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CONFINIA
ET
HORIZONTES

THE ENVIRONMENTAL HISTORY OF THE PREHISTORIC SÁRKÖZ REGION IN SOUTHERN HUNGARY

ESZTER BÁNFFY (ED.)

RGK

1

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CONFINIA ET HORIZONTES VOL. 1

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ESZTER BÁNFFY (ED.)

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Inhalt

Lectori salutem!

The launching of a new monograph series is a matter of courage and confidence. Courage that it is worthwhile to publish new books in this digital age of ours, and confidence in readers that they will be willing to take yet newer thick volumes in their hand and use them for their academic work or read them out of pure interest in prehistoric archaeology. The host institute, the Romano-Germanic Commission (RGK) of the German Archaeological Institute, has established, edited, and published several monograph series during its long life since it was founded in 1902: suffice it here to refer to the *Römisch-Germanische Forschun*gen, the *Kolloquien zur Vor- und Frühgeschichte*, the series *Die Ausgrabungen in Manching*, and to the *Limesforschungen*. So, one may rightly ask, wherefore yet another one?

During the past few years, research in the RGK has been organised around two major themes and two logistically separate work teams, which are nevertheless bound by many strands scientifically. Under the umbrella of *Forschungsfeld* 2, the research topics related to the Iron Age and the Roman provincial period, research on the Roman *limes* and on the Barbaricum, i. e. the regions not occupied by the Romans, as well as research on the Late Antique period are addressed through related overarching questions such as "border studies". *Forschungsfeld* 1, established at a later date, brings together fields of research and grand themes that had commanded scholarly interest during the first half of the 20th century and were revived during the past decade as part of the RGK research agenda. These cover the Late Mesolithic and the transition to the Neolithic, alongside themes from the Neolithic to the Bronze Age. Currently, there are several RGK and collaborative projects with various institutions and colleagues based in different countries within the framework of this research group. Similarly to the work group focusing on later prehistoric and early historic periods, the basic research questions in Neolithic and Bronze Age studies are few, but they are closely related to each of the running projects and those in plan.

While members of the *Forschungsfeld* 2 work team have had several options for publishing their findings in the traditional RGK monographs, the early periods could not be fitted into any of the already existing series. Hence the idea of establishing *Confinia et horizontes.* The title of the new series matches the major theme of *Forschungsfeld* 1, "Marginal zones, contact zones". The choice of one Latin and one Greek word was wholly intentional: marginal, liminal zones would be ideal settings for potential interactions between different groups initially separate from each other, which then established contacts through exchanges and trade, and later expanded the contacts to a mutual sharing and transferring of innovations and knowledge. And, as is usually the case, these contacts can be traced in the genetic make-up of the once separate population groups. Our goal is to publish cutting-edge new research: principally the projects of the RGK community, but since the time of individual research and authorship has since long passed, these publications, as a rule, will present the findings of dynamic collaboration with other institutions. The monographs will be grouped according to the various collaborative projects. Although it is not our intention to break up *Confinia et horizontes* into subseries, we shall quite clearly indicate if a major project is published in more than one volume that these volumes are closely related. Even more importantly, individual volumes will never be publications released

solely by the RGK, but will be equally owned by our partner institutes. This can also be seen as a symbolic gesture: these days, archaeological research generally involves the joint effort of specialists of fieldwork, environmental and non-invasive landscape research, geo- and bioarchaeology, all brainstorming together. The evaluation will then be based on data coming from each field of investigation. It needs to be repeatedly stressed that there is no difference between the two *Forschungsfelder*, between the different periods and phases of archaeological periodisation. Prehistory and history are equally important chapters of the human past. The ultimate goal of *Confinia et horizontes* is to integrate the data provided by various disciplines and interpret them jointly, in the hope that the result will contribute to a reconstruction and better understanding of the various dimensions of past societies. In other words, we truly hope that our prehistoric data will ultimately lead to history writing.

Eszter Bánffy

Angela Kreuz, Péter Pomázi, Anett Osztás, Krisztián Oross, Tibor Marton, Jörg Petrasch, László Domboróczki, Pál Raczky and Eszter Bánffy

Investigation of the plant macro-remains from four archaeological excavations at Fajsz-Garadomb and Alsónyék-Bátaszék in the Sárköz region and their comparison with the archaeobotanical record from other Hungarian Neolithic sites

Keywords: Hungary, Neolithic, agriculture, diet, cultural choice, archaeobotany

Schlagwörter: Ungarn, Neolithikum, Landwirtschaft, Ernährung, kulturbedingte Auswahl, Archäobotanik

Kulcsszavak: Magyarország, újkőkor, élelemtermelés, táplálkozás, kulturális értékválasztás, archeobotanika

Introduction

Following an intensive archaeological prospection in the years 2006–2008, the multi-period site of Fajsz-Garadomb in Hungary was excavated in the course of a research project supervised by Eszter Bánffy (then working in the Institute of Archaeology [RCH] of the Hungarian Academy of Sciences [HAS], Budapest) and Jörg Petrasch (Eberhard Karls Universität Tübingen, Ur- und Frühgeschichte und Archäologie des Mittelalters) funded by a grant from the German Research Foundation (DFG). This was the starting point of the first archaeobotanical investigations in the study area. The archaeobotanical samples from the excavations at Fajsz have been analysed as part of an MA thesis submitted to the University of Szeged (Pomázi 2010, tutored by the first author of the present paper). In the course of a subsequent research project focusing on Neolithic crop cultivation and land use in Hungary at the archaeobotanical department of the Landesamt für Denkmalpflege Hessen, hessenARCHÄOLOGIE (Wiesbaden), Péter Pomázi undertook the identification of the plant remains from another 22 Hungarian Neolithic sites, under the tutelage of the first author *(Tabs 1–2)*. The Landesamt für Denkmalpflege Hessen provided support for this archaeobotanical work since 2008, among others by facilitating sample preparation, the photographic documentation of the plant remains, and the archiving of the residues and plant remains with up-to-date standards. All raw data are stored in the *ArboDat* 2016 archaeobotanical database programme (based on Microsoft Access) in Wiesbaden, ensuring availability and access for future studies. Originally, the data was to be evaluated in a PhD thesis on these Neolithic plant remains at the Johannes Gutenberg-Universität Mainz. However, in May 2015, P. Pomázi left the institute in Wiesbaden to meet his other obligations in Hungary. Therefore, in agreement with him, the data evaluation was carried out by the first author of the present study.

Archaeobotanical material and method

As aptly noted by Kalicz et al. (2007, 20), the current state of archaeobotanical research on the Neolithic in Hungary makes it difficult to draw any final conclusions (Tempir 1964; see also Gyulai 2007; 2010). Therefore, the DFG project "Die Besiedlungsgeschichte der Siedlungskammer um Fajsz (Kom. Bács-Kiskun, Südungarn) in der Ältesten Bandkeramik" (2006–2010) as well as the excavations ahead of the construction of the Hungarian M6 motorway (Bánffy et al. 2010; 2014; Osztás et al. 2016, and further contributions in the same volume) provided an excellent opportunity to start

Archaeological dating			Starčevo / Körös	Körös	LBK	LBK	ALBK, Szakálhát	SOP, LENG	SOP, LENG, Tisza	BZ	ArchDat?	ArchDat?		
Excavation sites			**Sárköz:** **HU 1**, FAJSZ **HU 3** BSZÉK 5603 / 1 MT, **HU 6** BSZÉK 11	**HU 9** GORZSA 5, **HU 16** SARK	**Sárköz:** **HU 1** FAJSZ, **HU 2** BSZÉK 5603 / 1 56-út	HU 4 SZEMELY, **HU 7** APC 1, **HU 11** RABAP, **HU 14** ZSENNYE	HU 5 PTASK 1, **HU 8** HPAPI, **HU 10** MHEGYES, **HU 12** TBURA 5, **HU 16** SARK, **HU 17** VNAM, **HU 18** PPETRI, **HU 19** KANT, **HU 22** Büábr VII, **HU 23** Büábr XI / A	**Sárköz:** **HU 1** FAJSZ, **HU 2** BSZÉK 5603 / 1 56-út, **HU 6** BSZÉK 11	HU 5 PTASK 1, **HU 15** URAI	**Sárköz:** **HU 1** FAJSZ	**Sárköz:** **HU 2** BSZÉK 5603 / 1 56-út, **HU 6** BSZÉK 11	HU 5 PTASK 1, **HU 7** APC 1, **HU 11** RABAP, **HU 16** SARK, **HU 19** KANT		
Feature type(s)			Gr, SoBefu	Gr	Gr, Lgr	Gr, Lgr, Pfo, Gra, KöGrab	Gr, Lgr, Bru, KöGrab	Gr, Gra, KöGrab, SoBefu	Gr, Gra, KöGrab, SoBefu	Gr, Pfo, Koll	Gr	Gr, Pfo, Gra, Bru, KöGrab, BefuTyp?		
Sample type(s)			Eim, Gef	Eim, dir	Eim	Eim	Eim, dir	Eim	Eim	Eim	Eim	Eim		
Sample volume (litre)			147.15	235.01	334.5	456.6	1170.2	814	225.95	379	195	601		
Number of features			4	14	15	43	48	53	15	13	6	32		
Number of samples			7	22	20	58	139	72	20	23	15	56		
	RTyp	**Zust**											**English Name**	**Deutscher Name**
1 Riparian / Floodplain Vegetation														
Alisma plantago-aquatica	Em	vk					1						Water-plantain	Gewöhnlicher Froschlöffel
Chara spec.	Sa / Fr	vk										12	Stonewort	Armleuchteralge
Chara spec.	Sa / Fr	mi	1		25			3					Stonewort	Armleuchteralge
Eleocharis palustris agg.	Sa / Fr	vk					1					1	Common spike-rush	Gewöhnliche Sumpfbinse
cf. *Eleocharis palustris* agg.	Sa / Fr	vk								1			Common spike-rush	Gewöhnliche Sumpfbinse
Polygonum lapathifolium agg.	Sa / Fr	vk		2			1			1			Pale persicaria	Ampfer-Knöterich
Polygonum minus	Sa / Fr	vk		3						1			Small water pepper	Kleiner Knöterich
Potamogeton spec.	Sa / Fr	vk							26				Pondweed	Laichkraut
Rumex crispus / obtusifolius	Sa / Fr	vk	1	2			21						Curled / broad-leaved dock	Krauser / Stumpfblättriger Ampfer

Tab. 1. Compilation of the archaeobotanical results of the four Sárköz area excavations in comparison with further 22 Hungarian Neolithic sites. The results of features with mixed archaeological finds from different periods are entered in the *ArboDat* database as *ArchDat?* (for the abbreviations of the sites see *Tab. 2*; further abbreviations according to *ArboDat* 2016 see list of abbreviations).

Archaeological dating			Starčevo /	Körös	LBK Körös	LBK	ALBK, Szakálhát	SOP, LENG	SOP, LENG, Tisza	BZ	ArchDat?	ArchDat?		
Trapa natans	Sa / Fr	vk	1	100			32		5				Water caltrop	Wassernuss
2 Grassland Vegetation														
Alchemilla vulgaris agg.	Sa / Fr	vk						1					Lady's mantle	Frauenmantel
Carex muricata agg.	Sa / Fr	vk					2						Prickly sedge	Stachel-Segge
Centaurea jacea s.l.	Sa / Fr	vk								1			Brown knapweed	Wiesen-Flockenblume
Cerastium cf. *arvense*	Sa / Fr	vk	3				1			1			Field mouse-ear chickweed	Acker-Hornkraut
Coronilla cf. *varia*	Sa / Fr	vk					4						Crown vetch	Bunte Kronwicke
Festuca spec.	Sa / Fr	vk					2						Fescue	Schwingel
Festuca / Lolium	Sa / Fr	vk								5			Fescue / ryegrass	Schwingel / Lolch
Fragaria vesca	Sa / Fr	vk							2				Wild strawberry	Wald-Erdbeere
Galium mollugo agg.	Sa / Fr	vk								1			Hedge bedstraw	Wiesen-Labkraut
Lotus corniculatus s. str.	Sa / Fr	vk										1	Bird's-foot trefoil	Gewöhnlicher Hornklee
Lychnis flos-cuculi	Sa / Fr	vk				1	5		1			1	Ragged-Robin	Kuckucks-Lichtnelke
Lychnis flos-cuculi	Sa / Fr	mi					4						Ragged-Robin	Kuckucks-Lichtnelke
cf. *Medicago lupulina*	Sa / Fr	vk								2			Black medick	Hopfenklee
Phleum pratense s.l.	Sa / Fr	vk		1		1	1			2	2		Purple-stem cat's-tail	Wiesen-Lieschgras
Polygonum aviculare agg.	Sa / Fr	vk		4			4	1		1			Knotweed	Vogel-Knöterich
Poa annua	Sa / Fr	vk	1			1	1						Annual meadow-grass	Einjähriges Rispengras
Poa spec.	Sa / Fr	vk					6					4	Meadow-grass	Rispengras
Silene vulgaris	Sa / Fr	vk										1	Bladder campion	Aufgeblasenes Leimkraut
Stipa spec.	Sa / Fr	vk										4	Feather grass	Federgras
Stipa spec.	Gr	vk	1	1		9	21		7			22	Feather grass	Federgras
Teucrium cf. *chamaedrys*	Sa / Fr	vk						1					Wall germander	Edel-Gamander
Trifolium pratense s.l.	Sa / Fr	vk								1			Red clover	Roter Wiesen-Klee
Trifolium cf. *pratense* s.l.	Sa / Fr	vk								2			Red clover	Roter Wiesen-Klee
Trifolium camp. / dub. / arv.	Sa / Fr	vk	2			2	6			1		2	Hop trefoil / suckling clover	Feld- / Kleiner / Hasen-Klee
cf. *Trifolium camp. / dub. / arv.*	Sa / Fr	vk								4			Hop trefoil / suckling clover	Feld- / Kleiner / Hasen-Klee
Trifolium spec.	Sa / Fr	vk					3	2		1			Clover	Klee
Verbena officinalis	Sa / Fr	vk					1						Vervain	Gewöhnliches Eisenkraut

Tab. 1. (continued).

