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Plant macroremains from an early Neolithic site in eastern Kuyavia, central Poland

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ABSTRACT. The study examined plant remains from the Smólsk 2/10 site, situated on the border of two different landscapes and preserving traces of Neolithic occupation from several cultures: Early Linear Pottery culture (LBK, ca 5300–5200 cal. BC to ca 5000 cal. BC), Stroke Band Pottery culture (SBP, ca 4700–4400 cal. BC), the Brześć Kujawski group of Lengyel culture (BKG, ca 4500–4000/3900 cal. BC), Funnel Beaker culture (TRB, ca 3950–3380 BC), and also some features of the Lusatian culture (Hallstatt C, ca 970–790 cal. BC).

Mostly hulled wheat remains (*Triticum monococcum*, *T. dicoccum*) were found in the LBK, SBP, and BKG cultures; they were completely absent in younger cultures (TRB, Lusatian), where barley remains appeared. Among other plants the most numerous were remains of small-grain grasses (mostly cf. *Hierochloë* type), feather grass (*Stipa* sp.), wild buckwheat (*Fallopia convolvulus*), and goosefoot (*Chenopodium album* type), but the plant remains are relatively scarce.

The archaeobotanical data obtained from the site supplement data from neighbouring Osłonki to the west and Wolica Nowa to the north-west. The differences between those microregions are reflected mostly in the earlier appearance of feather grass (*Stipa* sp.) in the Smólsk area as well as the higher quantity of crop chaff remains in the Osłonki area, but their random occurrence, along with the fragmentariness of the archaeological data, must be taken into account. However, intentional introduction of feather grass by the first Neolithic settlers in eastern Kuyavia cannot be excluded. The relatively high proportion of small-grain grasses, usually interpreted as traces of fodder, together with the scarcity of crop remains at the Wolica Nowa site, suggests that the site was connected more with animal husbandry than with agriculture. On the other hand, the small-grain grasses at Smólsk are represented mainly by a large number of non-weedy grass (cf. *Hierochloë* type) grains from the crop sample, which cannot be explained in a simple way.

A comparison of the anthracological data from the Osłonki and Smólsk microregions reveals differences in woodland management and differences between the local environments. Pine wood was more accessible at Smólsk than at Osłonki, due to local landscape characteristics.

KEYWORDS: archaeobotany, archaeogeomorphology, Neolithic plant husbandry, *Stipa* sp., black earths, North European Plain

INTRODUCTION

The Kujawy region lies near the northern edge of the distribution of early Neolithic settlement in Central Europe. This part of the North European Plain was covered by ice during the last glaciation, which is reflected in the area's landscape variability (moraines, outwash plains, subglacial channels, kettle holes) and hydrological system (small lakes, slow-flowing streams).

Archaeological studies of southeastern Kujawy (Kuyavia) began in the early 20th century

(Jażdżewski 1938), mainly in Brześć Kujawski (Bogucki & Grygiel 1983, Grygiel 1986). The second important early Neolithic settlement complex was found at Osłonki, ca 10 km west of Brześć Kujawski (Grygiel & Bogucki 1997). Archaeological research in that region, including environmental studies, has been described in monographs and review papers (Grygiel 2004, 2008, Bogucki et al. 2012). Archaeobotanical studies of the sites (Zagajewice 1, Miechowice 4, Konary 1, Konary 1a, Miechowice 4a, Osłonki 1, Guźlin 2, Smólsk 4, Wolica Nowa 1) were described by Bieniek (2007); in the present paper we supplement those results with data from our archaeobotanical research at another site, Smólsk 2/10 (Fig. 1).

DESCRIPTION OF THE SITE

We studied the Smólsk 2/10 site as part of motorway rescue excavations by the Professor Konrad Jażdżewski Foundation for Archaeological Research in Łódź in 2008–2009 (Muzolf et al. 2012). The site is located in SE Kuyavia (Kujawy), ca 12 km east of the Osłonki site and 6 km east of Brześć Kujawski (N 52°36′, E 18°58′; 75–84 m a.s.l.) (Fig. 1). Smólsk 2/10 is on a morainic upland and the adjoining slope of a subglacial channel. Part of the floor of the subglacial channel is occupied by a kettle hole filled with organic deposits of a post-lake basin. The main part of the site is on a small local elevation of the morainic upland. The edge of

