fact, due to its characteristic form, location and state of preservation, the fortified site represents an example of deceptive thinking, according to which ALS derivatives are straightforward to read. Additionally, early medieval strongholds are amongst the iconic sites of Polish archaeology. These attract much attention, very often at the expense of other, less spectacular locations. Therefore, even if the site was somehow omitted by earlier archaeologists, it would have been most likely noticed either as a result of interpreting the 2012 ALS survey data or by other researchers immensely exploring the available national lidar dataset (Wroniecki et al. 2015).

Unquestionably, the capacity of ALS to represent subtle fluvial landforms depends on the resolution (Notebaert et al. 2009), and fortunately, in the case of middle Wieprza River basin, high-quality data have been collected (Table 2). Therefore, identification of various negative relief features within the floodplain was possible (Fig. 7). However, location and condition of the Sławsko stronghold in

Fig. 7 The maze of negative relief within the floodplain of the middle Wieprza River basin identified through interpretation of ALS data

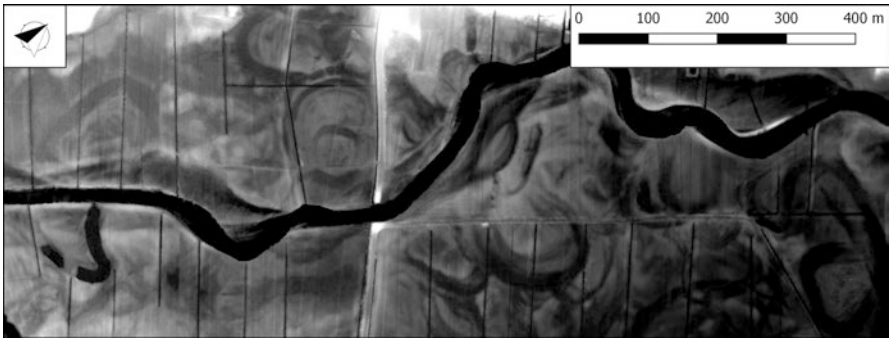

Fig. 8 The remains of the fortified site in Sławsko conceal themselves amongst the negative relief of Wieprza River floodplain

such a context illustrate an interpretative problem with the remotely acquired data. Undoubtedly, being aware of the site's presence made it to be distinguished from the surrounding maze of negative relief features within the floodplain. In this case, particular knowledge and experience played an important role and structured the interpretation. However, moats flanking both parts of the stronghold follow the course of the ancient river channels, and the topography of the site strongly resembles the omnipresent and natural remains of former oxbow lakes (Fig. 8). Thus, it is important to ask whether the site would be detected due to interpretation of ALS-derived DTM if it was not registered earlier. Definitely, it would require an experienced eye to discriminate it from natural negative relief features. However, unlike the case of the observer-based aerial reconnaissance, the area coverage approach makes that the data have already been collected and can be used on various occasions and the interpretation does not need to be made as quickly as during the observer-based reconnaissance flight. Hence, even if the stronghold was not identified immediately whilst interpreting ALS derivatives, it could be recognised during some other assessment that could be performed by an independent observer or for alternative purposes.

Besides highlighting the difficulty in separating archaeological earthworks from natural landforms, the stronghold in Sławsko illustrates that skills of reading the topography and 3D data are indispensable. The narrow ditch that was detected and partially understood as a site border during the surveying, which accompanied the geophysical prospection (2011), was examined in detail through interpretation of the ALS-derived DTM (2012) that was undertaken by a different archaeologist. Whereby the site extent drew by the geophysical surveying team presents an idealised and/or simplified picture, the ALS derivatives shows that the adjoined western sector resembles an oval indented at the south east corner (Fig. 5g, h). The most evident discrepancies are located in the northern and northeastern sector. Instead of drawing the site extent next to a modern causeway that leads towards a bridge over the Wieprza River, the narrow ditch curves sharply and joins the annular moat surrounding the central part of the princely seat.

Noteworthy, the same outline of the ditch was recorded in the height data collected in 2011 (Rączkowski et al. 2013), yet it was not properly identified at the time. However, after reading the ALS derivatives, previous data were re-examined (Fig. 5i, j), and thus, it became clear that the ditch was misinterpreted, most likely due to a few reasons. Firstly, as said above, studying topography has been underestimated in Polish archaeology, and researchers usually treat it without esteem. Although site topographic maps have been created, these have not been thoroughly studied. Secondly, the height data collection was not the main purpose of the 2011 survey, and thus it was not prioritised during processing and interpretation. Thirdly, the stronghold was not covered equally with GPS measurements since a few linear obstacles made some areas inaccessible. Actually, one fence cuts across the narrow ditch and made the DTM interpretation slightly more demanding. Fourthly, the 2011 height data seem to be more noisy than the classified ALS point cloud. Most likely, it is a result of the data collection strategy and the irregular surface of the meadow, where every step caused inclination of a GPS unit. Lastly, it seems that a simple hill-shade visualisation technique was used to interpret the DTM. Whilst illumination source was situated beyond top-left corner of the imagery, a part of the ditch that leads towards the annular moat surrounding the central sector of the site was occluded. Using alternative visualisation method (Challis et al. 2011a) could help to eliminate this bias; however, in this case, there is no evidence for using any other technique.