Archaeological dating			Starčevo /	Körös	LBK Körös	LBK	ALBK, Szakálhát	SOP, LENG	SOP, LENG, Tisza	BZ	ArchDat?	ArchDat?		
3 Ruderal Vegetation														
Bromus sterilis	Sa / Fr	vk										8	Barren brome	Taube Trespe
cf. *Bromus sterilis / tectorum*	Sa / Fr	vk						1					Barren brome / drooping brome	Taube / Dach-Trespe
Galium cf. *aparine*	Sa / Fr	vk					60			1			Goosegrass	Kletten-Labkraut
Hyoscyamus niger	Sa / Fr	vk		1			2	1	2			7	Henbane	Schwarzes Bilsenkraut
Malva sylvestris	Sa / Fr	vk				2							Common mallow	Wilde Malve
Nepeta cf. *cataria*	Sa / Fr	vk	1										Cat-mint	Gewöhnliche Katzenminze
Sambucus ebulus	Sa / Fr	vk	1		1		22					37	Danewort	Zwerg-Holunder
Sambucus ebulus	Sa / Fr	mi										1	Danewort	Zwerg-Holunder
Silene dioica	Sa / Fr	vk					2						Red campion	Tag-Lichtnelke
Sisymbrium spec.	Sa / Fr	vk								1			Rocket	Rauke
Torilis japonica	Sa / Fr	vk					1						Upright hedge-parsley	Gewöhnlicher Klettenkerbel
Urtica dioica	Sa / Fr	mi	1										Common nettle	Große Brennnessel
4 Ruderals / Segetals undifferentiated														
Atriplex / Chenopodium	Sa / Fr	mi	32	5		2	1		12			18	Orache / goosefoots	Melde / Gänsefuß
Chenopodium album	Sa / Fr	vk	384	16	7	84	1319	28	64	17	55	132	Fat-hen	Weißer Gänsefuß
Chenopodium album	Sa / Fr	mi					5		10				Fat-hen	Weißer Gänsefuß
Chenopodium hybridum	Sa / Fr	vk	1	2			7	4	4			1	Maple-leaved goosefoot	Unechter Gänsefuß
Chenopodium spec.	Sa / Fr	vk					2	1	1				Goosefoot	Gänsefuß
Chenopodium spec.	Sa / Fr	mi				843					1		Goosefoot	Gänsefuß
Echinochloa crus-galli	Sa / Fr	vk	8	2		2	15	1	4	1	10	5	Cockspur	Hühnerhirse
cf. *Echinochloa crus-galli*	Sa / Fr	vk					1					1	Cockspur	Hühnerhirse
cf. *Echinochloa crus-galli*	Sa / Fr	mi							1				Cockspur	Hühnerhirse
Lepidium spec.	Sa / Fr	mi							1				Pepperwort	Kresse
Portulaca oleracea s.l.	Sa / Fr	vk										4	Common purslane	Portulak s.l.
Silene alba	Sa / Fr	vk	2										White campion	Weiße Lichtnelke
Solanum nigrum	Sa / Fr	vk	4			1	5			1		4	Black nightshade	Schwarzer Nachtschatten
5 Crops														
Hordeum distichon / vulgare	Sa / Fr	vk	19	20			125	2	1	15		2	Barley	Kulturgerste undiff.
cf. *Hordeum distichon / vulgare*	Sa / Fr	vk					3			3			Barley	Kulturgerste undiff.

Tab. 1. (continued).

Archaeological dating			Starčevo /	Körös	LBK Körös	LBK	ALBK, Szakálhát	SOP, LENG	SOP, LENG, Tisza	BZ	ArchDat?	ArchDat?		
Hordeum distichon / vulgare	Spi	vk	4				3						Barley	Kulturgerste undiff.
Panicum miliaceum	Sa / Fr	vk								230	2	11	Common millet	Echte Hirse
cf. *Panicum miliaceum*	Sa / Fr	vk								17			Common millet	Echte Hirse
Triticum aestivum s.l. / *durum / turgidum*	Sa / Fr	vk				1	1	1	1	6		11	Naked wheat	Nacktweizen
Triticum aestivum s.l. / *durum / turgidum*	Spi	vk				1	3					114	Naked wheat	Nacktweizen
Triticum cf. *aestivum* s.l. / *durum / turgidum*	Sa / Fr	vk					7			3		1	Naked wheat	Nacktweizen
Triticum dicoccum	Sa / Fr	vk		3	1	13	172	4	5	8		57	Emmer	Emmer
Triticum cf. *dicoccum*	Sa / Fr	vk	2	3		1	16		2	1	1	11	Emmer	Emmer
Triticum dicoccum	HSB	vk	196	249	55	587	6526	1181	160	87	4247	2540	Emmer	Emmer
Triticum cf. *dicoccum*	HSB	vk			5	16	66	68	19	4			Emmer	Emmer
Triticum dicoccum	Spi	vk					6	2			2	1	Emmer	Emmer
Triticum cf. *dicoccum*	Spi	vk					1						Emmer	Emmer
Triticum monococcum	Sa / Fr	vk	2	6	1	8	29	2	7	6	1	43	Einkorn	Einkorn
Triticum cf. *monococcum*	Sa / Fr	vk				1	8		1			1	Einkorn	Einkorn
Triticum monococcum	HSB	vk	274	112	203	913	1514	2911	154	349	4448	6643	Einkorn	Einkorn
Triticum cf. *monococcum*	HSB	vk	12	4	2	12	53	5	30				Einkorn	Einkorn
Triticum monococcum	Spi	vk					2					1	Einkorn	Einkorn
Triticum monococcum, 2-grained	Sa / Fr	vk					24	2		1		8	Einkorn 2-grained	Einkorn
Triticum cf. *monococcum*, 2-grained	Sa / Fr	vk					1		1				Einkorn 2-grained	Einkorn
Triticum aest. s.l. / *dur.* / *turg.* / *dicoccum*	Sa / Fr	vk					3				1	5	Naked wheat / emmer	Nacktweizen / Emmer
Triticum monococcum / *dicoccum*	Sa / Fr	vk	1	3	12	13	65	2	1	4	8	51	Einkorn / emmer	Einkorn / Emmer
Triticum monococcum / *dicoccum*	HSB	vk	386	819	501	1994	13422	19320	2114	1117	17656	7495	Einkorn / emmer	Einkorn / Emmer
Triticum dicoccum / *spelta*	Sa / Fr	vk					2			3			Emmer / spelt	Emmer / Dinkel
Triticum dicoccum / *spelta*	HSB	vk				1		1		2			Emmer / spelt	Emmer / Dinkel
Triticum spec., Spelzweizen	HSB	vk	2		7	1	2	552		136			Glume wheat	Spelzweizen

Tab. 1. (continued).

Archaeological dating			Starčevo /	Körös	LBK Körös	LBK	ALBK, Szakálhát	SOP, LENG	SOP, LENG, Tisza	BZ	ArchDat?	ArchDat?		
Triticum spec.	Sa / Fr	vk	6	2		11	28	3	8	11	2	9	Wheat	Weizen undifferenziert
Cerealia indet.	Sa / Fr	vk	71	145	50	152	1846	126	70	105	66	466	Cereals	Getreide
Cerealia indet.	Spi	vk		3	2	4	301	46		4	88	91	Cereals	Getreide
Lens culinaris	Sa / Fr	vk		8		8	30	1	1	1	1	19	Lentil	Linse
cf. *Lens culinaris*	Sa / Fr	vk					1						Lentil	Linse
Pisum sativum	Sa / Fr	vk				1	10					3	Garden pea	Erbse
cf. *Vicia ervilia*	Sa / Fr	vk		1									Bitter vetch	Linsen-Wicke
Fabaceae (kult.)	Sa / Fr	vk					15						Pulses	Hülsenfrüchte kultiviert
Camelina sativa	Sa / Fr	vk								4			Gold-of-pleasure	Saat-Leindotter
Linum usitatissimum	Sa / Fr	vk					1						Flax	Gebauter Lein, Flachs
Linum usitatissimum	Sa / Fr	mi					5						Flax	Gebauter Lein, Flachs
Papaver somniferum	Sa / Fr	vk				3	2						Opium poppy	Schlaf-Mohn
6 Weeds of hoed fields and gardens														
Digitaria ischaemum	Sa / Fr	vk								2			Red millet	Faden-Fingergras
Digitaria cf. *ischaemum*	Sa / Fr	vk								1			Red millet	Faden-Fingergras
Setaria verticillata / viridis	Sa / Fr	vk				1	9		8		19	1	Lively / green bristle-grass	Quirlige / Grüne Borstenhirse
7 Weeds of cereal fields														
Agrostemma githago	Sa / Fr	vk										32	Corn-cockle	Kornrade
Anagallis arvensis	Sa / Fr	vk								2			Scarlet pimpernel	Acker-Gauchheil
Bromus cf. *arvensis*	Sa / Fr	vk		1						3			Field brome	Acker-Trespe
Bromus cf. *secalinus*	Sa / Fr	vk		1		1	45			14		20	Chess grass	Roggen-Trespe
Camelina spec. *microcarpa*	Sa / Fr	vk					3			1			Lesser gold-of-pleasure	Kleinfrüchtiger Leindotter
Galium spurium	Sa / Fr	vk	3	1	1	2	246		4	3		6	False cleavers	Saat-Labkraut
Galium cf. *spurium*	Sa / Fr	vk							1				False cleavers	Saat-Labkraut
Papaver dubium / rhoeas	Sa / Fr	vk	2										Long-headed / field poppy	Klatsch-, Saat-Mohn
Polygonum convolvulus	Sa / Fr	vk	6	5	1	17	164	9	2	2	42	31	Black bindweed	Winden-Knöterich
Scleranthus annuus s.str.	Sa / Fr	vk					1						Annual knawel	Einjähriges Knäuelkraut
Stachys annua	Sa / Fr	vk								3			Annual woundwort	Einjähriger Ziest
Vicia hirsuta	Sa / Fr	vk					10			1	1		Hairy tare	Rauhhaarige Wicke
Vicia hirsuta / tetrasperma	Sa / Fr	vk		1	1		2						Hairy / slender tare	Rauhhaarige / Viersamige Wicke
10 Deciduous Forests / Shrubbery														
Alnus cf. *glutinos*a	Sa / Fr	vk	1										Alder	Schwarz-Erle
Cornus mas	Sa / Fr	vk	2	6	12	5	54	164	3	62		6	Cornelian cherry	Kornelkirsche

Tab. 1. (continued).

Archaeological dating			Starčevo /	Körös	LBK Körös	LBK	ALBK, Szakálhát	SOP, LENG	SOP, LENG, Tisza	BZ	ArchDat?	ArchDat?		
Cornus sanguinea	Sa / Fr	vk				1		1					Dogwood	Roter Hartriegel
Corylus avellana	Sa / Fr	vk		3	1	5	7	4	5		3	5	Hazel	Hasel
cf. *Pyrus pyraster*	Sa / Fr	vk				1							Wild pear	Wild-Birnbaum
Rubus spec.	Sa / Fr	vk									1		Blackberry / raspberry / dewberry	Brombeere, Himbeere, Kratzbeere
Sambucus nigra	Sa / Fr	vk			2		1					18	Elder	Schwarzer Holunder
Sambucus cf. *nigra*	Sa / Fr	vk				1		1					Elder	Schwarzer Holunder
Sambucus spec.	Sa / Fr	vk	4	1	6	5	37		4		12	9	Elder	Holunder
Sambucus spec.	Sa / Fr	mi	2					6					Elder	Holunder
cf. *Vitis sylvestris*	Sa / Fr	vk						1					Wild vine	Weinrebe
11 Varia														
Apiaceae	Sa / Fr	vk						1		1			Umbelliferous plants	Doldengewächse
Asteraceae	Sa / Fr	vk					1						Daisy family	Korbblütler
Avena spec.	Gr	vk			1		1	19		26			Oat	Hafer
Avena / Secale	Sa / Fr	vk							1				Oat / rye	Hafer / Roggen
Bromus spec.	Sa / Fr	vk	1										Brome	Trespe
Brassicaceae	Sa / Fr	vk					1	1		2			Cabbage family	Kreuzblütler
Brassicaceae	Sa / Fr	mi							1				Cabbage family	Kreuzblütler
Carex spec.	Sa / Fr	vk	2				1	1		1		1	Sedge	Segge bicarpellat
Caryophyllaceae	Sa / Fr	vk		1		1	2	1	1				Carnation family	Nelkengewächse
Caryophyllaceae / Chenopodiaceae	Sa / Fr	vk					83	1	5	2	1		Carnation / goosefoot families	Nelken- / Meldengewächse
Caryophyllaceae / Chenopodiaceae	Sa / Fr	mi	3		183			1			10		Carnation / goosefoot families	Nelken- / Meldengewächse
Cyperaceae	Sa / Fr	vk				3	2	1					Sedges	Sauergräser
Fabaceae	Sa / Fr	vk	1	2		5	158		2	7	1	17	Legumes	Hülsenfrüchte
cf. Fabaceae	Sa / Fr	vk								2			Legumes	Hülsenfrüchte
Galium spec.	Sa / Fr	vk					143	1	4	1			Bedstraw	Labkraut
Galium spec.	Sa / Fr	mi					1						Bedstraw	Labkraut
Hordeum spec.	Sa / Fr	vk	1				6						Barley undiff.	Gerste undiff.
Lamiaceae	Sa / Fr	vk	1				2						Labiatae	Lippenblütler
Lamiaceae	Sa / Fr	mi	15							3			Labiatae	Lippenblütler
Lathyrus / Vicia spec.	Sa / Fr	vk					6						Vetchling / tare	Platterbse / Wicke
Panicoideae	Sa / Fr	vk		2		4	9		2	1	34	4	Millet-like	Hirseartige
Panicoideae	Sa / Fr	mi					1						Millet-like	Hirseartige
Poaceae	Sa / Fr	vk	3	18	1	6	97	6	7	6	3	5	Grasses	Süßgräser

Tab. 1. (continued).