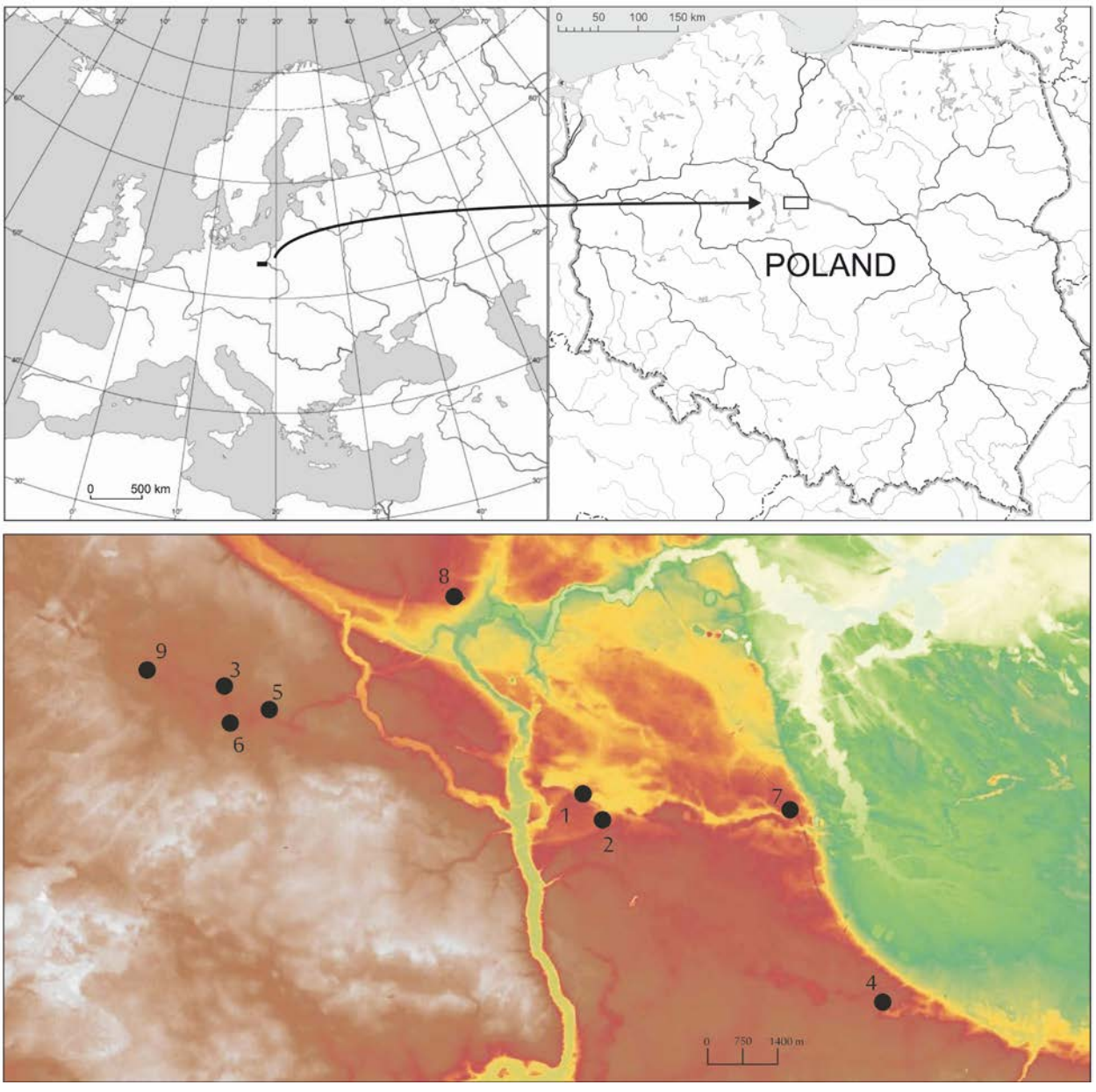

Fig. 1. Location of the archaeobotanically studied sites (map shows dynamic hypsometry). Sites: **1** – Brześć Kujawski, **2** – Guźlin, **3** – Konary, **4** – Ludwinowo, **5** – Miechowice, **6** – Osłonki, **7 – Smólsk**, **8** – Wolica Nowa, **9** – Zagajewice

the Plock Basin (part of the Vistula ice-marginal streamway), with its very distinctive topography, is in the close vicinity of the site to the east (Kittel 2015). At present the subglacial channel floor is covered with hydromorphic soils. The site is at the border of two different landscapes and also large geobotanical divides: the Plock Basin to the east, covered by sandy soil and mixed pine forest developed mainly on fluvioglacial deposits of ice-marginal streamway terraces; and Black Kuyavia to the west, covered by black and brown soils on morainic upland with numerous closed depressions. The Plock Basin belongs to the Toruń-Eberswald ice-marginal streamway (Pradolina Toruńsko-Eberswaldzka), and the Kuyavian Lakeland (Pojezierze Kujawskie) belongs to the Great Poland Lakeland (Pojezierze Wielkopolskie) (Kondracki 2000). The morphology of the area occupied by the site was much more diverse in the past than today, with several small closed depressions (area 200–4,000 m^2, depth to 1.8–2.0 m) and the lake basin near the site to the south-east (Kittel 2015, Kittel et al. 2015).

