Vegetation History and Archaeobotany (2024) 33:195–208
https://doi.org/10.1007/s00334-023-00954-w

REVIEW

Triticum timopheevii s.l. ('new glume wheat') finds in regions of southern and eastern Europe across space and time

Dragana Filipović[1] · Glynis Jones[2] · Wiebke Kirleis[1] · Amy Bogaard[3] · Rachel Ballantyne[3] · Michael Charles[3] · Anne de Vareilles[4] · Müge Ergun[3] · Eugenia Gkatzogia[5] · Amy Holguin[3] · Ivanka Hristova[6] · Angeliki Karathanou[5] · Magda Kapcia[7] · Dolores Knežić[8] · Georgia Kotzamani[9] · Pavlos Lathiras[5] · Alexandra Livarda[10] · Elena Marinova[11] · Stavroula Michou[5] · Marine Mosulishvili[12,13] · Aldona Mueller-Bieniek[14] · Djurdja Obradović[15] · Matthew Padgett[16] · Pelagia Paraskevopoulou[5] · Chryssi Petridou[5] · Haroula Stylianakou[5] · Tanja Zerl[17] · Doris Vidas[3] · Soultana Maria Valamoti[5]

Received: 28 February 2023 / Accepted: 7 August 2023 / Published online: 12 October 2023

Abstract

Triticum timopheevii sensu lato ('new glume wheat', NGW) was first recognised as a distinct prehistoric cereal crop through work on archaeobotanical finds from Neolithic and Bronze Age sites in northern Greece. This was later followed by its identification in archaeobotanical assemblages from other parts of Europe. This paper provides an overview of the currently known archaeobotanical finds of Timopheev's wheat in southeastern and eastern Europe and observes their temporal span and spatial distribution. To date, there are 89 prehistoric sites with these finds, located in different parts of the study region and dated from the Neolithic to the very late Iron Age. Their latest recorded presence in the region is in the last centuries BCE. For assemblages from the site as a whole containing at least 30 grain and/or chaff remains of Timopheev's wheat, we take a brief look at the overall relative proportions of *Triticum monococcum* (einkorn), *T. dicoccum* (emmer) and *T. timopheevii* s.l. (Timopheev's wheat), the three most common glume wheats in our study region in prehistory. We highlight several sites where the overall proportions of Timopheev's wheat might be taken to suggest it was a minor component of a mixed crop (maslin), or an unmonitored inclusion in einkorn or emmer fields. At the same sites, however, there are also discrete contexts where this wheat is strongly predominant, pointing to its cultivation as a pure crop. We therefore emphasise the need to evaluate the relative representation of Timopheev's wheat at the level of individual samples or contexts before making inferences on its cultivation status. We also encourage re-examination of prehistoric and historic cereal assemblages for its remains.

Keywords Prehistory · Europe · Cereals · *Triticum timopheevii* · Maslin crop

Introduction

The first recognition of 'new glume wheat' (NGW) as a distinct prehistoric crop was made based on the archaeobotanical finds from Neolithic and Bronze Age sites in northern Greece (Jones et al. 2000). This was soon followed by the identification of this cereal at Bronze Age Stillfried, Austria (Kohler-Schneider 2003). Subsequently, through new discoveries or revision of previously ambiguous identifications of wheat remains, its presence has been confirmed at a series of prehistoric sites across Europe. However, the taxonomic identity of this wheat remained unresolved.

Several recent publications placed the 'new glume wheat' under a new spotlight as they applied advanced methods such as detailed morphological, geometric morphometric and ancient DNA analyses of archaeological specimens, to determine its taxonomic identity and its domestication location and status (Czajkowska et al. 2020; Charles et al. 2021; Badaeva et al. 2022; Roushannafas et al. 2022). They demonstrated that NGW was a tetraploid member of the *Triticum timopheevii* group, which entered domestication in southwest Asia from the mid/late 9th millennium BCE. In comparison to *T. timopheevii* sensu stricto, the wheat traditionally grown in western Georgia as a component of the *Zanduri* landrace mixture which is geographically restricted

Communicated by M. Ptáková.

Extended author information available on the last page of the article

to this region (Jones et al. 2000; Bedoshvili et al. 2021), the ancient *T. timopheevii* sensu lato (Timopheev's wheat) had a much wider distribution. This is indicated by recent evidence from western Asia (Bogaard et al. 2017, 2021; Ergun et al. 2018; Ulaş and Fiorentino 2021) and reviews for Europe (Kenéz et al. 2014; Toulemonde et al. 2015).

Now that the identity of Timopheev's wheat has been resolved, it is necessary to examine its geographical and temporal spread in greater detail, as a means to understand its biogeography, cultivation and uses. The (marked) presence of *T. timopheevii* s.l. at Neolithic sites in western Asia, together with *T. monococcum* (einkorn) and *T. dicoccum* (emmer), demonstrates its status as one of the 'founder crops'. It was shown that during its long cultivation history at Çatalhöyük, central Anatolia, Timopheev's wheat was undergoing domestication (Charles et al. 2021; Roushannafas et al. 2022). Ulaş and Fiorentino (2021) suggest that, in parts of western Asia and Thrace, it was becoming adapted to local growing conditions and that, thanks to its ability to withstand cold conditions, it successfully spread across prehistoric Europe.

This paper assembles the existing data on the presence of this crop in selected parts of southern and eastern Europe, in the territories of the modern states of Ukraine, Moldova, Romania, Bulgaria, Greece, North Macedonia, Albania, Kosovo (European Commission 2023), Serbia, Montenegro, Bosnia and Herzegovina, Croatia and Hungary. Much of this region was less known archaeobotanically up to about a decade ago, and some parts of it even until recently. New archaeological investigations have benefited from archaeobotanical field and laboratory work, most of which was carried out by the present authors and has offered a wealth of new data on crop growing and consumption in prehistory. We have taken advantage of our direct access to the recently retrieved study materials, as well as some of those which were previously analysed (and published) and which we have now been (re-)examining for the presence of Timopheev's wheat.

This paper provides a list of sites with published and unpublished records of Timopheev's wheat along with, where possible, absolute counts or estimates of the quantity of finds of this wheat per site. In some cases, the analysis is still in progress. As far as the current data allow, we explore spatial, temporal and quantitative patterns in the occurrence of *T. timopheevii* s.l. and compare them with those of einkorn and emmer. The AMS ^{14}C dates obtained on a selection of the finds have confirmed their expected ages according to the archaeological chronologies of the sites and show that the early finds are indeed early and not intrusions from later occupation layers. They also allow us to estimate the time of the start and possible end of the cultivation of this wheat in our study region. Parts of this area represent the earliest and longest enduring farming zones in Europe and therefore offer an opportunity to take a long-term perspective on the presence of Timopheev's wheat in places where it first appeared on the continent. This overview aims to track its presence through time in these and other parts of the region where we conducted new analyses or re-examination.

Materials and methods

We compiled all records of *T. timopheevii* s.l. grain and chaff (glume bases and spikelet forks) in the study region that are known to us to date; the majority have been identified by us and they derive from 89 site phases (ESM 1, 2). Some of the records have already been published, often with details of the quantities found and archaeological contexts. Others come from the assemblages that are currently being analysed and so full information is not yet available. Examples of the assemblages considered here include those recovered in recent or ongoing large, long-running, systematic projects (EUROFARM, PlantCult, EXPLO and CRC 1266), as well as those from older excavations that have now been checked and the finds of Timopheev's wheat in them confirmed, such as several collections from Bulgaria and Serbia. We note that, ideally, all assemblages from old excavations should undergo re-examination using the identification criteria specified in the publications presenting the first discoveries of Timopheev's wheat (Jones et al. 2000; Kohler-Schneider 2003) and those that followed. Our paper reflects the varied pace of progress in this direction in our study region. Of note is that, in the re-assessments done so far, remains of Timopheev's wheat have often been encountered among remains initially identified as 'einkorn/emmer', '*Triticum spelta* (spelt)' or 'emmer'.