Archaeological dating			Starčevo /	Körös	LBK Körös	LBK	ALBK, Szakálhát	SOP, LENG	SOP, LENG, Tisza	BZ	ArchDat?	ArchDat?		
Polygonum convolvulus / aviculare	Sa / Fr	vk		75	9	12	374	120	81	22	6	6	Black bindweed / knotgrass	Winden- / Vogel-Knöterich
Polygonum convolvulus / dumetorum	Sa / Fr	vk					2		1	1		1	Black bindweed / copse-bindweed	Winden- / Vogel-Knöterich
Polygonum convolvulus / dumetorum	Sa / Fr	mi					2		2				Black bindweed / copse-bindweed	Winden- / Vogel-Knöterich
Polygonum lapathifolium / persicaria	Sa / Fr	vk		2									Pale persicaria / red shank	Ampfer- / Pfirsich-blättriger Knöterich
Polygonum spec.	Sa / Fr	vk		4			1					2	Smartweed	Knöterich
Rumex spec.	Sa / Fr	vk		1									Dock	Ampfer
Polygonaceae	Sa / Fr	vk					4				4		Smartweed family	Knöterichgewächse
Rosaceae	Sa / Fr	vk				1	1						Rose family	Rosengewächse
Silene spec.	Sa / Fr	vk					1						Catchfly	Leimkraut
Solanaceae	Sa / Fr	vk					11					1	Nightshades	Nachtschattengewächse
Solanaceae	Sa / Fr	mi	1			3		2			1		Nightshades	Nachtschattengewächse
Vicia spec.	Sa / Fr	vk					1						Tare	Wicke
Viola spec.	Sa / Fr	vk	1										Violet	Veilchen
20 Other														
Indeterminata	Sa / Fr	vk	1	164		2	36	13	8	62		37	Unidentified seed / fruit	unbestimmte Samen / Früchte
Indeterminata	Sa / Fr	mi	13		161	771	31	2	1	1	20	25	Unidentified seed / fruit	unbestimmte Samen / Früchte
Indeterminata	Kap / Kapz	vk					1					1	Capsule fragment	Kapselfragment
Indeterminata	Veget	vk		6		3	601	5	4	14	1	34	Vegetative plant remains	vegetative Pflanzenreste
Indeterminata	Knos	vk				3	100	1	1		6	31	Buds	Knospen
Indeterminata	Do / St	vk								2			Thorn	Dorn / Stachel
Indeterminata	BGF	vk		7			100			42	6		Porridge / pastry / fruit	Brei / Gebäck / Fruchtfleisch
Indeterminata	Fisch	vk					1	10			14		Fish remains	Fischwirbel / schuppen
Indeterminata	Fisch	so	674	2079	1608	131	812	23035	352	407	403	397	Fish remains	Fischwirbel / schuppen
Indeterminata	Insek	mi	6										Insect remains	Insekten
Indeterminata	Knoz	so	16	49	25	60	151	83	19	30	26	63	Bone / teeth	Knochen / Zähne
Indeterminata	Kopr	vk	1	6	4	18	58	3		3	2	142	Coprolithe	Koprolithen, cf. Maus

Tab. 1. (continued).

Fig. 1. During the excavation of the Neolithic site near Fajsz-Garadomb, Bács-Kiskun county, a systematic archaeobotanical sampling was carried out by the excavators. The dry mineral soil conditions allowed charred or mineralised preservation of the plant remains (in the centre Eszter Bánffy and Péter Pomázi; 14th October 2007).

systematic archaeobotanical investigations in the Sárköz region for the first time. Of the four excavated sites in the Sárköz region, the samples comprise plant remains dating to the Neolithic and, although to a lesser extent, to the Bronze Age (the latter included here for the sake of completeness only). This study reviews and discusses the fully archived and assessed quantitative data with the *ArboDat* 2016 archaeobotanical database programme (for the latter, see Kreuz / Schäfer 2012).

All calculations are based on charred or mineralised plant material that was preserved under dry mineral soil conditions. The processing of the samples (wet sieving and sorting) was carried out at the Landesamt für Denkmalpflege Hessen, hessenARCHÄOLOGIE (Wiesbaden), and follows the methods described, e. g., in Jacomet / Kreuz (1999). Wet sieving was conducted with sieves of 1 mm to 0.5 mm mesh width. The reference collections and the archaeobotanical literature of the department in Wiesbaden were used for the species determination of the plant remains. The plant remains are stored as single species and are labelled with their project, feature, and sample numbers.

A total of 56 509 plant remains have been identified in the 137 samples collected from 91 archaeological features of the Sárköz region *(Tab. 1)*. The number of sites, features, samples, and the sample volumes vary strongly for the different time periods. Therefore, in the following, the archaeobotanical data are summarised according to the three major archaeological periods of the Neolithic in Hungary.

(1) Early Neolithic, after 5800 cal BC
Late Starčevo (Spiraloid B), late Körös: three excavation sites (HU 1 Fajsz, HU 3 and HU 6 Alsónyék), four features, seven samples;

(2) Middle Neolithic, c. 5500–4950 cal BC
Linerarbandkeramik culture (hereinafter LBK) (Bicske-Bíňa phase and LBK undifferentiated): two excavation sites (HU 1 Fajsz, HU 2 Alsónyék), 15 features, 20 samples;

(3) Late Neolithic, c. 4900–4500 cal BC
Sopot and Lengyel cultures: three excavation sites (HU 1 Fajsz, HU 2, and HU 6 Alsónyék), 53 features, 72 samples (see *Tab. 1*).

Project number	Abbreviation site	Site	Location	Easting	Northing	Excavation year
HU 1	FAJSZ	Fajsz	Garadomb	18.937807	46.402068	2007, 2008
HU 2	BSZÉK 5603/1	Alsónyék-Bátaszék	M6 TO 5603/1 56-út	18.705132	46.208121	2009
HU 3	BSZÉK 5603/1 MT	Alsónyék-Bátaszék	M6 TO 5603/1 Mérnöki Telep	18.702595	46.206970	2009
HU 4	SZEMELY	Szemely	M60 83	18.338697	46.024756	2007
HU 5	PTASK 2	Pusztataskony	Ledence	20.509958	47.460995	2009
HU 6	BSZÉK 11	Alsónyék-Bátaszék	M6 TO 11	18.701670	46.208639	2009
HU 7	APC 1	Apc	Berekalja 1	19.670949	47.802355	2009
HU 8	HPAPI 1	Hejőpapi	1	20.873172	47.918639	2009, 2010
HU 9	GORZSA 5	Gorzsa	V. Homokbánya	20.311681	46.334006	2009
HU **10**	MHEGYES	Magyarbánhegyes	Boglyás-Lengés dűlő	20.939869	46.439658	2010
HU 11	RÁBAP	Rábapatona	Kós-domb	17.475372	47.657400	2011
HU 12	TBURA	Tiszabura	Bónis-hát	20.515383	47.449967	2009
HU 14	ZSENNYE	Zsennye	Kavicsbánya	16.817442	47.117678	2007
HU 15	URAI	Uraiújfalu	Alájáró-dűlő	16.997679	47.371613	2010
HU 16	SARKAD	Sarkad	59	21.440775	46.755975	2012
HU 17	VNAM	Vásárosnamény	Perényi tanyától D-re (M3 219)	22.253587	48.078001	2011
HU 18	PPETRI	Pócspetri	Bikaréti szivárgó (M3 212)	22.008021	47.907448	2011
HU 19	KANT	Kántorjánosi	Homoki-dűlő Ny-i pereme (M3/52+52d)	22.146671	47.952447	2010
HU 22	BÜÁBR VII	Bükkábrány	VII	20.726297	47.878250	2012
HU **23**	BÜÁBR XI/A	Bükkábrány	XI/A	20.730569	47.883052	2012, 2013
Sum						

Tab. 2. Table of the archaeobotanically investigated Hungarian Neolithic sites.
All data are archived with the archaeobotanical database programme *ArboDat* 2016.

Archaeological Dating	Features	Samples	Sample volume (litre)	Excavator(s)	Institution
KÖR, LBK Bic, SOP, BZ	52	74	1049	Dr. Jörg Petrasch / Prof. Dr. Eszter Bánffy	Eberhard Karls Universität Tübingen / Institute of Archaeology of the Hungarian Academy of Sciences Budapest]
LBK HU, LENG, ArchDat?	30	46	604	Prof. Dr. István Zalai-Gaál / Anett Osztás	Institute of Archaeology of the Hungarian Academy of Sciences Budapest / Archaeosztráda Kft.[company of archaeological services, Budapest]
STAR_L	2	4	122.15	Prof. Dr. István Zalai-Gaál / Anett Osztás	Institute of Archaeology of the Hungarian Academy of Sciences Budapest / Archaeosztráda Kft.[company of archaeological services, Budapest]
LBK II-V HU, LBK HU	3	5	14.5	Zsolt Gallina / Krisztina Somogyi	Ásatárs Kft. [company of archaeological services, Kecskemét]
SZAK, TIS, Neol HU, ArchDat?	26	30	450	Prof. Dr. Pál Raczky / Dr. Katalin Sebők	Eötvös Loránd University, (ELTE), Budapest
STAR_L, LENG, ArchDat?	7	13	94.5	Zsolt Gallina / Krisztina Somogyi	Ásatárs Kft. [company of archaeological services, Kecskemét]
LBK Bic, LBK HU, LBK Not, LBK Zse, ArchDat?	37	69	813.5	Dr. László Domboróczki / József Danyi	Dobó István Vármúzeum, Eger [Museum, Eger]
ALBK	11	48	536	Miklós Makoldi	Herman Ottó Múzeum, Miskolc [Museum, Miskolc]
KÖR	7	15	171.51	Katalin Tóth / Tibor Paluch	Tornyai János Múzeum, Hódmezővásárhely [Museum, Hódmezővásárhely]
SZAK 2	2	21	65	Dániel Pópity	Field service for cultural heritage
LBK Not, ArchDat?	28	30	175.5	Péter Polgár	Xantus János Múzeum, Győr [Museum, Győr]
ALBK	2	2	34	Prof. Dr. Pál Raczky / Gábor Váczi	Eötvös Loránd University, Budapest
LBK Kes	1	3	1.6	Csilla Farkas	Savaria Múzeum, Szombathely [Museum, Szombathely]
LENG	2	6	4.95	Csilla Farkas / Réka Mladoniczky	Savaria Múzeum, Szombathely [Museum, Szombathely]
KÖR, ALBK 3, Neol HU, ArchDat?	6	9	55.45	Anita Vári / Gábor Bácsmegi	Munkácsy Múzeum, Békéscsaba [Museum, Békéscsaba]
ALBK 1, Neol HU	11	28	71.5	Katalin Kurucz	Magyar Nemzeti Múzeum (Hungarian National Museum)
ALBK	2	4	17.5	Katalin Kurucz	Magyar Nemzeti Múzeum (Hungarian National Museum)
ALBK, ArchDat?	5	6	41	Katalin Kurucz	Magyar Nemzeti Múzeum (Hungarian National Museum)
ALBK	2	5	42	András Kalli	Herman Ottó Múzeum, Miskolc [Museum, Miskolc]
ALBK	5	12	169	András Kalli	Herman Ottó Múzeum, Miskolc [Museum, Miskolc]
	241	**430**	**4532.66**		

Tab. 2. (continued).