During rescue excavations a 8.67 ha area was explored, uncovering a number of archaeological features, including clay pits, storage pits and waste pits, postholes, burials in clay pits, skeleton and cremation graves, ditches, as well as isolated hearths and concentrations of ceramics belonging to nine chronological levels (Muzolf et al. 2012). The most relevant for our study were those of the Neolithic occupation (occupation levels 2–5). Level 2, radiocarbon dated from ca 5300–5200 cal. BC to ca 5000 cal. BC, was represented by 114 features of the Early Linear Pottery culture (LBK), including IA (Gniechowice phase), IB (Zofipole phase – Flomborn), and II (generally the music note phase). The features of the Early Linear Pottery culture are clustered in two groups ca 500 m apart in the north and south parts of the site. The southern group consists of about twenty house yards, only three of which can be clearly reconstructed on the basis of postholes and other features. The houses were rectangular and small, ca 15–16 m long and up to 6 m broad. The northern group was smaller, consisting of up to three house yards. During the excavation a 5 m deep well (feature 1709) dated to the LBK was discovered. The well was dug in morainic glacial till, with no remains of casing preserved.

Level 3 was of the Stroked Band Pottery culture (SBP, phases IVb and V according to Zápotocká 1970, ca 4700–4400 cal. BC), and is represented by 23 archeological features including one skeletal grave. The remains of that culture are clustered in three groups, two of which are probably remains of camp sites. That occupation level is usually mixed with remains of the younger (level 4) chronological level connected with the Brześć Kujawski group of the Lengyel culture (BKG). In the features dated to the decline of the SBP (clay pit 1000) the influence of Danubian cultures (Cisa-Polgare cultures, e.g. the Herpaly group) as well as connections with the Little Poland (Małopolska), Lower Silesia (Dolny Śląsk), and Rössen culture were visible, showing the syncretic character of the culture and its development into the BKG, represented by at least 26 archaeological features, including 7 skeletal burials. No traces of trapezoid houses were found, perhaps due to soil erosion. Some postholes were most probably connected with pile buildings of that culture. The BKG remains are dated to its early phase and the beginning of the classical phase (ca 4500–4000/3900 cal. BC).

Level 5 is associated with the Funnel Beaker culture (TRB, ca 3950–3380 BC), represented by 117 archaeological features clustered in 3 groups, one of which is interpreted as a cemetery with 7 very damaged skeletal graves.

The next chronological levels are connected with the Bronze Age and the start of the Early Iron Age (Hallstatt Period C) (ca 970–790 cal. BC) occupation, mostly represented by features (255) of the Lusatian culture located in the south part of the site. The last layer was represented by two graves dated to the Iron Age (La Tène period).

MATERIAL AND METHODS

Archaeobotanical analyses were done in the Institute of Botany (Polish Academy of Sciences) in Kraków by A. Mueller-Bieniek (fruits, seeds) and K. Cywa (charcoal fragments). In total, 54 soil samples from 38 archaeological features of different chronology were collected by the excavators (B. Muzolf, P. Kittel, P. Muzolf) and forwarded to the botanists. Sample volume ranged from 0.1 l to 5 l, 122 l in total. Soil samples were mixed with water and the floating fraction was poured through sieves (0.5 mm mesh). Dried material was sorted and identified under a binocular microscope at 6–70× and with an incident light metallurgical microscope at magnification up to 200×. The material was identified by comparison with specimens from the seed and wood reference collections of the Department of Palaeobotany and the herbarium of the

Table 1. Characteristics of the archaeobotanical samples from the Smólsk 2/10 site. **LBK** – Early Linear Pottery culture, **SBP** – Stroke Band Pottery culture, **BKG** – Brześć Kujawski group of the Lengyel culture (late Linear Pottery culture), **TRB** – Funnel Beaker culture, Lusatian – Lusatian culture (Bronze V – Hallstatt C)

Chronology	Total volume of examined sediment [litres]	Mean vol. per sample [litres]	Number of studied samples	Number of samples with charcoal	Number of samples with charred diaspores	Mean number of charred diaspores in 1 litre of sediment	Mean number of uncharred (recent) diaspores in 1 litre of sediment
LBK	48.3	2.1	23	18	6	1.0	0.6
SBP	7.8	3.9	2	2	2	2.5	0.0
SBP/BKG	13.3	2.7	5	5	3	117.3	0.0
BKG	25.2	2.3	11	10	4	0.5	0.1
TRB	15.5	1.9	8	4	2	4.0	0.1
Lusatian	11.8	2.4	5	4	3	0.5	0.5

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Most of the samples were taken from the LBK features (Tabs 1, 2), including 8 samples from the well (feature no. 1709), in which only one charred cereal grain fragment was found; 4 samples did not contain any plant remains. No recent uncharred remains were noted in the samples from the well; the other samples contained charred and uncharred (recent) diaspores. Uncharred plant remains are assumed to be of recent origin and are therefore excluded from the interpretations, but their presence is important in explaining post-depositional processes (Tabs 1, 4). Few or no uncharred remains were noted in the samples dated to the SBP, BKG, and TRB. The samples taken from the Bronze Age settlement are very contaminated by recent plant remains. Most of the uncharred plant remains belong to *Chenopodium* sp., but diaspores of *Trifolium* sp., *Urtica dioica*, *Stellaria* sp., and *Polycnemum arvense* are also present. Besides the LBK well, feature no. 512 (dated to SBP/BKG) was also rich in plant remains. Four samples were taken from that feature; in one of them a lot of charred plant macroremains were found. Charred remains from two samples were AMS radiocarbon dated (Tab. 2) and the other two samples contained no diaspores.

