

ANTHONY HARDING and WŁODZIMIERZ RĄCZKOWSKI  
with a specialist report by TOMASZ WAŻNY

## THE DATE AND INTERNAL ORGANISATION OF EARLY IRON AGE FORTIFIED SITES IN NORTH-WESTERN POLAND: NEW RESULTS FROM GEOPHYSICAL SURVEY AND DENDROCHRONOLOGICAL DATING

Geophysical and aerial survey of a number of Early Iron Age sites in central Poland has produced information on the internal organisation of these sites that contributes to the question of the so-called "Biskupin type". In particular, a new plan of Sobiejuchy suggests that the type of spatial organisation present there was significantly different from that at Biskupin, Izdebno and Smuszewo. Samples for dendro dating were also obtained which suggest that the main period of use of Sobiejuchy was a little earlier than that of Biskupin. A single date was also obtained on a post from Ostrowite Trzemeszeńskie. Together these contribute to the question of the start date of Hallstatt C in Central Europe, the period to which the material culture of these sites mainly belongs.

KEY-WORDS: geophysical survey, aerial photographs, dendro dating, Biskupin, Sobiejuchy, Early Iron Age

### INTRODUCTION

The Early Iron Age site of Biskupin in central Poland has been well known to archaeologists for many years, since its discovery in 1933 and the early seasons of excavation from 1934 up until the Second World War. It is famous both for the detailed and virtually complete plan of a timber-built stockade of the period (Fig. 1), and for the pioneering techniques which were used in its investigation, including balloon photography, the construction of a caisson to create suitable conditions for excavation, and for the reconstruction of the rampart and several internal buildings on the site. Although one part of the site remains unexcavated, the recovered

plan shows thirteen parallel rows of buildings that ran through the interior, with an internal street running round the inside of the rampart and breakwaters or defences of oblique pointed posts lying outside (Kostrzewski 1950).

From the early years of excavation it was evident that detailed information was available on craft activities, the differential function of different parts of the site, and chronology. Study of the pottery indicated that it should be contemporary with the periods known in Germany and Austria as Hallstatt C and D; traditionally the start of Ha C was placed at

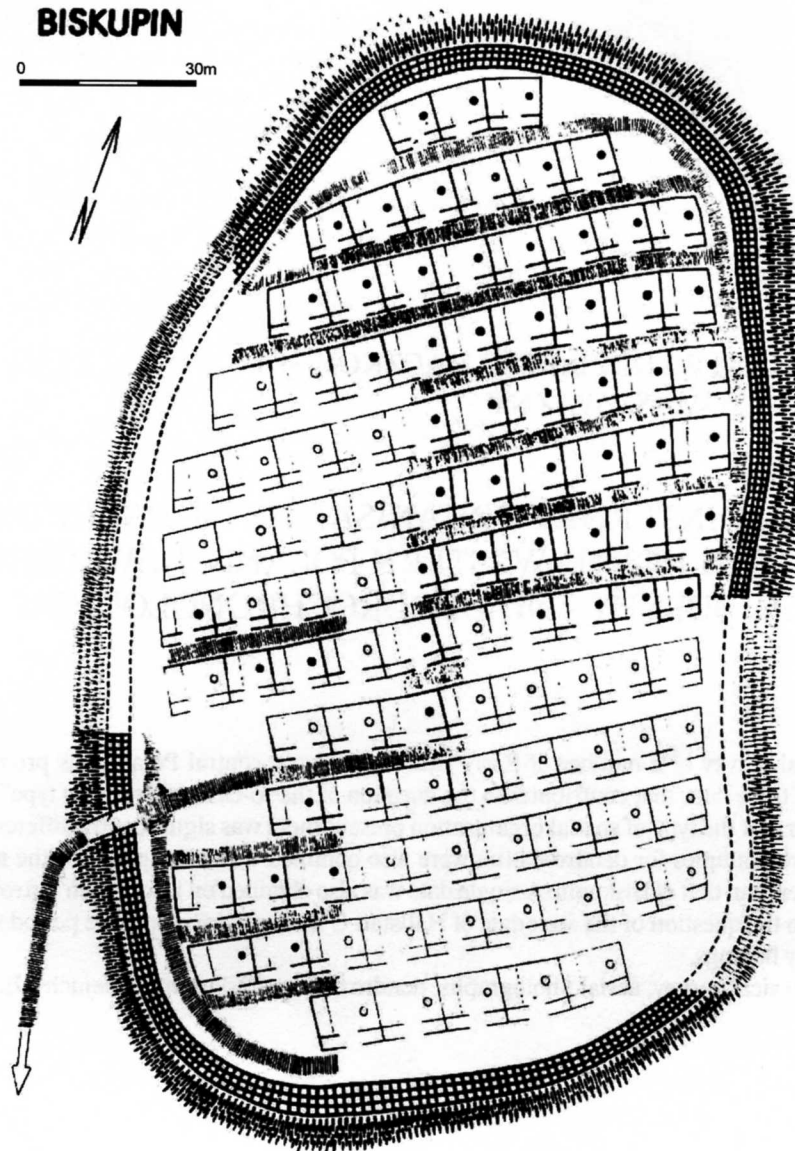


Fig. 1. Biskupin, district Żnin: plan of the excavated areas of the site

ca 700 BC and the start of Ha D at ca 630/620 BC, though it is now known that these dates need to be modified, as discussed below, with a start for Ha C as early as 800 BC.

The discovery of Biskupin was followed by a realisation that other sites in this part of Poland lay in similar situations, on small islands or peninsulas in or on the shores of lakes, and (where excavation took place) dating to the Late Bronze and Early Iron Ages. Although published excavation results to support this notion were few, the notion of

a Biskupin “type” arose. Sites of this type were similar in date and function to other Early Iron Age forts in Central Europe, including those on hilltops, but were characterised (so the belief went) by the parallel rows of houses, the wooden stockades, gateways and breakwaters, and the lakeside situation that were apparent at Biskupin. Excavation took place at some of these sites, usually on a relatively small scale: that at Sobiejuchy, Jankowo and Izdebnno may be mentioned. The problems of the sites, in terms of their function and their relatively short lifespan, were addressed on a number of occasions (e.g. Ostoja-

Zagórski 1976; 1991; Niesiołowska-Wędzka 1974; for more references see Piotrowska 2008), but fundamental issues such as those relating to the internal structure of the sites, how long they lasted, whe-

ther they were contemporary or not, remained unanswered. It is in this context that the work described here took place.

## PROGRAMME OF WORK AND METHODS

As part of a collaborative programme of work between the British Academy and the Institute of Archaeology and Ethnology, Polish Academy of Sciences, a programme of work on several of these sites was undertaken in the summers of 2004 and 2005. The work consisted of geophysical surveys (using a gradiometer) supported by aerial survey, and the collection of wood samples for dendrochronological dating<sup>1</sup>. In 2004 the instrument used was a Geoscan FM256 single-sensor gradiometer, belonging to the University of Durham. In 2005 a Bartington 601 dual-sensor gradiometer with two fixed sensors 1 m apart was used, belonging to the University of Exeter. The latter machine enabled rapid progress to be maintained, the main barrier to even swifter progress being the need to lay out grids on the sites. The results have been processed using the software Geoplot (produced by Geoscan Research Limited).

In 2005 the grids were georeferenced using a Leica differential GPS 1200 system. Considerable difficulty was experienced in fitting this to the available Polish maps (1965 system at 1:10 000), whose coordinate system is not a standard one, so that simple conversion to the European Standard Grid or latitude and longitude is possible only with difficulty; only after the application of a transformation package applied by Sławomir Królewicz was

a fit possible. Most recently, orthophotomaps have become available, which would easily facilitate carrying out work of this kind.

Aerial photography in the region has most commonly been linked with Biskupin, where it was used to document the progress of excavations in the 1930s. After World War II several aerial photographs were taken of sites like Sobiejuchy, Izdebno or Jankowo, but they mostly played an illustrative role in presenting the location of sites (Kobyliński 2005). The discovery of the settlement at Jurkowo in 1999 (Nowakowski, Rączkowski 2000) has moved the interests of some archaeologists towards the potential of aerial photographs in the investigation of Biskupin-type settlements. The aerial photographs analysed here were taken during aerial survey managed within other projects carried out by the *European Landscapes: past, present & future* Project, the Archaeological Museum in Biskupin, and Wojewódzki Konserwator Zabytków in Poznań. Air photographs have been rectified using AirPhoto, facilitated by the availability of these orthophotomaps and maps at 1:10 000 converted to the 1992 system.

Dendro samples were taken from Sobiejuchy and Ostrowite Trzemeszeńskie. No timbers were visible at other sites, though it is known that they exist in some cases.

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<sup>1</sup> Funds for the programme were provided jointly by the two Academies, covering the cost of travel, subsistence, laboratory costs, and image processing. The official partner on the Polish side is Professor Janusz Ostoja-Zagórski (Institute of Archaeology and Ethnology of the Polish Academy of Sciences and the Kazimierz Wielki University in Bydgoszcz), but the two authors are the active participants. Thanks are expressed to the two Academies for financial support. Professor Romuald Schild, at the time Director of the Institute of Archaeology and Ethnology of the Polish Academy of Sciences was of enormous assistance. The work

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on the ground was carried out by the first author with the assistance of Marcin Michalski, Lidia Żuk and Darryl Freer; air photography was carried out by the second author, who also organised the ground-based survey work. The post-survey mapping was initially carried out by Chris Carey, with notable assistance with map transformation being provided by Sławomir Królewicz. The final form of the plans is presented thanks to work in Exeter by Brynmor Morris.

## THE RESULTS BY SITE

Six sites were surveyed (Fig. 2): Smuszewo, district Damasławek; Izdebno, district Rogowo; Pudliszki Site 5, district Krobia; Tarnowa, district Pyzdry; Jurkowo, district Krzywiń; and Sobiejuchy, district Żnin. A small area was also surveyed inside the rampart at Biskupin. Survey was impossible at two further candidate sites because of difficulty of access or the overgrown nature of the sites: Ostrowite Trzemeszeńskie, district Trzemeszno (which nevertheless provided timber for dating purposes), and Koziegłowy, district Kleczew. The results from Pudliszki are not presented here as the site is very disturbed and our work was limited in extent; a more extensive programme of work, including geophysical survey and excavation, was subsequently conducted by a team from Poznań and Kiel universities (Jaeger *et al.* 2008).

Aerial photographs of all these sites were taken by Rączkowski either in 2004-5 or subsequently; only the photographs of Jurkowo (the subject of interpretation here) were taken back in 1999. Most of the settlements are located in low, marshy areas, which means that cropmarks or grassmarks were unlikely to be found. Only Smuszewo is located on higher land, and the area of the site cultivated.

### *Sobiejuchy* (Figs. 3-5)

The Sobiejuchy site was extensively excavated in the 1950s and again in the 1980s. Full details of the later excavations, with references to the earlier work, were recently published (Harding *et al.* 2004). The site, which extends to about 6 ha, lies at the present day between two lakes (the Dobrylewo Lake to the south and the eponymous Sobiejuchy Lake to the north), but in ancient times it was almost certainly an island, cut off from the surrounding land by several dozen metres of open water (Fig. 3). Work in the 1950s showed that the date of the occupation was close to that of the much better known Biskupin, some 14 km to the south, and the nature of the occupation was domestic, with hearths, ovens and pits being recovered. Significantly, Zbigniew Bukowski, who became the principal excavator of the site at that time, recovered timber posts at a considerable depth in his cutting near the present-day canal joining the two lakes on the western side (Bu-

kowski 1959-60; 1962). No dating work was carried out on this wood at the time; it came a little too soon for radiocarbon dating in 1950s Poland, nor had a dendrochronological sequence been established for Central Europe. As a consequence, the dating of the pottery from this site and from Biskupin remained the mainstay of the site's chronology until recent times.

The 1980s excavations uncovered a rather larger area in the north-eastern part of the site, confirming the extensive nature of domestic occupation on the site but still only uncovering a small fraction of the whole. In both 1987 and 1988 geophysical surveys were carried out, that done with a Geoscan FM18 gradiometer in 1988 producing a remarkable pattern of streets and buildings (Harding *et al.* 2004, 36 ff., Figs 30-33). In several ways, however, this work was less than satisfactory. Although little has changed in the principles behind the operation of gradiometers (cf Gaffney, Gater 2004), much has improved in terms of speed and the ease of manipulation of the resulting data, while georeferencing using differential GPS enables rapid and highly accurate placing of survey grids onto maps. Somewhat more troubling, however, was the scepticism voiced by some colleagues to whom the survey plans were shown prior to publication. These plans show a site that is completely different in layout and organisation from the regimented lines apparent at Biskupin, and repeated on other sites (if preliminary reports and very partial excavation are anything to go by), such as Izdebno, district Rogowo (Romanowska-Grabowska 1982), or Jankowo, district Inowrocław (Ostoja-Zagórski 1978). The doubts expressed about the 1988 plan revolved around the possibility either that geological features were being detected, or that "artefacts" of the survey itself were being created. Given the advances in technology that had taken place since the original survey work, it was thought to be worth-while to repeat the exercise, but covering the entire site instead of only the central areas.