Charring is the main form of archaeobotanical preservation for the study region, but mineralised and waterlogged remains also occur, such as from lake shore sites in North Macedonia; we considered all of these types of preservation. All of the sites with Timopheev's wheat which are known for the region benefited from a careful analytical procedure. They were all archaeobotanically sampled; the samples were processed by bucket or machine flotation, using sieves with small mesh sizes (down to 0.5–0.25 mm). The information on the numbers of analysed samples or contexts and the soil sample volumes helps to distinguish between sites which are 'poor' in Timopheev's wheat, those with a high number of samples or large soil volume processed and very few finds of this wheat, as opposed to sites 'rich' in Timopheev's wheat, of which some yielded large, dense deposits of it.

For some of the sites, only presence/absence information is currently available. For a subset of sites with detailed quantitative data, we considered the amounts of einkorn, emmer and Timopheev's wheat. These represent the most common glume wheats found at prehistoric sites in the region; they required the same type of processing for consumption and, whether grown individually or in some combinations, they may have been processed together. To gain a first impression of how prominent Timopheev's wheat is among the three glume wheats, we calculated their relative proportions in the site level assemblages containing a minimum of 30 remains of this wheat. In the future, it will be important to do this for individual archaeological contexts, notwithstanding various taphonomic factors, and use it to make inferences on the status of each glume wheat, its combined or separate cropping, storage, processing and discard.

Recognising the remains of Timopheev's wheat is challenging, particularly when dealing with small numbers of specimens, or if they are poorly preserved. Some of the remains we could identify only tentatively ('cf.'), especially in the case of grains, and these determinations should be treated with caution. As was the case in the initial study (Jones et al. 2000), we also find the chaff of Timopheev's wheat easier to differentiate from that of other hulled wheats, unlike the grains. Therefore, for some of the assemblages included here, the initial identifications of grain as spelt, emmer or two-grained einkorn are yet to be fully evaluated. In this overview, we consider only the remains that we are confident as (most likely) originating from *T. timopheevii* s.l. Some of the absolute counts presented here may change in the future, as the (re-) analyses continue.

The attribution of sites to archaeological periods, phases and cultures follows relevant archaeological information published or otherwise available to the archaeobotanists who studied these assemblages. The start/end and duration of the identically or similarly named periods and phases inevitably lack synchrony within the large region covered here. This is because the cultural developments identifying them, such as the emergence of agriculture (Gronenborn et al. 2021), took place at different times across the region; other reasons are differences in the local histories of research and in archaeological interpretations. These are often confined to modern administrative territories and we therefore present and discuss the results within subregions or states and cultural periods/phases as they are defined locally. The remains from which we obtained radiocarbon dates were selected according to their immediate availability and their attribution to 'early' (Neolithic) or 'late' (late Iron Age) periods according to the archaeological chronology. Additionally, dates on the remains from two sites (Feudvar and Stolniceni) result from general archaeological programmes of radiocarbon dating of these sites.

In order to consider the finds of Timopheev's wheat identified in our study region within their broader geographical context, we also compiled its occurrences in other parts of Europe and in Asia, on the basis of archaeobotanical reports accessible to us at the time of writing.

Results and discussion

Temporal and spatial distribution

The current evidence shows the presence of *T. timopheevii* s.l. across central and western Asia and large parts of Europe (Fig. 1). Its occurrence in different biogeographical zones and a range of local ecologies suggests that it could tolerate varied growing conditions, though the extent of its tolerance may have changed between different environments. The growing of Timopheev's wheat in prehistory seems to have been a widespread practice and one that persisted through millennia, along with the cultivation of a range of other crops.

In our study region, there are numerous sites with finds of this wheat, altogether 89 site phases known so far (Fig. 2, ESM 1, 2). The earliest finds originate from the early Neolithic and the latest are from the Hellenistic and La Tène periods, demonstrating that *T. timopheevii* s.l. was present in the area for nearly six millennia, from the late 7th to the late 1st millennia BCE. Much of the evidence comes from the earlier part of this time span, principally Neolithic sites, partly because of the greater research focus on the earliest farming in the region. As noted above, archaeological chronologies and terminology differ between parts of our study region; therefore, we rely on rough time spans attributed to major periods in very broad subregions (Table 1). We use archaeological periods only as standardised markers of the cultural developments that define them and do not attempt a reconstruction of the chronology of occurrence of Timopheev's wheat at the subregional level.

New archaeobotanical investigations in northern Greece, where Timopheev's wheat was first recognised, as well as in areas to the north and west of it (Albania, North Macedonia, Serbia), and the ongoing re-analysis of the material from sites in Bulgaria, demonstrate that it was one of the first cereal crops in the region, along with einkorn and emmer, and that it was ubiquitous (Fig. 2, ESM 1, 2). Either dated archaeological materials or direct radiocarbon dates place the first occurrences of *T. timopheevii* s.l. in the last two centuries of the 7th or the first several centuries of the 6th millennium BCE, the Neolithic (Table 1; Fig. 3). New information on its temporal and spatial distribution adds to the growing evidence that there was high crop diversity from the very beginnings of agricultural activity in our study region (Valamoti and Kotsakis 2007; Bogaard and Walker 2011; Marinova and Valamoti 2014; Motuzaite Matuzeviciute 2020; de Vareilles et al. 2022; Sabanov et al. 2023).

At the subregional scale, a detailed and quantitative assessment of *T. timopheevii* s.l. finds through time has recently been completed for Neolithic Greece, charting the history of the growing and use of this wheat in the earliest

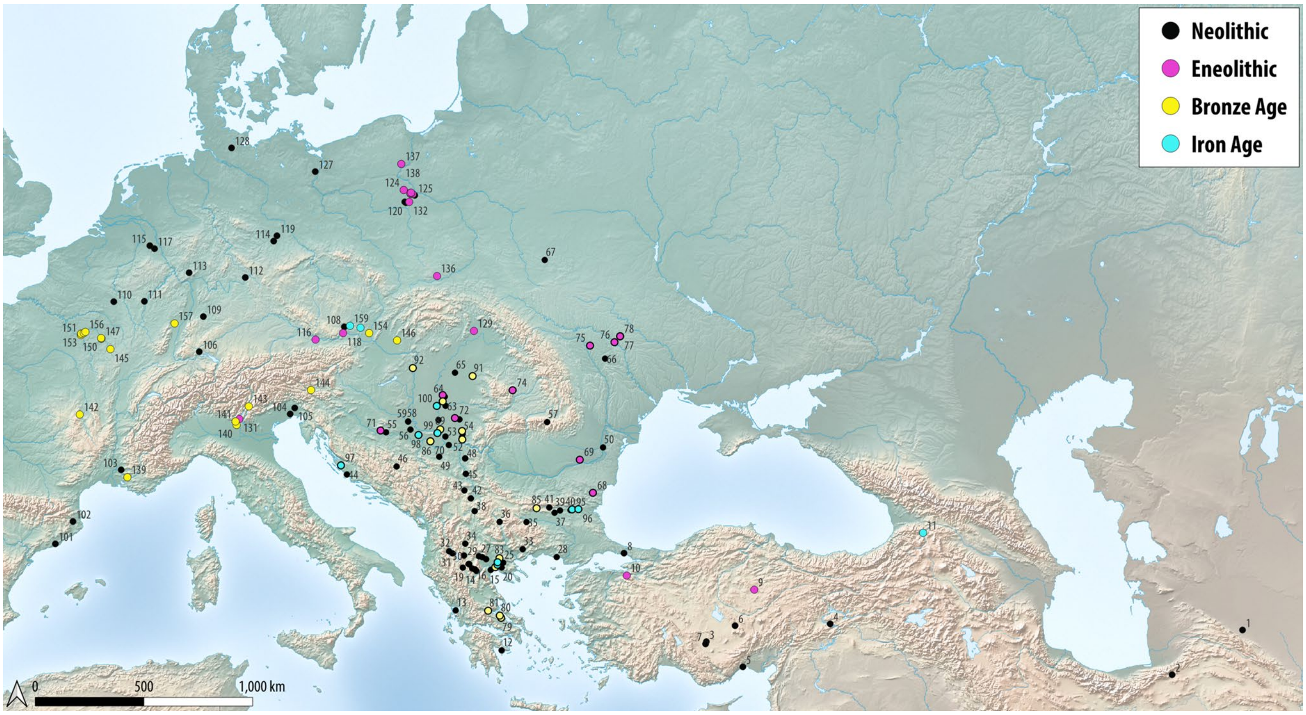

Fig. 1 Map of sites with currently known records of Timopheev's wheat in Eurasia (attribution to periods based on the information in the source publication; see ESM 1 for site names and location details)