RESULTS

Detailed results are presented in Table 3 for the charcoal analysis and in Table 4 for the carpological analysis. Plant nomenclature follows Mirek et al. (2002). One sample (Tab. 4, no 13) dated to the SBP/BKG is exceptional for its abundance of crop remains, mostly grains of wheat (cf. *Triticum* sp.). In that sample a significant number of grains identified as probably holly grass were also noted (cf. *Hierochloë* type); other similar grasses such as *Anthoxanthum*, *Holcus*, and *Phalaris* cannot be excluded, as the plant material is badly preserved and the surface pattern is not clearly visible (for description see Bieniek 2003a). Data from that sample were excluded from the comparative diagrams. Among the cultivars, wheat remains dominated all the material. Barley grains were noted in only one Neolithic sample dated to the TRB culture and one Lusatian sample. The chronology of the carpological data (Fig. 2) shows a general increase in the presence of crops through time

Table 2. Radiocarbon dates

Sample	Lab. number	^{14}C conventional data	Calibrated data
Bot 13 (feat.512 A1)	Poz-44465	5450 ± 40 BP	4361BC (95.4%) 4235BC
Bot 15 (feat.512 B2)	Poz-44466	5720 ± 40 BP	4685BC (95.4%) 4463BC

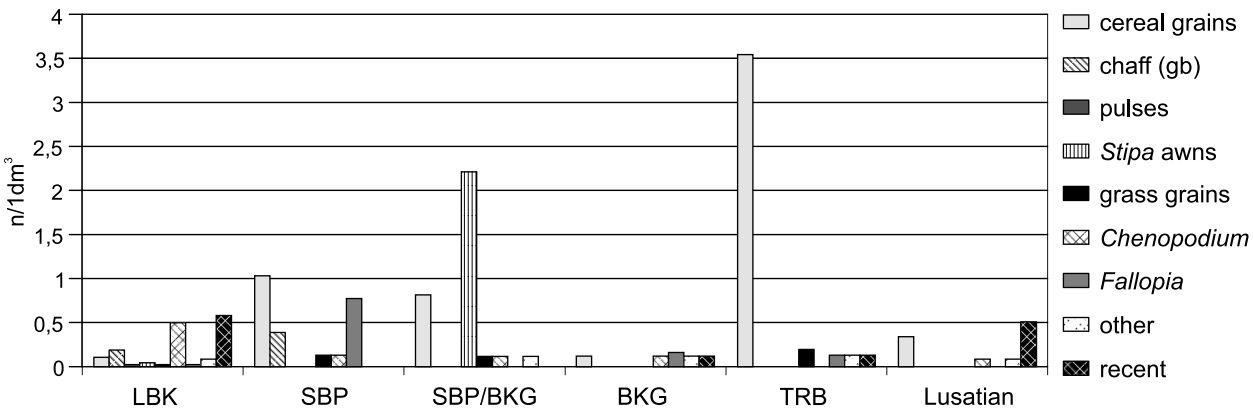

Fig. 2. Composition of plant macroremains (excluding charcoal) found at the Smólsk 2/10 site. Total number of specimens per litre of sediment, excluding sample 13 from feature 512 dated to the SBP/BKG (large number of grains)

Table 3. List of the studied samples from the Smólsk 2/10 site, with their charcoal content (analysed by K. Cywa)