The new survey was carried out over three days in August 2005. The entire site was surveyed using traverse intervals of 1 m (east-west) and sample in-



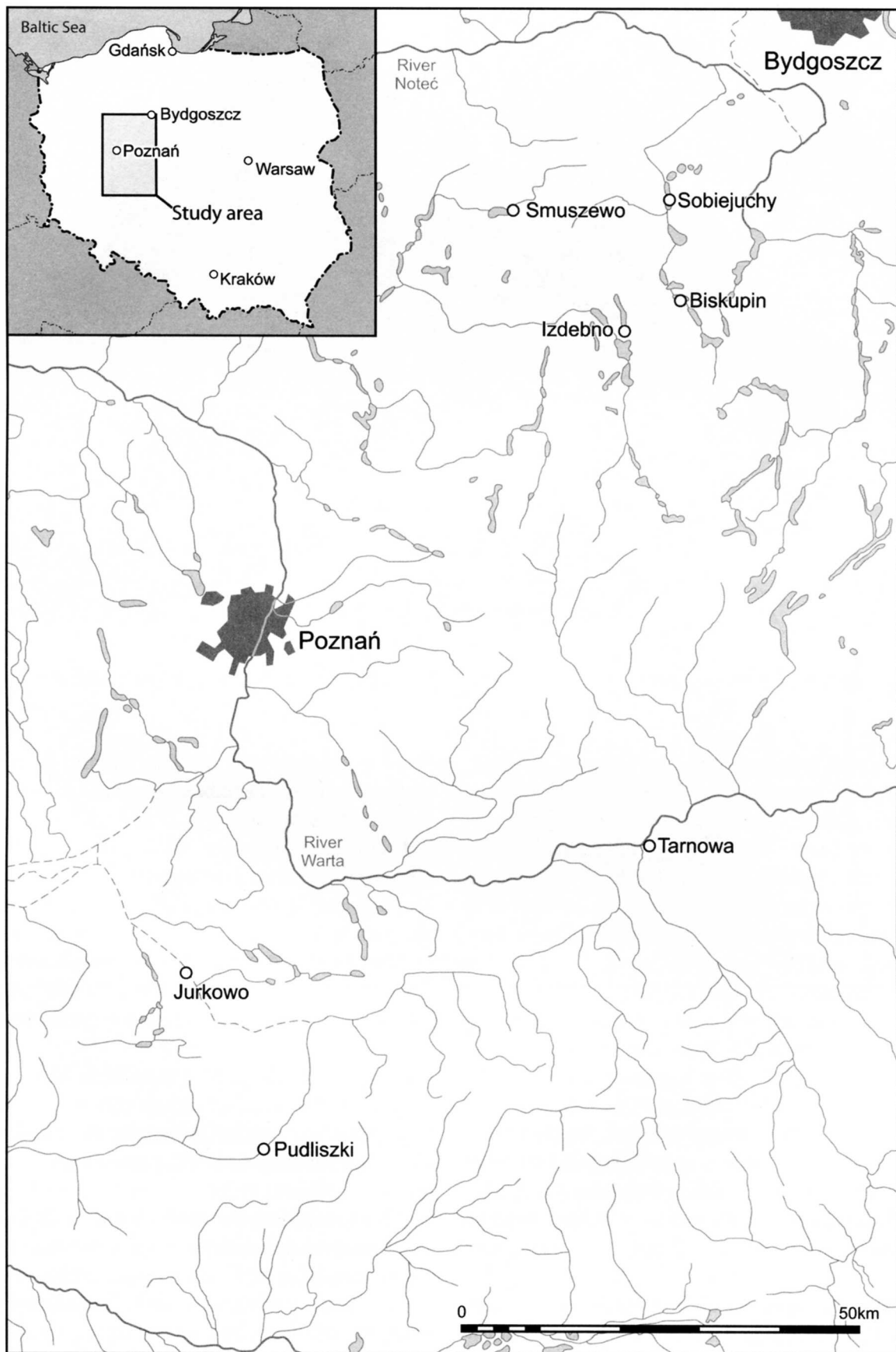


Fig. 2. The study area showing the sites surveyed

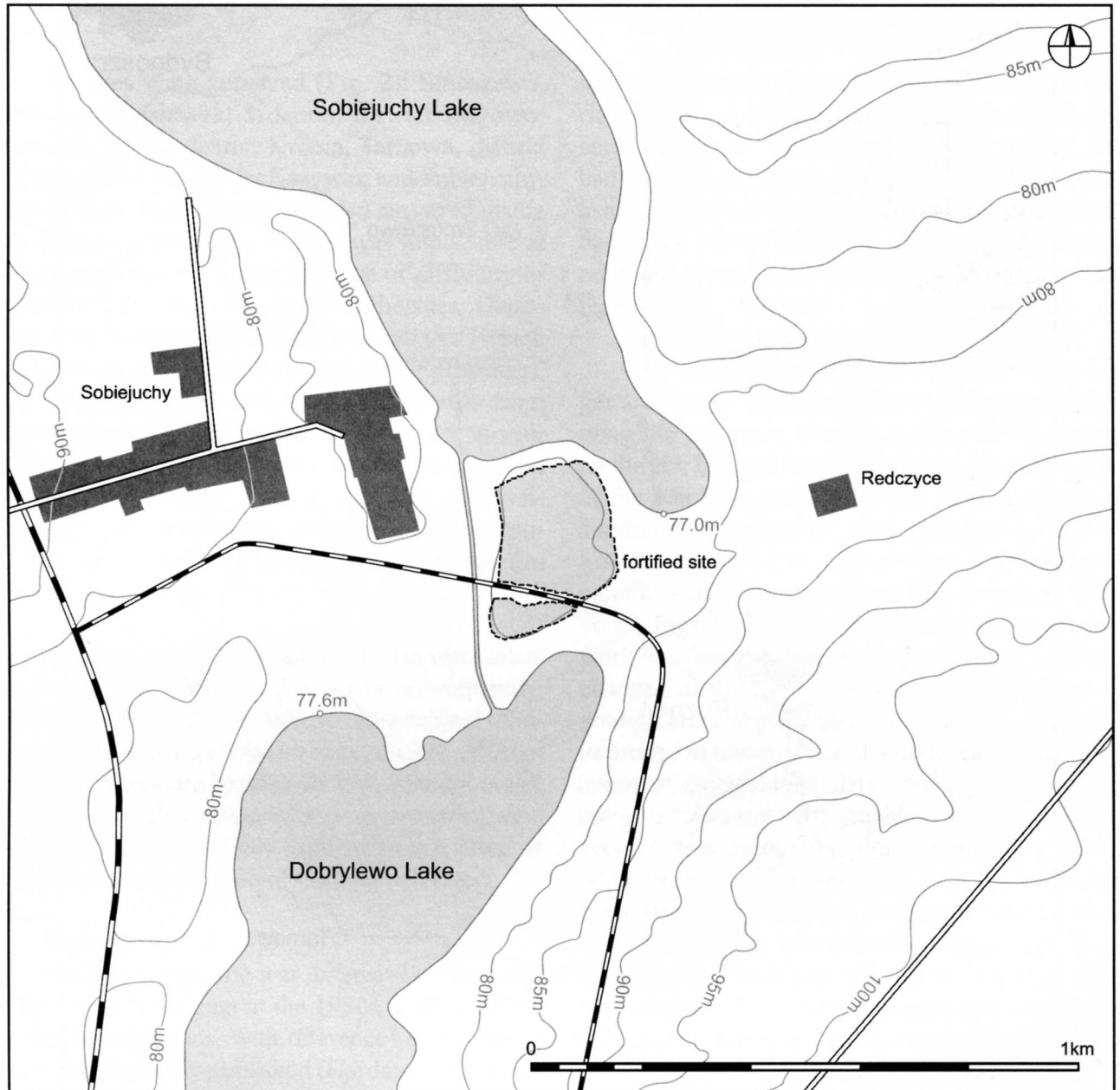


Fig. 3. Sobiejuchy, district Żnin: situation plan

tervals of 0.25 m (north-south). Subsequently an area in the centre of the site where buildings appeared to be exceptionally clearly defined were resurveyed at 0.5 m traverse interval, though the resulting increase in information was not significant.

Aerial photographs of Sobiejuchy were taken on July 10<sup>th</sup> 2005, July 4<sup>th</sup> 2006 and June 30<sup>th</sup> 2007. Only on photographs taken in 2005 are grassmarks visible (Fig. 4). They are very faint and their interpretation is very ambiguous. The interpretation

should not be treated as a base for the interpretation of the spatial structure of the settlement.

The geophysical survey plan (Fig. 5) is remarkable, and while confirming the validity of the previous survey it adds very considerably to it. All available areas of the site were included; the only parts that could not be covered were a small strip at the north end where trees and shrubs cover the edge of the terrace and its descent towards the lake, and a section near the southern end where a narrow-gauge



Fig. 4. Sobiejuchy: A. rectified air photograph, 2005; B. the image (A) with interpretation of grassmarks

agricultural railway used to run, nowadays overgrown. An area of blank readings near this is the site of an electricity pylon. Everywhere else the magnetic response was within appropriate limits and features are well differentiated. Interestingly, the plan does not differentiate between excavated and unexcavated areas. The position of the 1980s trenches can only be located to within a couple of metres since the grid of that time has long since disappeared and GPS positioning was not available at the time.

The published trench plans in Harding *et al.* 2004 do not provide much guidance in the interpretation of the survey plan, other than indicating that common features in excavation were accumulations of daub (in some cases lying in straight lines and presumed to have fallen from wattle or timber walls), hearths, and ovens. It is these burnt clay features that are probably represented by the differential responses picked up by the gradiometer and shown on the plan.

A main street (A) runs diagonally across the site. To its east are structures, marked by darker patches

(areas of higher magnetic response) that probably represent lines of daub or burnt clay, such as were found in the excavations of the 1980s. The 1988 survey plan (Harding *et al.* 2004: Fig. 30) showed a street running east-west across the northern part of the survey area, but this is less evident in the new plan, where a series of short lengths of street appear to lie between house structures (B). An area on the west side of the site (C) appears not to be built up, perhaps an open area for meetings, animal grazing, or even market activities. Most of the structures seem, as was proposed in the 2004 excavation report, to be up to 20 m long and 5-7 m wide, which contrasts with the Biskupin houses that typically measure 9 x 8 m, but were joined together to form long rows. Indeed, the entire plan appears markedly different from that at Biskupin; we discuss this further below.

#### *Smuszewo* (Figs. 6-8)

The site, extending over about 2.2 ha, lies at the east end of the Czeszewo lake (Fig. 6), around 21 km west of Sobiejuchy, and was partially excavated