Fig. 2 Map showing sites with finds of Timopheev's wheat in our study region (attribution to periods based on the information in the source publication; see ESM 1 for site names and location details)

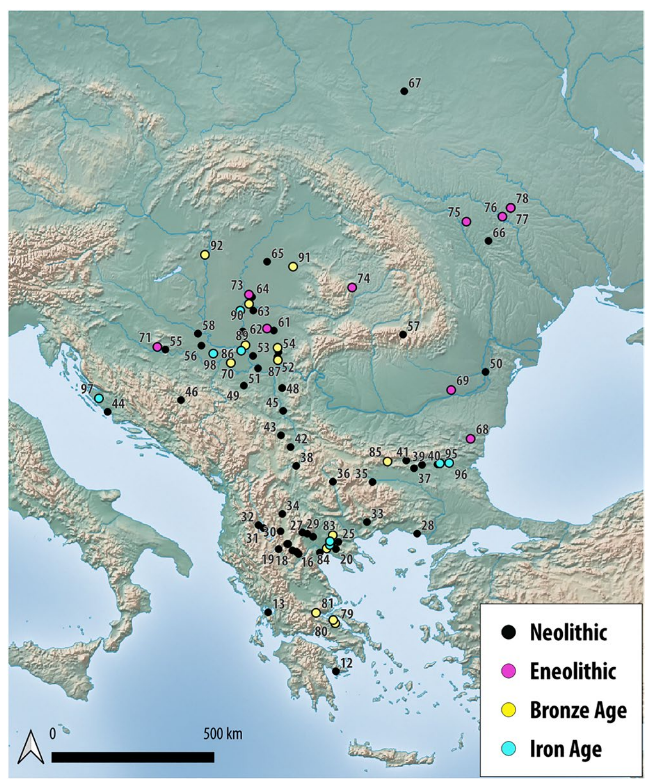

Table 1 Approximate beginning and end of the four main periods of later prehistory in different parts of the study region (see ESM 1 for refined chronological attribution of the sites); Central and W Balkans: North Macedonia, Albania, Montenegro, Kosovo (European Commission 2023), Serbia, Bosnia and Herzegovina, Croatia; E Balkans: Bulgaria, W Romania; North Pontic region: E Romania, Moldova, Ukraine. All dates are BCE

Period	Aegean (Greece)	Central and W Balkans	E Balkans	North Pontic region	Hungarian Plain (Hungary)
Neolithic	6700–3500	6200–4400	6200–4900	6000–4300	5800–4600
Chalcolithic/Eneolithic/ Copper Age	n/a	4400–2500	4900–3400	4300–3000	4600–3000
Bronze Age	3500–1100	2500–1000	3400–1100	3300–900	2600–1100
Iron Age	1100–750	1000–1	1100–1	900–1	1100–1

^{14}C AMS dates on charred remains of Timopheev's wheat					*Unmodelled (BC)*			
ID	Laboratory code	site	material	BP age, uncertainty	from	to	% probability	median
1	KIA-56230	Jaričište	1 grain	6630, 35	*-5625*	*-5482*	95.4	*-5564*
2	KIA-56229	S. Čuka	1 grain	6625, 35	*-5623*	*-5482*	95.4	*-5560*
3	KIA-56921	Pavlovac	1 grain	6050, 40	*-5201*	*-4837*	95.4	*-4949*
4	KIA-55901	Stolniceni	2 glume bases	5100, 30	*-3971*	*-3798*	95.4	*-3862*
5	KIA-56228	Feudvar W3063	1 grain	3430, 27	*-1874*	*-1629*	95.4	*-1726*
6	KIA-56865	Kanjiža	1 spikelet fork	2216, 26	*-381*	*-197*	95.4	*-278*

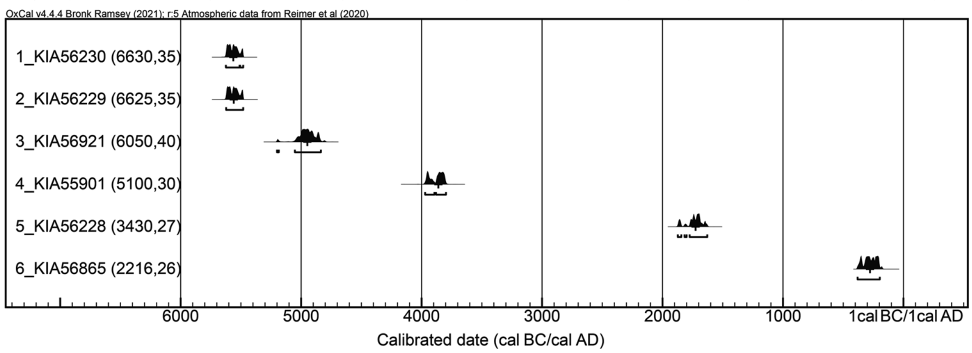

Fig. 3 AMS radiocarbon dates obtained directly on the remains of Timopheev's wheat from the region (images of the dated specimens in ESM 3); calibrated with OxCal (Bronk Ramsey 2021) using IntCal20 (Reimer et al. 2020)

farming societies in Europe (Valamoti et al. 2022a). We build on this by looking at Neolithic and later sites elsewhere in the region that offer more detailed information from already finalised and/or published analyses.

Compared to the Neolithic, there are fewer known finds of Timopheev's wheat from later periods, the reason for which may lie in the lack of archaeobotanical (re-)analyses, certainly in the Balkans north of Greece and in the North Pontic area (eastern Romania, Moldova and Ukraine). As an example, it is only recently that Timopheev's wheat has been detected at the Chalcolithic mega-sites of the Trypillia culture in Ukraine and Moldova (Kirleis et al. 2023). Nonetheless, the remains that have been recorded came from different parts of the study region, illustrating the wide distribution of this crop after the Neolithic (Fig. 2). The latest remains, dating from the 4th-2nd centuries BCE, originate from the early Hellenistic town of Kabyle in Thrace (south-east Bulgaria) and a La Tène farmstead at the site of Kanjiža in Vojvodina (north Serbia).

To our knowledge, no traces of Timopheev's wheat have been found at sites dated to later periods in our study region, to classical antiquity, medieval and modern times. However, the available archaeobotanical evidence from these periods is very limited compared to prehistoric finds, therefore future research might alter the current picture. The records of Timopheev's wheat from elsewhere in Eurasia are also confined to prehistoric periods (Fig. 1, ESM 1, 2). In Georgia for instance, where cultivation of *T. timopheevii* s.str. as part of a glume wheat maslin was practised in recent history, there is just one record, found in the deposits dated to the middle to second half of the 1st millennium BCE at the site of Atskuri (Bieniek and Licheli 2007). Our observations for the regions considered here should be compared with other parts of Europe.

Archaeological contexts and finds

All of the records we have compiled come from settlement sites, which are of different types (tells, flat-extended, lakeside settlements). The contexts of the finds include features and deposits such as pits, house floors, pottery, ovens and hearths, clay storage bins, cultural layers, ditches, or waste disposal areas. They indicate that the remains of Timopheev's wheat are a result of domestic activities involved in crop storage, processing, consumption and discard. Most of the remains are fragments of chaff (glume bases or spikelet forks), but this does not necessarily mean that Timopheev's wheat is chiefly represented by processing by-products. Whereas many sites do indeed contain only chaff remains of this and other wheats, for some sites these remains reflect the level of identification possible, given that the identification is more difficult for Timopheev's grain than chaff; or the progress of re-examination of previously analysed assemblages, where normally chaff is the first to be checked for its presence. Short descriptions of the (unpublished) evidence of *T. timopheevii* s.l. from a subset of sites are given in ESM 4, serving as an illustration of the types of sites and contexts from which some of the finds considered here derived.