Sample number	Arch. feature	Arch. remarks	Size of fragment (cm)	Number of fragments				Remarks	Charred seeds/ fruits	Volume of soil sample (litres)
				Pinus sylvestris L.	*Quercus* sp.	indet. (vitrified)	*Alnus* sp.			
Early Linear Pottery culture										
2	53	0–20 cm	0.1–0.4	25	3	2			yes	3
5	200	clay pit	0.2–0.3	4					no	4.2
6	59	niche A from a pot						empty	no	3.05
7	445		0.2–0.9	69	5	4			yes	3.95
25	806		0.2–3.0	153					no	0.2
26	729		0.1–0.4	111	29				yes	3
27	788		0.2–0.5	18	2				yes	2.75
28	789	grave? niche C/from E	0.2–1.0	436					no	0.2
29	789	grave niche C/from W	0.2–0.9	43					no	0.7
34	909		17	85	3				no	1.7
38	1391		0.2–2.3	17	28	6			no	4.2
45	1943		0.1–0.8	30					no	3
46	1911	niche A	0.1–0.4	8	12	6			yes	4.2
50	1709	300 cm	0.1–0.5			2			no	4.1
51	1709	well bottom layer 480 cm	0.2–1.0	17	2	1			no	1.75
52	1709	well bottom layer 550 cm	0.2–0.4	22	7	1			yes	2.45
53	1709	pot 4	0.2–0.7	75					no	1.85
54	1709	pot 6						empty	no	0.9
55	1709	pot 12						empty	no	0.28
56	1709	pot 13						empty	no	0.5
57	1709	pot 15						empty	no	0.75
30	789	grave? niche C/bottom	0.2–1.5	214					no	1.1
49	1927		0.1–3.5	2263				very burnt, vitrified	no	0.5
Stroked Band Pottery culture										
17	542		0.2–0.7	196		2			yes	5
22	78		0.3–1.5	195		6			yes	2.75
Stroked Band Pottery culture and Brześć Kujawski group of Lengyel culture										
13	512	niche A1	0.2–1.5	827	39	48			yes	4.7
14	512	niche B1	0.3–0.7	7					no	4.9
15	512	niche B2	0.2–0.7	33		5			yes	3.25
16	512	niche G	0.2–2.5	396		19			no	0.35
39	1000	niche B3	0.2–4.0	428					yes	0.1
Brześć Kujawski group of Lengyel culture										
3	477	niche A	0.2–2.0	465		22		very burnt, roasted	no	3.4
4	477	niche A	0.3–1.1	48	1	15		very burnt, vitrified	no	2.4
9	460		0.2–1.9	638	106				no	0.4
10	477		0.2–1.0	32					yes	3.75
11	510		0.2–1.5	64	8		1		yes	2.5
12	510		0.2–1.9	190					no	0.3
23	854	niche D	0.1–0.6	43	4				yes	2.65
24	854	lower layer	0.2–0.5	9					yes	2.85
31	790		0.2–1.2	33					no	2.7
32	900	niche A2						empty	no	1.5
33	900	niche B1	0.2	1		1			no	2.75
Funnel Beaker culture										
37	1020	40 cm	0.2–0.3	2	2	2			yes	1.87
40	1887		0.2–0.8	11		1			yes	2.35
41	1570	niche C							no	0.35
42	1390	niche A	0.2–1.4		539	2		very silted, fragments covered by silty shell	no	1.95

Table 3. Continued

Sample number	Arch. feature	Arch. remarks	Size of fragment (cm)	Number of fragments				Remarks	Charred seeds/ fruits	Volume of soil sample (litres)
				Pinus sylvestris L.	*Quercus* sp.	indet. (vitrified)	*Alnus* sp.			
44	1959							empty	no	3.6
47	1852							empty	no	0.45
48	1884							empty	no	0.1
Lusatian culture (BrV-HaC)										
8	462		0.2–1.0	66	4				yes	4.1
18	594		0.2–3.2	624					no	0.3
19	593		0.1–3.2	796					yes	0.2
20	593		0.1–0.6	17	2		1		yes	3.3
21	601							empty	no	3.9

in the Neolithic samples. Chaff remains were present only in the Danubian cultures. In the TRB samples only a number of barley grains were noted. The beginning of the settlement (LBK) is marked by the scarcity of crop and other remains and the presence of fat hen (*Chenopodium album* type) charred seeds as well as some recent contamination. Later (SBP period) the fruits of black bindweed (*Fallopia convolvulus*) became significant, and feather grass (*Stipa pennata*) remains were more frequent in a sample where remains of both SBP and BKG (the cultures probably contemporaneous in some crucial time) were noted. In samples dated exclusively to the BKG culture, plant remains were very scarce in general. The data from the Lusatian samples show only that the studied area was barely settled or not settled after Neolithic times, or else very eroded, with abundant contamination by recent seeds.

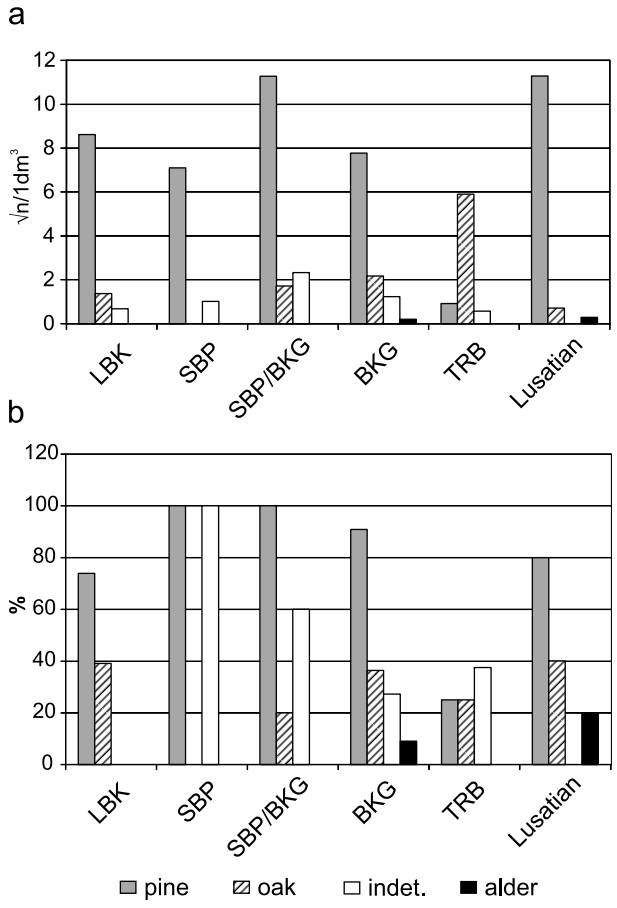

Fig. 3. Results of charcoal analysis from the Smólsk 2/10 site, a – square root of number of charcoal fragments per litre of studied sediment, b – frequency of wood species in studied samples (empty samples excluded). Chronological culture codes as in Table 1