Archaeological dating	Starčevo / Körös	LBK	ALBK, Szakálhát	SOP, LENG, Tisza	BZ	ArchDat?
Site(s)	**HU 1** FAJSZ, **HU 3** BSZÉK 5603 / 1 MT, **HU 6** BSZÉK 11, **HU 9** GORZSA 5, **HU 16** SARK	**HU 1** FAJSZ, **HU 2** BSZÉK 5603 / 1 56-út, **HU 4** SZEMELY, **HU 7** APC 1, **HU 11** RABAP, **HU 14** ZSENNYE	**HU 5** PTASK 1, **HU 8** HPAPI, **HU 10** MHEGYES, **HU 12** TBURA 5, **HU 16** SARK, **HU 17** VNAM, **HU 18** PPETRI, **HU 19** KANT, **HU 22** Büábr VII, **HU 23** Büábr XI / A	**HU 1** FAJSZ, **HU 2** BSZÉK 5603 / 1 56-út, **HU 5** PTASK 1, **HU 6** BSZÉK 11 **HU 15** URAI	**HU 1** FAJSZ	**HU 2** BSZÉK 5603 / 1 56-út, **HU 5** PTASK 1, **HU 6** BSZÉK 11, **HU 7** APC 1, **HU 11** RABAP, **HU 16** SARK, **HU 19** KANT
Charred concentration (piece / l) **all sites / all feature types**	8.3	6.2	23.4	44.6	6.2	56.2
Charred concentration (piece / l) **all sites / only pits**	8.3	7.5	24.1	54.9	14.4	63.7
Charred concentration (piece / l) **all feature types / only Sarköz area**	10.9	3.1		52	6.2	137

Tab. 3. Comparison of the concentration values of the charred plant remains for the different archaeological periods (Ecological Groups 1–7, 10–11; see *Tab. 1*).

In addition, further 23 samples from 13 archaeological features of the excavation at the HU 1 Fajsz site dated to the Hungarian Bronze Age (from 2200 cal BC onwards) are included here for the sake of the completeness of the Sárköz sites.

As mentioned in the above, supplementary to the archaeobotanical samples from the Sárköz excavation sites, we received additional archaeobotanical material for the research project from a further 19 Hungarian Neolithic sites, representing, among others, the Alföld Linearbandkeramik (hereinafter Alföld-LBK or ALBK) and the Szakálhát group of eastern Hungary *(Tabs 1–2)*. Additionally, material from two Romanian Neolithic sites has been evaluated, which is not included here. All in all, 79 plant species (Ecological Groups 1–7, 10) and 20 plant taxa (Ecological Group 11 Varia; *Tabs 1–2*) from 113 170 plant remains have been determined and are archived fully quantitatively with the archaeobotanical database programme *ArboDat* [1].

Today, the one-time occupation surface of Neolithic settlement sites is usually eroded. Therefore, predominantly features that in the past were dug into the ground are preserved. In the case of our investigation, the regularly sampled archaeological features are different kinds of pits, post-holes, ditches, and graves. At all sites, we are dealing with dry mineral soils with a preponderance of the charred preservation of the plant remains (e. g. as at the excavation at Fajsz; *Fig. 1*). Mineralised remains occurred in about 10 % of the features only and in very low quantities. The general archaeobotanical experience is that the remains of crop species are well preserved in a charred form due to their contact with cooking fires and hearths. Therefore, it is not surprising that, on the average, 94 % of all charred plant remains discussed here come from cereals, pulses, and the other crop plants *(Tab. 1)*.

Table 3 clearly illustrates the variability of the concentration values of the charred plant remains for the different archaeological periods. The concentration values are calculated for all charred plant remains of Ecological Groups 1–7, 11 of all sites and all feature types. They are also calculated for "only pit features" and for "all features from the Sárköz region", respectively (for the latter, see the last line of *Tab. 3*). Remarkably, the values of the Sárköz sites partly mirror the general trend. The high values of the features with uncertain archaeological dating (ArchDat?) can in part be attributed to the higher amount of charred cereal chaff remains in the relevant samples. In fact, it is too early for a contextual interpretation of the existing quantitative data. If, for example, we

1 The assignation of archaeobotanical finds to modern phytosociological units, e. g. modern weed associations, often makes no sense, especially for earlier prehistoric periods. Instead, as an aid for the sorting of wild and cultivated species, taxa can be classified into so-called Ecological Groups, following their modern, natural main distribution. The Ecological Groups used here and from the *ArboDat* database programme are listed in *Tab. 1*.

Fig. 2. Historical map from the Sárköz area by Mihály Ruttkay 1763 (1 : 20 000) showing the surroundings of the archaeological site near Fajsz (orange square). Recognisable are the numerous meanders and fens in the marginal depression area of the river Danube to the east.

compare the concentration values of 1749 samples from 551 LBK features from Germany and Austria, which is 16.5 charred plant remains per litre (Kreuz 2012) with the LBK value of 3.1 pieces per litre from the Sárköz sites (based on 20 samples from 15 features, see *Tab. 1*), it is obvious that the more samples investigated in future, the better the archaeobotanical output and the potential for a differentiated interpretation.

The study area and the Neolithic landscapes

The study area is located in the alluvial Danube Valley, in a micro-region known as the Sárköz region. The landscape is bordered to the east by the sandy plains of the Danube-Tisza interfluve and to the west by the Mecsek Mountains and the hilly landscape of southern Transdanubia.

The excavation at Fajsz-Garadomb lays some 4 km east of the current Danube channel, at about 93 m a.s.l., which is 4 m higher than the modern river bed and thus rises above the floodplain with its yearly inundations. It seems very likely that this was the case in the Neolithic too, since according to our current knowledge, the former river channel ran deeper than today (Gábris / Nádor 2007). On the testimony of studies in the comparable areas of the Upper Rhine Valley and the German low mountain range, due to erosion the relief has been flattened up to 50 % including a considerable sedimentation in the river valleys during the Holocene (e. g. Thiemeyer 1987; Wunderlich 2000; Dambeck / Thiemeyer 2002; Dambeck 2005; Gábris / Nádor 2007; Kreuz et al. 2007). A similar development can be assumed for the Danube Valley in the Hungarian Plain too. Three other excavations around Alsónyék in the Sárköz region were located about 40 km south-west of Fajsz, about 10 km west of the Danube (for further geographic information, see, e. g., Somogyi 1961; Kosse 1979; Marosi / Somogyi 1990; Bánffy et al. 2014; Sümegi et al. in this volume).

The entire Danube Valley is characterised by the changeful development of the numerous rivers and streams and their abandoned channels and oxbow lakes (see also the topographical maps as well as Borsy et al. 1969, 237; Somogyi 1961; Sümegi 2001; Bánffy et al.

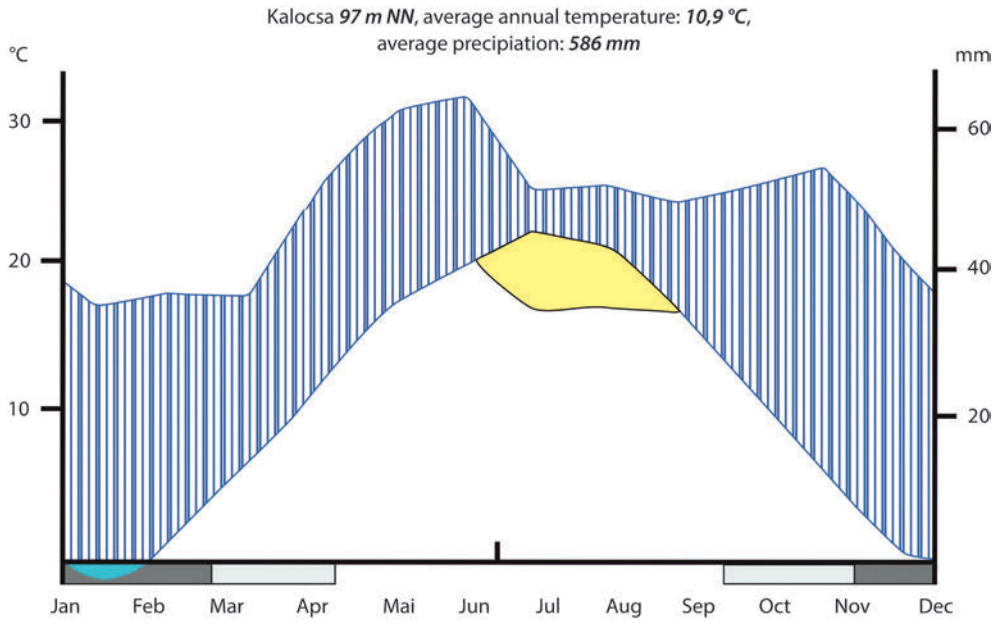


Fig. 3. Diagram illustrating the climate in the area of the modern town of Kalocsa, Bács-Kiskun county (from Walter / Lieth 1967). The decrease of the precipitation coincides with the highest temperatures in July (lower curve). Therefore, today there is a risk of summer drought.

2014; Osztás et al. 2016, fig. 2). Regrettably, the absolute dating of the oxbows is mostly still lacking and it is unknown until when they were small "lakes" in the landscape. On the other hand, former meanders can still be seen on the historic maps of the 18th century (*Fig. 2*; Ruttkay 1763 in Arcanum 2009). These historic maps show that at least part of the abandoned channels and oxbow lakes still contained water at that time. Moreover, on the testimony of the map, there were extended fens along the eastern edge of the Danube Valley in the year 1763, in the marginal depression area *(Randsenke)* of the river valley.

The fluvial sediments consisting of gravel, sand, clay, and loam are today overlain by up to 1 m thick loess sediments (Geological Map of Hungary, Máfi 2009; Sümegi 2001; 2003). Chernozem soils and brown soils developed during the Pre-Boreal from the late-glacial virgin soils under terrestrial conditions (Horvat et al. 1974, 41; 282–285; Stefanovits et al. 1999, 279–318; 409; for the development of chernozem soils see e. g. Schalich 1988; Schachtschabel et al. 1989; Semmel 1990). The entire Sárköz region and the areas of the other Neolithic sites included here are under agricultural use today and provided an excellent substrate for crop cultivation in prehistoric times.

The climate

Modern Hungary is located at the intersection of the Eastern European continental, the Western European oceanic, and the South European sub-Mediterranean climate zones (Pécsi / Sárfalvi 1962, 42; see also Sümegi et al. in this volume). The Sárköz region has a more continental, warm, and dry climate (*Fig. 3*; Walter / Lieth 1967, type nos 6–7). Currently, the annual average temperature around Kalocsa and in the Sárköz region is about 10.5–10.9 °C. The average temperature of the vegetation period is 17 °C. The period without frost lasts from April 5 until October 25. The temperature ranges from a maximum of 34.4 °C in summer to -15.5 and -16 °C in winter (Vadász 1969; Marosi / Somogyi 1990, 50). The annual average precipitation ranges from about 570 to 590 mm. Today, the area's environment can be characterised by a slightly arid tendency with the risk of summer drought (*Fig. 3*; Marosi / Somogyi 1990, 50).

The palaeoclimate records for the study period suggest a European climate having been characterised by warmer summers with higher rainfall than today, which seems to be a global tendency for the northern hemisphere (for details see Kreuz 2012, 49–56; contributions in Litt 2003). In sum, the Sárköz region quite certainly provided a favourable climate and very good soil conditions for prehistoric crop cultivation (Pécsi / Sárfalvi 1962, 46; Marosi / Somogyi 1990, 48–50). Considering the probably more humid climate in the mid- and later 6th millennium BC, summer droughts probably did not mean a major problem for the early farming communities settling there.

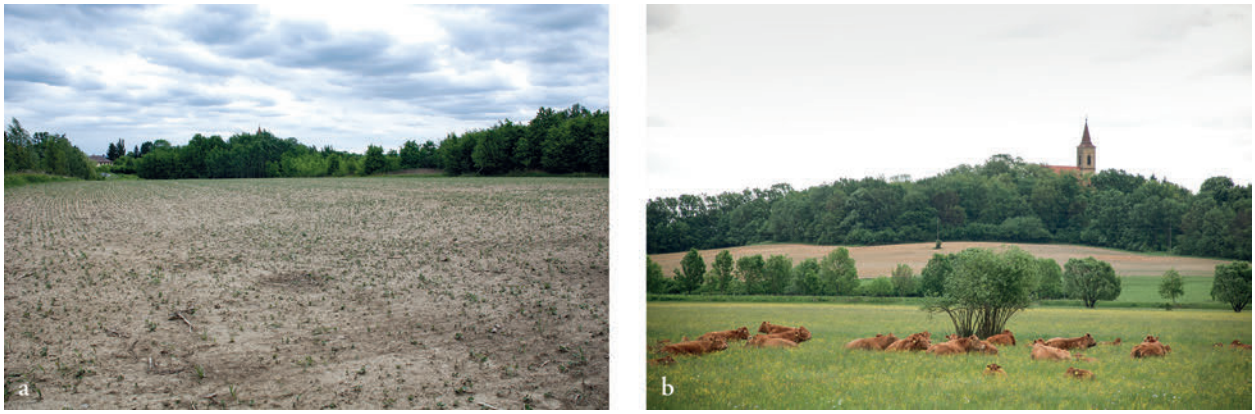


Fig. 4. A settlement dating to the "formative LBK" has been excavated in parts at the site Szentgyörgyvölgy-Pityerdomb, Zala county, by E. Bánffy (Bánffy 2004). a View to the west; due to the ecological conditions the sunflowers are not thriving well (16th May 2012). b Appropriate to the ecological potential of the landscape, the focus of agricultural use around the modern village is more on pasture and cattle breeding. The excavation was carried out behind the church tower.