Cultivation status

The study that first recognised *T. timopheevii* s.l. in the archaeological record was also the first to recognise the potentially combined cultivation of Timopheev's and einkorn wheats in some cases, based on their proportional representation in individual samples and contexts (Jones et al. 2000). Applied to some other sites and assemblages, this approach raised the possibility of the cultivation of Timopheev's wheat as a (nearly) pure crop. This may have been the case at Neolithic Apsalos and Kyparissi in northern Greece, where it is the dominant component of certain samples (Valamoti et al. 2022a). There are also instances of rich concentrations of remains of this wheat from elsewhere in Eurasia, providing evidence of its cultivation as a dominant or pure crop. Some examples are Neolithic Çatalhöyük and Yenikapı in Turkey and the Bronze Age sites of Stillfried (Austria), Lucone (Italy) and Feudvar (Serbia) (Kohler-Schneider 2003; Perego 2015; Kroll 2016; Bogaard et al. 2017; Ulaş and Fiorentino 2021).

Sites that yielded hundreds or thousands of *T. timopheevii* s.l. remains, from either individual samples and contexts or overall site assemblages, suggest a marked degree of growing and use of this wheat at these sites in the respective periods. Many of the sites with Timopheev's wheat in our region produced remains of other glume wheats too, mostly einkorn and emmer (Table 2, ESM 4). Here, remains of two or three of these glume wheats are frequently mixed in archaeological deposits. They point to a possibility that Timopheev's wheat was a component of a 'maslin' crop composed of different glume wheats. In other cases, it could have been a contaminant, a tolerated or desired admixture in fields of other wheats.

Previous archaeobotanical studies used the relative proportions and frequencies of occurrence of glume wheats to explore the cultivation status of *T. timopheevii* s.l. (Jones et al. 2000; Toulemonde et al. 2015; Obradović 2020; Valamoti et al. 2022a). Here, we take a general look at the relative proportions of Timopheev's wheat, einkorn and emmer. Currently, the counts of grains or chaff of these wheats are available for 53 sites in our study region (Table 2). We explore the quantitative relationships for 31 sites that have provided at least 30 remains of Timopheev's wheat (Fig. 4). At three sites (Feudvar, Hódmezővásárhely-Gorzsa and Apsalos), the percentages of Timopheev's wheat exceed those of einkorn and emmer and the assemblage from Hódmezővásárhely-Gorzsa is dominated by it, being more abundant than einkorn (no emmer was reported). Only chaff of Timopheev's wheat was mentioned for this site, but this may change as the final report on the analysis is pending (Medović and Horvath 2012). The same is true of other sites undergoing re-evaluation. For instance, the recently re-analysed site assemblage from Mursalevo is composed of 50% or more of emmer (Fig. 4, ESM 4), but storage deposits comprising mainly Timopheev's wheat have also been noted. Similarly, although einkorn constitutes more than half of the Kapitan Dimitrievo site assemblage, discrete stores of cereals dominated by Timopheev's wheat were found there too, demonstrating that this wheat was the main crop in some cases. Revision of the large cereal deposit from Dabene-Sarovka, initially reported as composed of spelt, revealed the presence of Timopheev's wheat in it (ESM 4). The assemblage from Feudvar considered here originated from a single feature, a large pit containing fragments of a structure made of daub and a large dense deposit of grain and chaff of Timopheev's wheat (Fig. 5). This deposit convincingly reflects harvest(s) made up entirely or primarily of this wheat. It also emphasises the need to consider individual samples and contexts and not only site level assemblages; for instance, the assemblage from the Feudvar site as a whole is vastly dominated by einkorn (Kroll 2016, p. 71).

There are some recently fully analysed site assemblages where Timopheev's wheat is present (almost) only in the form of chaff, such as the one from Apsalos, where only glume bases and spikelet forks were found, but no grain, as was also the case with einkorn and emmer at this site (Valamoti et al. 2022a, Table 1.1). Further north, the Timopheev's wheat component of the site assemblage from Pavlovac-Gumnište was primarily made up of chaff, most of which was discovered in outdoor hearths, along with the chaff of einkorn and emmer, suggesting combined processing of the three glume wheats (Obradović 2020). A mixture of chaff of Timopheev's wheat, einkorn and emmer in a large pit associated with a mega-structure at Stolniceni may also reflect

Table 2 Abridged information on the representation of Timopheev's wheat, einkorn and emmer (summary counts) for sites with some quantitative data

ID on maps, site	No./volume (L) of samples analysed	*T. timopheevii* (glume bases)	*T. timopheevii* (grains)	*T. monococcum* (chaff+grain)	*T. dicoccum* (chaff+grain)
Neolithic (7th–5th mill. BCE)					
13 Paliambela		7		Low numbers	
14 Toumba Kremastis Koiladas	51	153		529	104
15 Makriyalos	53/4,835	919		22,709	4,373
16 Kleitos (LN)	89/768	1,654		349	1,697
17 Kleitos (FN)	9/57	11		1,220	7
20 Kyparissi	40/339	1,392	449	2,274	962
21 Anarghiri III	73/321.5	700	150	31,745	10,989
25 Koroneia	58/260	11		50	7
27 Mandalo	24	66		2,147	9,427
28 Makri	21/824.5	2,762		12,542	1,343
29 Apsalos	93	1,939		1,271	218
30 Veluška Tumba	17/52	58		796	155
33 Arkadikos	25/477	983		3,225	840
34 Vrbjanska Čuka	21/132	96		1,470	317
35 Kapitan Dimitrievo	42/690	246	1,927	6,298	3,417
36 Mursalevo	19/275	127	562	1,430	3,815
38 Pavlovac-Gumnište	185/1,664.5	1,541	64	3,072	724
40 Hadzhidimitrovo	87/555.7	14		300	123
42 Svinjarička Čuka	68/779	4	3	28	46
43 Pločnik	68/479	871	4	1,610	861
44 Velištak	52/571.5	2		33	29
45 Drenovac	440/3,672.5	22		386	191
47 Belovode (S)	3/17	20		104	26
48 Belovode (V)	45/276	149	2	623	345
49 Jaričište 1	7/55		cf. 1		7
50 Hârşova	19/333	Unspecified	Unspecified	94	189
52 Potporanj	11/110		cf. 4	741	78
54 At	10/100		cf. 1	13	
55 Ravnjaš	62/781	4		220	187
56 Sopot	147/2,842	2	3	163	191
57 Măgura-Buduiasca	694	44		91	4
58 Hermanov Vinograd I	96/602.5	cf. 1	cf. 24	806	184
59 Hermanov Vinograd II	33/210	cf. 4	cf. 52	108	148
62 Uivar (LN)	158/1,352 (kg)	65,410		224,925	20,922
64 Hódmezővásárhely-Gorzsa	73/730	6,226		1,716	
65 Ecsegfalva 23	125/4,756.7	41		61	118
66 Nicolaevca V	25/226	Minimum 1		Dominant	
Eneolithic/Copper Age/Chalcolithic (5th–3rd mill. BCE)					
68 Provadia-Solnitsata	36/480	189	654	7,426	2,713
71 Slavča	90/1,056	8		125	198
72 Uivar (E)	21/203	307		703	44
73 Hódmezővásárhely-Kopáncs I.	79/450.1	10		344	23
74 Peştera Ungurească	49	44		180	100
75 Stolniceni	289/2,383	110	4	196	191
77 Hariachkivka 7	6/41	1		1	20
78 Hariachkivka 8	7/64	1		3	1
Bronze Age (3rd–1st mill. BCE)					
85 Dabene-Sarovka	21/249	32	283	604	2,168
88 Vatin	21/207	1		64	12
89 Feudvar W3063	510	38,754	85,957	2,609	226
90 Klárafalva	125	223		2,344 (chaff)	109 (chaff)
91 Toboliu (tell)	15/52.6	136		185	581
Iron Age (1st mill. BCE)					
95 Kabyle	11/42.3	2		15	
96 Malenovo	69/237.4	30		102	58
98 Gradina-on-Bosut	20	cf. 5	cf. 138	11,221	1,498
99 Kalakača	11/211	368	1	1,909	862
100 Kanjiža 19	8/80	6	cf. 6	190	36

this practice (Kirleis and Dal Corso personal communicaton). There are numerous similar examples across the study region, demonstrating the complexity of the evidence and the difficulty in tracing it back to the cultivation status of Timopheev's wheat. Whether grown as a pure crop, a component of maslin, or as a random (tolerated) inclusion may have varied even between households and sowing seasons (see below).