Wood charcoal analysis (Tab. 1, Fig. 3) shows the general dominance of pine wood (*Pinus sylvestris*) in samples dated to the so-called Danubian cultures (LBK, SBP, BKG); in the TRB samples oak (*Quercus* sp.) wood is at least as important as pine, but there is a possibility of overrepresentation of oak from one construction item (Tab. 3). The presence of alder (*Alnus* sp.) is low in the total material. The charcoal fragments were very badly preserved in general, yielding only limited data (Tab. 3).

DISCUSSION

The data from the Smólsk 2/10 site are a valuable source of information about the Neolithic plant economy in that part of Kuyavia in central Poland on the North European Plain, especially when compared with the data from neighbouring and contemporary sites. The site holds evidence of a long sequence of Neolithic occupation. It is located east of the Osłonki microregion, an area well studied archaeologically (Grygiel 2004, 2008) and palaeoecologically (Bieniek 2002,

Table 4. Fruits and seeds found in the samples from the Smólsk 2/10 site. **LBK** – Early Linear Pottery culture. **SBP** – Stroke Band Pottery culture. **BKG** – Brześć Kujawski group of Lengyel culture. **TRB** – Funnel Beaker culture. **sb** – spikelet basis. **gb** – glume basis. **c** – grain. **s/f** – seed/fruit. **a** – awn fragment. **tub**– tuber. Uncharred plant remains probably are from recent contamination (analysed by A. Mueller-Bieniek)

Type of remain	**Chronology**	LBK						SBP		SBP/BKG			BKG				TRB		Lusatian		
	sample number	1	7	27	52	26	46	22	17	13	15	39	10	11	23	24	37	40	8	19	20
	feature number	53	445	788	1709	729	1911	78	542	512	512	1000	477	510	854	854	1020	1887	462	593	593
	volume [litres]	3	3.95	2.75	2.45	3	4.2	2.75	5	4.7	3.25	0.1	3.75	2.5	2.65	2.85	1.87	2.35	4.1	0.2	3.3
sb	*Triticum monococcum*									35											
gb	*Triticum monococcum*									3											
c	*Triticum* cf. *monococcum*							3													
sb	*Triticum* cf. *monococcum*							1													
gb	*Triticum* cf. *monococcum*							1													
c	*Triticum* cf. *dicoccon*								1						1						
gb	*Triticum* cf. *dicoccon*									6											
sb	*Triticum* sp. ('new' type)									6											
sb	*Triticum* sp. (hulled)			3						35											
gb	*Triticum* sp. (hulled)		1	2						80											
c	*Triticum* sp.			1																	
c	cf. *Triticum* sp.								1	1100	2										
c	*Hordeum vulgare* (hulled)																	17		2	
c	cf. *Hordeum vulgare*																			1	
c	Cerealia indet.			3							1	3		1	1			30			
c	cf. Cerealia indet.				1				3		1							8	1		
s/f	cf. *Pisum sativum*						1														
c	cf. *Bromus* sp.								1												
a	*Stipa pennata*			2								19									
c	cf. *Stipa* sp.											1									
c	cf. *Hierochloë* type									148											
tub	cf. *Phleum pratense*		1																		
c	*Setaria* sp./*Echinochloa crus-galli*			1																	
c	*Poa* sp.									2											
c	Poaceae indet.																	3			
s/f	*Chenopodium album* type	12	9	3				1			1		1	1		1					1
s/f	*Fallopia convolvulus*		1						6	10					2	2		2			

Table 4. Continued

Type of remain	Chronology	LBK						SBP		SBP/BKG			BKG				TRB		Lusatian		
	sample number	1	7	27	52	26	46	22	17	13	15	39	10	11	23	24	37	40	8	19	20
	feature number	53	445	788	1709	729	1911	78	542	512	512	1000	477	510	854	854	1020	1887	462	593	593
	volume [litres]	3	3.95	2.75	2.45	3	4.2	2.75	5	4.7	3.25	0.1	3.75	2.5	2.65	2.85	1.87	2.35	4.1	0.2	3.3
s/f	*Solanum nigrum*										1										
s/f	*Plantago lanceolata*																			1	
s/f	*Schoenoplectus tabernaemontani / triquater*					1															
s/f	indet.					1				23			1		2		1				
	Uncharred – recent																				
s/f	*Urtica dioica*		2																		
s/f	*Polycnemum arvense*		1																		
s/f	*Stellaria* sp.			2																	
s/f	*Trifolium* sp.																				
s/f	*Chenopodium* sp.	6	2			8	2							2			1		3		3

2007, Nalepka 2005, Nowaczyk 2008, Bogucki et al. 2012). The Smólsk 2/10 site adds much to the extant data, though plant remains were generally scarce there: ca 14 items per litre on average (Tab. 1), including massive finds of grass grains in one sample (Tab. 4); the average is only 2 items per litre when the data from that exceptional sample are excluded. Such a paucity of plant remains is common in that region and period. For material recovered from the other Kuyavian Neolithic sites the average density of plant remains per culture and site varies from 1 to 70 items per litre (Bieniek 2007). Moskal-del Hoyo et al. (in press) noted a similar density of charred plant remains at the Miechów 3 site in southern Poland, where the counts ranged from 2 to 5 per litre in Neolithic samples, 4 to 8 items per litre in Bronze Age and Iron Age samples, and finally ca 30 items per litre in medieval samples.