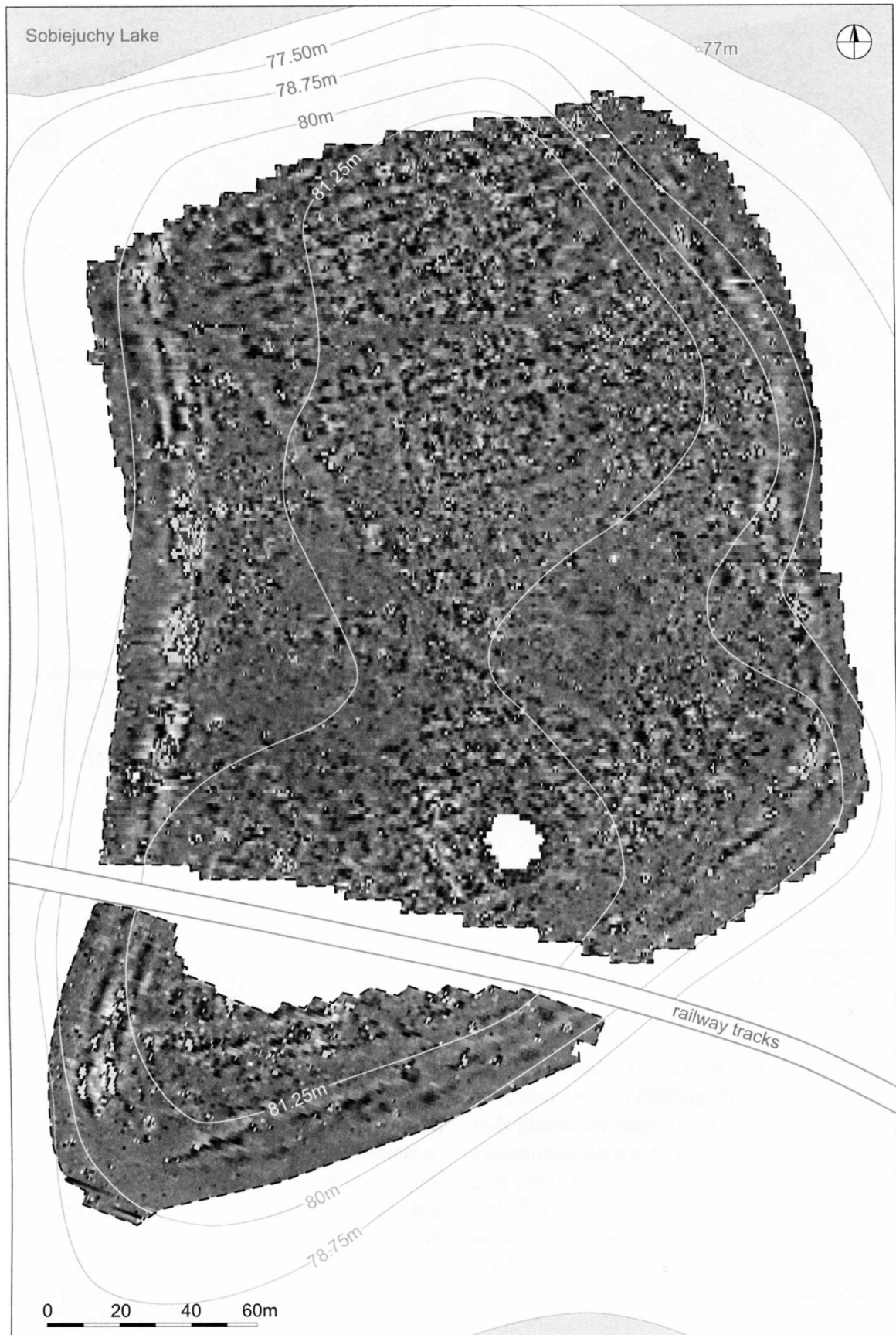


Fig. 5. Sobiejuchy: geophysical survey plan, 2005

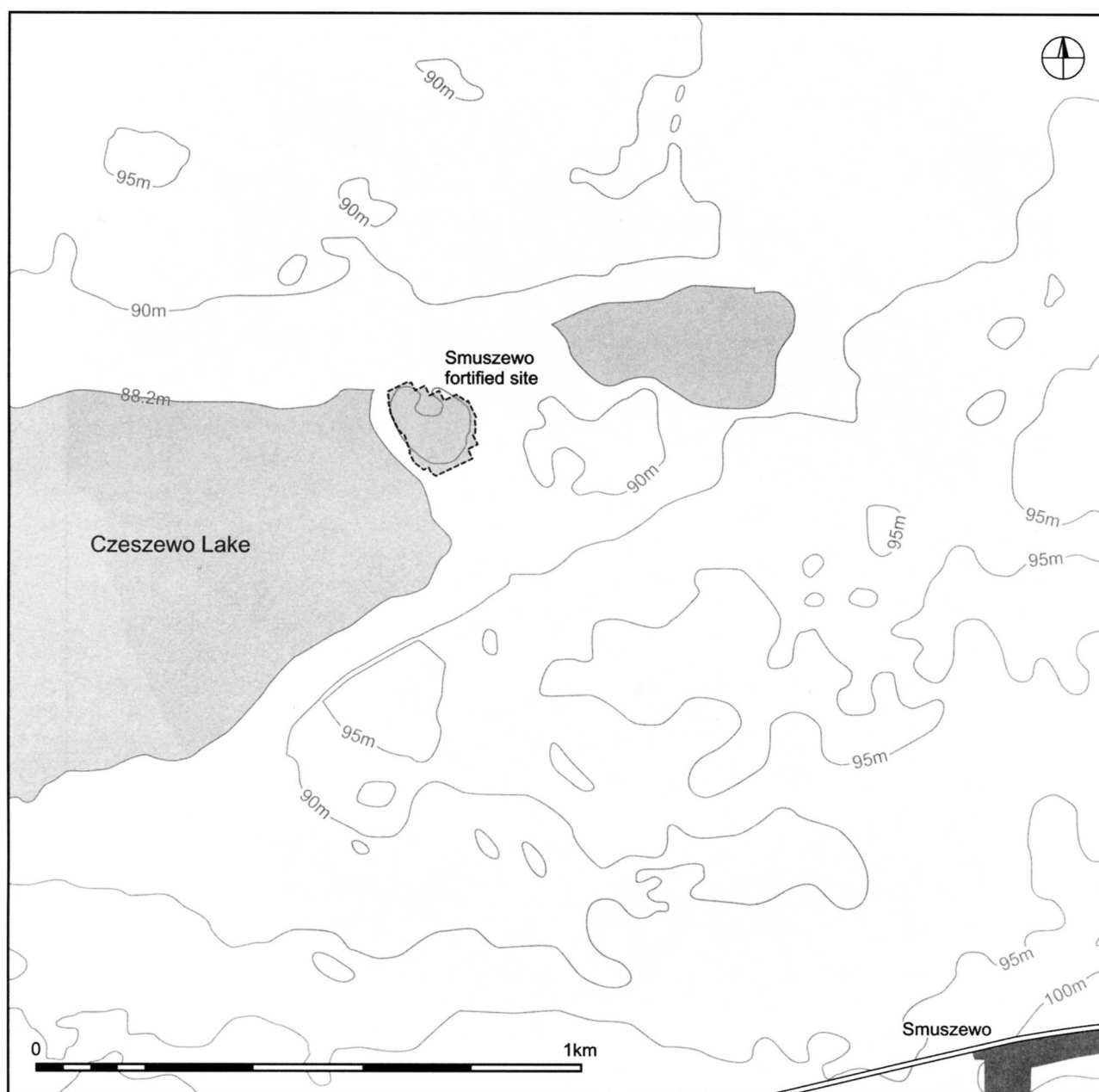


Fig. 6. Smuszewo, district Damasławek: situation plan

in the 1960s by Dobromir Durczewski, though no final report has been published (Durczewski 1960; 1985 for the finds; Bukowski 1962)<sup>2</sup>. It is not known if the site was originally an island, but since the adjacent ground to the east and south is low-lying and damp, this seems likely.

<sup>2</sup> The site archive and material, including plans, is in the Archaeological Museum, Poznań. Reports on the plant remains and animal bones have been published (Klichowska 1977; Godynicki, Sobociński 1977).

Aerial photographs of the site were taken on 1 April and 20 June 2007 and 26 June 2008. Both soilmarks (April) and cropmarks (June) show the rampart of the settlement as a sandy, dry, light band (Fig. 7). No internal structures are visible.

The survey plan (Fig. 8) shows very clear lines of structures running north-west – south-east, probably seven in number, and marked by higher anomalies at roughly 10 m intervals – perhaps hearths or ovens inside individual buildings. The rampart was marked by a very strong anomaly running all



Fig. 7. Smuszewo: rectified air photograph, 2007

the way around, and inside it a second, weaker line, perhaps from a burnt palisade.

These results appear to confirm that rows of structures, as at Biskupin, were present at Smuszewo; in other words, it seems indeed to have been “of Biskupin type”.

#### *Izdebno* (Figs 9-11)

The site, which extends over about 1.6 ha, lies on the Wola lake 9 km south-west of Biskupin (Fig. 9). It has been known for many years, and was partially excavated by Olga Romanowska in the 1970s when parts of wooden buildings were recovered (Romanowska-Grabowska 1982). Only a preliminary report is available.

Aerial photographs were taken on 10 July 2005, 4 July 2006 and 30 June 2007. Those from 2005

show some regular features visible as grassmarks (Fig. 10). These are faint, but after computer processing some parallel lines can be recognised (? possible streets).

The site was magnetically very quiet, though possible lines of features are visible on the survey (Fig. 11) that must represent structural components. It is unclear how the geophysical survey relates to the excavation, whose precise location, in the absence of a published report, is not known.

#### *Biskupin* (Fig. 12-13)

The area surveyed on this extensively excavated site was the small remaining unexcavated area in the south-east part of the interior of the stockade (Fig. 12), measuring around 30 x 30 m. Unfortunately the edges were much disturbed by modern iron in the rampart reconstruction and other features.





Fig. 8. Smuszewo: geophysical survey plan, 2004



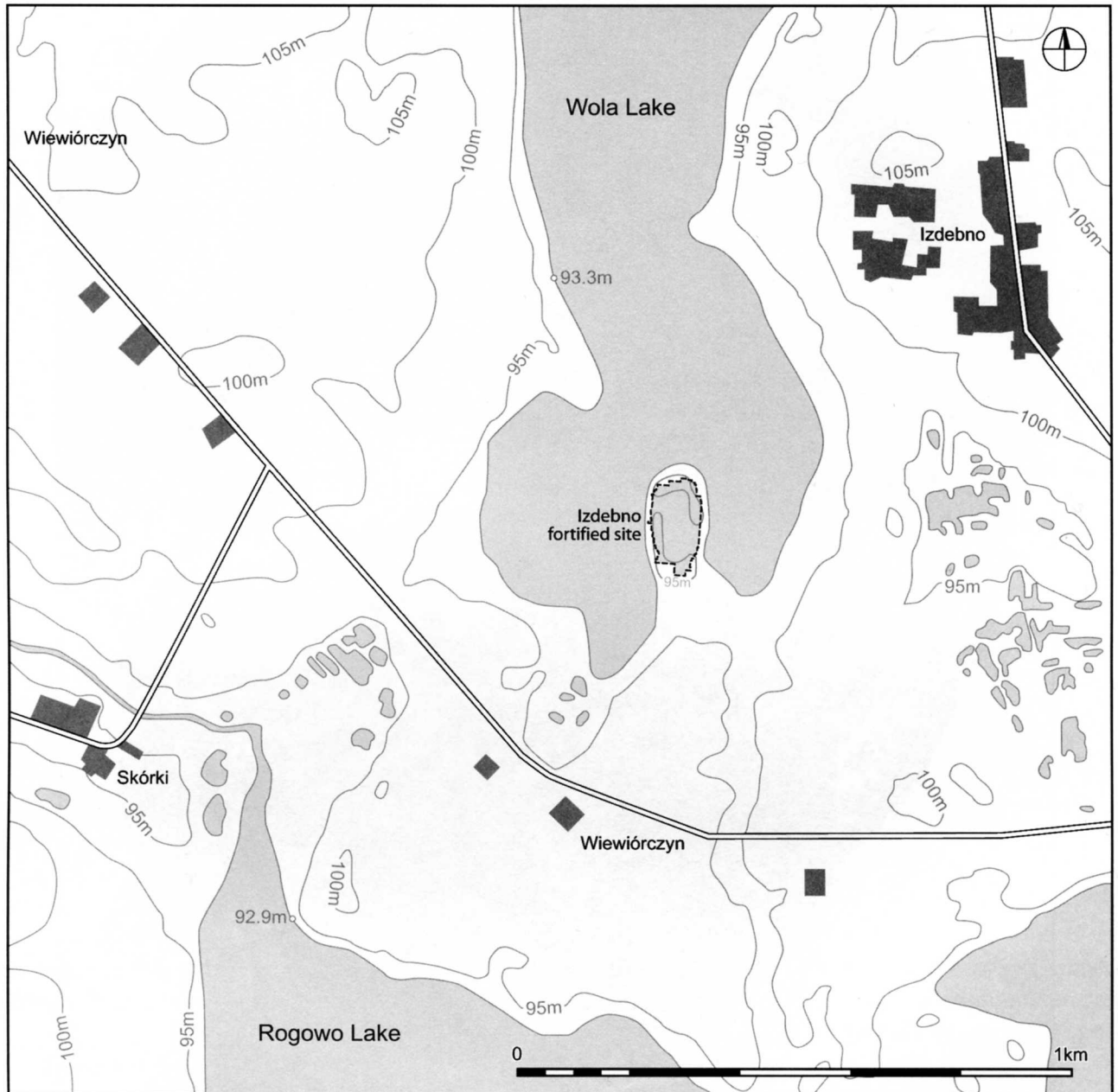


Fig. 9. Izdebno, district Rogowo: situation plan

Traces of a line, presumably from a building, are evident (Fig. 13), but it is unclear if or how this might relate to the buildings recovered in the pre-war excavations.

#### *Jurkowo* (Figs 14-17)

The site lies on low ground 5 km east of the Wonieść lake, on low-lying mainly marshy ground at the bottom of the Obra river valley (Fig. 14), drained by a number of ditches. It was discovered

from the air by one of us in 1999 (Nowakowski & Rączkowski 2000). The remains of the rampart are visible as a circular band with less dense or even no grass covering the bottom of the valley (Fig. 15). Small-scale excavations by a Polish team took place in August 2000 and the trenches are visible on the aerial photograph as rectangular features. Excavation demonstrated that wooden structures were present both in the rampart and in the interior of the site (Figs. 16A, B).