In their ethnographic work, Jones and Halstead (1995) noted that the proportions of maslin crop components vary between fields and harvests, and between farmers and their choices. The purpose of planting different cereals together is that in some years (or locations) one cereal may do well, but in the next season (or a different place), another one may provide higher returns. Growing maslins is a farming strategy intended to counter the risk of crop failure or underperformance (cf. McAlvay et al. 2022). The great regional variety of the site level proportions of the three wheats that

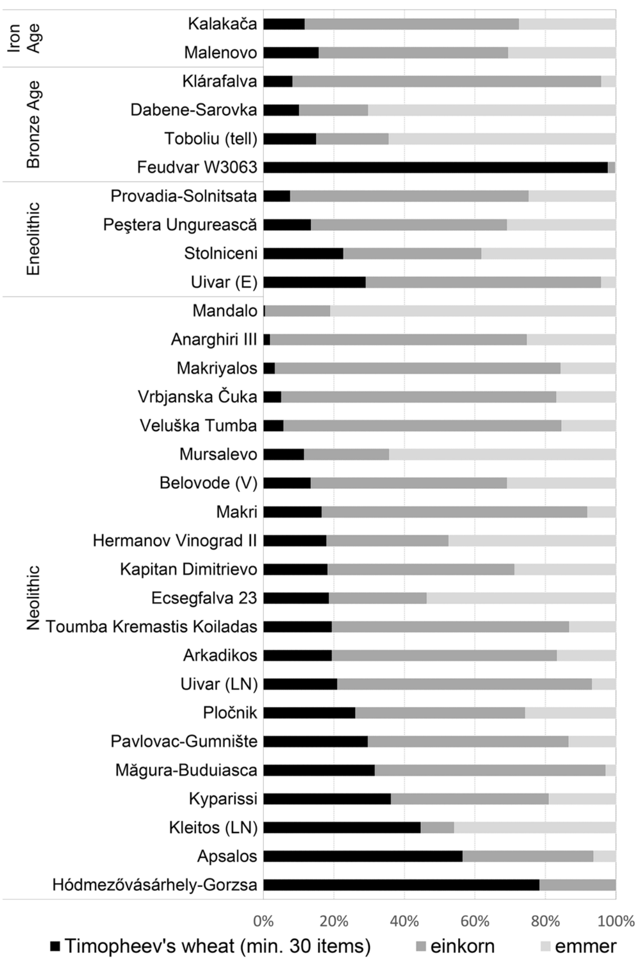

Fig. 4 Relative proportions of the three hulled wheats in the assemblages from 31 sites with 30 or more remains of grain and chaff combined of Timopheev's wheat in our study region; numbers in brackets denote site IDs as listed in Table 2 and indicated in Figs. 1 and 2 (E, Eneolithic; V, Vinča culture; LN, Late Neolithic)

we considered here could indeed be a reflection of this. Even relatively pure deposits of a single cereal could represent the result of growing a maslin, in which this particular cereal outperformed the others. Ethnographic work at Kolofana (on the island of Amorgos, Greece) revealed that cereals were primarily grown as a maslin of *Hordeum vulgare* ssp. *vulgare* (hulled barley), *Triticum aestivum* (bread wheat) and *T. durum* (durum wheat), with the composition of harvests from different fields ranging from what could be described as 'monocrops' of either barley or wheat to a more or less evenly balanced (ca. 50:50) mixture of both (Jones and Halstead 1995). Also, harvests did not necessarily (or even usually) return cereals in the same proportions that had been sown. Because barley is more drought tolerant than the wheats, it would tend to become the dominant cereal in the maslin over time, and farmers sometimes manipulated the balance between wheat and barley in the maslin to enrich the wheat component of subsequent seed corn (Jones and Halstead 1995). What we are seeing archaeologically could therefore be a variable spectrum of maslin harvests of einkorn, emmer and Timopheev's wheat. In other words, the variation in the composition of the site assemblages may reflect a single practice, that of growing a mixture of glume wheats.

As the archaeobotanical evidence of Timopheev's wheat in the region continues to grow, we will soon be able to explore in detail whether or not there was a change through time or geographical variation in its presence as has been done for eastern France, for instance (Toulemonde et al. 2015), and its cultivation status. Some preliminary impressions can be gained from the relative proportions of Timopheev's, einkorn and emmer wheat in site level assemblages for the 31 sites with at least 30 remains of *T. timopheevii* s.l. (Fig. 6). What we notice is the apparent variation in the proportions of the three glume wheats within the subregions represented by more than just a few sites (namely the northern Aegean, the central–eastern Balkans and the Pannonian Plain). When comparing the subregions, einkorn and Timopheev's wheat appear more prominent in the south of the study region (northern Aegean) than in the north (central and northern Balkans), where there is more emmer. This first glimpse further emphasises the potential of future detailed investigations of individual samples and contexts to evaluate the importance of Timopheev's wheat at local and regional scales.

From a founder crop to its abandonment

We have not come across records of Timopheev's wheat which are later than the final centuries of the 1st millennium BCE, the end of the Hellenistic period in the study region. There are altogether only a few finds from the preceding period, with the finds from the mid 1st millennium BCE (late

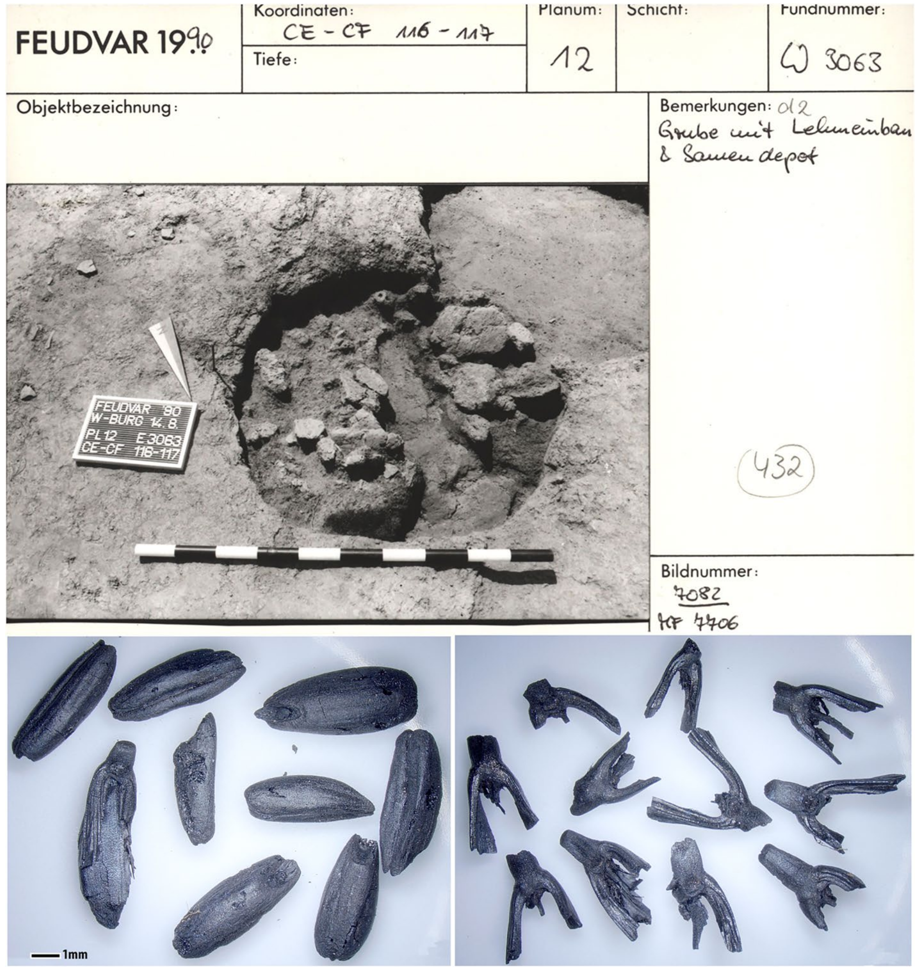

Fig. 5 Feudvar, Serbia, Bronze Age settlement: large pit (top) containing fragments of a daub feature and a large dense deposit of grain and chaff of Timopheev's wheat (bottom) (top photo by Frank Falkenstein; grain and chaff photos by Dragana Filipović)

Iron Age) comprising only a few remains per site assemblage. It seems that Timopheev's wheat was gradually abandoned, but more data and re-analysis of previously studied material will test this impression. Archaeobotanical analyses of Roman, Byzantine and medieval sites in the region do not report the presence of Timopheev's wheat, but we should probably revisit these assemblages too, before we entirely exclude this possibility.