The early Neolithic features of Danubian cultures (including relicts of houses) are concentrated around small closed depressions. Those relief forms were partly levelled as a result of slope wash in the partially open landscape (Kittel 2015). The closed depressions with black earths (Budek et al. 2012) must be considered the main potential areas of intense cultivation activity at the site in prehistory. Fertile hydromorphic soils at the bottom of the subglacial channel could be cultivated as well. Intense exploitation of unforested slopes of the subglacial channel near the palaeolake basin is confirmed by palaeoenvironmental research at the site (Kittel 2015, Kittel et al. 2015).

Despite the small number of plant remains and analysed samples, some changes in plant composition are seen, reflected in less abundant pine wood in the TRB samples, a probable switch from wheat to barley after the BKG culture, and the archaeologically noted decline of settlement after the TRB culture; these are in accordance with the geoarchaeological data. The research on slope cover at and near the site shows two main phases of distinct human impacts on the landscape in the Neolithic, connected with Danubian culture communities (5300/5200–4000 BC) and with TRB people (after 3800 and not later than 3000 BC), and indicates two settlement hiatuses dated to ca 4000–3800 BC and after ca 3000–2900 BC (Kittel 2015). The later sparse traces of human occupation are dated to the Early Bronze Age – people of the Iwno culture (ca 2200–1900 BC) and Trzciniec culture

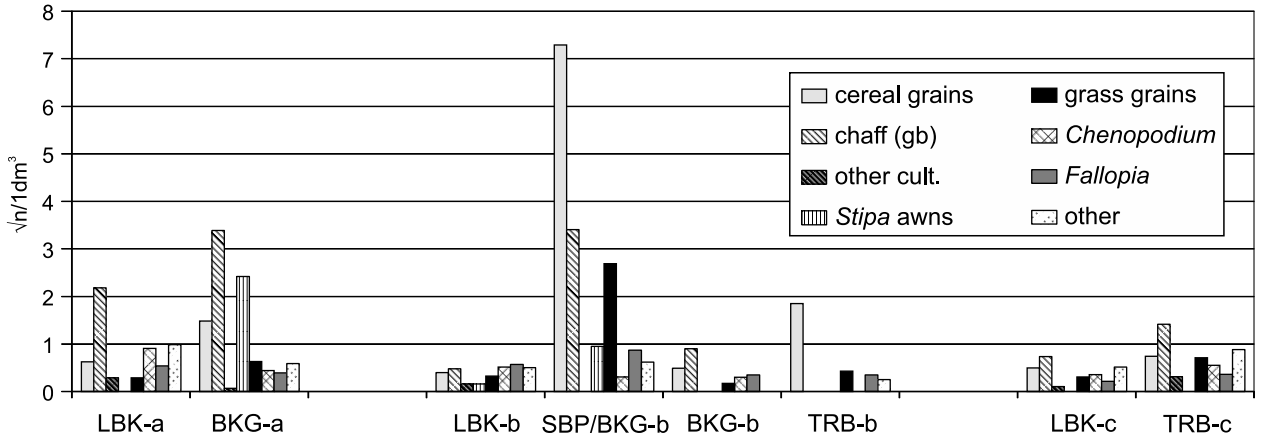

Fig. 4. Combined composition of plant macroremains from three studied microregions, separated to archaeological cultures (chronological culture codes as in Table 1): **a** – Osłonki microregion including Zagajewice 1, Miechowice 4, Konary 1, Konary 1a, Miechowice 4a, and Osłonki 1 sites; **b** – Smólsk microregion, including Guźlin 2, Smólsk 4, Smólsk 2/10 sites; **c** – Wolica Nowa site given separately (compare Grygiel 2004, 2008; Bieniek 2007). The data are given as square roots of total number of specimens per litre of studied sediment of the culture. Remains from coarse sieving were not included in the sum (mainly from site 1 at Osłonki, where more than 2000 crop grains were collected with very coarse sieves during the excavation)

(ca 1650–1450 BC) (Muzolf et al. 2012). Deluvial accumulation is also connected with the Lusatian culture occupation in the Hallstatt period (Kittel 2015). Geomorphologic processes were very intense during the occupation by TRB communities, as confirmed by palaeoecological data (Kittel et al. 2014).