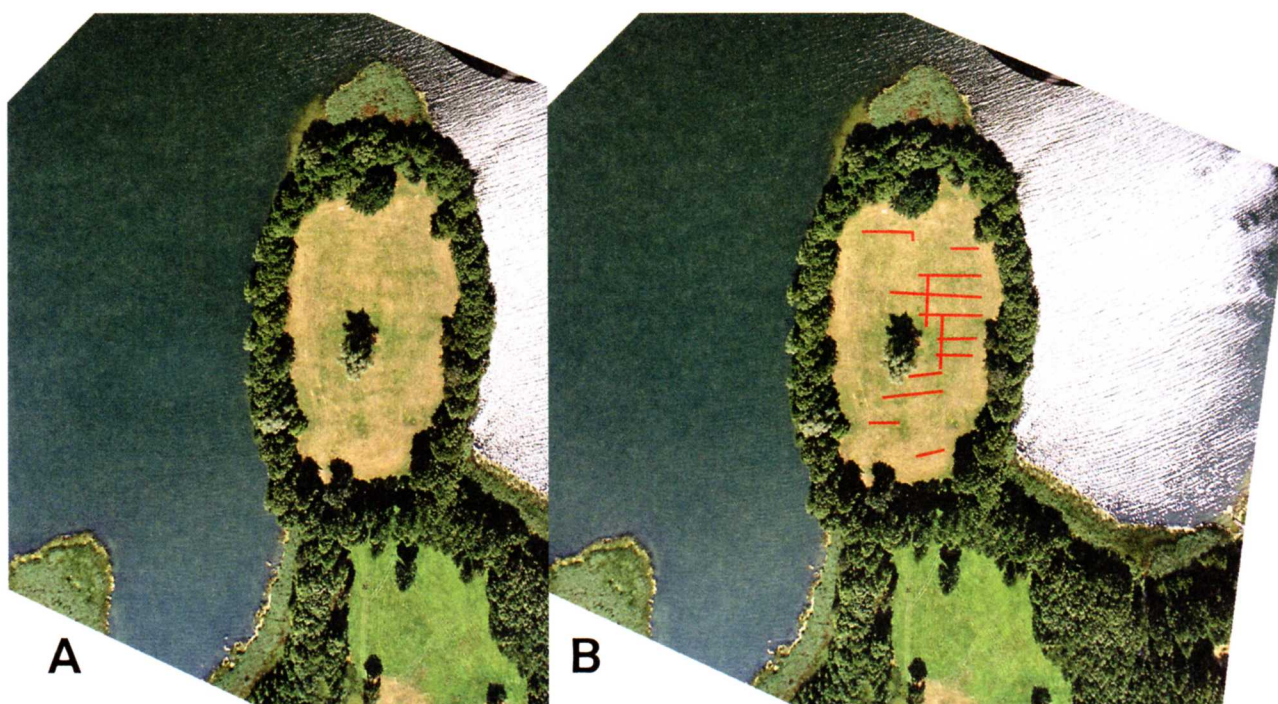


Fig. 10. Izdebno: A. rectified air photograph, 2005; B. the image (A) with interpretation of grassmarks

The site was surveyed in 2004. Only the major, northern, part was accessible; the small area east of a drainage ditch was covered in high grass and difficult of access. The survey (Fig. 17) revealed lines of definite though slight and poorly defined anomalies, probably hearths or pits inside houses, at least sixteen being visible, around 6-7 m apart.

#### *Tarnowa* (Figs 18-20)

The site (Okopy Szwedzkie, “Swedish trenches”) lies on the flood-plain south of the present-day course of the river Warta (Fig. 18), and consists of an enclosure around 80 m in diameter, marked by a well-preserved rampart. A small excavation was carried out in 1957 in the eastern part of the site interior, though the name of the excavators is not recorded in the archive; in 1976 a test trench was dug by a member of the Poznań branch of the IHKM of the Polish Academy of Sciences, but no details are available<sup>3</sup>.

Aerial photographs of the site taken on 20 April 2005 and 21 April 2006 do not show grassmarks. The ‘moat’ surrounding the rampart is clearly visible (Fig. 19).

The whole of the interior of this site, and those parts of the rampart that are not under vegetation, were surveyed in 2005. The ramparts clearly show a double anomaly, similar to that at Sobiejuchy. The interior appears to show a small number of large rectangular features (Fig. 20) but the level of detail is not good enough to be sure whether they are disposed in a regular fashion.

#### *Other sites*

In addition, two further sites were assessed, though on neither was fieldwork possible. At Koziegłowy (district Konin) access to the site was impossible because of flooding to the areas round this peninsula in the lake. From the air photos and the views obtainable from the lake shore it appeared that the site is overgrown and unlikely to be suitable for geophysical survey (Fig. 21). The site was discovered in 1937 by J. Kostrzewski, and partially excavated in 1968-69 by Ł. Pawlicka and A. No-

<sup>3</sup> Archive material in the Archaeological Museum, Poznań.



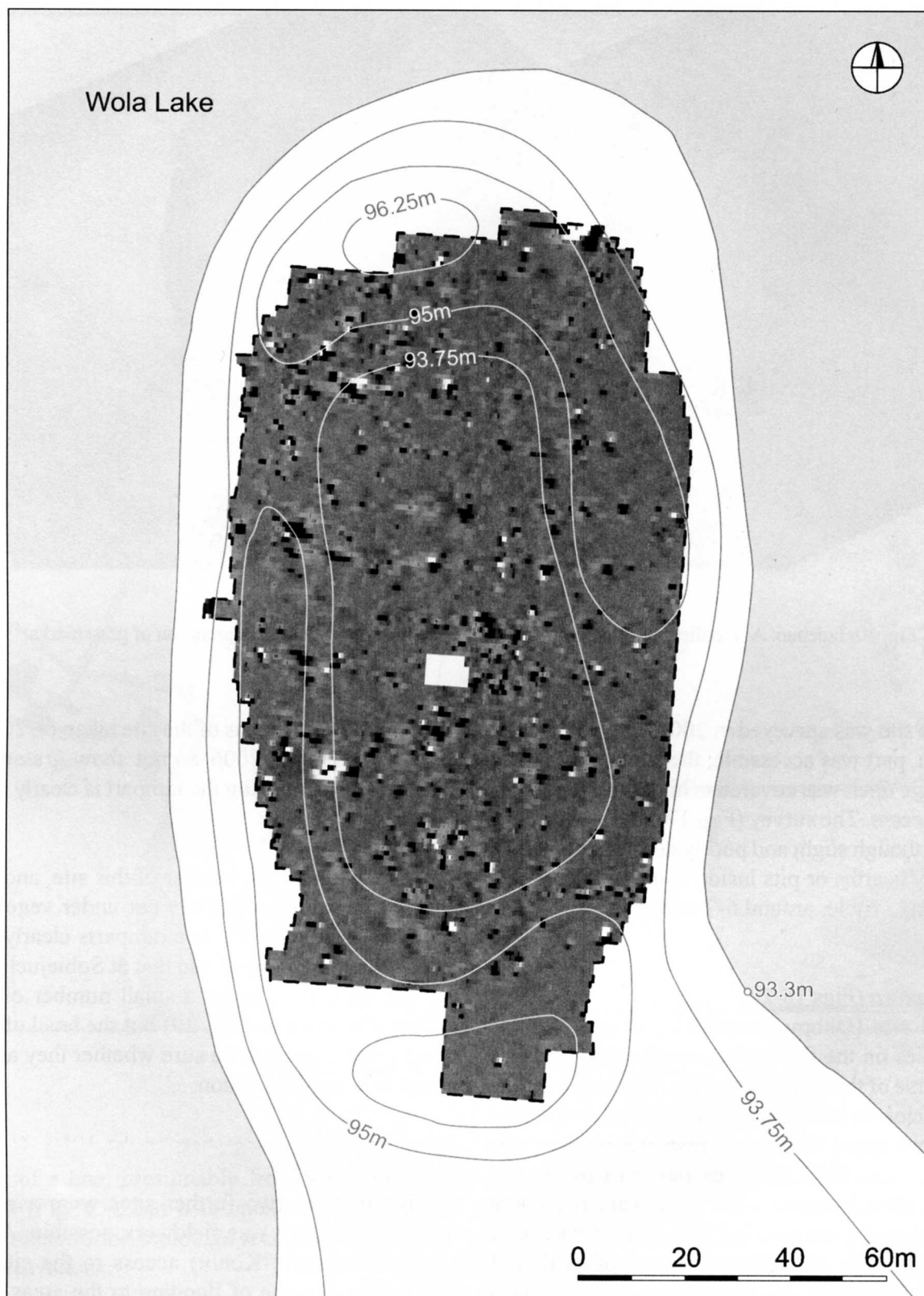


Fig. 11. Izdebno: geophysical survey plan, 2005

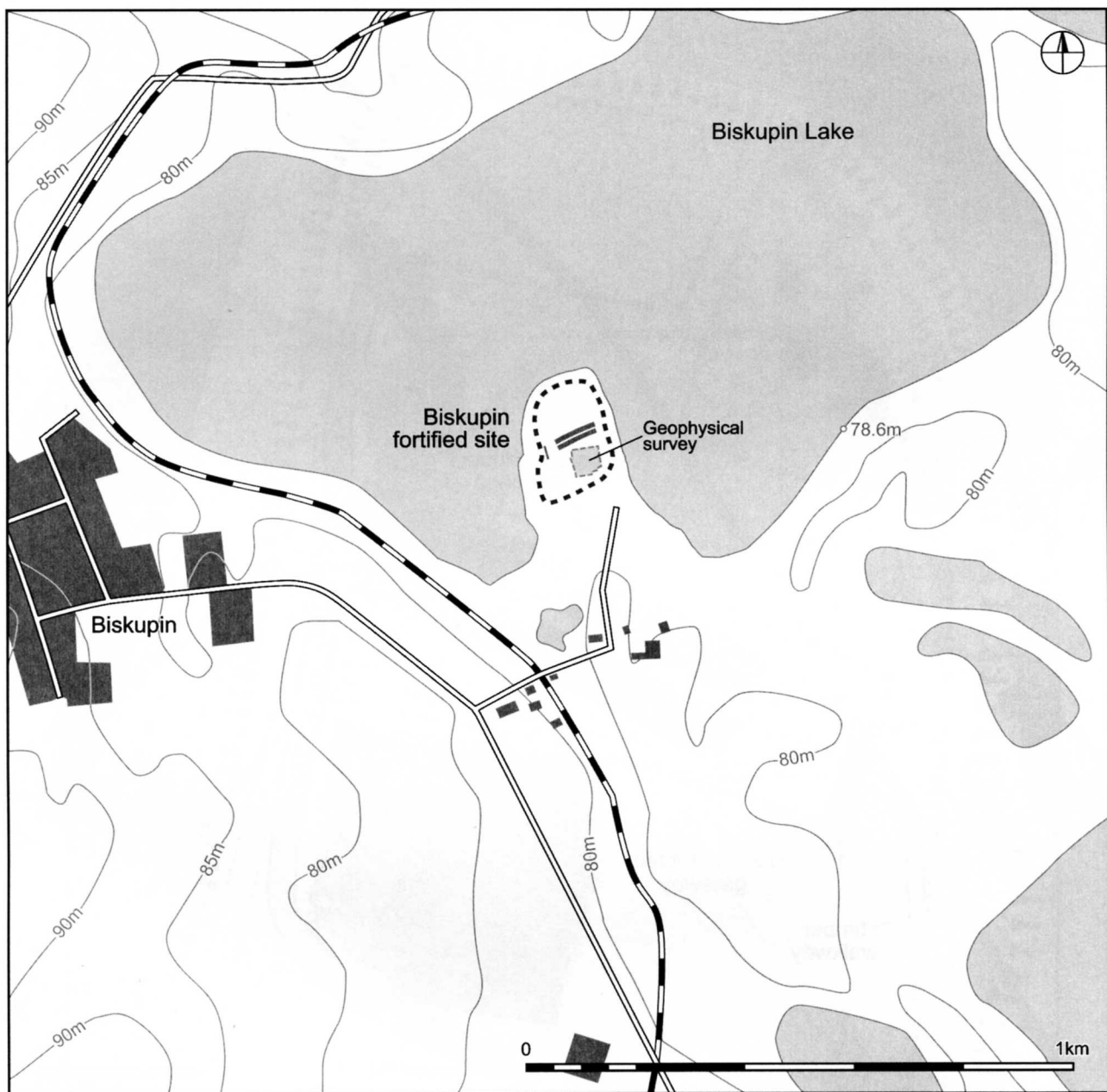


Fig. 12. Biskupin: location map for geophysical survey

wak, who dug a section through the rampart, the breakwaters, main gate, and identified the street outside the rampart and the internal street leading from the gate; they failed to identify houses, only a few clusters of stones, some of them perhaps hearths, others possibly house foundations. Pottery and iron objects gave a Ha D date (Nowakowie 1970; Nowiński 1992).

The site of Ostrowite Trzemeszeńskie (Trzemeszno) (Szafranski 1957) lies on a small island in the eponymous lake (Fig. 22) and was visited by boat.

Excavations took place here in the 1960s (Jasnosz 1970), but nowadays the site is almost entirely covered with trees and shrubs, and survey was not possible. However, on the south side of the site two wooden piles were visible protruding from the lake mud (see below – Fig. 23).