The disappearance of Timopheev's wheat from the cereal spectrum would have happened in the context of the socio-economic transformations following the Roman conquest of much of the region in the last two centuries BCE. The Roman period that ensued saw as a whole significant changes in agriculture, most notably a growth in the scale of crop growing and a decrease in its intensity compared to previous periods (cf. Kreuz 2005). This unfolded against the backdrop of increasingly hierarchical societies and a developing market economy, and it apparently resulted in a focus on crops with higher productivity (Nesbitt and Samuel 1996, p. 86). Although both einkorn and emmer occur in the assemblages from Roman sites, they are found in much smaller quantities than spelt or free-threshing wheat (Gyulai 2010; Slavova 2013; Reed and Ožanić Roguljić 2020). Other cereals, *Hordeum* (barley), *Panicum miliaceum* (millet), *Secale cereale* (rye) and *Avena* (oats) became more prominent in the late Roman and early Byzantine periods (Baron et al. 2019). The evidence from the region is, however, sparse and is rarely from rural contexts, where the local (autochthonous) population may have continued cultivation of 'traditional' crops.

Ancient writings and inscriptions offer equally limited information for rural areas. These tell of a growing demand for food and local food production to supply newly founded urban and military centres. This requirement led to an expansion of state land ownership at the expense of small land holders, and to the cultivation of monocrops on extensive fields (Ilić 2012, pp. 44ff), with an apparent (perhaps prescribed) emphasis on large- or multi-grained wheats, as indicated by the archaeobotanical evidence. Textual evidence for the historic periods until the 2nd century CE suggests that ancient Greek authors like Theophrastus, Hippocrates and Galen knew of three glume wheats (einkorn, emmer and spelt), giving further support to the theory of the abandonment of this crop (Valamoti et al. 2022b). However, the story told from ancient texts may differ from the

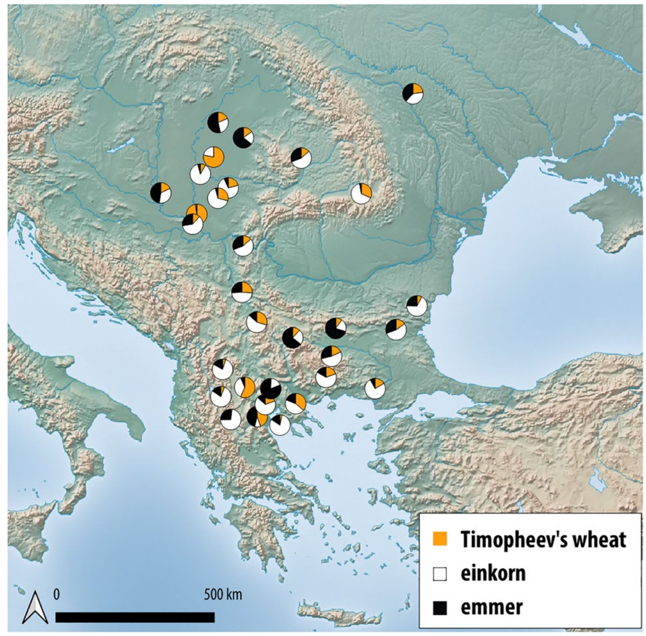

Fig. 6 Map showing relative proportions of the three glume wheats in the 31 site assemblages with 30 or more remains (grain + chaff) of Timopheev's wheat (Table 2)

archaeobotanical record, which for prehistoric Greece and surrounding regions from this period includes four glume wheats: einkorn, emmer, Timopheev's wheat and spelt (Valamoti et al. 2022b). It is possible that *T. timopheevii* s.l. continued to be grown in parts of the study region in the common era (CE), something that only systematic archaeobotanical research on later periods can reveal.

In thinking about the reasons why its cultivation ceased, the recent history of the cultivation of *T. timopheevii* s.str. in Georgia (called *Chelta Zanduri* there) offers some useful clues (Jorjadze et al. 2014; Bedoshvili et al. 2021; Nocente et al. 2022). For many centuries, this wheat was grown as part of a mixed *Zanduri* crop together with einkorn (known as *Gvatsa Zanduri*) and *T. zhukovskyi*, and this *Zanduri* crop was grown in the mountainous Lechkhumi and Racha provinces of Western Georgia at 600–900 m on thin or poor soils where no other wheat was sown. In contrast, the fertile soils of the Lechkhumi plain were used for growing *T. aestivum* (bread wheat). In 1965, by the decree of the Soviet government, which was enforced across parts of Asia and eastern Europe, small land owners cultivating the mountain slopes were forbidden to sow their own wheat, because cheap wheat was being imported from the USSR. After the 1970s, legumes and potatoes replaced endemic glume wheats, which were additionally neglected due to the war with Russia and associated economic crisis in the 1990s. Since the early 2000s, *Zanduri* cultivation has slowly been restored thanks to enthusiastic farmers; however they now grow single glume wheats obtained from botanical collections rather than mixtures as previously. Nowadays, *T. timopheevii* s.str. is grown on several farms in the lowlands and highlands, on both good and poor soils in various parts of Georgia (M. Mosulishvili personal observation; Fig. 7). Curiously, a recent attempt at growing Georgian *T. timopheevii* s.str. on fertile soil on a plot near Kraków (Poland) failed, in contrast to a successful growing experiment carried out on a low mountain slope at 283 m on a relatively poor soil substrate near Tarnów (Poland) (A. Mueller-Bieniek personal observation).

These insights instruct us to look for reasons for the abandonment of Timopheev's wheat cultivation in the last centuries BCE in a range of contexts—ecological, socioeconomic, political; this, again, should be done on a smaller spatial and temporal scale than the one used in this overview. Furthermore, we should not rule out the possibility that cultivation of *T. timopheevii* s.l. persisted for a while after the final centuries BCE, for instance in remote, agriculturally less attractive areas of the Roman Empire or outside its borders. On current evidence, this crop seems to have been 'lost' but we should not lose sight of it when analysing archaeobotanical assemblages from historical periods.

Conclusions and future prospects

This paper summarises the current state of knowledge on the archaeobotanical occurrence of *T. timopheevii* s.l. in large areas of southern and eastern Europe. The early and recent discoveries demonstrate its presence from the beginning of farming in the region; it arrived during the process of Neolithisation as one of the founder crops that originated in southwest Asia. It was present in various parts of the region until at least the last centuries BCE.

Timopheev's wheat regularly occurs in site level assemblages together with einkorn and/or emmer, indicating their

Fig. 7 *T. timopheevii* s.str. plants growing in a field in Georgia in July 2020 (photo by Gulnari Chkhutiashvili)

likely combined cultivation as a mixed crop (maslin). The available evidence shows considerable variation in time and space within the region in the proportions of Timopheev's wheat relative to the other two glume wheats. This is consistent with the likelihood that the components of a mixed crop contributed different amounts to the harvests, which is a tendency observed ethnographically. The differences, dictated by environmental and cultural factors, may have arisen on an annual basis, creating a continuum from 'pure' monocrop to 'balanced' maslin harvests, potentially discernible in archaeobotanical assemblages from individual samples or contexts. The first study dealing with Timopheev's wheat already demonstrated the need for and benefit of carefully examining the composition of each sample and context when investigating the cultivation status of various crops and their possible combinations in the field. Such analysis has been done or is under way for many of the sites included in this overview.

Future research into the (pre)history of *T. timopheevii* s.l. should try to revisit early identifications of spelt and ambiguous wheat identifications, such as 'einkorn/emmer' and 'emmer/spelt' and even two-grained einkorn. It should also look for patterns in the composition and distribution of assemblages containing Timopheev's wheat in relation to the type of archaeological context and site, and the cultural period. This will help to elucidate the uses and importance of this crop, and perhaps point to possible reasons for its abandonment.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00334-023-00954-w.