The past vegetation

The natural vegetation cover provided the prehistoric ecological basis for the wild and domestic grazing and browsing animals as well as the potential for collecting herbs, nuts, berries, mushrooms, roots, and the like for human consumption. Regarding the ecological potential of the landscapes settled by the early farmers, the openness of the Neolithic woodland cover is an important, but still debated factor (e. g. Kreuz 2008a). Kosse (1979) reconstructed a forest-steppe for the Neolithic period in Hungary, forming a transition between woodland and steppe vegetation. Natural steppe vegetation is connected with summer droughts and an annual precipitation of ≤ 450 mm, resulting in a restricted groundwater table, constraining the growth of bigger trees (e. g. Walter 1968; Walter / Straka 1970). In fact, at present, a steppe-like vegetation covers the lowlands of central Hungary, e. g. the "alkali puszta" in the Hungarian National Park in the Hortobágy / Debrecen region east of the Tisza and the "sand puszta" of Bugac / Kecskemét in the sandy region of the Danube-Tisza interfluve. However, according to the current evidence, western Hungary probably did not have a steppe forcing climate during the 6th millennium BC (see also Bánffy / Sümegi 2012; see above, for further literature). In addition, this modern Pannonian salt and steppe vegetation probably is due to the considerable and artificial lowering of the groundwater level and increased evaporation as a consequence of the lack of a woodland cover (see also the discussion by Járai-Komlódi 2003, 49 f.; Kreuz 1990, 159–162, with further literature). Based on the 570–590 mm annual precipitation in the Sárköz region today and with the probably higher rainfall in Atlantic times, a natural steppe-like vegetation should have been restricted to dry stands, as to be expected on steep slopes or on sand dunes in the river valleys and in the Danube-Tisza interfluve. The possible indicator plants for such special stands are discussed below.

For a more detailed reconstruction of the vegetation and the question of the openness of the woodland pollen analytical studies in the Sárköz study area are needed. An interesting deposit can be found near Császártöltés on the eastern margins of the Sárköz Danube Valley *(Randsenke)*, c. 15 km east of Fajsz (Persaits et al. 2008; see also Sümegi et al. in this volume). Based on the ^{14}C dates, the pollen diagram probably spans the entire Early Neolithic, but it should be analysed more in detail for a sound interpretation, as, for example, herbs and grasses, and other potential anthropogenic indicators are lacking from the published profile diagram. The profile from the Kolon-tó site at Izsák, lying 50 km north-east of Fajsz, is dated to the Atlantic period by its biostratigraphy (Járai-Komlódi 1985). Unfortunately, this interesting profile lacks an absolute dating and thus its interpretation in the context of a vegetation reconstruction of the Neolithic runs into difficulties. In any case, as shown by the pollen analytical results of Járai-Komlódi (1966, 198; 1985; 2003, 50 f.) and Lóczy (1989), oak, elm, and lime species *(Quercus*, *Ulmus*, *Tilia* sp.*)* as well as hazel *(Corylus avellana)* were widespread in the former woodland of the Hungarian plain, accompanied – especially at higher altitudes – by beech *(Fagus sylvatica)* and hornbeam *(Carpinus betulus).*

The map of the modern natural vegetation of Europe (Bohn et al. 2003) provides further clues for the Neolithic woodland distribution in Hungary. The map shows Pannonian steppe-oak forests (dominated by *Quercus robur*, with *Quercus cerris* and *pubescens* in minor quantities, alongside *Acer tartaricum*, *Fraxinus ornus*, etc.) alternating with small areas of herb-grass steppes and sand steppes in the Danube-Tisza interfluve as well

Fig. 5. Forest reserve near Kerecsend "A kerecsendi Berek erdő" (9th May 2012) showing a young mixed deciduous forest (Aceri tataricum-Quercetum) with four oak species *(Quercus robur*, *Quercus petraea*, *Quercus pubescens* as well as *Quercus cerris)*, ash *(Fraxinus excelsior* and *Fraxinus ornus)*, maple *(Acer tatarcicum* and *Acer campestre)*, elm *(Ulmus minor)*, and a shrub layer with sloe *(Prunus spinosa)*, hawthorn *(Crataegus monogyna)*, roses (*Rosa* species), spindle bush *(Euonymus europaeus)*, and cornelian cherry *(Cornus mas)*, etc.

as east and south of the Great Hungarian Plain (see also the description of the *Aceri tartarici-Quercion* in Horvat et al. 1974, 275–319). Further to the north-west, the woodland becomes denser, for example in the region around Lake Balaton and in the region of Pécs and the Mecsek Mountains as well as in the region between the Drava and the Sava (Bohn et al. 2003).

It is remarkable that the settlement sites of the formative LBK (Bánffy 2004; Oross / Bánffy 2009) in the Balaton region of Transdanubia are located in landscapes that had at the time probably been covered by darker forests with hornbeam *(Carpinus betulus)*, and beech *(Fagus sylvatica)*, which, due to the comparably less advantageous soils and climate (Bohn et al. 2003; for Pityerdomb, see *Fig. 4*), were in all likelihood not ideally suited for crop growing. Actually, at the LBK sites of Neckenmarkt, Strögen, and Rosenburg in Austria near the border to north-western Hungary, charcoal of beech and spruce *(Picea abies)* as well as charred fruits of hornbeam have been identified (Kreuz 1990). Before the Copper and Bronze Ages, beech and hornbeam did not spread further to the northern LBK distribution area, where spruce remained restricted to certain mountain areas (e. g. Lang 1994; Schäfer 1996; for the archaeobotanical finds of further wood species, etc., see below). Instead, in the Sárköz region of southern Hungary, the current state of research indicates a mixed deciduous woodland with a rich shrub layer as the dominant vegetation cover on the fertile chernozem soils in the 6th millennium BC (for the potential shrub spectrum, see Horvat et al. 1974, 360–363). One rare possible "relict" of mixed deciduous woodland of this type can be visited today in a nature reserve south of Eger near Kerecsend in northern Hungary *(Fig. 5)*.

The crop spectra within their archaeological context

During the entire Hungarian Neolithic period, there is evidence for eight crop species, which were most likely cultivated by the early farmers: barley *(Hordeum distichon / vulgare)*, free-threshing wheat *(Triticum aestivum s. l. / durum / turgidum)*, emmer *(Triticum dicoccum)*, and einkorn *(Triticum monococcum*; one- and two-grained varieties) among cereals, lentil *(Lens culinaris)* and pea *(Pisum sativum)* among pulses as well as flax *(Linum usitatissimum)* and opium poppy *(Papaver somniferum)* among oil / fibre plants (*Tab. 4*; e. g. Tempir 1964; Hartyáni / Nowáki 1975; Füzes 1990; 1991; Gyulai 2010; Kreuz et al. 2005; Kreuz 2007; 2008a; 2012; see also the compilation in Pomázi 2010).

Regarding the Early Neolithic Starčevo and Körös groups of the Sárköz region, archaeobotanical data from four features are available. In addition, 22 samples from further 14 archaeological features collected during excavations in the other regions have been analysed *(Figs 6–7; Tabs 1; 4–5*[2]*)*. The samples from the excavations at HU 1 Fajsz and HU 3 and HU 6 Alsónyék are the first analysed archaeobotanical samples of the Körös and Starčevo culture in the Sárköz region (representing the later spiraloid B phase), showing the good potential of systematic investigations in the future. The seven samples contained 19 grains and four rachis fragments of barley, two grains and 286 glume bases of einkorn, and two grains and 196 glume bases of emmer. The lack of further crop species that could be expected (see, e. g., Bogaard et al. 2007 for the Körös site at Ecseg-

2 *Tab. 5* is available as digital supplement only: https://doi.org/10.34780/confinia.v1i0.1000.

Archaeological period	Early Neolithic		Middle Neolithic			Late Neolithic		Bronze Age	
	Körös / Starčevo formative LBK		LBK	late LBK	ALBK, Szakálhát	SOP, LENG, Tisza		diverse phases	
Region	**Sárköz**	**HUN**	**Sárköz**	**HUN**	**HUN**	**Sárköz**	**HUN**	**Sárköz**	
Number of samples	**7**	**22**	**20**	**58**	**139**	**72**	**20**	**23**	
Cultivated crop species									**English names**
Hordeum distichon / vulgare	x	x			x	x	x	x	Barley
Triticum aestivum s.l. / durum / turgidum		x		(x)	x	x	x	x	Naked wheat
Triticum dicoccum		x	x	x	x	x	x	x	Emmer
Triticum monococcum	x	x	x	x	x	x	x	x	Einkorn
Panicum miliaceum								x	Common millet
Lens culinaris		x		x	x	x	x	x	Lentil
Pisum sativum				x	x				Pea
Linum usitatissimum					x				Flax
Papaver somniferum				x	x				Opium poppy
Camelina sativa								x	Gold-of-pleasure

Tab. 4. The cultivated crop species of the different archaeological periods and the Sárköz area in comparison with further Hungarian (HUN) Neolithic sites (explanations and references in the text).

falva in south-eastern Hungary) can be attributed to the still small database. The other investigated Körös sites also yielded barley, naked wheat, lentil, and bitter vetch (*Vicia* cf. *ervilia*; *Tab. 1*, sites HU 16 Sarkad and HU 9 Hódmezővásárhely; for naked wheat, see also Bogaard et al. 2007). Further evidence of emmer and an undifferentiated wheat species was identified from imprints on Starčevo pottery sherds and a figurine fragment from Kéthely, Dombóvár-Gunaras, and Mernye (surface finds; Füzes 1990, 1991; Bánffy 2004, 355–358).

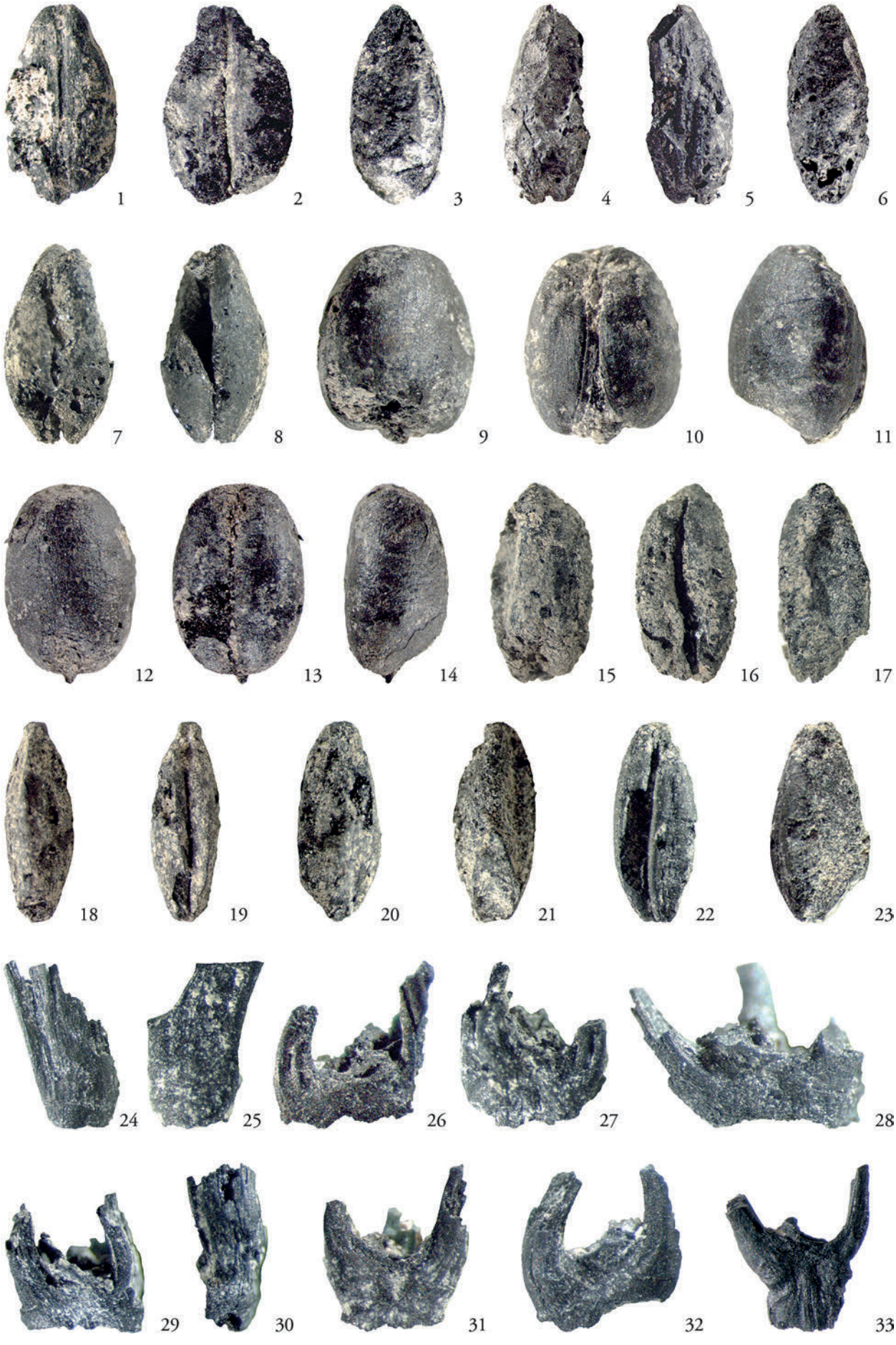
Regarding the LBK culture, einkorn (one grain, 205 glume bases) and emmer (one grain, 60 glume bases) have been found in the Sárköz region to date (for the botanical names of the crop species, see above and *Tab. 1*). Lentil and pea as well as opium poppy have been identified at the other investigated Hungarian sites of the younger LBK *(Fig. 7; Tabs 1; 4)*. Emmer, einkorn, pea, lentil, and flax are part of the regularly found spectrum at the earliest LBK sites in Germany and Austria as well. Opium poppy as the sixth species occurs from the Flomborn phase of the LBK onwards, arriving there from the western Mediterranean (Bakels 1982; Kreuz et al. 2005; Kreuz 2012).