#### *Discussion*

The results from the sites surveyed in 2004-5 are important and revealing in a number of respects. First, they confirm that Biskupin was not alone in

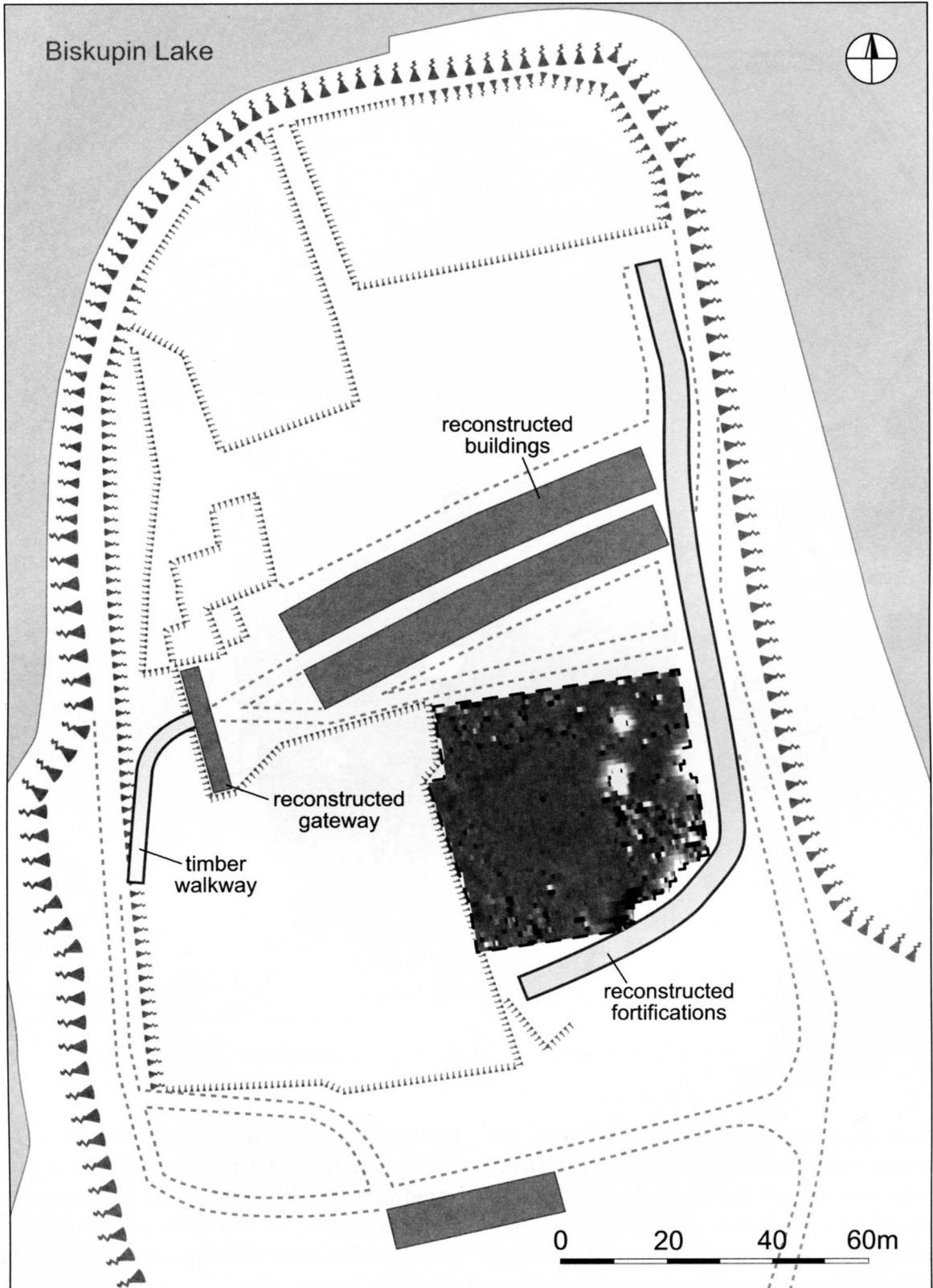


Fig. 13. Biskupin: geophysical survey plan 2005

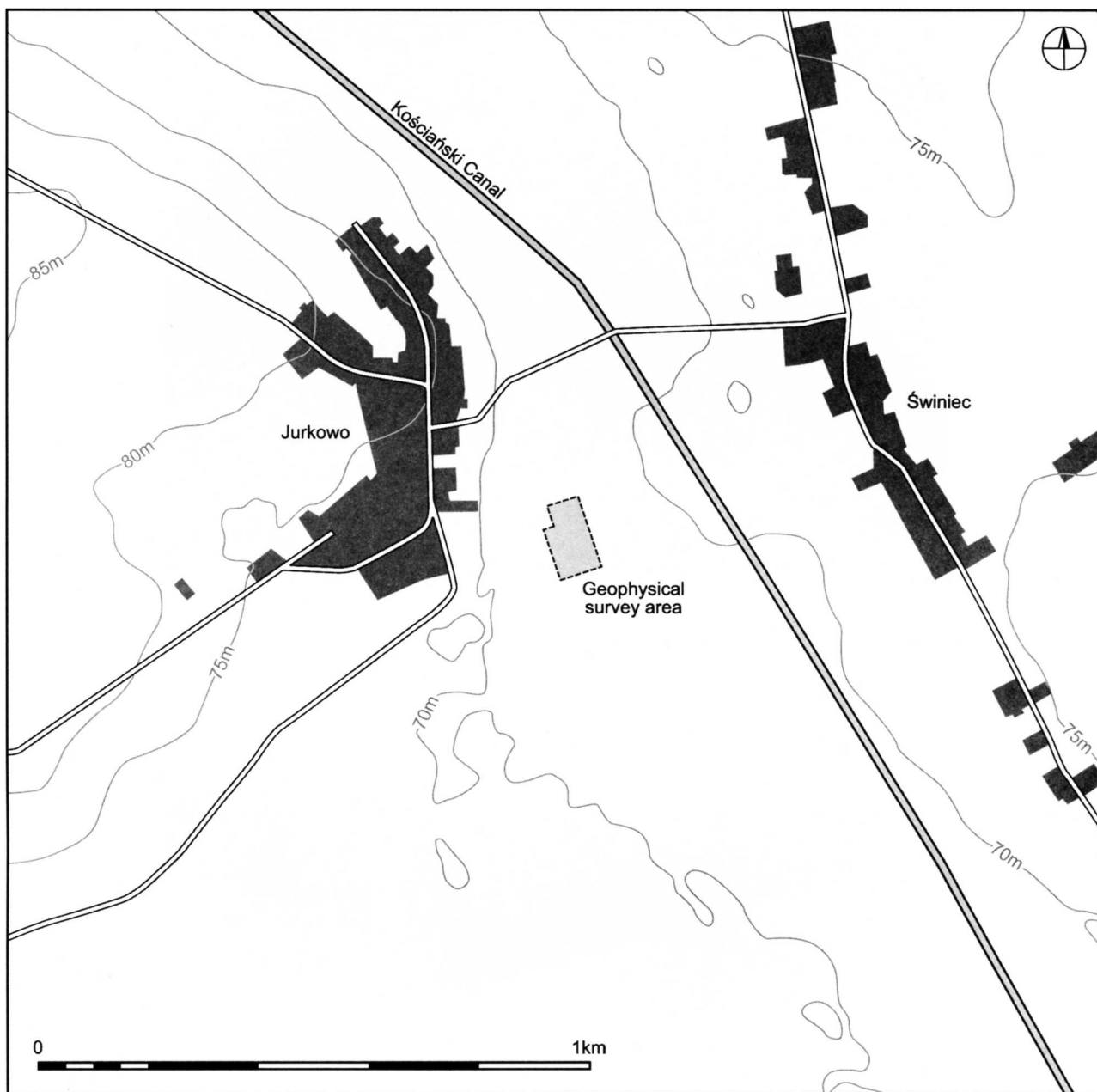


Fig. 14. Jurkowo, district Leszno: situation plan

having regular rows of structures filling the entire enclosed area: this pattern is present at Smuszewo and Jurkowo, and probably present at Izdebn. Second, and possibly more important, they show that a quite different arrangement of structures was used at the near-contemporary site of Sobiejuchy. Here the houses were not arranged in such regular rows, and they did not cover the entire site interior – which at 6 ha is in any case much larger than the other sites considered here. Sobiejuchy lies only 14 km from Biskupin, and may have been slightly earlier in date

(see below); but it is close enough in time and place that the inhabitants of one site must have been aware of those of the other. Instead, it may be argued that a different type of social organisation was present at the two sites, that at Sobiejuchy being of a looser, and arguably less risk-prone, than that at Biskupin. At the same time, it seems likely that communities in such close proximity spatially and chronologically could not have differed in any significant way culturally, so that the impact of social structures on the layout of the sites remains a matter for debate.





Fig. 15. Jurkovo, air photograph 2008

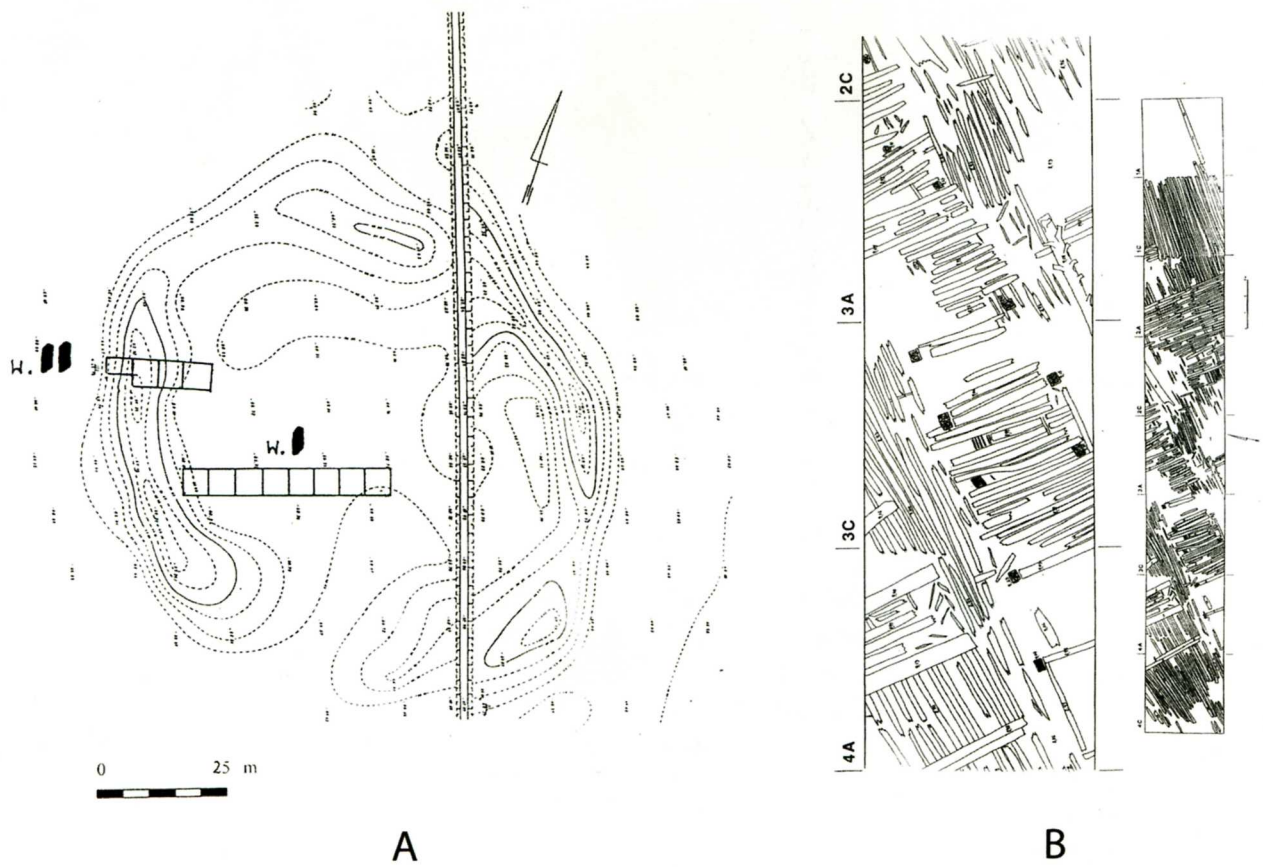


Fig. 16. Jurkovo: general plan (A) and excavation plan 2000 (B). Source: Elżbieta Wyrwińska