Besides investigating the relief of the princely seat in Sławsko, thanks to the area coverage approach, a desk-based assessment of the entire floodplain was undertaken, which resulted with a discovery of previously unknown archaeological earthworks. Presumably, these features are related to a historic road network, which used to cut the fluvial landscape. Possible remains of a causeway were identified few hundred metres from the stronghold in Sławsko (Fig. 9). Within the maze of palaeochannels and drainage system, a L-shaped object is located. Its shorter part is almost parallel to the contemporary riverbed and lies on an irregular, quasi-trapezoidal and slightly elevated platform, whereas the longer section runs across a former oxbow lake. It is clear that the feature was constructed intentionally and should not be understood as a natural deposit. Its shape and orientation is exceptional within the floodplain, where no other palaeochannel has been cut by an elevated strip of land.

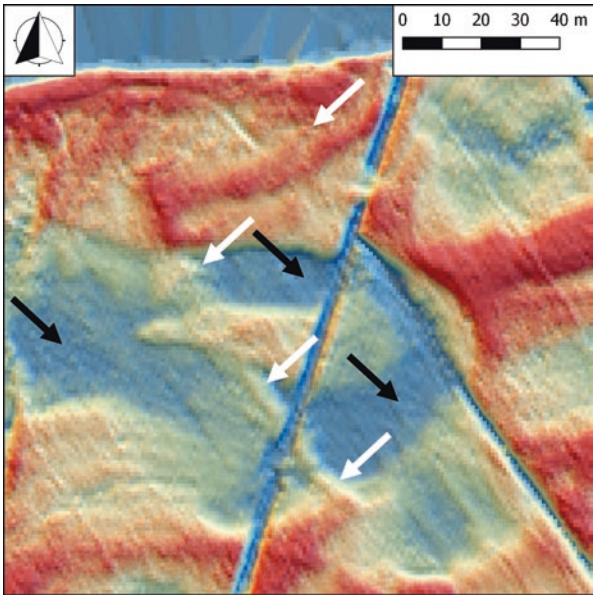

Fig. 9 Supposed relief remains of a causeway (white arrows) crossing a former oxbow lake (black arrows) of Wieprza River as visible in the ALS-derived DTM visualisation

Interpretation of the ALS derivatives gave also a significant, yet indirect, indicator of other roads within the floodplain. Moraine upland near the fortified site in Września is cut by a medieval route (Banaszek 2015). Although it leads towards the stronghold, the relief feature can be tracked only to a place where uplands meet the floodplain. Nevertheless, the course of the road, and the fact that the identified section was partly constructed as a causeway, suggests that the track was intentionally maintained. Hence, organic remains of a sunken causeway that could cut across the floodplain, and thus making an extension of the road towards the fortified site, are most likely to be hidden underneath the accumulated river deposits.

Discussion

Undoubtedly, fluvial landscape has far greater potential than the set of archaeological information that has been already extracted from it. However, the characteristics of the floodplain do not derive only from the data collected by the researchers. It is the archaeological pre-understanding that formulates the scope of this complex phenomenon. A contextualised set of theories, methods, questions to be answered and prospection traditions determines the scope of actions that are being performed to meet the actual research expectations. Depending on the background of an individual archaeologist, particular features are defined as interesting, whilst the others are left

unnoticed. Moreover, the fluvial landscape is a distinct area, where solutions that are successfully applied for other regions do not bring any significant evidence. Therefore, it has to be treated individually. Otherwise, it would remain a gap on archaeological map as it used to be from the limited field-walking perspective.

The case study of the middle Wieprza River basin illustrates some interpretative issues. Early archaeologists and the practice of the pedestrian survey developed a particular research and interpretative model. This caused a significant redundancy in the classification of past human activities performed in particular environments. Therefore, the gaps in the settlement pattern that are often situated within the river terraces should not be treated as the result of past human actions. On the contrary, these should be understood as a consequence of decisions made by the researchers. The practice clearly shows that continuous application of the same prospection method is not going to qualitatively alter our understanding of the past landscape. Therefore, to include previously marginalised areas into the scope of landscape studies is a serious challenge, and a profound change in approaching the subject of the research is required.

We demonstrated that archaeological pre-understanding is a crucial aspect of any research. A conscious and experienced mind is required to identify the archaeological features and extract them from other objects within the analysed landscape. Both the natural structures and the results of the contemporary human actions constitute a puzzle in which individual elements intertwine, and untangling such a knot is a challenge.

Although nearly levelled, the former princely seat in Sławsko resembles in plan the other early medieval strongholds scattered across Pomerania (Łosiński et al. 1971). However, due to its condition, the site is an excellent example showing that although archaeological information is being recorded within different datasets, it is the matter of human mind to extract it from other palaeoenvironmental features. This mind has to be aware of deceitfulness of the acquired data, processing methods and archaeological practice. It is hard to say how many other sites like Sławsko have not yet been registered and are hidden within floodplains. However, undoubtedly, these will not be identified without an experienced interpreter, and if the problem is going to be approached traditionally.

Moreover, we illustrated that the maze of negative relief features on the Wieprza River floodplain can be deciphered. It might be useful in planning further surveys (Carey et al. 2006), which, instead of taking the whole area into account, would focus on slightly elevated and thus dryer spots and platforms that were not cut by any noticeable palaeochannel. Such information can be treated as an indicator to predict areas, where archaeological finds are more likely to be detected on ground surface if mole or drainage activity occurs, and if, actually, any settlement took place within the floodplain. In this sense, the use of ALS data would be quite different from detecting spots that are characterised by greater moisture as it is investigated through the ALS intensity data (Challis et al. 2011b, c). Therefore, the proposed usage of airborne lidar derivatives would rather focus on knowledge-based mapping of the areas within the floodplain where settlement was more likely to happen.

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