Naked wheat and barley appear to have been adopted by the LBK farmers not before the end of the Bandkeramik period as deliberately cultivated crops[3]. They belong to the spectrum of the Neolithic farming systems of the subsequent Hinkelstein, Großgartach, and Rössen cultures in Germany and Austria (Kreuz 2012). Barley and naked wheat are cereals with higher yields compared to einkorn and emmer. On the other hand, they require more nitrogen input than hulled wheats, while naked wheat calls for much more careful weeding (e. g. Körber-Grohne 1988; Geisler 1991; Hydri Agri Dülmen 1993; Kreuz 2005, 134).

Remarkably, the initial situation in Transdanubia in north-western Hungary has been as follows: barley and naked wheat were part of the farming spectrum of the formative LBK, as evidenced by the Szentgyörgyvölgy-Pityerdomb site (Bánffy 2004, 313; 333; Berzsényi / Dálnoki 2005; Kreuz 2012, 138). The material culture of Pityerdomb was strongly influenced by the Starčevo complex (e. g. Bánffy 2004; Oross / Bánffy 2009; Bánffy et al. 2010, 48), and therefore the occurrence of naked wheat and barley, part of the crop spectrum of the Starčevo agricultural system, is not surprising. Unfortunately, no further archaeobotanical samples and data are available from the formative LBK sites in Transdanubia.

Strikingly, naked wheat and barley together with hulled wheats, lentil, pea, flax, and opium poppy have been found in samples from the Alföld-LBK and the Szakálhát group in eastern Hungary, which were in part

3 The two naked wheat finds from the site HU 7 Apc, features 763–764 and 779 (= LBK undifferentiated) comprise one rachis fragment and one grain. A ^{14}C date would be useful to confirm the absolute age of these single naked wheat finds.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contemporaneous with the western LBK culture. As for barley and naked wheat, their rejection by the western LBK farmers in contrast to the Alföld-LBK and Szakálhát groups, and the late Starčevo-Körös complex *(Tabs 1; 4)* was very probably a cultural decision, as proven by their later cultivation in all the former areas of the LBK distribution from the 5th millennium BC onwards (Hinkelstein, Großgartach, and Rössen cultures; Kreuz 2012). The reduction of the crop species diversity in the early LBK (Bicske-Bíňa phase) agrarian system following the formative phase was probably a consequence of a shift in agricultural emphasis, e. g. a greater emphasis on stockbreeding (for a discussion, see Kreuz 2012, e. g. 83–90 and tab. 9).

It is instructive to compare the crop spectra of various Hungarian Neolithic cultures with the corresponding archaeobotanical results of the areas settled earlier during the Neolithic further to the south and east of Europe, and beyond. Apart from cereals and flax, mentioned above, lentil, pea, chickpea, broad bean, bitter vetch, and grass pea belonged to the early crop spectrum of South-West Asia. Apart from broad bean, these spread westward to the Balkan Peninsula, arriving there in the centuries around 6000 cal BC (e. g. Kroll 1991; Marinova 2006; Fuller et al. 2011; Zohary et al. 2012; Reed 2015; González Carretero et al. 2017). Of these pulse species grown in the 6th millennium BC further to the north, only pea and lentil were integrated into the Neolithic agrarian systems of the different archaeological cultures in Hungary (Kreuz et al. 2005; Kreuz 2012). The solitary charred seed find of bitter vetch *(Vicia ervilia)* from the Körös site Hódmezővásárhely-Gorzsa (HU 9, sample 332–1) east of Szeged and the Tisza Valley of southern Hungary could well be a relic from the Balkan spectrum that "survived" as a weed among the cultivated pulses[4]. According to the archaeobotanical state of research, only after millennia did additional pulse species spread further to the north-west (e. g. bitter vetch and broad bean from the Bronze Age onward; Kreuz 2016).

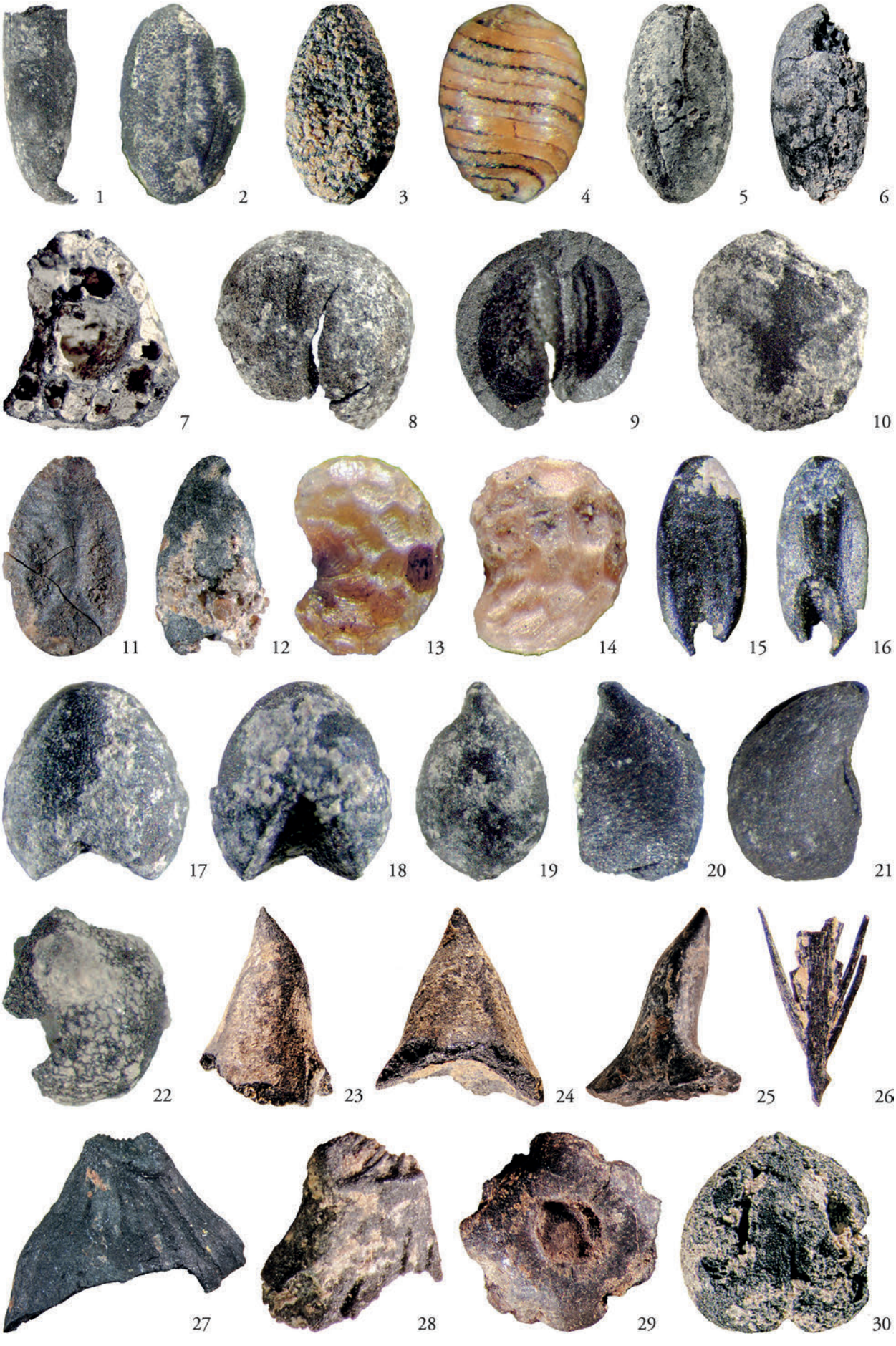
The reduction of the Neolithic pulse species spectrum during its spread to the north-west can be interpreted as a reflection of different cultural traditions in terms of the adopted agrarian systems and the diet (discussed in detail in Kreuz 2012; Kreuz / Marinova 2017; see also the cultivation experiment in Kreuz 2015, with pictures and further literature). For the Neolithic farmers of the neighbouring Balkan Peninsula, growing more pulse species probably acted as a kind of risk management to cope with the problem of summer droughts. In contrast, in the Hungarian Neolithic agrarian systems which apparently did not suffer from droughts, this would have caused additional work in the fields and more laborious processing, e. g. to make the poisonous pulse seeds of the *Vicia* and *Lathyrus* species edible (Kreuz 2015).

In the case of the Late Neolithic Sopot / Lengyel groups in the Sárköz region, we found an increase in the number of cultivated cereal species compared to the LBK system *(Tabs 1; 4)*[5]. This appears to be an analogous trend as could be noted in the more or less contemporaneous Middle Neolithic in Germany, possibly related to newly evolving demographic and social factors. As for the Bronze Age, represented by several phases at the HU 1 Fajsz site only, apart from barley, naked wheat, einkorn, emmer, and lentil, there is evidence for the two other typical crop species of the Metal Ages, namely gold-of-pleasure (*Camelina sativa*: four seeds) and foxtail millet (*Panicum miliaceum*: 247 grains) *(Fig. 7; Tab. 1)*. This further increase in the diversity of crop species can certainly be linked to the period's special economic and social developments (see also Kreuz 2016) that can, among others, be associated with the beginnings of metallurgy, as attested in other research areas as well.

◁ Fig. 6. Finds of plant remains from the Hungarian sites (see *Tab. 1*; for the abbreviations of the sites see *Tab. 2; l. length*). If not indicated differently the remains are preserved charred and belong to the site HU 1 Fajsz. 1–8 barley *(Hordeum distichon / vulgare)*: 1 grain ventral (l. 4.5 mm), feature 125, transect 125-1; 2–3 grain ventral, lateral (l. 4.1 mm), feature 46, transect 46-1; 4–6 grain dorsal, ventral, lateral (l. 5.6 mm), feature 46, transect 46-1; 7–8 grain dorsal, ventral (l. 6.1 mm), feature 126, transect 126-1; 9–14 naked wheat *(Triticum aestivum* s.l. / *durum / turgidum)*: 9–11 grain dorsal, ventral, lateral (l. 3.8 mm), feature 125, transect 125-1; 12–14 grain dorsal, ventral, lateral (l. 4.1 mm), feature 102, transect 102-1; 15–17 emmer *(Triticum dicoccum)*, grain dorsal, ventral, lateral (l. 5.9 mm), feature 126, transect 126-3; 18–23 einkorn *(Triticum monococcum)*: 18–20 grain dorsal, ventral, lateral (l. 3.8 mm), feature 183, transect 183-1; 21–23 grain dorsal, ventral, lateral (l. 4.1 mm), feature 46, transect 46-1; 24–28 emmer *(Triticum dicoccum)*: 24 glume base (l. 2.0 mm), feature 161, transect 161-1; 25 glume base (l. 1,65 mm), feature 165, transect 165-1; 26–28 spikelet fork: 26 (l. 1,8 mm), feature 173, transect 173-1; 27 (l. 1,7 mm), feature 165, transect 165-1; 28 (l. 1.3 mm), feature 161, transect 161-1; 29–33 einkorn *(Triticum monococcum)*: 29 spikelet fork (l 1.5 mm), feature 161, transect 161-1; 30 glume base (l. 2 mm), feature 161, transect 161-1; 31–33 spikelet fork: 31 (l. 1.5 mm), feature 167, transect 167-1; 32 (l. 1.55 mm), feature 165, transect 165-1; 33 (l. 1,9 mm), HU 3 feature 1501, transect 1501-1.

4 The cf. determination of *Vicia ervilia* is due to the small size and the singularity of the find; the shape of the seed is exactly the same as of bitter vetch.

5 At the current state of research, it is not possible to estimate the cultivation of pulses and oil / fibre plants.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The potential prehistoric weed species that grow together with the crops in the fields and are transported to the settlements together with the harvest can be assigned to the Ecological Groups "Weeds of cereal fields", "Weeds of hoed fields and gardens", "Ruderals", and "Segetal Vegetation", and in part possibly to "Grassland Vegetation" *(Tab. 1)*. The weed spectrum of the sites in the Sárköz region and beyond is still quite limited, possibly a reflection of the current state of research. As often experienced during other archaeobotanical investigations, there is a strong correlation between the number of investigated samples and the number of identified species (see also the concentration values mentioned above and the methodological remarks in the archaeobotanical overview of Neolithic Croatia by Reed 2015). At the moment, these first finds of potential weeds *(Tab. 1)* are too few to allow any conclusions with regard to field management, crop harvesting methods, etc.; the study of these important questions and aspects of Neolithic agriculture remains a task for future archaeobotanical investigations (for a discussion, see Kreuz / Schäfer 2011; Kreuz 2012). Given the fertile soils and the assumed weather conditions during the Neolithic, shifting cultivation seems unlikely – instead, permanent fields on terrestrial soils can be expected. Moreover, manuring by grazing animals after harvest combined with crop rotation should have been sufficient for the nutrient regime of the cultivated crops (Kreuz 2012, 91–111). Finds of charred coprolites occurring together with the crop finds indicate that the storages of cereals and pulses were frequented by mice in all periods *(Tab. 1)*.