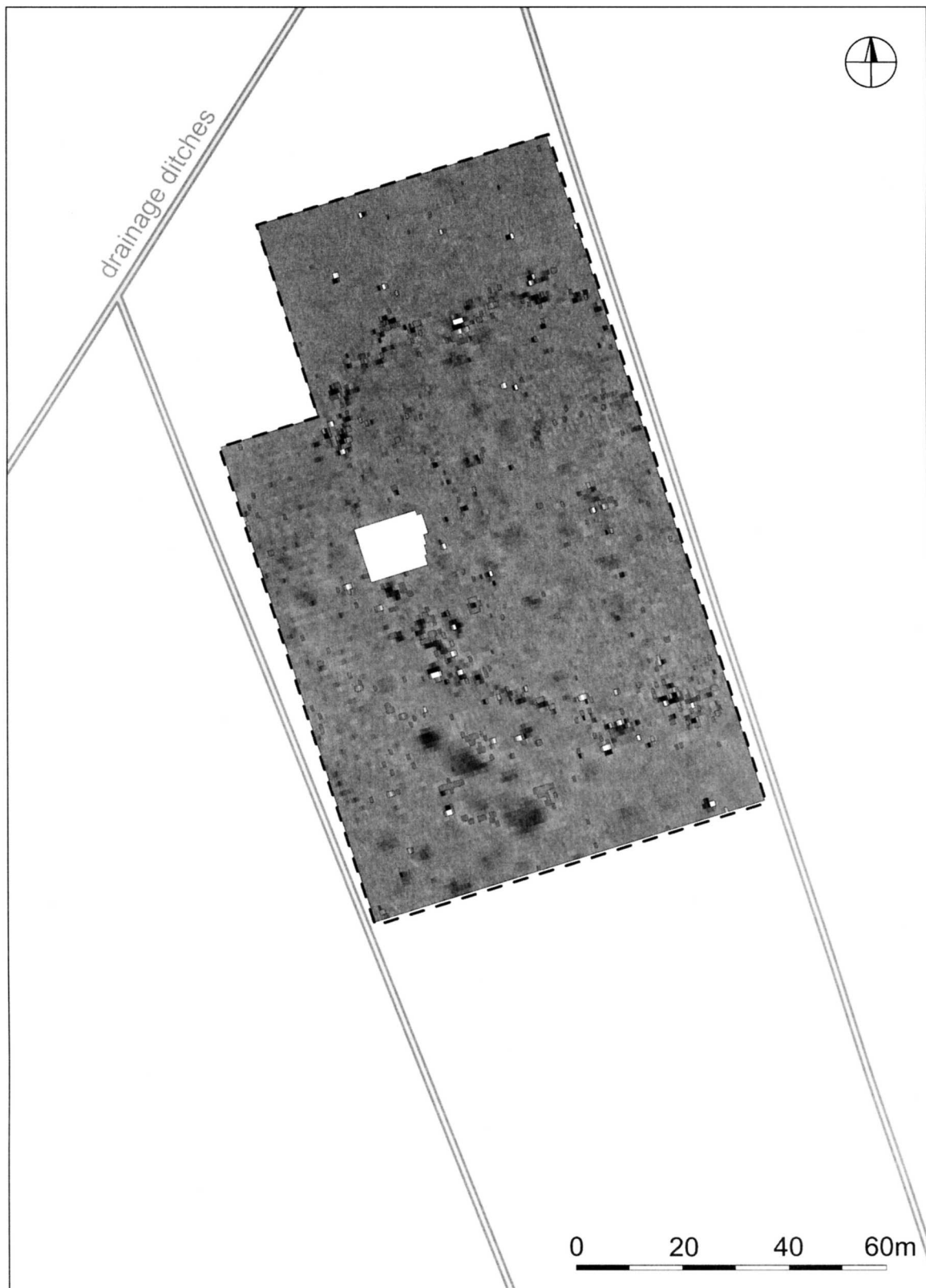


Fig. 17. Jurkowo: geophysical survey plan 2004

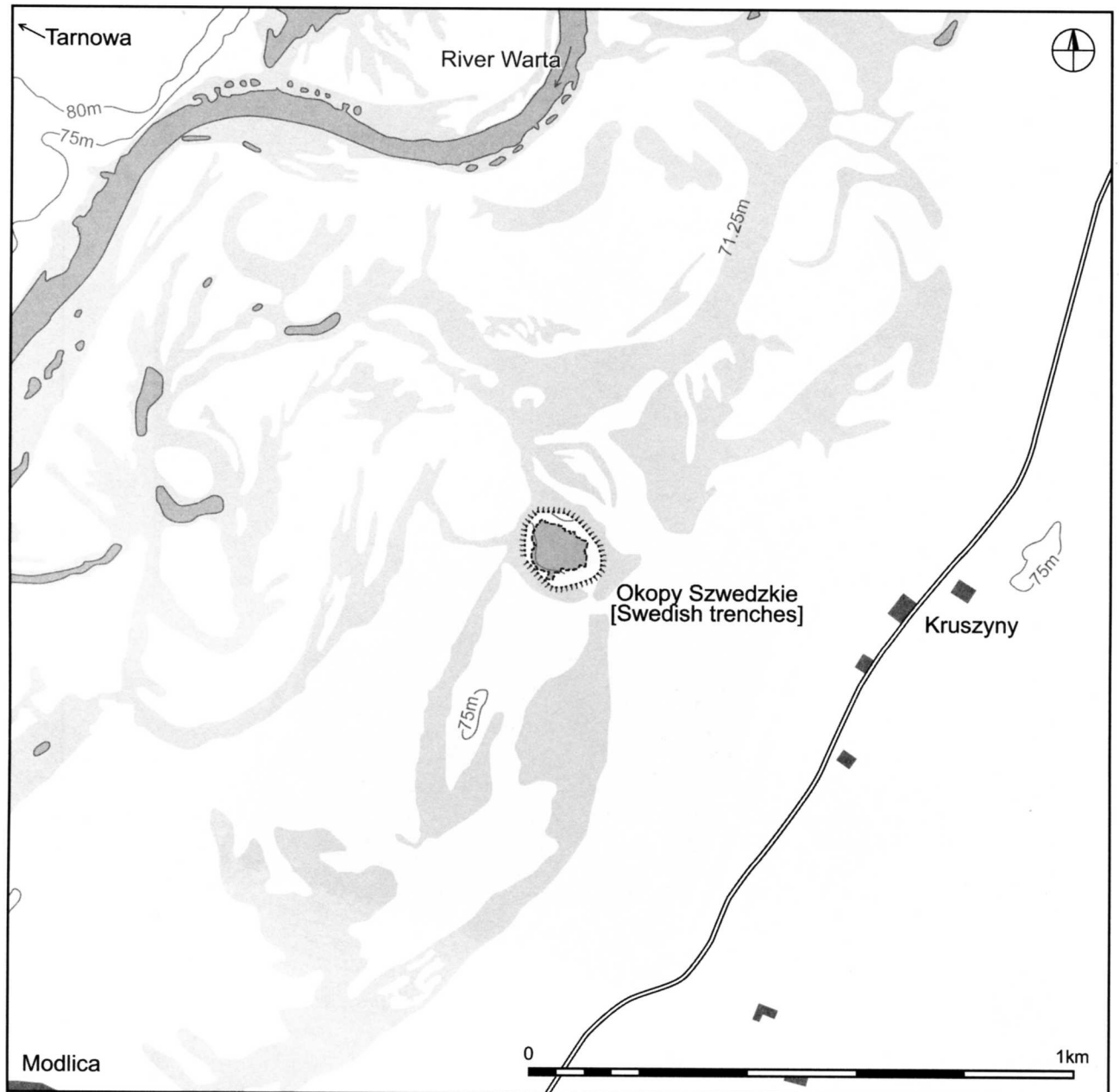


Fig. 18. Tarnowa, district Pyzdry: situation plan

Was the “Biskupin type” then the standard stockade of the Polish Early Iron Age? Clearly the lakeside site, surrounded by a wood-framed rampart, with regular rows of houses in the interior, was a major element of settlement patterning in that area and period. On the other hand, it is clear from the surveys reported here that other forms of house and street organisation were also possible.

It has been argued on occasion that sites like Biskupin would have been unstable politically and

socially, with all the inhabitants crowded into a confined space, perhaps with their animals as well; there is no open area for gatherings, recreation, or neighbour and spouse avoidance; craft activities, including perhaps even metallurgy and pot-firing, took place on the island; subsistence was dependent on the mainland, so that all food must have been brought in by boat, and all agricultural activities necessitated a journey to the mainland, and no doubt some way into the hinterland. On the other hand, it might be that such an arrangement would become unstable



Fig. 19. Tarnowa: rectified air photograph 2006

only if other factors, e.g. overexploitation of resources, started to play a role. If the ramparts were intended to deter hostile attack, they may have succeeded in that goal but they simultaneously brought about the danger that the islanders could be cut off from their source of food and other resources. Of course this 'defensive' function has been questioned in recent years (e.g. Mierzwiński 2000), and cannot be taken for granted (see discussion in Harding *et al.* 2004, 199). If human rather than environmental explanations are to be sought for the rise and fall of Biskupin and related sites, then structural instability arising from both the layout and the environmental situation of the sites must surely emerge as a highly plausible candidate.

Seen in this light, the internal organisation of Sobiejuchy can be seen as much preferable to that of Biskupin or Smuszewo. The defences and the island situation, however, still emerge as crucial

weaknesses in the organisational scheme (though at least some sites, e.g. Jurkowo and Tarnowa were not on islands). Of course, if the ramparts and situation were not intended to be defensive, we might enter into a new debate about the meaning of the social structures involved and how this impacted on the form of settlement – though lies beyond our present scope.

What then of sites outside the Biskupin region? Little can be said about the wider situation for Jurkowo, as it appears an isolated fort at present. The site at Tarnowa may be part of the same system as Kozięłowy, but at neither site is enough information available to confirm or reject this hypothesis. The same is true for Ostrowite Trzemeszeńskie. It remains to be seen whether further sites of this type will be discovered in the future; given the years of intensive work by Polish archaeologists, this is less likely than it might seem.

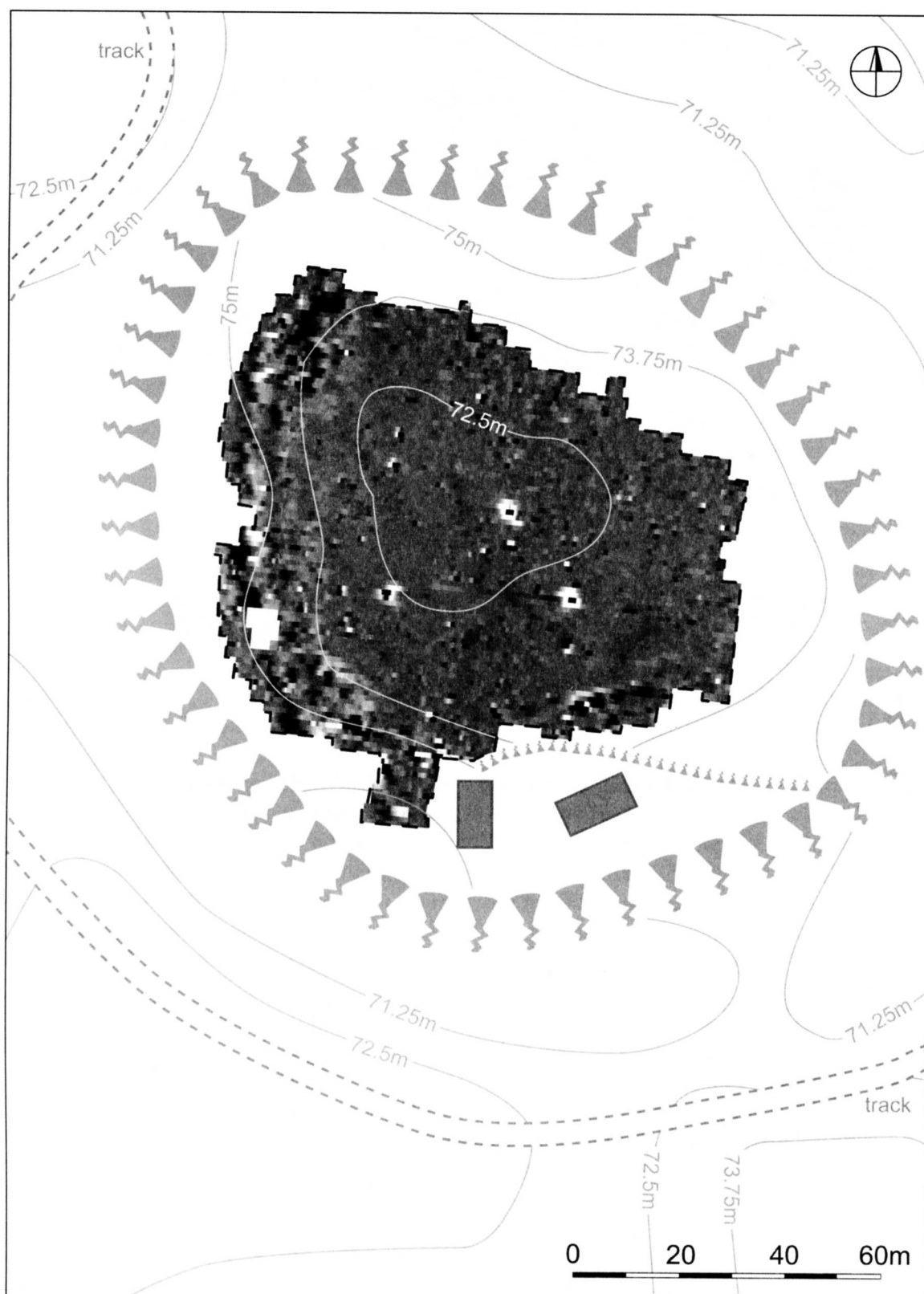


Fig. 20. Tarnowa: geophysical survey plan 2005





Fig. 21. Koziegłowy, district Konin: air photograph 2006



Fig. 22. Ostrowite Trzemeszeńskie, district Trzemeszno: air photograph 2006





Fig. 23. Ostrowite Trzemeszeńskie: post recovered from lake bed at southern end of site. Photo: Marcin Michalski

## DATING

As part of the project, and with the aim of elucidating the hitherto rather imprecise chronology of the Early Iron Age sites of Biskupin type, timbers were sought at three sites: Sobiejuchy, Izdebno, and Ostrowite Trzemeszeńskie, in order to obtain dendro dates. The radiocarbon calibration curve is flat at this point in the first millennium BC, with the result that radiocarbon dates have standard deviations far too large for establishing an effective chronology (cf Harding *et al.* 2004, 175 ff.). On the other hand, sites of this type are ideal for dendro dating, and at Biskupin a substantial series of dates has already been obtained (Ważny 1994; 2001; 2009).