COMPARISON OF THE DATA FROM DIFFERENT MICROREGIONS

In comparing carpological data we notice some similarity of the findings from the western part of the studied microregion, represented mostly by the sites at Osłonki, Miechowice, and Konary (Fig. 4), and the eastern part, where the archaeobotanical data comes mostly from the Smólsk 2/10 site. The differences – the earlier appearance of feather grass in the Smólsk area and the higher amount of crop chaff remains in the Osłonki area – may be chance results, the outcome of fragmentary archaeological data. Nevertheless, intentional introduction of feather grass by the first Neolithic settlers in eastern Kuyavia cannot be excluded (cf. Bieniek 2002, Bieniek & Pokorny 2005, Mueller-Bieniek & Nalepka 2010). The Wolica Nowa area is characterised by scarcity of crop remains and no archaeological traces of the Danubian BKG culture. That Neolithic culture was best developed in that part of Kuyavia, causing significant but usually local and transient alterations of the environment, followed by regeneration of the same types of forest as before Neolithic settlement (Bogucki et al. 2012). We suggest that the Wolica Nowa site was connected more with animal husbandry than with agriculture. This suggestion is supported by the relatively high proportion of small-grain grasses, usually interpreted as traces of fodder (see grass grains in Fig. 4, Bieniek 2007). The small-grain grasses in the Smólsk area (SBP/BKG-b, Fig. 4) are represented mainly by a large number of grains, probably of holly grass (cf. *Hierochloë* type), from crop sample 13. The putative species (*H. australis* or *H. odorata*) and other candidate taxa (e.g. *Holcus mollis*, *H. lanatus*, *Phalaris arundinacea*) are not known as weedy forms. Their presence may indicate use as fodder or insulation. The lack of feather grass remains at the Wolica Nowa site may be connected rather with its archaeological chronology, as the plant was linked mostly with BKG settlers in the studied area (Fig. 4, Bieniek 2002, 2007, Bieniek & Pokorny 2005). The prehistoric nature of feather grass in Kuyavia is different than in southern Poland (Małopolska Upland) where the occurrence of feather grass is continuous (Moskal-del Hoyo et al. in press). The limited scale of agricultural activity (cf. Bogaard 2004), and the variability of the landscape, are reflected in the archaeological and environmental data.

Charcoal from the Osłonki area was analysed by A. Bieniek (Bieniek 2003b, unpubl). In that study the results were given as volume and frequency (presence) of wood taxa. In a comparison of frequency of the main taxa (pine and oak) in the studied areas (Fig. 5) a strong difference is visible in the domination of pine wood in the Smólsk area. It can be explained by the site's location on the border

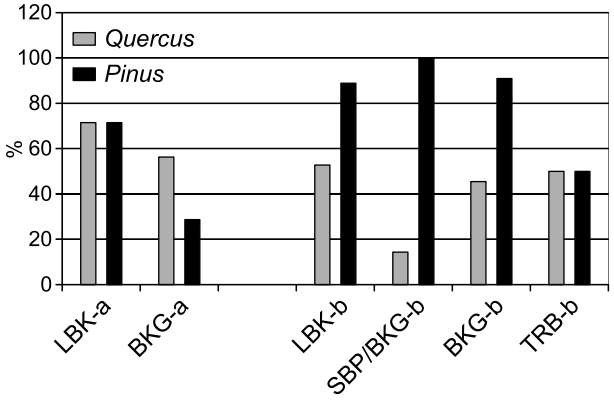

Fig 5. Frequency of charcoal remains of the main tree taxa, oak (*Quercus* sp.) and pine (*Pinus silvestris*), in the studied microregions, excluding Wolica Nowa. Chronological culture codes as in Table 1, **a** and **b** abbreviations as in Fig. 4

between two mesoregions (and macroregions as well): the Plock Basin belonging to the Toruń-Eberswald ice-marginal streamway (Pradolina Toruńsko-Eberswaldzka) in the east and the Kuyavian Lakeland (Pojezierze Kujawskie) in the west (Kondracki 2000). The difference in the surrounding forests of the two studied areas is well visible in the presence of dispersed charcoal remains (Moskal-del Hoyo 2014).

CONCLUSIONS

The presented data from the Smólsk 2/10 site show the continuity of Neolithic occupation, from the Early Neolithic Linear Pottery culture (LBK) through the Stroke Band Pottery culture (SBP) and the Brześć Kujawski group of the Lengyel culture (BKG) to the Funnel Beaker culture (TRB). Such an uncommon representation at one studied site of all cultures noted in that area, together with the geoarchaeological data, allows us to make inferences about settlement development and changes in plant use. The most important change is the apparent transformation from wheat cultivation to barley cultivation after the decline of the BKG culture, which is separated from the younger next culture (TRB) by a hiatus seen in geoarchaeological studies. This change in cultivation may be only local or may be an artefact of the sparseness of data. Study of other sites in the region are needed to verify the finding.

The data from the Osłonki and Smólsk microregions show differences in woodland management and differences between the local environments. Pine wood was more accessible in Smólsk than in Osłonki, due to local landscape characteristics.

At the Smólsk site, *Chenopodium* sp. seeds were more numerous in samples from the beginning of the Neolithic than in later material. The plant material was sparse in general, but this is typical for that time and type of archaeological site.

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