◁ Fig. 7. Finds of plant remains from the Hungarian sites (see *Tab. 1*; for the abbreviations of the sites see *Tab. 2; l. length*). 1 cornflower *(Centaurea cyanus)*, fruit (l. 3.3 mm), feature 46, transect 46-1; 2 gold-of-pleasure *(Camelina sativa)*, seed (l. 1.4 mm), feature 125, transect 125-1; 3 elder *(Sambucus* cf. *nigra)*, pip (l. 2.7 mm), HU 6 feature 3806, transect 3806-1; 4 stonewort *(Chara* spec.*)*, mineralised oogonium (l. 0.7 mm), HU 6 feature 3802, transect 3802-1; 5–7 cornelian cherry *(Cornus mas)*: 5 pit (l. 10.7 mm), feature 43, transect 43-1; 6 pip (l. 11.9 mm), feature 189, transect 189-3; 7 fragment internal view (l. 3 6 mm), feature 173, transect 173-1; 8–9 dogwood *(Cornus sanguinea)*, pip, fragment external, internal view (l. 3.5 mm), feature 189, transect 189-3; 10 lentil *(Lens culinaris)*, seed (l. 2 mm), feature 31, transect 1; 11–12 flax *(Linum usitatissimum)*: 11 seed (l. 3.2 mm), HU 17 feature 476, transect 476-2; 12 seed (l. 2.65 mm), HU 1 feature 542, transect 542-1; 13–14 opium poppy mineralised seed *(Papaver somniferum)*: 13 (l. 0.92 mm), HU 10 feature 7, transect 7-7; 14 (l. 0.9 mm), HU 10 feature 7, transect 7-3; 15–16 red millet *(Digitaria* cf. *ischaemum)*, fruit ventral, dorsal (l. 1 mm), feature 43, transect 43-8; 17–18 common millet *(Panicum miliaceum)*, fruit ventral, dorsal (l. 1.7 mm), feature 102, transect 102-1; 19 hudson *(Polygonum minus)*, fruit (l. 1,65 mm), feature 125, transect 125-1; 20 lady's mantle *(Alchemilla vulgaris* agg.*)*, fruit (l. 1 mm), HU 3 feature 92, transect 92-1; 21 silver-weed *(Potentilla anserina)*, fruit (l. 0.95 mm), HU 3 feature 1501, transect 1501-1; 22 black nightshade (*Solanum nigrum*), seed (l. 1.15 mm), feature 125, transect 125-1; 23–29 water caltrop *(Trapa natans)*: 23–25 spike fragments, 23–24 frontal, lateral (l. 6.3 mm), HU 5 feature 252, transect 252-1; 25 (l. 8,4 mm), HU 9 feature 333, transect 333-2; 26 appendix (l. 1.8 mm), HU 5 feature 38, transect 38-2; 27 shell fragment (l. 9.2 mm), HU 27 feature 1, transect 1-1; 28 shell fragment (l. 4.3 mm), HU 9 feature 333, transect 333-1; 29 shell fragment (l. 5.3 mm), HU 5 feature 252, transect 252-1; 30 wild vine *(*cf. *Vitis sylvestris*), pip (l. 3.9 mm), feature 71, transect 71-2.

Useful plants from the wild

Some of the most characteristic traits of the flat Hungarian Plain are the (former) meanders and oxbow lakes of the rivers bordered by hardwood alluvial forests, scrubland, and reed vegetation as well as the chernozem soils and brown soils that developed from loess or fluvial sediments under terrestrial conditions *(Fig. 8)*. As mentioned above, in prehistoric times the latter were probably covered by thermophilous mixed deciduous broad-leaved forests with *Quercus robur*, *Quercus cerris* and *pubescens*, *Acer tataricum*, *Fraxinus ornus*, *Carpinus betulus*, etc. (see also, e. g., Kerner von Marilaun 1916; Horvat et al. 1974). Depending on their position relative to the water level, the areas in the river valleys provided an attractive potential for pasturing, hunting, fishing, and (outside the floodplains) crop cultivations during all prehistoric periods. Actually, finds of water plantain *(Alisma plantago-aquatica)*, stonewort *(Chara* sp.*)*, common spike-rush *(Eleocharis palustris)*, pale persicaria *(Polygonum lapathifolium)*, hudson *(Polygonum minus)*, pond weed *(Potamogeton* sp.*)*, curled / broad-leaved dock *(Rumex crispus / obtursifolius)*, water caltrop *(Trapa natans)*, alder *(Alnus* cf. glutinosa), and ragged-robin *(Lychnis flos-cuculi) (Tab. 1)* suggest the exploitation of riparian or floodplain vegetation areas and the on-site disposal of the according plant remains by the Neolithic farmers, herders, and perhaps their domestic animals. This is attested by the archaeozoological finds of diverse fish species, Eurasian coots *(Fulica atra)*, mallards *(Anas platyrhynchos)*, and mute swans *(Cygnus olor)* in the Starčevo features of the Sárköz region (Nyerges / Biller 2015, 2).

Water caltrop is a floating aquatic plant *(Fig. 9)*, growing in warmer areas of Europe in standing or little-moving shallow and nutrient-rich water, such as, e. g., the numerous Hungarian oxbow lakes. It produces edible fruits rich in starch, ripening from September to October (Oberdorfer 1990). The fruits can be roast-

Fig. 8. Today, due to the area-wide agricultural use the Hungarian lowland is characterised in particular by two types of vegetation cover: fields (to the left) on the chernozem and brown soils developed out of loess or fluviatile sediments under terrestrial conditions, and meadows (puszta) on sandy and alkaline soils, here sand dunes. In addition, the edges of channels and former oxbow lakes are marked e. g. by shrubbery of alder and willow (here in the background). Photo near Kisköre, Heves county, in the Tisza Valley (9th May 2012).

ed to improve their taste and to make them preservable for longer, which was probably the reason for their continuous on-site charred preservation *(Fig. 7)*.

Interestingly, *Trapa natans* occurs in the samples from Körös, Alföld-LBK, and Late Neolithic sites (see also, e. g., Bogaard et al. 2007 for the Körös site at Ecsegfalva; Gyulai 2010), but is lacking from all the 78 samples recovered from six Hungarian LBK settlements *(Tab. 1)*. The LBK distribution area in Germany and Austria, where *Trapa* has been and still is a native plant too (e. g. Gams 1927; Behre 1970; Lang 1994), yielded no finds on the settlement sites either (Kreuz 2012), even though the taxon can be easily identified from the archaeobotanical point of view, e. g. by the charred fragments of its fruit spikes *(Fig. 7)*. Obviously, irrespective of its wide natural distribution during the Neolithic, the use of *Trapa* in human diet in Central Europe is restricted to certain regions such as the Hungarian Plain and the Alpine foreland (for the latter, see Karg 2006, with further literature), where it has been continuously used up to modern times.

The regular occurrence of fat-hen *(Chenopodium album)* could be an indication of the use of its starch-rich fruits for human nutrition as well (e. g. Knörzer 1971; Kroll 1990; Behre 2008). Other plants that were quite certainly collected in the wild – providing important vitamins and nutrients – include the nuts and fruits of cornelian cherry *(Cornus mas)* and hazelnut *(Corylus avellana)* as well as dogwood *(Cornus sanguinea)*, wild strawberry *(Fragaria vesca)*, wild pear *(Pyrus pyraster)*, wild blackberry / raspberry / dewberry *(Rubus* sp.*)*, black elder *(Sambucus nigra),* and wild vine *(*cf. *Vitis sylvestris)*. Interestingly enough, in contrast to the LBK finds further to the north-west, sloe is absent among the Hungarian Neolithic plant remains: no LBK, Starčevo or Körös finds until now *(Tab. 1)*. It appears to have been unpopular among these Hungarian Neolithic communities, perhaps owing to its special taste.

The regular occurrence of cornelian cherry remains in the samples of all prehistoric periods from Hungarian sites is interesting for the vegetation reconstruction of the mixed oak forests (see above). The small cornelian cherry tree is part of the natural South-East European open and light dry forests on nutrient and base rich soils, which are characteristic for the northern Mediterranean downy oak region (*Flaumeichengebiet*; Oberdorfer 1990; *Figs 7; 10*). The evidence of awn fragments and grains of feather grass *(Stipa* sp.*)* is likewise remarkable since this species grows in a steppe like vegetation on sand dunes, steep slopes, etc., or under dry summer conditions. In combination with the species group of "Grassland Vegetation" and the collected fruits, recurrent finds

Fig. 9. a–b The water caltrop *(Trapa natans)* is well recognisable by its leaf rosettes floating on the water, here at a former Tisza meander near Mártély north of Szeged (13th May 2012). b–c The ripe fruits are floating on the water surface and have been washed up in quantities at the shore of the oxbow lake.

Fig. 10. One of the collected plants typical for the Neolithic of Hungary and the countries adjacent to the south and east is the thermophile shrub or small tree cornelian cherry *(Cornus mas)*. The shining red longitudinal edible fruits ripen from August onwards and supply among others vitamin C and B (13th October 1994, Botanical Garden of Frankfurt; see also *Fig. 7*).

of *Stipa* awns *(Tab. 1)* are probably an indication of open stands in the woodland area of the Sárköz region and in the lowlands of the Hungarian Plain, in contrast to e. g. the Balaton hinterland settled by the formative LBK (see above, as well as the examples in TMLFUN 2013). This is confirmed by the archaeozoological results: the hunted wild species comprise, among others, species preferring forest glades and open woodland such as hare *(Lepus europaeus)*, badger *(Meles meles)*, red fox *(Vulpes vulpes)*, beaver *(Castor fiber)*, and buzzard *(Buteo buteo)*. On the other hand, the finds of feather grass should not be over-interpreted, given that it has been found in LBK features of Nieder-Eschbach / Frankfurt am Main and Eitzum / Schöppenstedt, south of the Harz range, as well (both in Germany), where a steppe like zonal vegetation was unlikely during the Neolithic (Kreuz 2012).

Other useful wild plant species have also been found on the Hungarian Neolithic sites: these include medicinal plants for healing purposes such as lady's mantle *(Alchemilla vulgaris* agg.*)*, henbane *(Hyoscyamus niger)*, and common mallow *(Malva sylvestris)* (*Tab. 1*, Ecological Groups 2–3). It seems likely that the knowledge of wild plants, of their characteristics, and possible use was widespread in all prehistoric periods, as supported by the rich ethnographic evidence from native societies all over the world (Kreuz 2012, 116–119).

Differences in Neolithic subsistence and diet

The two most important innovations in Early Neolithic subsistence practices were crop cultivation and animal breeding. The use of the crops is not merely a question of their nutritional value. Considering the different cereal, pulse, and oil plant species, new dishes and new tastes appeared (Kreuz 2009; 2012, 112–130). For example, cereals are rich in carbohydrates and very filling, but in addition, they also enabled the baking of "real" breads for the first time, that were less perishable than soups and stews and were also suitable for storage and transport. Besides, cereals can be used for the production

Fig. 11. As an example for the aquatic resources used in Neolithic times, some (a) mussel and (b) fish remains from the Körös site near Hódmezővásárhely, Csongrád county, situated east of Szeged and the river Tisza (HU 9 Gorzsa 5 HB 2009, sample 345–1).

of alcoholic beverages. The pulses provided the farmers with vegetable protein and new types of healthy and filling meals, as did the flavoursome oil plants.

Despite the insufficient state of archaeobotanical research, we can nevertheless assess, with all due caution, that the crop growing system of the Alföld-LBK, comprising a larger crop spectrum than the western early LBK, including naked wheat and barley *(Tabs 1; 4)*, has greater affinities with the (south-) eastern Balkans (for the latter, see Kreuz et al. 2005; Kreuz / Marinova 2017). This is also reflected, for example, in differences in house architecture (Bánffy 2004), burial traditions (Kalicz / Makkay 1977; Oravecz 1998 / 1999), and different archaeological finds such as stone artefacts (e. g. Biagi / Starnini 2010), bone spoons (spatulas) (e. g. Beldiman / Sztancs 2011; Tóth 2012; Vitezović 2016a; 2016b), and clay figurines / idols (e. g. Becker 2009; 2011), which differ substantially from the western LBK. For example, the bone spoons made from large ungulate metapodials were widespread in the Near East and Anatolia and abundant in the entire Starčevo-Körös-Criș and Alföld-LBK distribution area in Hungary as well, reflecting a cultural affiliation between the latter regions. In contrast, they are lacking from among the LBK settlement finds further to the north-west, pointing again to different cultural habits and another culinary identity there.