Acknowledgements Our gratitude goes to: Felix Bittmann (access to Tell Azmak material and permission to AMS date it); Frank Falkenstein (Feudvar photo and permission to AMS date the finds); Marija Ljuština (permission to use unpublished data for Židovar); John O'Shea (permission to use unpublished data for Klárafalva); Neda Mirković-Marić (permission to use unpublished data and to AMS date the find from Kanjiža); Tanja Reiser (sorting and identification of material from Ukrainian and Moldovan sites; photography); Agnes Heitmann (photography); Gerrit Gunter (advice to DF on creation of maps); Helmut Kroll (access to Feudvar mass find); Angela Kreuz, Magdalena Moskal-del Hoyo, Giedre Motuzaite-Matuzeviciute, Kelly Reed (information on sites and papers); Renata Šoštarić (supervisor to Dolores Knežić); Barbara Horejs, Mirjana Blagojević (permission to AMS date the finds from Svinjarička Čuka and Jaričište respectively). We benefited from the advice and recommendations offered by the reviewers and we thank them for their time and careful reading of the manuscript. We are grateful to the editors and the copy-editor of the special volume for their patience and help.

Author contributions Authors contributing detailed unpublished data: DF, AV, GJ, IH, WK, DK, GK, AL, EM, AM-B, DO, TZ. Authors contributing unpubl. presence/absence data: AB, RB, ME, EG, AH, AK, PL, SM, MP, PP, CP, HS, DV, SMV.

Funding Open Access funding enabled and organized by Projekt DEAL. Funding for some of the research projects contributing to this study was provided by the *European Research Council* (ERC), *Deutsche Forschungsgemeinschaft* (DFG), *Fonds zur Förderung der wissenschaftlichen Forschung* (FWF, *Austrian Science Fund*) and *Ministry of Culture of the Republic of Serbia*. The paper is a product of the ERC-project 'PlantCult: Investigating the Plant Food Cultures of Ancient Europe' (CoG 682529), Aristotle University of Thessaloniki, Greece; the ERC-project 'EXPLO: Exploring the dynamics and causes of prehistoric land use change in the cradle of European farming' (SyG 810586), University of Oxford, UK; the Collaborative Research Centre 'Scales of Transformation in Prehistoric and Archaic Societies' (DFG-Ref. 2901391021-SFB1266) and the Excellence Cluster EXC2150 'ROOTS: Social, Environmental and Cultural Connectivity in Past Societies' (DFG-Ref. 390870439), both of Kiel University, Germany.

References

Badaeva ED, Konovalov FA, Knüpffer H et al (2022) Genetic diversity, distribution and domestication history of the neglected GGA^{t}A^t genepool of wheat. Theor Appl Genet 135:755–776. https://doi.org/10.1007/s00122-021-03912-0

Baron H, Reuter AE, Marković N (2019) Rethinking ruralization in terms of resilience: subsistence strategies in sixth-century Caričin Grad in the light of plant and animal bone finds. Quat Int 499:112–128

Bedoshvili D, Mosulishvili M, Chkhutiashvili G, Maisaia I, Ustiashvili N, Merabishvili M (2021) Diversity and local use of wheat in Georgia. Ann Agrar Sci 19:103–110

Bieniek A, Licheli V (2007) Archaeobotanical studies at the Atskouri settlement (SE Georgia, 1st mill BC)—preliminary results. In: 14th Symposium of the International Work Group for Palaeoethnobotany, Kraków, Poland, 16–23 June 2007

Bogaard A, Walker A (2011) Plant use and management at Măgura-Buduiasca (Teleor 003), southern Romania: preliminary report on the archaeobotanical analysis. Report prepared for the European Union, Brussels, pp 1–23

Bogaard A, Filipović D, Fairbairn A, Green L, Stroud E, Fuller DQ, Charles M (2017) Agricultural innovation and resilience in a long-lived early farming community: the 1,500-year sequence at Neolithic to early Chalcolithic Çatalhöyük, central Anatolia. Anatol Stud 67:1–28

Bogaard A, Charles M, Filipović D et al (2021) The archaeobotany of Çatalhöyük: results from 2009–2017 excavations and final synthesis. In: Hodder I (ed) Peopling the Landscape of Çatalhöyük: reports from the 2009–2017 Seasons. Çatalhöyük Research Project Series, vol 13. British Institute at Ankara, London, pp 91–123

Charles M, Fuller DQ, Roushannafas T, Bogaard A (2021) An assessment of crop plant domestication traits at Çatalhöyük. In: Hodder I (ed) Peopling the Landscape of Çatalhöyük: reports from the 2009–2017 Seasons. Çatalhöyük Research Project Series, vol 13. British Institute at Ankara, London, pp 125–136

Czajkowska BI, Bogaard A, Charles M, Jones G, Kohler-Schneider M, Mueller-Bieniek A, Brown TA (2020) Ancient DNA typing indicates that the "new" glume wheat of early Eurasian agriculture is a cultivated member of the *Triticum timopheevii* group. J Archaeol Sci 123:105258. https://doi.org/10.1016/j.jas.2020.105258

De Vareilles A, Filipović D, Obradović Đ, Vander Linden M (2022) Along the Rivers and into the Plain: early crop diversity in the Central and Western Balkans and its relationship with environmental and cultural variables. Quaternary 5:6. https://doi.org/10.3390/quat5010006

Ergun M, Tengberg M, Willcox G, Douché C (2018) Plants of Aşıklı Höyük and changes through time: first archaeobotanical results from the 2010-14 excavation seasons. In: Özbaşaran M, Duru G, Stiner C (eds) The early settlement at Aşıklı Höyük. Essays in honor of Ufuk Esin. Ege yayınları, Istanbul, pp 191–217

European Commission (2023) https://ec.europa.eu/neighbourhood-enlargement/countries/detailed-country-information/kosovo_en, last accessed 9 September 2023

Gronenborn D, Horejs B, Börner M, Ober M (2021) Condensed and simplified map of the spread of farming in western Eurasia 2021.2. RGZM, Mainz/ÖAI, Vienna

Gyulai F (2010) Archaeobotany in Hungary. Seed, fruit, food and beverage remains in the Carpathian Basin from the Neolithic to the late Middle Ages. Archaeolingua Series Maior 21. Archaeolingua, Budapest

Ilić OR (2012) Poljoprivredna proizvodnja u rimskim provincijama na tlu Srbije: od I do prve polovine V veka (Agricultural production in the Roman provinces in the territory of Serbia: from the 1st to the first half of the 5th century). Doctoral thesis, University of Belgrade, Belgrade

Jones G, Halstead P (1995) Maslins, mixtures and monocrops: on the interpretation of archaeological crop samples of heterogeneous composition. J Archaeol Sci 22:103–114. https://doi.org/10.1016/S0305-4403(95)80168-5

Jones G, Valamoti S, Charles M (2000) Early crop diversity: a "new" glume wheat from northern Greece. Veget Hist Archaeobot 9:133–146. https://doi.org/10.1007/BF01299798

Jorjadze M, Berishvili T, Shatberashvili E (2014) The ancient wheats of Georgia and their traditional use in the southern part of the country. Emir J Food Agric 26:192–202

Kenéz Á, Pető Á, Gyulai F (2014) Evidence of 'new glume wheat' from the Late Neolithic (Copper Age) of south-eastern Hungary (4th millennium cal. B.C.). Veget Hist Archaeobot 23:551

Kirleis W, Dal Corso M, Pashkevych G et al (2023) A complex subsistence regime revealed for Cucuteni–Trypillia sites in Chalcolithic eastern Europe based on new and old macrobotanical data. Veget Hist Archaeobot. https://doi.org/10.1007/s00334-023-00936-y

Kohler-Schneider M (2003) Contents of a storage pit from late Bronze Age Stillfried, Austria: another record of the "new" glume wheat. Veget Hist Archaeobot 12:105–111. https://doi.org/10.1007/s00334-003-0010-y

Kreuz A (2005) Landwirtschaft im Umbruch? Archäobotanische Untersuchungen zu den Jahrhunderten um Christi Geburt in Hessen und Mainfranken. Ber RGK 85:97–292

Kroll H (2016) Die Pflanzenfunde von Feudvar. In: Kroll H, Reed K (eds) Die Archäobotanik. Würzburg University Press, Würzburg, pp 37–194