### Sobiejuchy

In 2005 a cutting was made into the site terrace where the Polish excavations of the 1950s had taken place. A machine with narrow front bucket was used and timber was quickly found. The cutting was in total around 10 m long and 1-1.5 m wide (Fig. 24), though the area containing the timbers was only around 2 m long. The timbers noted in 1959 were seen at a depth of around 2.5 m, and ten piles (and some fragments) were extracted for dating purposes. Six of the ten came from a line lying in the easterly part of the trench; the remainder from the middle and western part. It was unclear whether the western timbers formed another line, but this seems likely given that Bukowski found two lines forming a timber-framed rampart.

### Izdebno

Although in past years timbers were visible in the lake water on the east side of the site, nothing was visible in 2005. Only excavation can now produce the timbers with which to date the site more precisely. Ważny has reported a single date from the site (see below).

### Ostrowite Trzemeszeńskie

Two wooden piles were extracted from the lake muds at the southern end of the island; one was submitted for dating (Fig. 23).

### Discussion

Ważny's report (below) indicates that the most likely felling date for the Sobiejuchy timbers was within a few years of 750 BC. This compares with the date of 738-7 BC for the felling date of timbers of the "first phase" at Biskupin (Ważny 1994), while Ważny's subsequent work (61 dated samples from the western part of the Biskupin peninsula) confirmed that "the vast majority of timbers originate from the felling activity 739-736 BC", though the range is wider than before at 750 to 708/7 BC (Ważny 2009). The difference between the two sites is not great, but there are other reasons for believing the Sobiejuchy material to be a little older than that from Biskupin (Harding *et al.* 2004, 174-5), which this gap would allow. It is notable, for instance, that

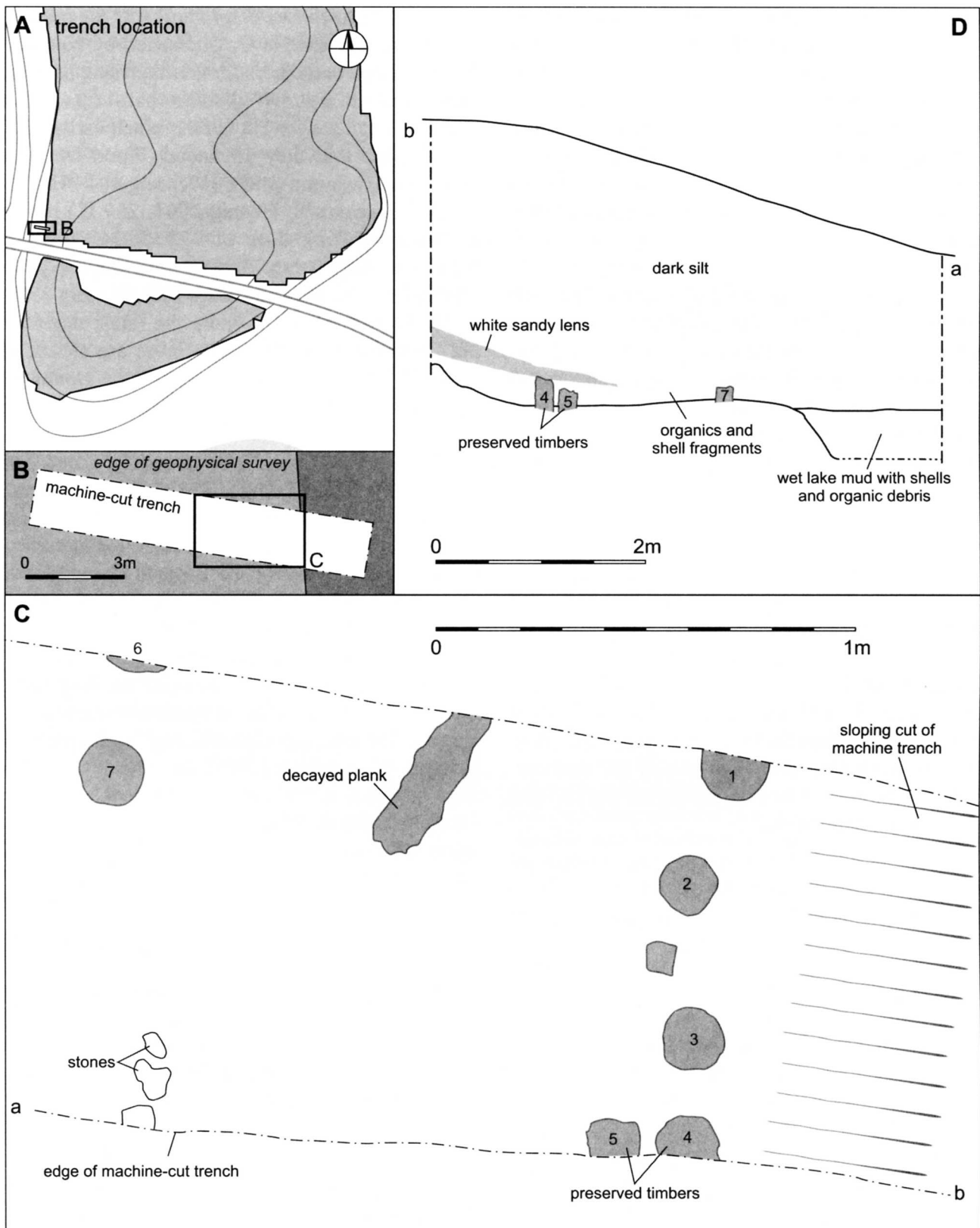


Fig. 24. Sobiejuchy: A-B. location plans for the trench dug in 2005 to recover rampart timbers; C. sketch plan of the trench showing recovered timbers (numbered); D. north-facing profile of the trench



little or no material uniquely characteristic of Ha D has been recovered from Sobiejuchy, such as Encrusted Pottery; it is, however, present at Biskupin (Miklaszewska-Balcer 1991), where certain metal forms also fall in that period. The majority of datable material at Sobiejuchy falls in Ha C, where an indication is possible, though it cannot be ruled out that it continued later than this, as some metal forms have a long lifespan.

Interestingly, the dated timber from Ostrowite Trzemeszeńskie, where the most likely felling date is 706 BC, falls significantly later (40-50 years) than either Sobiejuchy or Biskupin, but with a single date available at present not too much can be read into this. The same is true for Izdebno, where the single date obtained so far, “around or after 729 BC”, lies between the two extremes represented by Sobiejuchy and Ostrowite (Ważny 2009).

The dendrochronological dates thus obtained clearly indicate a date in the mid-eighth century BC for Sobiejuchy. This confirms, but also adds much greater precision to, the date range obtained by radiocarbon and thermoluminescence for the site (Harding *et al.* 2004, 175 ff.). Because of the difficulties of using radiocarbon for the time period in question, a broad span between 760 and 410 cal BC was suggested. It is clear now that the earlier part of that time bracket is involved.

## CONCLUSION AND PROSPECTS

It is abundantly clear that there were two – or more – fortified site types in use in the Early Iron Age of central Poland at this time. On the face of it, the Sobiejuchy type may have been the more likely to succeed: one of the crucial objections to the sustainability of the Biskupin type was the fact that there is no open space in the site where people could meet. The size of Sobiejuchy may be another pointer here: at nearly 6 ha it is roughly four times larger than Biskupin, with potentially a considerably larger population, no doubt with varied craft and other skills to match. It is uncertain if flooding played a part in the demise of Biskupin, but Sobiejuchy seems always to have been dry land even though separated from the mainland by water or boggy

ground. The question of environmental changes during the course of the eighth century BC is a large one which cannot be considered here, though it may be crucial for an understanding of why Biskupin and related sites came to exist and why they then collapsed.

It has been shown before now that the traditional chronology for Ha C established by Kossack, Müller-Karpe and others for Germany and adjacent areas needs to be revised somewhat; in particular that the start date for Ha C falls much earlier than the 700 BC that they advanced. Wood from the Wehringen waggon-grave (Wehringen I “Hexenbergle”, Tumulus 8: Hennig 2001: 259 ff.) has an estimated felling date of 778±5 BC, the last measurable ring being 793 BC, with some 15 years allowed for the sapwood (Friedrich, Hennig 1995; 1996; Friedrich 2001), while the latest dates for Ha B3 contexts on the Swiss lakes are all earlier than 800 BC. These datings confirm the arguments by Pare for an early phase of Ha C characterised by Gündlingen swords (into which the Wehringen grave falls) (Pare 1987), and by Parzinger for a start date around 750 BC (Parzinger 1989; 1995). The new dendro dates are in perfect accord with these arguments. On the other hand, the recent dating of timber in a Ha C grave in the Isis and Great Mother sanctuary in Mainz to 704 BC suggests that Ha C may have been a long period (Bauer 2008). The dendro dating of the south German Iron Age has recently been reviewed by Billamboz (2008); the present work adds new material of some relevance to his survey, which bears only indirectly on the problem in hand.

If, as discussed above, there is a small time difference between Sobiejuchy and Biskupin, the scene is set for a dynamic relationship between these two sites, and no doubt between these two and Izdebno, where we have no dendro dates so far. Clearly, in order to specify this relationship in greater detail, we need a greatly expanded programme of dendro dating, so that the phases by which the ramparts at

ground. The question of environmental changes during the course of the eighth century BC is a large one which cannot be considered here, though it may be crucial for an understanding of why Biskupin and related sites came to exist and why they then collapsed.

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the sites came into being can be specified; by that means, one could see whether adaptation and re-forestation (as is alleged for Biskupin) took place as a result of, or concurrent with, activities at neighbouring sites. Potentially a highly detailed picture could be obtained; one which could hardly be rivalled in European prehistory.

This does raise the question of the sequence of events at Biskupin, the most extensively excavated site of all those discussed here, and the site with the most recovered wood. From the earliest stages of excavation it has been repeatedly stated that two phases are present on this site; the second following a conflagration which destroyed the first, and used less oak than the first. This is a matter which requires detailed investigation, since the reports from the first fifteen years of excavation give little clear indication to support the idea (no section drawings, many ambiguities on the published plans, no clear typological sequence). Coupled with these doubts one may add that the dendro dating gives no indication of two phases, merely that some timbers were still being brought on to the site after the main felling period, and indeed up to 40 or so years after the fort was first constructed (although we do not know for sure when that first construction took place). Wazny's recent work (2009) confirms this picture, suggesting that repairs took place at Biskupin over a period of thirty years or so, with an eventual abandonment in or after 708 BC. This date naturally raises questions over the cultural affinities of the site, since it is far too early for Ha D – a start for which cannot be much earlier than the latter decades of the

seventh century BC. This suggests that the material attributed to Ha D at Biskupin did in fact start earlier than that.

These doubts can be conclusively laid to rest, however, if a systematic programme of dating were to take place, not only at Biskupin (where there are now more than 120 dendro dates) but elsewhere. What is reported here is merely a start; it should be easy enough to get more timber from Izdebno and the same type of programme might be applied to other microregions, for instance that at Jankowo near Kruszwica (itself also a prehistoric and early medieval fortified site, perhaps of "Biskupin type") – which was dug as a rescue project in the 1970s prior to flooding by the raising of the lake level (Ostojka-Zagórski 1978)<sup>4</sup>.

The work reported here is merely a start, but it has demonstrated some of the potential of what are now routine methods used in archaeology. Some of them involve expense, and some time; but all are accessible. It is to be hoped that other researchers will now take up the challenge.

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<sup>4</sup> The site is currently inaccessible, being crossed by a conveyor bucket system bringing limestone and gypsum from the Mowap quarry at Wapienno near Barcin to the Janikosoda plant at Janikowo. This does not mean, however, that timbers cannot be extracted: indeed, because the site has effectively been written off as destroyed, there can be little objection to a rapid investigation to recover piles for dating.