The other serious innovation of Neolithic subsistence and diet is represented by the introduction of the domestic animals cattle, sheep, goat, and pig to a regionally varying extend. The use of meat alone probably was no reason to start livestock farming, as meat could have been procured from hunted animals as well. Instead, a new element gained from domestic cattle, goats, and sheep was the creation of milk products, whose use has been repeatedly proven by the residue analysis of pottery fragments from refuse pits (e. g. Dudd / Evershed 1998; Craig 2002; Craig et al. 2005; Helmer et al. 2007; Vigne / Helmer 2007; Evershed et al. 2008; for the Neolithic Sárköz region, see the discussion in Nyerges / Biller 2015, 3; Balasse et al. 2017; Ethier et al. 2017). To avoid any misunderstandings, the consumption of fresh milk in larger quantities is a modern habit. Instead, in prehistoric periods, a variety of milk *products* can be expected, judging from the rich ethnographic evidence from native societies. These could include dry curd, yogurt, and cheese products, easy to prepare, store, and transport (see the preparation experiments in Kreuz 2008).

The use of dogs and specialised shepherds would have made it possible to graze larger herds even at greater distances from the permanent settlements. In addition to the referring pollen analytical record and the archaeological finds, evidence for transhumance has been yielded by isotope investigations in the lower mountain areas of Germany as well (Bentley et al. 2002; for examples for the LBK, see Price et al. 2006; Knipper / Price 2009; for the Michelsberg culture, see Kreuz et al. 2014, 91–95).

The current archaeozoological state of research includes evidence for a variable emphasis on stockbreeding by the different Hungarian Neolithic archaeological cultures, judging from the assumed correlation between the archaeological bone samples recovered from settlement sites and the species preferences of Neolithic farmers. Whereas the LBK farmers had a focus on cattle breeding and sometimes pig, the Körös farmers of south-eastern Hungary apparently preferred sheep / goat herding (based on 12 Körös sites by Bartosiewicz 2012, with further papers in the same volume; Domboróczki 2010, tabs 2 and 3, assessment by I. Vörös; Domboróczki et al.

Period	Early Neolithic	Middle Neolithic	Middle Neolithic	Late Neolithic	Bronze Age	Early Neolithic
Archaeological culture	**Starčevo / Körös**	**LBK**	**ALBK, Szakálhát**	**SOP, LENG, Tisza**	**BZ**	**LBK Germany / Austria**
Site(s)	**HU 1** FAJSZ, **HU 3** BSZÉK 5603 / 1 MT, **HU 6** BSZÉK 11, **HU 9** GORZSA 5, **HU 16** SARK	**HU 1** FAJSZ, **HU 2** BSZÉK 5603 / 1 56-út, **HU 4** SZEMELY, **HU 7** APC 1, **HU 11** RABAP, **HU 14** ZSENNYE	**HU 5** PTASK 1, **HU 8** HPAPI, **HU 10** MHEGYES, **HU 12** TBURA 5, **HU 16** SARK, **HU 17** VNAM, **HU 18** PPETRI, **HU 19** KANT, **HU 22** Büábr VII, **HU 23** Büábr XI / A	**HU 1** FAJSZ, **HU 2** BSZÉK 5603 / 1 56-út, **HU 5** PTASK 1, **HU 6** BSZÉK 11 **HU 15** URAI	**HU 1** FAJSZ	37 sites in Germany and Austria
Feature type	Gr	Gr, Lgr	Gr, Lgr	Gr	Gr	Gr, GrKo, Lgr, GrIn
Sample type	Eim, dir, Gef	Eim	Eim, dir	Eim	Eim	Eim
Sample volume (litre)	346.66	603.6	1125.7	799.45	144.5	25593.2
No. of features	14	32	44	49	10	488
No. of samples	25	51	132	68	11	1520
Fish remains	**7.5**	**2.9**	**0.7**	**26.4**	**1.8**	**0.002**
Water plants	**0.3**	**0.04**	**0.05**	**0.04**	**0.02**	**0.004**

Tab. 6. Comparison of the concentration values of fish and plant remains of the Ecological Group 1 "Riparian and shallow water vegetation" differentiated for the prehistoric periods and regions. Concentration values in piece per litre. The values in which the site HU 1 Fajsz has been involved should be higher because the fish remains have not been counted in detail, but entered as 1 per sample, that means as presence / absence only.

2010; Kovács et al. 2010; see also Bökönyi 1974; 1981; 1984; Benecke 2006; Greenfield / Jongsma 2008; Nyerges 2013). This is ecologically surprising, as the open forests in the hinterland of the Körös sites would have provided ideal pastureland for cattle too. In contrast, a dominance of cattle has been demonstrated for the Early Neolithic of parts of Bulgaria and Romania (Benecke / Ninov 2002; El Susi 2008; 2011). Archaeozoological investigations of the Hungarian Starčevo sites are restricted to the excavation at Alsónyék in the Sárköz region (Nyerges / Biller 2015, 2; fig. 2) and Lánycsók (Bökönyi 1981) situated about 20 km to the south. Therefore, the stock breeder activities in this area remain open to discussion. Three further Starčevo sites with archaeozoological finds are situated in the region of the Vojvodina (Donja Branjevina and Golokut; BLAŽÍC 1985; 2005) and the Banat (Starčevo; CLASON 1980). They revealed low numbers of identified specimen as well. An enlarged bioarchaeological database would be helpful for testing the hypothesis of cultural choices determining differences in agricultural emphasis on crop growing and stock breeding.

Regularly occurring fish, mussel, and snail remains in the sieving fractions of all the Hungarian Neolithic samples (examples in *Fig. 11*) point to the continuous tradition of their consumption as an additional important source of animal protein[6]. However, as shown in *Table 6*, fish remains are rather rare in the archaeobotanical sieving residues of the LBK settlements in Germany and Austria. Again, this is interesting in terms of regionally different dietary habits, as the use or rejection of aquatic resources such as *Trapa natans*, mentioned in the above, could be an indication of regional diversity in culinary traditions.

6 The numerous fish remains from the different archaeobotanically investigated sites could not be determined until now. Fish specialist Dr Heidemarie Hüster Plogmann (IPNA Basel [Switzerland]) has kindly examined one sample with fish remains from Fajsz to gain an impression of the archaeozoological material and to estimate the effort needed for the scientific analysis. In her view, it is well preserved, with a huge variety of different species, ranging in dimension from 10 cm length to very big specimens. The different fish species were not only fished in different biotopes, but also, by necessity, with different fishing equipment, ranging from fish traps and fishing rods to fishnets and harpoons. In the case of the examined sample, the fish remains were certainly leftovers of meals, as the finds consist mainly of fish vertebrae and bear traces of digestion (kind information Dr Heidemarie Hüster Plogmann by e-mail to the first author, 01.11.2010). Fish remains from the Lengyel graves at Alsónyék-Bátaszék (HU 2, HU 6) have been identified as originating from wels catfish *(Silurus glanis)*, northern pike *(Esox Lucius)*, and carp species (Cyprinidae) (Nyerges / Biller 2015, 6).

Concluding remarks

Archaeobotanical investigations have been carried out in the context of an archaeobotanical research project focusing on Neolithic agriculture and land use in Hungary. The results from 22 archaeological excavation sites have been collected and archived with the archaeobotanical database programme *ArboDat* 2016. The synthesis presented here is based on the determinations of 113 996 botanical remains sorted out from 459 samples originating from 261 archaeological features. 4558.41 litres of sediment have been processed and 99 plant taxa were determined. The plant material has been archived at the Landesamt für Denkmalpflege Hessen, Wiesbaden.

Based on the available dataset, the Neolithic site catchment in the Sárköz region can be reconstructed as a region well suited for early agriculture. The farmers settling in the region found fertile soils for their fields and the probable climatic conditions were highly favourable for crop cultivation and other agrarian activities. The deciduous forests provided timber, collectable herbs, roots, fruits, nuts, etc., as well as hunting ground. The floodplain areas of the river valleys offered rich nourishment for the livestock, but also indirectly for the inhabitants through hunting and fishing, etc., as proven by the archaeobiological finds.

It is an old research question whether local Mesolithic groups were engaged in the Neolithic transformation process during its spread from the Near East to West-Central Europe. In fact, the extent of the differences between the legacy of the western early LBK farmers and those of the neighbouring southern and eastern farming communities suggest that a Mesolithic population of Transdanubia in north-western Hungary, influenced by the material culture of the Starčevo complex, was involved in developing a creative new strategy of LBK agrarian subsistence in the mid-6th millennium BC (for a discussion, see, e. g., Bánffy 2004; Kreuz 2012, chapters 6 and 9, with further literature; Oross / Bánffy 2009).

Archaeobotanical research provides important insights into former daily life with its underlying cultural and in part ecologically induced choices. On the other hand, more archaeobotanical research based on fully quantitative data is needed for an even better understanding of the on-site display of plant remains within different site and feature types of the different Hungarian Neolithic archaeological cultures and periods. We are looking forward to the results of further interdisciplinary investigations of these exciting subjects with all their fascinating facets in future.

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Digital supplement

Table 5 is available as digital supplement via iDAI.publications / books: https://doi.org/10.34780/confinia.v1i0.1000.

List of abbreviations

agg. = *aggregatio*
ALBK = Alföld Linearbandkeramik
ALBK 3 = Late ALBK
ArchDat? = uncertain archaeological dating
Bef. = feature
BGF = porridge / (flat) bread / pulp
Bru = well
BZ = Bronze Age
cf. = *confere*
dir = directly taken plant remains
Do / St = thorn / prickle
Eim = bucket / bag
Fisch = fish remains
Gef = vessel content
Gra = ditch
GrKo = pit complex
Gr = pit
GrIn = pit in pit complex
HSB = glume base
HUN = Hungary
indet. = indeterminate
Insek = insect remains
Kap / Kapz = capsule / capsule dent
Knos = bud
Knoz = bones / teeth
KöGrab = inhumation
KÖR = Körös
Koll = colluvium
Kopr = coprolite
kult. = cultivated
LBK = Linearbandkeramik
LBK Bic = Bicske-Bíňa (LBK I)
LBK Not = Notenkopf (LBK II)
LBK Kes = Keszthely (LBK III)
LBK Zse = Zseliz (LBK IV–V)
LBK HU = Hungarian LBK undifferentiated
LENG = Lengyel
Lgr = pit alongside house
l = litre
mi = mineralised
Neol HU = Hungarian Neolithic undifferentiated
Pfo = poste hole
RTyp = plant remains type
Sa / Fr = seed / fruit
Siedl = site
s. l. = *sensu latu*
so = other conservation
SoBefu = other type of feature
SOP = Sopot
Spi = rachis segment
STAR_L = Late Starčevo
SZAK 2 = Late Szakálhát
TIS = Tisza Culture
Veget = vegetative remains
vk = charred
Zust = preservation state

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Abstract: Investigation of the plant macro-remains from four archaeological excavations in the Sárköz area around Fajsz-Garadomb and Alsónyék-Bátaszék and a comparison with the archaeobotanical results from further Hungarian Neolithic sites

Archaeobotanical investigations have been carried out in the context of an archaeobotanical research project concerning Neolithic agriculture and land use in Hungary. The results from 22 archaeological excavation sites of the Starčevo, Körös, (formative) Linearbandkeramik (LBK), and Alföld-LBK have been collected and archived with the database programme *ArboDat* 2016 at the Landesamt für Denkmalpflege Hessen in Wiesbaden (Germany). The results are discussed and compared with the archaeobotanical data from 551 LBK features from Germany and Austria. The available data give a hint for differences in subsistence and diet of the Hungarian Neolithic archaeological cultures.

Zusammenfassung: Untersuchungen an pflanzlichen Makroresten aus vier archäologischen Ausgrabungen in der Sárköz-Region nahe Fajsz-Garadomb und Alsónyék-Bátaszék und ein Vergleich mit den archäobotanischen Ergebnissen weiterer neolithischer Fundplätze Ungarns

Im Rahmen eines Forschungsprojektes zur neolithischen Landwirtschaft und Landnutzung in Ungarn wurden archäobotanische Bestimmungen von 22 Fundstellen der Starčevo, Körös, (formativen) Linearbandkeramik (LBK) und Alföld-LBK am Landesamt für Denkmalpflege Hessen in Wiesbaden (Deutschland) durchgeführt und mit dem Datenbankprogramm *ArboDat* 2016 erfasst. Die erarbeiteten Ergebnisse werden diskutiert und mit den archäobotanischen Daten von 551 bandkeramischen Befunden aus Österreich und Deutschland verglichen. Die Daten verweisen auf kulturspezifische Unterschiede hinsichtlich der bäuerlichen Subsistenz und der Ernährung neolithischer Gesellschaften Ungarns.

Absztrakt: Növényi maradványok vizsgálata Sárközi lelőhelyeken Fajsz-Garadombról és Alsónyék-Bátaszékről, további magyarországi újkőkori lelőhelyek botanikai anyagával összevetve

Egy, a magyarországi újkőkorban végbement mezőgazdasági és termőföld-használati folyamatokat kutató projekt keretében archeobotanikai kutatásokat végeztünk. A 22 lelőhelyről származó mintákat, amelyek a Starčevo, a Körös és a dunántúli és alföldi formatív-korai Vonaldíszes Kerámia népének kultúrájába (LBK) sorolhatók, a Landesamt für Denkmalpflege Hessen in Wiesbaden (Németország) *ArboDat* 2016 adatkezelő programjának segítségével gyűjtöttük és archiváltuk. A tanulmányban ismertetett eredményeket 551 ausztriai és németországi LBK-mintával összevetve értékeljük. Adataink a magyarországi neolitikum különböző életmódbeli és táplálkozási hagyományaira világítanak rá.

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