Marinova E, Valamoti SM (2014) Crop diversity and choice in prehistoric southeastern Europe: Cultural and environmental factors shaping the archaeobotanical record of northern Greece and Bulgaria. In: Chevalier A, Marinova E (eds) (eds) Plants and people: choices and diversity through Time. Oxbow Books, Oxford, pp 64–74. Peña-Chocarro L

McAlvay AC, DiPaola A, D'Andrea AC, Ruelle ML, Mosulishvili M, Halstead P, Power AG (2022) Cereal species mixtures: an ancient

practice with potential for climate resilience. A review. Agron Sustain Dev 42:100. https://doi.org/10.1007/s13593-022-00832-1
Medović A, Horváth F (2012) Content of a storage jar from the late Neolithic site of Hódmezővásárhely-Gorzsa, south Hungary: a thousand carbonized seeds of *Abutilon theophrasti* Medic. Veget Hist Archaeobot 21:215–220. https://doi.org/10.1007/s00334-011-0319-x
Motuzaite Matuzeviciute G (2020) The adoption of agriculture: Archaeobotanical studies and the earliest evidence for domesticated plants. In: Lillie MC, Potekhina ID (eds) Prehistoric Ukraine: from the first hunters to the first farmers. Oxbow Books, Oxford, pp 309–326
Nesbitt M, Samuel D (1996) From staple crop to extinction? The archaeology and history of the hulled wheats. In: Padulosi S, Hammer K, Heller J (eds) Hulled Wheat. Proceedings of the First International Workshop on Hulled Wheats, 21–22 July 1995, Castelvecchio Pascoli, Tuscany, Italy. IPGRI, Rome, pp 40–99
Nocente F, Galassi E, Taddei F, Natale C, Gazza L (2022) Ancient Caucasian wheats: a contribution for sustainable diets and food diversity. Foods 11:1209. https://doi.org/10.3390/foods11091209
Obradović Đ (2020) Arheobotanička istraživanja u kasnom neolitu Pomoravlja: društveni i ekonomski aspekti proizvodnje i pripreme hrane (Archaeobotanical investigations of the Late Neolithic Morava valley: the social and economic aspects of food production and preparation). Doctoral thesis, University of Belgrade, Belgrade
Perego R (2015) Contribution to the development of the Bronze Age plant economy in the surrounding of the Alps: an archaeobotanical case study of two Early and Middle Bronze Age sites in northern Italy (Lake Garda region). Doctoral thesis, University of Basel. http://edoc.unibas.ch/diss/DissB_12220. Accessed 25 February 2023
Ramsey CB (2021) Dealing with outliers and offsets in radiocarbon dating. Radiocarbon 51:1,023-1,045
Reed K, Ožanić Roguljić I (2020) The Roman food system in Southern Pannonia (Croatia) from the 1st – 4th Century A.D. Open Archaeol 6:38–62. https://doi.org/10.1515/opar-2020-0105
Reimer PJ, Austin WEN, Bard E et al (2020) The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). Radiocarbon 62:725–757. https://doi.org/10.1017/RDC.2020.41
Roushannafas T, Bogaard A, Charles M (2022) Geometric morphometrics sheds new light on the identification and domestication status of 'new glume wheat' at Neolithic Çatalhöyük. J Archaeol Sci 142:105599. https://doi.org/10.1016/j.jas.2022.105599
Sabanov A, Soteras R, Hajdas I, Naumov G, Antolín F (2023) New research on crop diversity of the early farmers in southeastern Europe (ca. 6400–5700 BCE). Veget Hist Archaeobot. https://doi.org/10.1007/s00334-023-00940-2
Slavova I (2013) Archaeobotanical research as a source of data for the reconstruction of paleoenvironment, paleodiet and the use of plants in ritual context during the Antiquity in southeastern Bulgaria. Doctoral thesis, Sofia University "St. Kliment Ohridski", Sofia (in Bulgarian)
Toulemonde F, Durand F, Berrio L, Bonnaire E, Daoulas G, Wiethold J (2015) Records of "new" glume wheat in France: a review. Veget Hist Archaeobot 24:197–206. https://doi.org/10.1007/s00334-014-0479-6
Ulaş B, Fiorentino G (2021) Recent attestations of "new" glume wheat in Turkey: a reassessment of its role in the reconstruction of Neolithic agriculture. Veget Hist Archaeobot 30:685–701. https://doi.org/10.1007/s00334-020-00807-w
Valamoti SM, Kotsakis K (2007) Transitions to agriculture in the Aegean: the archaeobotanical evidence. In: Colledge S, Conolly J (eds) The origins and spread of domestic plants in southwest Asia and Europe. Left Coast Press, Walnut Creek, pp 75–92
Valamoti SM, Kreuz A, Petridou C et al (2022a) Plant ingredients archived with ArboDat – evaluating regional food preferences and changes from crop remains, using the new archaeobotanical database for Greece. In: Valamoti SM, Dimoula A, Ntinou M (eds) Cooking with plants in ancient Europe and beyond: Interdisciplinary approaches to the archaeology of plant foods. Sidestone Press, Leiden, pp 19–42
Valamoti SM, Vasileios F, Konstantinos S (2022b) Food crops of ancient Greek cuisine: an archaeobotanical and textual study. University Studio Press, Thessaloniki

Authors and Affiliations

Dragana Filipović[1] · Glynis Jones[2] · Wiebke Kirleis[1] · Amy Bogaard[3] · Rachel Ballantyne[3] · Michael Charles[3] · Anne de Vareilles[4] · Müge Ergun[3] · Eugenia Gkatzogia[5] · Amy Holguin[3] · Ivanka Hristova[6] · Angeliki Karathanou[5] · Magda Kapcia[7] · Dolores Knežić[8] · Georgia Kotzamani[9] · Pavlos Lathiras[5] · Alexandra Livarda[10] · Elena Marinova[11] · Stavroula Michou[5] · Marine Mosulishvili[12,13] · Aldona Mueller-Bieniek[14] · Djurdja Obradović[15] · Matthew Padgett[16] · Pelagia Paraskevopoulou[5] · Chryssi Petridou[5] · Haroula Stylianakou[5] · Tanja Zerl[17] · Doris Vidas[3] · Soultana Maria Valamoti[5]

✉ Dragana Filipović
d.filipovic@ufg.uni-kiel.de

1 Institute for Prehistory and Protohistory, Kiel University, Johanna-Mestorf-Str. 2-6, 24118 Kiel, Germany

2 Department of Archaeology, University of Sheffield, Minalloy House, 10-16 Regent St, Sheffield S1 3NJ, UK

3 School of Archaeology, University of Oxford, 1 South Parks Rd, Oxford OX1 3TG, UK

4 Historic England, Cannon Bridge House, 25 Dowgate Hill, London EC4R 2YA, UK

5 Laboratory for Interdisciplinary Research in Archaeology, School of History and Archaeology, Center for Interdisciplinary Research and Innovation, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

6 Environmental Archaeology Laboratory, Umeå University, 90187 Umeå, Sweden

7 W. Szafer Institute of Botany, Polish Academy of Sciences, Lubicz 46, 31512 Kraków, Poland

8 Sisak, Croatia

[9] Hellenic Ministry of Culture and Sports, Directorate of Prehistoric and Classical Antiquities, 20-22 Bouboulinas Str, 10682 Athens, Greece

[10] Catalan Institute of Classical Archaeology, Rovira i Virgili University, Plaça d'en Rovellat, s/n, 43003 Tarragona, Spain

[11] Landesamt für Denkmalpflege Baden-Württemberg, Regierungspräsidium Stuttgart, Fischersteig 9, 78343 Gaienhofen-Hemmenhofen, Germany

[12] School of Natural Sciences and Medicine, Ilia State University, Cholokashvili 3/5 Avenue, 0162 Tbilisi, Georgia

[13] Georgian National Museum, 3 Shota Rustaveli Ave, 0105 Tbilisi, Georgia

[14] Faculty of Archaeology, University of Warsaw, Krakowskie Przedmieście 26/28, 00927 Warsaw, Poland

[15] Institute of Archaeology, Kneza Mihaila 35, Belgrade 11001, Serbia

[16] Department of Archaeology, School of Humanities and Sciences, Stanford University, 450 Jane Stanford Way, Stanford, CA 94305, USA

[17] Institute for Prehistoric Archaeology, University of Cologne, Weyertal 125, 50931 Cologne, Germany