TOMASZ WAŻNY (Cornell/Toruń)

## DENDROCHRONOLOGICAL ANALYSIS OF ARCHAEOLOGICAL TIMBER FROM SOBIEJUCHY AND OSTROWITE TRZEMESZEŃSKIE, POLAND

Dendrochronological examination of wooden constructions from the Early Iron Age settlement at Sobiejuchy (Poland) was carried out on thirteen samples taken from the western part of the Sobiejuchy fortification, and on one pile from Ostrowite Trzemeszeńskie. Posts No. 1-5 from Sobiejuchy represent the eastern line, samples No. 6-7 and samples without description were taken from the western line<sup>5</sup>.

### Methodology

This study was carried out using classical dendrochronological methods. The tree-ring widths were measured at the cross-section of analysed samples. The surface was cleaned using sharp knives and razor blades. The annual rings were measured on a *Sheffield* measuring stage to an accuracy of 0,01 mm. The series of tree-ring widths were com-

pared to and matched with European master chronologies. Cross-matching and chronology construction were undertaken using software CATRAS v. 4.35 (Aniol 1980-2003), TSAP and TSAPWin (Rinn 1996; 2005) and DENDRO for WINDOWS (Tyers 2004), supported by visual comparison. The “t-values” reported below were calculated using the Baillie-Pilcher algorithm transformed by Aniol (1983). Selected ring sequences were combined to form a site master curve (Sobiejuchy) and a mean curve (Ostrowite Trzemeszeńskie).

### Results

All thirteen analyzed samples from Sobiejuchy have been dated. The ring-patterns of samples varied between 60 and 123 rings (Table 2). Eight samples contained sapwood, six of them bark edge. The ten selected sequences were combined to form a site chronology P888001M, 117 years long. There is a highly significant correlation with the Biskupin master dated chronology running BC 862-746 (Table 1). All dating results are presented in Table 2 and illustrated by means of bar diagrams in Fig. 25.

<sup>5</sup> Unfortunately the labels of some samples became detached either during storage at Biskupin Museum or en route to the lab in Toruń. The overall conclusion of the analysis is not affected (*note by main authors*).

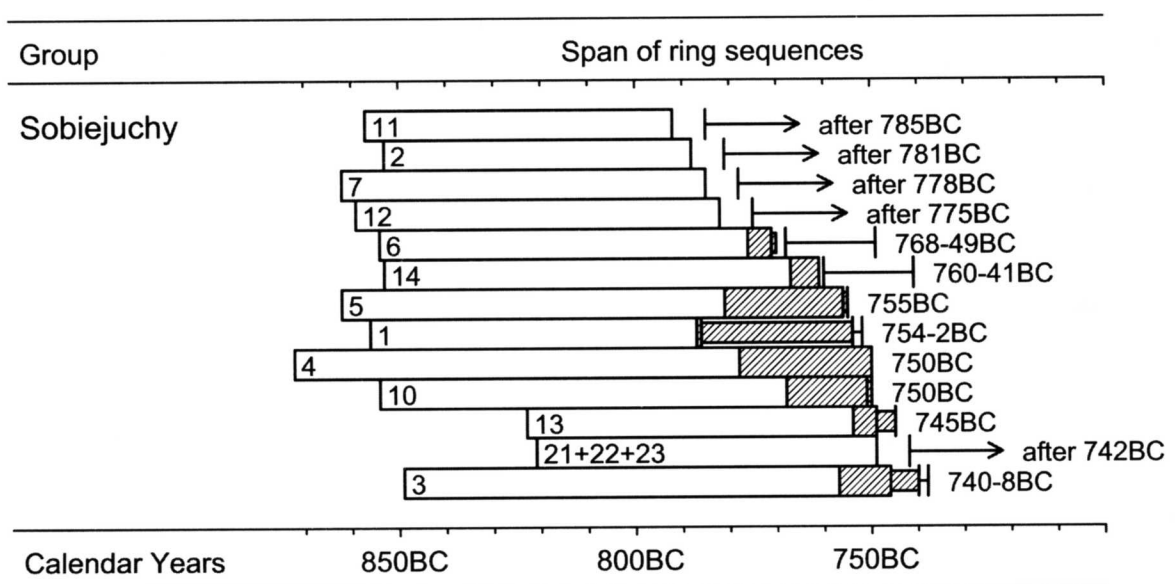


Fig. 25. Bar diagram showing the relative positions of the dated tree-ring sequences from Sobiejuchy. Sapwood and unmeasured rings are marked

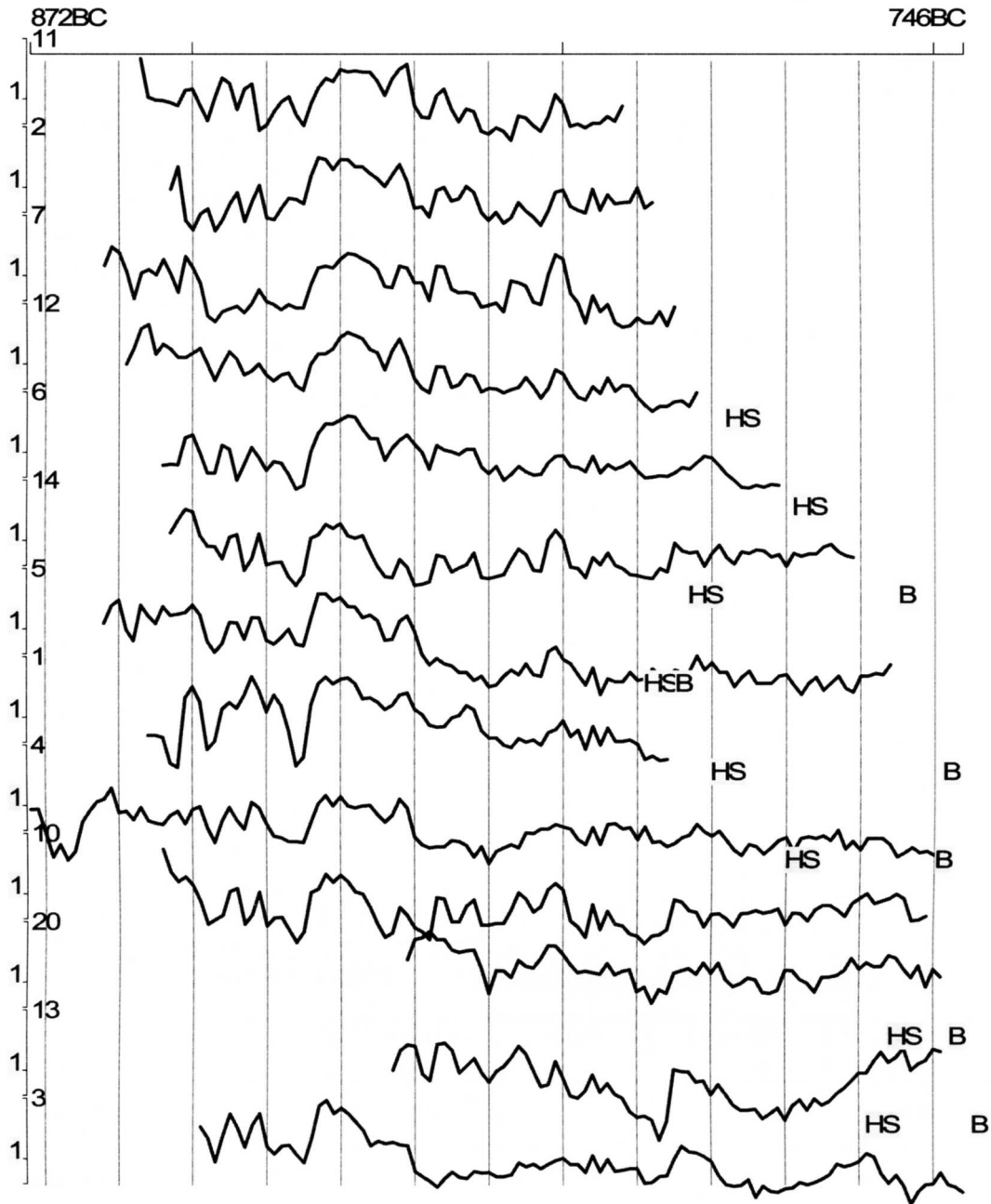


Fig. 26. Tree-ring sequences from Sobiejuchy

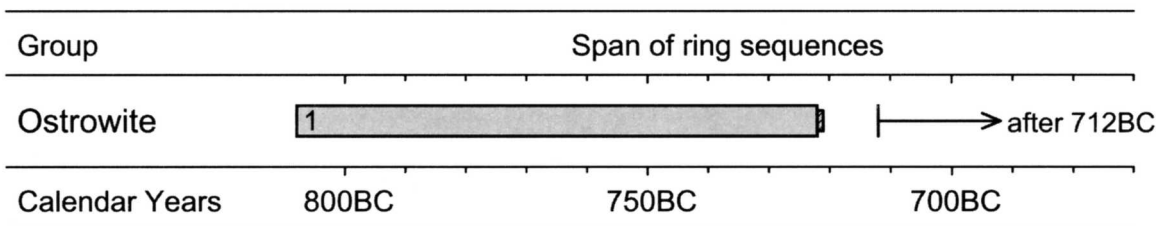


Fig. 27. Bar diagram showing the position of dated tree-ring sequence from Ostrowite Trzemeszeńskie

Six samples with preserved bark ring yielded the following dating results (felling years): BC 755, 754-752, 750, 750, 745 and 740-738. The less precise dating obtained for two samples was caused by extremely narrow or eroded tree-rings and resulted in some uncertainty in counting and measuring process. For samples with partially preserved sapwood the 7-26 year sapwood range with median 15 years has been applied.

The tree-ring series from Sobiejuchy are very similar to sequences from Biskupin. They are very sensitive and include a strong climatic signal. The ring widths in a single sequence can vary from 0,3

to 2,8 mm with long-lasting, deep growth depressions (Fig. 26). Sobiejuchy timbers contain precise records of a turbulent period in the 9<sup>th</sup> and 8<sup>th</sup> centuries BC preserved in their tree-ring structure – the same as reported by Ważny (2001) for Biskupin.

The analyzed sample from Ostrowite Trzemeszeńskie was successfully dated using the Biskupin and PL\_Hallstatt chronology (Fig. 27 and Table 3).

712 BC is the earliest possible falling year of the tree, 706 BC is the most probable. The pile has been made from a relatively regular growing tree, without the “ups and downs” which are characteristic for Biskupin timbers.

Table 1. Statistical correlations with master chronologies (“t-values”)

Master Chronology	Sobiejuchy MC10 (862 – 746 BC)
Biskupin 1 M	10,5
Moor_His (Goettingen, Leuschner)	4,0

Table 3. List of samples and dating results

P888 1. OSTROWITE TRZEM.

Key code	Total No. of rings	Sapwood rings	Bark	Cross-dating of sequence	Dating result	Species
1	87 (+1)*	-	-	808 – 722 BC	706 <sup>+6</sup> / <sub>-X</sub> BC**	oak

\* number in brackets means unmeasured rings; \*\* “X” means unknown number of missing heartwood rings

Table 2. List of samples and dating results P888. SOBIEJUCHY

Key code	Sample No. and origin of samples	Total No. of rings	Sapwood rings	Bark	Result	Cross-dating of sequence	Dating result	Species
1	Sob. 2005, post No. 1	71 (+32)*	35	+	dated	856-786 BC	<b>754-752 BC</b>	oak
2	Sob. 2005, post No. 2	66	-	-	dated	853-788 BC	<b>773<sup>+8</sup>/<sub>-x</sub> BC**</b>	oak
3	Sob. 2005, post No. 6	104 (+6)	17	+	dated	849-746 BC	<b>740-738 BC</b>	oak
4	Sob. 2005, post No. 6	123	28	+	dated	872-750 BC	<b>750 BC</b>	oak
5	Sob. 2005, post No. 6	107 (+1)	26	+	dated	862-756 BC	<b>755 BC</b>	oak
6	Sob. 2005, post No. 6	85	5	-	dated	854-770 BC	<b>760<sup>+8</sup>/<sub>-11</sub> BC</b>	oak
7	Sob. 2005, post No. 6	78	-	-	dated	862-785 BC	<b>770<sup>+8</sup>/<sub>-x</sub> BC</b>	oak
10	Sob. 2005, no number	104 (+1)	18	+	dated	854-751 BC	<b>750 BC</b>	oak
11	without description	60	-	-	dated	851-792 BC	<b>777<sup>+8</sup>/<sub>-x</sub> BC</b>	oak
12	Sob. 2005, no number	66	-	-	dated	853-788 BC	<b>773<sup>+8</sup>/<sub>-x</sub> BC</b>	oak
13	Sob. 2005, no number	75 (+4)	9	+	dated	823-749 BC	<b>745 BC</b>	oak
14	Sob. 2005, no number	93	6	-	dated	853-761 BC	<b>752<sup>+8</sup>/<sub>-11</sub> BC</b>	oak
21	three pieces of wood	73	-	-	dated	821-749 BC	<b>734<sup>+8</sup>/<sub>-x</sub> BC</b>	oak
22	from the same tree,							
23	without description (Ostrowite?)							

\* number in brackets means unmeasured rings; \*\* "X": unknown number of missing heartwood rings

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